BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	39.23
Reach:	119+64.19 to 121+21.11	**Comments:**							High
Location:	Right Bank 10	**Bank Length**	160						
Date:	5/4/2018								

Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio

Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	1.00	2.50	8.57	Very High	

Root Depth / Bank Height Ratio

Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.25	2.50	0.10	8.44	Very High	

Weighted Root Density

Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	0.10	4.00	10.00	Extreme	

Bank Angle

Bank Angle (°)		Index	Bank Erosion Potental	Notes
90.00		7.90	High	

Surface Protection

Surface Protection (%)		Index	Bank Erosion Potental	Notes
50.00		4.32	Moderate	

	Adjustment		Notes
Bank Materials	0.00		
	Adjustment		Notes
Bank Stratification	0.00		
TOTAL SCORE	39.23		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

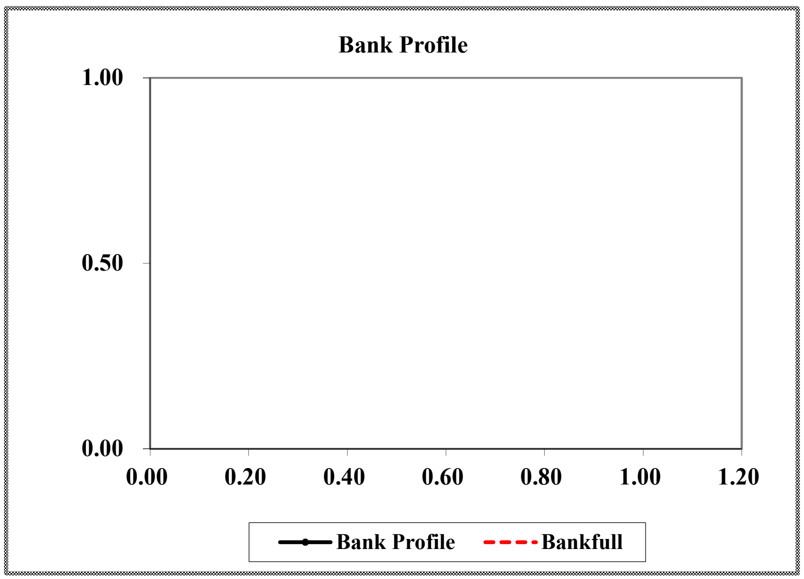
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 10**

Station: **119+64.19 to 121+21.11** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High

Extensive deposition (continuous, cross-channel)…………………………..…… …………...NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………………..…NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.57	**0.36**	**1.5833333**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	**43.30**
Reach:	120+25.66 to 121+23.56	**Comments:**							**Very High**
Location:	Left Bank 10	**Bank Length**	97						
Date:	5/4/2018								

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.00	1.00	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	3.00	0.14	8.00	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.14	7.00	8.78	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
65.00			3.11	Low	
			Adjustment		Notes
Bank Materials			10.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**43.30**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

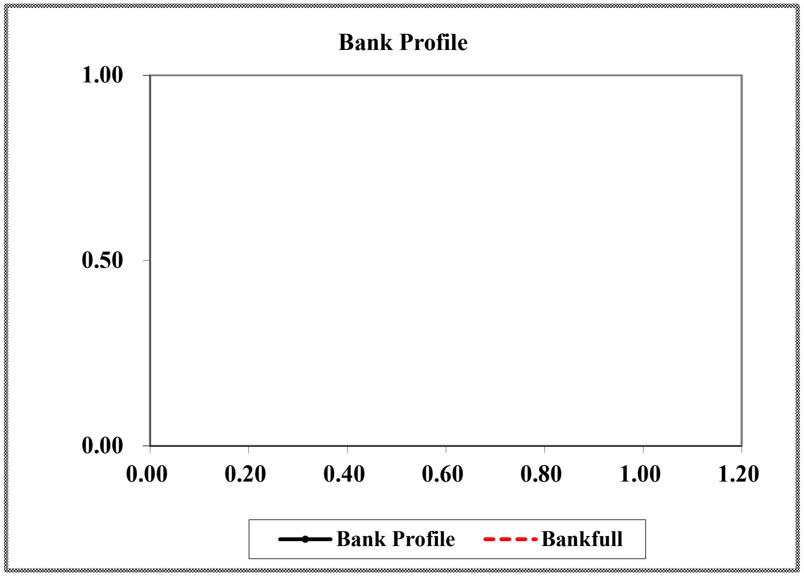
Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile		
Horizontal Distance	**Vertical Height**	**Notes**
Bankfull		
Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 10**

Station: **120+25.66 to 121+23.56** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous…………. ……………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..…….. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. …………...NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.67**	**0.44**	**1.5227273**	**Moderate**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	**38.20**		
Reach:	116+39.48 to 119+64.19	**Comments:**							**High**		
Location:	Right Bank 11	**Bank Length**	325					**Total Score**	**Very Low**	**Low**	**Moderate** / **High** / **Very High** / **Extreme**
Date:	5/4/2018							**Values:**	5-10	10-20	20-30 / 30-40 / 40-45 / 45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.50	1.50	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.67	4.50	0.15	7.92	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
65.00	0.15	9.68	8.48	Very High	
Bank Angle					
Bank Angle ($^{\circ}$)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
80.00			1.90	Very Low	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**38.20**		

Bank Erosion Potential		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Erodibility Variables

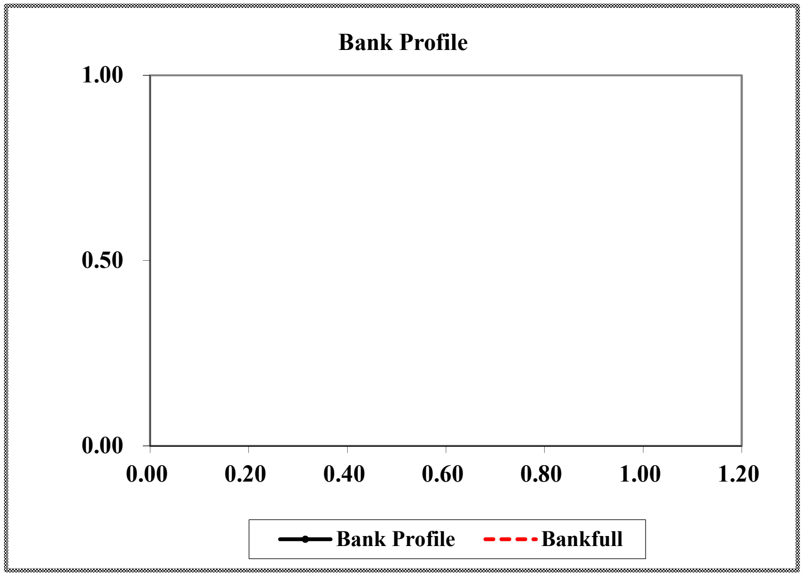
Adjustments	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Bank Material

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile		
Horizontal Distance	**Vertical Height**	**Notes**
Bankfull		
Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 11**

Station: **116+39.48 to 119+64.19** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………..… ………………..…NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………….………..…NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.56	**0.39**	**1.4358974**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	37.28			
Reach:	114+61.16 to 120+25.66	**Comments:**							High			
Location:	Left Bank 11	**Bank Length**	595					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
4.50	1.50	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.67	4.50	0.15	7.92	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
60.00	0.15	8.93	8.56	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
60.00			3.90	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
80.00			1.90	Very Low	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**37.28**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

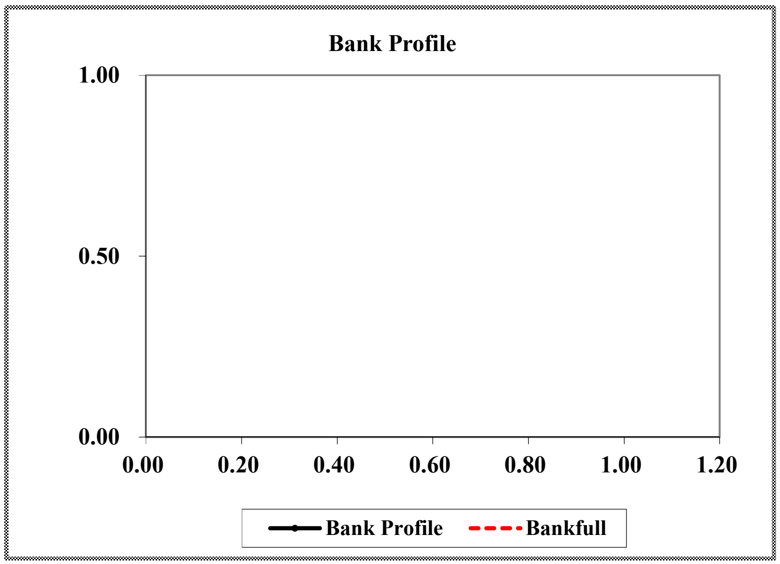
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 11**

Station: **114+61.16 to 120+25.66** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..…….. ………….....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… …………...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.57	**0.46**	**1.2391304**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	39.49
Reach:	115+14.22 to 116+39.48	**Comments:**							High
Location:	Right Bank 12	**Bank Length**	124						
Date:	5/4/2018								

Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.50	1.50	3.67	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.67	5.50	0.12	8.20	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
65.00	0.12	7.92	8.68	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
70.00			2.71	Low	
			Adjustment		Notes
Bank Materials			5.00		
					Notes
Bank Stratification			0.00		
		TOTAL SCORE	39.49		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

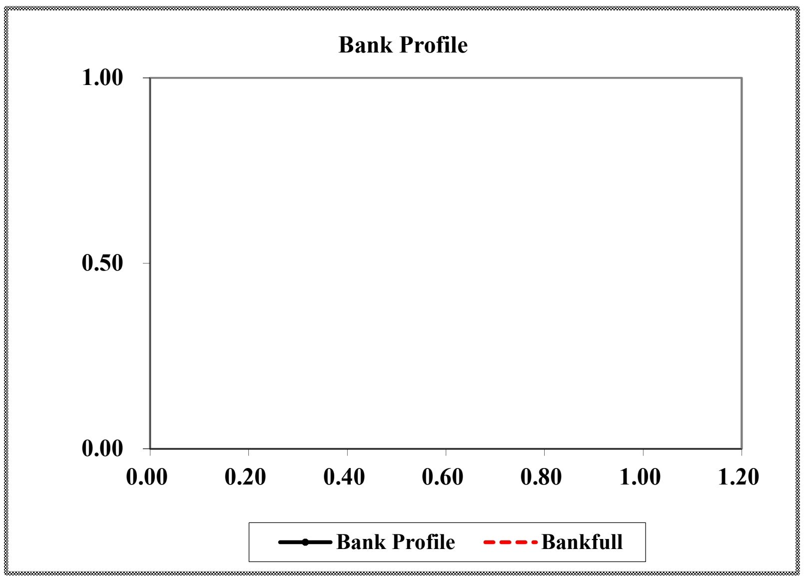
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Right Bank 12**	
Station: **115+14.22 to 116+39.48**	Stream Type:	Valley Type:
Observers:		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……… …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.56	**0.39**	**1.4358974**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating: Low

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	32.76			
Reach:	111+99.76 to 114+61.16	**Comments:**							High			
Location:	Left Bank 12	**Bank Length**	246					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40

Total Score Values	Very High	Extreme
	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.00	1.00	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	3.00	0.14	8.00	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
65.00	0.14	9.10	8.54	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
60.00			3.90	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
75.00			2.32	Low	
			Adjustment		Notes
Bank Materials			0.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**32.76**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

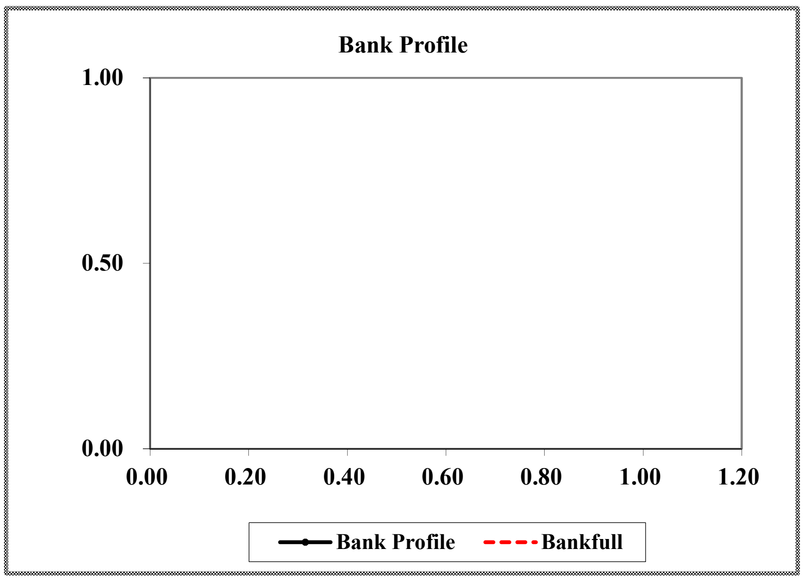
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Left Bank 12**	
Station: **111+99.76 to 114+61.16**	Stream Type:	Valley Type:
Observers:		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………….…….. …………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… …………..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)	0.41	3.97	0.1032746	Extreme

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	**2**
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	40.50				
Reach:	113+44.63 to 115+14.22	**Comments:**							Very High				
Location:	Right Bank 13	**Bank Length**	160					**Total Score**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.20	1.00	2.20	8.14	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	2.20	0.23	6.85	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.23	11.36	8.29	Very High	
Bank Angle					
Bank Angle (^{o})			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
50.00			4.32	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**40.50**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

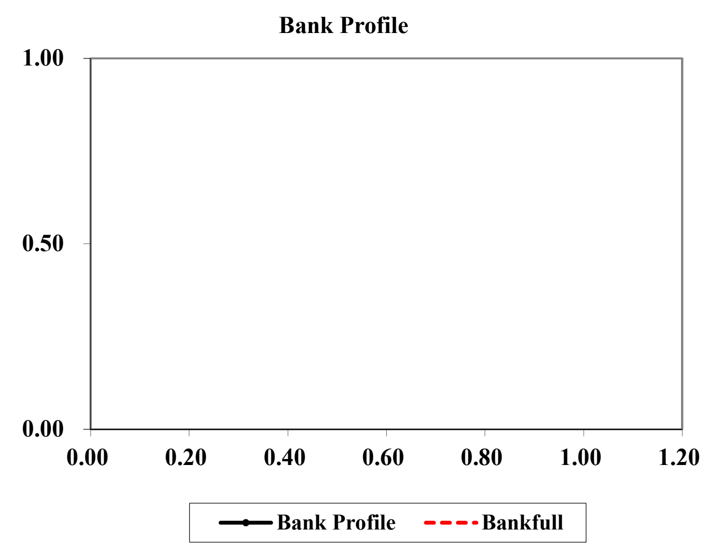
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 13**

Station: **113+44.63 to 115+14.22** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.45	**0.25**	**1.8**	**Moderate**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	35.52			
Reach:	110+41.23 to 111+99.76	**Comments:**							High			
Location:	Left Bank 13	**Bank Length**	147					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40

Total Score Values	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
3.50	1.00	3.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.42	3.50	0.12	8.22	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
50.00	0.12	6.00	8.89	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials			0.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	35.52		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

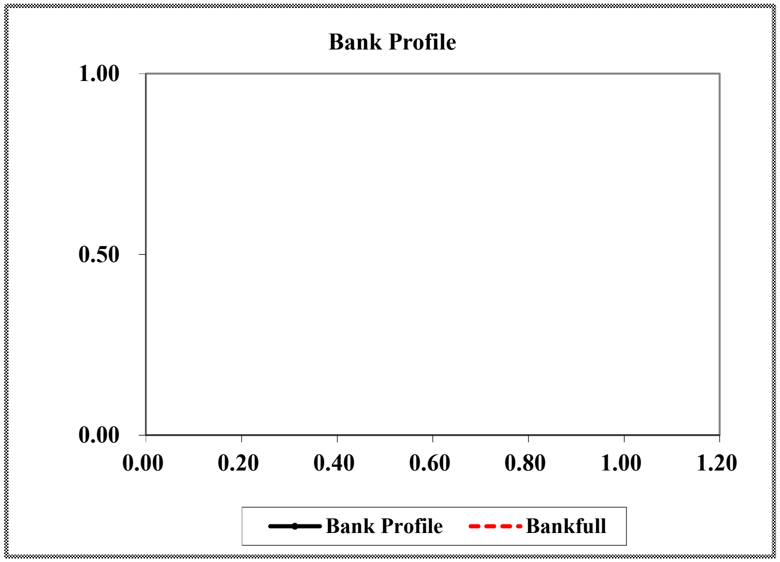
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 13**

Station: **110+41.23 to 111+99.76** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………..……… …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… …………...NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.73	**0.48**	**1.5208333**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	49.56				
Reach:	112+84.76 to 113+44.63	**Comments:**							Extreme				
Location:	Right Bank 14	**Bank Length**	76					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High** / **Extreme**
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40	40-45 / 45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	0.50	5.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	2.50	0.17	7.66	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.17	1.68	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**49.56**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

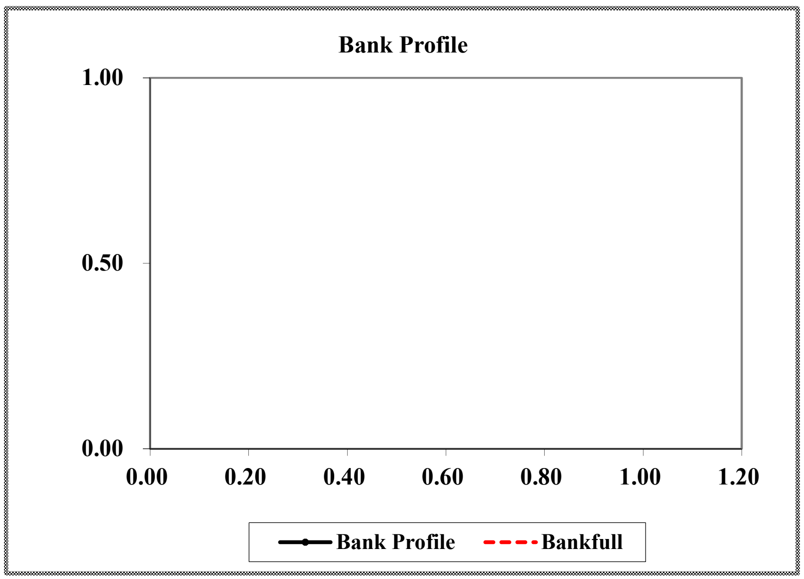
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Right Bank 14**	
Station: **112+84.76 to 113+44.63**	Stream Type:	Valley Type:
Observers:		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………….....……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………….………..….NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
0.21	4.93	0.0425963	Extreme

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	2
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating: Extreme

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	Observer(s):	PVC	Data:	SH	QA/QC:		Total Score:	48.45				
Reach:	108+67.52 to 110+41.23	Comments:							Extreme				
Location:	Left Bank 14	Bank Length	188					Total Score	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/4/2018							Values:	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
3.00	1.00	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.33	3.00	0.11	8.33	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
10.00	0.11	1.10	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials			0.00		
			Adjustment		Notes
Bank Stratification			5.00		
		TOTAL SCORE	48.45		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

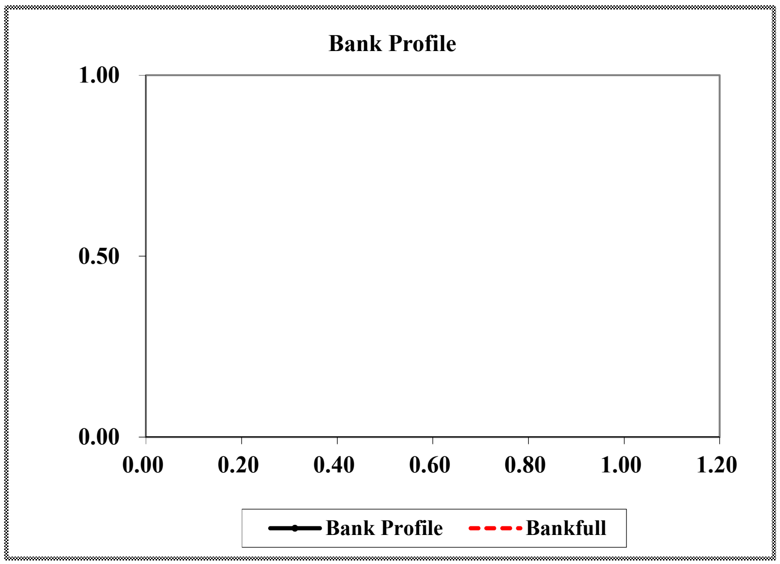
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 14**

Station: **108+67.52 to 110+41.23** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ……………….….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……… …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.73	**0.48**	**1.5208333**	**Moderate**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	**43.20**
Reach:	112+3.47 to 112+84.76	**Comments:**							**Very High**
Location:	Right Bank 15	**Bank Length**	79					**Total Score Values:**	
Date:	5/4/2018								

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.00	1.50	2.00	7.90	High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.25	3.00	0.08	8.63	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
45.00	0.08	3.75	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
45.00			3.17	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials			10.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	43.20		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

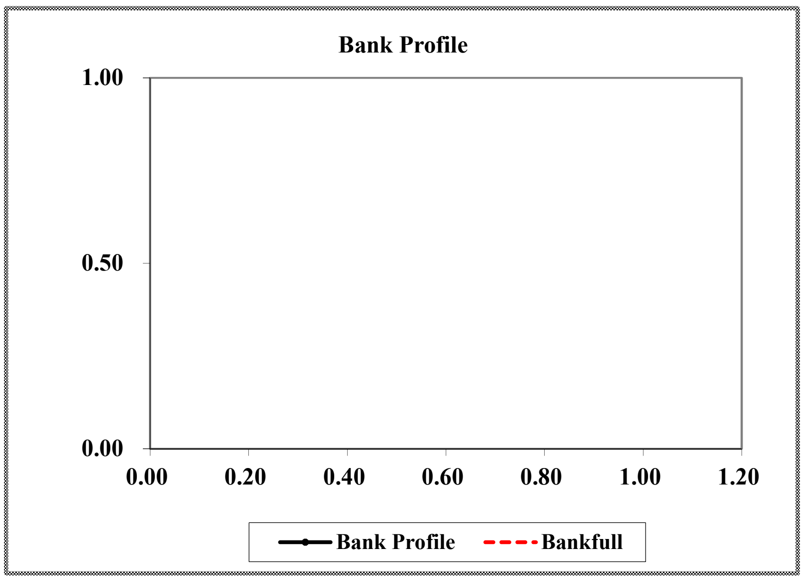
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 15**

Station: **112+3.47 to 112+84.76** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous…………. ………………..….NBS = High / Very High

Extensive deposition (continuous, cross-channel)……………..………………..……. …………....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow……………………. ……….…..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.45	**0.25**	**1.8**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**	
Reach:	107+61.02 to 108+67.52	**Comments:**					
Location:	Left Bank 15	**Bank Length**	103				
Date:	5/4/2018						

Total Score:	**45.10**					
	Very High					
Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.17	2.50	0.07	8.80	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
50.00	0.07	3.40	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
50.00			4.32	Moderate	
			Adjustment		Notes
Bank Materials			10.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**45.10**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

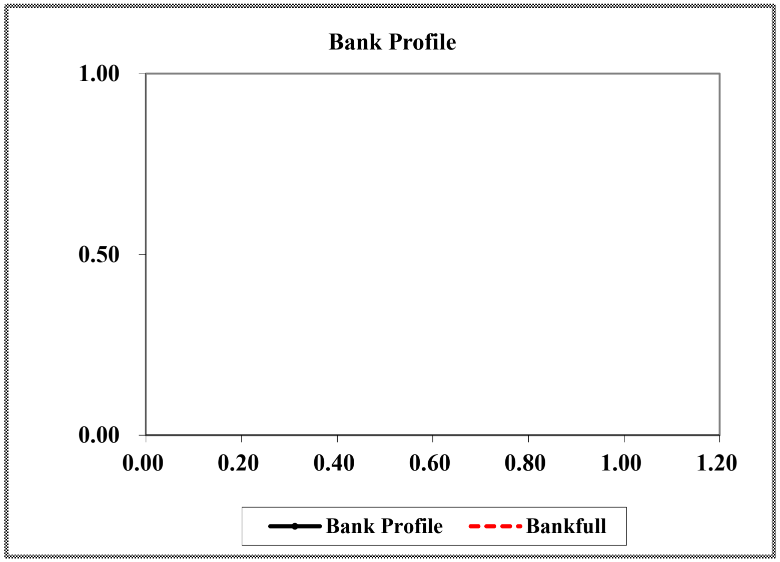
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Left Bank 15**	
Station: **107+61.02 to 108+67.52**	Stream Type:	Valley Type:
Observers:		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ……………..…NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……… …………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… …………..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.89	**0.65**	**1.3692308**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	**34.67**
Reach:	110+65.05 to 112+3.47	**Comments:**							**High**
Location:	Right Bank 16	**Bank Length**	140						
Date:	5/4/2018								

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.50	1.00	3.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	3.50	0.12	8.22	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.12	6.00	8.89	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
55.00			3.66	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
55.00			3.90	Low	
			Adjustment		Notes
Bank Materials			0.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	34.67		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

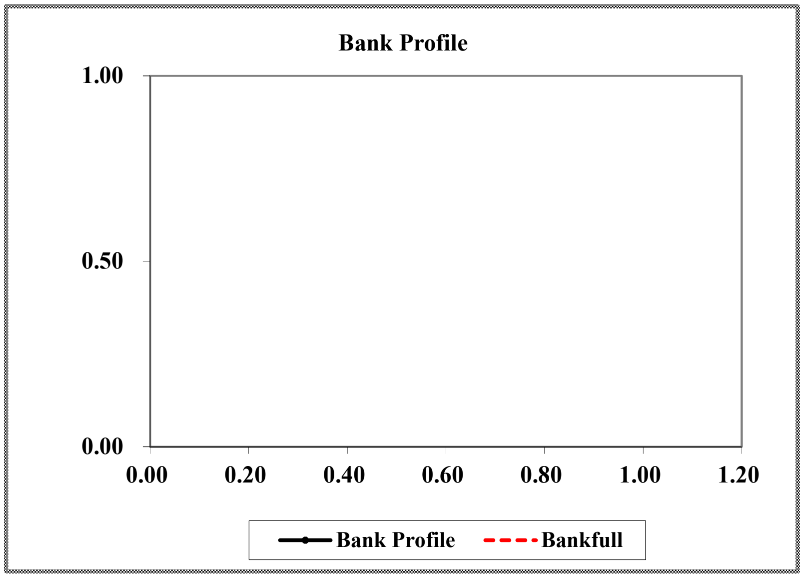
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 16**

Station: **110+65.05 to 112+3.47** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……. …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.45**	**0.25**	**1.8**	**Moderate**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	43.56
Reach:	106+23.76 to 107+61.02	**Comments:**							Very High
Location:	Left Bank 16	**Bank Length**	138						
Date:	5/4/2018								

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	2.50	0.17	7.66	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
55.00	0.17	9.24	8.53	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
55.00			3.90	Low	
			Adjustment		Notes
Bank Materials			10.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**43.56**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

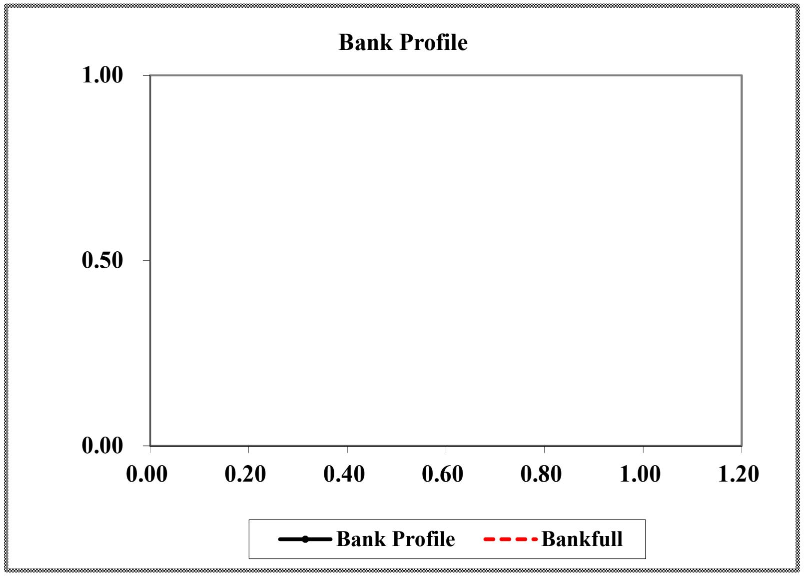
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 16**

Station: **106+23.76 to 107+61.02** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous……….… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………..………..….NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Low	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.89**	**0.65**	**1.3692308**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**		40.14				
Reach:	107+61.59 to 110+65.05	**Comments:**								Very High				
Location:	Right Bank 17	**Bank Length**	298					**Total Score Values:**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
2.00	1.00	2.00	7.90	High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.25	2.00	0.13	8.17	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
50.00	0.13	6.25	8.86	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
50.00			4.32	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**40.14**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

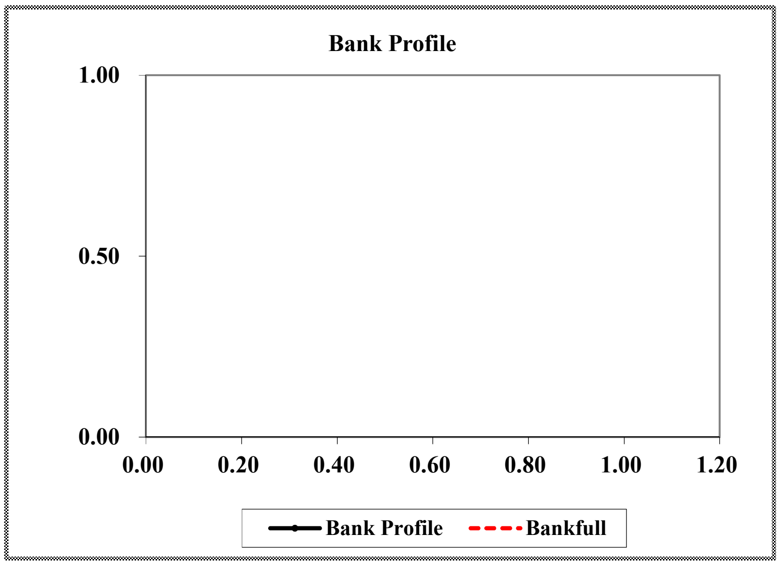
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 17**

Station: **107+61.59 to 110+65.05** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High

Extensive deposition (continuous, cross-channel)…………….……………..……. …………....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Very High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**	
Reach:	102+41.73 to 106+23.76	**Comments:**					
Location:	Left Bank 17	**Bank Length**	419				
Date:	5/4/2018						

Total Score:	**39.49**					
	High					
Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	2.50	0.07	8.80	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.07	1.36	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials			0.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**39.49**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

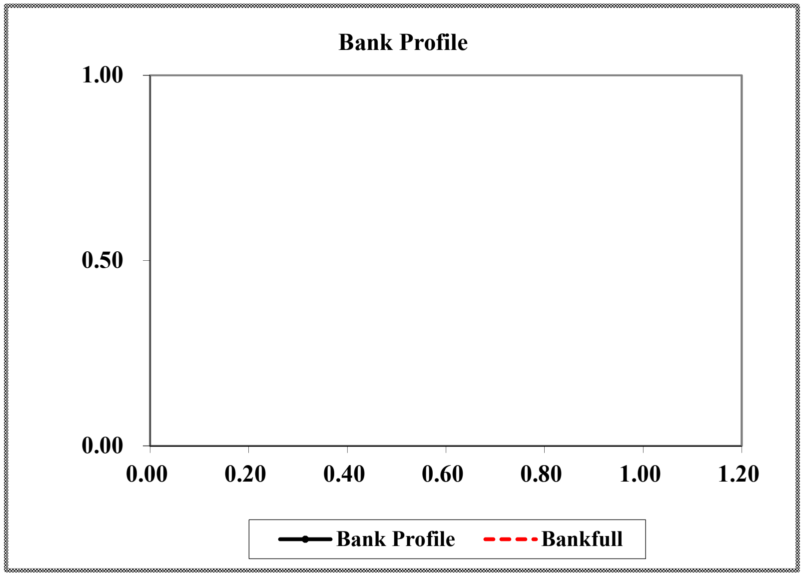
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 17**

Station: **102+41.73 to 106+23.76** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……… …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……….......NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
High	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**2.08**	**1.11**	**1.8738739**	**High**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	**38.06**
Reach:	106+3.93 to 107+61.59	**Comments:**							**High**
Location:	Right Bank 18	**Bank Length**	157					**Total Score Values:**	
Date:	5/4/2018								

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	2.50	0.17	7.66	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
55.00	0.17	9.24	8.53	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
65.00			4.40	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
55.00			3.90	Low	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	38.06		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

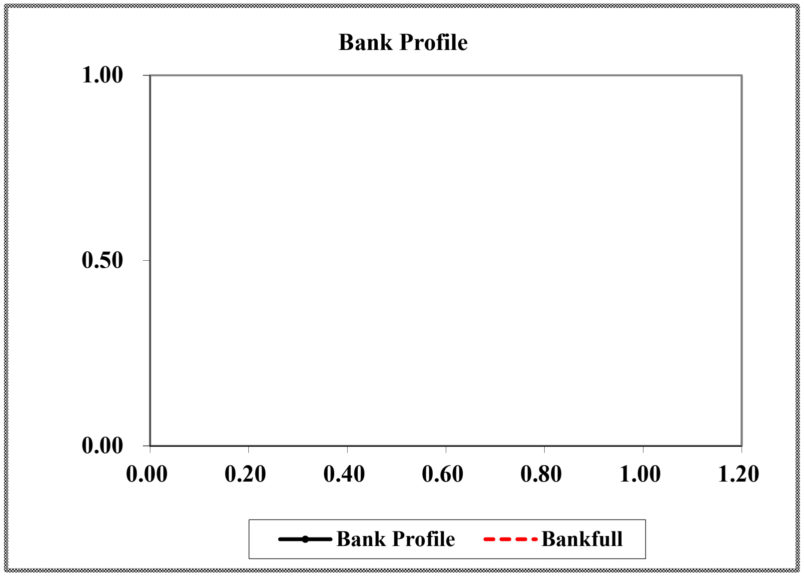
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 18**

Station: **106+3.93 to 107+61.59** Stream Type: Valley Type:

Observers: Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………… …………………..….NBS = High / Very High

Extensive deposition (continuous, cross-channel)……………..…………….....……. …………....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.75	**0.64**	**1.171875**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**		**48.90**			
Reach:	202+64.02 to 205+15.89	**Comments:**								**Extreme**			
Location:	Left Bank 18	**Bank Length**	279					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.50	1.00	3.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	3.50	0.05	10.00	Extreme	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.05	0.49	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
60.00			3.90	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**48.90**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material		
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

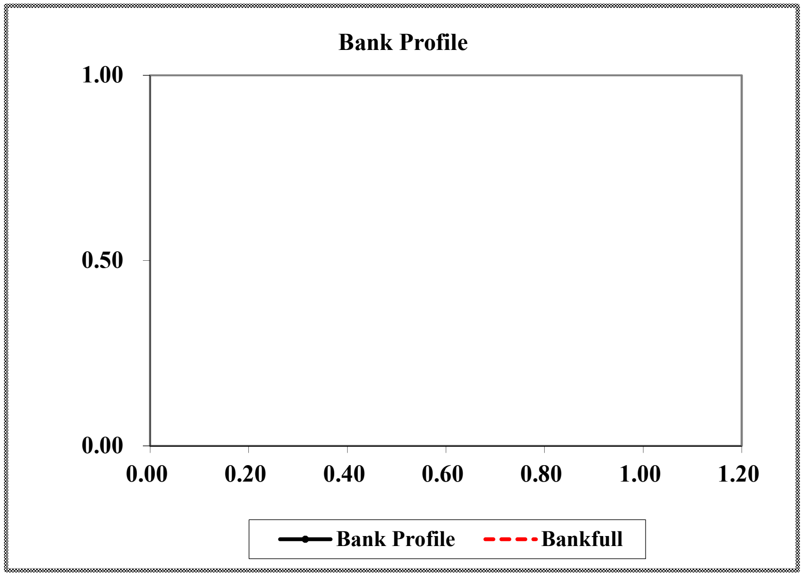
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 18**

Station: **202+64.02 to 205+15.89** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..………………..……… …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… …………….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.72	**0.55**	**1.3090909**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	Observer(s):	PVC	Data:	SH	QA/QC:		Total Score: 42.67
Reach:	102+40.18 to 106+3.93	Comments:						Very High
Location:	Right Bank 19	Bank Length	362					
Date:	5/4/2018							

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.17	2.50	0.07	8.80	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
30.00	0.07	2.04	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
65.00			4.40	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
30.00			5.90	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	42.67		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

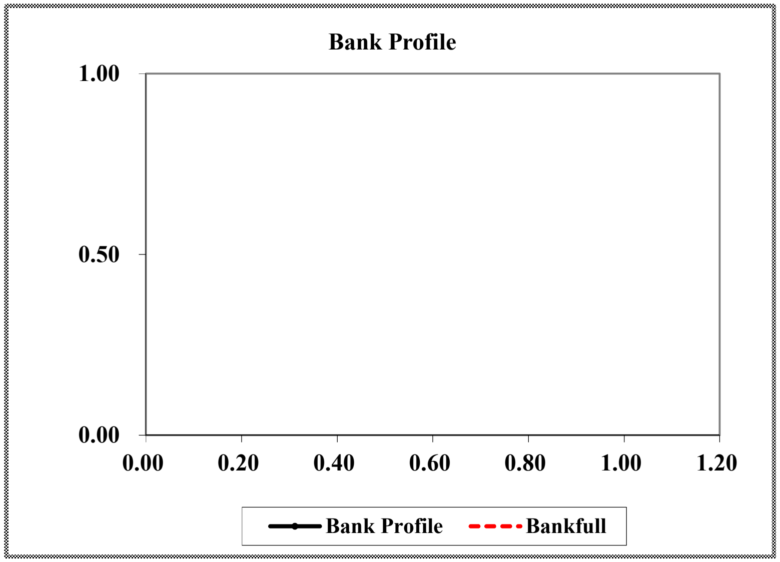
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Right Bank 19**	
Station: **102+40.18 to 106+3.93**	Stream Type:	Valley Type:
Observers: **PVC & SH**		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

- Transverse and/or central bars-short and/or discontinuous…………………………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)………………..………………..………………..NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow……………………………………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	2.37	1.92	1.234375	Low

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating: Low

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	40.03
Reach:	205+15.89 to 205+62.34	**Comments:**							Very High
Location:	Left Bank 19	**Bank Length**	43						
Date:	5/4/2018								

Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	1.00	2.00	7.90	High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	2.00	0.09	8.61	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
30.00	0.09	2.55	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**40.03**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

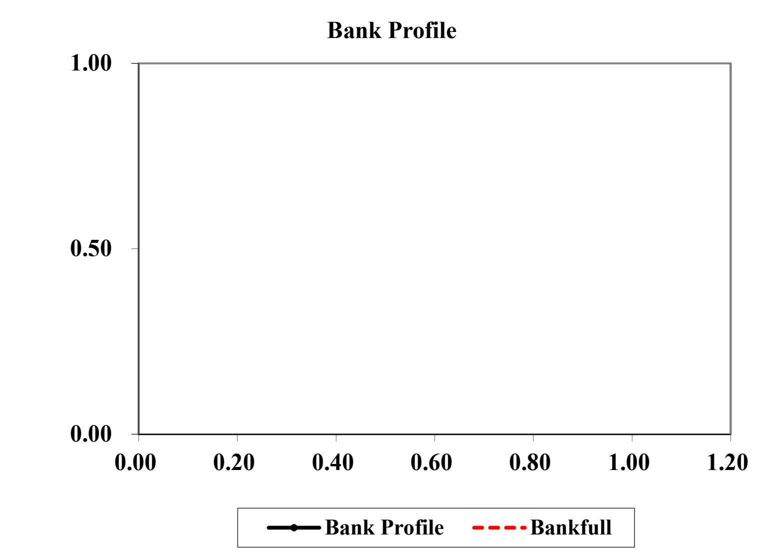
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 19**

Station: **205+15.89 to 205+62.34** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………….....…… ……….......NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……….......NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.72	0.55	1.3090909	Low

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

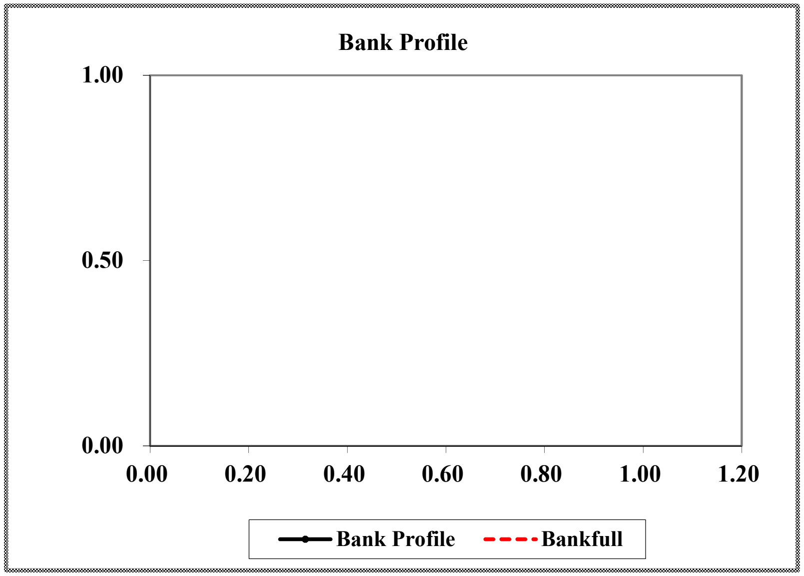
BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**		41.36			
Reach:	202+64.58 to 205+11.94	**Comments:**								Very High			
Location:	Right Bank 20	**Bank Length**	244					**Total Score**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.00	1.00	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.25	3.00	0.08	8.63	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.08	2.50	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
50.00			4.32	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**41.36**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Bank Profile		
Horizontal Distance	**Vertical Height**	**Notes**
Bankfull		
Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 20**

Station: **202+64.58 to 205+11.94** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……… ……………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.64	**0.2**	**3.2**	**Extreme**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	37.77				
Reach:	404+4.57 to 405+60.53	**Comments:**							High				
Location:	Left Bank 20	**Bank Length**	155					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40	40-45

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
0.50	0.50	1.00	1.00	Very Low	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.42	0.50	0.84	2.24	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
10.00	0.84	8.40	8.62	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials			10.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	37.77		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

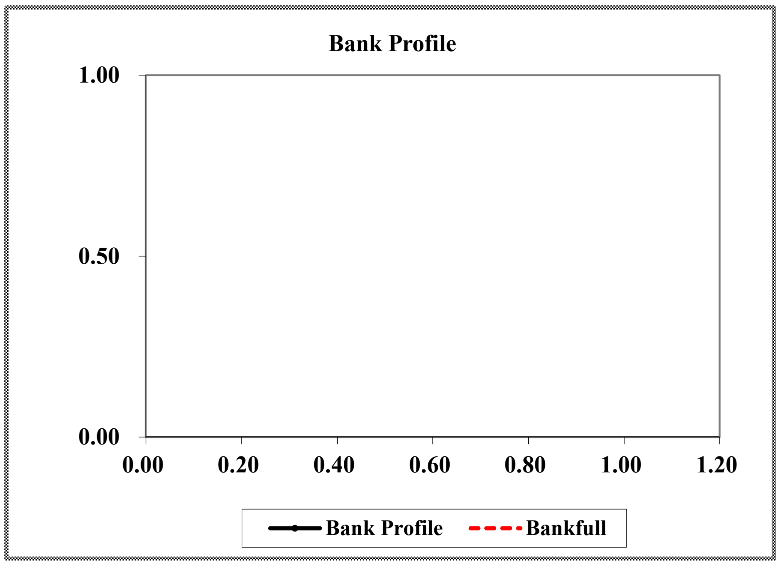
Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile		
Horizontal Distance	**Vertical Height**	**Notes**
Bankfull		
Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 20**

Station: **404+4.57 to 405+60.53** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………..… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………….………..….NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Low	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.72**	**0.55**	**1.3090909**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	41.23				
Reach:	205+11.94 to 205+58.48	**Comments:**							Very High				
Location:	Right Bank 21	**Bank Length**	47					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40	40-45

Extreme
45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
2.00	1.00	2.00	7.90	High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.17	2.00	0.09	8.61	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
30.00	0.09	2.55	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
75.00			5.40	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
50.00			4.32	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**41.23**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

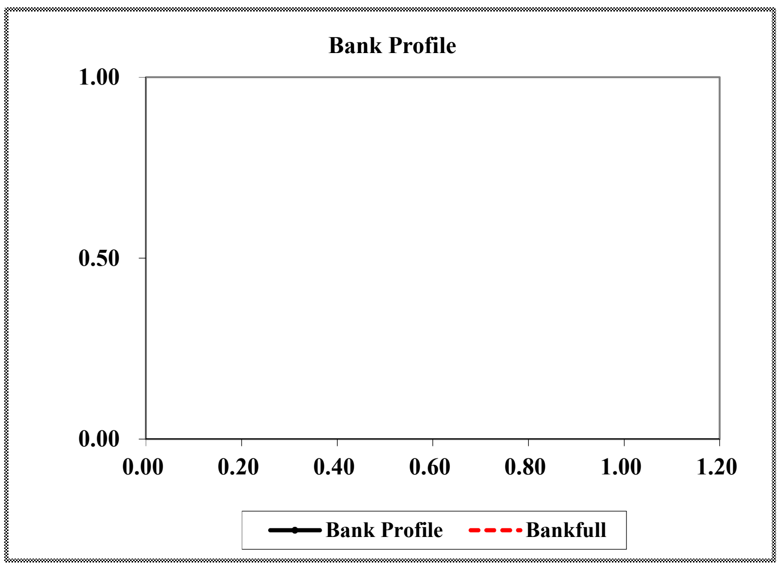
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Right Bank 21**	
Station: **205+11.94 to 205+58.48**	Stream Type:	Valley Type:
Observers: **PVC & SH**		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….………...……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..………..….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.64	**0.2**	**3.2**	**Extreme**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	36.05
Reach:	405+60.53 to 410+65.09	**Comments:**							High
Location:	Left Bank 21	**Bank Length**	517						
Date:	5/4/2018								

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.80	1.00	2.80	9.00	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.58	2.80	0.21	7.12	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.21	10.36	8.40	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
65.00			3.11	Low	
		Adjustment			Notes
Bank Materials		5.00			
		Adjustment			Notes
Bank Stratification		0.00			
	TOTAL SCORE	36.05			

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

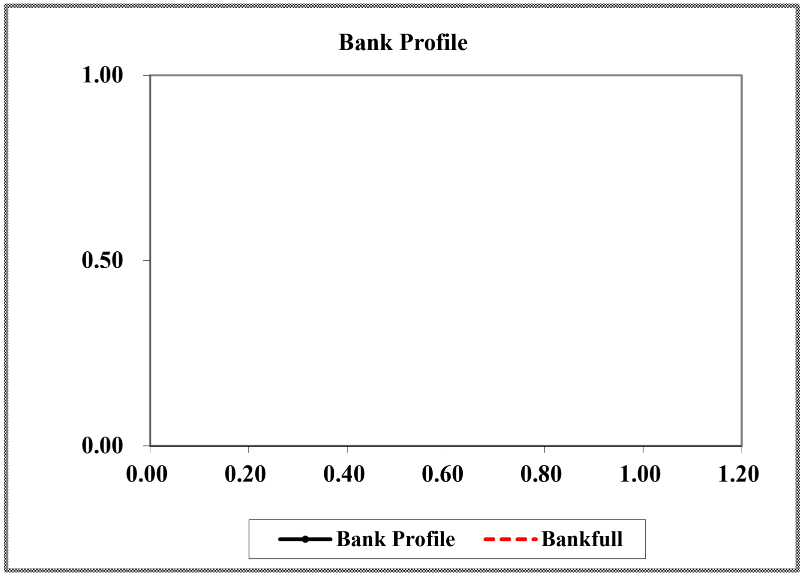
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 21**

Station: **405+60.53 to 410+65.09** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………...……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow………………….…………..…NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.72	**0.55**	**1.3090909**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	**37.77**
Reach:	404+7.41 to 405+56.34	**Comments:**							**High**
Location:	Right Bank 22	**Bank Length**	147						
Date:	5/4/2018								

Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
0.50	0.50	1.00	1.00	Very Low	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	0.50	0.84	2.24	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.84	8.40	8.62	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials			10.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	37.77		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

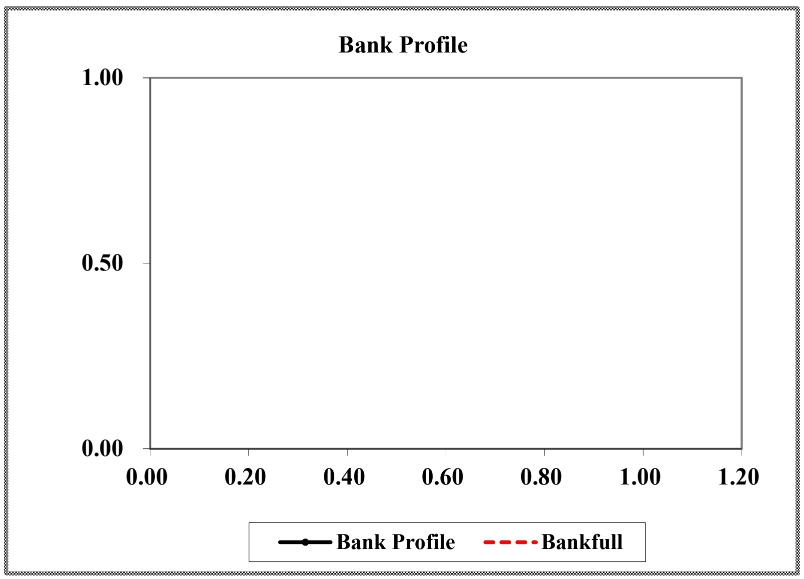
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	**Vertical Height**	**Notes**

Bankfull

Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Right Bank 22**	
Station: **404+7.41 to 405+56.34**	Stream Type:	Valley Type:
Observers: **PVC & SH**		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous……….… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow………………………..…………..….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.64	**0.2**	**3.2**	**Extreme**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	Observer(s):	PVC	Data:	SH	QA/QC:		Total Score:	46.13			
Reach:	309+20.39 to 311+1.38	Comments:							Extreme			
Location:	Left Bank 22	Bank Length	178					Total Score	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/4/2018							Values:	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.42	2.50	0.17	7.66	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
20.00	0.17	3.36	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials			0.00		
			Adjustment		Notes
Bank Stratification			5.00		
		TOTAL SCORE	46.13		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

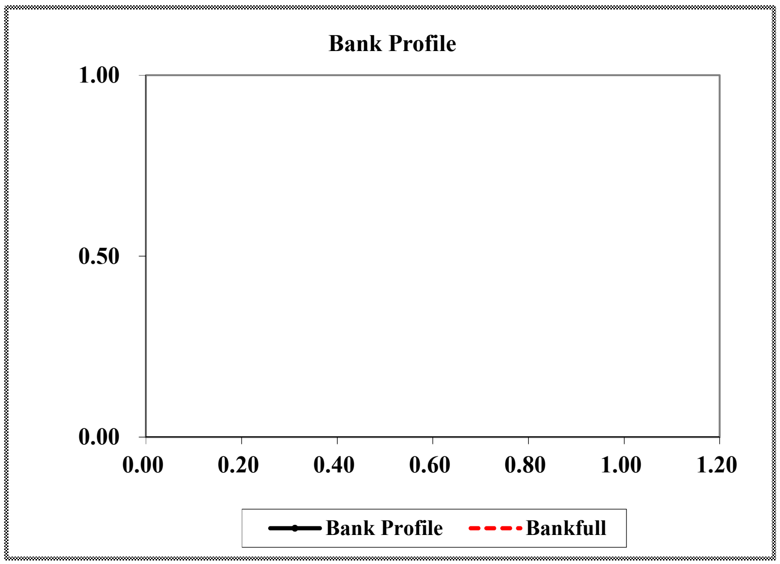
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 22**

Station: **309+20.39 to 311+1.38** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ……………….…NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………..…… …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… …………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**5**
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.53	**0.38**	**1.3947368**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	33.39
Reach:	405+56.34 to 410+65.81	**Comments:**							High
Location:	Right Bank 23	**Bank Length**	516						
Date:	5/4/2018								

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	1.00	2.00	7.90	High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.58	2.00	0.29	6.00	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.29	14.50	7.97	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
65.00			3.11	Low	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	33.39		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

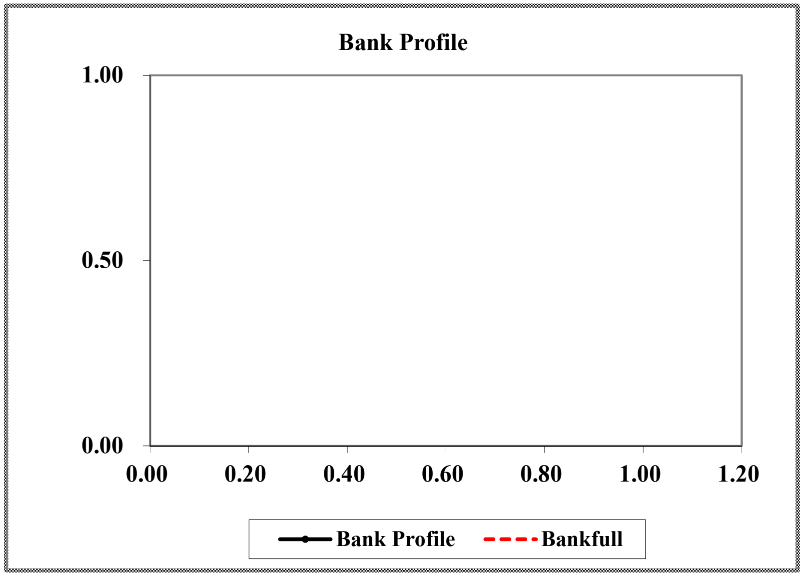
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 23**

Station: **405+56.34 to 410+65.81** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)
(3)				

Method	5
Dominant Near-Bank Stress	
Extreme	

	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.64**	**0.2**	**3.2**	**Extreme**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**	
Reach:	307+55.25 to 309+20.39	**Comments:**					
Location:	Left Bank 23	**Bank Length**	163				
Date:	5/4/2018						

Total Score:	40.65					
	Very High					
Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	2.50	0.07	8.80	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	0.07	2.72	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
45.00			3.17	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**40.65**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

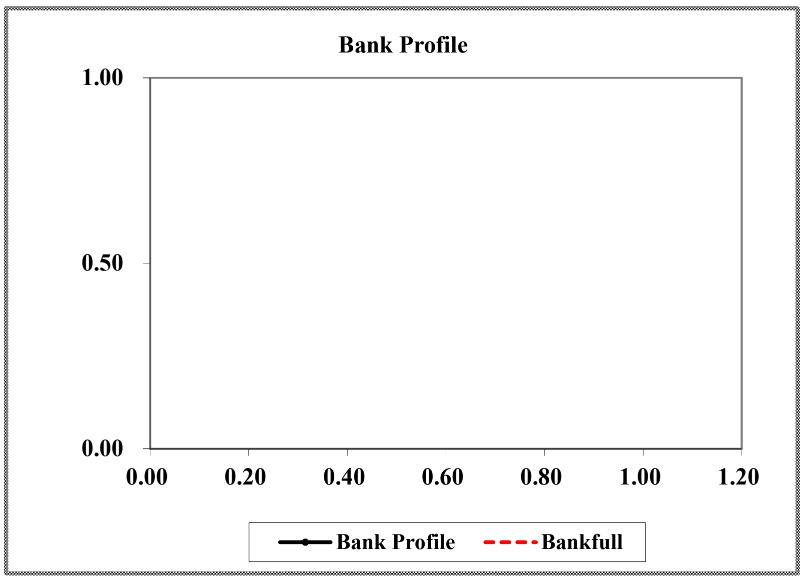
Bank Material		
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile		
Horizontal Distance	**Vertical Height**	**Notes**

Bankfull		
Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 23**

Station: **307+55.25 to 309+20.39** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ……………...….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……… …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.53	**0.38**	**1.3947368**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

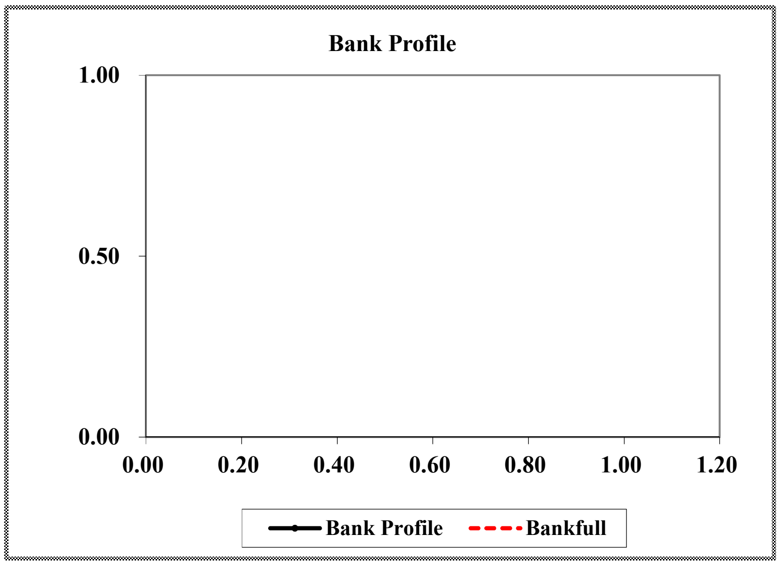
Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	36.77					
Reach:	306+16.05 to 310+97.33	**Comments:**							High					
Location:	Right Bank 24	**Bank Length**	486					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.58	2.50	0.23	6.79	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
60.00	0.23	13.92	8.01	Very High	
Bank Angle					
Bank Angle (º)			Index	Bank Erosion Potential	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	36.77		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments		
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.
Stratification		
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.	

Bank Profile		
Horizontal Distance	**Vertical Height**	**Notes**
Bankfull		
Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 24**

Station: **306+16.05 to 310+97.33** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ……………...….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………...……. …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.55	**0.43**	**1.2790698**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	Observer(s):	PVC	Data:	SH	QA/QC:		Total Score:	36.77					
Reach:	306+18.16 to 307+55.25	Comments:							High					
Location:	Left Bank 24	Bank Length	137					Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.58	2.50	0.23	6.79	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
60.00	0.23	13.92	8.01	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	36.77		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

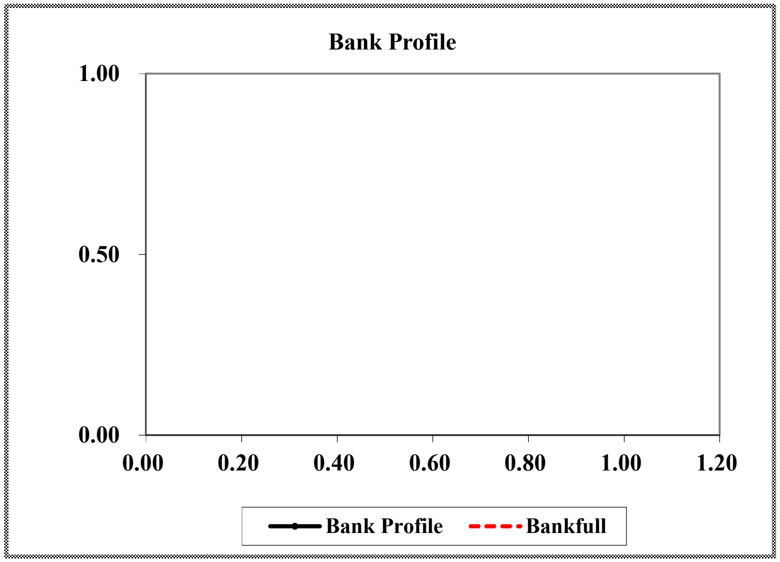
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile		
Horizontal Distance	Vertical Height	Notes

Bankfull		
Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 24**

Station: **306+18.16 to 307+55.25** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous…………………………..…NBS = High / Very High
- Extensive deposition (continuous, cross-channel)…………………………..………………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow……………………………………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.53	**0.38**	**1.3947368**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	55.27			
Reach:	305+52.82 to 306+16.05	**Comments:**							Extreme			
Location:	Right Bank 25	**Bank Length**	62					**Total Score Values:**	**Very Low** 5-10	**Low** 10-20	**Moderate** 20-30	**High** 30-40 / **Very High** 40-45 / **Extreme** 45-50
Date:	5/4/2018											

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potential	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potential	Notes
0.17	2.50	0.07	8.80	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potential	Notes
5.00	0.07	0.34	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potential	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potential	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials			10.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	55.27		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

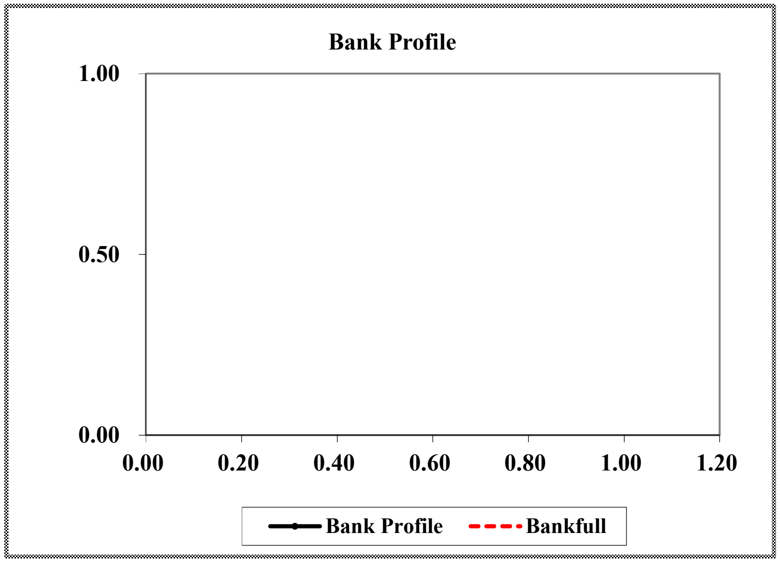
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 25**

Station: **305+52.82 to 306+16.05** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… …………………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………….…….. …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… …………….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.55	**0.43**	**1.2790698**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	47.27
Reach:	305+51.43 to 306+18.16	**Comments:**							Extreme
Location:	Left Bank 25	**Bank Length**	65						
Date:	5/4/2018								

Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio

Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	1.00	2.50	8.57	Very High	

Root Depth / Bank Height Ratio

Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	2.50	0.07	8.80	Very High	

Weighted Root Density

Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.07	0.68	10.00	Extreme	

Bank Angle

Bank Angle (°)		Index	Bank Erosion Potental	Notes
20.00		1.90	Very Low	

Surface Protection

Surface Protection (%)		Index	Bank Erosion Potental	Notes
15.00		8.00	Very High	

	Adjustment		Notes
Bank Materials	10.00		
	Adjustment		Notes
Bank Stratification	0.00		
TOTAL SCORE	47.27		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material		
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

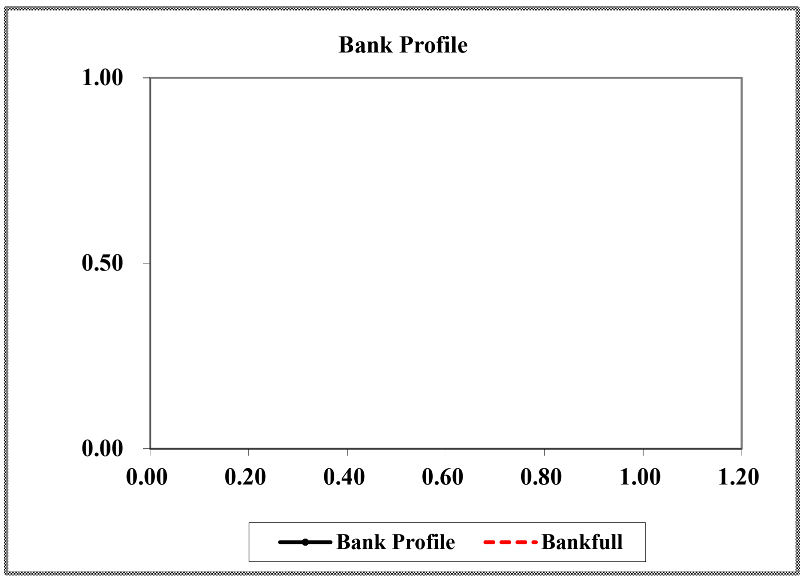
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	**Vertical Height**	**Notes**

Bankfull

Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 25**

Station: **305+51.43 to 306+18.16** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High

Extensive deposition (continuous, cross-channel)……………..…………...……. ………….....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………….…………..…NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.53	**0.38**	**1.3947368**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**	
Reach:	302+31.22 to 305+52.82	**Comments:**					
Location:	Right Bank 26	**Bank Length**	335				
Date:	5/4/2018						

Total Score:	**36.77**					
	High					
Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.58	2.50	0.23	6.79	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
60.00	0.23	13.92	8.01	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**36.77**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

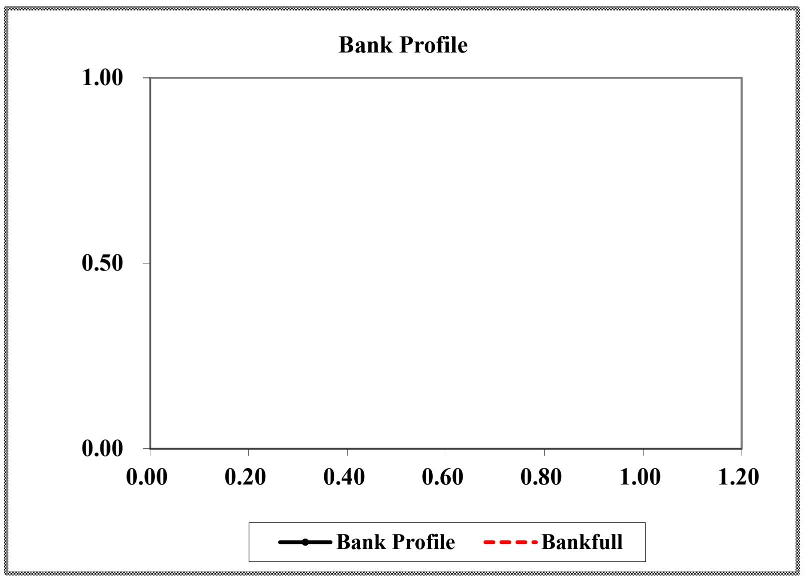
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 26**

Station: **302+31.22 to 305+52.82** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………..……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… …………….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.55	**0.43**	**1.2790698**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

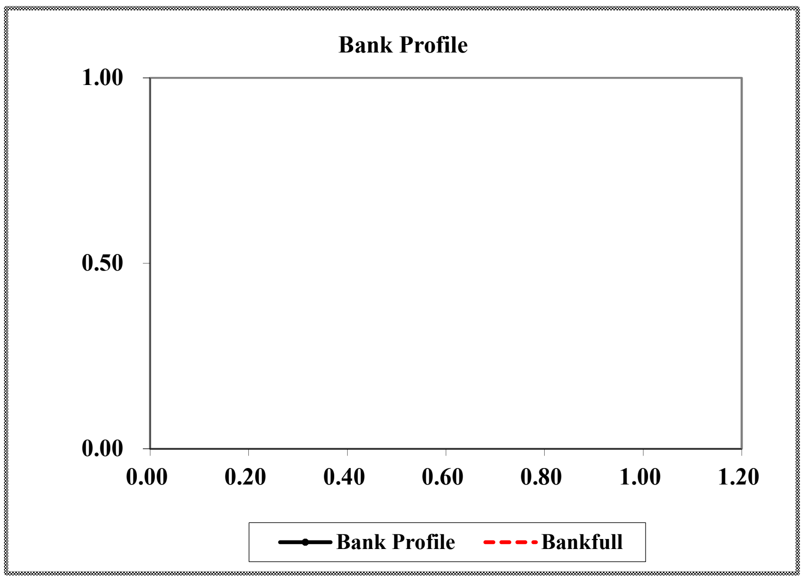
BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	36.77					
Reach:	302+30.62 to 305+51.43	**Comments:**							High					
Location:	Left Bank 26	**Bank Length**	322					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	1.00	2.50	8.57	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.58	2.50	0.23	6.79	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
60.00	0.23	13.92	8.01	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**36.77**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Bank Profile		
Horizontal Distance	**Vertical Height**	**Notes**
Bankfull		
Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 26**

Station: **302+30.62 to 305+51.43** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………..… ………………..….NBS = High / Very High

Extensive deposition (continuous, cross-channel)……………..……………..……. …………....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………….……….….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.53	0.38	1.3947368	Low

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**		30.90				
Reach:	301+33.97 to 302+31.22	**Comments:**								High				
Location:	Right Bank 27	**Bank Length**	111					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.00	1.00	4.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	4.00	0.04	10.00	Extreme	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
0.00	0.04				
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
0.00					
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	**30.90**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

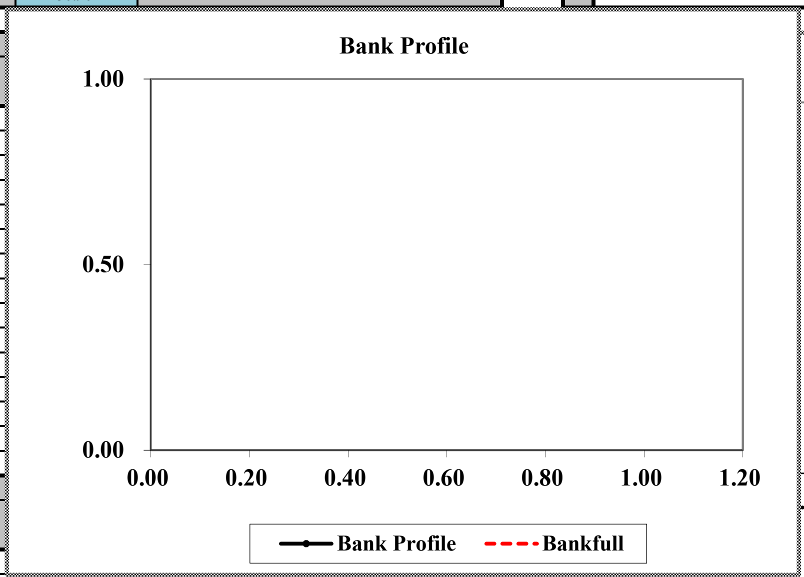
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile		
Horizontal Distance	**Vertical Height**	**Notes**

Bankfull		
Horizontal Distance	**Vertical Height**	**Notes**



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 27**

Station: **301+33.97 to 302+31.22** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……. …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.55	**0.43**	**1.2790698**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**		43.41				
Reach:	301+25.14 to 302+30.62	**Comments:**								Very High				
Location:	Left Bank 27	**Bank Length**	107					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	1.00	2.00	7.90	High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.25	2.00	0.13	8.17	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	0.13	5.00	9.00	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
30.00			2.44	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
30.00			5.90	Moderate	
			Adjustment		Notes
Bank Materials			10.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	43.41		

Bank Erosion Potential

Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

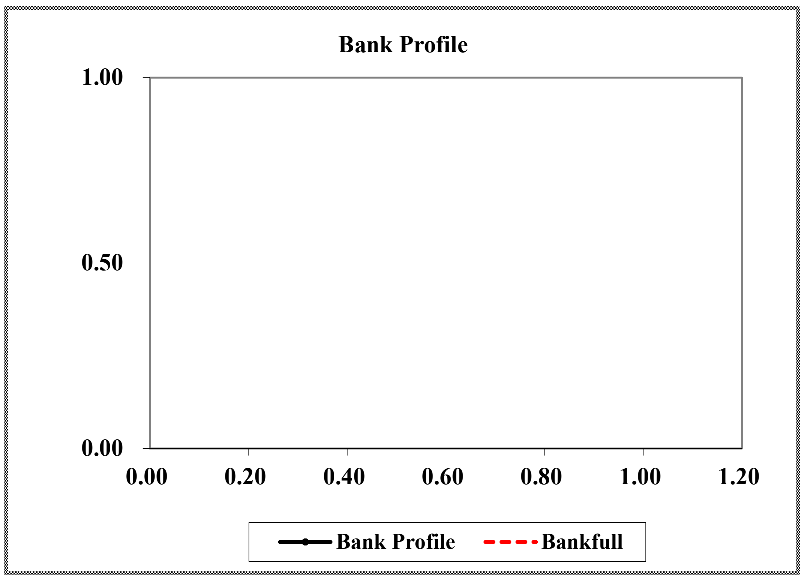
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Left Bank 27**	
Station: **301+25.14 to 302+30.62**	Stream Type:	Valley Type:
Observers: **PVC & SH**		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous…………. ……………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……… ……………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Very High	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.53	**0.38**	**1.3947368**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating: Very High

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	45.43
Reach:	500+3.19 to 503+63.08	**Comments:**							Very High
Location:	Right Bank 28	**Bank Length**	345						
Date:	5/4/2018								

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
6.00	1.50	4.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	6.00	0.08	8.63	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.08	1.67	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
30.00			5.90	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	45.43		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

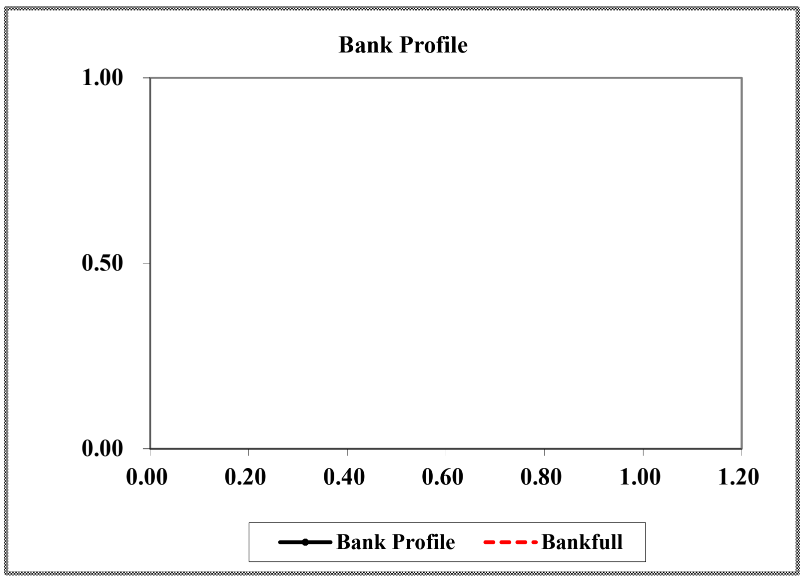
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 28**

Station: **500+3.19 to 503+63.08** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….…………..…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Very High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.83	**0.62**	**1.3387097**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	44.64				
Reach:	500+2.38 to 503+65.54	**Comments:**							Very High				
Location:	Left Bank 28	**Bank Length**	367					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
6.00	1.50	4.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	6.00	0.08	8.63	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.08	2.50	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	44.64		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

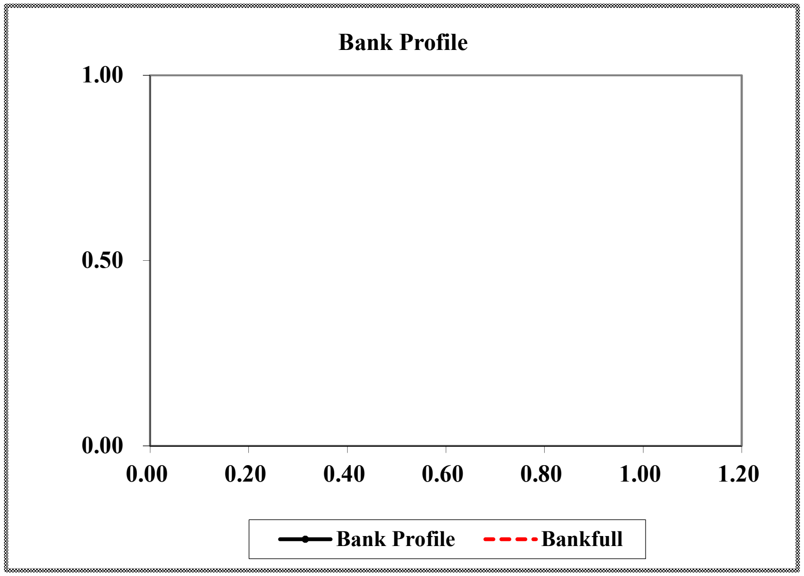
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Left Bank 28**

Station: **500+2.38 to 503+65.54** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………….. ……………….….NBS = High / Very High

Extensive deposition (continuous, cross-channel)……………..……………..……. …………....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………….…………..…NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.77	**0.49**	**1.5714286**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**		43.66			
Reach:	503+63.08 to 507+15.6	**Comments:**								Very High			
Location:	Right Bank 29	**Bank Length**	358					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/4/2018								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.00	1.50	3.33	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	5.00	0.10	8.44	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.10	2.00	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
50.00			4.32	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	43.66		

Bank Erosion Potential

Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

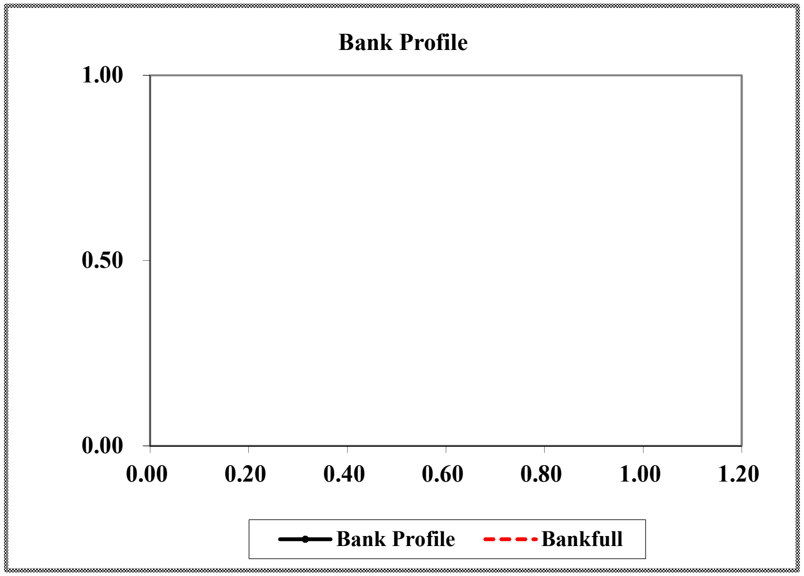
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston** Location: **Right Bank 29**

Station: **503+63.08 to 507+15.6** Stream Type: Valley Type:

Observers: **PVC & SH** Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………..……… …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ………..….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**5**
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.83	**0.62**	**1.3387097**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Eccleston Mitigation Bank	**Observer(s):**	PVC	**Data:**	SH	**QA/QC:**		**Total Score:**	44.45			
Reach:	503+65.54 to 507+20.72	**Comments:**							Very High			
Location:	Left Bank 29	**Bank Length**	352					**Total Score**	**Very Low**	**Low**	**Moderate**	**High** / **Very High** / **Extreme**
Date:	5/4/2018							**Values:**	5-10	10-20	20-30	30-40 / 40-45 / 45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.00	1.50	3.33	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	5.00	0.10	8.44	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.10	3.00	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials			5.00		
			Adjustment		Notes
Bank Stratification			0.00		
		TOTAL SCORE	44.45		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

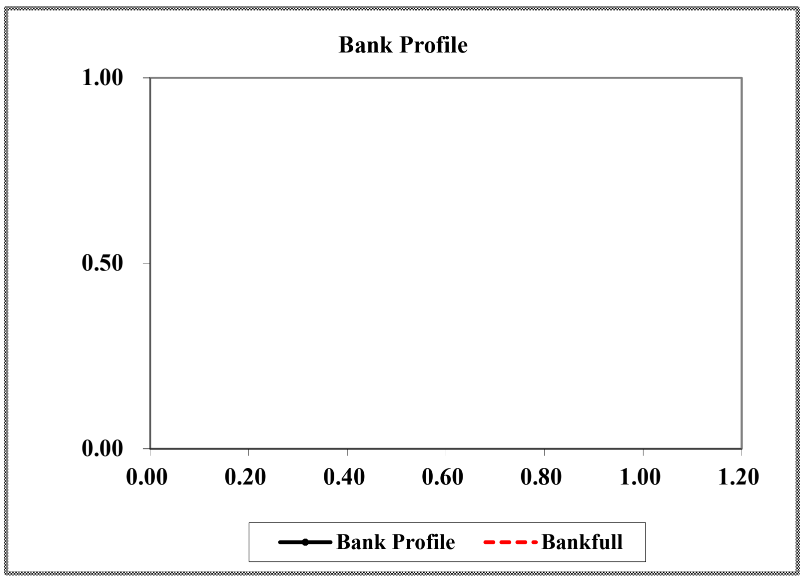
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Bank Profile

Horizontal Distance	Vertical Height	Notes

Bankfull

Horizontal Distance	Vertical Height	Notes



Estimating Near-Bank Stress (NBS)

Stream: **Eccleston**	Location: **Left Bank 29**	
Station: **503+65.54 to 507+20.72**	Stream Type:	Valley Type:
Observers: **PVC & SH**		Date: **5/4/2018**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……. …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……….…..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**5**
Dominant Near-Bank Stress	
Moderate	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.77	**0.49**	**1.5714286**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

Sediment and Nutrient Removal for TMDL Credit
Eccleston
Baltimore County, MD

By: PVC
Date: 12/20/2017

indicates results to be Reported to the State (per Section 7.1.3)

Protocol 1
Credit for Prevented Sediment during Storm Flow

Step 1: Estimate stream sediment erosion rate

Erosion Rate =	2024.8	tons/yr*	*-from Eccleston stream bank erosion rate (BEHI-NBS data)*
Study Length =	12754	LF	*-Combined right and left bank lengths*
Unit Erosion Rate =	0.158758	tons/ft/yr	** Unit Density of soil = 2286.74 lb/CY (per Bulk Density testing)*
Existing Stream length to be restored =	5564	LF	
x	0.158758	tons/ft/yr	
Total Erosion =	883.3	tons/yr	

Step 2: Convert stream bank erosion to nutrient loading

Nitrogen Concentration =	1.35	lbs/ton	*- from recommendations of the Expert Panel to Define Removal Rates for individual Stream*
Phosphorus Concentration =	0.445	lbs/ton	*Restoration Projects prepared by Tom Schueler and Bill Stack*

Step 3: Estimate stream restoration efficiency

Load Reductions (50% efficiency)		
Sediment (TSS) =	883,330	lbs/yr
Nitrogen (TN) =	596.2	lbs/yr
Phosphorus (TP) =	196.5	lbs/yr

Protocol 2
Credit for in-stream and riparian nutrient processing within the hyporheic zone during base

Step 1: Determine the total post construction stream length that has been reconnected using the bank height ratio of 1.0 or less

Restored (proposed) Stream Length =	6796	LF	*length of restored stream where BHR = 1.0 or less*

Step 2: Determine the dimensions of the hyporheic box

Channel Width =	9	ft	*where BHR = 1.0 or less*	*Channel Width = average of all stream reaches*
Left Floodplain Width =	5	ft	*(max. credit = 5 ft)*	
Right Floodplain Width =	5	ft	*(max. credit = 5 ft)*	
Width Hyporheic Box =	19	ft		
Depth Hyporheic Box =	5	ft	*from guidance*	
x	6796	LF		
Total Vol. Hyporheic Zone =	645,620	ft^3		
Mass of hyporheic box =	31085.4	tons*	** Unit Density of soil = 2600 lb/CY*	

Step 3: Multiply the hyporheic box mass by the unit denitrification rate

Unit Denitrification Rate =	1.06E-04	lbs/ton/day	
			Watershed Area at Downstream POI = 1,728 acres
Load Reduction			Impervious Area = 22.7%
Nitrogen (TN) =	1202.7	lbs/yr*	**<40% of watershed annual N load (full credit is applicable)*

Protocol 3

Credit for Floodplain Reconnection Volume

**Not performed for this project*

APPENDIX F
Ecological Uplift

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Intersection Trib
STATION #________ RIVERMILE________	STREAM CLASS
LAT____________ LONG____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 5/4/18 TIME ________ AM PM REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Intersection Trib

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Below Cypress
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 5/4/18 TIME ________ AM PM ‖ REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
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SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Below Cypress

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
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SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Downstream Forested Jones
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 5/4/18 TIME ________ AM PM / REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Downstream Forested Jones

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Walnut
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 5/4/18 TIME ________ AM PM — REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Walnut

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Middle Jones
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 5/4/18 TIME ________ AM PM — REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Middle Jones

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Braided Trib
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 5/4/18 TIME ________ AM PM REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Braided Trib

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. Braided	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Railroad Trib
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE ________ TIME ________ AM PM — REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Railroad Trib

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION Cypress
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 5/4/18 TIME ________ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Cypress

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

APPENDIX G
Design Computations

RIVERMORPH CROSS SECTION SUMMARY

River Name: Proposed Design
Reach Name: Main Stem
Cross Section Name: Typical Section - B stream
Survey Date: 09/27/2018

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	2	
10	0	2	BKF
11.75	0	1.3	
16.25	0	1	
20.75	0	1.3	
22.5	0	2	
32	0	2	

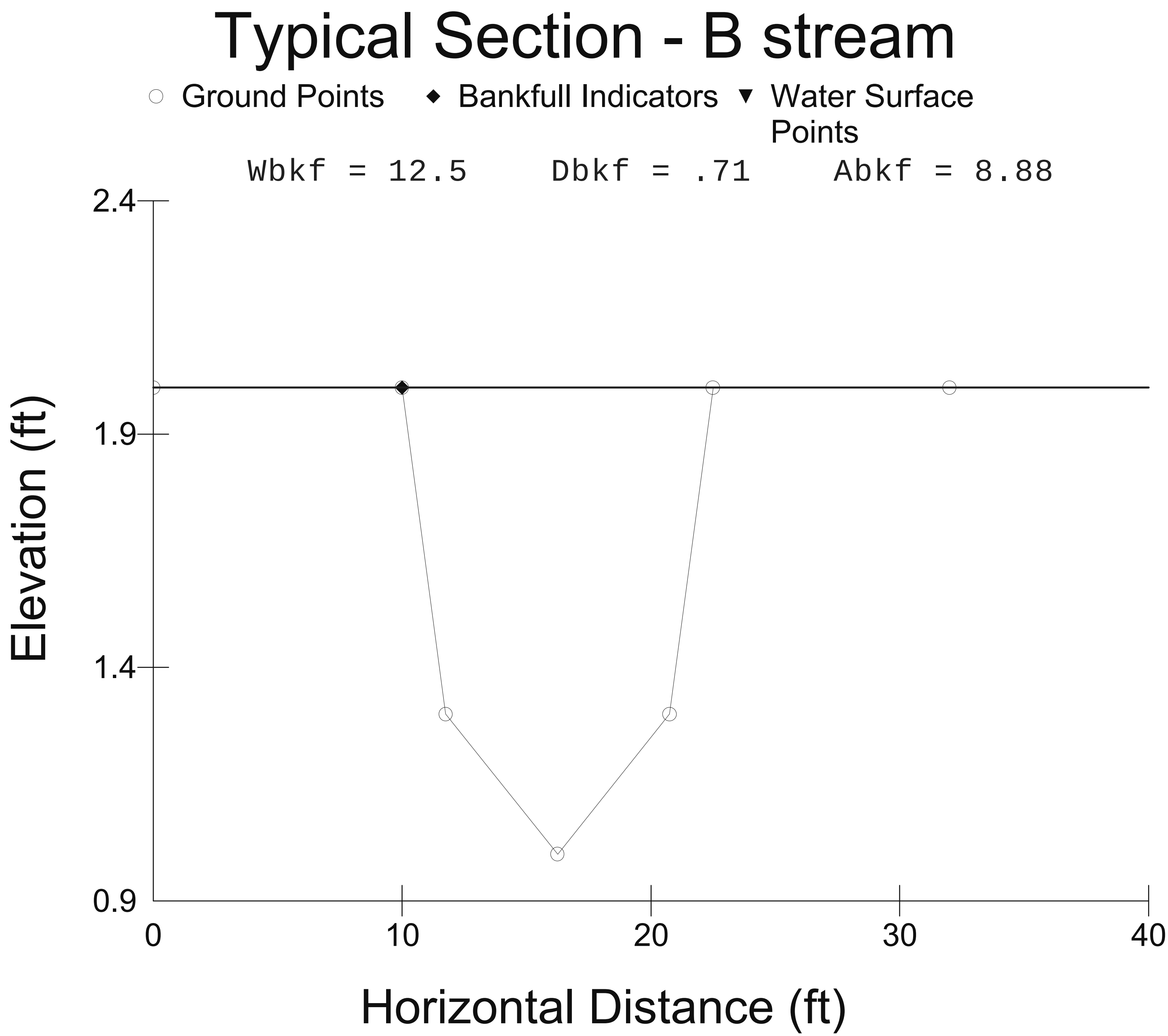
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	3	3	3
Bankfull Elevation (ft)	2	2	2
Floodprone Width (ft)	32	-----	-----
Bankfull Width (ft)	12.5	6.25	6.25
Entrenchment Ratio	2.56	-----	-----
Mean Depth (ft)	0.71	0.71	0.71
Maximum Depth (ft)	1	1	1
Width/Depth Ratio	17.61	8.8	8.8
Bankfull Area (sq ft)	8.88	4.44	4.44
Wetted Perimeter (ft)	12.79	7.39	7.39
Hydraulic Radius (ft)	0.69	0.6	0.6
Begin BKF Station	10	10	16.25
End BKF Station	22.5	16.25	22.5

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


Typical Section - B stream
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 12.5
Dbkf = .71
Abkf = 8.88
Elevation (ft)
2.4
1.9
1.4
0.9
0
10
20
30
40
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Proposed Design
Reach Name: Main Stem
Cross Section Name: Typical Section - C stream
Survey Date: 09/13/2018

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	2	
10	0	2	BKF
11.5	0	1.4	
14.5	0	1.2	
17.5	0	1.4	
19	0	2	
29	0	2	

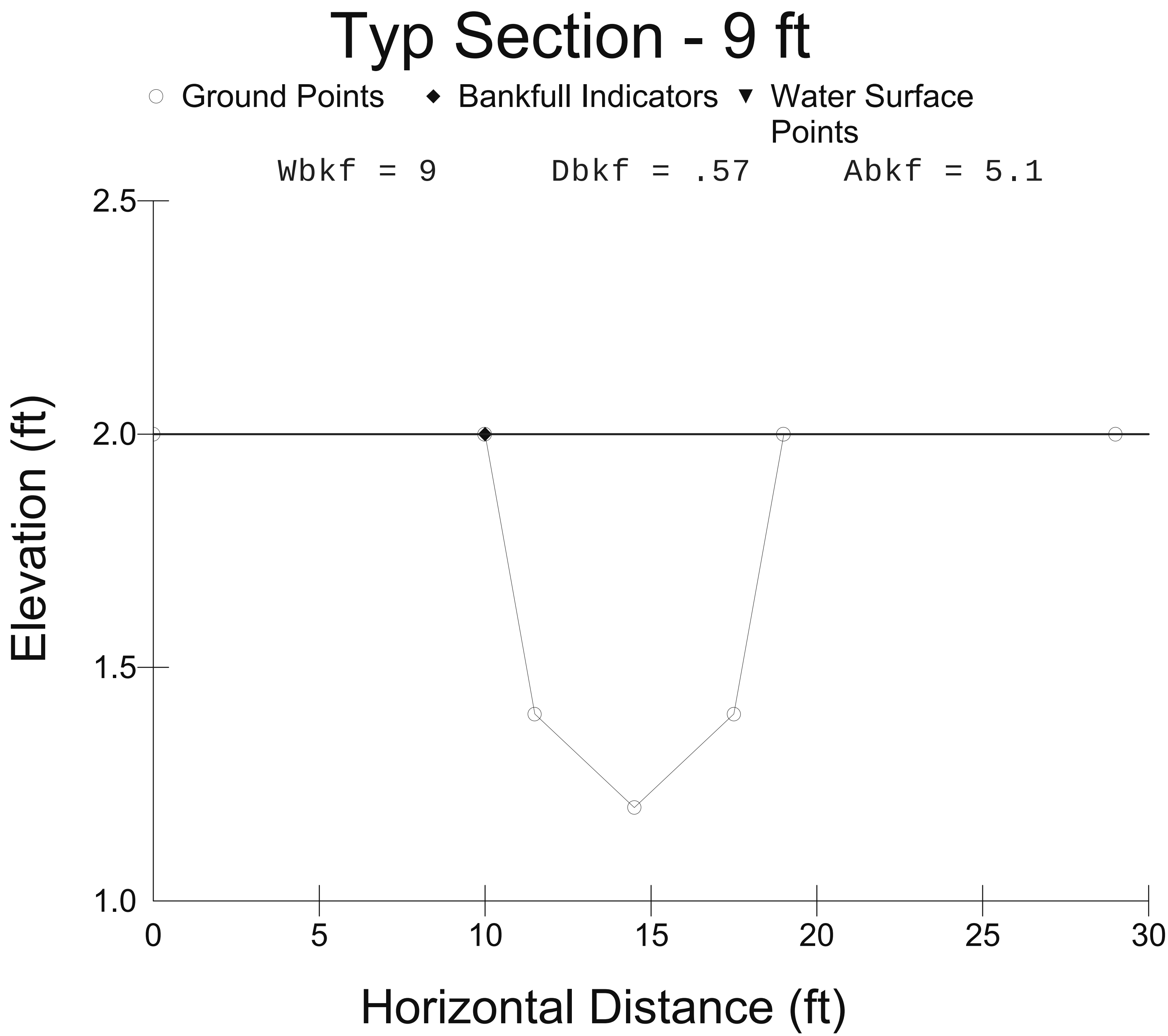
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	2.8	2.8	2.8
Bankfull Elevation (ft)	2	2	2
Floodprone Width (ft)	29	-----	-----
Bankfull Width (ft)	9	4.5	4.5
Entrenchment Ratio	3.22	-----	-----
Mean Depth (ft)	0.57	0.57	0.57
Maximum Depth (ft)	0.8	0.8	0.8
Width/Depth Ratio	15.79	7.94	7.89
Bankfull Area (sq ft)	5.1	2.55	2.55
Wetted Perimeter (ft)	9.24	5.42	5.42
Hydraulic Radius (ft)	0.55	0.47	0.47
Begin BKF Station	10	10	14.5
End BKF Station	19	14.5	19

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			



Typ Section - 9 ft
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 9
Dbkf = .57
Abkf = 5.1
2.5
2.0
1.5
1.0
Elevation (ft)
0
5
10
15
20
25
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Proposed Design
Reach Name: South Tributary
Cross Section Name: Typical Section - B stream
Survey Date: 09/18/2018

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	2	
10	0	2	BKF
10.75	0	1.7	
12	0	1.7	
13	0	1.3	
14	0	1.3	
15	0	1.7	
16.25	0	1.7	
17	0	2	
26	0	2	

Cross Sectional Geometry

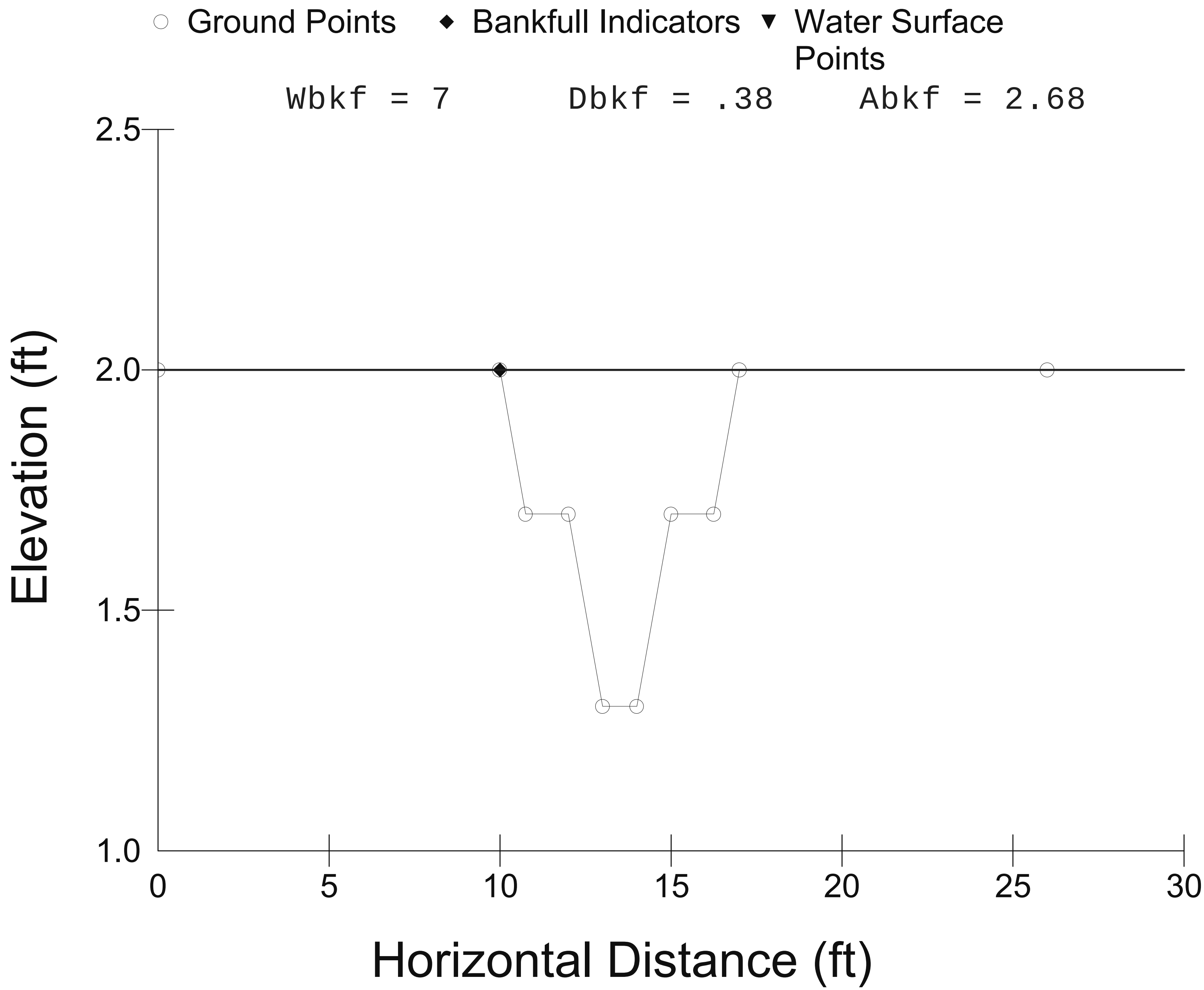
	Channel	Left	Right
Floodprone Elevation (ft)	2.7	2.7	2.7
Bankfull Elevation (ft)	2	2	2
Floodprone Width (ft)	26	-----	-----
Bankfull Width (ft)	7	3	4
Entrenchment Ratio	3.71	-----	-----
Mean Depth (ft)	0.38	0.33	0.42
Maximum Depth (ft)	0.7	0.7	0.7
Width/Depth Ratio	18.42	9.11	9.52
Bankfull Area (sq ft)	2.67	0.99	1.69
Wetted Perimeter (ft)	7.27	3.83	4.83
Hydraulic Radius (ft)	0.37	0.26	0.35
Begin BKF Station	10	10	13
End BKF Station	17	13	17

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

Typical Section - B stream



RIVERMORPH CROSS SECTION SUMMARY

River Name: Proposed Design
Reach Name: South Tributary
Cross Section Name: Typical Section - C Stream
Survey Date: 09/19/2018

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	2	
10	0	2	BKF
11.05	0	1.58	
12.25	0	1.5	
13.45	0	1.58	
14.5	0	2	
24.5	0	2	

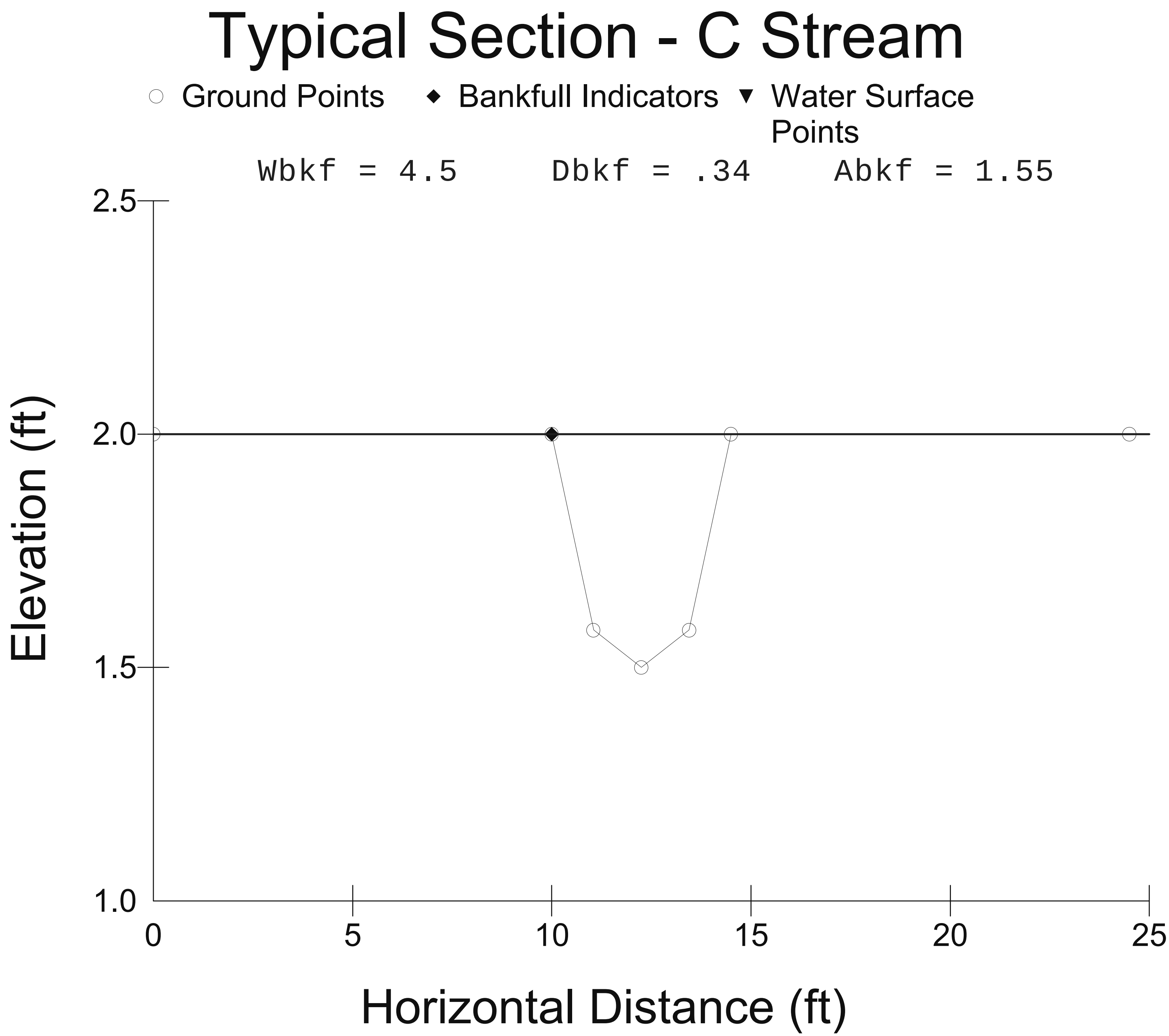
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	2.5	2.5	2.5
Bankfull Elevation (ft)	2	2	2
Floodprone Width (ft)	24.5	-----	-----
Bankfull Width (ft)	4.5	2.25	2.25
Entrenchment Ratio	5.44	-----	-----
Mean Depth (ft)	0.34	0.34	0.34
Maximum Depth (ft)	0.5	0.5	0.5
Width/Depth Ratio	13.24	6.55	6.62
Bankfull Area (sq ft)	1.54	0.77	0.77
Wetted Perimeter (ft)	4.67	2.83	2.83
Hydraulic Radius (ft)	0.33	0.27	0.27
Begin BKF Station	10	10	12.25
End BKF Station	14.5	12.25	14.5

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


Typical Section - C Stream
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 4.5
Dbkf = .34
Abkf = 1.55
Elevation (ft)
2.5
2.0
1.5
1.0
0
5
10
15
20
25
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Proposed Design
Reach Name: North Tributary
Cross Section Name: Typical Section - B Stream 10ft
Survey Date: 09/18/2018

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	2	
10	0	2	BKF
11.25	0	1.5	
12.75	0	1.5	
14	0	1.2	
16	0	1.2	
17.25	0	1.5	
18.75	0	1.5	
20	0	2	
30	0	2	

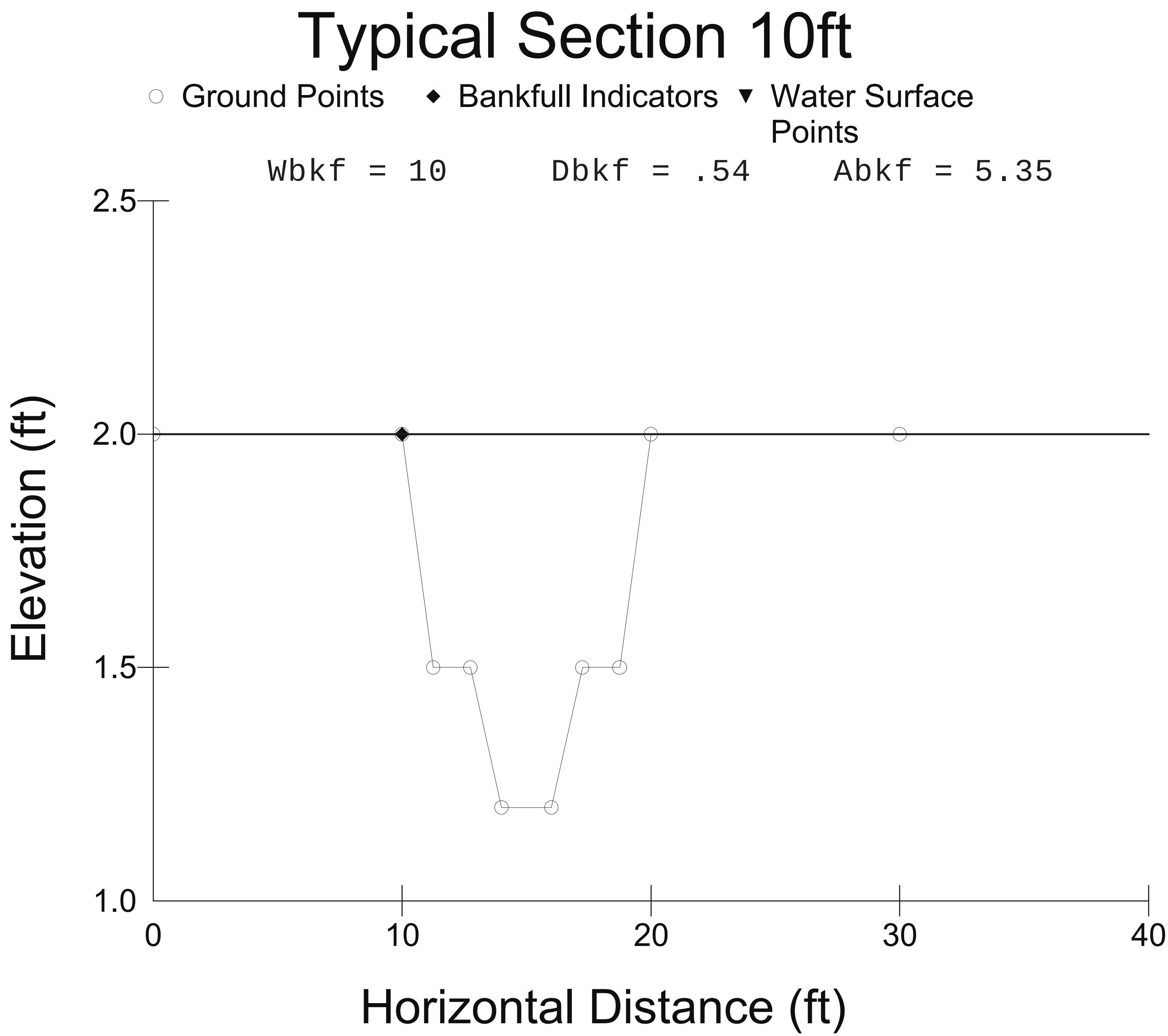
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	2.8	2.8	2.8
Bankfull Elevation (ft)	2	2	2
Floodprone Width (ft)	30	-----	-----
Bankfull Width (ft)	10	5	5
Entrenchment Ratio	3	-----	-----
Mean Depth (ft)	0.53	0.53	0.54
Maximum Depth (ft)	0.8	0.8	0.8
Width/Depth Ratio	18.87	9.35	9.26
Bankfull Area (sq ft)	5.35	2.67	2.68
Wetted Perimeter (ft)	10.26	5.93	5.93
Hydraulic Radius (ft)	0.52	0.45	0.45
Begin BKF Station	10	10	15
End BKF Station	20	15	20

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			



Typical Section 10ft
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 10
Dbkf = .54
Abkf = 5.35
Elevation (ft)
2.5
2.0
1.5
1.0
0
10
20
30
40
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Proposed Design
Reach Name: North Tributary
Cross Section Name: Typical Section - C Stream
Survey Date: 09/18/2018

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	2	
10	0	2	BKF
11.15	0	1.54	
13.25	0	1.4	
15.35	0	1.54	
16.5	0	2	
28	0	2	

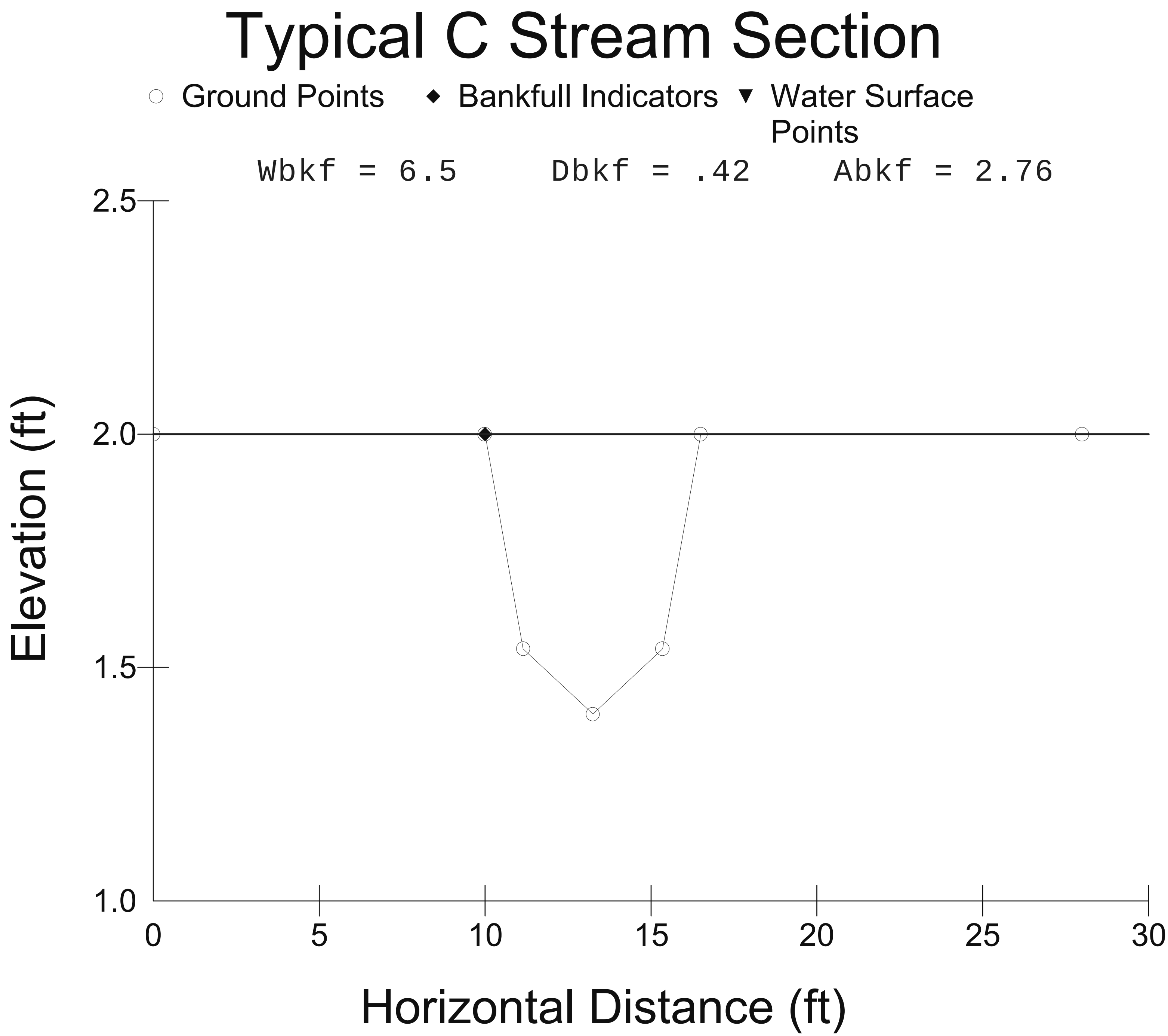
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	2.6	2.6	2.6
Bankfull Elevation (ft)	2	2	2
Floodprone Width (ft)	28	-----	-----
Bankfull Width (ft)	6.5	4	2.5
Entrenchment Ratio	4.31	-----	-----
Mean Depth (ft)	0.42	0.45	0.38
Maximum Depth (ft)	0.6	0.6	0.55
Width/Depth Ratio	15.48	8.85	6.58
Bankfull Area (sq ft)	2.75	1.81	0.95
Wetted Perimeter (ft)	6.69	4.64	3.14
Hydraulic Radius (ft)	0.41	0.39	0.3
Begin BKF Station	10	10	14
End BKF Station	16.5	14	16.5

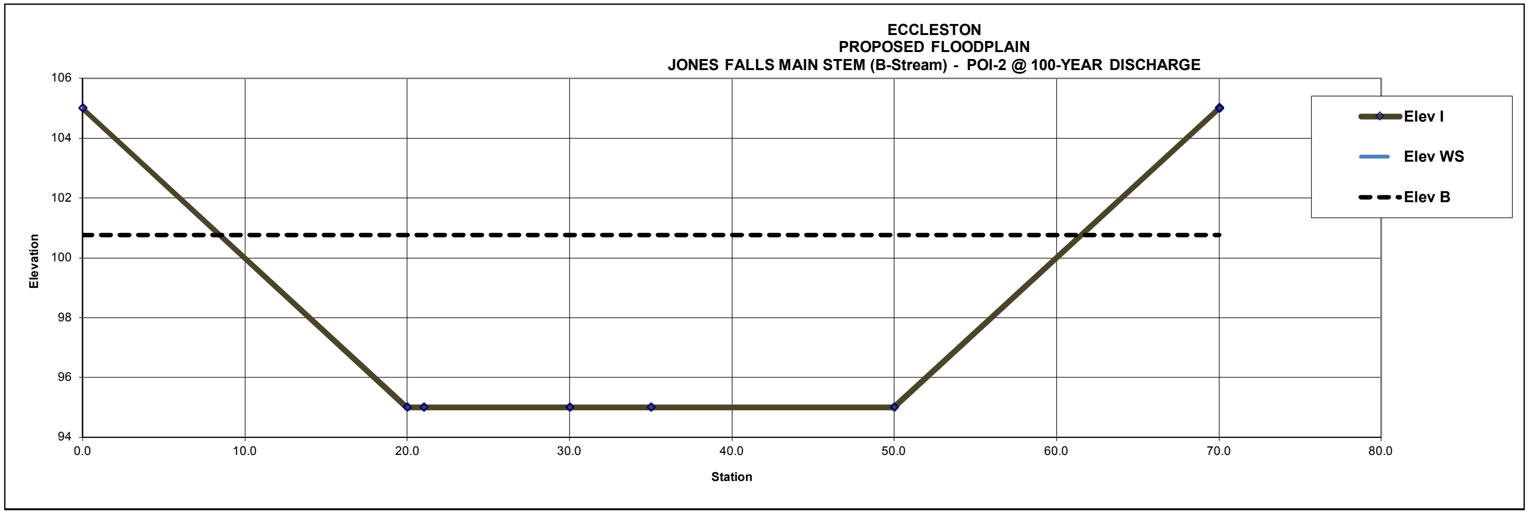
Entrainment Calculations

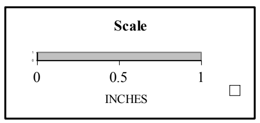
Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


Typical C Stream Section
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6.5
Dbkf = .42
Abkf = 2.76
Elevation (ft)
2.5
2.0
1.5
1.0
0
5
10
15
20
25
30
Horizontal Distance (ft)

Proposed Floodplain - Jones Falls Sta. 100+00 to 101+43.02





Note: Scale set for print and view magnification at 65%

Plot Scale		
1inch =		feet horiz.
1inch =		feet vert.

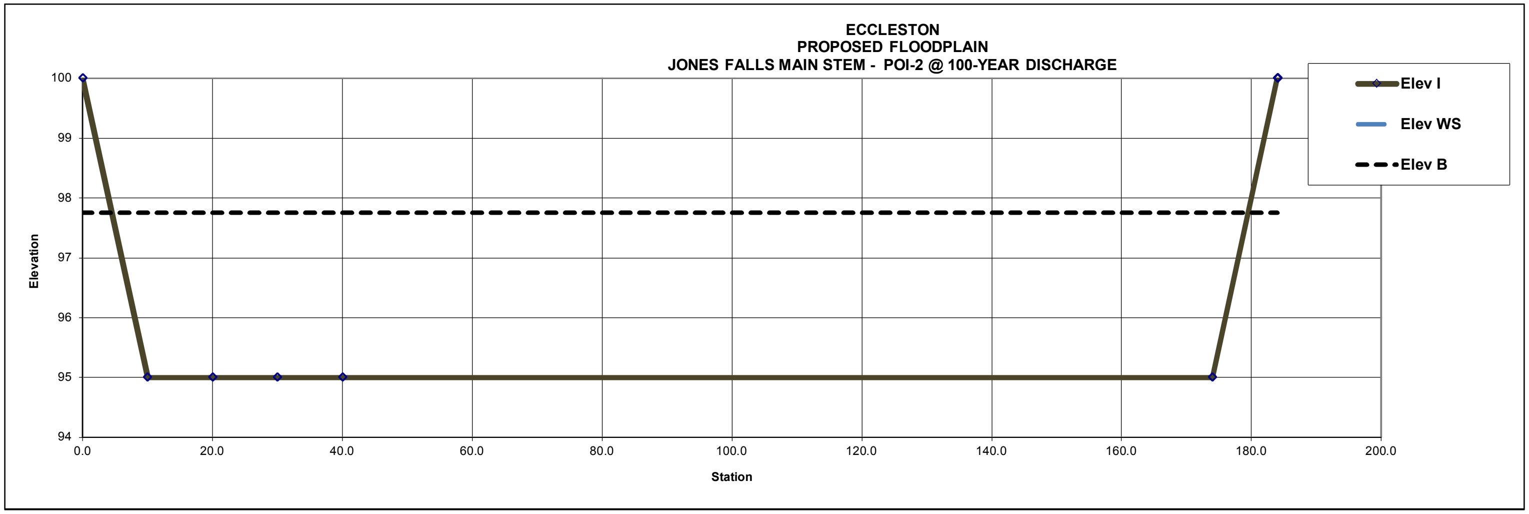
English Units

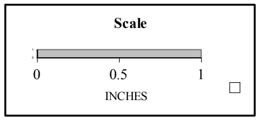
GEOMETRY	
Bank Full Elevation	100.77
Bank Full Width	53.06
Bank Full Depth	4.51
Maximum Depth	5.77
Bank Full Area	239.4
Hydraulic Radius	3.96
Wetted Perimeter	60.5
Width/Depth Ratio	11.8
Flood Prone Width	70.0
Entrenchment	
Stream Type	C4/E4
Rc	

English Units

HYDRAULICS	
Slope (ft/ft)	0.0205
Manning's n	0.08
Velocity (ft./s)	6.66
Froud #	0.59
Discharge (cu ft/s)	1593.4
Shear Stress (lb/sq ft)	5.06
CX Power (ft lb/s)	2038.2
Critical Size (mm)	497.1
Flow Type	Subcritical Flow
Rec. Interval	

Proposed Floodplain - Jones Falls Sta. 101+43.02 to 107+52.45





Note: Scale set for print and view magnification at 65%

Plot Scale		
1inch =		feet horiz.
1inch =		feet vert.

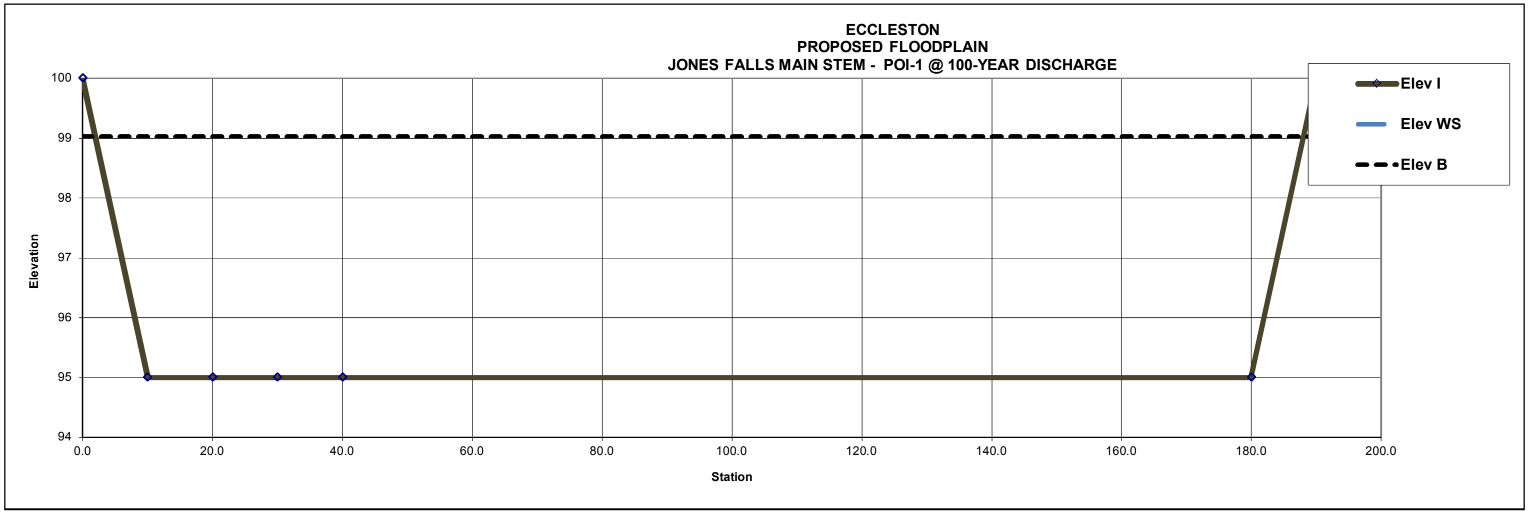
English Units

GEOMETRY	
Bank Full Elevation	97.75
Bank Full Width	175.01
Bank Full Depth	2.67
Maximum Depth	2.75
Bank Full Area	466.7
Hydraulic Radius	2.61
Wetted Perimeter	178.9
Width/Depth Ratio	65.6
Flood Prone Width	184.0
Entrenchment	
Stream Type	C4/E4
Rc	

English Units

HYDRAULICS	
Slope (ft/ft)	0.0094
Manning's n	0.08
Velocity (ft./s)	3.41
Froud #	0.37
Discharge (cu ft/s)	1593.1
Shear Stress (lb/sq ft)	1.53
CX Power (ft lb/s)	934.5
Critical Size (mm)	136.7
Flow Type	Subcritical Flow
Rec. Interval	

Proposed Floodplain - Jones Falls Sta. 107+52.45 to 126+76.91
*Minimum width of the proposed floodplain to calculate the maximum shear stress.



Scale

0 0.5 1

INCHES

Note: Scale set for print and view magnification at 65%

Plot Scale		
1inch =		feet horiz.
1inch =		feet vert.

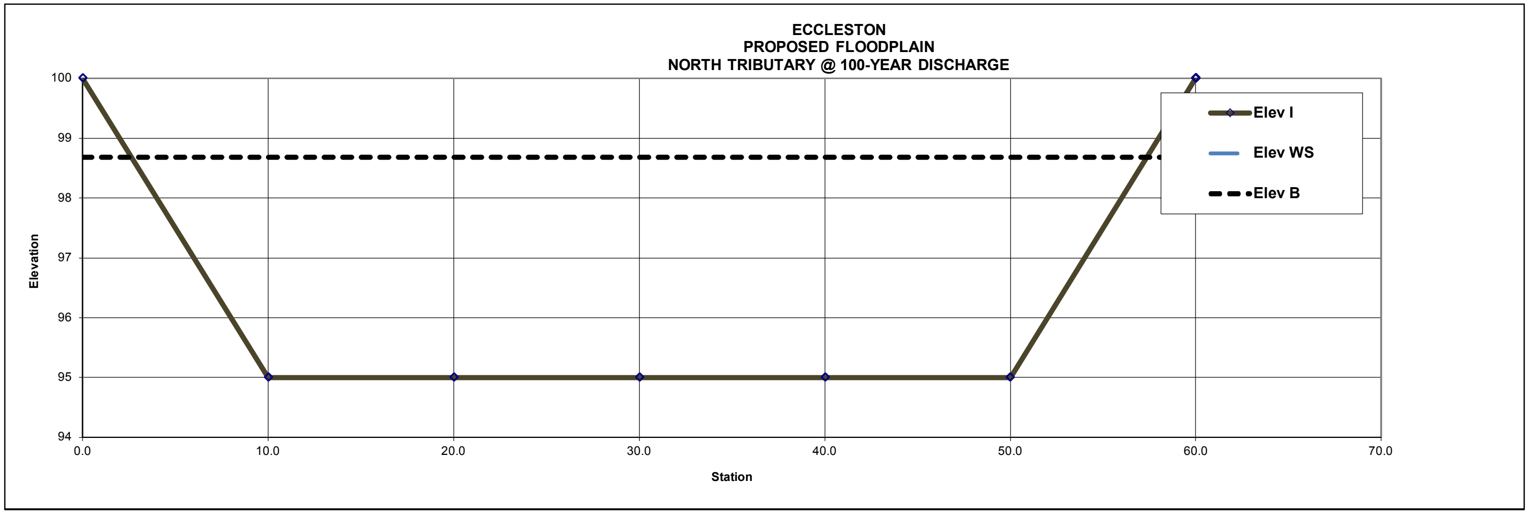
English Units

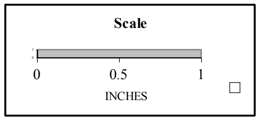
GEOMETRY	
Bank Full Elevation	99.03
Bank Full Width	186.11
Bank Full Depth	3.85
Maximum Depth	4.03
Bank Full Area	717.2
Hydraulic Radius	3.80
Wetted Perimeter	189.0
Width/Depth Ratio	48.3
Flood Prone Width	190.0
Entrenchment	
Stream Type	C4/E4
Rc	

English Units

HYDRAULICS	
Slope (ft/ft)	0.0094
Manning's n	0.08
Velocity (ft./s)	4.38
Froud #	0.40
Discharge (cu ft/s)	3144.2
Shear Stress (lb/sq ft)	2.23
CX Power (ft lb/s)	1844.3
Critical Size (mm)	204.9
Flow Type	Subcritical Flow
Rec. Interval	

Proposed Floodplain - North Tributary 600+00 to 601+35.58





Note: Scale set for print and view magnification at 65%

Plot Scale		
1inch =		feet horiz.
1inch =		feet vert.

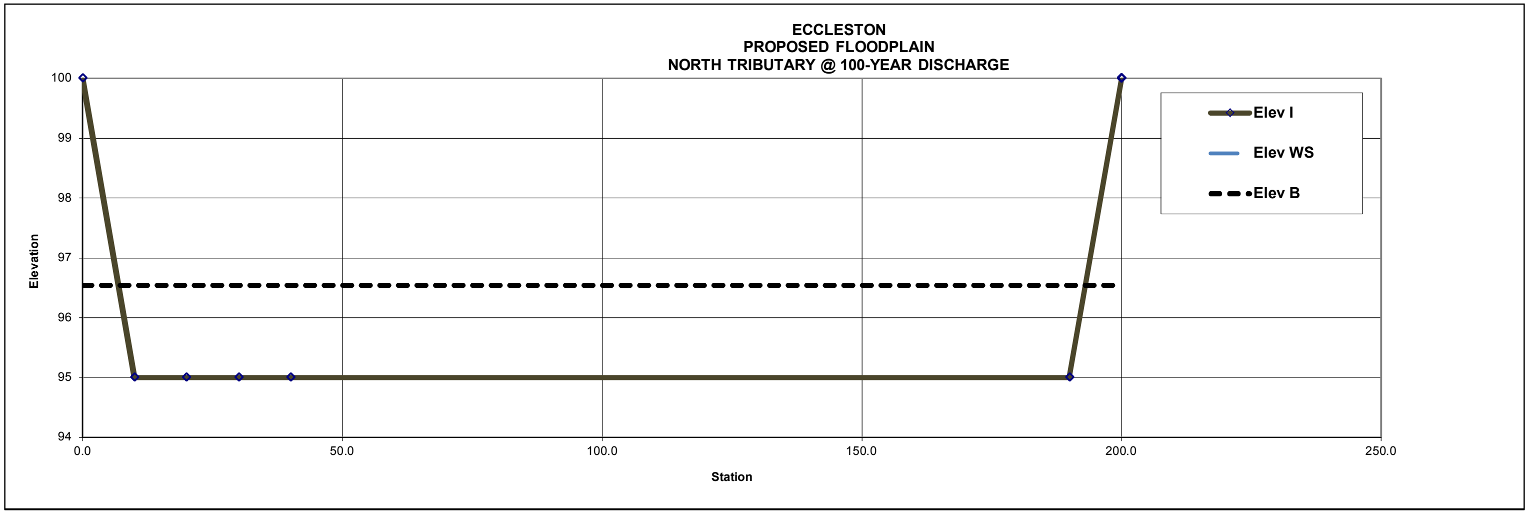
English Units

GEOMETRY	
Bank Full Elevation	98.68
Bank Full Width	54.72
Bank Full Depth	3.19
Maximum Depth	3.68
Bank Full Area	174.3
Hydraulic Radius	3.02
Wetted Perimeter	57.8
Width/Depth Ratio	17.2
Flood Prone Width	60.0
Entrenchment	
Stream Type	C4/E4
Rc	

English Units

HYDRAULICS	
Slope (ft/ft)	0.0230
Manning's n	0.08
Velocity (ft./s)	5.88
Froud #	0.60
Discharge (cu ft/s)	1025.7
Shear Stress (lb/sq ft)	4.33
CX Power (ft lb/s)	1472.0
Critical Size (mm)	420.0
Flow Type	Subcritical Flow
Rec. Interval	

Proposed Floodplain - North Tributary 601+35.58 to 607+66.51



Scale		
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INCHES		

Note: Scale set for print and view magnification at 65%

Plot Scale		
1inch =		feet horiz.
1inch =		feet vert.

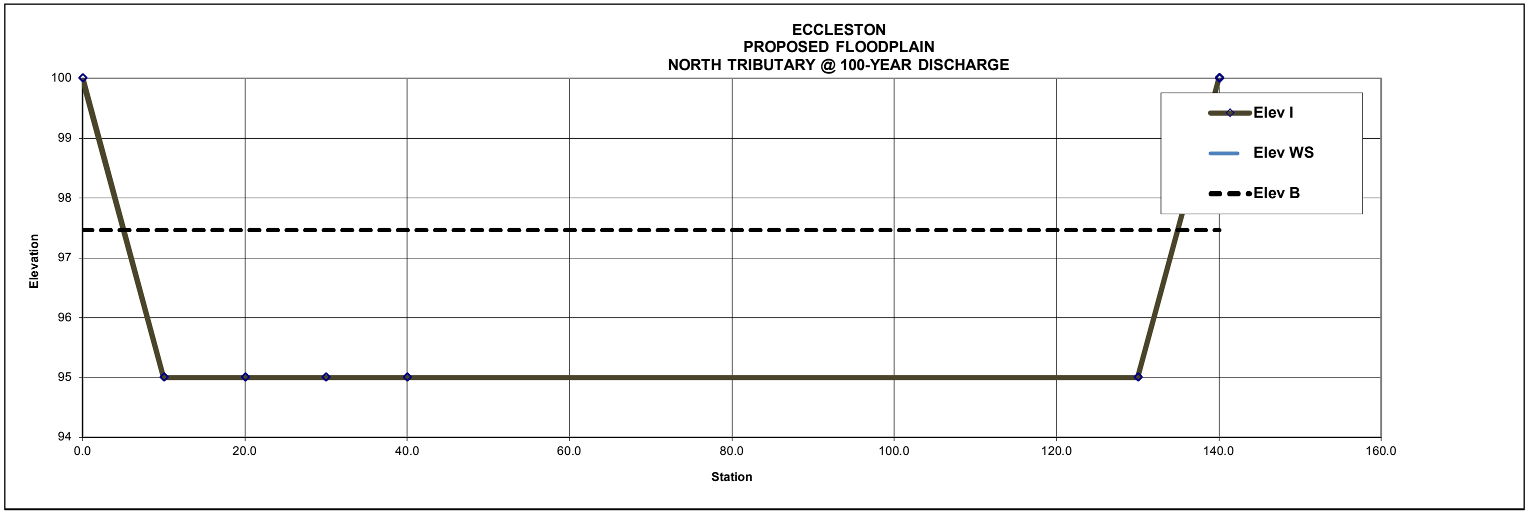
English Units

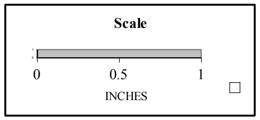
GEOMETRY	
Bank Full Elevation	96.54
Bank Full Width	186.16
Bank Full Depth	1.51
Maximum Depth	1.54
Bank Full Area	281.9
Hydraulic Radius	1.47
Wetted Perimeter	191.7
Width/Depth Ratio	122.9
Flood Prone Width	192.3
Entrenchment	1.03
Stream Type	C4/E4
Rc	

English Units

HYDRAULICS	
Slope (ft/ft)	0.0230
Manning's n	0.08
Velocity (ft./s)	3.64
Froud #	0.53
Discharge (cu ft/s)	1027.2
Shear Stress (lb/sq ft)	2.11
CX Power (ft lb/s)	1474.2
Critical Size (mm)	193.4
Flow Type	Subcritical Flow
Rec. Interval	

Proposed Floodplain - North Tributary 607+66.51 to 614+42.09





Note: Scale set for print and view magnification at 65%

Plot Scale		
1inch =		feet horiz.
1inch =		feet vert.

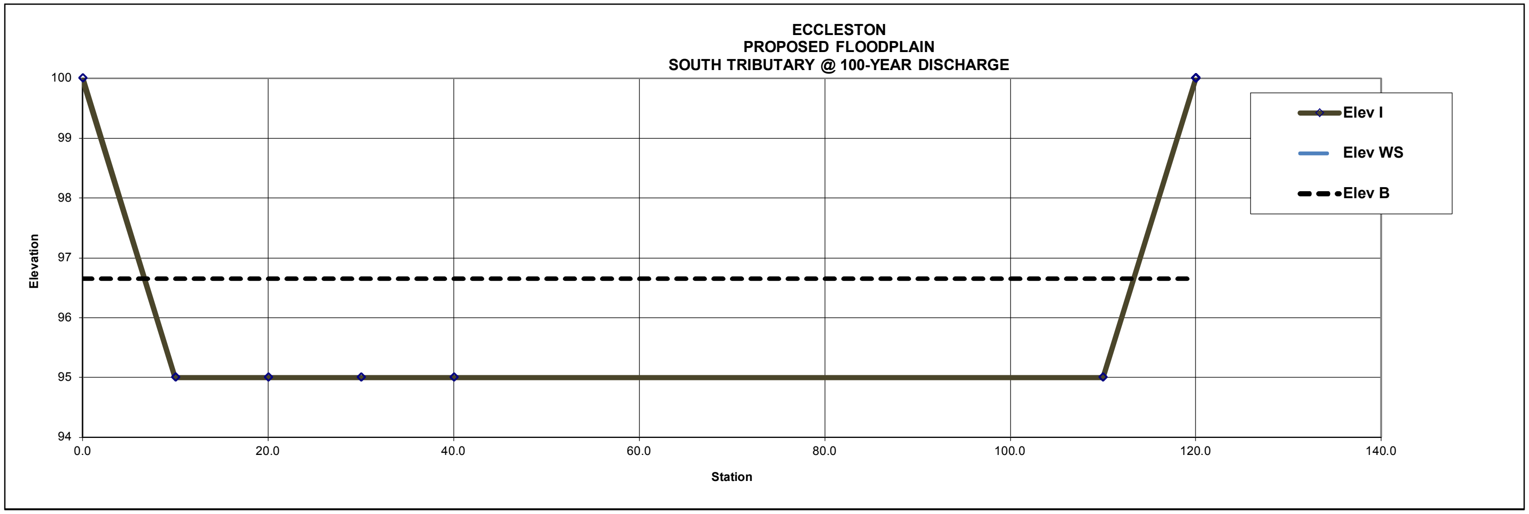
English Units

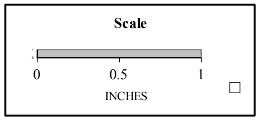
GEOMETRY	
Bank Full Elevation	97.47
Bank Full Width	129.86
Bank Full Depth	2.37
Maximum Depth	2.47
Bank Full Area	308.0
Hydraulic Radius	2.30
Wetted Perimeter	134.0
Width/Depth Ratio	54.8
Flood Prone Width	139.7
Entrenchment	1.08
Stream Type	C4/E4
Rc	

English Units

HYDRAULICS	
Slope (ft/ft)	0.0106
Manning's n	0.08
Velocity (ft./s)	3.33
Froud #	0.39
Discharge (cu ft/s)	1025.7
Shear Stress (lb/sq ft)	1.52
CX Power (ft lb/s)	678.4
Critical Size (mm)	135.7
Flow Type	Subcritical Flow
Rec. Interval	

Proposed Floodplain - South Tributary 200+00 to 207+62.80 and 300+00 to 304+16.88





Note: Scale set for print and view magnification at 65%

Plot Scale		
1inch =		feet horiz.
1inch =		feet vert.

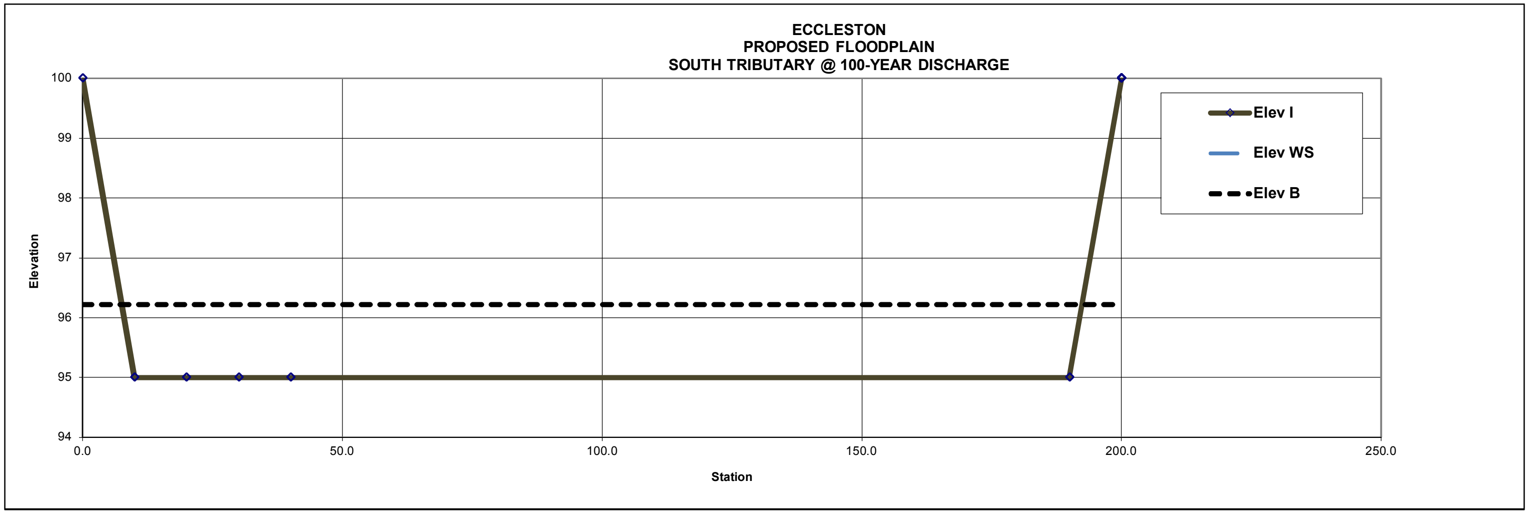
English Units

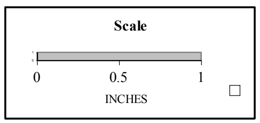
GEOMETRY	
Bank Full Elevation	96.65
Bank Full Width	106.60
Bank Full Depth	1.60
Maximum Depth	1.65
Bank Full Area	170.6
Hydraulic Radius	1.52
Wetted Perimeter	112.0
Width/Depth Ratio	66.6
Flood Prone Width	113.2
Entrenchment	1.06
Stream Type	C4/E4
Rc	

English Units

HYDRAULICS	
Slope (ft/ft)	0.0220
Manning's n	0.08
Velocity (ft./s)	3.65
Froud #	0.52
Discharge (cu ft/s)	622.1
Shear Stress (lb/sq ft)	2.09
CX Power (ft lb/s)	854.0
Critical Size (mm)	191.5
Flow Type	Subcritical Flow
Rec. Interval	

Proposed Floodplain - South Tributary 207+62.80 to 211+52.03 and 304+16.88 to 309+72.59





Note: Scale set for print and view magnification at 65%

Plot Scale		
1inch =		feet horiz.
1inch =		feet vert.

English Units

GEOMETRY	
Bank Full Elevation	96.22
Bank Full Width	184.88
Bank Full Depth	1.20
Maximum Depth	1.22
Bank Full Area	222.6
Hydraulic Radius	1.16
Wetted Perimeter	191.1
Width/Depth Ratio	153.6
Flood Prone Width	189.8
Entrenchment	1.03
Stream Type	C4/E4
Rc	

English Units

HYDRAULICS	
Slope (ft/ft)	0.0186
Manning's n	0.08
Velocity (ft./s)	2.80
Froud #	0.46
Discharge (cu ft/s)	624.2
Shear Stress (lb/sq ft)	1.35
CX Power (ft lb/s)	724.4
Critical Size (mm)	119.6
Flow Type	Subcritical Flow
Rec. Interval	

Intersection Tributary Typical Riffle Section Q-Qs output for determining max shear stress within channel

ELEV	DEPTH	AREA	WET PER	WIDTH	HYD RAD	MEAN D	SLOPE	ROUGH	R/D84	VELOCITY	U/U*	U^2/2g	DISCHARGE	SHEAR	POWER	POWER/W	FROUDE	TRANSPORT
(ft)	(ft)	(sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	[n] (ft^(1/6))		(fps)		(ft)	(cfs)	(psf)	(lb/s)	(lb/ft/s)		(lb/s)
1.1	0.1	0.03	0.54	0.5	0.05	0.05	0.0218	0.055	0	0.54	2.89	0	0.02	0.07	0.02	0.04	0.43	0
1.2	0.2	0.1	1.08	1	0.09	0.1	0.0218	0.055	0	0.8	3.19	0.01	0.08	0.12	0.11	0.11	0.45	0
1.3	0.3	0.23	1.62	1.5	0.14	0.15	0.0218	0.055	0	1.08	3.43	0.02	0.25	0.19	0.34	0.22	0.49	0
1.4	0.4	0.4	2.15	2	0.19	0.2	0.0218	0.055	0	1.32	3.61	0.03	0.53	0.26	0.72	0.36	0.52	0
1.5	0.5	0.63	2.69	2.5	0.23	0.25	0.0218	0.055	0	1.5	3.73	0.03	0.94	0.31	1.28	0.51	0.53	0.01
1.6	0.6	0.9	3.23	3	0.28	0.3	0.0218	0.055	0	1.71	3.85	0.05	1.54	0.38	2.09	0.7	0.55	0
1.7	0.7	1.22	3.77	3.5	0.32	0.35	0.0218	0.055	0	1.87	3.94	0.05	2.28	0.44	3.1	0.89	0.56	0
1.8	0.8	1.6	4.31	4	0.37	0.4	0.0218	0.055	0	2.06	4.04	0.07	3.29	0.5	4.48	1.12	0.57	0.83

MAX SHEAR STRESS

Intersection Trib Bankfull Channel - Critical Shear

Sediment Transport Analysis

Andrews Methodology

Project:	**Eccleston Mitigation Site**		
Reach:	**Intersection Tributary**		
D(50) Riffle:	152	mm	
D(50) Bar/Sub:	n/a	mm	
Mobile Size (Di):	5	mm =	0.016 ft.
***Slope:**	0.0218	ft/ft	

*Slope of the steepest riffle to evaluate the max shear conditions

Use Class '0' RipRap with D50 of 6 inches (152 mm) - Shear stress is meets the stress results from the hydraulic analysis (1.01 lb/sf).

Andrews 1984 Methodology		*Andrews 1995 Methodology*	
Tc* (1984)	**Tc (1984)**	**Tc* (1995)**	**Tc (1995)**
#VALUE!	#VALUE! lb/sf	1.11986	1.89 lb/sf
Depth (1984)		**Depth (1995)**	
#VALUE! ft.		1.39 ft.	

Andrews 1984 Methodology:

Tc* = 0.0834 x [(D50(riffle) / D50(bar)]^-0.872

Tc = Tc* x 1.65 x 62.4 x Di

Depth = (Tc* x 1.65 x Di) / Slope

Andrews 1995 Methodology:

Tc* = 0.0376 x [(Di / D50(riffle)]^-0.994

Tc = Tc* x 1.65 x 62.4 x Di

Depth = (Tc* x 1.65 x Di) / Slope

Main Stem B Stream Typical Riffle Section Q-Qs output for determining max shear stress within channel

ELEV	DEPTH	AREA	WET PER	WIDTH	HYD RAD	MEAN D	SLOPE	ROUGH	R/D84	VELOCITY	U/U*	U^2/2g	DISCHARGE	SHEAR	POWER	POWER/W	FROUDE	TRANSPORT
(ft)	(ft)	(sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	[n] (ft^(1/6))		(fps)		(ft)	(cfs)	(psf)	(lb/s)	(lb/ft/s)		(lb/s)
1.1	0.1	0.15	3.01	3	0.05	0.05	0.02	0.055	0	0.52	2.89	0	0.08	0.06	0.1	0.03	0.41	0
1.2	0.2	0.6	6.01	6	0.1	0.1	0.02	0.055	0	0.82	3.24	0.01	0.49	0.12	0.62	0.1	0.46	0
1.3	0.3	1.35	9.02	9	0.15	0.15	0.02	0.055	0	1.08	3.47	0.02	1.46	0.19	1.82	0.2	0.49	0
1.4	0.4	2.27	9.56	9.5	0.24	0.24	0.02	0.055	0	1.48	3.75	0.03	3.35	0.3	4.18	0.44	0.53	0
1.5	0.5	3.25	10.1	10	0.32	0.32	0.02	0.055	0	1.79	3.94	0.05	5.81	0.4	7.25	0.73	0.56	0
1.6	0.6	4.28	10.64	10.5	0.4	0.41	0.02	0.055	0	2.08	4.09	0.07	8.88	0.5	11.08	1.06	0.57	2.01
1.7	0.7	5.35	11.17	11	0.48	0.49	0.02	0.055	0	2.34	4.21	0.09	12.54	0.6	15.65	1.42	0.59	5.73
1.8	0.8	6.48	11.71	11.5	0.55	0.56	0.02	0.055	0	2.57	4.31	0.1	16.63	0.69	20.75	1.8	0.6	11.05
1.9	0.9	7.65	12.25	12	0.62	0.64	0.02	0.055	0	2.78	4.4	0.12	21.26	0.77	26.53	2.21	0.61	18.47

MAX SHEAR STRESS

Main Stem B Stream Section Bankfull Channel - Critical Shear

Sediment Transport Analysis

Andrews Methodology

Project:	**Eccleston Mitigation Site**		
Reach:	**Mainstem B Stream**		
D(50) Riffle:	152	mm	
D(50) Bar/Sub:	n/a	mm	
Mobile Size (Di):	5	mm =	0.016 ft.
***Slope:**	0.02	ft/ft	

*Slope of the steepest riffle to evaluate the max shear conditions

Use Class '0' RipRap with D50 of 6 inches (152 mm) - Shear stress is meets the stress results from the hydraulic analysis (0.77 lb/sf).

Andrews 1984 Methodology		*Andrews 1995 Methodology*	
Tc* (1984)	**Tc (1984)**	**Tc* (1995)**	**Tc (1995)**
#VALUE!	#VALUE! lb/sf	1.11986	1.89 lb/sf
Depth (1984)		**Depth (1995)**	
#VALUE! ft.		1.52 ft.	

Andrews 1984 Methodology:

Tc* = 0.0834 x [(D50(riffle) / D50(bar)]^-0.872
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

Andrews 1995 Methodology:

Tc* = 0.0376 x [(Di / D50(riffle)]^-0.994
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

Main Stem C Stream Typical Riffle Section Q-Qs output for determining max shear stress within channel

ELEV	DEPTH	AREA	WET PER	WIDTH	HYD RAD	MEAN D	SLOPE	ROUGH	R/D84	VELOCITY	U/U*	U^2/2g	DISCHARGE	SHEAR	POWER	POWER/W	FROUDE	TRANSPORT
(ft)	(ft)	(sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	[n] (ft^(1/6))		(fps)		(ft)	(cfs)	(psf)	(lb/s)	(lb/ft/s)		(lb/s)
1.3	0.1	0.15	3.01	3	0.05	0.05	0.007	0.055	0	0.32	2.89	0	0.05	0.02	0.02	0.01	0.25	0
1.4	0.2	0.6	6.01	6	0.1	0.1	0.007	0.055	0	0.5	3.24	0	0.3	0.05	0.14	0.02	0.28	0
1.5	0.3	1.23	6.55	6.5	0.19	0.19	0.007	0.055	0	0.77	3.61	0.01	0.95	0.09	0.44	0.07	0.31	0
1.6	0.4	1.9	7.09	7	0.27	0.27	0.007	0.055	0	0.97	3.83	0.01	1.85	0.12	0.85	0.12	0.33	0
1.7	0.5	2.62	7.63	7.5	0.34	0.35	0.007	0.055	0	1.13	3.98	0.02	2.97	0.16	1.37	0.18	0.34	0
1.8	0.6	3.4	8.17	8	0.42	0.43	0.007	0.055	0	1.3	4.12	0.03	4.43	0.19	2.05	0.26	0.35	0
1.9	0.7	4.23	8.71	8.5	0.49	0.5	0.007	0.055	0	1.45	4.23	0.03	6.11	0.23	2.82	0.33	0.36	0

MAX SHEAR STRESS

Main Stem C Stream Section Bankfull Channel - Critical Shear

Sediment Transport Analysis
Andrews Methodology

Project:	**Eccleston Mitigation Site**		
Reach:	**Mainstem C Stream**		
D(50) Riffle:	26.84	mm	
D(50) Bar/Sub:	n/a	mm	
Mobile Size (Di):	5	mm =	0.016 ft.
***Slope:**	0.0074	ft/ft	

*Slope of the steepest riffle to evaluate the max shear conditions

Use Basal Gravel on site with average D50 of 26.84 mm - Shear stress is within acceptable tolearance of the results from the hydraulic analysis (0.23 lb/sf), therefore imported material is not needed.

Andrews 1984 Methodology		*Andrews 1995 Methodology*	
Tc* (1984)	**Tc (1984)**	**Tc* (1995)**	**Tc (1995)**
#VALUE!	#VALUE! lb/sf	0.19981	0.34 lb/sf
Depth (1984)		**Depth (1995)**	
#VALUE! ft.		0.73 ft.	

Andrews 1984 Methodology:

Tc* = 0.0834 x [(D50(riffle) / D50(bar)]^-0.872
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

Andrews 1995 Methodology:

Tc* = 0.0376 x [(Di / D50(riffle)]^-0.994
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

North Tributary B Stream Typical Riffle Section Q-Qs output for determining max shear stress within channel

ELEV	DEPTH	AREA	WET PER	WIDTH	HYD RAD	MEAN D	SLOPE	ROUGH	R/D84	VELOCITY	U/U*	U^2/2g	DISCHARGE	SHEAR	POWER	POWER/W	FROUDE	TRANSPORT
(ft)	(ft)	(sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	[n] (ft^(1/6))		(fps)		(ft)	(cfs)	(psf)	(lb/s)	(lb/ft/s)		(lb/s)
1.3	0.1	0.24	2.86	2.83	0.08	0.09	0.0207	0.055	0	0.72	3.13	0.01	0.17	0.1	0.22	0.08	0.42	0
1.4	0.2	0.57	3.71	3.67	0.15	0.15	0.0207	0.055	0	1.1	3.47	0.02	0.63	0.19	0.81	0.22	0.5	0
1.5	0.3	0.97	4.57	4.5	0.21	0.22	0.0207	0.055	0	1.37	3.67	0.03	1.33	0.27	1.72	0.38	0.52	0
1.6	0.4	1.75	8.11	8	0.22	0.22	0.0207	0.055	0	1.42	3.7	0.03	2.48	0.28	3.2	0.4	0.53	0
1.7	0.5	2.57	8.65	8.5	0.3	0.3	0.0207	0.055	0	1.74	3.9	0.05	4.48	0.39	5.78	0.68	0.56	0
1.8	0.6	3.45	9.19	9	0.38	0.38	0.0207	0.055	0	2.04	4.05	0.06	7.04	0.49	9.09	1.01	0.58	1.55
1.9	0.7	4.37	9.73	9.5	0.45	0.46	0.0207	0.055	0	2.28	4.17	0.08	9.98	0.58	12.89	1.36	0.59	4.26

MAX SHEAR STRESS

North Trib B Stream Section Bankfull Channel - Critical Shear

Sediment Transport Analysis

Andrews Methodology

Project:	**Eccleston Mitigation Site**		
Reach:	**North Trib B Stream**		
D(50) Riffle:	152	mm	
D(50) Bar/Sub:	n/a	mm	
Mobile Size (Di):	5	mm =	0.016 ft.
***Slope:**	0.0207	ft/ft	

*Slope of the steepest riffle to evaluate the max shear conditions

Use Class '0' RipRap with D50 of 6 inches (152 mm) - Shear stress is meets the stress results from the hydraulic analysis (0.58 lb/sf).

Andrews 1984 Methodology		*Andrews 1995 Methodology*	
Tc* (1984)	**Tc (1984)**	**Tc* (1995)**	**Tc (1995)**
#VALUE!	#VALUE! lb/sf	1.11986	1.89 lb/sf
Depth (1984)		**Depth (1995)**	
#VALUE! ft.		1.46 ft.	

Andrews 1984 Methodology:

Tc* = 0.0834 x [(D50(riffle) / D50(bar)]^-0.872
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

Andrews 1995 Methodology:

Tc* = 0.0376 x [(Di / D50(riffle)]^-0.994
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

North Tributary C Stream Typical Riffle Section Q-Qs output for determining max shear stress within channel

ELEV	DEPTH	AREA	WET PER	WIDTH	HYD RAD	MEAN D	SLOPE	ROUGH	R/D84	VELOCITY	U/U*	U^2/2g	DISCHARGE	SHEAR	POWER	POWER/W	FROUDE	TRANSPORT
(ft)	(ft)	(sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	[n] (ft^(1/6))		(fps)		(ft)	(cfs)	(psf)	(lb/s)	(lb/ft/s)		(lb/s)
1.5	0.1	0.15	3.01	3	0.05	0.05	0.0083	0.055	0	0.33	2.89	0	0.05	0.03	0.03	0.01	0.26	0
1.6	0.2	0.56	4.53	4.5	0.12	0.12	0.0083	0.055	0	0.6	3.35	0.01	0.34	0.06	0.17	0.04	0.3	0
1.7	0.3	1.03	5.07	5	0.2	0.21	0.0083	0.055	0	0.84	3.64	0.01	0.87	0.1	0.45	0.09	0.32	0
1.8	0.4	1.56	5.61	5.5	0.28	0.28	0.0083	0.055	0	1.05	3.85	0.02	1.64	0.14	0.85	0.15	0.35	0
1.9	0.5	2.13	6.15	6	0.35	0.35	0.0083	0.055	0	1.22	4	0.02	2.6	0.18	1.35	0.22	0.36	0

MAX SHEAR STRESS

North Trib C Stream Section Bankfull Channel - Critical Shear

Sediment Transport Analysis
Andrews Methodology

Project:	**Eccleston Mitigation Site**		
Reach:	**North Tributary C Stream**		
D(50) Riffle:	26.84	mm	
D(50) Bar/Sub:	n/a	mm	
Mobile Size (Di):	5	mm =	0.016 ft.
***Slope:**	0.008	ft/ft	

*Slope of the steepest riffle to evaluate the max shear conditions

Use Basal Gravel on site with average D50 of 26.84 mm - Shear stress is within acceptable tolearance of the results from the hydraulic analysis (0.18 lb/sf), therefore imported material is not needed.

Andrews 1984 Methodology		*Andrews 1995 Methodology*	
Tc* (1984)	**Tc (1984)**	**Tc* (1995)**	**Tc (1995)**
#VALUE!	#VALUE! lb/sf	0.19981	0.34 lb/sf
Depth (1984)		**Depth (1995)**	
#VALUE! ft.		0.68 ft.	

Andrews 1984 Methodology:

Tc* = 0.0834 x [(D50(riffle) / D50(bar)]^-0.872
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

Andrews 1995 Methodology:

Tc* = 0.0376 x [(Di / D50(riffle)]^-0.994
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

South Tributary B Stream Typical Riffle Section Q-Qs output for determining max shear stress within channel

ELEV	DEPTH	AREA	WET PER	WIDTH	HYD RAD	MEAN D	SLOPE	ROUGH	R/D84	VELOCITY	U/U*	U^2/2g	DISCHARGE	SHEAR	POWER	POWER/W	FROUDE	TRANSPORT
(ft)	(ft)	(sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	[n] (ft^(1/6))		(fps)		(ft)	(cfs)	(psf)	(lb/s)	(lb/ft/s)		(lb/s)
1.4	0.1	0.12	1.54	1.5	0.08	0.08	0.0218	0.055	0	0.74	3.13	0.01	0.09	0.11	0.12	0.08	0.46	0
1.5	0.2	0.3	2.08	2	0.14	0.15	0.0218	0.055	0	1.08	3.43	0.02	0.32	0.19	0.44	0.22	0.49	0
1.6	0.3	0.53	2.62	2.5	0.2	0.21	0.0218	0.055	0	1.36	3.64	0.03	0.72	0.27	0.98	0.39	0.52	0
1.7	0.4	0.8	3.15	3	0.25	0.27	0.0218	0.055	0	1.58	3.78	0.04	1.27	0.34	1.72	0.57	0.54	0
1.8	0.5	1.38	6.19	6	0.22	0.23	0.0218	0.055	0	1.45	3.7	0.03	2.01	0.3	2.73	0.46	0.53	0
1.9	0.6	2	6.73	6.5	0.3	0.31	0.0218	0.055	0	1.79	3.9	0.05	3.58	0.41	4.87	0.75	0.57	0

MAX SHEAR STRESS

South Trib B Stream Section Bankfull Channel - Critical Shear

Sediment Transport Analysis
Andrews Methodology

Project:	**Eccleston Mitigation Site**		
Reach:	**South Trib B Stream**		
D(50) Riffle:	152	mm	
D(50) Bar/Sub:	n/a	mm	
Mobile Size (Di):	5	mm =	0.016 ft.
***Slope:**	0.0218	ft/ft	

*Slope of the steepest riffle to evaluate the max shear conditions

Use Class '0' RipRap with D50 of 6 inches (152 mm) - Shear stress is meets the stress results from the hydraulic analysis (0.41 lb/sf).

Andrews 1984 Methodology		*Andrews 1995 Methodology*	
Tc* (1984)	**Tc (1984)**	**Tc* (1995)**	**Tc (1995)**
#VALUE!	#VALUE! lb/sf	1.11986	1.89 lb/sf
Depth (1984)		**Depth (1995)**	
#VALUE! ft.		1.39 ft.	

Andrews 1984 Methodology:

Tc* = 0.0834 x [(D50(riffle) / D50(bar)]^-0.872
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

Andrews 1995 Methodology:

Tc* = 0.0376 x [(Di / D50(riffle)]^-0.994
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

South Tributary C Stream Typical Riffle Section Q-Qs output for determining max shear stress within channel

ELEV	DEPTH	AREA	WET PER	WIDTH	HYD RAD	MEAN D	SLOPE	ROUGH	R/D84	VELOCITY	U/U*	U^2/2g	DISCHARGE	SHEAR	POWER	POWER/W	FROUDE	TRANSPORT
(ft)	(ft)	(sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	[n] (ft^(1/6))		(fps)		(ft)	(cfs)	(psf)	(lb/s)	(lb/ft/s)		(lb/s)
1.6	0.1	0.15	2.51	2.5	0.06	0.06	0.012	0.055	0	0.45	2.98	0	0.07	0.04	0.05	0.02	0.33	0
1.7	0.2	0.42	3.05	3	0.14	0.14	0.012	0.055	0	0.8	3.43	0.01	0.34	0.1	0.25	0.08	0.38	0
1.8	0.3	0.74	3.59	3.5	0.21	0.21	0.012	0.055	0	1.05	3.67	0.02	0.77	0.16	0.58	0.17	0.4	0
1.9	0.4	1.12	4.13	4	0.27	0.28	0.012	0.055	0	1.24	3.83	0.02	1.39	0.2	1.04	0.26	0.41	0

MAX SHEAR STRESS

South Trib C Stream Section Bankfull Channel - Critical Shear

Sediment Transport Analysis
Andrews Methodology

Project:	**Eccleston Mitigation Site**			
Reach:	**South Trib C Stream**			
D(50) Riffle:	26.84	mm		
D(50) Bar/Sub:	n/a	mm		
Mobile Size (Di):	5	mm	=	0.016 ft.
***Slope:**	0.012	ft/ft		

*Slope of the steepest riffle to evaluate the max shear conditions

Use Basal Gravel on site with average D50 of 26.84 mm - Shear stress is within acceptable tolearance of the results from the hydraulic analysis (0.20 lb/sf), therefore imported material is not needed.

Andrews 1984 Methodology		*Andrews 1995 Methodology*	
Tc* (1984)	**Tc (1984)**	**Tc* (1995)**	**Tc (1995)**
#VALUE!	#VALUE! lb/sf	0.19981	0.34 lb/sf
Depth (1984)		**Depth (1995)**	
#VALUE! ft.		0.45 ft.	

Andrews 1984 Methodology:

Tc* = 0.0834 x [(D50(riffle) / D50(bar)]^-0.872
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

Andrews 1995 Methodology:

Tc* = 0.0376 x [(Di / D50(riffle)]^-0.994
Tc = Tc* x 1.65 x 62.4 x Di
Depth = (Tc* x 1.65 x Di) / Slope

Outlet Protection of 60" RCP at Intersection Tributary

Type I - Preformed Scour Hole (Depressed 1/2 Culvert Rise)

Using Empirical Preformed Scour Hole Equations from MDSHA Highway Drainage Manual, I-3-E-2:

$D_{50} = (0.0125d^2/TW)(Q_{10}/d^{2.5})^{1.333}$ where:

D_{50} =	Median stone diameter (ft)		
d =	Pipe diameter (ft)	=	5
***TW =	Tailwater depth (ft)	=	2
**Q =	Design pipe flow (cfs)	=	261

D_{50} = 1.22 ft

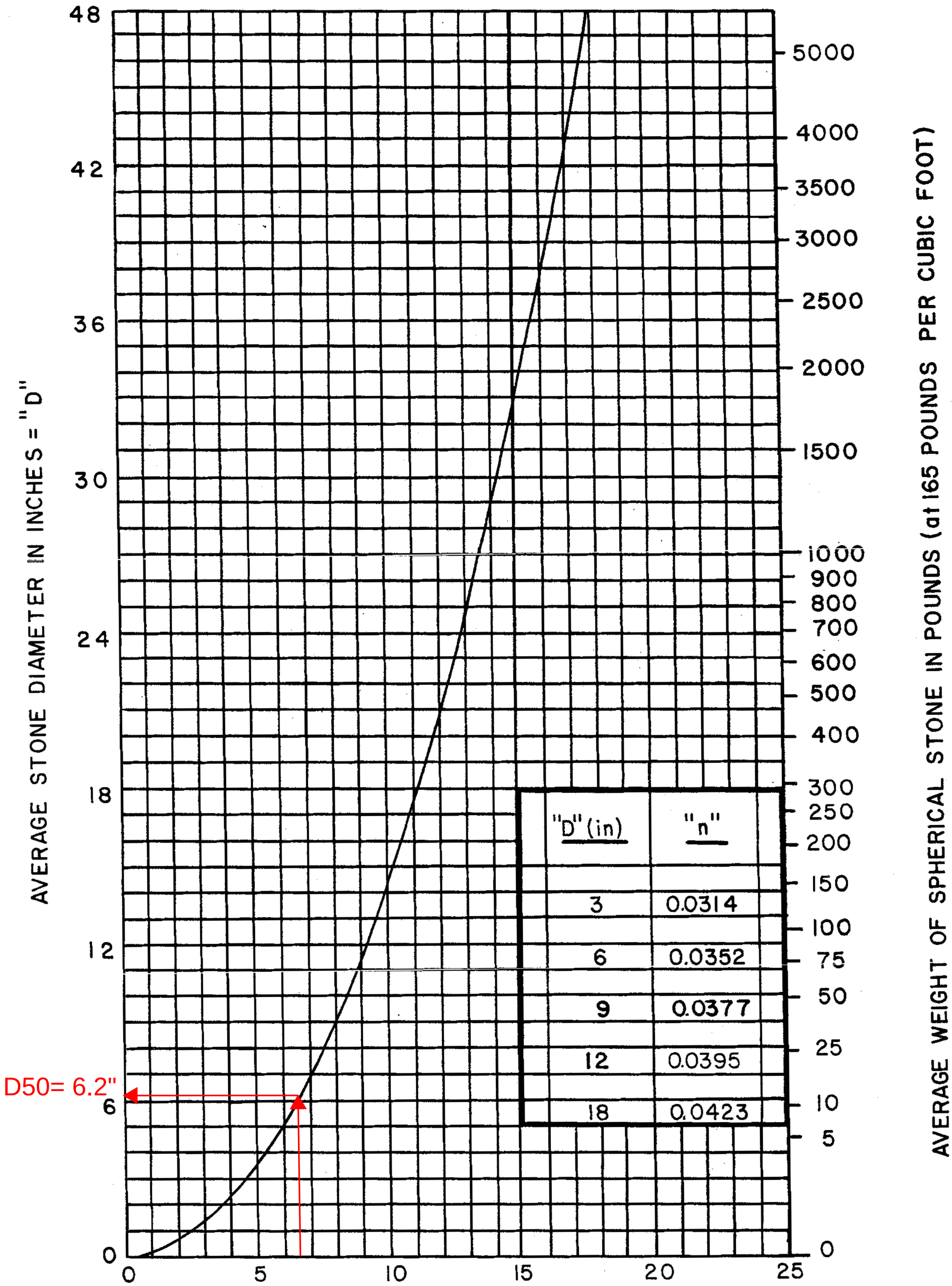
C =	Basin Length (ft)	=	30
A =	Basin Inlet Width (ft)	=	25
B =	Basin Outlet Width (ft)	=	25
D =	Basin Riprap Thickness (ft)	=	2.4373 *
E =	Culvert Span (ft)	=	5
F =	Basin Depression (ft)	=	2.5
d =	Culvert Diameter or Span (ft)	=	5
D_{50} =	Median Stone Diameter (ft)	=	1.22

CLASS 'II' RIPRAP WITH D50 OF 16 INCHES IS PROPOSED

NOTES

** Q100 Value
***Assumed Tailwater. Value to be revised once 100-year elevation is computed.

Riprap Sizing for Scour Hole at South Tributary
This supports that the proposed Class 'I' riprap (d50=9.5") is within the acceptable tolerance for the channel velocities.



"D" (in)	"n"
3	0.0314
6	0.0352
9	0.0377
12	0.0395
18	0.0423

FROM USBR

LIMITING VELOCITIES FOR RIP-RAP LINING

MARYLAND STATE HIGHWAY ADMINISTRATION SHA-61.1-405.1

Riprap Channel Stabilization Computations								
Location	**Drainage Area, A (ac)**	**Runoff Coefficient, C***	**Rainfall Intensity, I (in/hr)****	**Q10=CIA (cfs)**	**Velocity, v=Q/A (ft/s)*****	**d50 (in)******	**Proposed Riprap Size**	**Riprap d50 (in)**
RP-1	3.00	0.26	5.1	3.98	5.60	4.5"	Class 'I'	9.5
RP-2	3.19	0.28	5.1	4.56	6.01	5.0"	Class 'I'	9.5

*Runoff Coefficient from Table SHA 61.1-401.0. (Residential 1 acre, Type B soil, 6%+ and Residential 1 acre, Type C soil, 6%

**Rainfall Intensity from MDE Stromwater Sizing Criteria Table 2.2

***Velocity from Rivermorph Q-Qs Output over channel cell

****d50 determined from Isbash curve

RIPRAP CHANNEL STABILIZATION
COMPUTATIONS FOR RP-1 AND RP-2

Sizing techniques

There are many techniques for sizing stone, and each method has advantages and disadvantages. Many techniques were derived under specific conditions and developed for particular applications. While this list is not complete and the description is not exhaustive, several commonly used methods are presented. The designer should review the applicability of a technique before choosing it to size stone for a particular project. Following is a brief description of several rock sizing techniques.

Isbash method

The Isbash formula (Isbash 1936) was developed for the construction of dams by depositing rocks into moving water. The Isbash curve should only be used for quick estimates or for comparisons. A coefficient is provided to target high- and low-turbulence flow conditions, so this method can be a high- or low-energy application. The equation is:

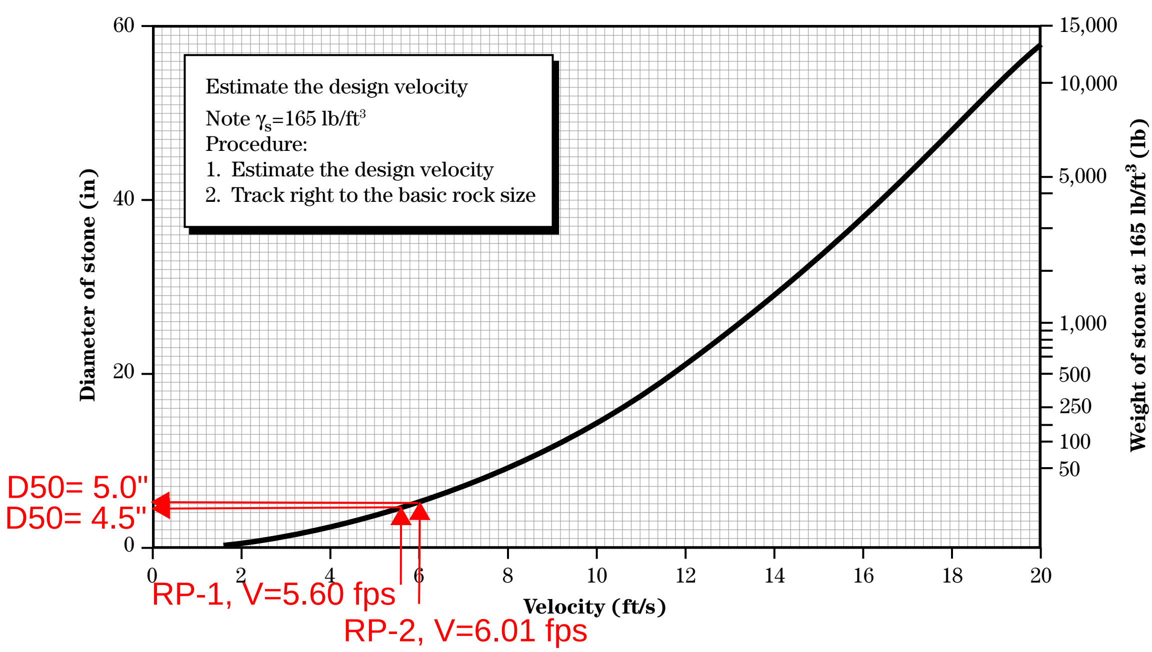
$$V_c = C \times \left(2 \times g \times \frac{\gamma_s - \gamma_w}{\gamma_w}\right)^{0.50} \times \left(D_{50}\right)^{0.50} \quad \text{(eq. TS14C–1)}$$

where:
V_c = critical velocity (ft/s)
C = 0.86 for high turbulence
C = 1.20 for low turbulence
g = 32.2 ft/s^2
γ_s = stone density (lb/ft^3)
γ_w = water density (lb/ft^3)
D_{50} = median stone diameter (ft)

A graphical solution is provided in figure TS14C–5 (ch. 16 of the Engineering Field Manual) This graph should be used only for quick estimates at a conceptual design level.

The U.S. Army Corps of Engineers (USACE) provides additional guidance for the use of the Isbash technique in EM 1110–2–1601. The required inputs are channel velocity, specific gravity of the stone, and a turbulence coefficient. The turbulence coefficient has two values that represent either high turbulence or low turbulence. The graphical solution for this is shown in figure TS14C–6(a) and (b).

Figure TS14C–5 Rock size based on Isbash curve



APPENDIX H
Hydraulics Analysis Data

Stream and Location: Eccleston

Reach: South Tributary

Event for which n is assigned: Bankfull flow condition

1. Is roughness uniform throughout the reach being considered? Yes

If not, should n be assigned for the average condition of the reach? N/A

2. Is roughness uniformly distributed along the cross section? Yes

Is a division between channel and floodplain necessary? Yes

(Channel Roughness uses steps 3-13, Floodplain roughness uses steps 14-23.)

Is roughness uniformly distributed across the channel? Yes

If not, what basis should n for the individual segments be weighted? N/A

3. Describe the channel. Are present conditions representative of those during the flood?

A silt/sand bed stream with course gravel exhibiting a riffle / pool system.

If not, describe the probable conditions during the flood. Assume that channel conditions are representative of channel flowing full (to elevation of the floodplain/bankfull condition)

4. How will the roughness-producing effects of the following on the channel be accounted for?

Bank roughness:

Bedrock outcrops: No bedrock present.

Isolated boulders: No boulders present.

Vegetation: Mostly herbaceous near channel. Mix of woody and herbaceous vegetation in floodplain.

Obstructions: Woody debris jams.

Meander: Little to No sinuosity

5-10. Computation n for the channel

Segment Number and Material	Approximate Dimensions		Wetted perimeter	Area (sf)	Grain Size (mm)	Base n for segment	Adjustments	Adjusted n	Weight Factors	times weight factors
	width (ft)	depth (ft)								
1					37.42	0.032	None	N/A	N/A	0.032
								SUM		0.032
								Weighted n =		**0.032**

11-13. Computation n for the channel
Adjustment factors for the channel

Factor	Describe conditions briefly	Adjustment
Irregularity, n_1	Minor - Compares to carefully degraded channels in good condition but having slightly eroded or scoured side slopes.	0.005
Alignment, n_2	Alternating occasionally- Large and small cross sections alternate occasionally, or the main flow occasionally shifts from side to side owing to changes in cross-sectional shape.	0.003
Obstructions, n_3	Minor- Obstructions less than 15 percent of the cross-sectional area, and the spacing between obstructions is such that the sphere of influence around one obstruction does not extend to the sphere of influence around another obstruction.	0.007
Vegetation, n_4	Medium- Brushy, moderately dense vegetation, similar to 1-to-2-year-old willow trees in the dormant season, growing along the banks, and no significant vegetation is evident along the channel bottoms	0.010
Meander, m	Minor- Ratio of the channel length to valley length is 1.0 to 1.2	1.00
	Weighted n plus n_x adjustments	0.057
	Computed n times m factor =	**0.057**

Stream and Location: Eccleston

Reach: North Tributary

Event for which n is assigned: Bankfull flow condition

1. Is roughness uniform throughout the reach being considered? Yes

If not, should n be assigned for the average condition of the reach? N/A

2. Is roughness uniformly distributed along the cross section? Yes

Is a division between channel and floodplain necessary? Yes

(Channel Roughness uses steps 3-13, Floodplain roughness uses steps 14-23.)

Is roughness uniformly distributed across the channel? Yes

If not, what basis should n for the individual segments be weighted? N/A

3. Describe the channel. Are present conditions representative of those during the flood?

A silt/sand bed stream with course gravel exhibiting a riffle / pool system

If not, describe the probable conditions during the flood. Assume that channel conditions are representative of channel flowing full (to elevation of the floodplain/bankfull condition)

4. How will the roughness-producing effects of the following on the channel be accounted for?

Bank roughness:

Bedrock outcrops: No bedrock present.

Isolated boulders: No boulders present.

Vegetation: Mostly herbaceous near channel. Mix of woody and herbaceous vegetation in floodplain.

Obstructions: Woody debris jams.

Meander: Little to No sinuosity

5-10. Computation n for the channel

Segment Number and Material	Approximate Dimensions		Wetted perimeter	Area (sf)	Grain Size (mm)	Base n for segment	Adjustments	Adjusted n	Weight Factors	times weight factors
	width (ft)	depth (ft)								
1					26.67	0.031	None	N/A	N/A	0.031
								SUM		0.031
								Weighted n =		**0.031**

11-13. Computation n for the channel
Adjustment factors for the channel

Factor	Describe conditions briefly	Adjustment
Irregularity, n_1	Minor - Compares to carefully degraded channels in good condition but having slightly eroded or scoured side slopes.	0.005
Alignment, n_2	Alternating occasionally- Large and small cross sections alternate occasionally, or the main flow occasionally shifts from side to side owing to changes in cross-sectional shape.	0.003
Obstructions, n_3	Minor- Obstructions less than 15 percent of the cross-sectional area, and the spacing between obstructions is such that the sphere of influence around one obstruction does not extend to the sphere of influence around another obstruction.	0.007
Vegetation, n_4	Medium- Brushy, moderately dense vegetation, similar to 1-to-2-year-old willow trees in the dormant season, growing along the banks, and no significant vegetation is evident along the channel bottoms	0.015
Meander, m	Minor- Ratio of the channel length to valley length is 1.0 to 1.2	1.00
	Weighted n plus n_x adjustments	0.061
	Computed n times m factor =	**0.061**

Stream and Location: Eccleston

Reach: Main Stem

Event for which n is assigned: Bankfull flow condition

1. Is roughness uniform throughout the reach being considered? Yes

If not, should n be assigned for the average condition of the reach? N/A

2. Is roughness uniformly distributed along the cross section? Yes

Is a division between channel and floodplain necessary? Yes

(Channel Roughness uses steps 3-13, Floodplain roughness uses steps 14-23.)

Is roughness uniformly distributed across the channel? Yes

If not, what basis should n for the individual segments be weighted? N/A

3. Describe the channel. Are present conditions representative of those during the flood?

A silt/sand bed stream with course gravel exhibiting a riffle / pool system.

If not, describe the probable conditions during the flood. Assume that channel conditions are representative of channel flowing full (to elevation of the floodplain/bankfull condition)

4. How will the roughness-producing effects of the following on the channel be accounted for?

Bank roughness:

Bedrock outcrops: No bedrock present.

Isolated boulders: No boulders present.

Vegetation: Mostly herbaceous near channel. Mix of woody and herbaceous vegetation in floodplain.

Obstructions: Woody debris jams.

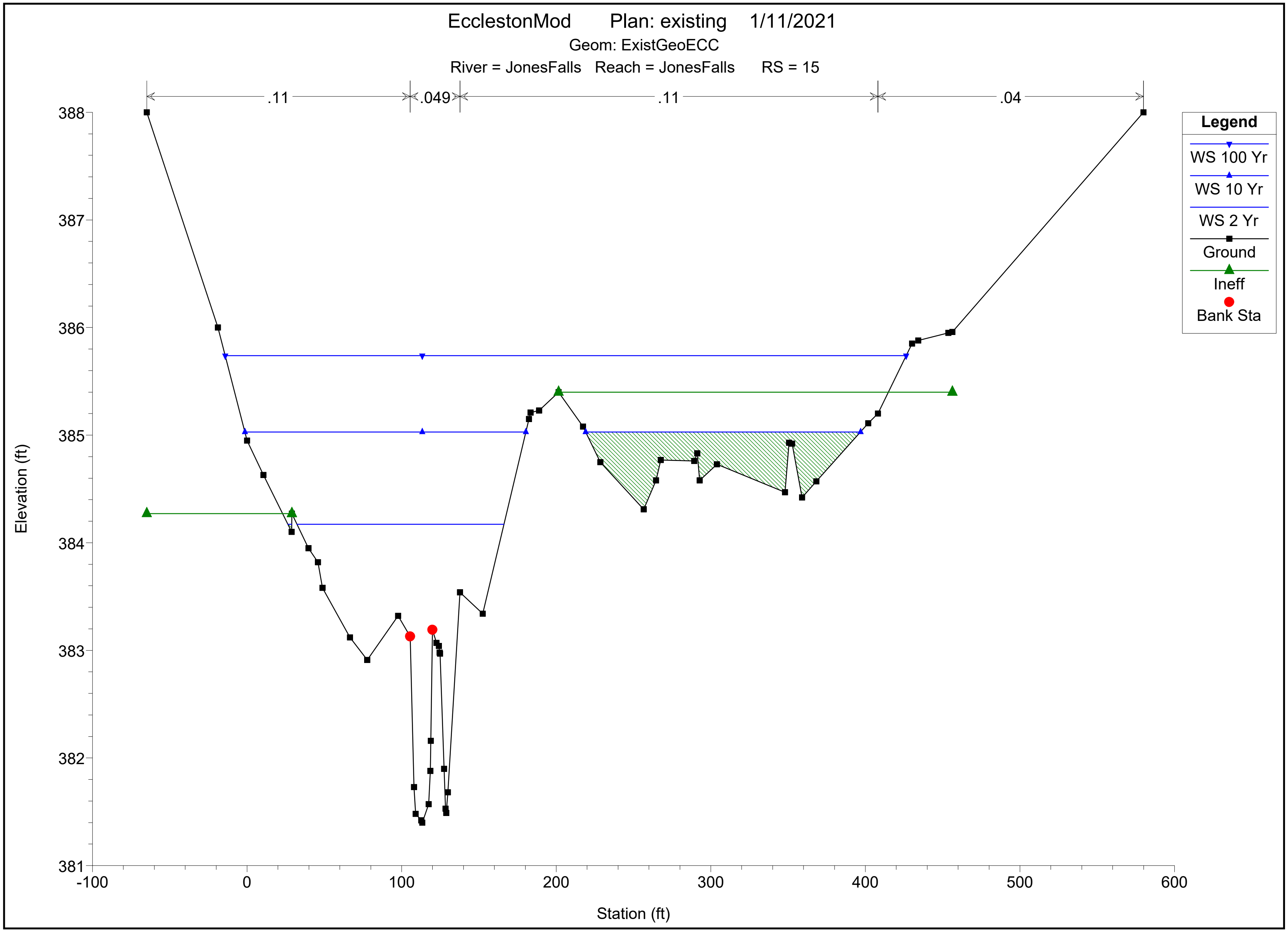
Meander: Little to No sinuosity

5-10. Computation n for the channel

Segment Number and Material	Approximate Dimensions		Wetted perimeter	Area (sf)	Grain Size (mm)	Base n for segment	Adjustments	Adjusted n	Weight Factors	times weight factors
	width (ft)	depth (ft)								
1					36.892	0.032	None	N/A	N/A	0.032
								SUM		0.032
								Weighted n =		**0.032**

11-13. Computation n for the channel
Adjustment factors for the channel

Factor	Describe conditions briefly	Adjustment
Irregularity, n_1	Minor - Compares to carefully degraded channels in good condition but having slightly eroded or scoured side slopes.	0.005
Alignment, n_2	Alternating occasionally- Large and small cross sections alternate occasionally, or the main flow occasionally shifts from side to side owing to changes in cross-sectional shape.	0.003
Obstructions, n_3	Minor- Obstructions less than 15 percent of the cross-sectional area, and the spacing between obstructions is such that the sphere of influence around one obstruction does not extend to the sphere of influence around another obstruction.	0.004
Vegetation, n_4	Small- the average depth of flow is atleast two times the height of the vegetation	0.005
Meander, m	Minor- Ratio of the channel length to valley length is 1.0 to 1.2	1.00
	Weighted n plus n_x adjustments	0.049
	Computed n times m factor =	**0.049**



EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls RS = 15
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
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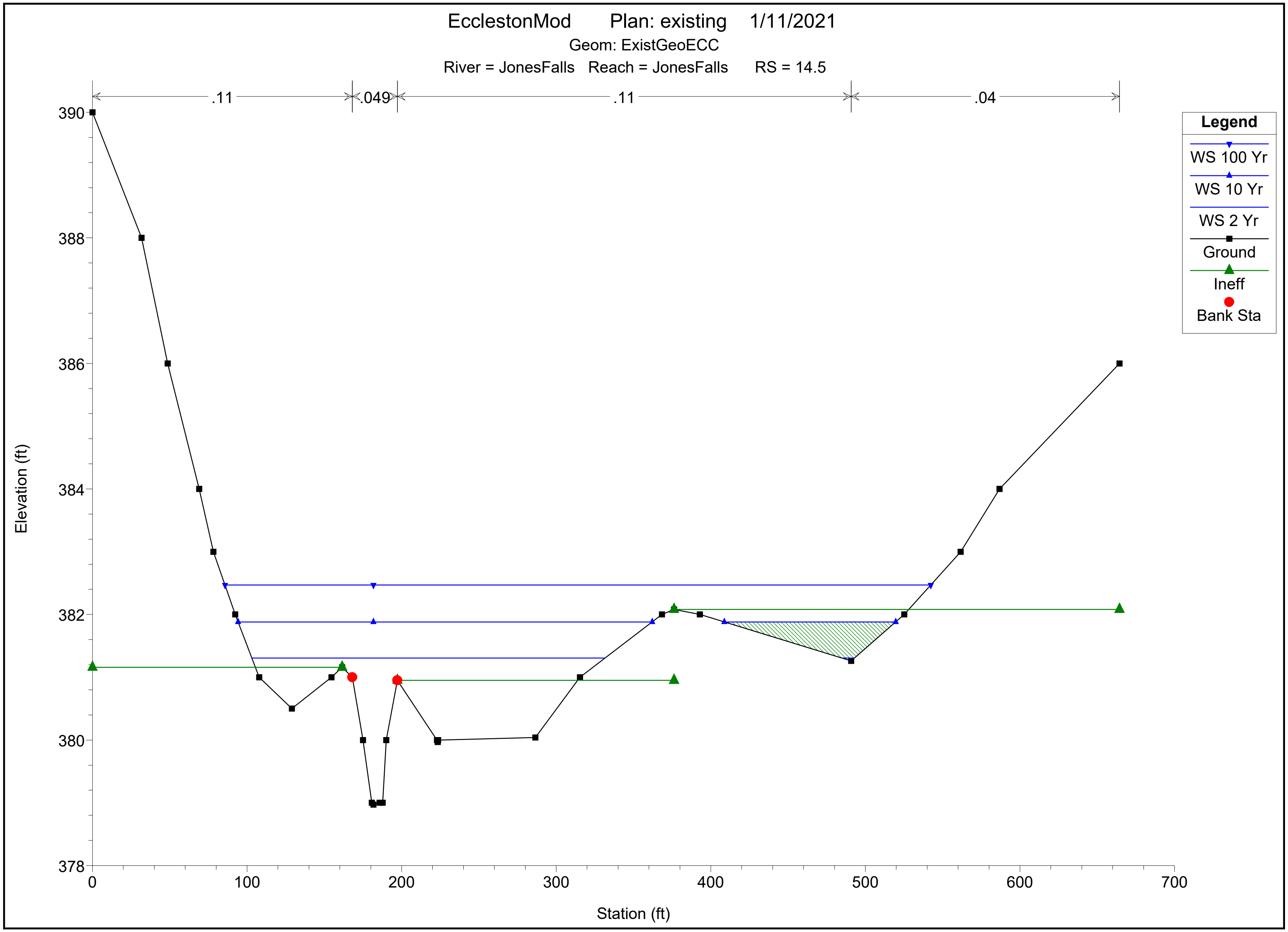
387
386
385
384
383
382
381
-100
0
100
200
300
400
500
600
Station (ft)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.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
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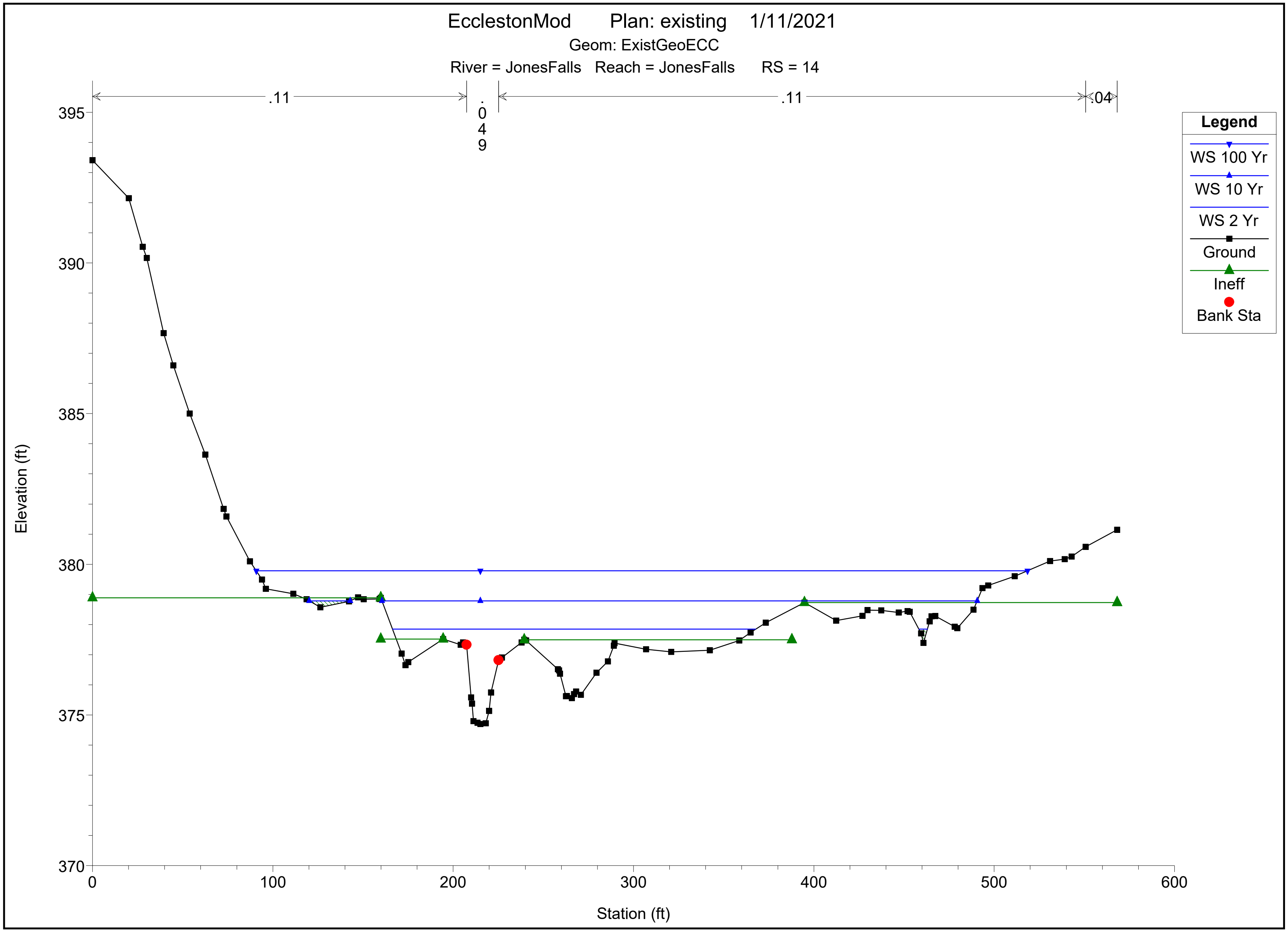
388
386
384
382
380
378
0
100
200
300
400
500
600
700
Station (ft)


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls RS = 14
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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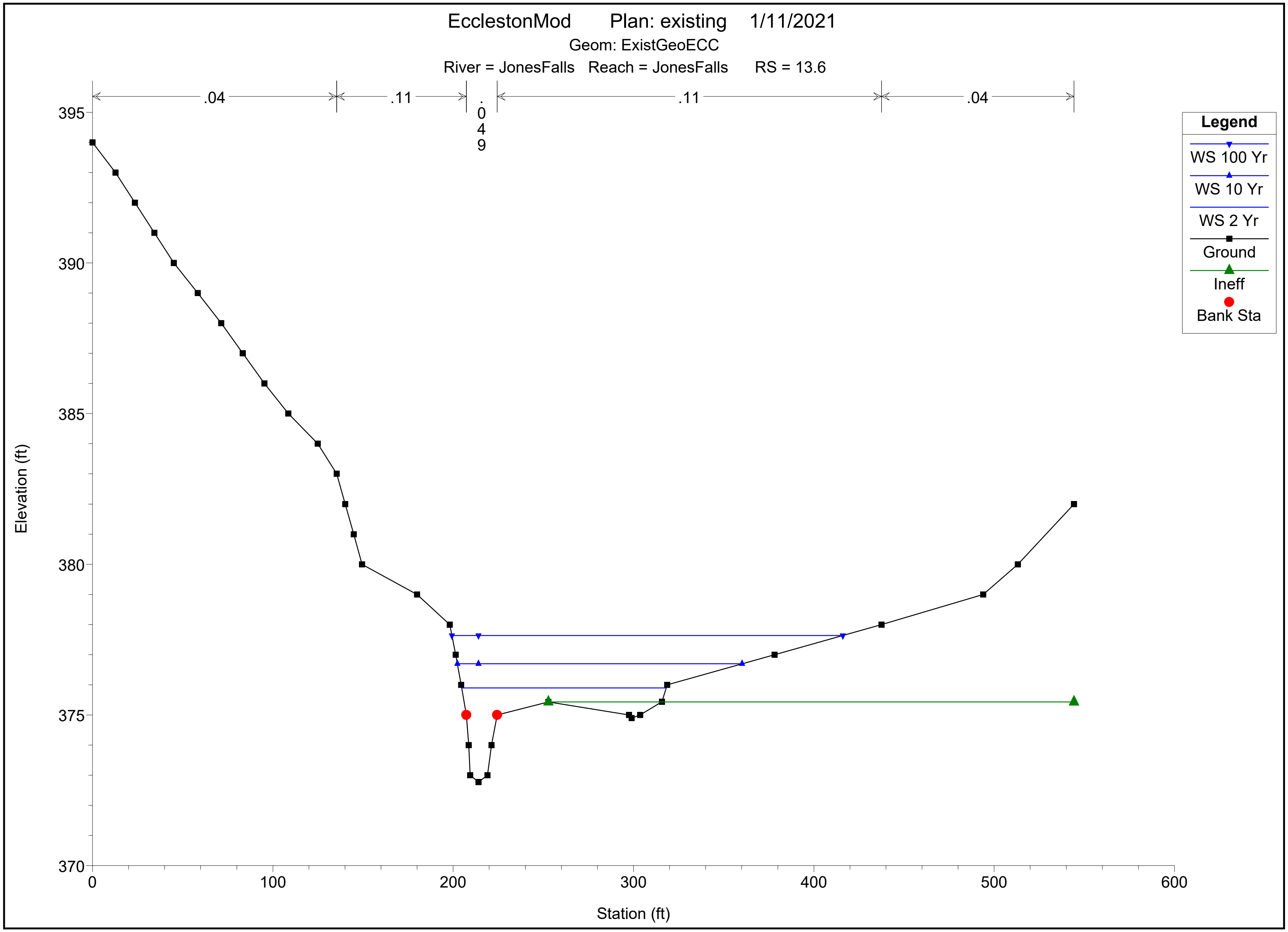
390
385
380
375
370
0
100
200
300
400
500
600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Geom: ExistGeoECC
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.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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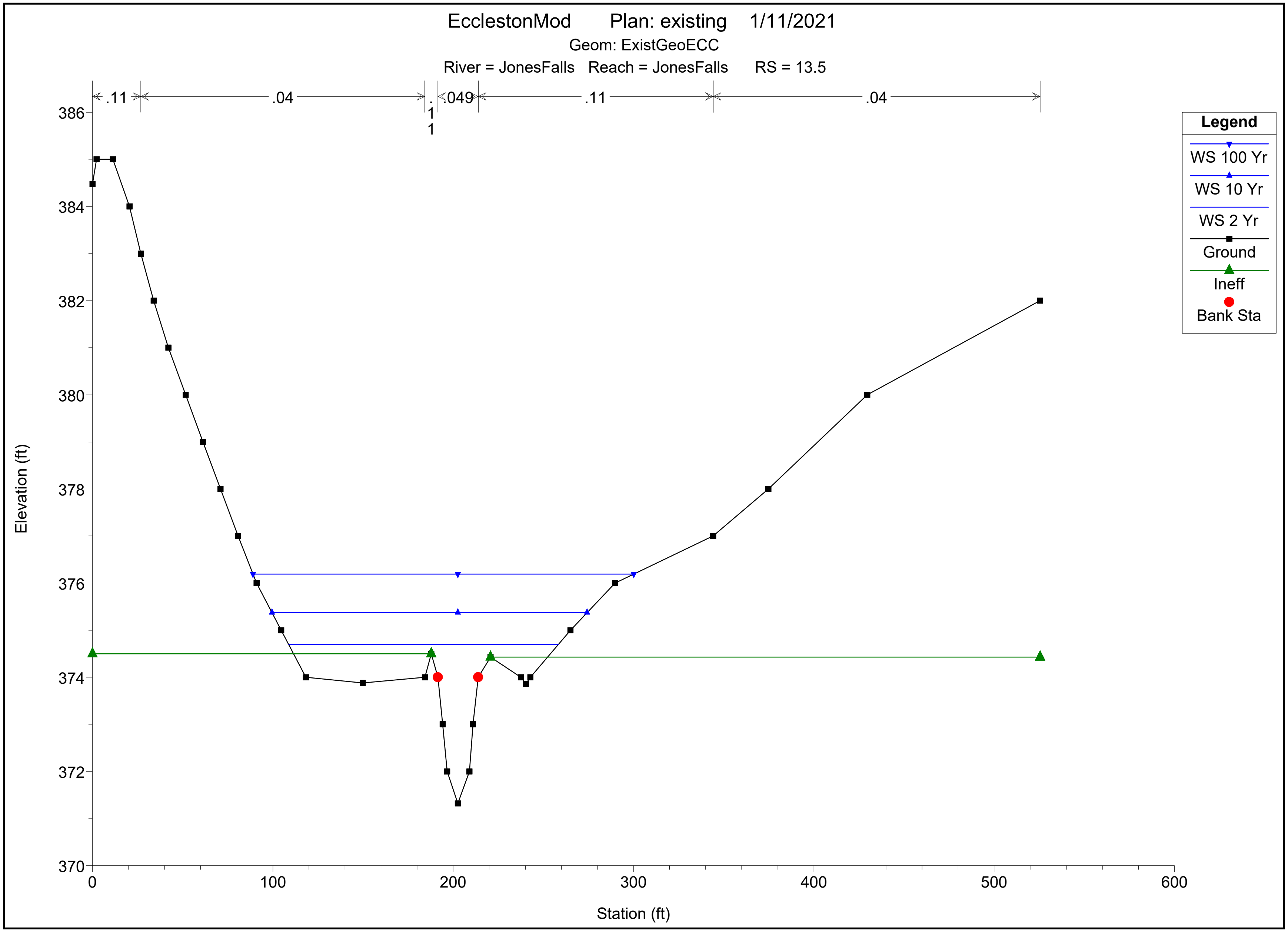
390
385
380
375
370
0
100
200
300
400
500
600



EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls RS = 13.5
.11
.04
.1
1
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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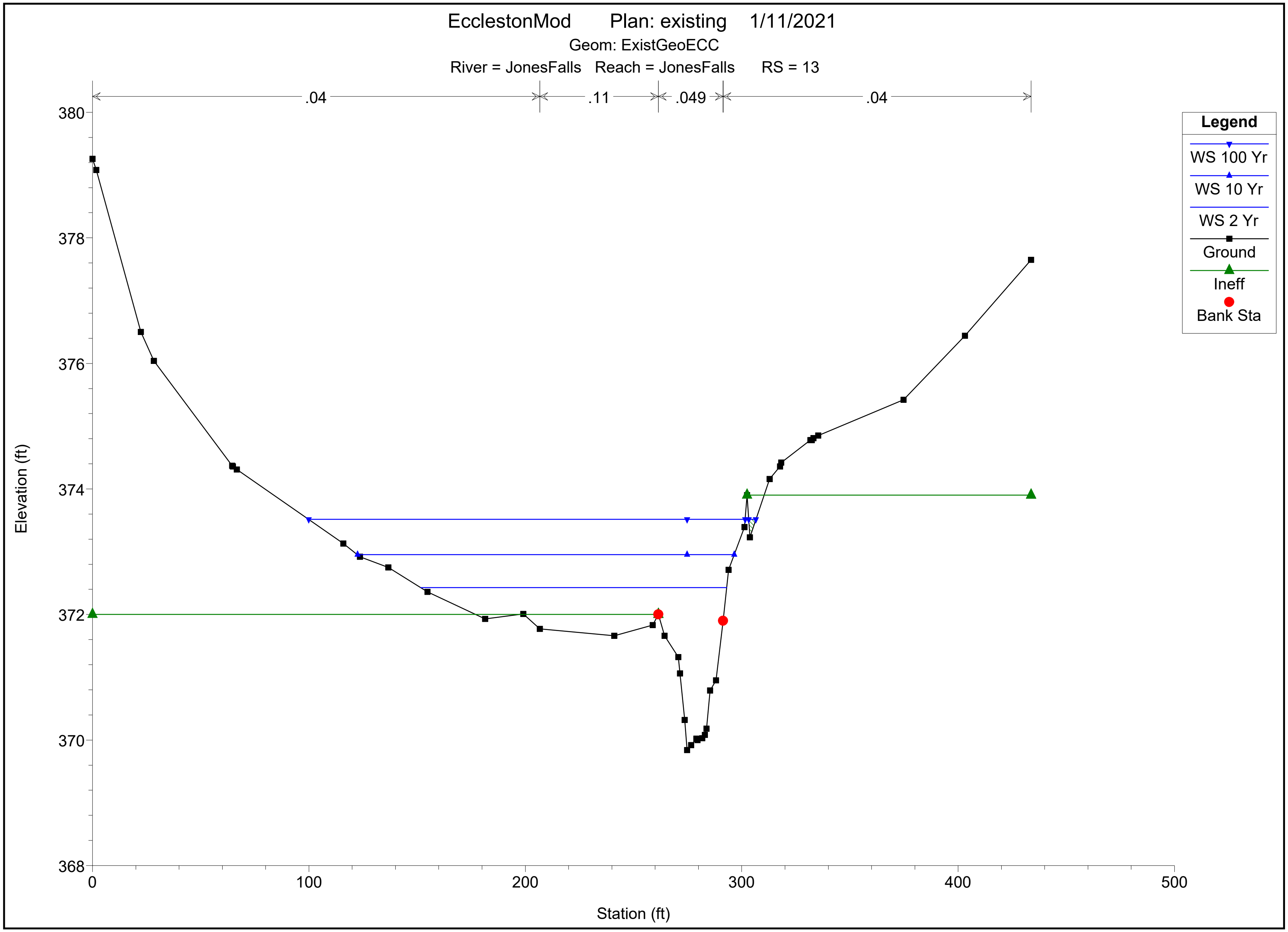
384
382
380
378
376
374
372
370
0
100
200
300
400
500
600



EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls RS = 13
.04
.11
.049
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
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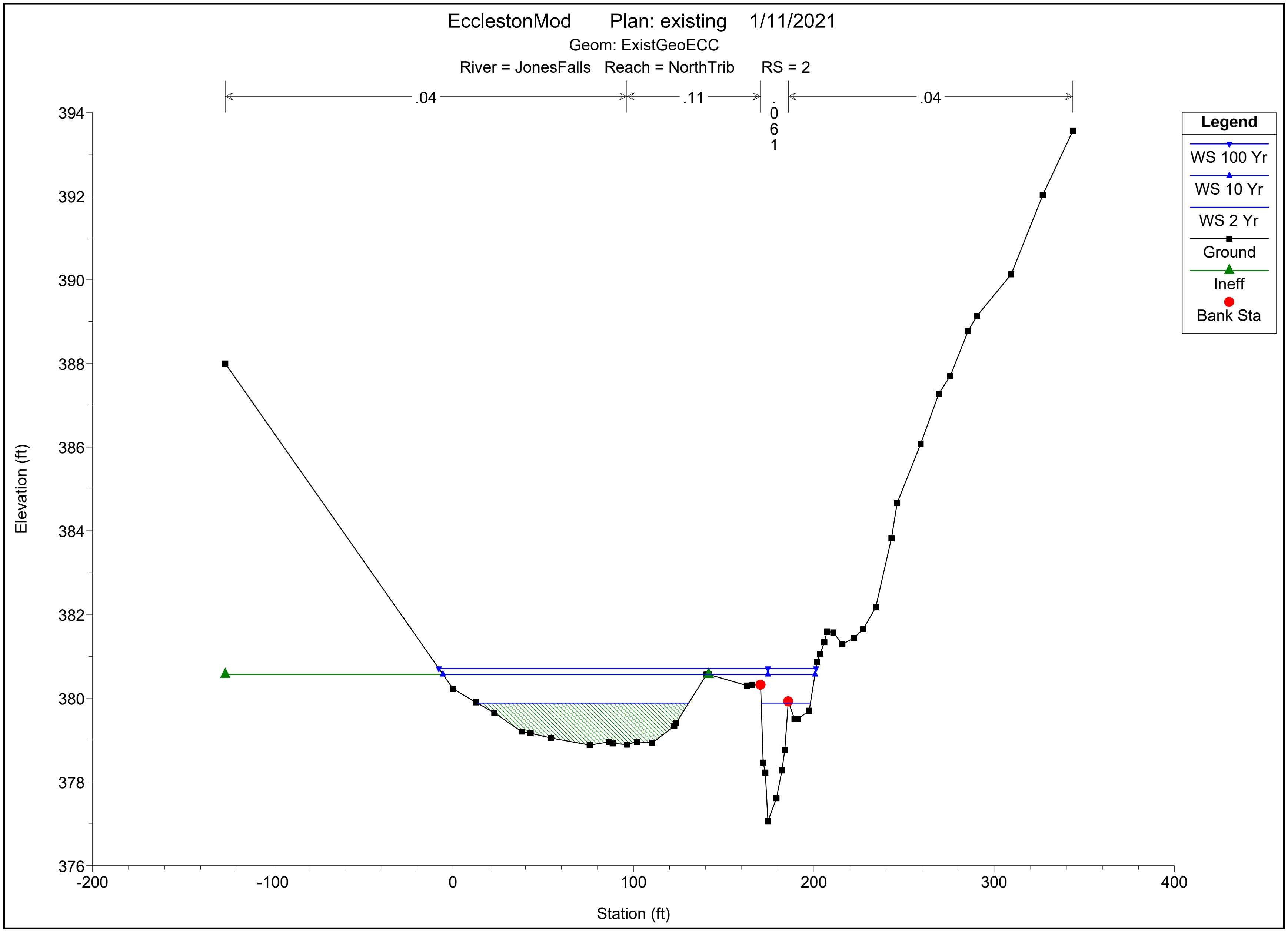
378
376
374
372
370
368
0
100
200
300
400
500
Station (ft)



EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
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.04
.11
.061
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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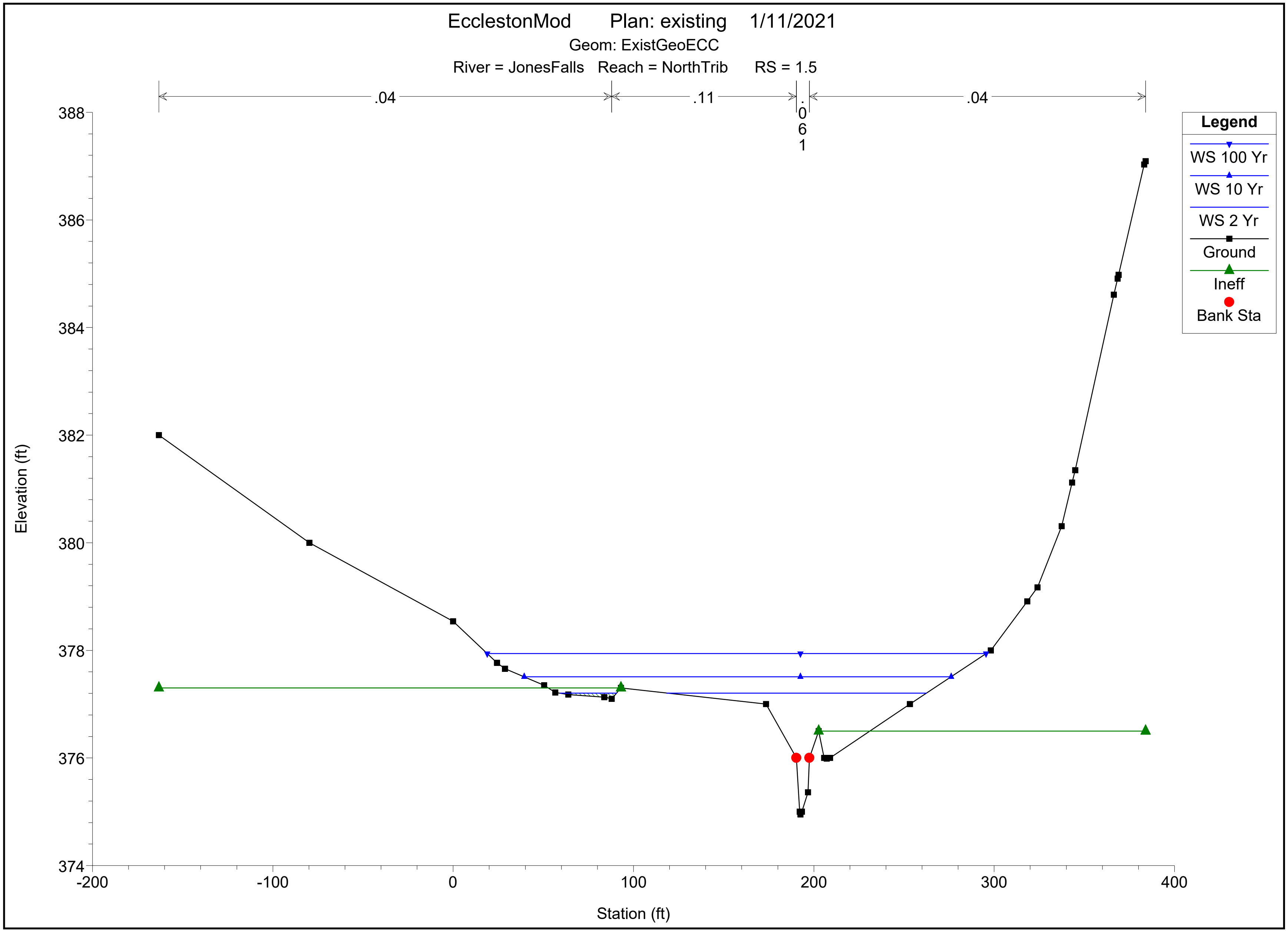
392
390
388
386
384
382
380
378
376
-200
-100
0
100
200
300
400



EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = NorthTrib RS = 1.5
.04
.11
.061
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
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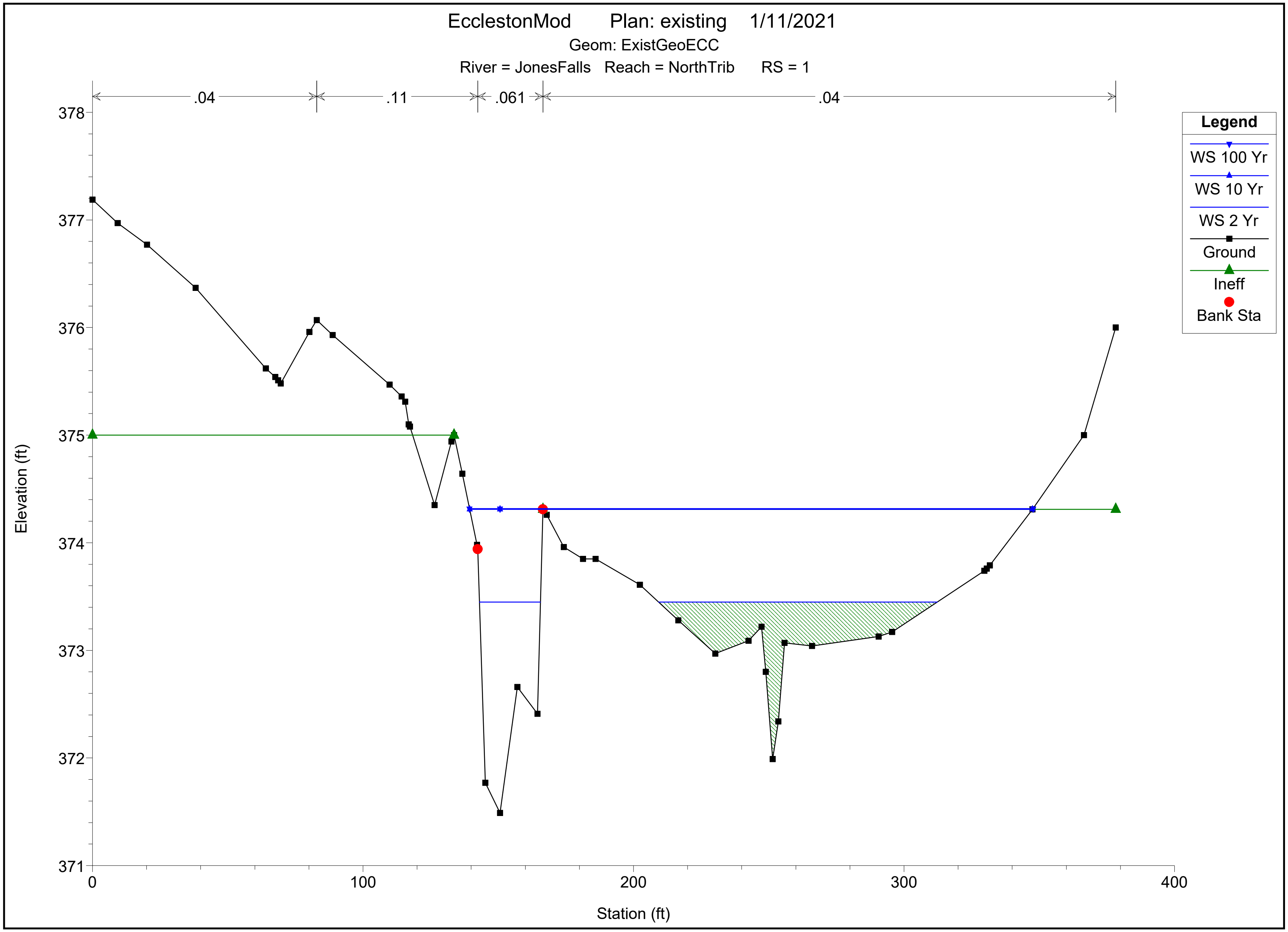
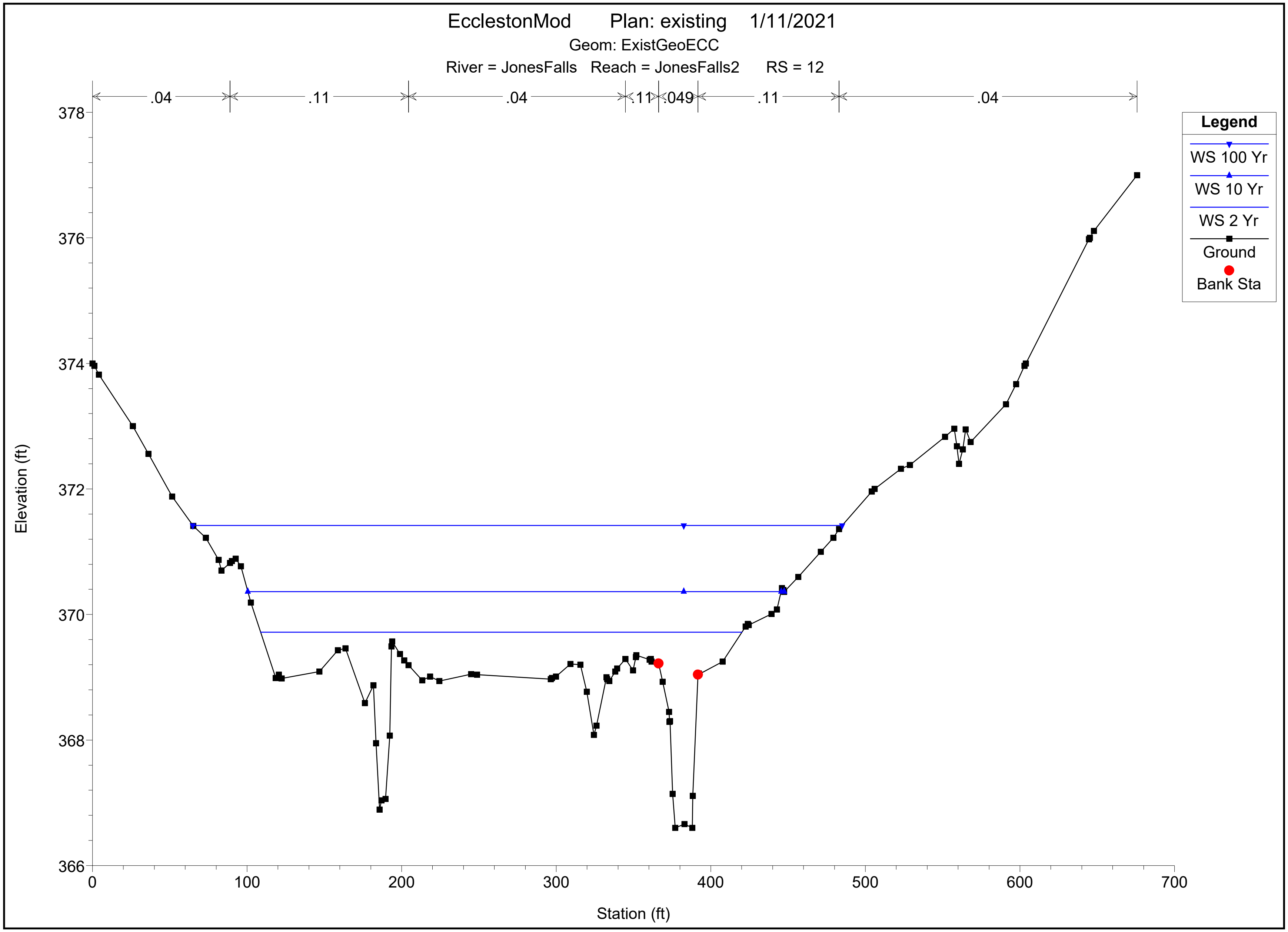
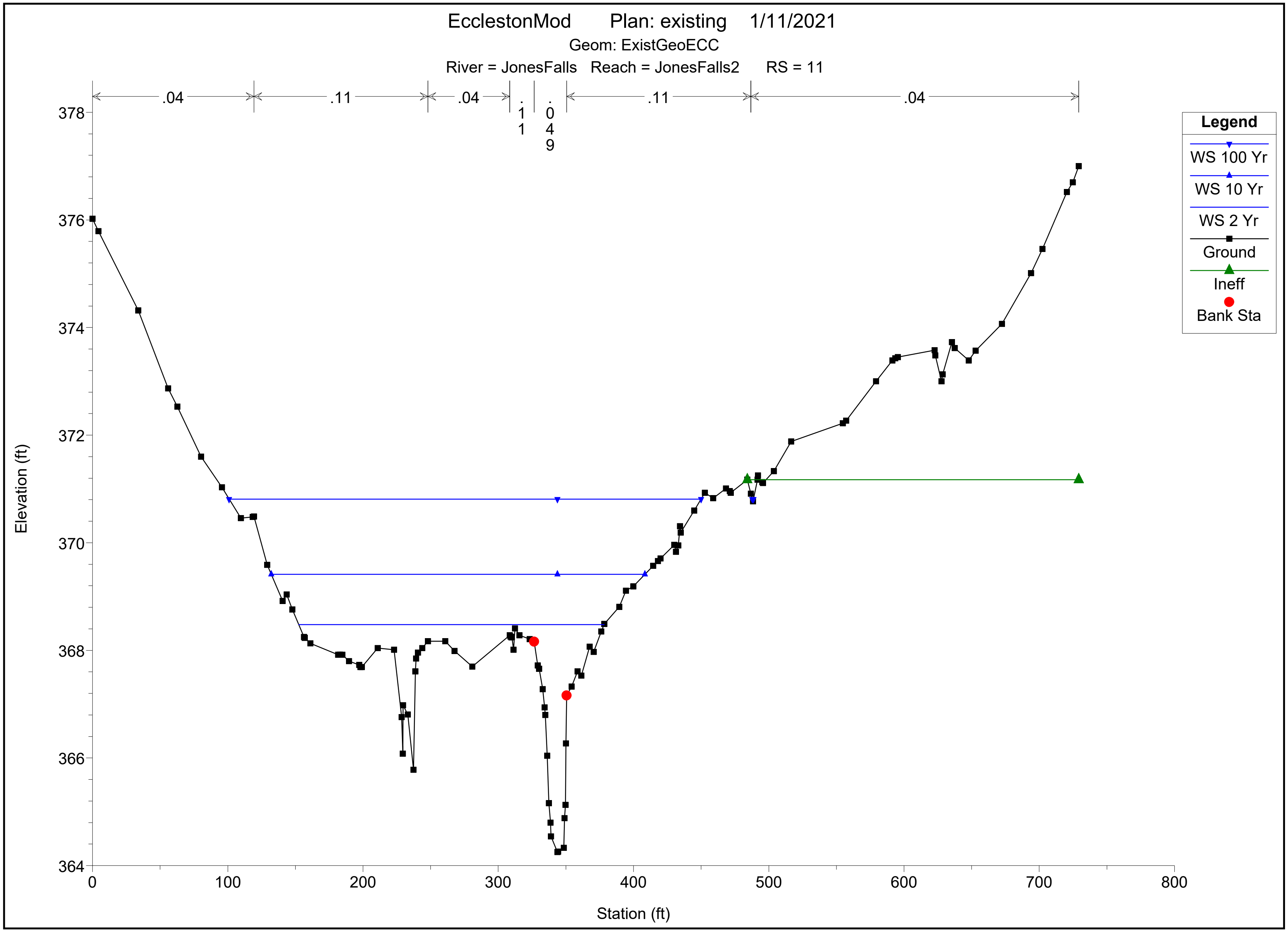
386
384
382
380
378
376
374
-200
-100
0
100
200
300
400
Station (ft)

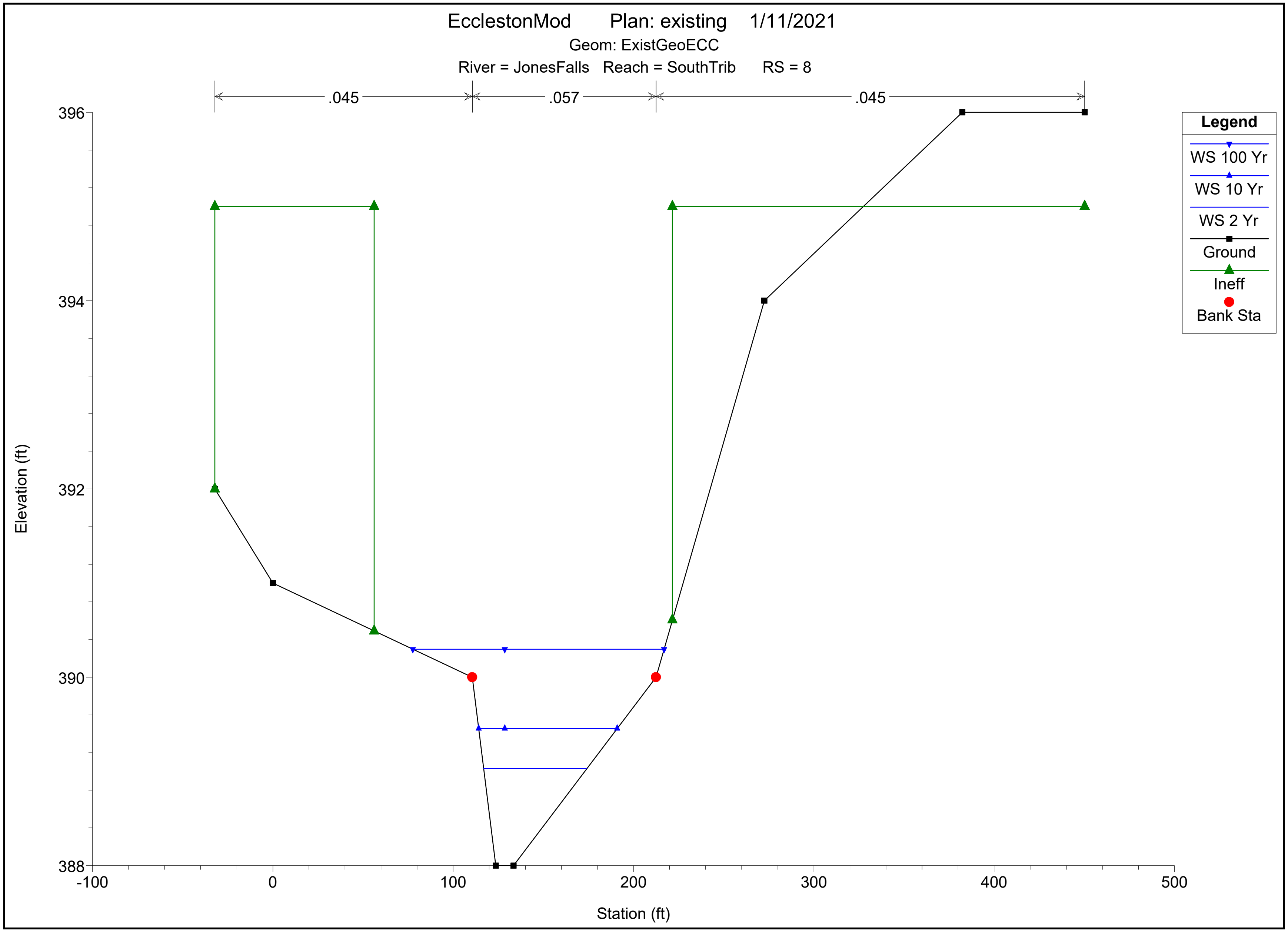

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = NorthTrib RS = 1
.04
.11
.061
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
378
377
376
375
374
373
372
371
0
100
200
300
400
Station (ft)



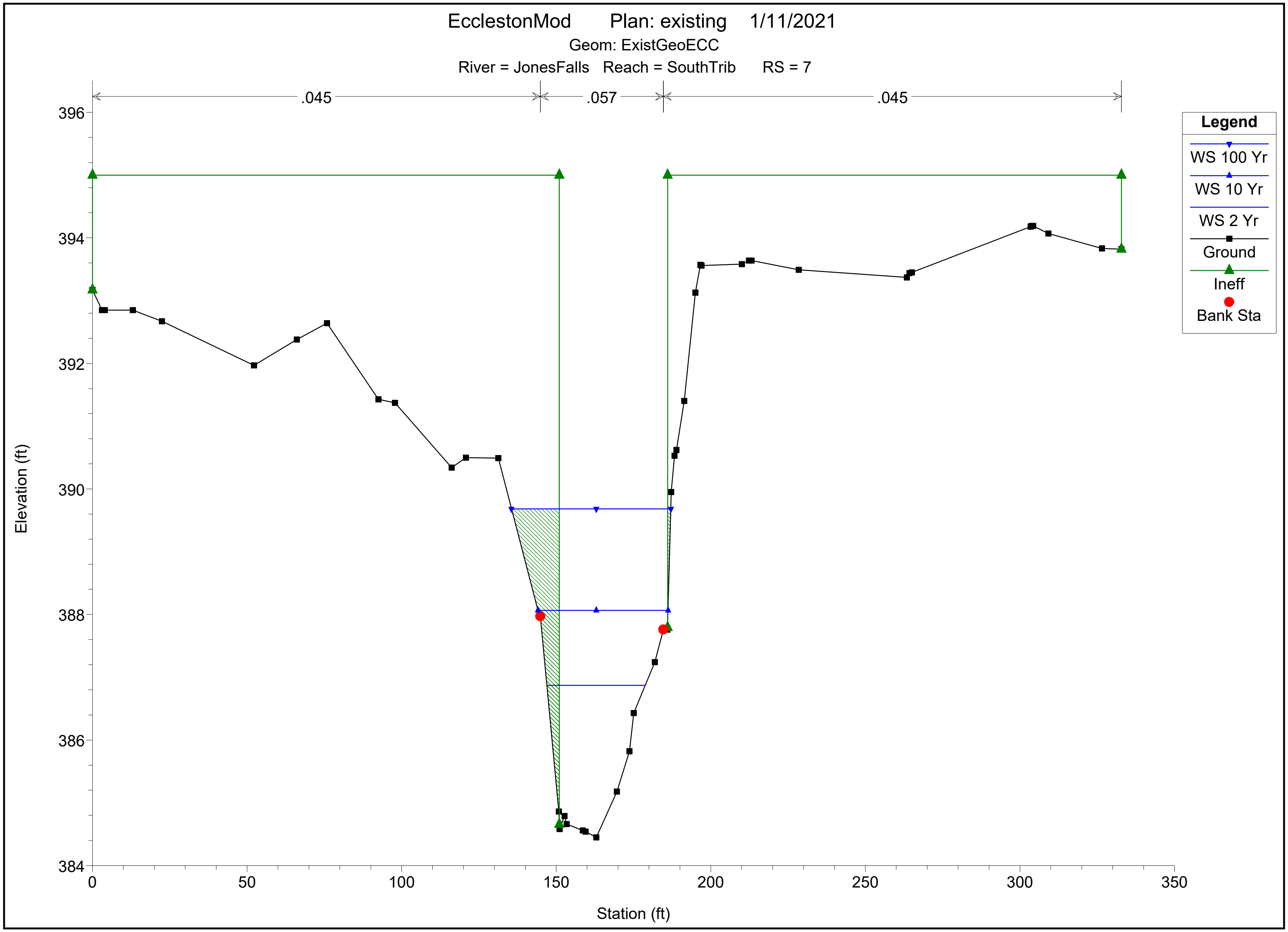
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls2 RS = 12
.04
.11
.04
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
0
100
200
300
400
500
600
700

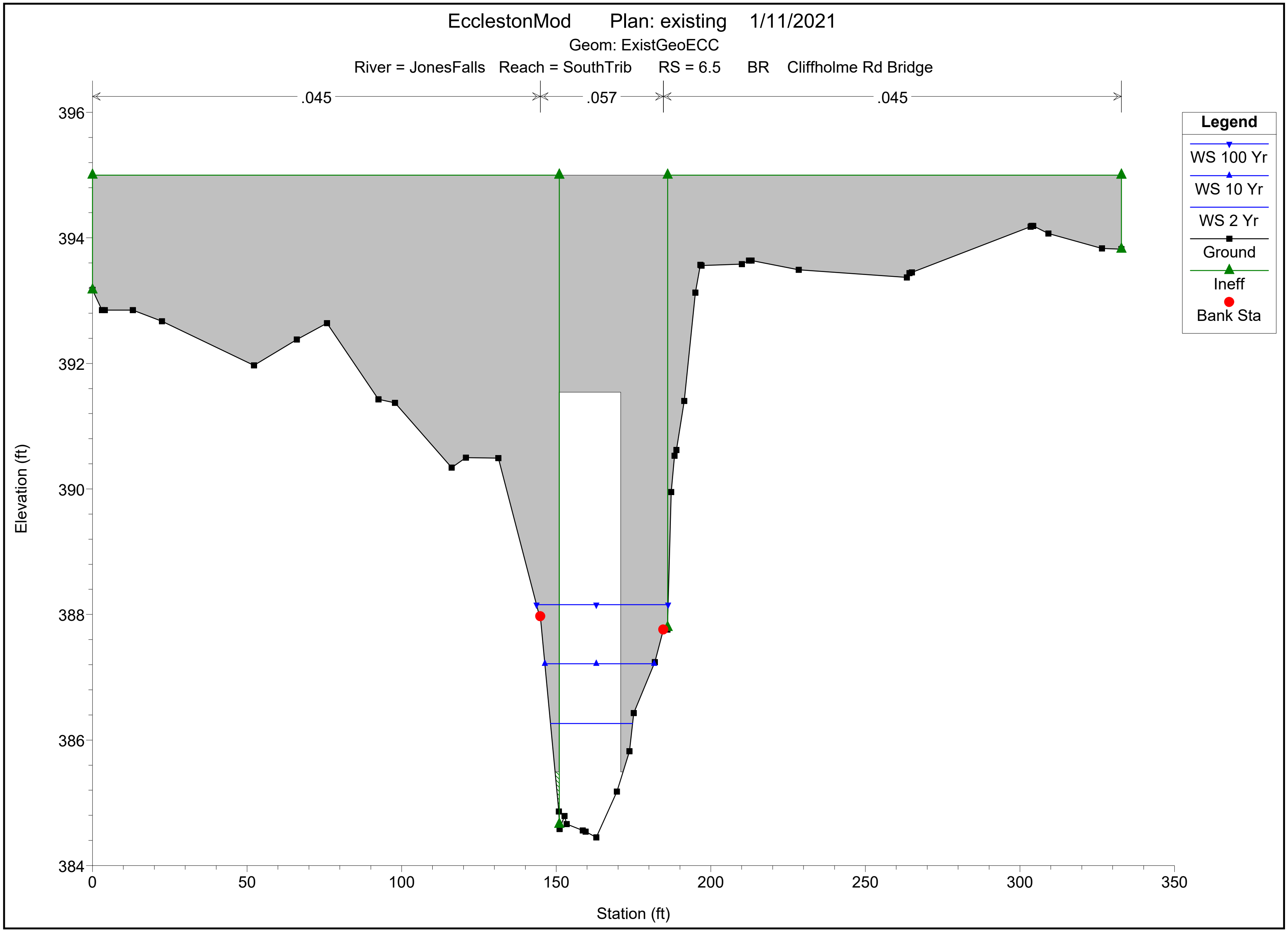


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls2 RS = 11
.04
.11
.04
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
364
0
100
200
300
400
500
600
700
800

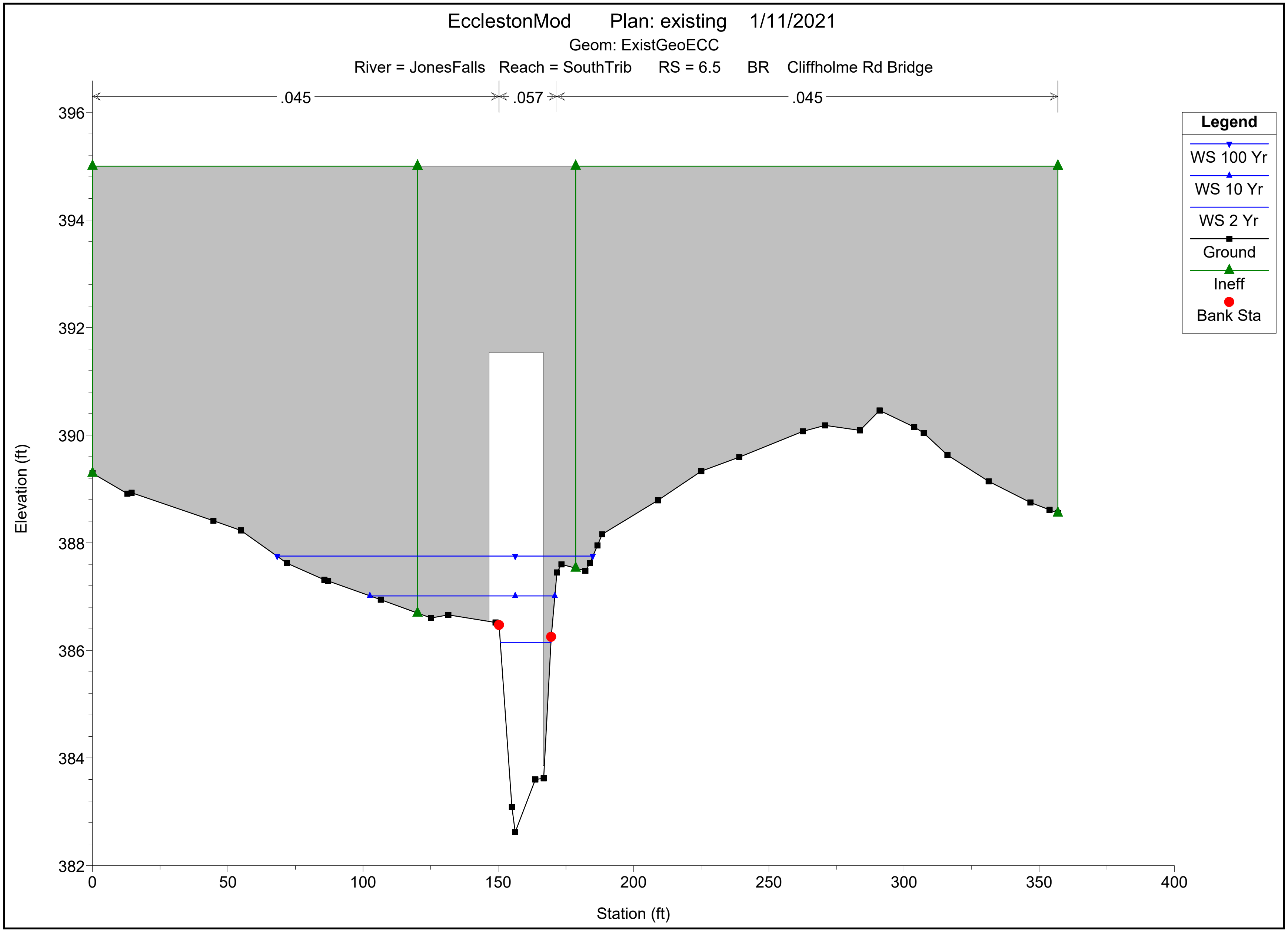


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 8
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
396
394
392
390
388
-100
0
100
200
300
400
500
Station (ft)

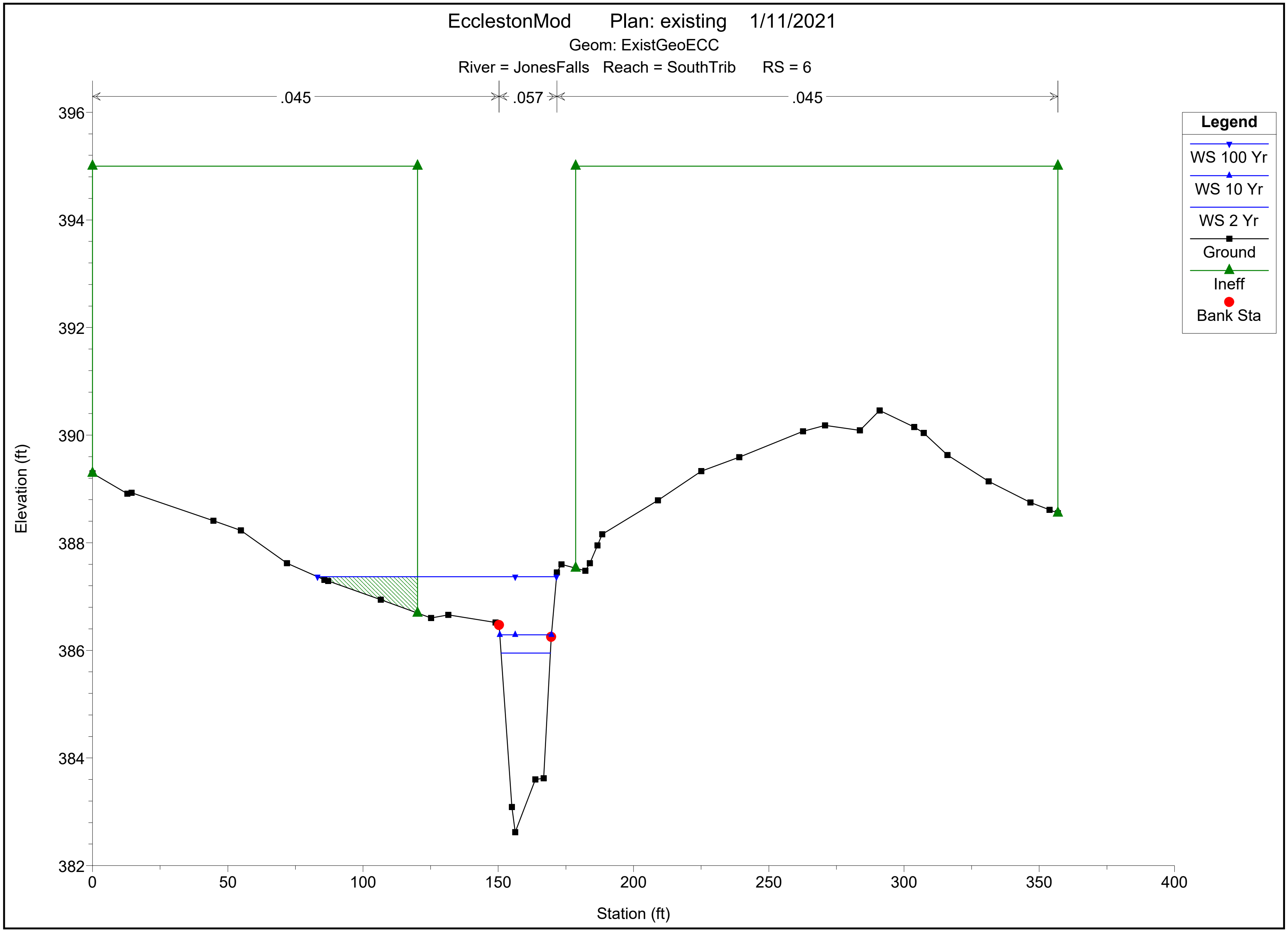

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 7
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
396
394
392
390
388
386
384
0
50
100
150
200
250
300
350

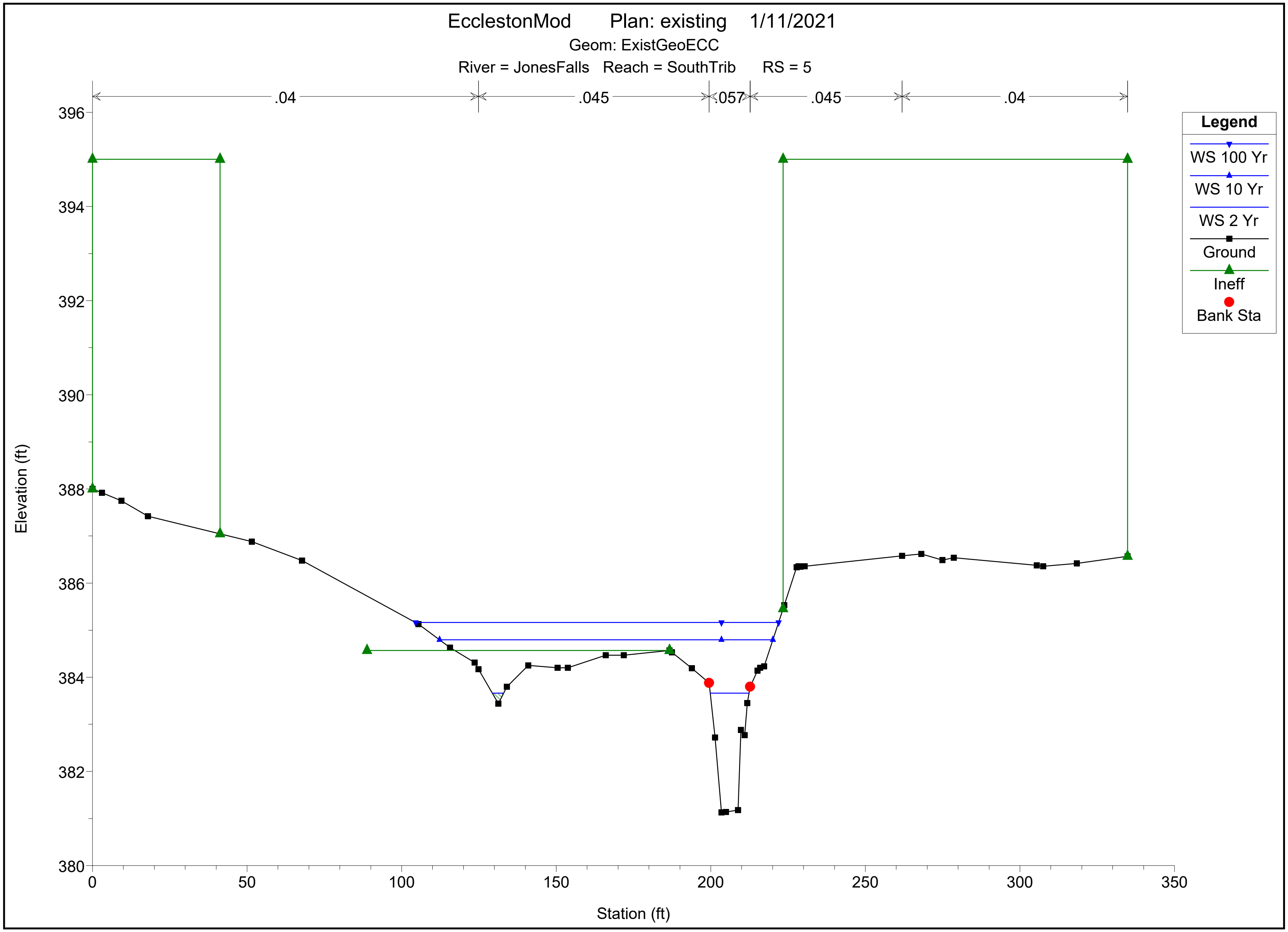


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 6.5 BR Cliffholme Rd Bridge
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
396
394
392
390
388
386
384
0
50
100
150
200
250
300
350

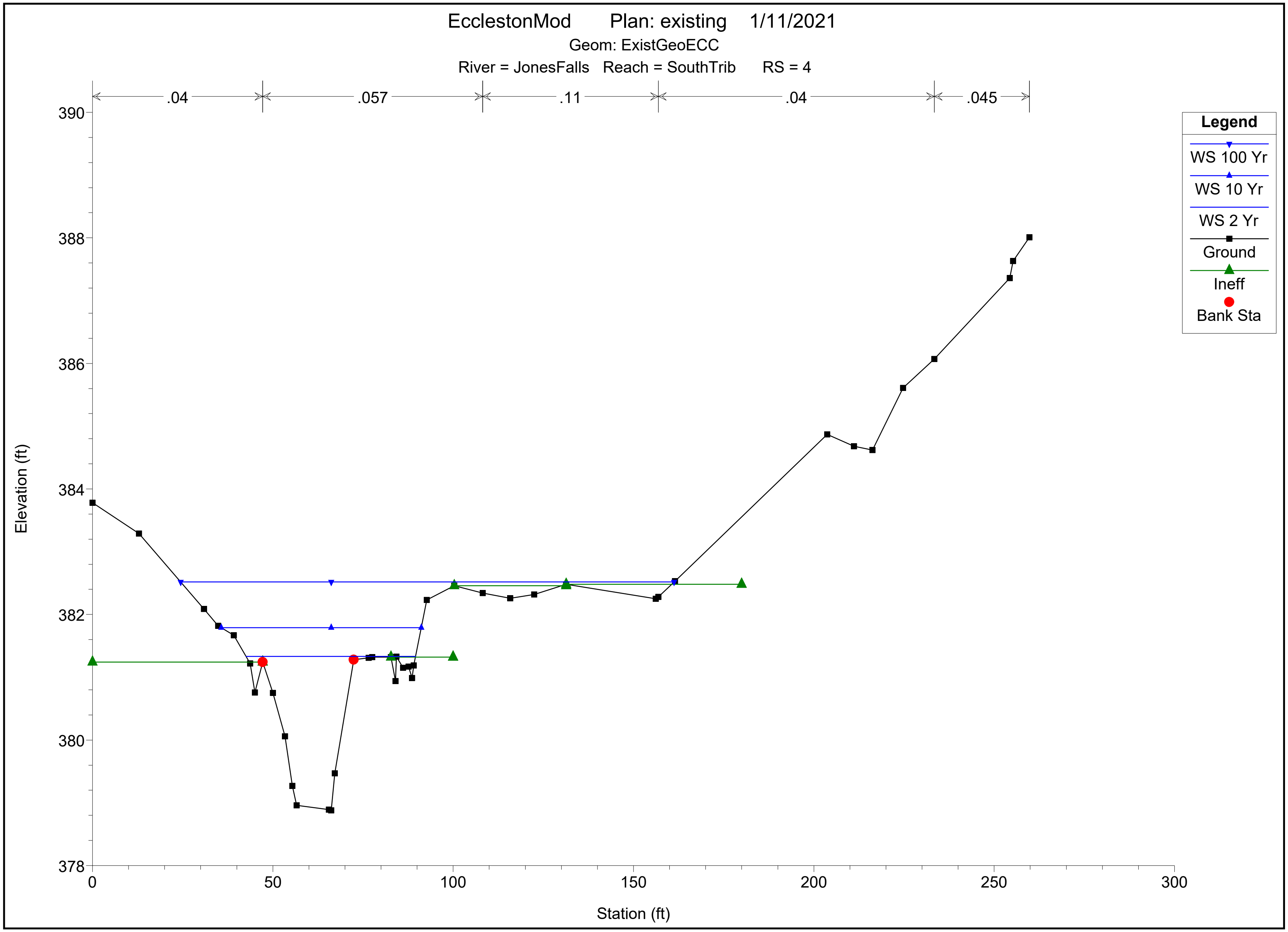


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 6.5 BR Cliffholme Rd Bridge
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
396
394
392
390
388
386
384
382
0
50
100
150
200
250
300
350
400

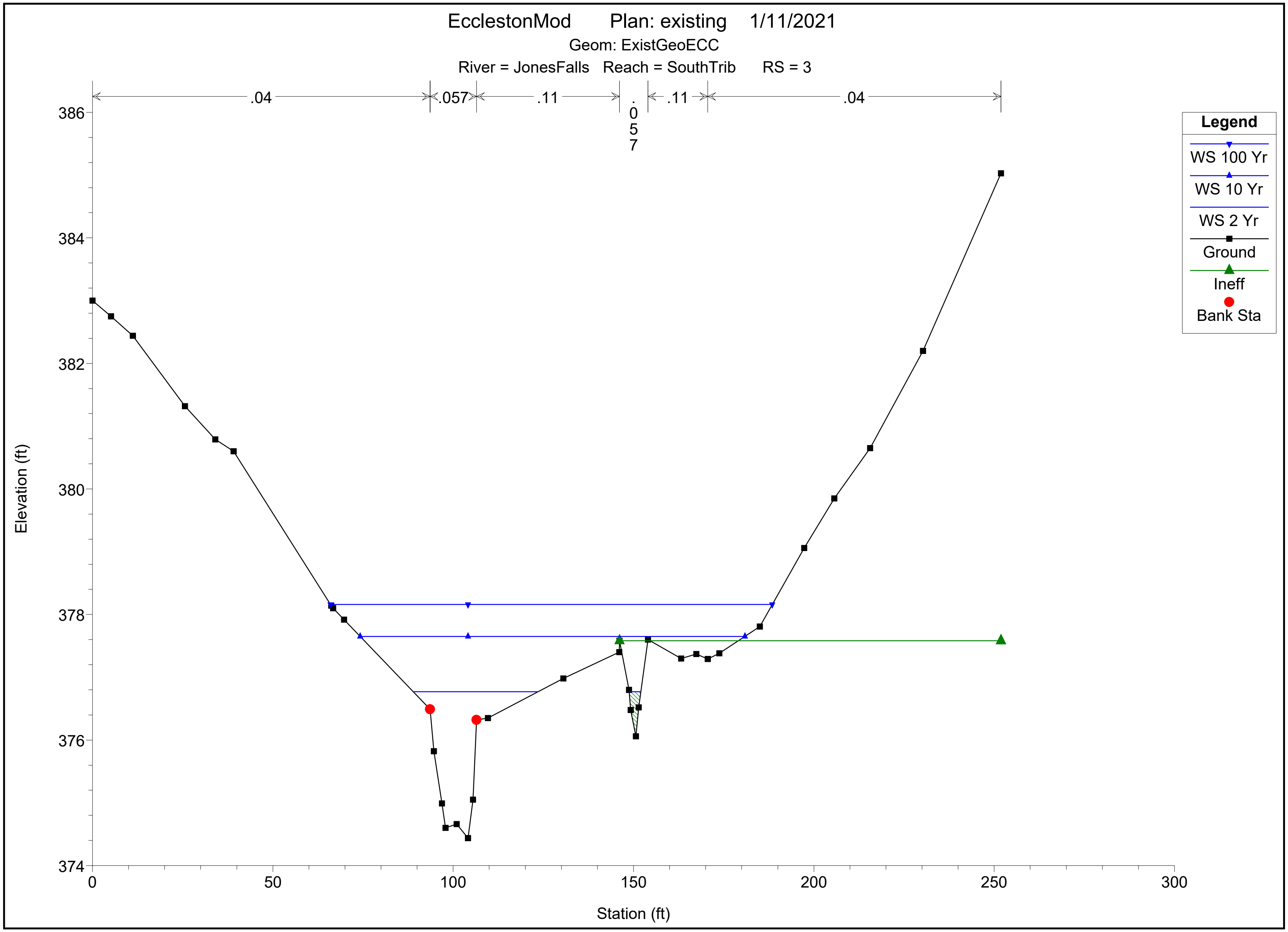

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 6
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
396
394
392
390
388
386
384
382
0
50
100
150
200
250
300
350
400
Station (ft)

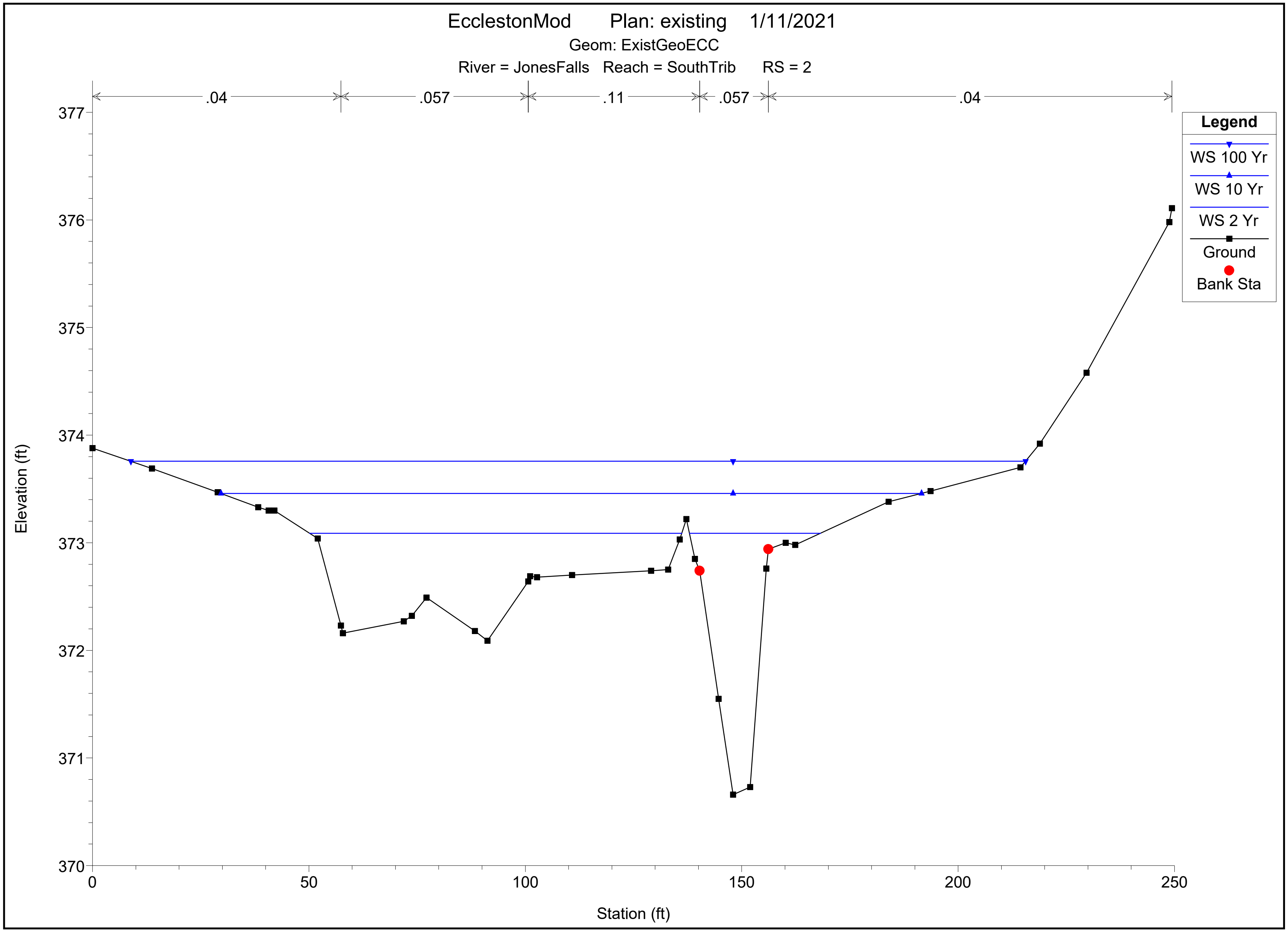


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 5
.04
.045
.057
.045
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
396
394
392
390
388
386
384
382
380
0
50
100
150
200
250
300
350
Station (ft)

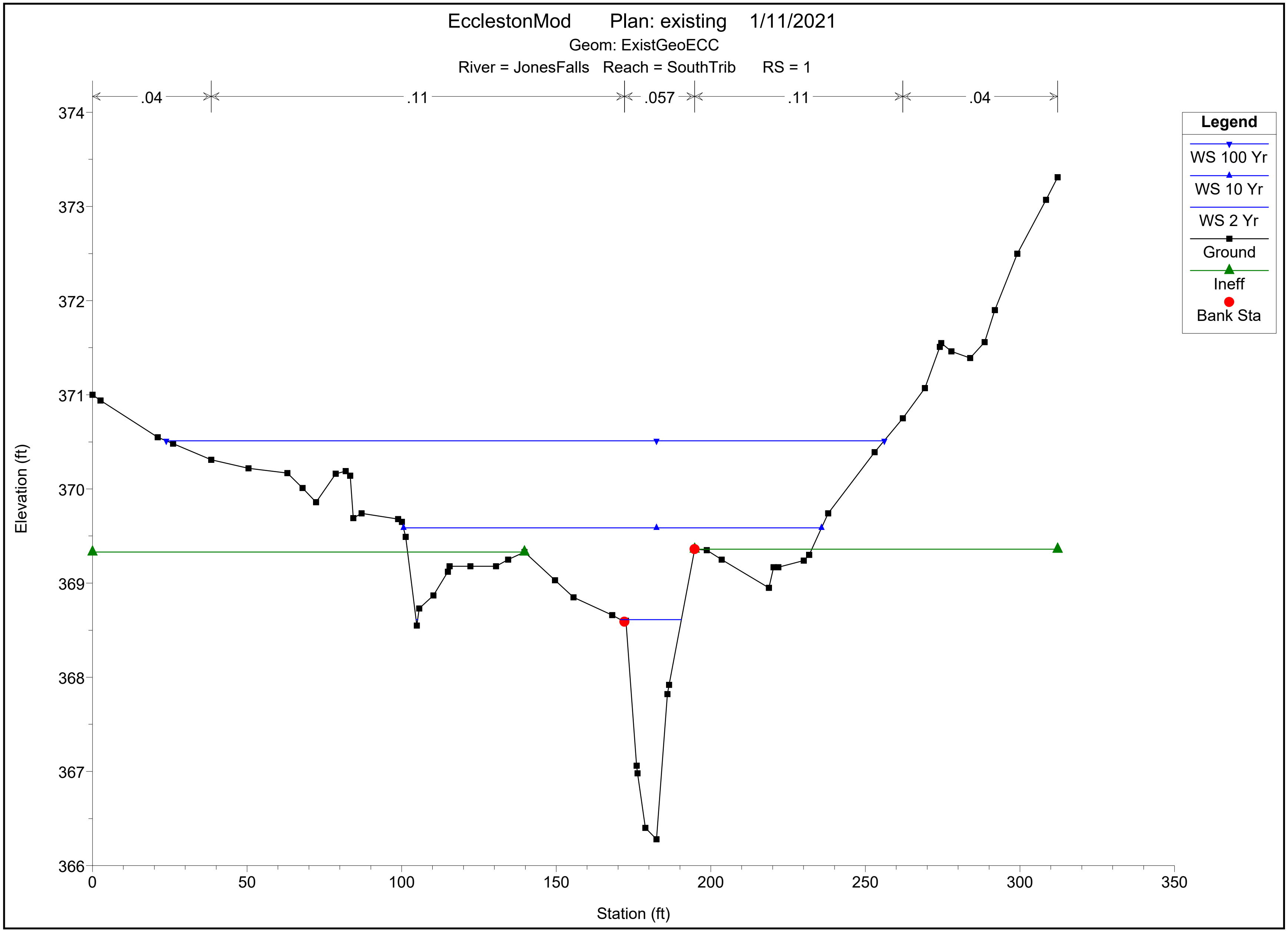


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 4
.04
.057
.11
.04
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
390
388
386
384
382
380
378
0
50
100
150
200
250
300

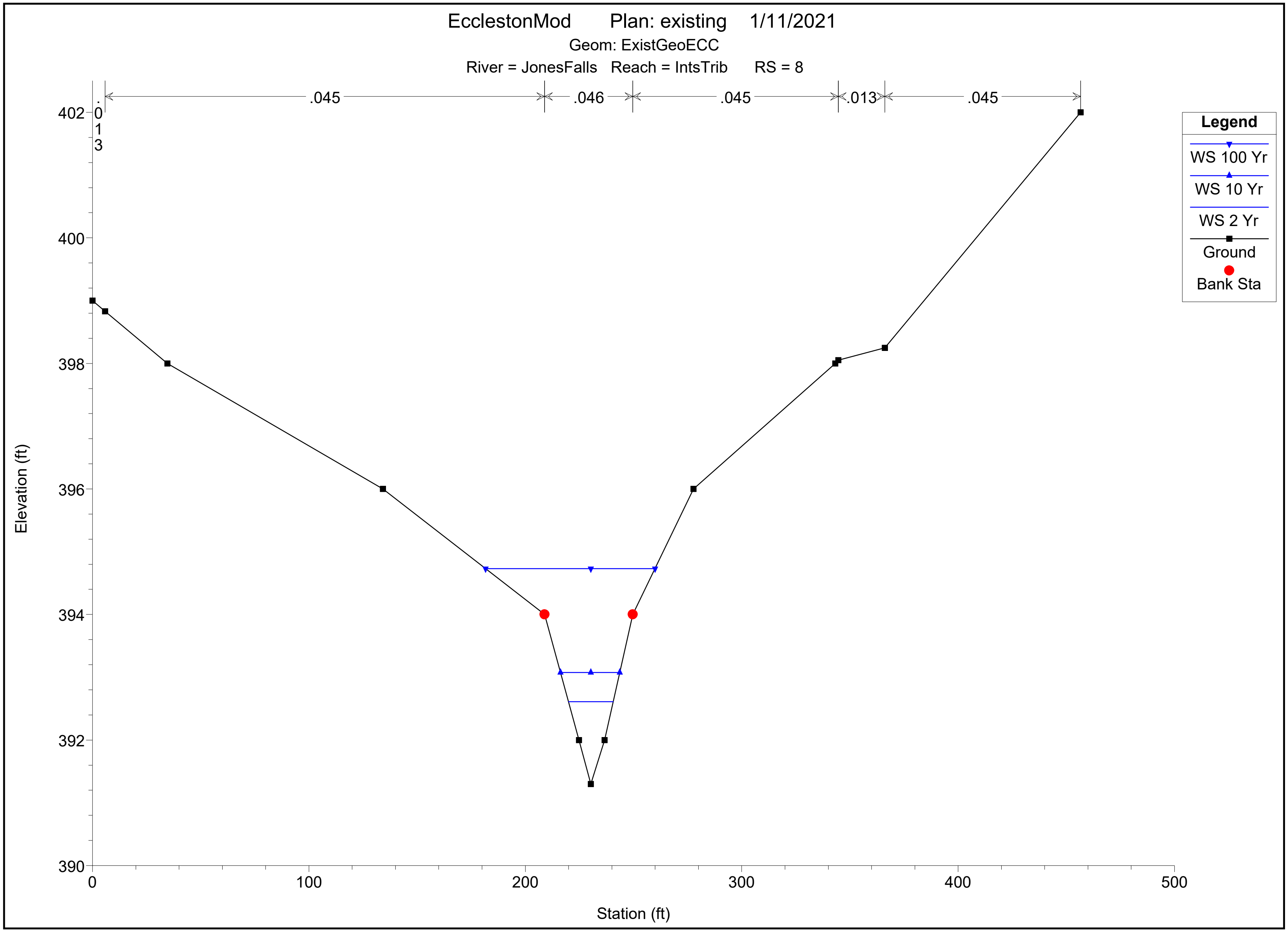

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 3
.04
.057
.11
.057
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
386
384
382
380
378
376
374
0
50
100
150
200
250
300
Station (ft)



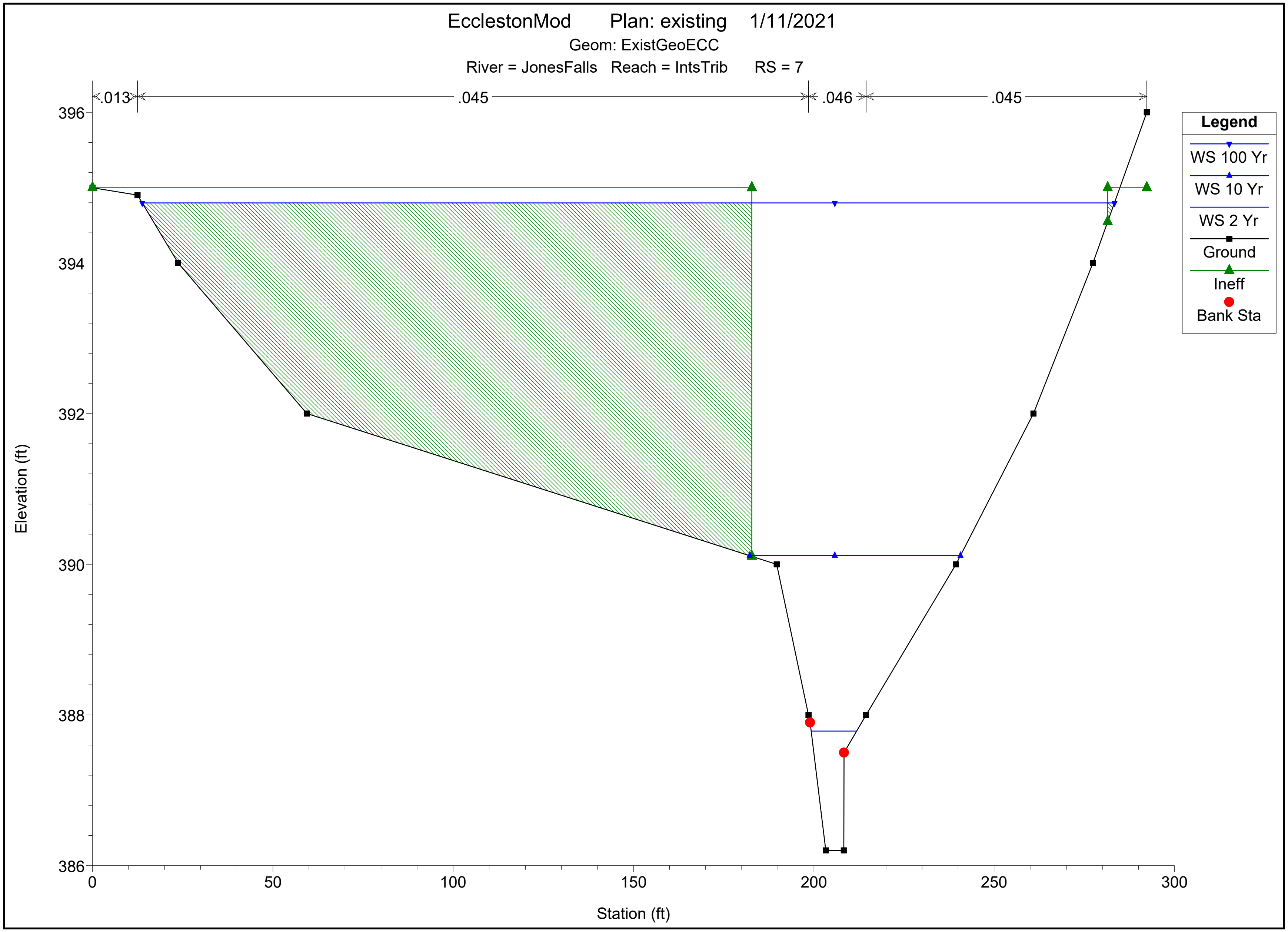
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 2
.04
.057
.11
.057
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
377
376
375
374
373
372
371
370
0
50
100
150
200
250
Station (ft)

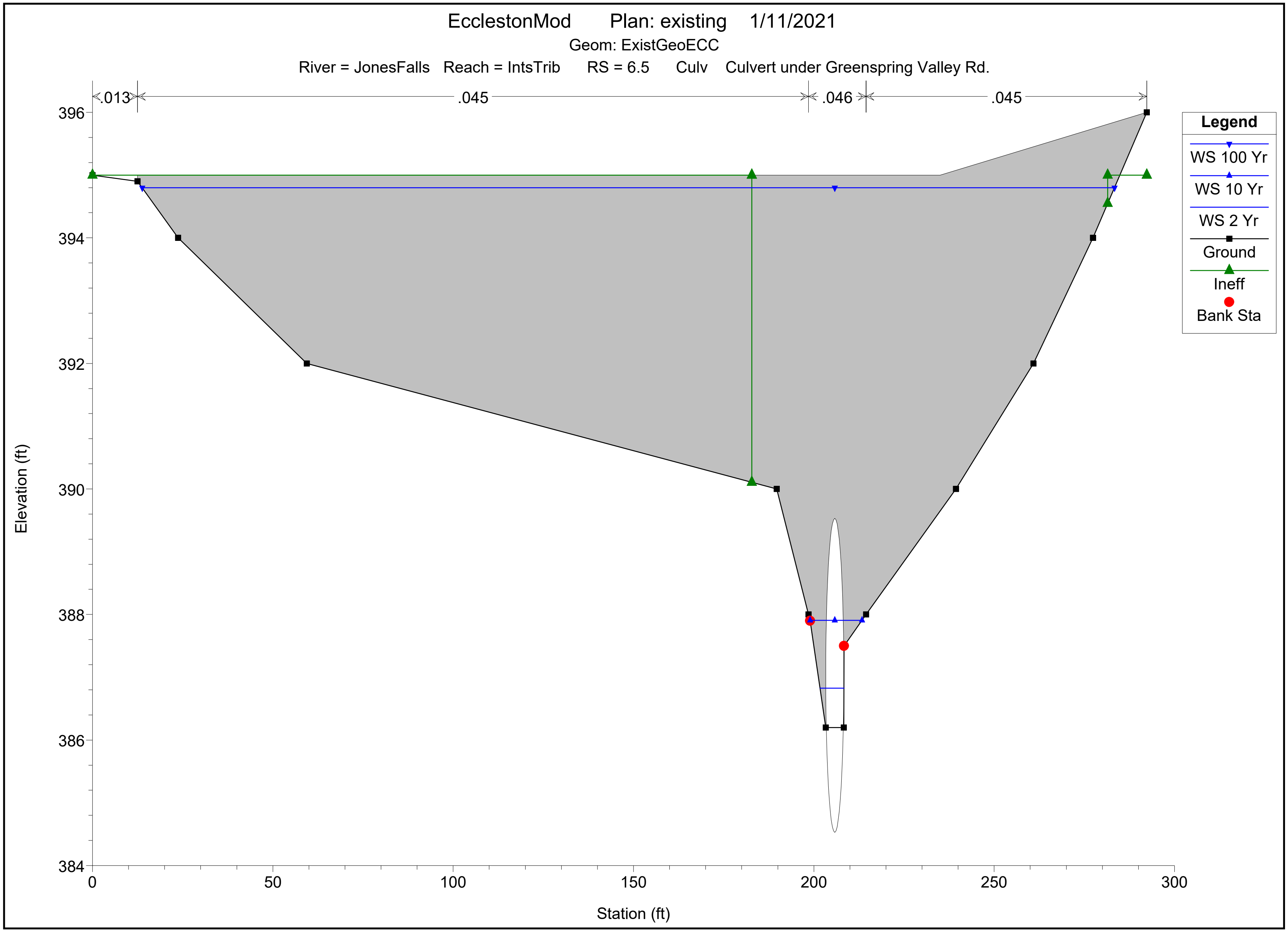


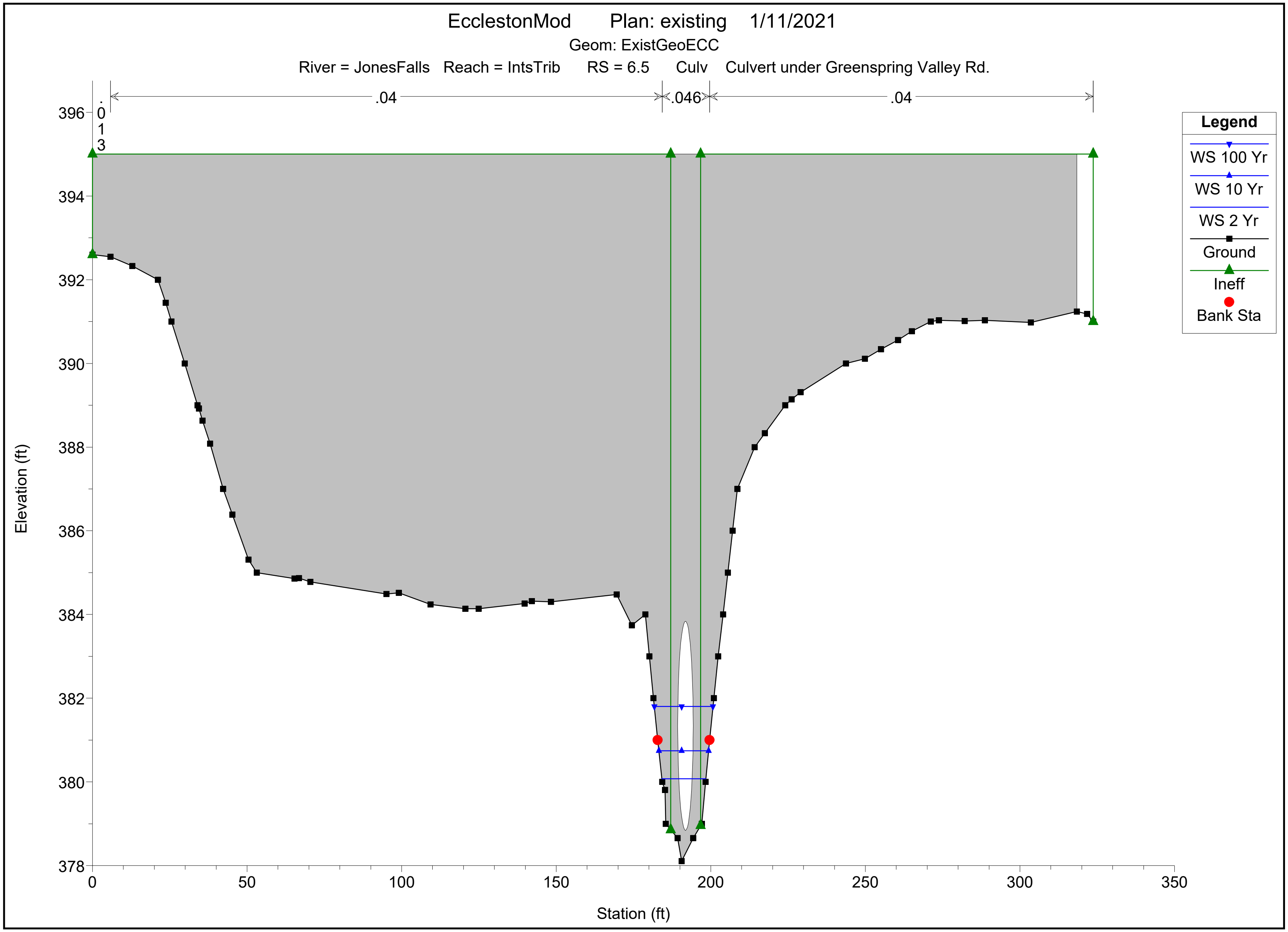
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = SouthTrib RS = 1
.04
.11
.057
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
374
373
372
371
370
369
368
367
366
0
50
100
150
200
250
300
350
Station (ft)



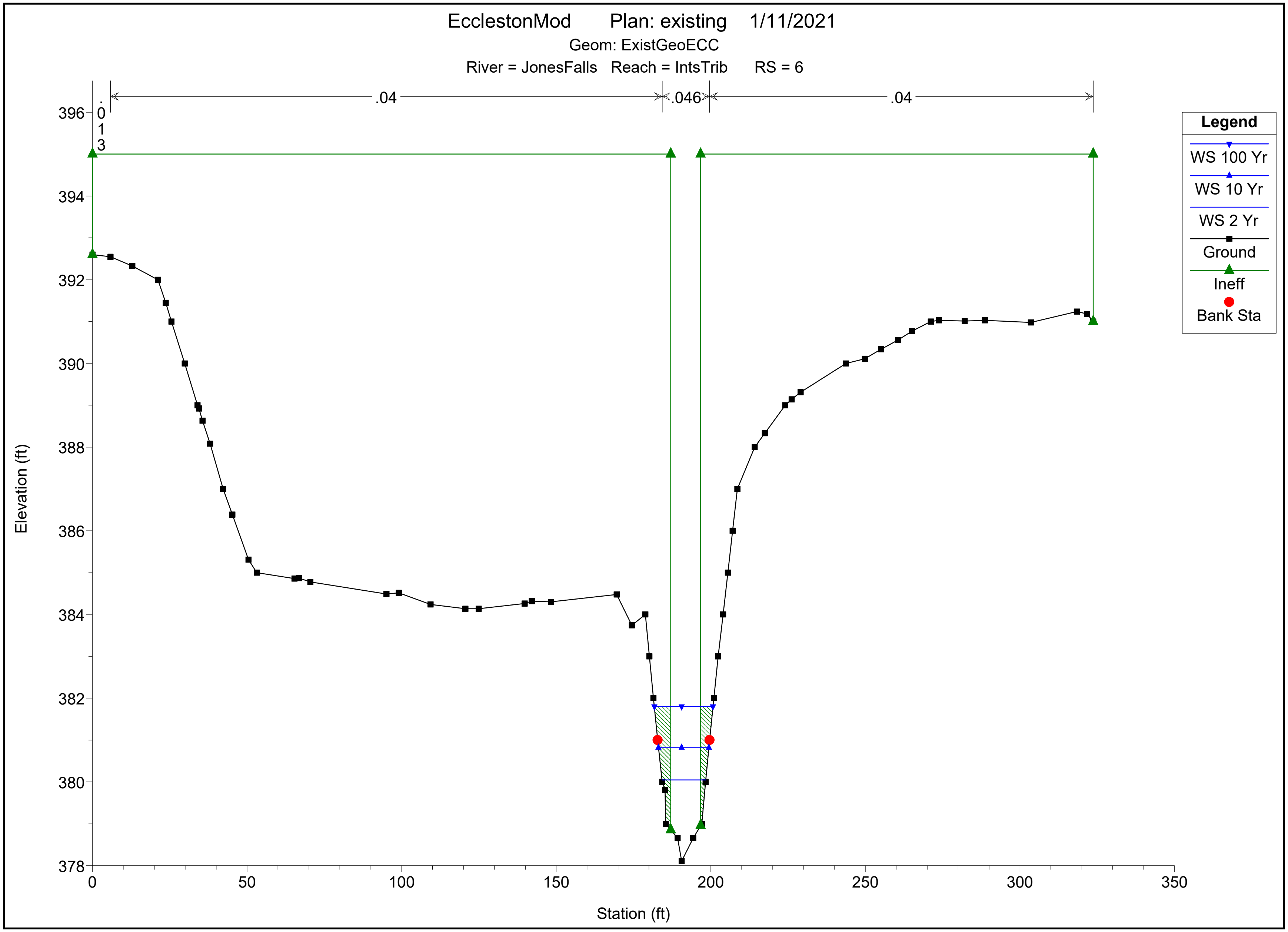
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 8
.013
.045
.046
.045
.013
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
402
400
398
396
394
392
390
0
100
200
300
400
500


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 7
.013
.045
.046
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
396
394
392
390
388
386
0
50
100
150
200
250
300
Station (ft)

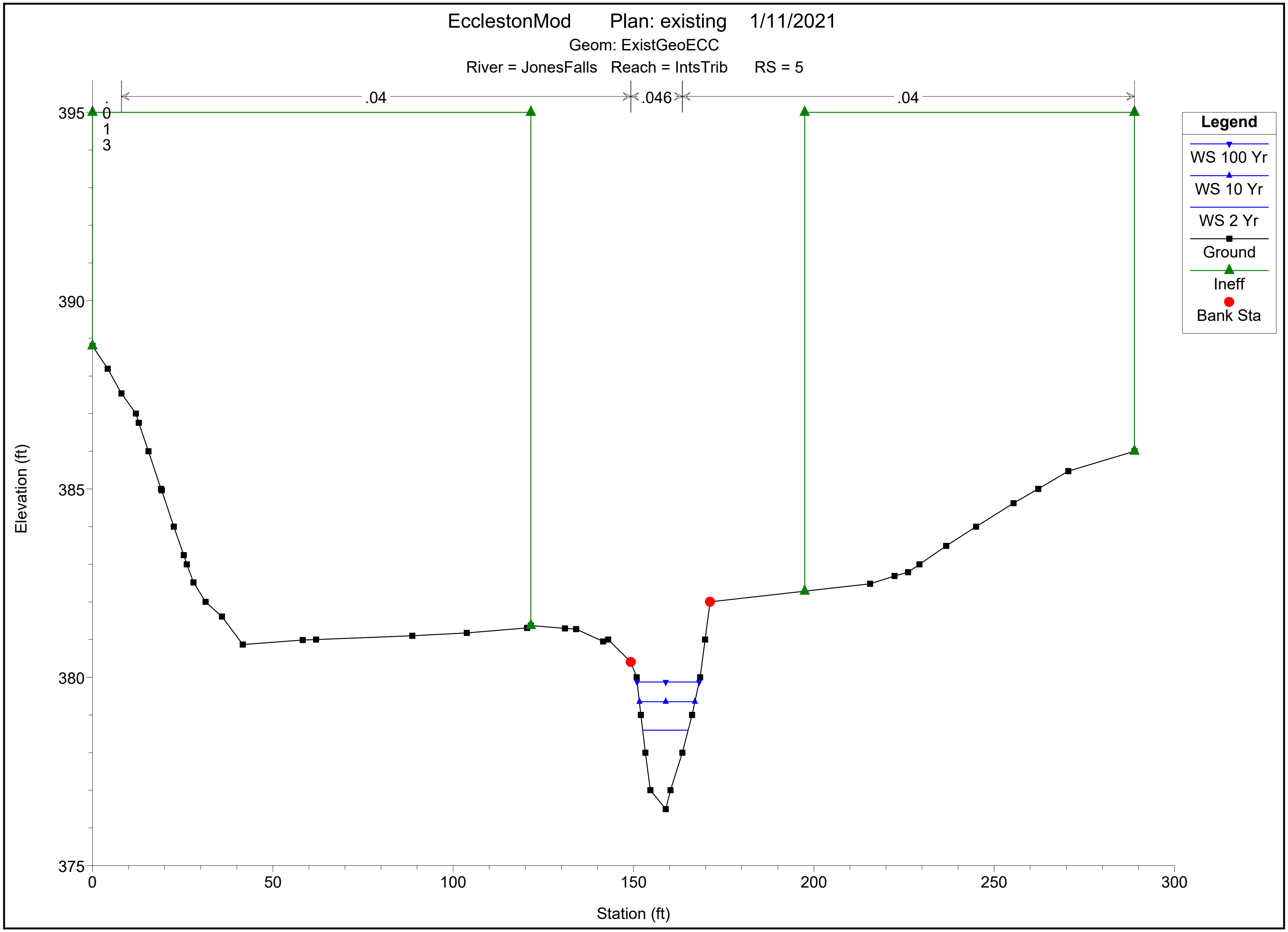

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 6.5 Culv Culvert under Greenspring Valley Rd.
.013
.045
.046
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
396
394
392
390
388
386
384
0
50
100
150
200
250
300



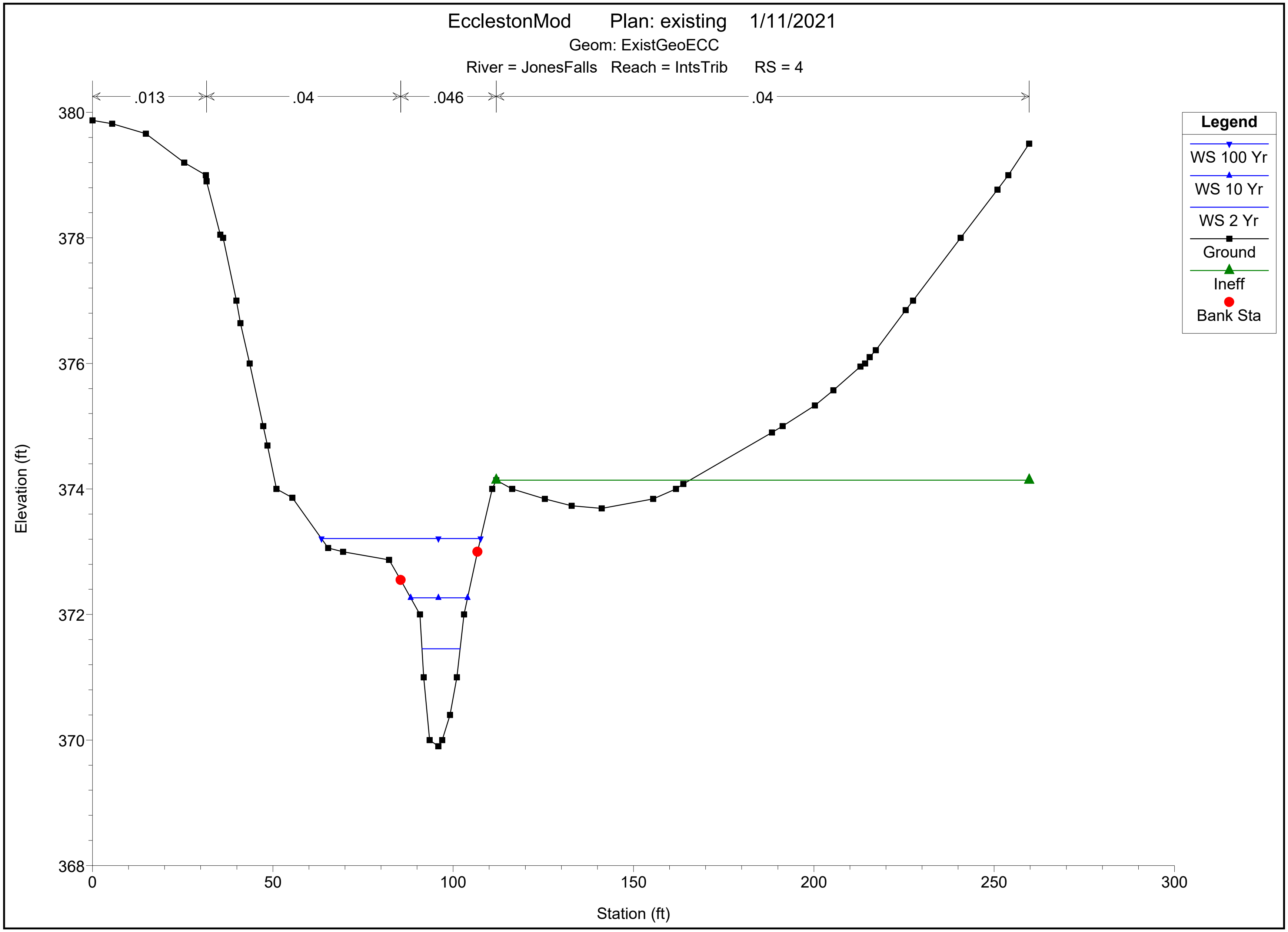
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 6.5 Culv Culvert under Greenspring Valley Rd.
.013
.04
.046
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
396
394
392
390
388
386
384
382
380
378
0
50
100
150
200
250
300
350



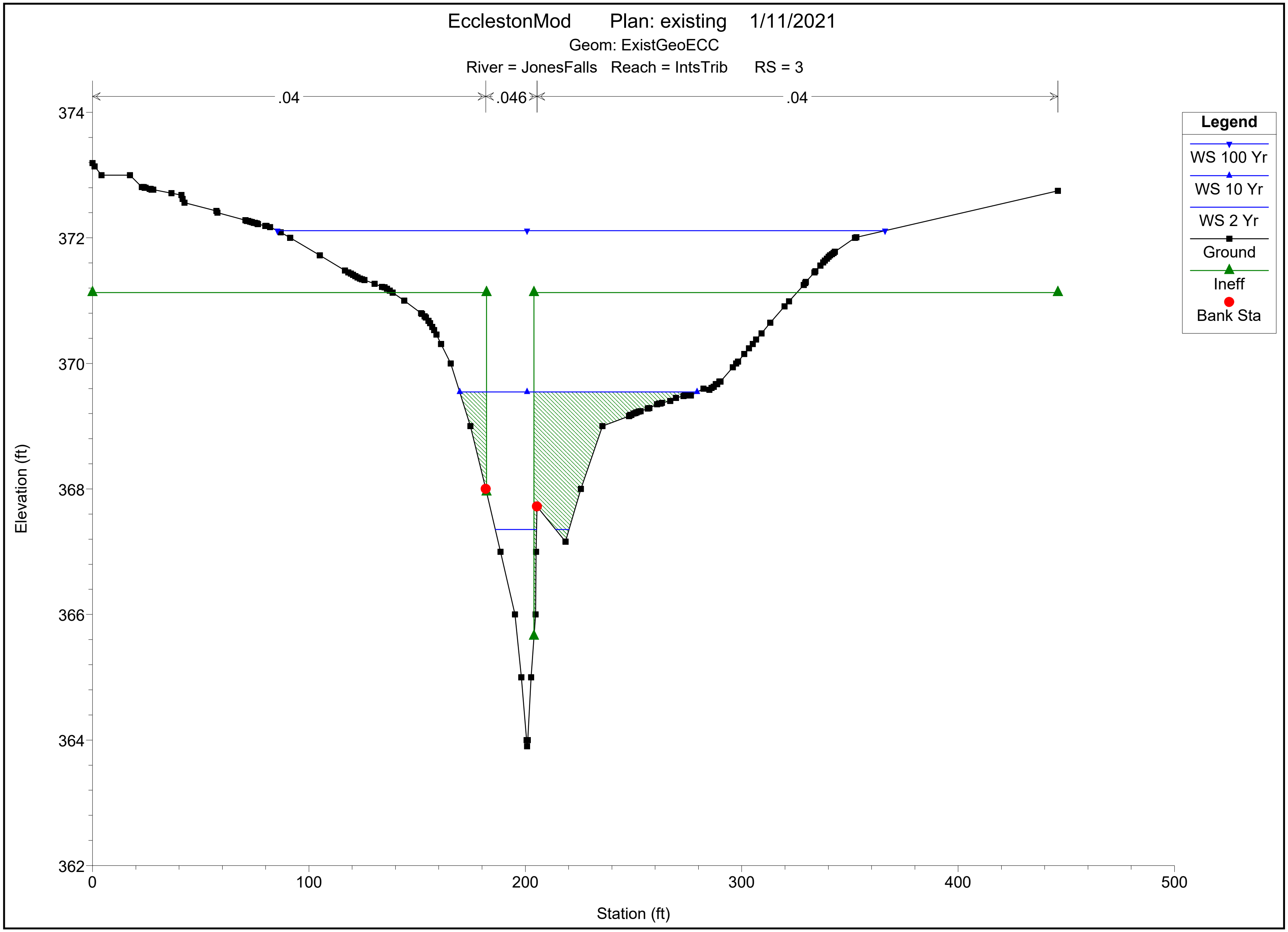
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 6
.04
.046
.04
.013
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
396
394
392
390
388
386
384
382
380
378
0
50
100
150
200
250
300
350



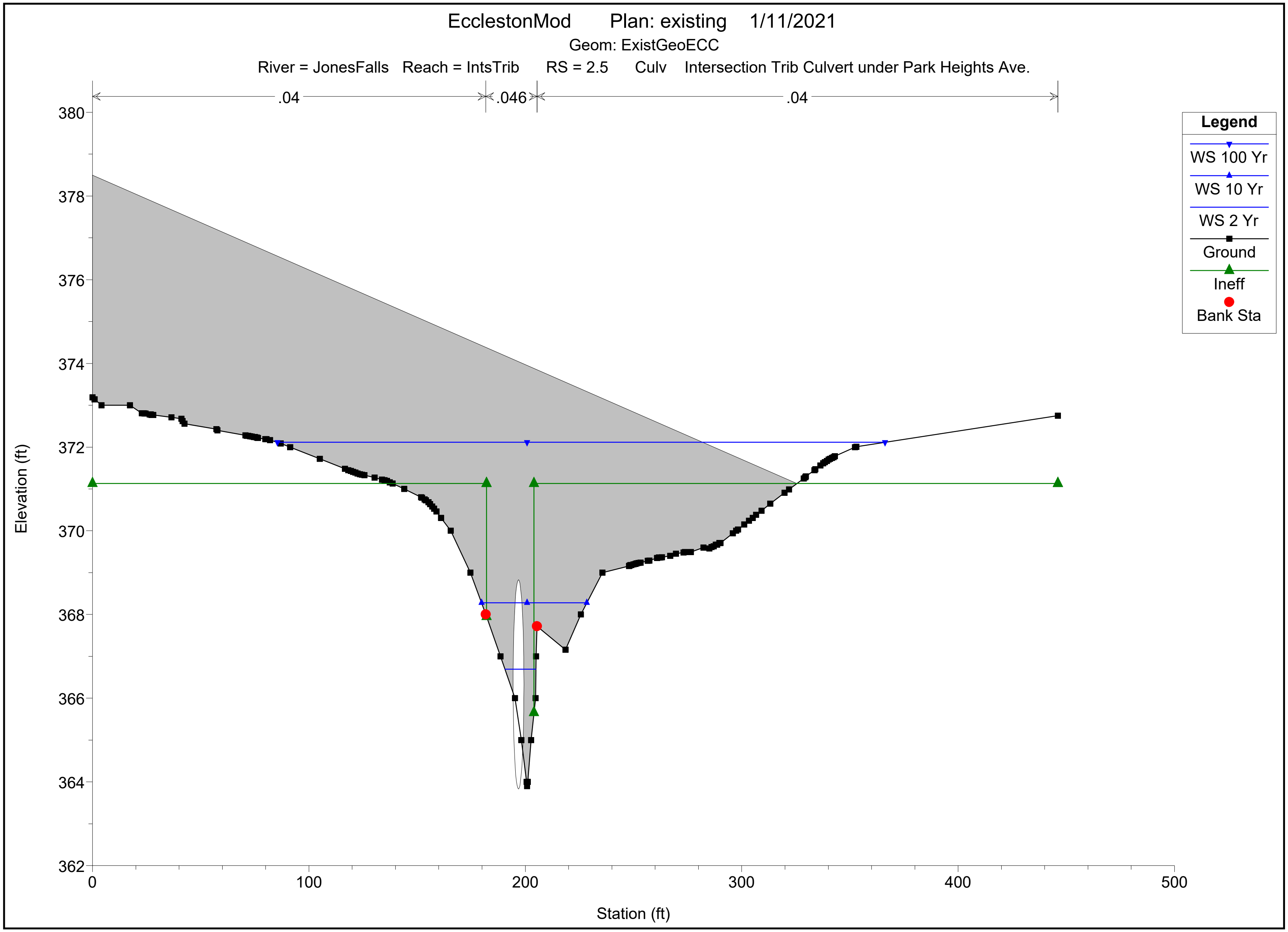
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 5
.04
.046
.04
.013
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
375
380
385
390
395
0
50
100
150
200
250
300



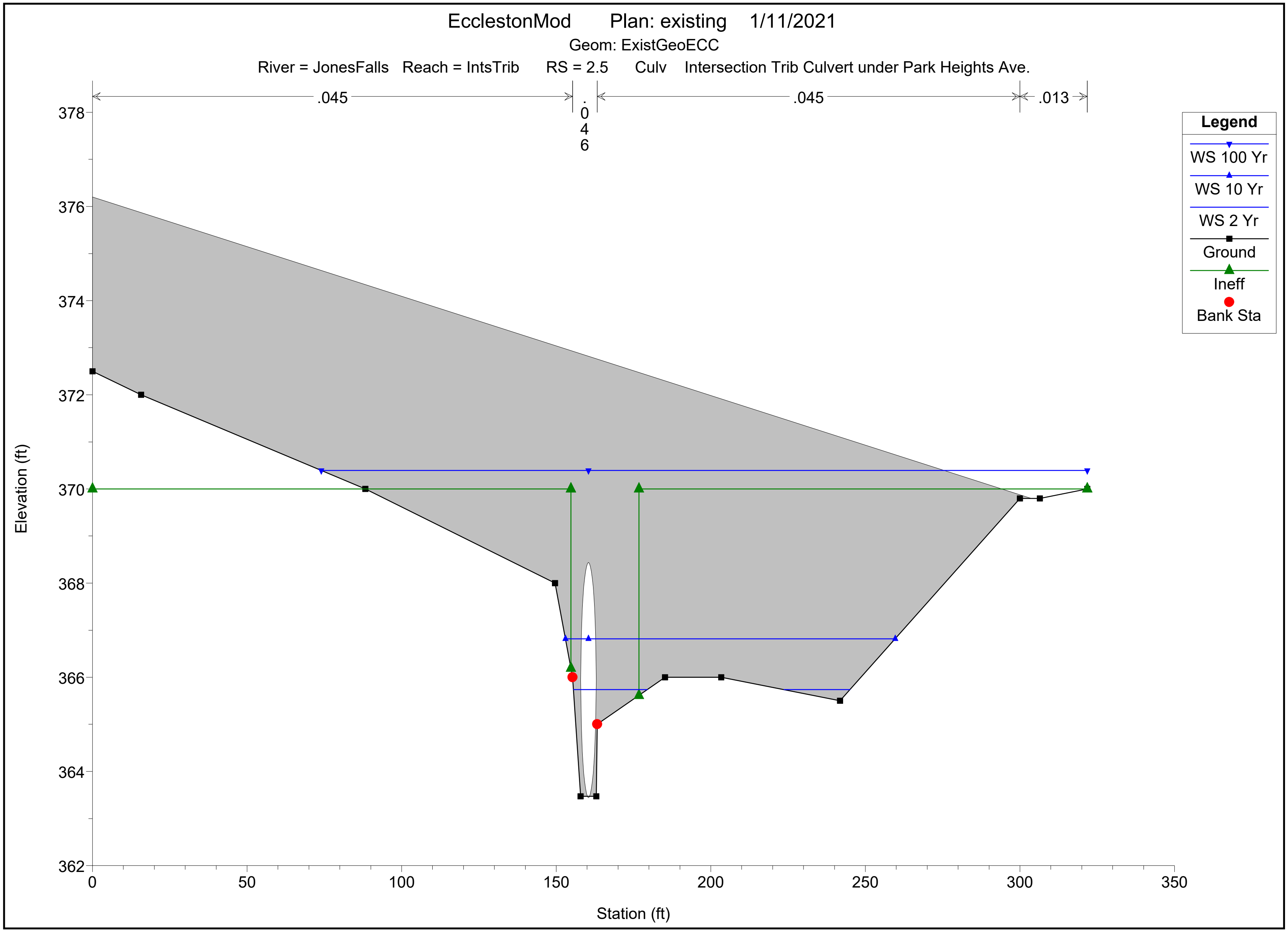
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 4
.013
.04
.046
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
380
378
376
374
372
370
368
0
50
100
150
200
250
300
Station (ft)



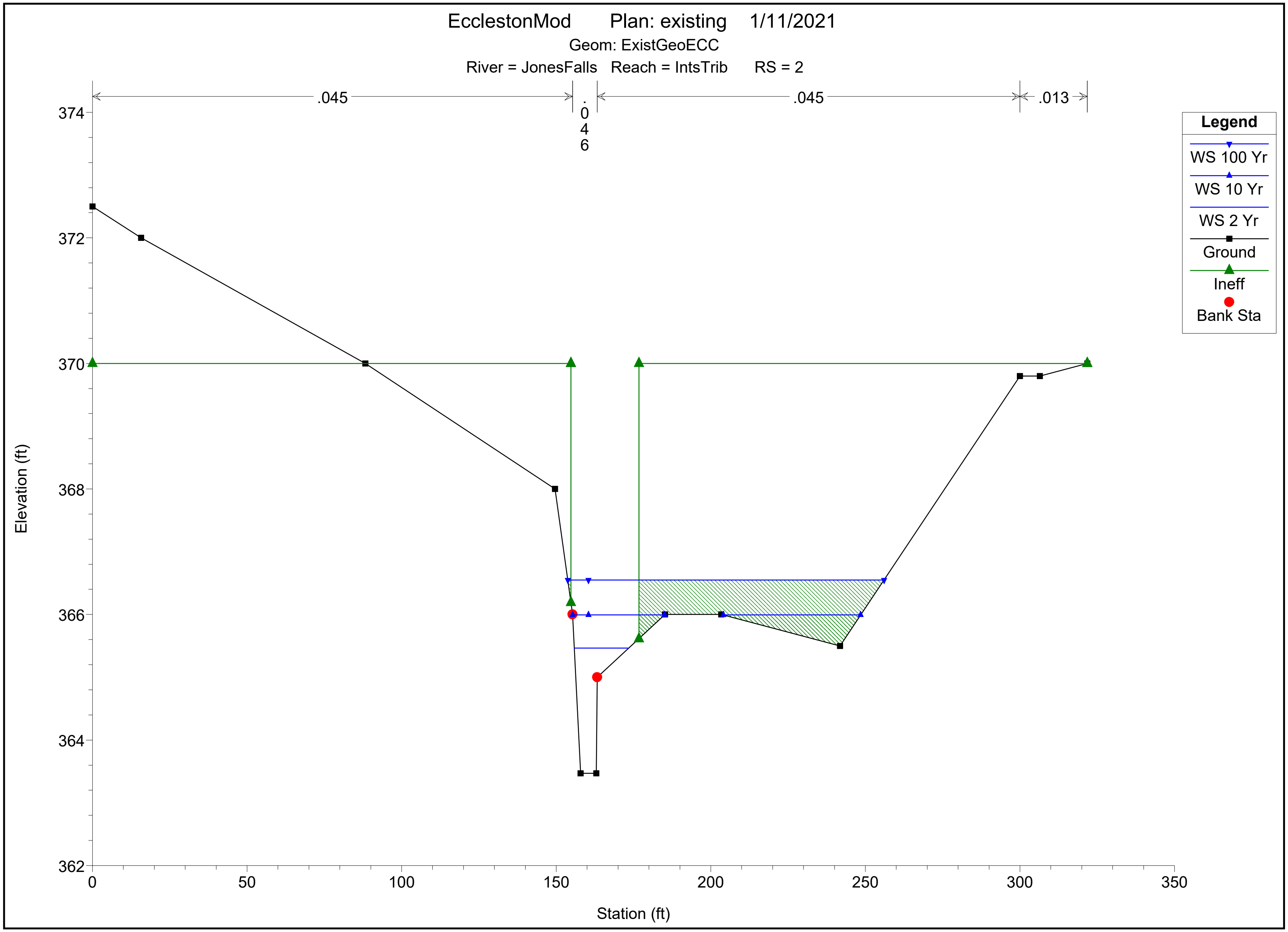
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 3
.04
.046
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
374
372
370
368
366
364
362
0
100
200
300
400
500

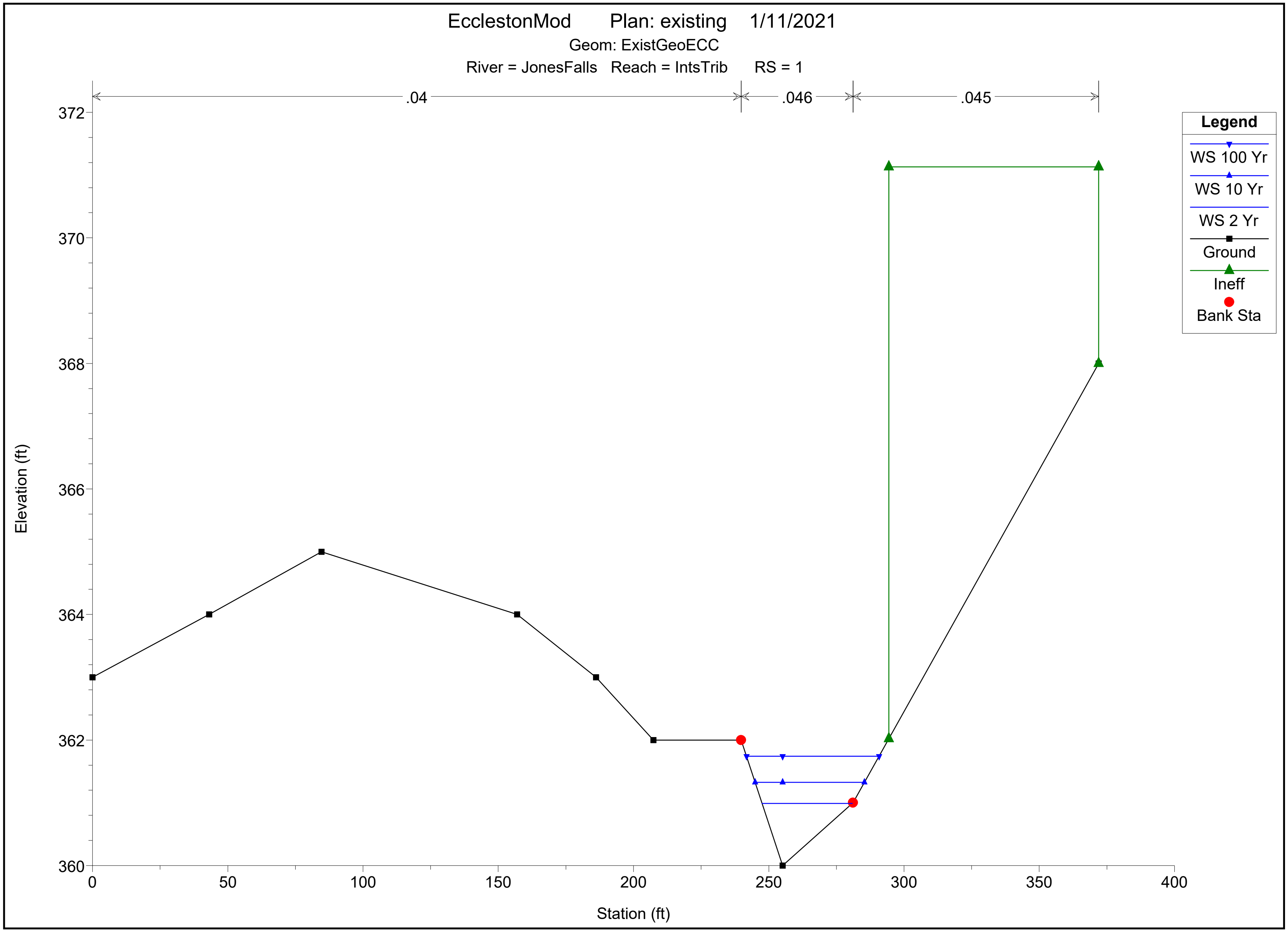


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 2.5 Culv Intersection Trib Culvert under Park Heights Ave.
.04
.046
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
380
378
376
374
372
370
368
366
364
362
0
100
200
300
400
500

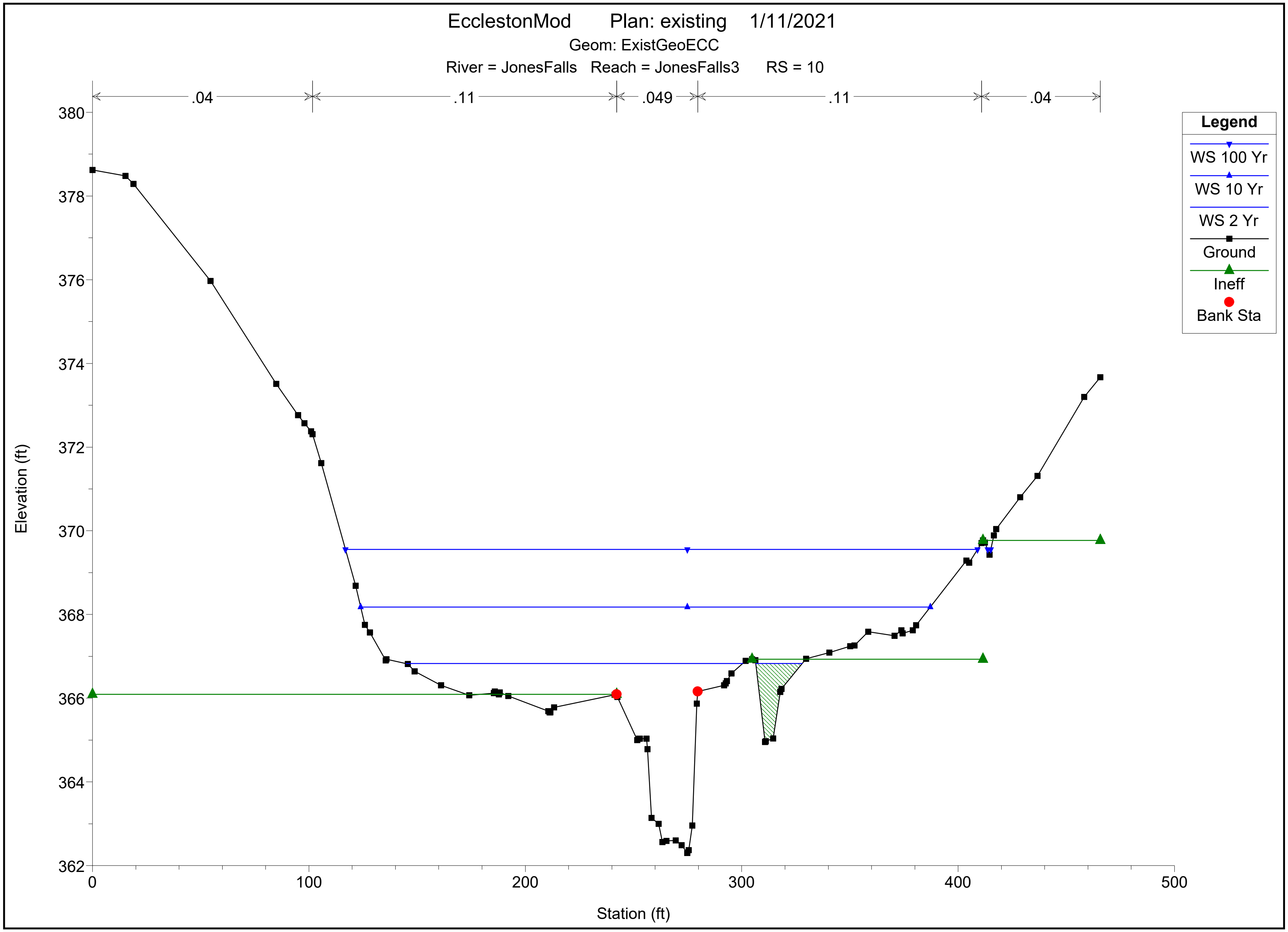


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 2.5 Culv Intersection Trib Culvert under Park Heights Ave.
.045
.046
.045
.013
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
362
364
366
368
370
372
374
376
378
0
50
100
150
200
250
300
350

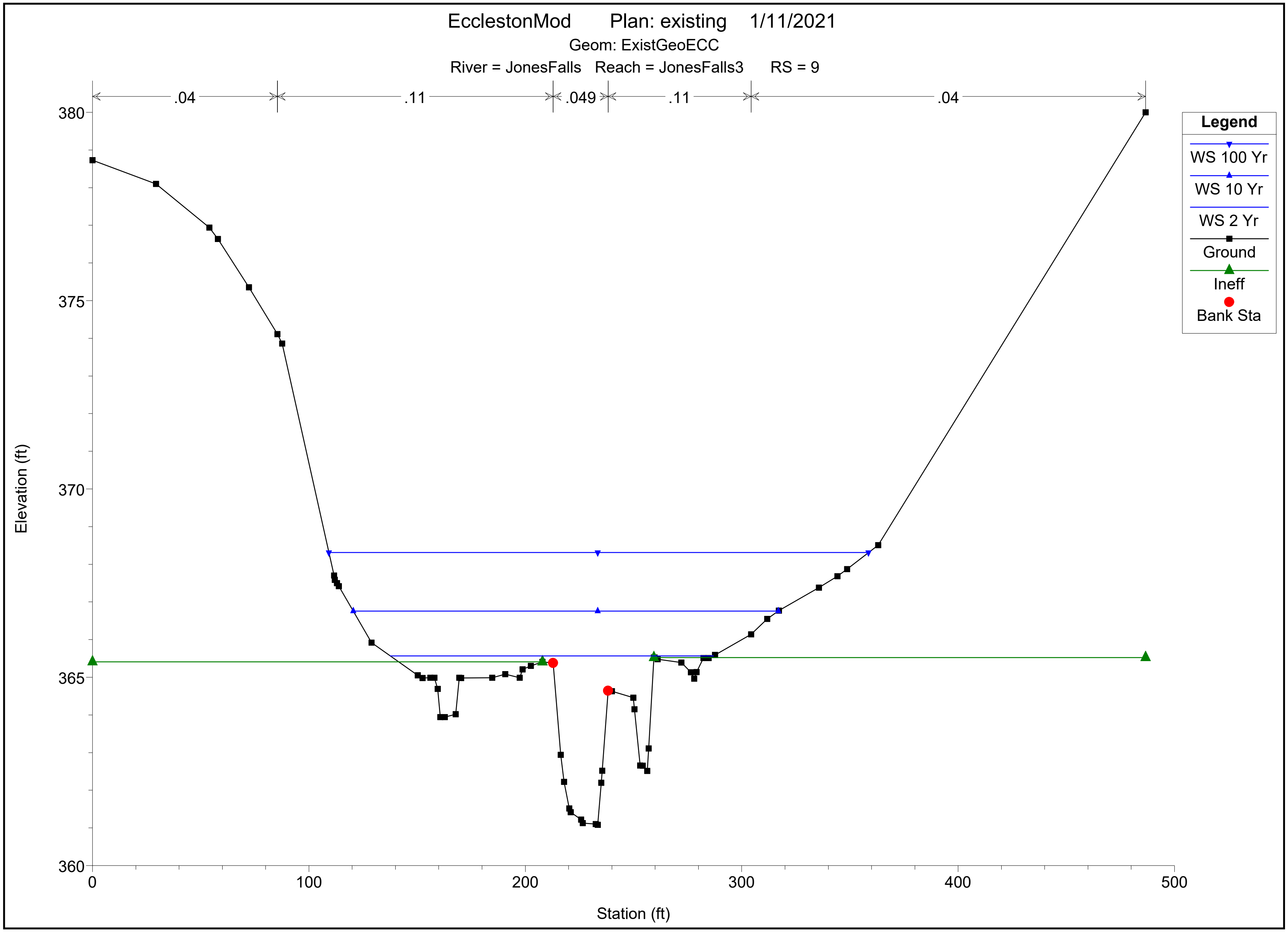

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 2
.045
.046
.045
.013
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
374
372
370
368
366
364
362
0
50
100
150
200
250
300
350

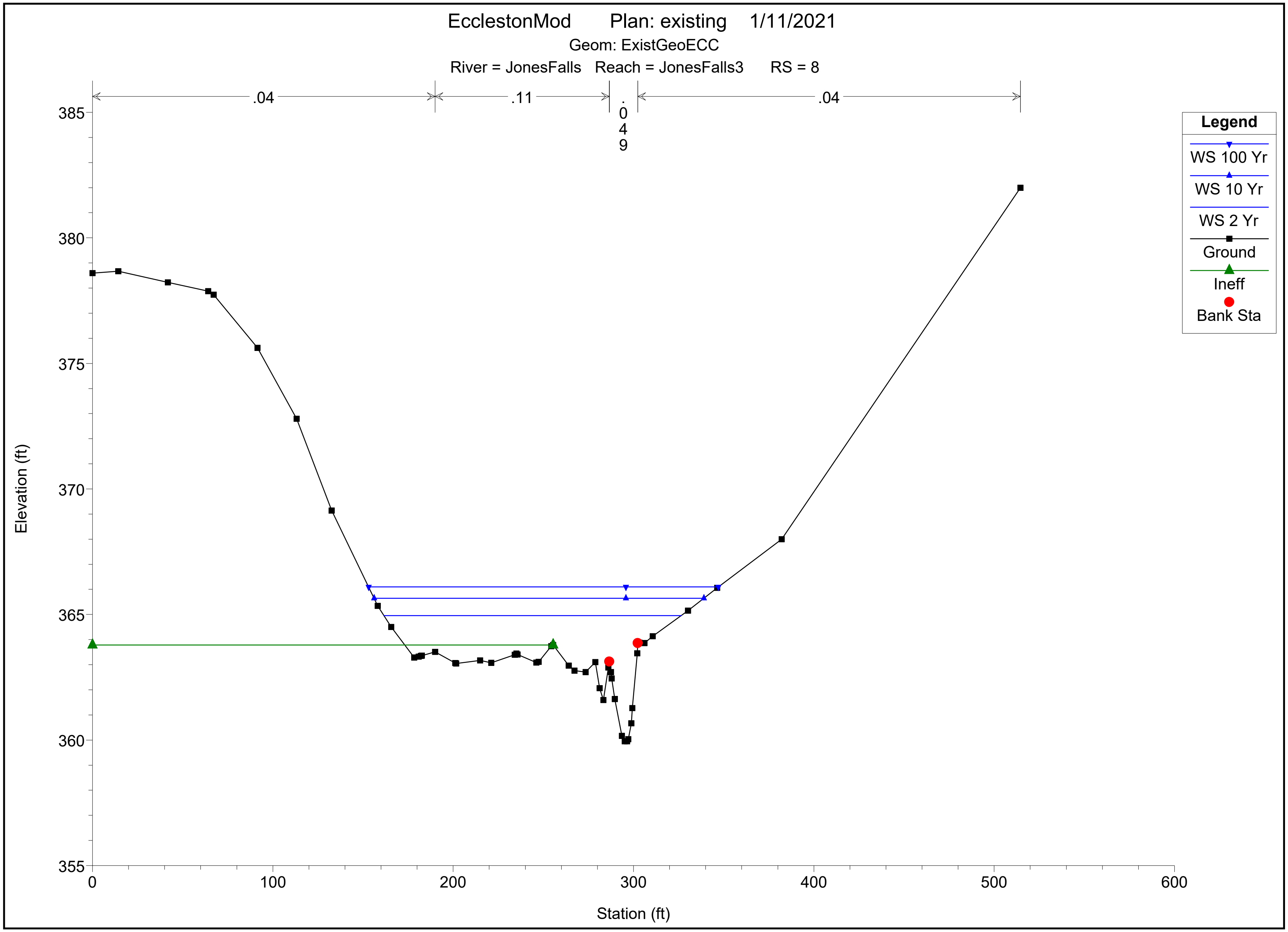


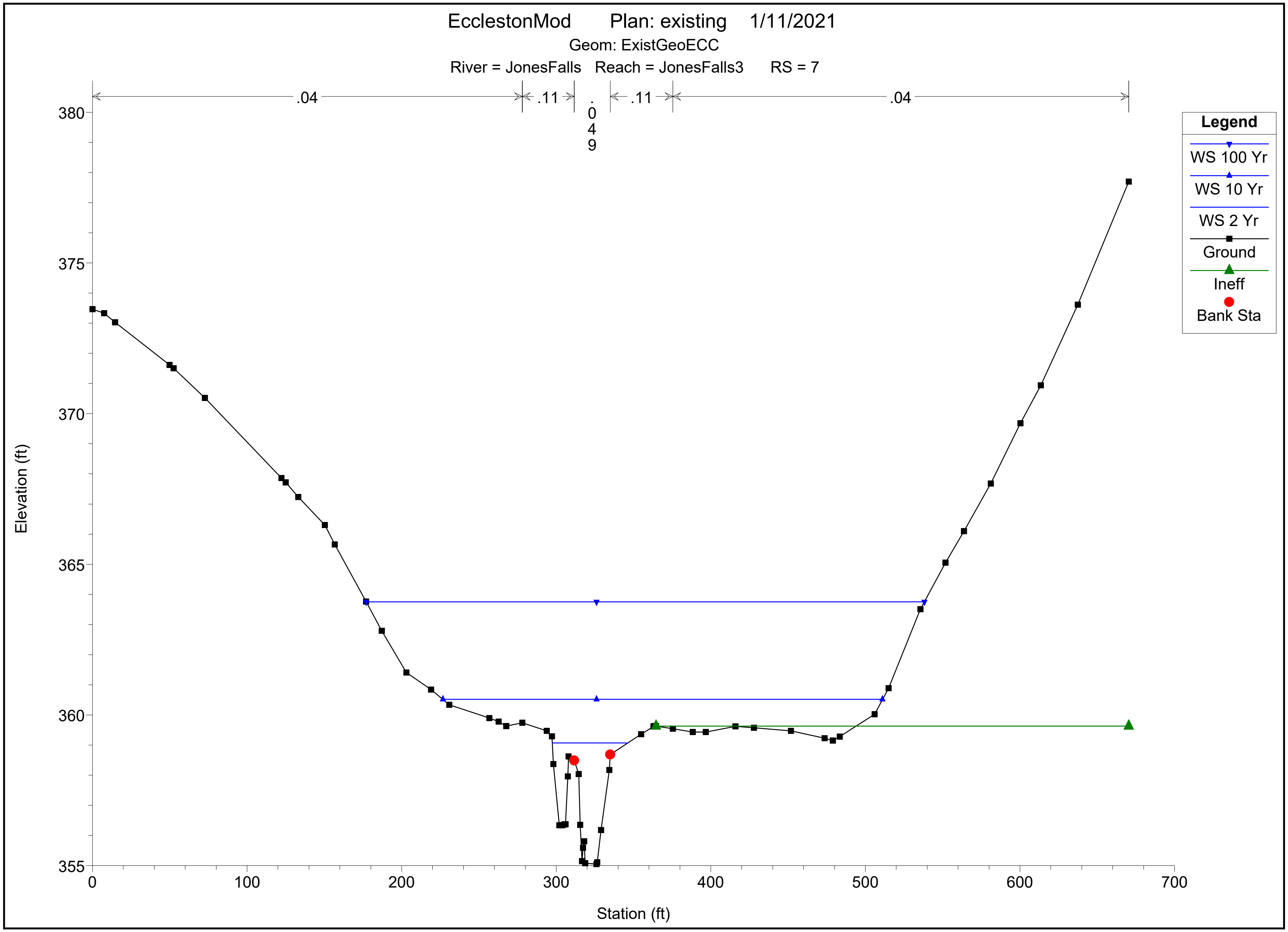
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = IntsTrib RS = 1
.04
.046
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
372
370
368
366
364
362
360
0
50
100
150
200
250
300
350
400
Station (ft)

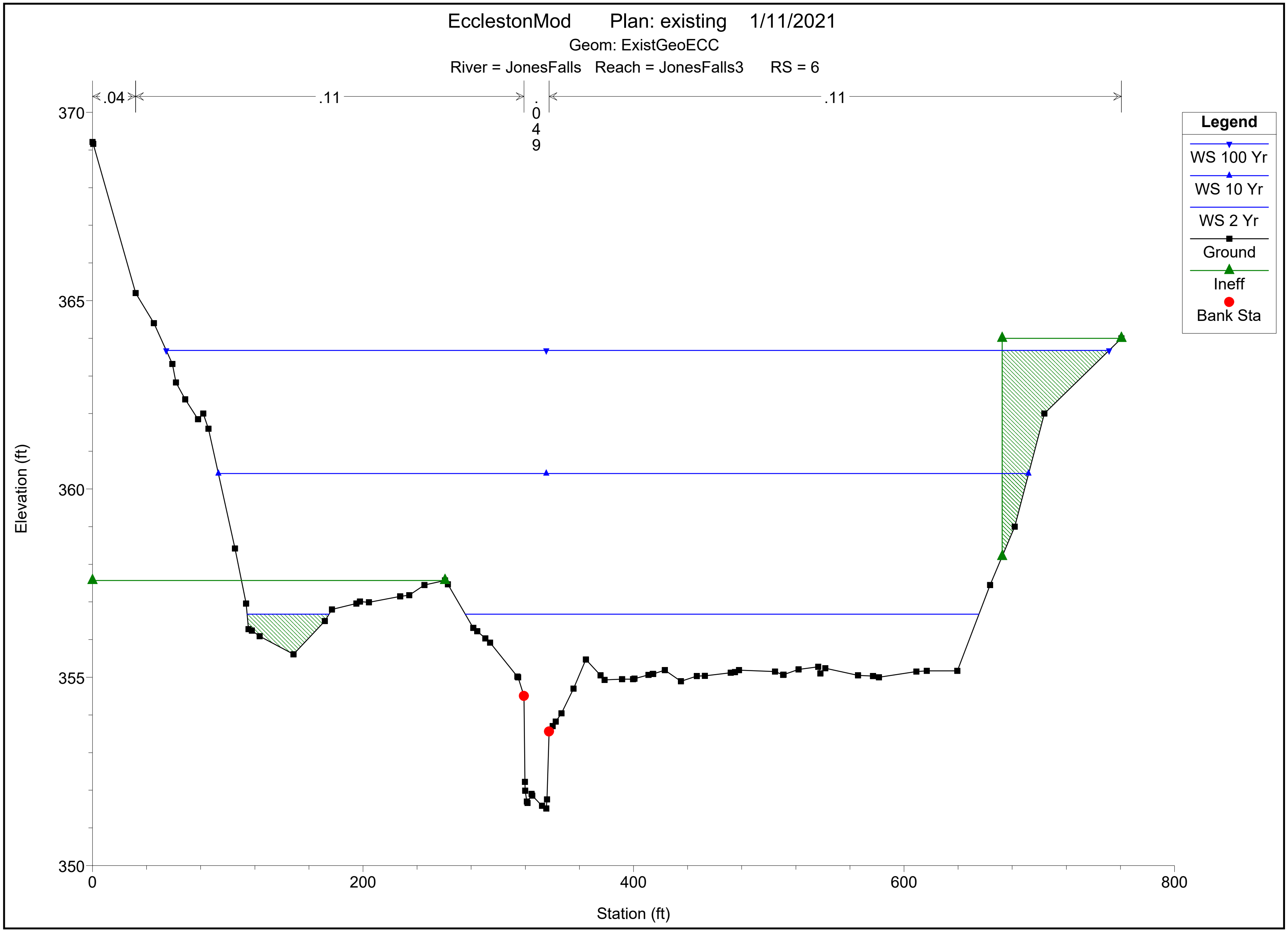


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 10
.04
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
380
378
376
374
372
370
368
366
364
362
0
100
200
300
400
500
Station (ft)

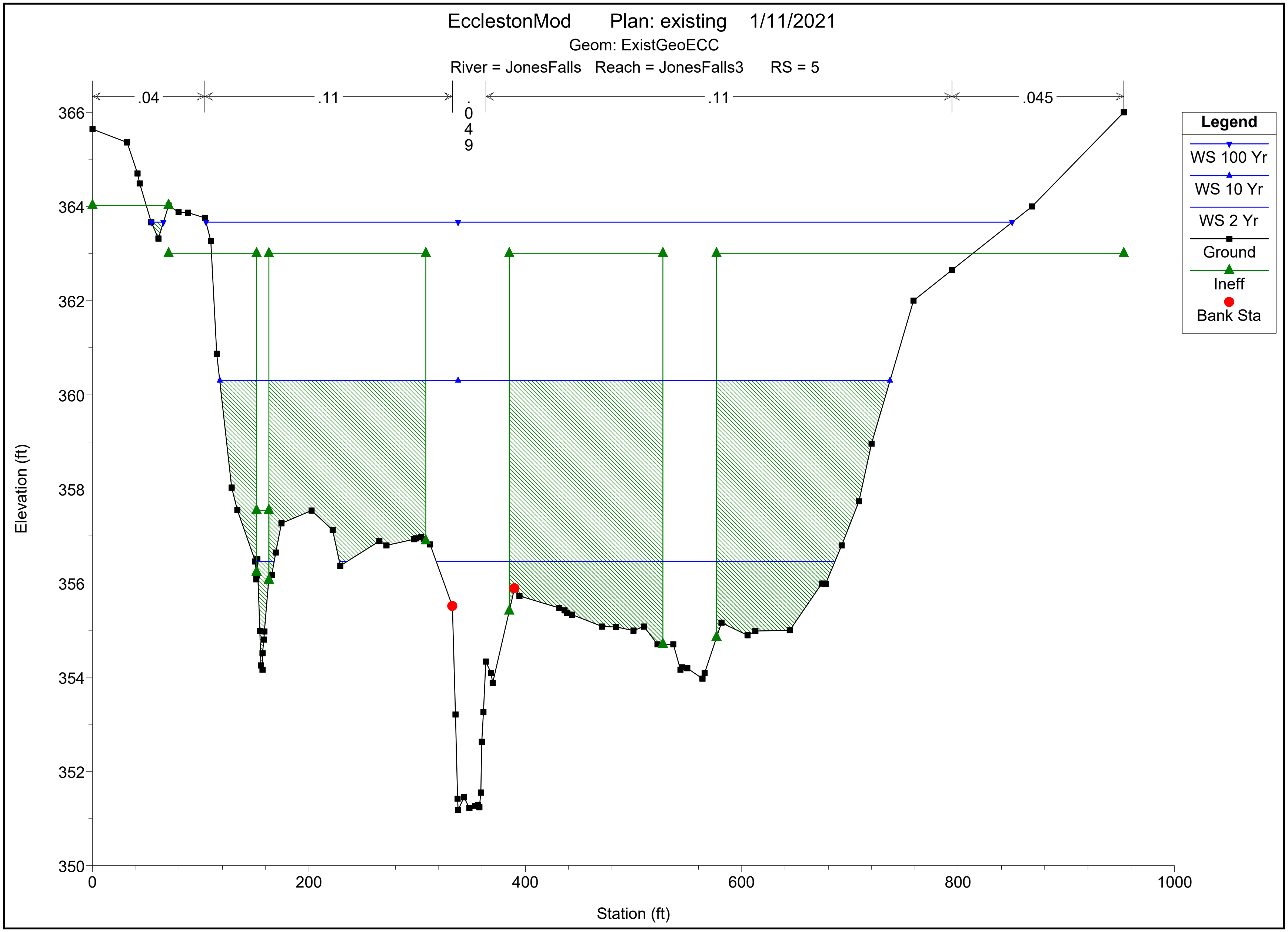

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 9
.04
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
380
375
370
365
360
0
100
200
300
400
500
Station (ft)


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 8
.04
.11
.049
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
385
380
375
370
365
360
355
0
100
200
300
400
500
600
Station (ft)

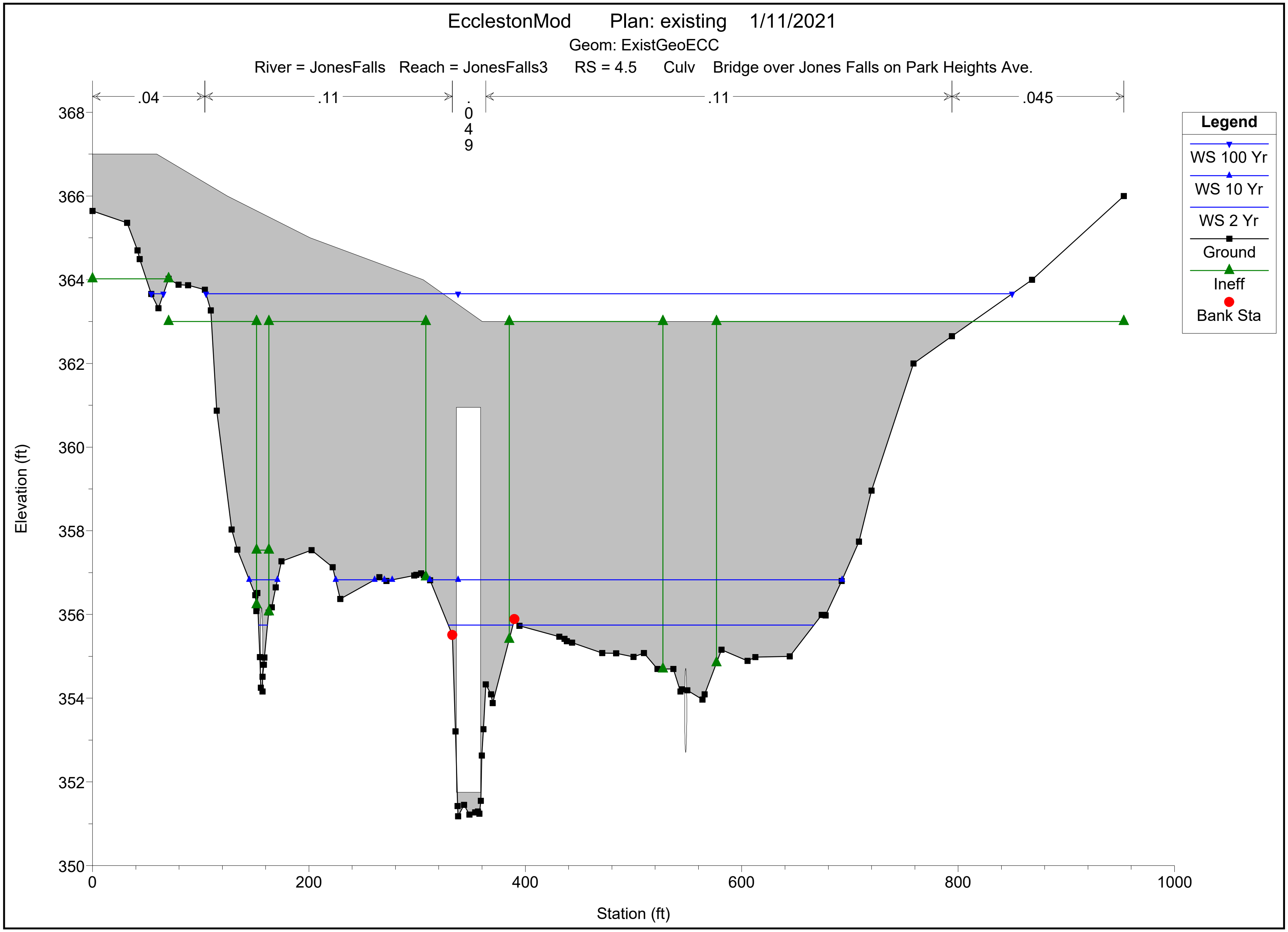

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 7
.04
.11
.
0
4
9
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
380
375
370
365
360
355
0
100
200
300
400
500
600
700

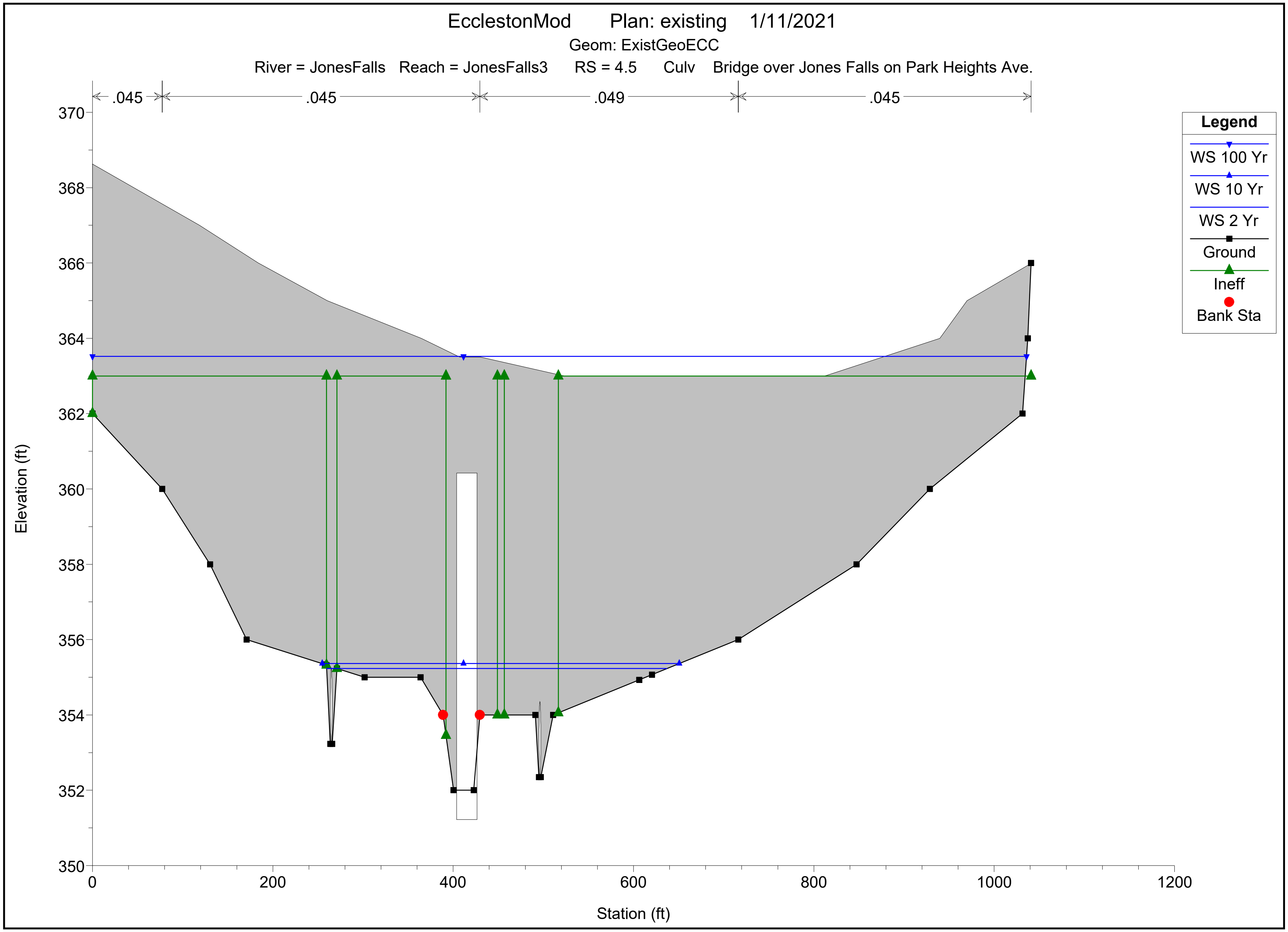


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 6
.04
.11
.049
.11
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
370
365
360
355
350
0
200
400
600
800

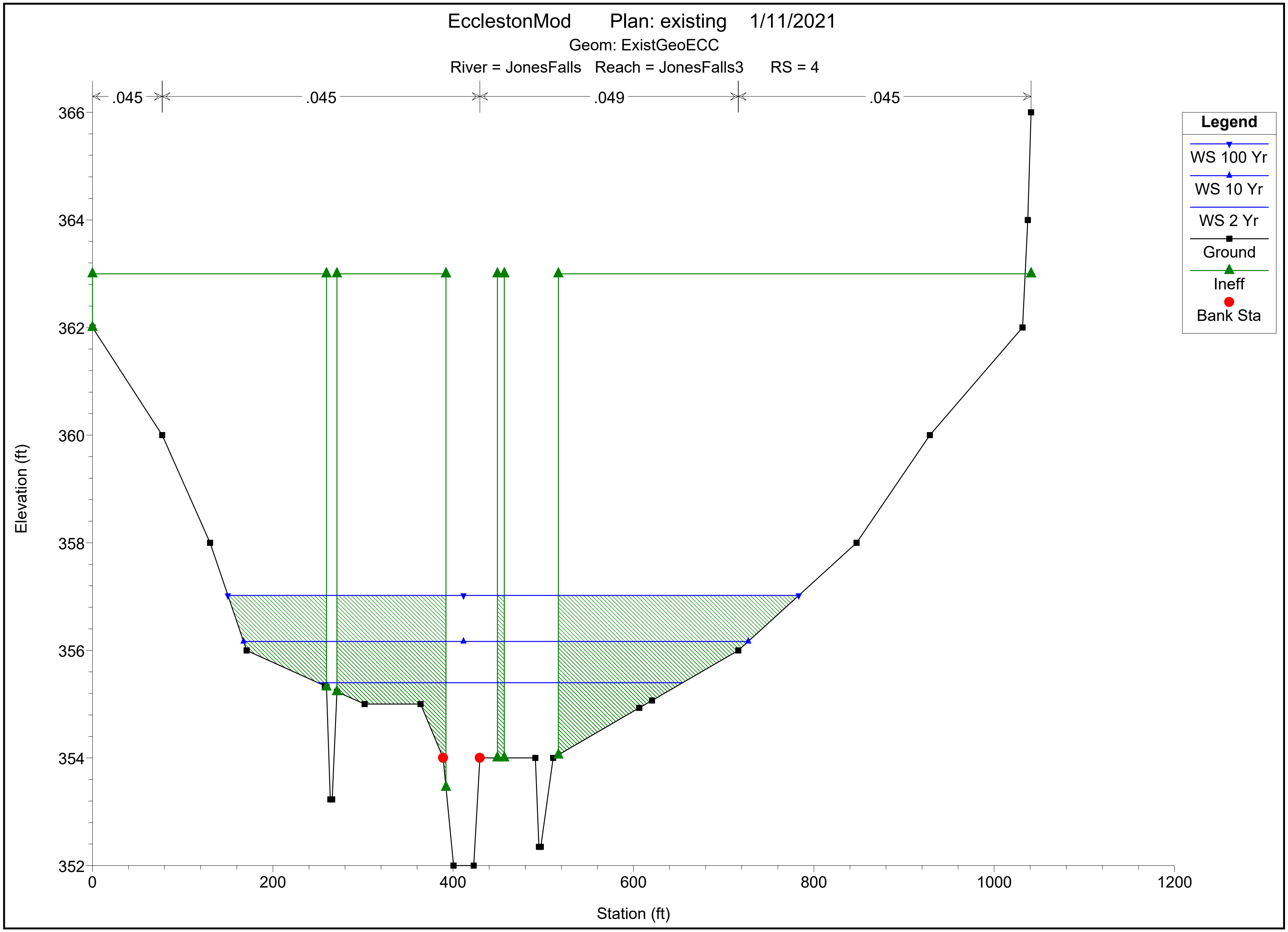


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 5
.04
.11
.049
.11
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
366
364
362
360
358
356
354
352
350
0
200
400
600
800
1000
Station (ft)

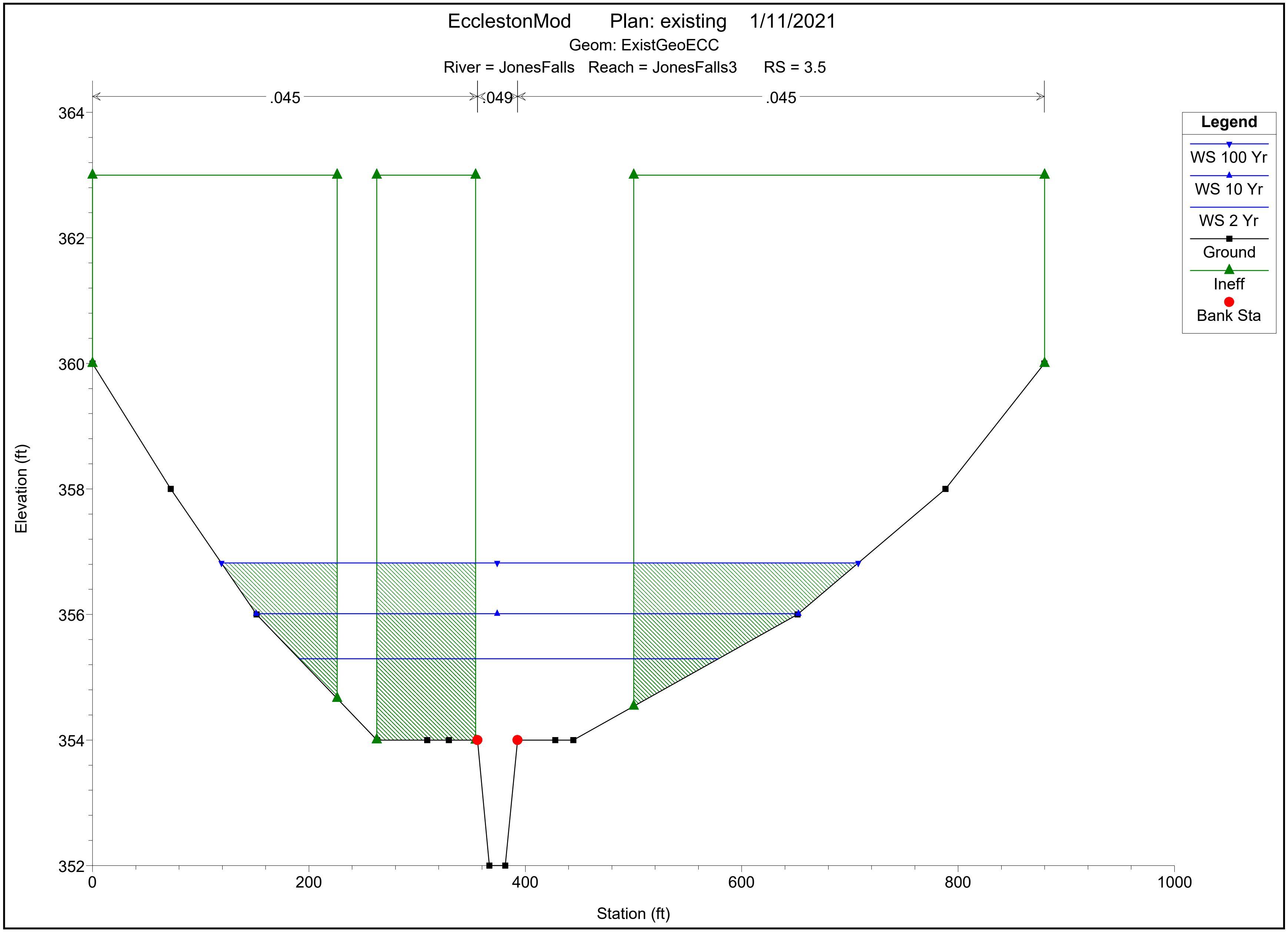

EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 4.5 Culv Bridge over Jones Falls on Park Heights Ave.
.04
.11
.049
.11
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
368
366
364
362
360
358
356
354
352
350
0
200
400
600
800
1000



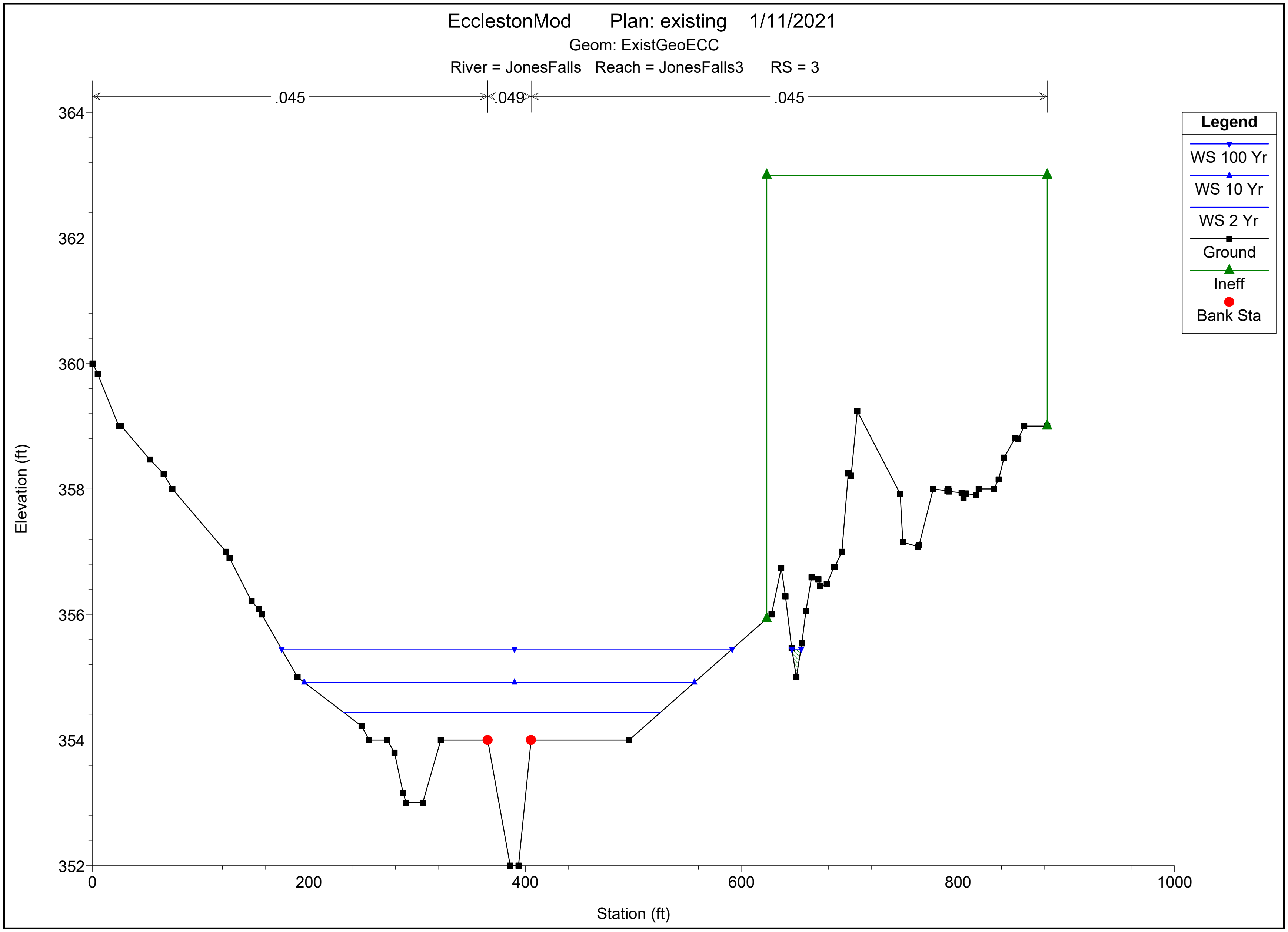
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 4.5 Culv Bridge over Jones Falls on Park Heights Ave.
.045
.045
.049
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
370
368
366
364
362
360
358
356
354
352
350
0
200
400
600
800
1000
1200



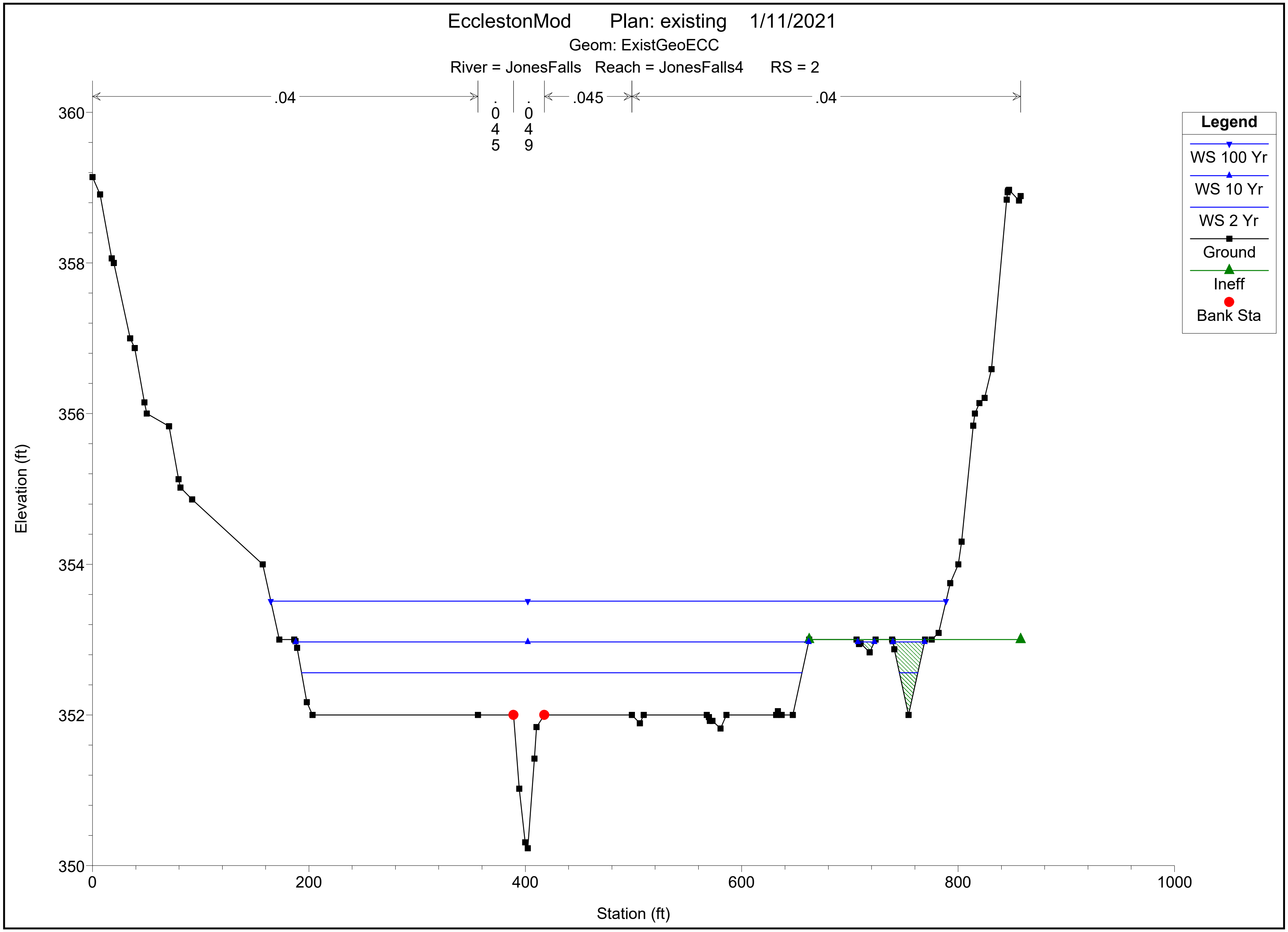
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 4
.045
.045
.049
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
366
364
362
360
358
356
354
352
0
200
400
600
800
1000
1200



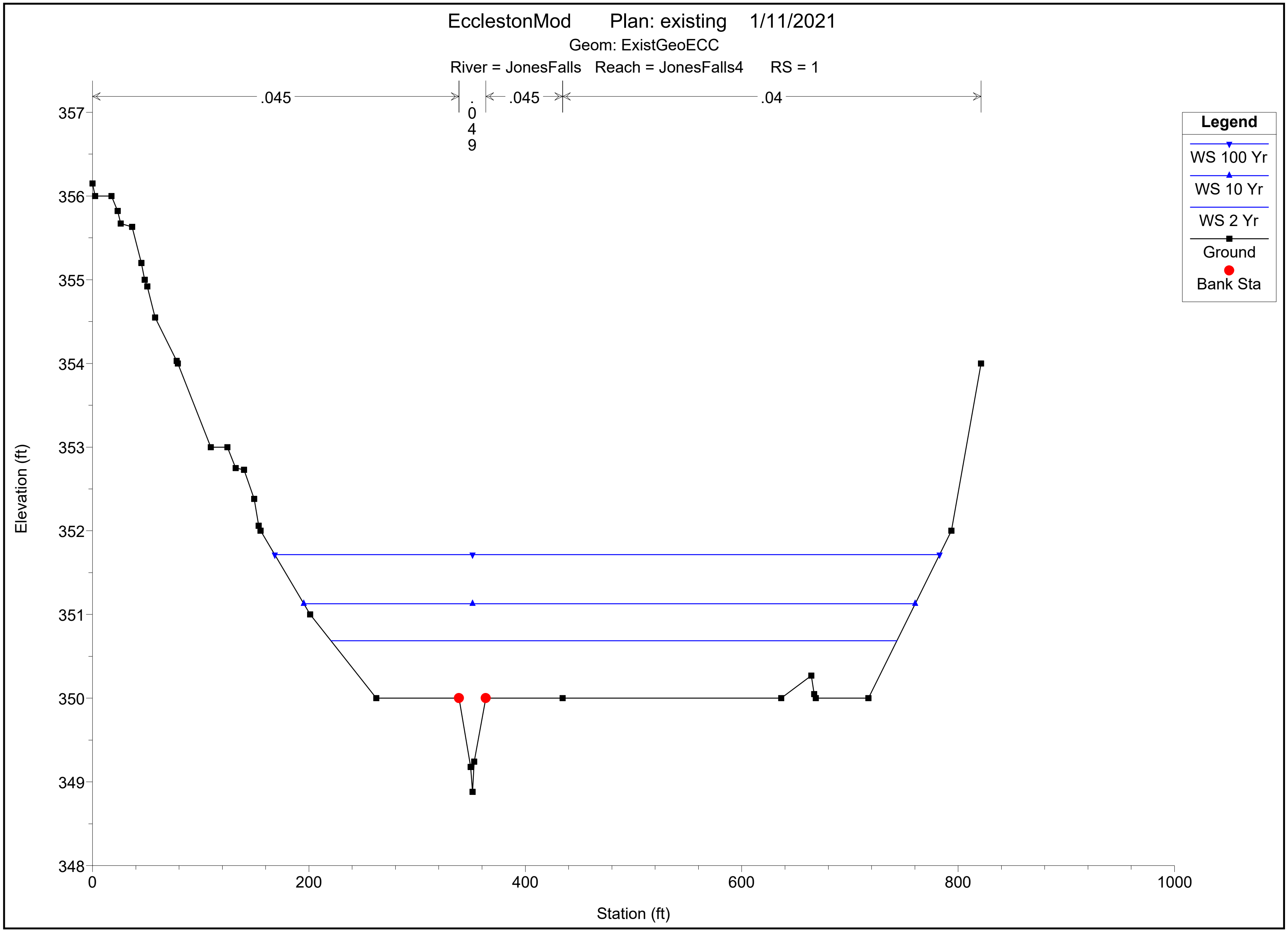
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 3.5
.045
.049
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
364
362
360
358
356
354
352
0
200
400
600
800
1000
Station (ft)



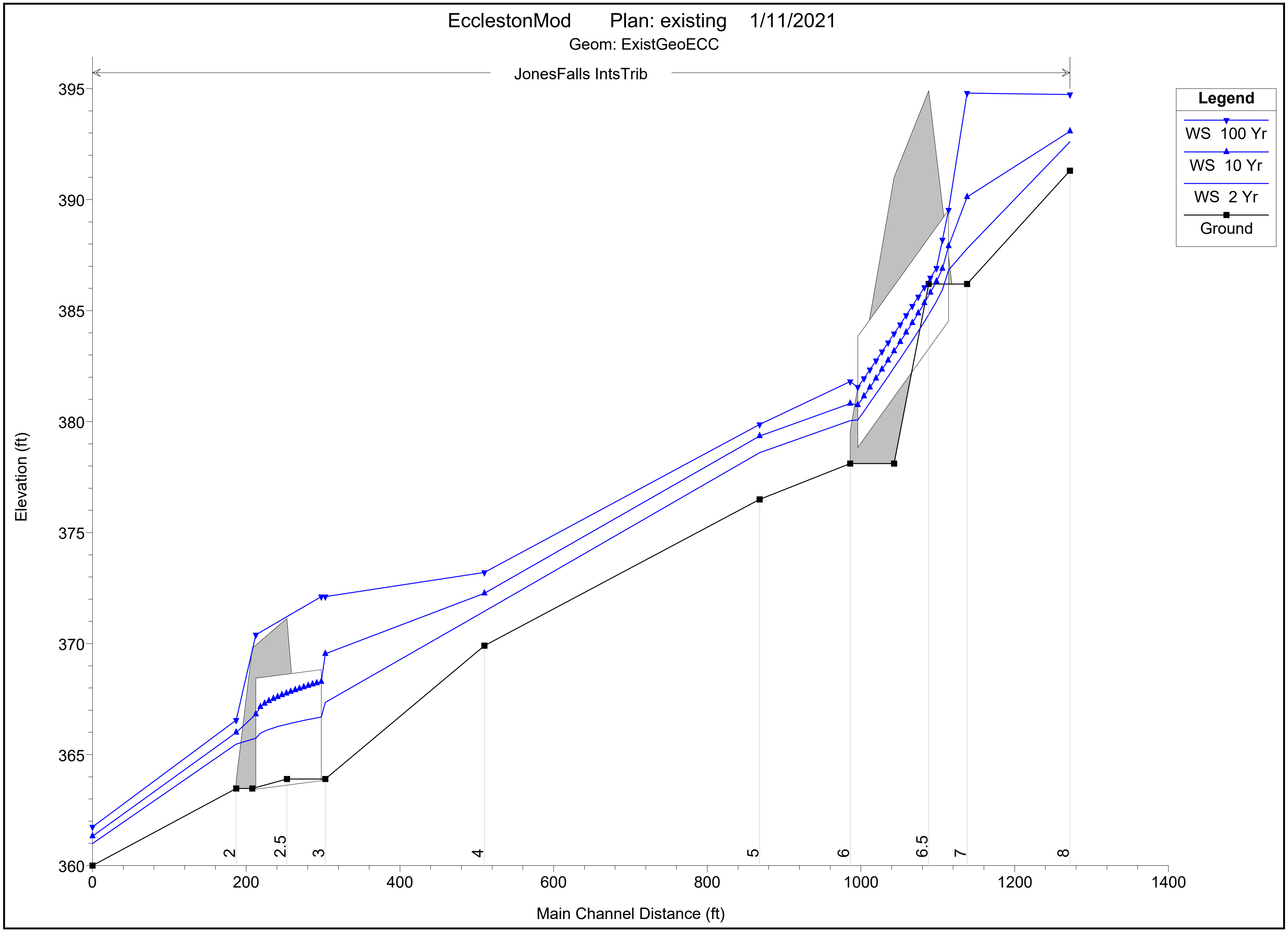
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls3 RS = 3
.045
.049
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
364
362
360
358
356
354
352
0
200
400
600
800
1000

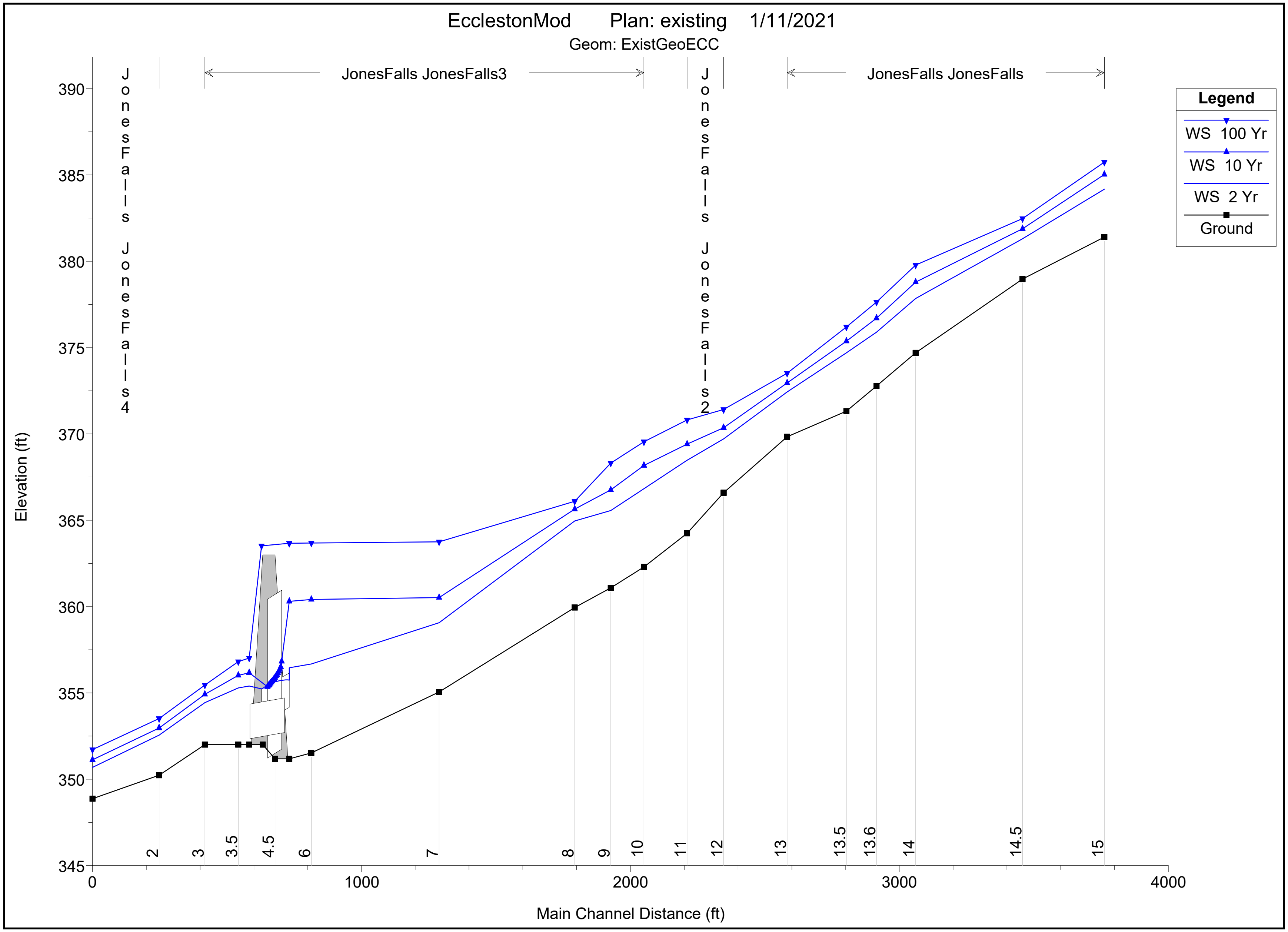


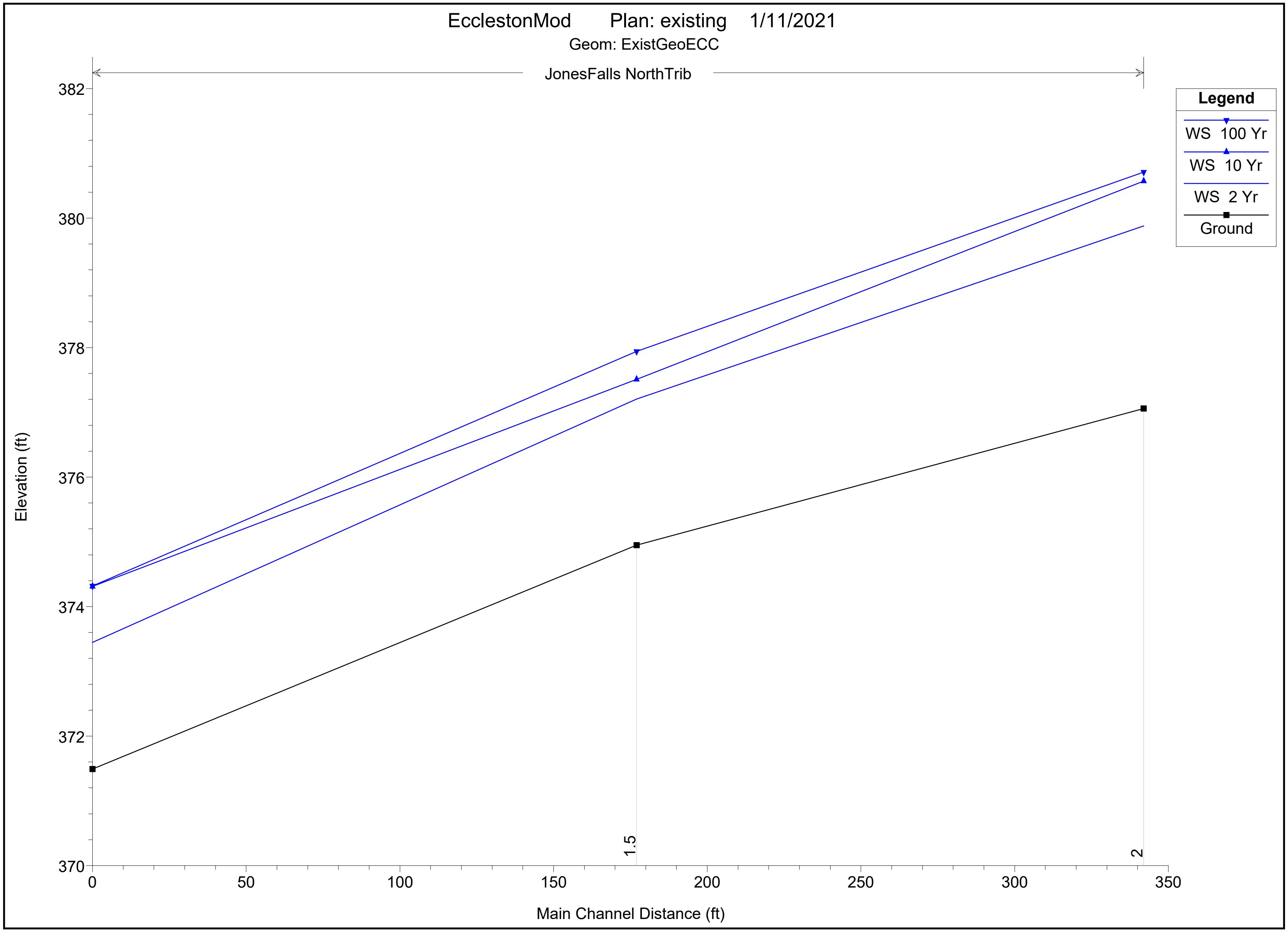
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls4 RS = 2
.04
.045
.049
.045
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
360
358
356
354
352
350
0
200
400
600
800
1000



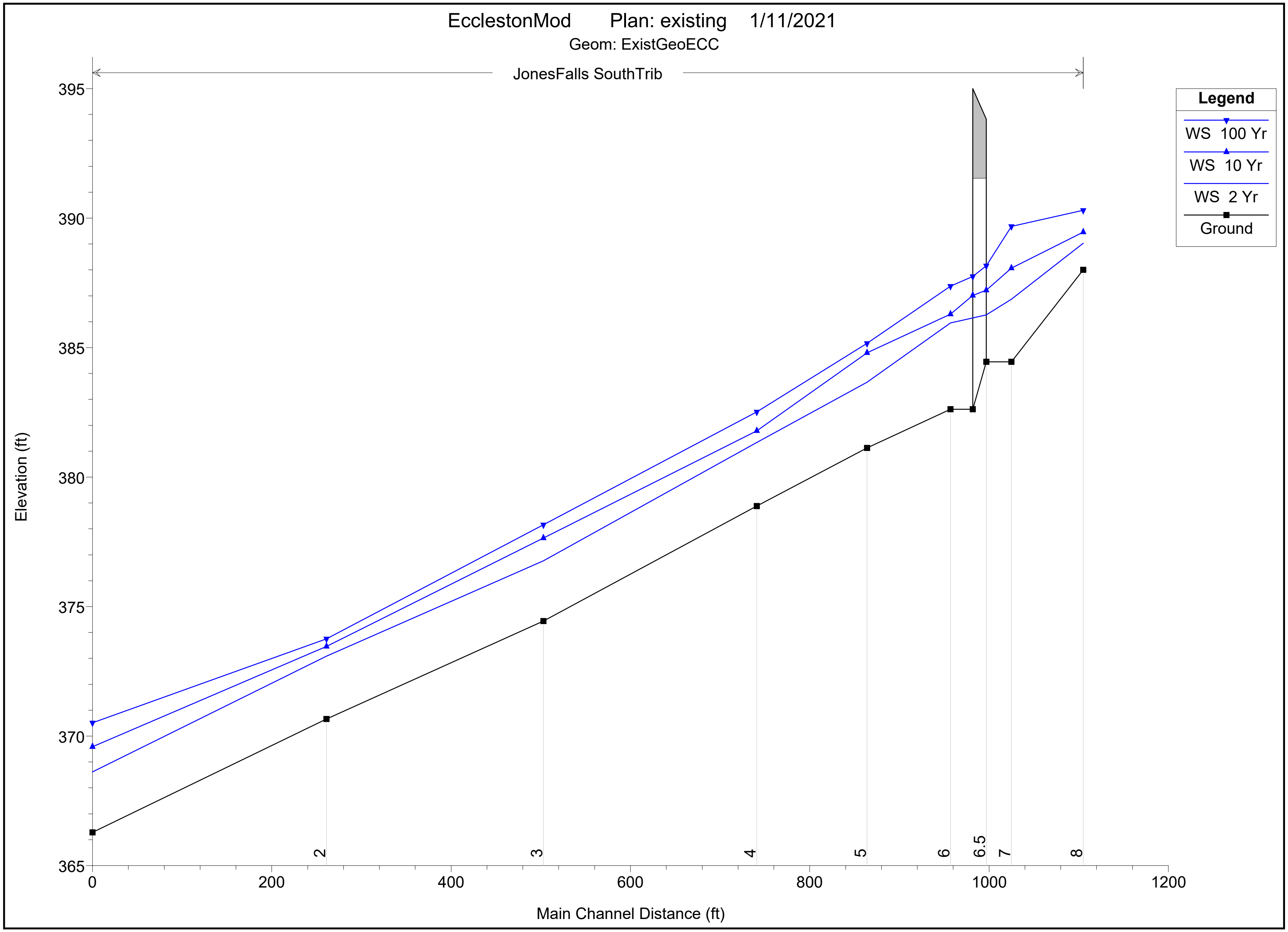
EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
River = JonesFalls Reach = JonesFalls4 RS = 1
.045
.049
.045
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
357
356
355
354
353
352
351
350
349
348
0
200
400
600
800
1000
Station (ft)


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
JonesFalls IntsTrib
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Elevation (ft)
Main Channel Distance (ft)
360
365
370
375
380
385
390
395
0
200
400
600
800
1000
1200
1400
2
2.5
3
4
5
6
6.5
7
8


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
JonesFalls JonesFalls4
JonesFalls JonesFalls3
JonesFalls JonesFalls2
JonesFalls JonesFalls
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Elevation (ft)
Main Channel Distance (ft)
390
385
380
375
370
365
360
355
350
345
0
1000
2000
3000
4000
2
3
3.5
4.5
6
7
8
9
10
11
12
13
13.5
13.6
14
14.5
15



EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
JonesFalls NorthTrib
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Elevation (ft)
382
380
378
376
374
372
370
0
50
100
150
200
250
300
350
1.5
2
Main Channel Distance (ft)


EcclestonMod Plan: existing 1/11/2021
Geom: ExistGeoECC
JonesFalls SouthTrib
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Elevation (ft)
395
390
385
380
375
370
365
0
200
400
600
800
1000
1200
Main Channel Distance (ft)
2
3
4
5
6
6.5
7
8

HEC-RAS Plan: existing

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	Flow Area	Top Width	Froude # Chl	Shear Total	Shear Chan	Shear LOB	Shear ROB	Vel Total	Vel Chnl	Vel Left	Vel Right
			(cfs)	(ft)	(ft)	(ft)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
JonesFalls	15	2 Yr	363.30	381.40	384.17	383.83	139.48	136.40	0.56	0.58	1.27	0.46	0.54	2.60	4.96	1.12	2.76
JonesFalls	15	10 Yr	798.40	381.40	385.03	384.51	278.02	359.68	0.60	0.87	1.76	0.75	0.85	2.87	6.14	1.55	3.22
JonesFalls	15	100 Yr	1593.40	381.40	385.74	385.28	634.23	440.54	0.62	0.83	2.16	1.06	0.67	2.51	7.02	1.95	2.13
JonesFalls	14.5	2 Yr	363.30	378.97	381.30	380.96	199.86	236.31	0.58	0.58	0.94	0.30	0.63	1.82	3.95	0.82	1.35
JonesFalls	14.5	10 Yr	798.40	378.97	381.88	381.42	342.69	378.62	0.66	0.99	1.54	0.73	1.00	2.33	5.34	1.44	1.79
JonesFalls	14.5	100 Yr	1593.40	378.97	382.47	382.00	632.33	456.61	0.70	1.11	2.07	1.13	1.02	2.52	6.46	1.92	2.00
JonesFalls	14	2 Yr	363.30	374.70	377.85	377.63	191.16	206.05	0.54	0.49	1.17	0.32	0.45	1.90	4.76	0.89	1.12
JonesFalls	14	10 Yr	798.40	374.70	378.79	378.14	446.32	352.77	0.51	0.55	1.28	0.57	0.49	1.79	5.25	1.37	1.23
JonesFalls	14	100 Yr	1593.40	374.70	379.78	378.73	846.33	427.70	0.48	0.65	1.35	0.49	0.67	1.88	5.64	1.28	1.57
JonesFalls	13.6	2 Yr	363.30	372.77	375.90	375.90	108.21	113.34	0.73	0.90	2.20	0.40	0.66	3.36	6.55	0.94	1.30
JonesFalls	13.6	10 Yr	798.40	372.77	376.70	376.70	214.72	157.95	0.84	1.53	3.49	0.89	1.30	3.72	8.64	1.55	1.99
JonesFalls	13.6	100 Yr	1593.40	372.77	377.64	377.64	390.80	216.73	0.91	2.21	4.86	1.50	1.98	4.08	10.63	2.16	2.61
JonesFalls	13.5	2 Yr	363.30	371.32	374.69	374.33	130.61	149.40	0.48	0.34	0.90	0.26	0.18	2.78	4.20	2.22	0.64
JonesFalls	13.5	10 Yr	798.40	371.32	375.37	374.97	240.71	174.79	0.51	0.56	1.22	0.52	0.38	3.32	5.09	3.36	1.04
JonesFalls	13.5	100 Yr	1593.40	371.32	376.19	375.61	397.04	211.20	0.55	0.83	1.67	0.84	0.59	4.01	6.19	4.59	1.37
JonesFalls	13	2 Yr	363.30	369.84	372.43	372.43	105.88	141.36	0.76	0.83	1.73	0.58	0.28	3.43	5.44	1.79	1.97
JonesFalls	13	10 Yr	798.40	369.84	372.95	372.95	187.75	174.11	0.83	1.29	2.48	1.05	0.44	4.25	6.83	2.94	2.63
JonesFalls	13	100 Yr	1593.40	369.84	373.52	373.52	293.48	205.02	0.91	1.94	3.53	1.72	0.84	5.43	8.47	4.29	3.97
NorthTrib	2	2 Yr	175.50	377.06	379.88	379.88	30.02	143.82	0.81	2.23	3.44		0.55	5.85	6.20		2.79
NorthTrib	2	10 Yr	459.70	377.06	380.57	380.57	231.31	206.33	0.27	0.24	0.46	0.22	0.18	1.99	2.39	1.91	1.92
NorthTrib	2	100 Yr	1025.90	377.06	380.71	380.58	260.69	209.16	0.51	0.93	1.74	0.87	0.71	3.94	4.67	3.80	3.92
NorthTrib	1.5	2 Yr	175.50	374.95	377.21	376.91	75.33	175.38	0.44	0.29	1.01	0.14	0.38	2.33	3.41	0.50	2.72
NorthTrib	1.5	10 Yr	459.70	374.95	377.51	377.51	142.43	236.79	0.64	0.69	2.38	0.46	0.96	3.23	5.37	1.32	4.47
NorthTrib	1.5	100 Yr	1025.90	374.95	377.94	377.94	254.11	276.51	0.71	1.22	3.31	1.02	1.41	4.04	6.52	2.40	5.64
NorthTrib	1	2 Yr	175.50	371.49	373.45	373.45	27.89	125.49	1.00	3.94	3.94			6.29	6.29		
NorthTrib	1	10 Yr	459.70	371.49	374.31	374.31	212.41	208.10	0.28	0.24	0.44	0.04	0.21	2.16	2.28	0.27	2.14
NorthTrib	1	100 Yr	1025.90	371.49	374.32	374.32	213.96	208.36	0.63	1.17	2.17	0.21	1.05	4.79	5.04	0.60	4.74
JonesFalls2	12	2 Yr	538.80	366.60	369.72	369.47	252.74	311.28	0.46	0.31	0.81	0.28	0.16	2.13	3.90	1.70	0.60
JonesFalls2	12	10 Yr	1258.10	366.60	370.36		467.36	345.23	0.48	0.51	1.02	0.50	0.29	2.69	4.57	2.52	0.88
JonesFalls2	12	100 Yr	2619.30	366.60	371.42		869.68	419.98	0.44	0.58	1.04	0.60	0.36	3.01	4.87	3.09	1.09
JonesFalls2	11	2 Yr	538.80	364.25	368.48	368.48	182.58	225.79	0.62	0.54	1.68	0.38	0.47	2.95	5.79	1.43	1.10
JonesFalls2	11	10 Yr	1258.10	364.25	369.41	369.04	415.18	276.22	0.57	0.78	1.75	0.72	0.53	3.03	6.19	2.39	1.24
JonesFalls2	11	100 Yr	2619.30	364.25	370.81	369.78	851.47	349.70	0.48	0.80	1.53	0.82	0.58	3.08	6.13	2.92	1.42
SouthTrib	8	2 Yr	151.70	388.00	389.03	389.03	34.45	57.16	1.00	2.11	2.11			4.40	4.40		
SouthTrib	8	10 Yr	322.20	388.00	389.46	389.46	63.03	76.80	0.99	2.57	2.57			5.11	5.11		
SouthTrib	8	100 Yr	622.10	388.00	390.30	389.94	147.54	139.26	0.65	1.17	1.55	0.17	0.16	4.22	4.33	1.24	1.24
SouthTrib	7	2 Yr	151.70	384.45	386.87	385.94	48.49	31.81	0.42	0.75	0.75			3.13	3.13		
SouthTrib	7	10 Yr	322.20	384.45	388.06	386.70	86.68	42.04	0.41	0.90	0.94		0.11	3.72	3.73		1.14
SouthTrib	7	100 Yr	622.10	384.45	389.68	387.69	143.40	51.54	0.38	1.06	1.09		0.50	4.34	4.36		3.28
SouthTrib	6.5		Bridge														
SouthTrib	6	2 Yr	151.70	382.62	385.95	384.86	40.81	18.22	0.44	1.00	1.00			3.72	3.72		
SouthTrib	6	10 Yr	322.20	382.62	386.29	385.83	47.16	19.08	0.76	3.28	3.29			6.83	6.83		0.27
SouthTrib	6	100 Yr	622.10	382.62	387.37	387.37	92.00	88.34	0.73	2.08	3.83	0.93	0.59	6.76	7.82	3.85	2.24

HEC-RAS Plan: existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	Flow Area	Top Width	Froude # Chl	Shear Total	Shear Chan	Shear LOB	Shear ROB	Vel Total	Vel Chnl	Vel Left	Vel Right
			(cfs)	(ft)	(ft)	(ft)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
SouthTrib	5	2 Yr	151.70	381.13	383.66	383.66	20.82	16.21	1.00	4.34	4.34			7.28	7.28		
SouthTrib	5	10 Yr	322.20	381.13	384.80	384.80	84.68	107.81	0.59	0.68	2.06	0.46	0.48	3.81	5.45	2.59	2.63
SouthTrib	5	100 Yr	622.10	381.13	385.16	385.16	125.97	117.38	0.68	1.21	3.04	0.95	0.88	4.94	6.76	4.10	3.74
SouthTrib	4	2 Yr	151.70	378.88	381.33	380.62	42.99	46.96	0.51	0.62	1.08	0.18	0.05	3.53	3.69	1.59	0.50
SouthTrib	4	10 Yr	322.20	378.88	381.79	381.60	66.03	55.43	0.68	1.32	2.26	0.44	0.57	4.88	5.56	2.66	2.21
SouthTrib	4	100 Yr	622.10	378.88	382.52	382.23	122.40	136.79	0.71	0.98	2.99	0.83	0.43	5.08	6.74	4.07	2.25
SouthTrib	3	2 Yr	151.70	374.44	376.77	376.77	28.02	37.79	0.84	1.50	3.13	0.26	0.48	5.41	6.34	1.74	0.94
SouthTrib	3	10 Yr	322.20	374.44	377.65	377.65	90.10	106.62	0.66	0.88	2.59	0.61	0.62	3.58	6.16	3.36	1.62
SouthTrib	3	100 Yr	622.10	374.44	378.16	378.16	148.71	122.45	0.73	1.44	3.53	1.01	1.23	4.18	7.41	4.60	2.50
SouthTrib	2	2 Yr	151.70	370.66	373.09		76.50	116.32	0.41	0.29	0.68	0.26	0.04	1.98	2.92	1.54	0.60
SouthTrib	2	10 Yr	322.20	370.66	373.46		127.06	161.84	0.49	0.47	1.13	0.47	0.16	2.54	3.90	2.16	1.50
SouthTrib	2	100 Yr	622.10	370.66	373.76	373.55	182.66	206.71	0.62	0.81	1.99	0.86	0.37	3.41	5.28	3.04	2.47
SouthTrib	1	2 Yr	151.70	366.28	368.61	368.61	23.58	20.20	1.00	3.33	3.55	0.03		6.43	6.44	0.15	
SouthTrib	1	10 Yr	322.20	366.28	369.59	369.59	100.09	135.21	0.72	0.96	2.45	0.74	0.49	3.22	5.73	1.34	1.02
SouthTrib	1	100 Yr	622.10	366.28	370.51	370.10	265.52	232.30	0.55	0.75	1.81	0.61	0.66	2.34	5.26	1.40	1.40
IntsTrib	8	2 Yr	66.30	391.30	392.61	392.61	14.04	20.65	1.01	1.52	1.52			4.72	4.72		
IntsTrib	8	10 Yr	138.90	391.30	393.07	393.07	25.18	27.38	1.01	1.88	1.88			5.52	5.52		
IntsTrib	8	100 Yr	261.20	391.30	394.73		100.24	78.31	0.35	0.23	0.39	0.07	0.07	2.61	2.87	0.91	0.91
IntsTrib	7	2 Yr	66.30	386.20	387.79	387.79	11.70	12.59	0.93	1.58	2.01		0.27	5.67	5.85		1.54
IntsTrib	7	10 Yr	138.90	386.20	390.11	388.54	86.64	58.39	0.20	0.09	0.19	0.04	0.08	1.60	2.17	0.88	1.35
IntsTrib	7	100 Yr	261.20	386.20	394.80	389.18	464.96	269.56	0.04	0.01	0.02	0.01	0.01	0.56	0.71	0.60	0.51
IntsTrib	6.5		Culvert														
IntsTrib	6	2 Yr	66.30	378.11	380.04	379.71	14.21	14.15	0.68	1.15	1.15			4.67	4.67		
IntsTrib	6	10 Yr	138.90	378.11	380.82	380.43	21.70	16.29	0.75	1.89	1.89			6.40	6.40		
IntsTrib	6	100 Yr	261.20	378.11	381.80	381.40	31.25	18.98	0.82	2.85	2.85			8.36	8.36		
IntsTrib	5	2 Yr	66.30	376.50	378.60	378.21	16.12	12.60	0.64	0.92	0.92			4.11	4.11		
IntsTrib	5	10 Yr	138.90	376.50	379.35	378.91	26.76	15.42	0.69	1.30	1.30			5.19	5.19		
IntsTrib	5	100 Yr	261.20	376.50	379.88	379.73	35.29	17.21	0.91	2.48	2.48			7.40	7.40		
IntsTrib	4	2 Yr	66.30	369.90	371.45	371.45	11.27	10.56	1.00	2.07	2.07			5.88	5.88		
IntsTrib	4	10 Yr	138.90	369.90	372.27	372.27	21.22	15.81	1.00	2.38	2.38			6.54	6.54		
IntsTrib	4	100 Yr	261.20	369.90	373.21	373.21	46.02	44.12	0.80	1.10	1.92	0.30	0.11	5.68	6.23	2.06	0.93
IntsTrib	3	2 Yr	66.30	363.90	367.36	366.19	27.39	25.28	0.34	0.31	0.31			2.42	2.42		
IntsTrib	3	10 Yr	138.90	363.90	369.54	366.96	74.25	109.70	0.18	0.14	0.14			1.87	1.87		
IntsTrib	3	100 Yr	261.20	363.90	372.12	367.77	609.36	280.76	0.05	0.01	0.01	0.00	0.01	0.43	0.63	0.27	0.40
IntsTrib	2.5		Culvert														
IntsTrib	2	2 Yr	66.30	363.47	365.47	365.19	14.87	17.64	0.68	0.78	1.36		0.24	4.46	5.00		1.60
IntsTrib	2	10 Yr	138.90	363.47	365.99	365.99	25.77	74.16	0.78	1.38	2.06		0.87	5.39	6.36		3.65
IntsTrib	2	100 Yr	261.20	363.47	366.55	366.55	37.97	102.29	0.85	2.20	2.89	0.60	1.75	6.88	7.84	2.82	5.73
IntsTrib	1	2 Yr	66.30	360.00	360.99	360.99	16.55	33.41	1.00	1.21	1.21			4.01	4.01		
IntsTrib	1	10 Yr	138.90	360.00	361.32	361.32	28.89	40.42	0.98	1.42	1.55		0.32	4.81	4.88		1.75
IntsTrib	1	100 Yr	261.20	360.00	361.74	361.74	47.53	49.02	0.95	1.64	1.89		0.63	5.50	5.71		2.80
JonesFalls3	10	2 Yr	655.40	362.30	366.83	365.98	192.07	177.03	0.54	0.59	1.33	0.36	0.21	3.41	5.24	0.98	0.69
JonesFalls3	10	10 Yr	1520.50	362.30	368.18	367.49	523.94	263.18	0.52	0.77	1.57	0.74	0.50	2.90	6.07	1.64	1.26

HEC-RAS Plan: existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	Flow Area	Top Width	Froude # Chl	Shear Total	Shear Chan	Shear LOB	Shear ROB	Vel Total	Vel Chnl	Vel Left	Vel Right
			(cfs)	(ft)	(ft)	(ft)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
JonesFalls3	10	100 Yr	3144.30	362.30	369.55	368.59	904.97	293.45	0.57	1.31	2.27	1.33	0.99	3.47	7.63	2.39	1.95
JonesFalls3	9	2 Yr	655.40	361.08	365.57	364.46	169.85	149.32	0.61	0.66	1.92	0.34	0.45	3.86	6.46	0.90	1.09
JonesFalls3	9	10 Yr	1520.50	361.08	366.76	366.61	379.17	196.38	0.69	1.32	3.02	1.09	1.00	4.01	8.51	1.92	1.98
JonesFalls3	9	100 Yr	3144.30	361.08	368.31	367.88	729.17	249.35	0.67	1.73	3.46	1.72	1.34	4.31	9.56	2.68	3.05
JonesFalls3	8	2 Yr	655.40	359.95	364.96	364.31	284.48	165.00	0.43	0.53	1.03	0.52	0.19	2.30	4.75	1.65	1.91
JonesFalls3	8	10 Yr	1520.50	359.95	365.64	365.13	403.98	182.89	0.62	1.32	2.38	1.38	0.60	3.76	7.44	2.93	3.62
JonesFalls3	8	100 Yr	3144.30	359.95	366.09	366.09	489.32	193.98	0.99	3.66	6.35	3.92	1.79	6.43	12.34	5.15	6.49
JonesFalls3	7	2 Yr	655.40	355.05	359.07	359.07	90.56	48.88	0.95	2.73	4.06	2.29	0.31	7.24	9.02	2.74	0.73
JonesFalls3	7	10 Yr	1520.50	355.05	360.52	360.52	373.81	284.48	0.64	0.83	2.44	0.66	0.67	4.07	7.48	2.13	3.17
JonesFalls3	7	100 Yr	3144.30	355.05	363.76	361.16	1436.20	361.17	0.20	0.20	0.34	0.17	0.20	2.19	3.08	1.76	2.24
JonesFalls3	6	2 Yr	655.40	351.52	356.67	355.73	635.24	440.29	0.25	0.16	0.40	0.09	0.15	1.03	3.07	0.51	0.71
JonesFalls3	6	10 Yr	1520.50	351.52	360.41	356.40	2738.24	599.02	0.09	0.05	0.08	0.04	0.06	0.56	1.52	0.42	0.53
JonesFalls3	6	100 Yr	3144.30	351.52	363.68	357.13	4690.01	697.05	0.09	0.07	0.09	0.05	0.07	0.67	1.71	0.54	0.67
JonesFalls3	5	2 Yr	655.40	351.18	356.46	354.55	294.36	392.98	0.28	0.32	0.43	0.06	0.28	2.23	2.99	0.38	1.02
JonesFalls3	5	10 Yr	1520.50	351.18	360.30	355.85	835.35	619.46	0.17	0.28	0.34	0.20	0.29	1.82	2.61	0.97	1.23
JonesFalls3	5	100 Yr	3144.30	351.18	363.67	357.27	5010.39	756.24	0.07	0.05	0.08	0.05	0.05	0.63	1.25	0.52	0.56
JonesFalls3	4.5		Culvert														
JonesFalls3	4	2 Yr	655.40	352.00	355.40	354.43	259.09	404.85	0.33	0.28	0.42	0.17	0.22	2.53	3.25	1.79	1.97
JonesFalls3	4	10 Yr	1520.50	352.00	356.17	355.20	357.64	559.74	0.48	0.75	1.03	0.53	0.65	4.25	5.29	3.41	3.57
JonesFalls3	4	100 Yr	3144.30	352.00	357.02	356.21	467.53	633.07	0.66	1.77	2.28	1.35	1.59	6.73	8.14	5.76	5.88
JonesFalls3	3.5	2 Yr	655.40	352.00	355.29	354.74	260.90	387.48	0.36	0.29	0.54	0.20	0.23	2.51	3.32	1.85	2.07
JonesFalls3	3.5	10 Yr	1520.50	352.00	356.01	355.30	392.29	501.41	0.46	0.65	1.03	0.52	0.57	3.88	4.77	3.28	3.51
JonesFalls3	3.5	100 Yr	3144.30	352.00	356.82	356.07	540.00	588.61	0.58	1.37	1.94	1.16	1.24	5.82	6.78	5.25	5.49
JonesFalls3	3	2 Yr	655.40	352.00	354.44	353.99	194.79	292.70	0.68	0.58	1.41	0.54	0.34	3.36	4.93	2.85	2.07
JonesFalls3	3	10 Yr	1520.50	352.00	354.92	354.84	351.53	360.59	0.76	0.97	2.08	0.91	0.73	4.33	6.26	3.94	3.39
JonesFalls3	3	100 Yr	3144.30	352.00	355.45	355.39	558.20	424.90	0.85	1.55	3.04	1.53	1.25	5.63	7.85	5.42	4.72
JonesFalls4	2	2 Yr	721.70	350.23	352.56	352.43	278.63	479.52	0.56	0.37	0.83	0.34	0.34	2.59	3.67	2.43	2.41
JonesFalls4	2	10 Yr	1659.40	350.23	352.97	352.72	470.41	518.92	0.58	0.61	1.07	0.57	0.58	3.53	4.35	3.45	3.41
JonesFalls4	2	100 Yr	3405.50	350.23	353.51	353.19	817.03	623.96	0.59	0.76	1.32	0.79	0.69	4.17	5.06	4.33	3.92
JonesFalls4	1	2 Yr	721.70	348.88	350.69	350.42	342.99	523.08	0.43	0.25	0.44	0.22	0.25	2.10	2.61	1.77	2.14
JonesFalls4	1	10 Yr	1659.40	348.88	351.13	350.72	583.50	565.06	0.45	0.40	0.61	0.33	0.40	2.84	3.24	2.36	2.95
JonesFalls4	1	100 Yr	3405.50	348.88	351.71	351.13	929.09	614.41	0.48	0.58	0.83	0.49	0.60	3.67	3.99	3.04	3.85

HEC-RAS HEC-RAS 5.0.7 March 2019
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X      XXX   XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X       X
X     X  X        X    X       X   X    X    X       X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: EcclestonMod
Project File : EcclestonMod.prj
Run Date and Time: 1/11/2021 3:48:41 PM

Project in English units

PLAN DATA

Plan Title: existing
Plan File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Existing HECRAS Model\EcclestonMod.p01

Geometry Title: ExistGeoECC
Geometry File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Existing HECRAS Model\EcclestonMod.g05

Flow Title : EccNormalDepth_ULT
Flow File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Existing HECRAS Model\EcclestonMod.f01

Plan Summary Information:

Number of:	Cross Sections =	38	Multiple Openings =	0
	Culverts =	3	Inline Structures =	0
	Bridges =	1	Lateral Structures =	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01

Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: EccNormalDepth_ULT
Flow File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Existing HECRAS Model\EcclestonMod.f01

Flow Data (cfs)

River	Reach	RS	2 Yr	10 Yr	100 Yr
JonesFalls	JonesFalls	15	363.3	798.4	1593.4
JonesFalls	NorthTrib	2	175.5	459.7	1025.9
JonesFalls	JonesFalls2	12	538.8	1258.1	2619.3
JonesFalls	SouthTrib	8	151.7	322.2	622.1
JonesFalls	IntsTrib	8	66.3	138.9	261.2
JonesFalls	JonesFalls3	10	655.4	1520.5	3144.3
JonesFalls	JonesFalls4	2	721.7	1659.4	3405.5

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
JonesFalls	JonesFalls4	2 Yr		Normal S = 0.00613

JonesFalls   JonesFalls4   10 Yr
Normal S = 0.00613
JonesFalls   JonesFalls4   100 Yr
Normal S = 0.00613

GEOMETRY DATA

Geometry Title: ExistGeoECC
Geometry File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Existing HECRAS Model\EcclestonMod.g05

Reach Connection Table

River	Reach	Upstream Boundary	Downstream Boundary
JonesFalls	JonesFalls		NorthTrib
JonesFalls	NorthTrib		NorthTrib
JonesFalls	JonesFalls2	NorthTrib	SouthTrib
JonesFalls	SouthTrib		SouthTrib
JonesFalls	IntsTrib		IntersTrib
JonesFalls	JonesFalls3	SouthTrib	IntersTrib
JonesFalls	JonesFalls4	IntersTrib	

JUNCTION INFORMATION

Name: IntersTrib
Description:
Energy computation Method

Length across Junction			Tributary			
River	Reach		River	Reach	Length	Angle
JonesFalls	IntsTrib	to	JonesFalls	JonesFalls4	507	
JonesFalls	JonesFalls3	to	JonesFalls	JonesFalls4	170	

Name: NorthTrib
Description:
Energy computation Method

Length across Junction			Tributary			
River	Reach		River	Reach	Length	Angle
JonesFalls	JonesFalls	to	JonesFalls	JonesFalls2	237	
JonesFalls	NorthTrib	to	JonesFalls	JonesFalls2	239	

Name: SouthTrib
Description:

Energy computation Method

Length across Junction		Tributary			
River	Reach	River	Reach	Length	Angle
JonesFalls	JonesFalls2	to JonesFalls	JonesFalls3	161	
JonesFalls	SouthTrib	to JonesFalls	JonesFalls3	93	0

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls RS: 15

INPUT
Description:
Station Elevation Data num= 56

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-64.81	388	-18.85	386	0	384.95	10.51	384.63	28.87	384.1
28.94	384.27	39.73	383.95	45.82	383.82	48.75	383.58	66.63	383.12
77.82	382.91	97.75	383.32	105.52	383.13	107.91	381.73	109.11	381.48
112.78	381.42	113.29	381.4	117.45	381.57	118.5	381.88	118.85	382.16
119.91	383.19	122.49	383.07	124.08	383.04	124.54	382.98	124.86	382.97
127.48	381.9	128.4	381.53	128.82	381.49	129.85	381.68	137.78	383.54
152.38	383.34	182.38	385.15	183.51	385.21	188.97	385.23	201.5	385.4
217.33	385.08	228.51	384.75	256.65	384.31	264.53	384.58	267.67	384.77
289.28	384.76	291.21	384.83	292.85	384.58	303.94	384.73	348.05	384.47
350.59	384.93	352.63	384.92	359.02	384.42	368.24	384.57	401.91	385.11
408.16	385.2	430.17	385.85	434.17	385.88	453.73	385.95	456.22	385.96
579.98	388								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-64.81	.11	105.52	.049	137.78	.11	408.16	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
105.52	119.91	306	304	297	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-64.81	28.94	384.27	F
201.5	456.22	385.4	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls RS: 14.5

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	390	31.7	388	48.67	386	69.09	384	78.17	383
92.38	382	107.84	381	129.03	380.5	154.65	381	161.43	381.16
168.17	381	175.06	380	180.75	379	181.81	378.97	185.75	379
187.74	379	189.99	380	197.29	380.95	222.86	380	223.27	379.97
223.67	380	286.46	380.04	315.37	381	368.42	382	376.18	382.08
392.93	382	490.79	381.26	525.16	382	561.64	383	586.8	384
664.47	386								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.11	168.17	.049	197.29	.11	490.79	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
168.17	197.29	422	398	305	.1	.3

Ineffective Flow num= 3

Sta L	Sta R	Elev	Permanent
0	161.43	381.16	F
197.29	376.18	380.95	F
376.18	664.47	382.08	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls RS: 14

INPUT
Description:
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	393.41	20.17	392.15	27.9	390.54	30.04	390.17	39.43	387.67
44.83	386.6	53.87	385	62.57	383.64	72.64	381.84	74.22	381.59
87.3	380.1	94.05	379.49	96.13	379.19	111.3	379.02	118.68	378.84
126.34	378.57	142.18	378.77	147.29	378.9	150.41	378.84	159.21	378.85
159.87	378.89	171.47	377.04	173.59	376.65	175.12	376.75	194.4	377.52
204.12	377.33	205.53	377.41	207.44	377.33	209.93	375.58	210.41	375.38
211.32	374.79	213.49	374.74	215.02	374.7	218.14	374.72	219.9	375.13
220.95	375.75	225.2	376.82	227	376.9	238	377.41	239.38	377.49
240.43	377.47	258.12	376.52	258.76	376.48	259.19	376.37	262.57	375.62
263.06	375.63	265.85	375.56	266.95	375.69	268.21	375.78	270.83	375.67
279.55	376.4	285.8	376.78	289.08	377.3	289.5	377.38	307.02	377.18
320.85	377.09	342.33	377.15	358.57	377.47	365	377.74	373.4	378.06
394.81	378.73	412.38	378.13	427.04	378.29	429.77	378.48	437.37	378.47
447.09	378.4	452.03	378.45	453.19	378.42	459.45	377.71	460.79	377.39
464.24	378.11	465.27	378.27	467.4	378.28	478.15	377.93	479.58	377.88
488.54	378.49	493.54	379.21	496.61	379.3	511.35	379.6	531.03	380.11
539.1	380.17	542.93	380.26	550.7	380.58	568.17	381.15		

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.11	207.44	.049	225.2	.11	550.7	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
207.44	225.2	145	145	147	.1	.3

Ineffective Flow num= 4

Sta L	Sta R	Elev	Permanent
0	159.87	378.89	F
159.87	194.4	377.52	F
239.38	387.85	377.49	F
394.81	568.17	378.73	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls RS: 13.6

INPUT
Description:
Station Elevation Data num= 37

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	394	12.73	393	23.59	392	34.32	391	45.06	390
58.43	389	71.33	388	83.31	387	95.36	386	108.62	385
124.87	384	135.45	383	140.16	382	144.82	381	149.48	380
179.94	379	198.16	378	201.34	377	204.49	376	207.29	375
208.63	374	209.36	373	214	372.77	218.97	373	221.19	374
224.42	375	252.87	375.43	297.54	375	298.96	374.9	303.71	375
315.82	375.44	318.62	376	378.18	377	437.47	378	493.97	379
513.08	380	544.28	382						

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	135.45	.11	207.29	.049	224.42	.11	437.47	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
207.29	224.42	134	112	114	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
252.87	544.28	375.43	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls RS: 13.5

INPUT
Description:
Station Elevation Data num= 34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	384.48	2.19	385	11.27	385	20.56	384	26.86	383
33.9	382	42.03	381	51.6	380	61.31	379	71.02	378
80.73	377	90.95	376	104.59	375	118.35	374	149.87	373.88
184.35	374	187.9	374.5	191.58	374	194.16	373	196.68	372
202.63	371.32	208.97	372	211.01	373	213.84	374	220.74	374.43
237.57	374	240.36	373.86	242.75	374	265.06	375	289.79	376
344.17	377	374.82	378	429.58	380	525.41	382		

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.11	26.86	.04	184.35	.11	191.58	.049	213.84	.11
344.17	.04								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
191.58	213.84	201	220	219	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	187.9	374.5	F
220.74	525.41	374.43	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls RS: 13

INPUT
Description:
Station Elevation Data num= 45

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	379.26	1.71	379.08	22.36	376.5	28.36	376.04	64.52	374.37
64.89	374.36	66.74	374.31	115.95	373.13	123.63	372.92	136.75	372.75
154.83	372.36	181.44	371.93	199.1	372.01	206.77	371.77	241.09	371.66
258.87	371.83	261.45	372	264.39	371.66	270.73	371.32	271.44	371.06
273.68	370.32	274.75	369.84	276.59	369.92	278.99	370.02	279.62	370
281.82	370.03	282.98	370.08	283.77	370.18	285.41	370.79	288.1	370.95
291.46	371.9	293.92	372.71	301.28	373.39	302.48	373.9	303.77	373.23
312.88	374.16	317.73	374.36	318.24	374.42	331.73	374.78	332.39	374.78
333.19	374.81	335.31	374.85	374.73	375.42	403.19	376.44	433.72	377.65

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	206.77	.11	261.45	.049	291.46	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
261.45	291.46	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	261.45	372	F

302.48	433.72	373.9	F

CROSS SECTION

RIVER: JonesFalls
REACH: NorthTrib RS: 2

INPUT
Description:
Station Elevation Data num= 50

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-126.44	388	0	380.22	12.77	379.9	22.81	379.65	37.96	379.2
42.95	379.16	54.09	379.05	75.73	378.88	86.45	378.95	88.4	378.92
96.27	378.89	101.95	378.96	110.35	378.93	122.55	379.33	123.54	379.4
140.55	380.56	141	380.56	141.73	380.57	162.9	380.3	165.85	380.32
170.52	380.32	171.95	378.46	173.1	378.22	174.55	377.06	179.21	377.61
182.33	378.27	183.9	378.76	185.85	379.92	189.2	379.5	191.11	379.5
197.41	379.7	201.76	380.87	203.52	381.05	205.89	381.34	207.21	381.59
210.88	381.57	215.88	381.29	222.27	381.44	227.45	381.65	234.42	382.18
243.08	383.82	246.21	384.66	259.25	386.07	269.35	387.28	275.59	387.7
285.54	388.77	290.54	389.14	309.39	390.13	326.94	392.02	343.62	393.56

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-126.44	.04	96.27	.11	170.52	.061	185.85	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
170.52	185.85	161	165	177	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
-126.44	141.73	380.57	F

CROSS SECTION

RIVER: JonesFalls
REACH: NorthTrib RS: 1.5

INPUT
Description:
Station Elevation Data num= 34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-163.18	382	-79.65	380	0	378.54	24.34	377.77	28.79	377.66
50.42	377.35	56.67	377.22	63.87	377.18	83.78	377.13	87.93	377.1
93.02	377.3	173.53	377	190.32	376	192.2	375	192.61	374.95
193.31	375	196.7	375.36	197.57	376	202.72	376.5	205.72	376
207.16	375.99	208.98	376	253.35	377	298.09	378	318.34	378.91
324.06	379.17	337.47	380.31	343.27	381.12	344.96	381.35	366.36	384.61
368.48	384.91	369	384.98	383.2	387.03	383.97	387.09		

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-163.18	.04	87.93	.11	190.32	.061	197.57	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
190.32	197.57	177	177	178	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-163.18	93.02	377.3	F
202.72	383.97	376.5	F

CROSS SECTION

RIVER: JonesFalls
REACH: NorthTrib RS: 1

INPUT
Description:
Station Elevation Data num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	377.19	9.31	376.97	20.2	376.77	38.13	376.37	64.1	375.62
67.58	375.54	68.65	375.51	69.6	375.48	80.2	375.96	82.87	376.07
88.76	375.93	109.84	375.47	114.28	375.36	115.61	375.31	116.94	375.1
117.31	375.08	126.46	374.35	132.72	374.94	133.66	375	136.74	374.64
142.13	373.98	142.43	373.94	145.18	371.77	150.64	371.49	157.08	372.66
164.47	372.41	166.52	374.31	167.94	374.26	174.2	373.96	181.31	373.85
186	373.85	202.36	373.61	216.59	373.28	230.26	372.97	242.48	373.09
247.37	373.22	248.87	372.8	251.43	371.99	253.56	372.34	255.84	373.07
265.98	373.04	290.65	373.13	295.66	373.17	329.68	373.74	330.6	373.76
331.69	373.79	347.53	374.31	366.53	375	378.27	376		

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	82.87	.11	142.43	.061	166.52	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
142.43	166.52	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	133.66	375	F
166.52	378.27	374.31	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls2 RS: 12

INPUT
Description:
Station Elevation Data num= 103

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	374	1.22	373.96	4.15	373.82	26.04	373	36.15	372.56
51.56	371.88	65.11	371.41	73.25	371.22	81.55	370.87	83.4	370.7
88.93	370.821	90.25	370.85	92.66	370.89	95.97	370.77	102.43	370.19
118.54	368.99	120.56	369.04	122.37	368.98	146.73	369.09	158.79	369.43
163.63	369.46	176.25	368.59	181.71	368.87	183.4	367.95	185.69	366.89
187	367.04	189.54	367.06	192.33	368.07	193.34	369.49	193.83	369.57
198.9	369.37	201.67	369.27	204.46	369.194	213.37	368.95	218.39	369.01
224.38	368.94	245.01	369.05	248.71	369.04	296.44	368.97	297.19	368.99
299.85	369.01	309.14	369.21	315.68	369.2	319.75	368.77	324.39	368.08
326.04	368.23	332.54	369	333.05	368.97	334.39	368.94	338.21	369.09
339.42	369.14	344.77	369.29	349.74	369.11	351.53	369.32	351.87	369.35
360.43	369.28	361.26	369.29	361.73	369.25	366.32	369.22	368.84	368.93
372.99	368.45	373.36	368.29	373.62	368.3	375.29	367.14	376.94	366.6
382.92	366.66	388.03	366.6	388.36	367.11	391.76	369.04	392.17	369.06
392.5	369.05	407.66	369.25	422.52	369.81	423.87	369.85	424.61	369.83
439.34	370.01	442.81	370.08	446.06	370.42	446.97	370.39	447.45	370.36
456.54	370.6	471.21	371	479.31	371.22	482.91	371.36	504.11	371.96
506	372	523.07	372.32	528.83	372.38	551.58	372.83	557.55	372.96
559.22	372.68	560.65	372.4	563.04	372.63	564.87	372.95	568.17	372.75
590.88	373.35	597.57	373.67	602.9	373.96	603.9	374	644.67	375.98
645.22	376	647.92	376.11	675.78	377				

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	88.93	.11	204.46	.04	344.77	.11	366.32	.049
391.76	.11	482.91	.04						

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
366.32	391.76	96	135	134	.1	.3

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls2 RS: 11

INPUT
Description:
Station Elevation Data num= 118

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	376.02	4.31	375.79	33.78	374.32	55.84	372.87	62.67	372.53
80.24	371.6	95.64	371.03	109.79	370.46	118.51	370.48	119.33	370.49
129.15	369.59	140.64	368.92	143.62	369.04	147.81	368.76	156.27	368.25
156.93	368.23	161.13	368.13	181.64	367.92	182.81	367.92	183.26	367.92
184.73	367.92	189.65	367.8	197.25	367.73	198.13	367.69	199.17	367.69
210.84	368.04	222.99	368.01	228.59	366.76	229.44	366.08	229.6	366.98

233.2	366.81	237.35	365.78	238.79	367.61	239.29	367.85	240.74	367.96
243.75	368.04	247.95	368.17	260.77	368.17	267.73	367.99	280.86	367.7
308.45	368.28	309.09	368.26	309.73	368.24	310.1	368.25	311.29	368.01
312.33	368.41	315.68	368.28	323.3	368.21	326.54	368.16	329.14	367.72
330.2	367.66	332.9	367.28	334.25	366.94	334.86	366.8	336.13	366.04
337.49	365.16	338.6	364.8	339	364.54	343.72	364.25	344.22	364.26
348.48	364.33	348.91	364.88	349.61	365.13	350.06	366.27	350.54	367.16
354.31	367.33	358.64	367.61	361.41	367.53	367.59	368.07	370.59	367.97
376.15	368.35	378.39	368.49	389.51	368.81	394.41	369.11	399.9	369.19
414.53	369.57	418.07	369.66	419.91	369.71	430.19	369.96	431.46	369.83
433.15	369.95	434.34	370.31	434.92	370.19	444.81	370.6	452.77	370.93
458.82	370.83	468.43	371.01	471.16	370.96	471.86	370.93	484.07	371.17
486.8	370.912	488.31	370.77	491.69	371.17	492.06	371.25	495.15	371.13
495.71	371.11	503.75	371.33	516.64	371.88	554.72	372.22	557.21	372.27
579.33	373	591.39	373.39	593.5	373.43	595.44	373.45	622.53	373.58
623.11	373.48	627.69	373	628.51	373.13	635.49	373.73	637.48	373.62
647.87	373.39	652.88	373.57	672.43	374.07	693.99	375.01	702.34	375.46
720.42	376.52	724.89	376.7	729.24	377				

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	119.33	.11	247.95	.04	308.45	.11	326.54	.049
350.54	.11	486.8	.04						

Bank Sta: Left	Right	Coeff Contr.	Expan.
326.54	350.54	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
484.07	729.24	371.17	F

CROSS SECTION

RIVER: JonesFalls
REACH: SouthTrib RS: 8

INPUT
Description:
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-32.1	392	0	391	110.6	390	123.66	388	133.45	388
212.45	390	272.51	394	382.34	396	450.2	396		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-32.1	.045	110.6	.057	212.45	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
110.6	212.45	75	80	75	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-32.1	56.22	395	F
221.59	450.2	395	F

CROSS SECTION

RIVER: JonesFalls
REACH: SouthTrib RS: 7

INPUT
Description:
Station Elevation Data num= 48

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	393.17	3.09	392.85	4.02	392.85	13.01	392.85	22.5	392.67
52.26	391.97	66.09	392.38	75.87	392.64	92.5	391.43	97.86	391.37
116.16	390.34	120.8	390.5	131.27	390.49	144.57	387.98	144.89	387.97
150.82	384.86	151.07	384.58	152.67	384.79	153.39	384.66	158.59	384.56
159.5	384.54	162.95	384.45	169.67	385.18	173.69	385.82	175.08	386.43
181.88	387.24	184.64	387.76	185.99	387.76	187.23	389.95	188.29	390.53
188.9	390.62	191.39	391.4	195.03	393.13	196.64	393.57	197	393.56
210.05	393.58	212.34	393.64	213.21	393.64	228.47	393.49	263.39	393.37
264.3	393.44	265.06	393.45	303.46	394.18	303.79	394.19	304.29	394.19
309.17	394.07	326.52	393.83	332.83	393.82				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	144.89	.057	184.64	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
144.89	184.64	74	68	66	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	151	395	F
186.01	332.83	395	F

BRIDGE

RIVER: JonesFalls
REACH: SouthTrib RS: 6.5

INPUT
Description: Cliffholme Rd Bridge
Distance from Upstream XS = 28
Deck/Roadway Width = 15.25
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord

0	395	385.492	150.892	395	385.492	150.892	395	391.54
170.892	395	391.54	170.892	395	385.492	332.826	395	385.492

Upstream Bridge Cross Section Data
Station Elevation Data num= 48

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	393.17	3.09	392.85	4.02	392.85	13.01	392.85	22.5	392.67
52.26	391.97	66.09	392.38	75.87	392.64	92.5	391.43	97.86	391.37
116.16	390.34	120.8	390.5	131.27	390.49	144.57	387.98	144.89	387.97
150.82	384.86	151.07	384.58	152.67	384.79	153.39	384.66	158.59	384.56
159.5	384.54	162.95	384.45	169.67	385.18	173.69	385.82	175.08	386.43
181.88	387.24	184.64	387.76	185.99	387.76	187.23	389.95	188.29	390.53
188.9	390.62	191.39	391.4	195.03	393.13	196.64	393.57	197	393.56
210.05	393.58	212.34	393.64	213.21	393.64	228.47	393.49	263.39	393.37
264.3	393.44	265.06	393.45	303.46	394.18	303.79	394.19	304.29	394.19
309.17	394.07	326.52	393.83	332.83	393.82				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	144.89	.057	184.64	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
144.89	184.64	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	151	395	F
186.01	332.83	395	F

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	395	383.862	146.652	395	383.862	146.652	395	391.54
166.652	395	391.54	166.652	395	383.862	416.81	395	383.862

Downstream Bridge Cross Section Data
Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	389.29	12.9	388.91	14.46	388.93	44.68	388.41	54.85	388.23
71.9	387.62	85.72	387.31	87.09	387.29	106.55	386.94	125.13	386.6
131.55	386.66	149.02	386.52	150.34	386.47	155.02	383.09	156.29	382.62
163.7	383.6	166.82	383.62	169.6	386.25	171.65	387.45	173.36	387.6
182.22	387.48	183.87	387.62	186.65	387.95	188.47	388.16	209.06	388.79
225.04	389.33	239.11	389.59	262.68	390.07	270.78	390.18	283.72	390.09
290.95	390.46	303.79	390.15	307.3	390.04	316.08	389.63	331.32	389.14
346.69	388.75	353.83	388.61	356.91	388.55				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	150.34	.057	171.65	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
150.34	169.6	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	120.13	395	F
178.58	356.91	395	F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: JonesFalls
REACH: SouthTrib RS: 6

INPUT
Description:
Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	389.29	12.9	388.91	14.46	388.93	44.68	388.41	54.85	388.23
71.9	387.62	85.72	387.31	87.09	387.29	106.55	386.94	125.13	386.6
131.55	386.66	149.02	386.52	150.34	386.47	155.02	383.09	156.29	382.62
163.7	383.6	166.82	383.62	169.6	386.25	171.65	387.45	173.36	387.6
182.22	387.48	183.87	387.62	186.65	387.95	188.47	388.16	209.06	388.79
225.04	389.33	239.11	389.59	262.68	390.07	270.78	390.18	283.72	390.09
290.95	390.46	303.79	390.15	307.3	390.04	316.08	389.63	331.32	389.14
346.69	388.75	353.83	388.61	356.91	388.55				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	150.34	.057	171.65	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
150.34	169.6	97	93	87	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	120.13	395	F
178.58	356.91	395	F

CROSS SECTION

RIVER: JonesFalls
REACH: SouthTrib RS: 5

INPUT
Description:
Station Elevation Data num= 45

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	388	3.06	387.92	9.34	387.75	17.98	387.42	51.53	386.88
67.76	386.48	105.47	385.13	115.67	384.63	123.63	384.31	124.82	384.17
131.31	383.44	134.03	383.8	140.92	384.25	150.43	384.2	153.77	384.2
166.03	384.47	171.83	384.47	186.66	384.57	187.42	384.53	193.85	384.19
199.44	383.88	201.35	382.72	203.47	381.13	204.93	381.14	208.79	381.18
209.72	382.88	210.93	382.77	211.8	383.45	212.75	383.8	215.14	384.14
215.93	384.2	217.27	384.23	223.76	385.53	227.75	386.34	228.37	386.36
228.99	386.35	230.36	386.36	261.9	386.578	268.07	386.62	274.9	386.49
278.6	386.54	305.44	386.38	307.55	386.36	318.43	386.42	334.83	386.57

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	124.82	.045	199.44	.057	212.75	.045	261.9	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
199.44	212.75	136	123	111	.1	.3

Ineffective Flow num= 3

Sta L	Sta R	Elev	Permanent
0	41.24	395	F
88.83	186.66	384.57	F
223.38	334.83	395	F

CROSS SECTION

RIVER: JonesFalls
REACH: SouthTrib RS: 4

INPUT

Description:
Station Elevation Data num= 42

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	383.78	12.91	383.29	30.89	382.09	34.85	381.82	39.18	381.67
43.74	381.22	45.02	380.76	47.21	381.24	50.03	380.75	53.38	380.06
55.42	379.27	56.61	378.96	65.52	378.89	66.22	378.88	67.2	379.47
72.44	381.28	76.57	381.31	77.54	381.32	82.76	381.32	83.98	380.94
84.29	381.33	86.12	381.15	87.65	381.17	88.59	380.99	89.07	381.19
92.68	382.23	100.29	382.46	108.21	382.34	115.81	382.26	122.45	382.32
131.35	382.48	156.19	382.25	156.9	382.28	161.48	382.53	203.7	384.87
211.14	384.68	216.23	384.62	224.74	385.61	233.39	386.07	254.31	387.36
255.26	387.63	259.77	388.01						

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	47.21	.057	108.21	.11	156.9	.04	233.39	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
47.21	72.44	261	238	226	.1	.3

Ineffective Flow num= 4

Sta L	Sta R	Elev	Permanent
0	47.21	381.24	F
82.76	100	381.32	F
100.29	131.35	382.46	F
131.35	180	382.48	F

CROSS SECTION

RIVER: JonesFalls
REACH: SouthTrib RS: 3

INPUT
Description:
Station Elevation Data num= 37

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	383	5.1	382.75	11.15	382.44	25.65	381.32	34.08	380.79
39.13	380.6	66.2	378.14	66.74	378.1	69.76	377.92	93.58	376.491
93.59	376.49	94.67	375.82	96.87	374.99	97.88	374.6	100.98	374.66
104.1	374.44	105.51	375.05	106.49	376.32	109.67	376.35	130.53	376.98
146.06	377.4	146.13	377.58	148.74	376.8	149.2	376.48	150.67	376.06
151.46	376.52	153.99	377.6	163.18	377.3	167.42	377.37	170.58	377.29
173.78	377.38	185.02	377.81	197.34	379.06	205.65	379.85	215.57	380.65
230.29	382.2	251.86	385.03						

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	93.59	.057	106.49	.11	146.13	.057	153.99	.11
170.58	.04								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
93.59	106.49	243	242	242	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
146.13	251.86	377.58	F

CROSS SECTION

RIVER: JonesFalls
REACH: SouthTrib RS: 2

INPUT
Description:
Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	373.88	13.75	373.69	28.9	373.47	38.3	373.33	40.7	373.3
42.02	373.3	52.03	373.04	57.4	372.23	57.86	372.16	71.9	372.27
73.81	372.32	77.18	372.49	88.35	372.18	91.24	372.09	100.68	372.64
101.12	372.69	102.7	372.68	110.83	372.7	129.08	372.74	133.02	372.75
135.69	373.03	137.23	373.22	139.2	372.85	140.27	372.74	144.66	371.55
148.03	370.66	151.94	370.73	155.68	372.76	156.15	372.94	160.16	373
162.36	372.98	183.93	373.38	193.64	373.48	214.42	373.7	218.91	373.92
229.69	374.58	248.8	375.98	249.38	376.11				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	57.4	.057	100.68	.11	140.27	.057	156.15	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
140.27	156.15	259	261	263	.1	.3

CROSS SECTION

RIVER: JonesFalls
REACH: SouthTrib RS: 1

INPUT
Description:
Station Elevation Data num= 58

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	371	2.59	370.94	21.12	370.55	26.1	370.48	38.41	370.31
50.43	370.22	63.04	370.17	67.93	370.01	72.29	369.86	78.66	370.16
81.88	370.19	83.39	370.14	84.39	369.69	87.05	369.74	98.85	369.68
100.11	369.65	101.34	369.49	104.93	368.55	105.67	368.73	110.28	368.87
114.94	369.12	115.51	369.18	122.22	369.18	130.5	369.18	134.46	369.25
139.7	369.33	149.62	369.03	155.63	368.85	168.11	368.66	172.12	368.59
172.53	368.6	175.97	367.06	176.33	366.98	178.85	366.4	182.45	366.28
185.93	367.82	186.53	367.92	194.77	369.36	198.66	369.35	203.49	369.25

218.82	368.95	220.29	369.17	221.88	369.17	230.05	369.24	231.8	369.3
237.96	369.74	253.02	370.39	262.15	370.75	269.25	371.07	274.09	371.51
274.57	371.55	277.83	371.46	283.88	371.39	288.6	371.56	291.9	371.9
299.14	372.5	308.4	373.07	312.19	373.31				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	38.41	.11	172.12	.057	194.77	.11	262.15	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
172.12	194.77	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	139.7	369.33	F
194.77	312.19	369.36	F

CROSS SECTION

RIVER: JonesFalls
REACH: IntsTrib RS: 8

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	399	5.8	398.83	34.6	398	134.2	396	208.9	394
224.8	392	230.3	391.3	236.6	392	249.7	394	277.7	396
343.2	398	344.7	398.05	366.1	398.25	456.6	402		

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	5.8	.045	208.9	.046	249.7	.045	344.7	.013
366.1	.045								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
208.9	249.7	135	134	134	.1	.3

CROSS SECTION

RIVER: JonesFalls
REACH: IntsTrib RS: 7

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	395	12.5	394.9	23.7	394	59.4	392	189.7	390
198.5	388	199	387.9	203.3	386.2	208.3	386.2	208.4	387.5

214.5	388	239.4	390	260.9	392	277.4	394	292.3	396

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	12.5	.045	198.5	.046	214.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
199	208.4	151	152	154	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	182.82	395	F
281.48	292.3	395	F

CULVERT

RIVER: JonesFalls
REACH: IntsTrib RS: 6.5

INPUT
Description: Culvert under Greenspring Valley Rd.
Distance from Upstream XS = 50
Deck/Roadway Width = 44.8
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 3

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
12.5	395		235	395		292.3	396	

Upstream Bridge Cross Section Data
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	395	12.5	394.9	23.7	394	59.4	392	189.7	390
198.5	388	199	387.9	203.3	386.2	208.3	386.2	208.4	387.5
214.5	388	239.4	390	260.9	392	277.4	394	292.3	396

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	12.5	.045	198.5	.046	214.5	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
199	208.4	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	182.82	395	F
281.48	292.3	395	F

Downstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord

0	395	318.418	395

Downstream Bridge Cross Section Data

Station Elevation Data   num=   65

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	392.6	5.79	392.55	12.92	392.33	21.15	392	23.69	391.45
25.57	391	29.86	390	33.99	389	34.45	388.92	35.56	388.63
38.05	388.08	42.25	387	45.22	386.39	50.45	385.31	53.16	385
65.34	384.86	66.76	384.87	70.47	384.78	95.11	384.49	99.06	384.52
109.39	384.24	120.6	384.14	124.89	384.14	139.77	384.26	142.13	384.32
148.31	384.3	169.55	384.48	174.44	383.74	178.8	384	180.12	383
181.44	382	182.82	381	184.26	380	185.21	379.81	185.41	379
189.3	378.66	190.58	378.11	194.3	378.66	197.05	379	198.29	380
199.62	381	200.96	382	202.41	383	203.95	384	205.51	385
207.07	386	208.62	387	214.21	388	217.51	388.33	224.09	389
226.14	389.14	229.1	389.31	243.69	390	249.81	390.11	255.04	390.34
260.58	390.56	265.06	390.77	271.2	391	273.76	391.03	282.12	391.01
288.64	391.03	303.53	390.98	318.42	391.24	321.72	391.18	323.68	391

Manning's n Values   num=   4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	5.79	.04	184.26	.046	199.62	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
182.82	199.62	.3	.5

Ineffective Flow   num=   2

Sta L	Sta R	Elev	Permanent
0	187.03	395	F
196.73	323.68	395	F

Upstream Embankment side slope   =   3.5 horiz. to 1.0 vertical
Downstream Embankment side slope   =   5 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =   .98
Elevation at which weir flow begins   =
Energy head used in spillway design   =
Spillway height used in design   =
Weir crest shape   = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
GrnsprngVal	Circular	5	

FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	Top n	Bottom n	Depth Blocked	Entrance Loss Coef	Exit Loss Coef
	24	118.04	.013	.013	0	.5	1

Upstream   Elevation = 384.53

```
           Centerline Station =  205.8
Downstream Elevation =  378.84
           Centerline Station =  191.8

CULVERT OUTPUT  Profile #2 Yr  Culv Group:  GrnsprngVal

  Q Culv Group (cfs)        66.30    Culv Full Len (ft)
  # Barrels                     1    Culv Vel US (ft/s)          7.54
  Q Barrel (cfs)            66.30    Culv Vel DS (ft/s)         17.61
  E.G. US. (ft)            388.15    Culv Inv El Up (ft)       384.53
  W.S. US. (ft)            387.79    Culv Inv El Dn (ft)       378.84
  E.G. DS (ft)             380.38    Culv Frctn Ls (ft)          2.82
  W.S. DS (ft)             380.04    Culv Exit Loss (ft)         4.51
  Delta EG (ft)              7.77    Culv Entr Loss (ft)         0.44
  Delta WS (ft)              7.74    Q Weir (cfs)
  E.G. IC (ft)             387.70    Weir Sta Lft (ft)
  E.G. OC (ft)             388.15    Weir Sta Rgt (ft)
  Culvert Control          Outlet    Weir Submerg
  Culv WS Inlet (ft)       386.83    Weir Max Depth (ft)
  Culv WS Outlet (ft)      380.07    Weir Avg Depth (ft)
  Culv Nml Depth (ft)        1.15    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)        2.30    Min El Weir Flow (ft)     395.01


Warning: During subcritical analysis, the water surface upstream of culvert went to
critical depth.
Warning: Since the culvert has supercritical flow, the program should be run in
mixed flow in order to check if the cross section
         downstream of the culvert has supercritical flow.
Note:    The flow in the culvert is entirely supercritical.

CULVERT OUTPUT  Profile #10 Yr  Culv Group:  GrnsprngVal

  Q Culv Group (cfs)       138.90    Culv Full Len (ft)
  # Barrels                     1    Culv Vel US (ft/s)          9.85
  Q Barrel (cfs)           138.90    Culv Vel DS (ft/s)         20.22
  E.G. US. (ft)            390.17    Culv Inv El Up (ft)       384.53
  W.S. US. (ft)            390.11    Culv Inv El Dn (ft)       378.84
  E.G. DS (ft)             381.45    Culv Frctn Ls (ft)          2.31
  W.S. DS (ft)             380.82    Culv Exit Loss (ft)         5.65
  Delta EG (ft)              8.71    Culv Entr Loss (ft)         0.75
  Delta WS (ft)              9.30    Q Weir (cfs)
  E.G. IC (ft)             389.78    Weir Sta Lft (ft)
  E.G. OC (ft)             390.17    Weir Sta Rgt (ft)
  Culvert Control          Outlet    Weir Submerg
  Culv WS Inlet (ft)       387.91    Weir Max Depth (ft)
  Culv WS Outlet (ft)      380.74    Weir Avg Depth (ft)
  Culv Nml Depth (ft)        1.68    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)        3.38    Min El Weir Flow (ft)     395.01
```

Warning: Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section
downstream of the culvert has supercritical flow.
Note: The flow in the culvert is entirely supercritical.

CULVERT OUTPUT Profile #100 Yr Culv Group: GrnsprngVal

Q Culv Group (cfs)	261.20	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	13.30
Q Barrel (cfs)	261.20	Culv Vel DS (ft/s)	24.10
E.G. US. (ft)	394.80	Culv Inv El Up (ft)	384.53
W.S. US. (ft)	394.80	Culv Inv El Dn (ft)	378.84
E.G. DS (ft)	382.89	Culv Frctn Ls (ft)	2.86
W.S. DS (ft)	381.80	Culv Exit Loss (ft)	7.68
Delta EG (ft)	11.92	Culv Entr Loss (ft)	1.38
Delta WS (ft)	13.00	Q Weir (cfs)	
E.G. IC (ft)	394.80	Weir Sta Lft (ft)	
E.G. OC (ft)	393.63	Weir Sta Rgt (ft)	
Culvert Control	Inlet	Weir Submerg	
Culv WS Inlet (ft)	389.53	Weir Max Depth (ft)	
Culv WS Outlet (ft)	381.54	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	2.37	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	4.49	Min El Weir Flow (ft)	395.01

Warning: Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section
downstream of the culvert has supercritical flow.
Note: The flow in the culvert is entirely supercritical.

CROSS SECTION

RIVER: JonesFalls
REACH: IntsTrib RS: 6

INPUT
Description:
Station Elevation Data num= 65

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	392.6	5.79	392.55	12.92	392.33	21.15	392	23.69	391.45
25.57	391	29.86	390	33.99	389	34.45	388.92	35.56	388.63
38.05	388.08	42.25	387	45.22	386.39	50.45	385.31	53.16	385
65.34	384.86	66.76	384.87	70.47	384.78	95.11	384.49	99.06	384.52
109.39	384.24	120.6	384.14	124.89	384.14	139.77	384.26	142.13	384.32
148.31	384.3	169.55	384.48	174.44	383.74	178.8	384	180.12	383
181.44	382	182.82	381	184.26	380	185.21	379.81	185.41	379
189.3	378.66	190.58	378.11	194.3	378.66	197.05	379	198.29	380
199.62	381	200.96	382	202.41	383	203.95	384	205.51	385

```
   207.07     386  208.62     387  214.21     388  217.51  388.33  224.09     389
   226.14  389.14   229.1  389.31  243.69     390  249.81  390.11  255.04  390.34
   260.58  390.56  265.06  390.77   271.2     391  273.76  391.03  282.12  391.01
   288.64  391.03  303.53  390.98  318.42  391.24  321.72  391.18  323.68     391

Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .013    5.79     .04  184.26    .046  199.62     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        182.82  199.62              117     118     119              .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  187.03     395       F
  196.73  323.68     395       F

CROSS SECTION


RIVER: JonesFalls
REACH: IntsTrib           RS: 5

INPUT
Description:
Station Elevation Data    num=      47
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   388.8     4.2  388.19    7.99  387.54   12.01     387   12.85  386.76
   15.48     386      19     385   19.18  384.96   22.57     384   25.33  383.24
   26.16     383   28.01  382.52   31.37     382    35.9  381.61   41.67  380.87
   58.33  380.99      62     381   88.64   381.1   103.8  381.18  120.46  381.31
  121.57  381.37  131.02   381.3  134.12  381.28  141.59  380.95  142.99     381
  149.28   380.4  150.83     380  152.06     379  153.29     378  154.64     377
  158.97   376.5  160.23     377  163.53     378  166.26     379  168.47     380
  169.86     381  171.23     382  215.58  382.48  222.36  382.69  226.15  382.79
   229.3     383  236.72  383.49  244.96     384  255.39  384.62   262.2     385
  270.55  385.47  288.89     386

Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .013    7.99     .04  149.28    .046  163.53     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        149.28  171.23              363     358     354              .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  121.57     395       F
  197.44  288.89     395       F

CROSS SECTION
```

RIVER: JonesFalls
REACH: IntsTrib RS: 4

INPUT
Description:
Station Elevation Data num= 51

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	379.87	5.44	379.82	14.76	379.66	25.44	379.2	31.41	379
31.63	378.9	35.44	378.05	36.19	378	39.89	377	40.99	376.64
43.6	376	47.3	375	48.49	374.69	51.03	374	55.44	373.86
65.36	373.06	69.47	373	82.23	372.87	85.44	372.55	90.78	372
91.86	371	93.44	370	95.92	369.9	96.98	370	99.1	370.4
101.04	371	103	372	106.76	373	110.85	374	111.94	374.14
116.32	374	125.44	373.84	132.83	373.73	141.16	373.69	155.44	373.84
161.77	374	163.8	374.08	188.37	374.9	191.34	375	200.3	375.33
205.44	375.57	212.93	375.95	214.25	376	215.44	376.1	217.16	376.21
225.44	376.85	227.48	377	240.72	378	250.9	378.77	253.95	379
259.72	379.5								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	31.63	.04	85.44	.046	111.94	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
85.44	106.76	188	207	219	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
111.94	259.72	374.14	F

CROSS SECTION

RIVER: JonesFalls
REACH: IntsTrib RS: 3

INPUT
Description:
Station Elevation Data num= 131

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	373.19	1.01	373.14	4.2	373	17.26	373	22.84	372.81
23.68	372.81	24.13	372.8	24.59	372.8	26.42	372.78	26.86	372.78
27.28	372.77	28.09	372.77	36.45	372.71	41.06	372.68	41.64	372.62
42.5	372.56	57.3	372.43	57.77	372.4	70.69	372.28	71.37	372.27
72.03	372.27	72.82	372.26	73.63	372.25	74.46	372.24	75.04	372.24
75.87	372.23	76.42	372.22	79.86	372.19	80.37	372.19	82.06	372.17
86.98	372.09	91.37	372	105.06	371.72	116.72	371.48	118.17	371.45
119.45	371.43	120.4	371.41	121.54	371.39	122.52	371.37	123.55	371.35
124.56	371.34	125.63	371.33	130.35	371.27	133.77	371.22	134.92	371.21
136.11	371.19	137.35	371.16	138.68	371.13	144.05	371	151.8	370.8

152.23	370.79	153.47	370.75	154.04	370.73	155.2	370.68	155.97	370.64
157	370.58	157.86	370.53	158.94	370.46	161.05	370.31	165.48	370
174.68	369	181.72	368	188.57	367	195.27	366	198.17	365
200.57	364	200.83	363.9	201.12	364	202.62	365	204.76	366
204.97	367	205.38	367.72	218.55	367.16	225.69	368	235.63	369
247.89	369.16	248.23	369.17	248.6	369.18	249.02	369.18	249.98	369.2
250.91	369.21	251.43	369.22	252.35	369.23	253.24	369.24	256.57	369.28
257.35	369.29	260.89	369.35	261.68	369.36	262.45	369.36	263.19	369.37
266.93	369.4	269.66	369.45	273.09	369.48	273.8	369.49	276.53	369.49
282.27	369.6	285.09	369.58	286.01	369.61	286.99	369.63	288.04	369.67
288.62	369.67	289.71	369.71	290.22	369.71	295.92	369.94	297.44	370
298.26	370.03	301.11	370.15	303.31	370.24	305.08	370.31	306.68	370.38
309.12	370.48	313.21	370.65	319.83	370.91	321.86	370.99	328.67	371.25
329.28	371.28	329.64	371.3	333.56	371.45	334.01	371.47	336.29	371.56
337.68	371.61	338.36	371.64	339.43	371.67	340.11	371.7	340.86	371.72
341.67	371.74	342.41	371.76	343.06	371.78	352.37	372	352.99	372.01
446.13	372.75								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	181.72	.046	205.38	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
181.72	205.38	112	116	119	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	182.06	371.13	F
204.02	446.13	371.13	F

CULVERT

RIVER: JonesFalls
REACH: IntsTrib RS: 2.5

INPUT
Description: Intersection Trib Culvert under Park Heights Ave.
Distance from Upstream XS = 50
Deck/Roadway Width = 45
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	378.5		446.13	368.4	

Upstream Bridge Cross Section Data
Station Elevation Data num= 131

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	373.19	1.01	373.14	4.2	373	17.26	373	22.84	372.81
23.68	372.81	24.13	372.8	24.59	372.8	26.42	372.78	26.86	372.78

27.28	372.77	28.09	372.77	36.45	372.71	41.06	372.68	41.64	372.62
42.5	372.56	57.3	372.43	57.77	372.4	70.69	372.28	71.37	372.27
72.03	372.27	72.82	372.26	73.63	372.25	74.46	372.24	75.04	372.24
75.87	372.23	76.42	372.22	79.86	372.19	80.37	372.19	82.06	372.17
86.98	372.09	91.37	372	105.06	371.72	116.72	371.48	118.17	371.45
119.45	371.43	120.4	371.41	121.54	371.39	122.52	371.37	123.55	371.35
124.56	371.34	125.63	371.33	130.35	371.27	133.77	371.22	134.92	371.21
136.11	371.19	137.35	371.16	138.68	371.13	144.05	371	151.8	370.8
152.23	370.79	153.47	370.75	154.04	370.73	155.2	370.68	155.97	370.64
157	370.58	157.86	370.53	158.94	370.46	161.05	370.31	165.48	370
174.68	369	181.72	368	188.57	367	195.27	366	198.17	365
200.57	364	200.83	363.9	201.12	364	202.62	365	204.76	366
204.97	367	205.38	367.72	218.55	367.16	225.69	368	235.63	369
247.89	369.16	248.23	369.17	248.6	369.18	249.02	369.18	249.98	369.2
250.91	369.21	251.43	369.22	252.35	369.23	253.24	369.24	256.57	369.28
257.35	369.29	260.89	369.35	261.68	369.36	262.45	369.36	263.19	369.37
266.93	369.4	269.66	369.45	273.09	369.48	273.8	369.49	276.53	369.49
282.27	369.6	285.09	369.58	286.01	369.61	286.99	369.63	288.04	369.67
288.62	369.67	289.71	369.71	290.22	369.71	295.92	369.94	297.44	370
298.26	370.03	301.11	370.15	303.31	370.24	305.08	370.31	306.68	370.38
309.12	370.48	313.21	370.65	319.83	370.91	321.86	370.99	328.67	371.25
329.28	371.28	329.64	371.3	333.56	371.45	334.01	371.47	336.29	371.56
337.68	371.61	338.36	371.64	339.43	371.67	340.11	371.7	340.86	371.72
341.67	371.74	342.41	371.76	343.06	371.78	352.37	372	352.99	372.01
446.13	372.75								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	181.72	.046	205.38	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
181.72	205.38	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	182.06	371.13	F
204.02	446.13	371.13	F

Downstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	376.2		303.7	369.8	

Downstream Bridge Cross Section Data
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	372.5	15.7	372	88.3	370	149.6	368	155.3	366
157.93	363.47	162.93	363.47	163.3	365	185.2	366	203.4	366
241.82	365.5	300	369.8	306.44	369.8	321.8	370		

Manning's n Values num= 4

```
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045   155.3    .046   163.3    .045     300    .013

Bank Sta: Left   Right    Coeff Contr.   Expan.
         155.3   163.3             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  154.76     370       F
  176.73   321.8     370       F

Upstream Embankment side slope             =     2.4 horiz. to 1.0 vertical
Downstream Embankment side slope           =     3.5 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins        =
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
ParkHgtsAve     Circular      5
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
               5.44   84.85     .024     .024        0                   .5
      1
Upstream   Elevation =  363.83
           Centerline Station =  196.84
Downstream Elevation =  363.44
           Centerline Station =  160.43

CULVERT OUTPUT  Profile #2 Yr  Culv Group:  ParkHgtsAve

  Q Culv Group (cfs)        66.30    Culv Full Len (ft)
  # Barrels                     1    Culv Vel US (ft/s)         5.71
  Q Barrel (cfs)            66.30    Culv Vel DS (ft/s)         7.54
  E.G. US. (ft)            367.45    Culv Inv El Up (ft)      363.83
  W.S. US. (ft)            367.36    Culv Inv El Dn (ft)      363.44
  E.G. DS (ft)             365.83    Culv Frctn Ls (ft)         0.58
  W.S. DS (ft)             365.47    Culv Exit Loss (ft)        0.78
  Delta EG (ft)              1.62    Culv Entr Loss (ft)        0.25
  Delta WS (ft)              1.89    Q Weir (cfs)
  E.G. IC (ft)             367.11    Weir Sta Lft (ft)
  E.G. OC (ft)             367.45    Weir Sta Rgt (ft)
  Culvert Control          Outlet    Weir Submerg
  Culv WS Inlet (ft)       366.69    Weir Max Depth (ft)
  Culv WS Outlet (ft)      365.74    Weir Avg Depth (ft)
```

Culv Nml Depth (ft)	3.06	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.30	Min El Weir Flow (ft)	371.14

CULVERT OUTPUT Profile #10 Yr Culv Group: ParkHgtsAve

Q Culv Group (cfs)	138.90	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	7.53
Q Barrel (cfs)	138.90	Culv Vel DS (ft/s)	9.85
E.G. US. (ft)	369.60	Culv Inv El Up (ft)	363.83
W.S. US. (ft)	369.54	Culv Inv El Dn (ft)	363.44
E.G. DS (ft)	366.52	Culv Frctn Ls (ft)	0.84
W.S. DS (ft)	365.99	Culv Exit Loss (ft)	1.81
Delta EG (ft)	3.08	Culv Entr Loss (ft)	0.44
Delta WS (ft)	3.55	Q Weir (cfs)	
E.G. IC (ft)	369.19	Weir Sta Lft (ft)	
E.G. OC (ft)	369.60	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	368.28	Weir Max Depth (ft)	
Culv WS Outlet (ft)	366.82	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	3.38	Min El Weir Flow (ft)	371.14

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the
height of the culvert.

CULVERT OUTPUT Profile #100 Yr Culv Group: ParkHgtsAve

Q Culv Group (cfs)	200.51	Culv Full Len (ft)	54.89
# Barrels	1	Culv Vel US (ft/s)	10.21
Q Barrel (cfs)	200.51	Culv Vel DS (ft/s)	11.79
E.G. US. (ft)	372.12	Culv Inv El Up (ft)	363.83
W.S. US. (ft)	372.12	Culv Inv El Dn (ft)	363.44
E.G. DS (ft)	367.34	Culv Frctn Ls (ft)	1.67
W.S. DS (ft)	366.55	Culv Exit Loss (ft)	2.30
Delta EG (ft)	4.78	Culv Entr Loss (ft)	0.81
Delta WS (ft)	5.57	Q Weir (cfs)	60.69
E.G. IC (ft)	371.99	Weir Sta Lft (ft)	283.46
E.G. OC (ft)	372.12	Weir Sta Rgt (ft)	362.14
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	368.83	Weir Max Depth (ft)	0.95
Culv WS Outlet (ft)	367.48	Weir Avg Depth (ft)	0.42
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	32.89
Culv Crt Depth (ft)	4.04	Min El Weir Flow (ft)	371.14

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the

```
         height of the culvert.

CROSS SECTION


RIVER: JonesFalls
REACH: IntsTrib           RS: 2

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   372.5    15.7     372    88.3     370   149.6     368   155.3     366
  157.93  363.47  162.93  363.47   163.3     365   185.2     366   203.4     366
  241.82   365.5     300   369.8  306.44   369.8   321.8     370

Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045   155.3    .046   163.3    .045     300    .013

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         155.3   163.3              209     187     167              .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  154.76     370       F
  176.73   321.8     370       F

CROSS SECTION


RIVER: JonesFalls
REACH: IntsTrib           RS: 1

INPUT
Description:
Station Elevation Data    num=      10
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     363    43.1     364    84.7     365  156.97     364  186.15     363
  207.34     362  239.78     362  255.12     360  281.17     361  371.98     368

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .04  239.78    .046  281.17    .045

Bank Sta: Left   Right    Coeff Contr.   Expan.
        239.78  281.17             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
  294.42  371.98  371.13       F
```

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls3 RS: 10

INPUT
Description:
Station Elevation Data num= 81

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	378.62	15.21	378.48	18.9	378.29	54.55	375.97	84.9	373.51
95.03	372.76	97.98	372.57	100.98	372.38	101.63	372.31	105.7	371.62
121.61	368.69	125.9	367.75	128.19	367.57	135.5	366.9	135.83	366.93
145.67	366.82	148.92	366.64	160.99	366.31	174.04	366.07	185.43	366.12
185.86	366.16	187.73	366.09	188.24	366.14	192.16	366.05	210.65	365.69
211.19	365.66	211.6	365.66	213.27	365.78	241.19	366.08	242.18	366.09
242.58	366.03	251.79	365	252.54	365.03	252.93	365.03	256.01	365.03
256.46	364.78	258.31	363.14	261.63	363	263.37	362.56	265.18	362.59
269.48	362.6	272.25	362.49	274.82	362.3	275.51	362.37	277.22	362.96
279.23	365.87	279.68	366.16	291.87	366.31	292.57	366.35	293.11	366.41
295.24	366.59	301.87	366.89	304.81	366.93	306.32	366.91	310.8	364.95
311.16	364.97	314.53	365.04	317.8	366.15	318.31	366.22	329.71	366.94
340.47	367.09	350.11	367.24	352.08	367.26	358.44	367.59	370.66	367.49
373.8	367.62	374.38	367.55	379.04	367.62	380.55	367.74	403.78	369.29
405.1	369.24	410.83	369.71	411.47	369.77	412.41	369.72	414.56	369.43
416.55	369.89	417.57	370.04	428.72	370.8	436.64	371.31	458.3	373.2
465.75	373.67								

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	101.63	.11	242.18	.049	279.68	.11	410.83	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
242.18	279.68	111	123	127	.1	.3

Ineffective Flow num= 3

Sta L	Sta R	Elev	Permanent
0	242.18	366.09	F
304.81	411.47	366.93	F
411.47	465.75	369.77	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls3 RS: 9

INPUT
Description:
Station Elevation Data num= 65

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	378.73	29.38	378.1	54.01	376.94	57.98	376.64	72.34	375.35
85.47	374.11	87.63	373.86	111.6	367.7	111.93	367.59	112.92	367.5
113.84	367.42	128.96	365.92	150.29	365.05	152.46	364.98	156.15	364.99
157.96	364.99	159.53	364.69	160.71	363.94	162.79	363.94	167.82	364.02
169.49	364.99	170.4	364.98	184.75	364.99	190.7	365.08	197.46	364.99
198.74	365.21	202.54	365.3	207.91	365.41	212.88	365.38	216.32	362.94
217.87	362.22	220.29	361.52	220.93	361.42	225.82	361.22	226.61	361.13
232.59	361.1	233.44	361.08	235.13	362.2	235.52	362.52	238.23	364.64
240.04	364.63	249.84	364.46	250.47	364.15	253.05	362.66	254.28	362.65
256.34	362.51	256.96	363.11	259.38	365.52	259.72	365.52	261.16	365.48
272.11	365.39	276.55	365.13	278.03	364.96	279.12	365.14	282.37	365.51
284.75	365.51	287.68	365.59	304.33	366.14	311.77	366.55	317.18	366.77
335.62	367.38	344.2	367.68	348.71	367.87	363.04	368.51	486.63	380

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	85.47	.11	212.88	.049	238.23	.11	304.33	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
212.88	238.23	129	134	140	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	207.91	365.41	F
259.38	486.63	365.52	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls3 RS: 8

INPUT
Description:
Station Elevation Data num= 52

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	378.6	14.28	378.67	41.86	378.23	64.11	377.88	67.17	377.74
91.51	375.62	113.24	372.8	132.69	369.14	158.16	365.34	165.6	364.5
178.36	363.28	180.93	363.32	182.02	363.35	182.58	363.36	190.01	363.51
201.12	363.07	201.62	363.05	214.96	363.17	221.07	363.08	234.1	363.4
235.06	363.44	235.76	363.41	246.15	363.09	247.37	363.11	254.4	363.74
255.43	363.78	264.07	362.96	267.26	362.76	273.43	362.71	278.9	363.1
281.26	362.07	283.26	361.59	286	362.89	286.6	363.12	287.49	362.71
287.97	362.45	289.67	361.63	293.51	360.17	295.11	359.95	296.42	359.95
297.11	360.03	298.87	360.67	299.33	361.27	302.13	363.45	302.33	363.86
303.32	363.88	306.02	363.86	310.69	364.13	330.3	365.15	346.45	366.06
382.15	368	514.52	382						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	190.01	.11	286.6	.049	302.33	.04

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         286.6  302.33              492     504     506             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
       0  255.43  363.78       F

CROSS SECTION


RIVER: JonesFalls
REACH: JonesFalls3        RS: 7

INPUT
Description:
Station Elevation Data    num=      65
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  373.47    7.46  373.33   14.51  373.03   49.91  371.62   52.51  371.51
   72.66  370.52  122.26  367.86  124.93  367.72  133.19  367.23  150.37   366.3
  156.71  365.66  176.99  363.76  187.11  362.79   203.1  361.41  218.95  360.84
  230.83  360.34  256.68   359.9  262.74  359.78  267.65  359.63  278.06  359.74
  293.91  359.47  297.27  359.29  298.15  358.37  302.02  356.34   302.9  356.34
  304.05  356.34  304.93  356.36  306.05  356.37  307.44  357.96  307.99  358.62
  311.71  358.49  314.57  358.04  315.48  356.35  316.69  355.15  317.28  355.59
  318.06   355.8  318.66  355.08   326.1  355.05  326.58  355.11  329.05  356.18
  334.34  358.17  334.98  358.68  354.97  359.36  362.89  359.61  363.42  359.63
   364.5  359.63   375.4 359.539  388.33  359.43  396.85  359.43   415.9  359.62
  427.89  359.57  451.79  359.47  473.59  359.23  479.06  359.15  483.51  359.28
  505.96  360.02     515  360.89  535.61  363.51  551.87  365.05  563.87   366.1
  581.17  367.68  600.29  369.68  613.52  370.94  637.42  373.62  670.42   377.7

Manning's n Values        num=       5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .04  278.06     .11  311.71    .049  334.98     .11   375.4     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        311.71  334.98              469     475     444             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
   364.5  670.42  359.63       F

CROSS SECTION


RIVER: JonesFalls
REACH: JonesFalls3        RS: 6

INPUT
Description:
Station Elevation Data    num=      81
```

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	369.21	.44	369.16	31.84	365.2	45.45	364.4	58.99	363.32
61.77	362.83	68.58	362.38	78.06	361.85	81.92	362	85.78	361.6
105.28	358.42	113.57	356.96	115.29	356.28	117.75	356.24	123.55	356.09
148.61	355.61	171.77	356.49	176.97	356.8	195.14	356.96	197.78	357.01
204.4	356.99	227.46	357.15	234.14	357.18	245.38	357.45	260.69	357.57
262.71	357.47	281.48	356.31	284.5	356.22	290.47	356.03	293.88	355.92
314.03	355.02	314.58	355	319.02	354.5	319.76	352.22	319.97	351.99
321.14	351.7	321.57	351.66	324.58	351.9	325.21	351.86	332.41	351.59
335.5	351.52	336.05	351.76	337.65	353.56	338.63	353.61	340.26	353.7
342.46	353.82	346.69	354.04	355.6	354.7	364.82	355.47	375.63	355.05
378.57	354.93	391.58	354.95	399.63	354.95	400.65	354.96	411.03	355.06
414.21	355.09	414.59	355.09	423.2	355.19	435.1	354.89	446.74	355.03
452.75	355.04	471.93	355.12	474.95	355.14	478	355.19	504.7	355.15
510.63	355.06	511.02	355.07	522.06	355.21	536.46	355.28	538.09	355.1
541.87	355.24	566.01	355.05	577.12	355.03	581.35	355	609.07	355.15
616.82	355.17	639.36	355.17	663.67	357.45	681.8	359	703.74	362
760.76	364								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	31.84	.11	319.02	.049	337.65	.11

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
319.02	337.65	122	82	93	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	260.69	357.57	F
672.5	760.76	364	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls3 RS: 5

INPUT
Description:
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	365.64	31.93	365.36	41.59	364.7	43.55	364.49	54.4	363.66
60.83	363.32	70.36	364.02	79.54	363.88	88.3	363.87	103.77	363.76
109.4	363.27	114.85	360.87	128.72	358.03	133.94	357.55	150.5	356.46
151.42	356.08	151.54	356.16	152.32	356.51	154.71	354.98	155.46	354.25
157.15	354.16	157.16	354.51	158.44	354.8	158.8	354.97	162.81	356.05
165.6	356.17	169.47	356.65	174.56	357.27	202.46	357.54	221.96	357.13
229.01	356.37	265.13	356.89	271.6	356.8	297.25	356.93	299.31	356.95
303.73	356.98	306.05	356.94	312.06	356.82	332.55	355.51	335.48	353.21
337.33	351.42	337.88	351.18	343.34	351.45	348.32	351.22	353.53	351.27
356.18	351.29	357.52	351.24	358.81	351.55	359.78	352.63	361.37	353.26

363.42	354.33	368.32	354.09	369.82	353.88	389.94	355.89	394.61	355.73
431.33	355.47	436.16	355.42	438.49	355.36	443.36	355.33	471.08	355.08
484.01	355.07	500.1	354.99	509.6	355.08	522.13	354.7	536.9	354.7
543.3	354.16	544.67	354.21	549.67	354.19	563.81	353.97	565.69	354.09
581.39	355.16	605.31	354.89	612.72	354.98	644.44	355	673.96	355.99
675.6	355.99	677.42	355.98	692.34	356.8	708.36	357.74	719.93	358.96
758.69	362	794.3	362.65	868.21	364	953.07	366		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	103.77	.11	332.55	.049	363.42	.11	794.3	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
332.55	389.94	132	149	230	.3	.5

Ineffective Flow num= 6

Sta L	Sta R	Elev	Permanent
0	70.36	364.02	F
70.36	151.7	363	F
151.7	163.09	357.54	F
163.09	308.17	363	F
385.08	527.24	363	F
576.78	953.07	363	F

CULVERT

RIVER: JonesFalls
REACH: JonesFalls3 RS: 4.5

INPUT
Description: Bridge over Jones Falls on Park Heights Ave.
Distance from Upstream XS = 53
Deck/Roadway Width = 46
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 14

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	367		27.063	367		59.34	367	
124.7	366		201.23	365		305.74	364	
360.23	363		360.23	363		382.84	363	
382.84	363		464.76	363		736.72	363	
839	363		883.95	364				

Upstream Bridge Cross Section Data
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	365.64	31.93	365.36	41.59	364.7	43.55	364.49	54.4	363.66
60.83	363.32	70.36	364.02	79.54	363.88	88.3	363.87	103.77	363.76
109.4	363.27	114.85	360.87	128.72	358.03	133.94	357.55	150.5	356.46
151.42	356.08	151.54	356.16	152.32	356.51	154.71	354.98	155.46	354.25

157.15	354.16	157.16	354.51	158.44	354.8	158.8	354.97	162.81	356.05
165.6	356.17	169.47	356.65	174.56	357.27	202.46	357.54	221.96	357.13
229.01	356.37	265.13	356.89	271.6	356.8	297.25	356.93	299.31	356.95
303.73	356.98	306.05	356.94	312.06	356.82	332.55	355.51	335.48	353.21
337.33	351.42	337.88	351.18	343.34	351.45	348.32	351.22	353.53	351.27
356.18	351.29	357.52	351.24	358.81	351.55	359.78	352.63	361.37	353.26
363.42	354.33	368.32	354.09	369.82	353.88	389.94	355.89	394.61	355.73
431.33	355.47	436.16	355.42	438.49	355.36	443.36	355.33	471.08	355.08
484.01	355.07	500.1	354.99	509.6	355.08	522.13	354.7	536.9	354.7
543.3	354.16	544.67	354.21	549.67	354.19	563.81	353.97	565.69	354.09
581.39	355.16	605.31	354.89	612.72	354.98	644.44	355	673.96	355.99
675.6	355.99	677.42	355.98	692.34	356.8	708.36	357.74	719.93	358.96
758.69	362	794.3	362.65	868.21	364	953.07	366		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	103.77	.11	332.55	.049	363.42	.11	794.3	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
332.55	389.94	.3	.5

Ineffective Flow num= 6

Sta L	Sta R	Elev	Permanent
0	70.36	364.02	F
70.36	151.7	363	F
151.7	163.09	357.54	F
163.09	308.17	363	F
385.08	527.24	363	F
576.78	953.07	363	F

Downstream Deck/Roadway Coordinates
num= 16

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-67	370		-27	369		118.54	367	
183.84	366		260.22	365		364.65	364	
407.21	363.5		407.21	363.5		430.39	363.5	
430.39	363.5		523.52	363		793.58	363	
812.03	363		939.68	364		970	365	
1041.63	366							

Downstream Bridge Cross Section Data
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	362	77.33	360	130.4	358	170.95	356	257.66	355.34
259.53	355.32	263.78	353.23	265.78	353.23	271.18	355.23	301.91	355
363.95	355	388.75	354	400.53	352	422.68	352	429.75	354
491.27	354	495.18	352.35	497.18	352.35	510.8	354	606.35	354.93
620.43	355.07	716.33	356	847.36	358	928.57	360	1031.52	362
1037.3	364	1040.91	366						

Manning's n Values num= 4

```
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045   77.33    .045  429.75    .049  716.33    .045

Bank Sta: Left   Right    Coeff Contr.   Expan.
        388.75  429.75             .3       .5
Ineffective Flow     num=       4
   Sta L   Sta R    Elev  Permanent
       0  259.53     363       F
  271.18  391.95     363       F
  449.03  456.73     363       F
  516.56 1040.91     363       F

Upstream Embankment side slope             =       4 horiz. to 1.0 vertical
Downstream Embankment side slope           =       4 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins        =     363
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Culverts =  3

Culvert Name     Shape      Rise    Span
Culvert #4      Circular       2
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
                  0  103.71     .013     .013        0                   .5
      1
Upstream   Elevation =  354.16
           Centerline Station =  156.31
Downstream Elevation =  353.23
           Centerline Station =  264.78

Culvert Name     Shape      Rise    Span
PHAve 24 N           Box     9.2    22.5
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
               28.7    52.9     .013     .013        0                   .4
      1
Upstream   Elevation =  351.75
           Centerline Station =  347.47
Downstream Elevation =  351.22
           Centerline Station =  415.1
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Culvert Name     Shape      Rise    Span
PHAve 24 S      Circular      2
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
              18.14  128.15     .013     .013        0                  .5
      1
Upstream   Elevation =  352.71
           Centerline Station =  548.25
Downstream Elevation =  352.35
           Centerline Station =  496.18

CULVERT OUTPUT  Profile #2 Yr  Culv Group:  Culvert #4

  Q Culv Group (cfs)         16.04    Culv Full Len (ft)         43.39
  # Barrels                      1    Culv Vel US (ft/s)          6.01
  Q Barrel (cfs)             16.04    Culv Vel DS (ft/s)          5.11
  E.G. US. (ft)             356.58    Culv Inv El Up (ft)       354.16
  W.S. US. (ft)             356.46    Culv Inv El Dn (ft)       353.23
  E.G. DS (ft)              355.52    Culv Frctn Ls (ft)          0.50
  W.S. DS (ft)              355.40    Culv Exit Loss (ft)         0.29
  Delta EG (ft)               1.06    Culv Entr Loss (ft)         0.28
  Delta WS (ft)               1.06    Q Weir (cfs)
  E.G. IC (ft)              356.53    Weir Sta Lft (ft)
  E.G. OC (ft)              356.59    Weir Sta Rgt (ft)
  Culvert Control           Outlet    Weir Submerg
  Culv WS Inlet (ft)        355.74    Weir Max Depth (ft)
  Culv WS Outlet (ft)       355.23    Weir Avg Depth (ft)
  Culv Nml Depth (ft)         1.29    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)         1.44    Min El Weir Flow (ft)     363.01


CULVERT OUTPUT  Profile #10 Yr  Culv Group:  Culvert #4

  Q Culv Group (cfs)         30.98    Culv Full Len (ft)        103.71
  # Barrels                      1    Culv Vel US (ft/s)          9.86
  Q Barrel (cfs)             30.98    Culv Vel DS (ft/s)          9.86
  E.G. US. (ft)             360.38    Culv Inv El Up (ft)       354.16
  W.S. US. (ft)             360.30    Culv Inv El Dn (ft)       353.23
  E.G. DS (ft)              356.48    Culv Frctn Ls (ft)          1.95
  W.S. DS (ft)              356.17    Culv Exit Loss (ft)         1.20
  Delta EG (ft)               3.90    Culv Entr Loss (ft)         0.76
  Delta WS (ft)               4.14    Q Weir (cfs)
  E.G. IC (ft)              359.36    Weir Sta Lft (ft)
  E.G. OC (ft)              360.38    Weir Sta Rgt (ft)
  Culvert Control           Outlet    Weir Submerg
  Culv WS Inlet (ft)        356.16    Weir Max Depth (ft)
  Culv WS Outlet (ft)       355.23    Weir Avg Depth (ft)
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  Culv Nml Depth (ft)         2.00    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)         2.00    Min El Weir Flow (ft)     363.01


Note:    The normal depth exceeds the height of the culvert.  The program assumes
that the normal depth is equal to the
         height of the culvert.
Note:    Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT  Profile #100 Yr  Culv Group:  Culvert #4

  Q Culv Group (cfs)         38.92    Culv Full Len (ft)        103.71
  # Barrels                      1    Culv Vel US (ft/s)         12.39
  Q Barrel (cfs)             38.92    Culv Vel DS (ft/s)         12.39
  E.G. US. (ft)             363.67    Culv Inv El Up (ft)       354.16
  W.S. US. (ft)             363.67    Culv Inv El Dn (ft)       353.23
  E.G. DS (ft)              357.78    Culv Frctn Ls (ft)          3.07
  W.S. DS (ft)              357.02    Culv Exit Loss (ft)         1.62
  Delta EG (ft)               5.89    Culv Entr Loss (ft)         1.19
  Delta WS (ft)               6.64    Q Weir (cfs)              701.55
  E.G. IC (ft)              361.60    Weir Sta Lft (ft)         323.09
  E.G. OC (ft)              363.67    Weir Sta Rgt (ft)         850.78
  Culvert Control           Outlet    Weir Submerg                0.00
  Culv WS Inlet (ft)        356.16    Weir Max Depth (ft)         0.68
  Culv WS Outlet (ft)       355.23    Weir Avg Depth (ft)         0.63
  Culv Nml Depth (ft)         2.00    Weir Flow Area (sq ft)    334.27
  Culv Crt Depth (ft)         2.00    Min El Weir Flow (ft)     363.01


Note:    The normal depth exceeds the height of the culvert.  The program assumes
that the normal depth is equal to the
         height of the culvert.
Note:    Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT  Profile #2 Yr  Culv Group:  PHAve 24 N

  Q Culv Group (cfs)        623.59    Culv Full Len (ft)
  # Barrels                      1    Culv Vel US (ft/s)          8.45
  Q Barrel (cfs)            623.59    Culv Vel DS (ft/s)          6.63
  E.G. US. (ft)             356.58    Culv Inv El Up (ft)       351.75
  W.S. US. (ft)             356.46    Culv Inv El Dn (ft)       351.22
  E.G. DS (ft)              355.52    Culv Frctn Ls (ft)          0.06
  W.S. DS (ft)              355.40    Culv Exit Loss (ft)         0.56
  Delta EG (ft)               1.06    Culv Entr Loss (ft)         0.44
  Delta WS (ft)               1.06    Q Weir (cfs)
  E.G. IC (ft)              356.26    Weir Sta Lft (ft)
  E.G. OC (ft)              356.58    Weir Sta Rgt (ft)
  Culvert Control           Outlet    Weir Submerg
  Culv WS Inlet (ft)        355.03    Weir Max Depth (ft)
  Culv WS Outlet (ft)       355.40    Weir Avg Depth (ft)
```

Culv Nml Depth (ft)	1.81	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.88	Min El Weir Flow (ft)	363.01

CULVERT OUTPUT Profile #10 Yr Culv Group: PHAve 24 N

Q Culv Group (cfs)	1460.10	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	12.78
Q Barrel (cfs)	1460.10	Culv Vel DS (ft/s)	15.66
E.G. US. (ft)	360.38	Culv Inv El Up (ft)	351.75
W.S. US. (ft)	360.30	Culv Inv El Dn (ft)	351.22
E.G. DS (ft)	356.48	Culv Frctn Ls (ft)	0.19
W.S. DS (ft)	356.17	Culv Exit Loss (ft)	2.69
Delta EG (ft)	3.90	Culv Entr Loss (ft)	1.02
Delta WS (ft)	4.14	Q Weir (cfs)	
E.G. IC (ft)	359.88	Weir Sta Lft (ft)	
E.G. OC (ft)	360.38	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	356.83	Weir Max Depth (ft)	
Culv WS Outlet (ft)	355.36	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	3.13	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	5.08	Min El Weir Flow (ft)	363.01

Warning: Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section
downstream of the culvert has supercritical flow.
Note: The flow in the culvert is entirely supercritical.

CULVERT OUTPUT Profile #100 Yr Culv Group: PHAve 24 N

Q Culv Group (cfs)	2366.86	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	15.01
Q Barrel (cfs)	2366.86	Culv Vel DS (ft/s)	17.90
E.G. US. (ft)	363.67	Culv Inv El Up (ft)	351.75
W.S. US. (ft)	363.67	Culv Inv El Dn (ft)	351.22
E.G. DS (ft)	357.78	Culv Frctn Ls (ft)	0.18
W.S. DS (ft)	357.02	Culv Exit Loss (ft)	4.29
Delta EG (ft)	5.89	Culv Entr Loss (ft)	1.42
Delta WS (ft)	6.64	Q Weir (cfs)	701.55
E.G. IC (ft)	363.67	Weir Sta Lft (ft)	323.09
E.G. OC (ft)	363.66	Weir Sta Rgt (ft)	850.78
Culvert Control	Inlet	Weir Submerg	0.00
Culv WS Inlet (ft)	358.76	Weir Max Depth (ft)	0.68
Culv WS Outlet (ft)	357.10	Weir Avg Depth (ft)	0.63
Culv Nml Depth (ft)	4.31	Weir Flow Area (sq ft)	334.27
Culv Crt Depth (ft)	7.01	Min El Weir Flow (ft)	363.01

Warning: Since the culvert has supercritical flow, the program should be run in

mixed flow in order to check if the cross section
downstream of the culvert has supercritical flow.

Note: The flow in the culvert is entirely supercritical.

CULVERT OUTPUT Profile #2 Yr Culv Group: PHAve 24 S

Q Culv Group (cfs)	15.77	Culv Full Len (ft)	128.15
# Barrels	1	Culv Vel US (ft/s)	5.02
Q Barrel (cfs)	15.77	Culv Vel DS (ft/s)	5.02
E.G. US. (ft)	356.58	Culv Inv El Up (ft)	352.71
W.S. US. (ft)	356.46	Culv Inv El Dn (ft)	352.35
E.G. DS (ft)	355.52	Culv Frctn Ls (ft)	0.60
W.S. DS (ft)	355.40	Culv Exit Loss (ft)	0.27
Delta EG (ft)	1.06	Culv Entr Loss (ft)	0.20
Delta WS (ft)	1.06	Q Weir (cfs)	
E.G. IC (ft)	355.05	Weir Sta Lft (ft)	
E.G. OC (ft)	356.61	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	354.71	Weir Max Depth (ft)	
Culv WS Outlet (ft)	354.35	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	1.43	Min El Weir Flow (ft)	363.01

CULVERT OUTPUT Profile #10 Yr Culv Group: PHAve 24 S

Q Culv Group (cfs)	29.42	Culv Full Len (ft)	128.15
# Barrels	1	Culv Vel US (ft/s)	9.37
Q Barrel (cfs)	29.42	Culv Vel DS (ft/s)	9.37
E.G. US. (ft)	360.38	Culv Inv El Up (ft)	352.71
W.S. US. (ft)	360.30	Culv Inv El Dn (ft)	352.35
E.G. DS (ft)	356.48	Culv Frctn Ls (ft)	2.17
W.S. DS (ft)	356.17	Culv Exit Loss (ft)	1.05
Delta EG (ft)	3.90	Culv Entr Loss (ft)	0.68
Delta WS (ft)	4.14	Q Weir (cfs)	
E.G. IC (ft)	357.54	Weir Sta Lft (ft)	
E.G. OC (ft)	360.38	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	354.71	Weir Max Depth (ft)	
Culv WS Outlet (ft)	354.35	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	1.85	Min El Weir Flow (ft)	363.01

CULVERT OUTPUT Profile #100 Yr Culv Group: PHAve 24 S

Q Culv Group (cfs)	36.97	Culv Full Len (ft)	128.15
# Barrels	1	Culv Vel US (ft/s)	11.77
Q Barrel (cfs)	36.97	Culv Vel DS (ft/s)	11.77
E.G. US. (ft)	363.67	Culv Inv El Up (ft)	352.71

W.S. US. (ft)	363.67	Culv Inv El Dn (ft)	352.35
E.G. DS (ft)	357.78	Culv Frctn Ls (ft)	3.43
W.S. DS (ft)	357.02	Culv Exit Loss (ft)	1.39
Delta EG (ft)	5.89	Culv Entr Loss (ft)	1.08
Delta WS (ft)	6.64	Q Weir (cfs)	701.55
E.G. IC (ft)	359.56	Weir Sta Lft (ft)	323.09
E.G. OC (ft)	363.67	Weir Sta Rgt (ft)	850.78
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	354.71	Weir Max Depth (ft)	0.68
Culv WS Outlet (ft)	354.35	Weir Avg Depth (ft)	0.63
Culv Nml Depth (ft)	2.00	Weir Flow Area (sq ft)	334.27
Culv Crt Depth (ft)	2.00	Min El Weir Flow (ft)	363.01

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the
height of the culvert.
Note: Culvert critical depth exceeds the height of the culvert.

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls3 RS: 4

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	362	77.33	360	130.4	358	170.95	356	257.66	355.34
259.53	355.32	263.78	353.23	265.78	353.23	271.18	355.23	301.91	355
363.95	355	388.75	354	400.53	352	422.68	352	429.75	354
491.27	354	495.18	352.35	497.18	352.35	510.8	354	606.35	354.93
620.43	355.07	716.33	356	847.36	358	928.57	360	1031.52	362
1037.3	364	1040.91	366						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.045	77.33	.045	429.75	.049	716.33	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
388.75	429.75	32	41	42	.3	.5

Ineffective Flow num= 4

Sta L	Sta R	Elev	Permanent
0	259.53	363	F
271.18	391.95	363	F
449.03	456.73	363	F
516.56	1040.91	363	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls3 RS: 3.5

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	360	72.39	358	151.55	356	263.03	354	309.27	354
329.24	354	355.77	354	366.7	352	381.39	352	392.81	354
427.66	354	444.38	354	651.69	356	788.38	358	879.65	360

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	355.77	.049	392.81	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
355.77	392.81	129	124	114	.1	.3

Ineffective Flow num= 3

Sta L	Sta R	Elev	Permanent
0	226.12	363	F
262.79	354.06	363	F
500.22	879.95	363	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls3 RS: 3

INPUT
Description:
Station Elevation Data num= 64

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	359.99	.34	360	4.87	359.83	24.26	359	26.66	359
52.98	358.47	65.8	358.24	73.86	358	123.46	357	126.73	356.9
147.04	356.21	153.61	356.09	156.52	356	189.59	355	248.58	354.22
255.72	354	272.26	354	279.04	353.8	287.01	353.16	289.84	353
305.32	353	321.86	354	365.33	354	386.15	352	393.78	352
405.44	354	495.82	354	627.55	356	636.55	356.74	640.53	356.29
646.19	355.47	650.59	355	655.67	355.54	659.28	356.05	664.62	356.59
670.81	356.56	672.36	356.45	678.66	356.48	685.44	356.76	685.95	356.76
692.7	357	698.53	358.25	701.09	358.21	706.73	359.24	746.51	357.92
748.84	357.15	762.88	357.08	763.95	357.11	776.92	358	790.11	357.97
790.96	358	791.93	357.96	803.2	357.94	804.99	357.86	807.07	357.93
816.28	357.9	819.03	358	833.07	358	837.35	358.15	842.45	358.5
852.49	358.81	855.53	358.8	861.14	359	882.29	359		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	365.33	.049	405.44	.045

Bank Sta: Left Right Coeff Contr. Expan.
365.33 405.44 .1 .3
Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
623.22	882.29	363	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls4 RS: 2

INPUT
Description:
Station Elevation Data num= 67

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	359.14	7.06	358.91	17.67	358.06	19.63	358	34.93	357
38.91	356.87	47.9	356.15	50.24	356	70.75	355.83	79.5	355.13
81.37	355.02	91.99	354.86	157.37	354	172.68	353	186.5	353
187.53	352.98	189.15	352.89	198.15	352.17	203.29	352	356.33	352
389.23	352	394.41	351.02	399.85	350.31	402.25	350.23	408.45	351.42
410.46	351.84	417.55	352	498.36	352	506.01	351.89	509.38	352
567.66	352	569.7	351.97	570.6	351.92	572.93	351.92	580.32	351.82
585.91	352	631.82	352	633.4	352.05	636.96	352	647.13	352
662.43	353	706.27	353	708.35	352.94	709.99	352.95	718.33	352.83
723.65	353	738.96	353	739.56	352.98	740.92	352.87	754.26	352
769.57	353	775.57	353	782.02	353.09	792.64	353.75	800.17	354
803.25	354.3	813.87	355.84	815.48	356	819.64	356.14	824.48	356.21
830.78	356.59	844.87	358.84	845.72	358.94	846.09	358.96	847.05	358.97
856.33	358.83	857.88	358.89						

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	356.33	.045	389.23	.049	417.55	.045	498.36	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
389.23 417.55 261 248 241 .1 .3
Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
662.43	857.88	353	F

CROSS SECTION

RIVER: JonesFalls
REACH: JonesFalls4 RS: 1

INPUT
Description:
Station Elevation Data   num=   34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	356.15	2.31	356	17.6	356	23.22	355.82	26.04	355.67
36.66	355.63	45.22	355.2	48.19	355	50.53	354.92	57.9	354.55
77.84	354.03	78.78	354	109.37	353	124.67	353	132.26	352.75
139.96	352.73	149.5	352.38	153.5	352.06	155.26	352	201.14	351
262.33	350	338.83	350	349.44	349.18	351.13	348.88	352.83	349.24
363.44	350	434.53	350	636.49	350	664.25	350.27	667.02	350.05
668.56	350	717.1	350	793.76	352	821.31	354		

Manning's n Values   num=   4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.045	338.83	.049	363.44	.045	434.53	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
338.83	363.44	.1	.3

SUMMARY OF MANNING'S N VALUES

River:JonesFalls

Reach	River Sta.	n1	n2	n3	n4	n5	n6	n7
JonesFalls	15	.11	.049	.11	.04			
JonesFalls	14.5	.11	.049	.11	.04			
JonesFalls	14	.11	.049	.11	.04			
JonesFalls	13.6	.04	.11	.049	.11	.04		
JonesFalls	13.5	.11	.04	.11	.049	.11	.04	
JonesFalls	13	.04	.11	.049	.04			
NorthTrib	2	.04	.11	.061	.04			
NorthTrib	1.5	.04	.11	.061	.04			
NorthTrib	1	.04	.11	.061	.04			
JonesFalls2	12	.04	.11	.04	.11	.049	.11	.04

JonesFalls2	11	.04	.11	.04	.11	.049	.11	.04
SouthTrib	8	.045	.057	.045				
SouthTrib	7	.045	.057	.045				
SouthTrib	6.5	Bridge						
SouthTrib	6	.045	.057	.045				
SouthTrib	5	.04	.045	.057	.045	.04		
SouthTrib	4	.04	.057	.11	.04	.045		
SouthTrib	3	.04	.057	.11	.057	.11	.04	
SouthTrib	2	.04	.057	.11	.057	.04		
SouthTrib	1	.04	.11	.057	.11	.04		
IntsTrib	8	.013	.045	.046	.045	.013	.045	
IntsTrib	7	.013	.045	.046	.045			
IntsTrib	6.5	Culvert						
IntsTrib	6	.013	.04	.046	.04			
IntsTrib	5	.013	.04	.046	.04			
IntsTrib	4	.013	.04	.046	.04			
IntsTrib	3	.04	.046	.04				
IntsTrib	2.5	Culvert						
IntsTrib	2	.045	.046	.045	.013			
IntsTrib	1	.04	.046	.045				
JonesFalls3	10	.04	.11	.049	.11	.04		
JonesFalls3	9	.04	.11	.049	.11	.04		
JonesFalls3	8	.04	.11	.049	.04			
JonesFalls3	7	.04	.11	.049	.11	.04		
JonesFalls3	6	.04	.11	.049	.11			

JonesFalls3	5	.04	.11	.049	.11	.045
JonesFalls3	4.5	Culvert				
JonesFalls3	4	.045	.045	.049	.045	
JonesFalls3	3.5	.045	.049	.045		
JonesFalls3	3	.045	.049	.045		
JonesFalls4	2	.04	.045	.049	.045	.04
JonesFalls4	1	.045	.049	.045	.04	

SUMMARY OF REACH LENGTHS

River: JonesFalls

Reach	River Sta.	Left	Channel	Right
JonesFalls	15	306	304	297
JonesFalls	14.5	422	398	305
JonesFalls	14	145	145	147
JonesFalls	13.6	134	112	114
JonesFalls	13.5	201	220	219
JonesFalls	13			
NorthTrib	2	161	165	177
NorthTrib	1.5	177	177	178
NorthTrib	1			
JonesFalls2	12	96	135	134
JonesFalls2	11			
SouthTrib	8	75	80	75
SouthTrib	7	74	68	66
SouthTrib	6.5	Bridge		
SouthTrib	6	97	93	87
SouthTrib	5	136	123	111
SouthTrib	4	261	238	226
SouthTrib	3	243	242	242
SouthTrib	2	259	261	263
SouthTrib	1			
IntsTrib	8	135	134	134
IntsTrib	7	151	152	154
IntsTrib	6.5	Culvert		
IntsTrib	6	117	118	119
IntsTrib	5	363	358	354

IntsTrib	4	188	207	219
IntsTrib	3	112	116	119
IntsTrib	2.5	Culvert		
IntsTrib	2	209	187	167
IntsTrib	1			
JonesFalls3	10	111	123	127
JonesFalls3	9	129	134	140
JonesFalls3	8	492	504	506
JonesFalls3	7	469	475	444
JonesFalls3	6	122	82	93
JonesFalls3	5	132	149	230
JonesFalls3	4.5	Culvert		
JonesFalls3	4	32	41	42
JonesFalls3	3.5	129	124	114
JonesFalls3	3			
JonesFalls4	2	261	248	241
JonesFalls4	1			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: JonesFalls

Reach	River Sta.	Contr.	Expan.
JonesFalls	15	.1	.3
JonesFalls	14.5	.1	.3
JonesFalls	14	.1	.3
JonesFalls	13.6	.1	.3
JonesFalls	13.5	.1	.3
JonesFalls	13	.1	.3
NorthTrib	2	.1	.3
NorthTrib	1.5	.1	.3
NorthTrib	1	.1	.3
JonesFalls2	12	.1	.3
JonesFalls2	11	.1	.3
SouthTrib	8	.1	.3
SouthTrib	7	.3	.5
SouthTrib	6.5	Bridge	
SouthTrib	6	.3	.5
SouthTrib	5	.1	.3
SouthTrib	4	.1	.3
SouthTrib	3	.1	.3
SouthTrib	2	.1	.3
SouthTrib	1	.1	.3
IntsTrib	8	.1	.3
IntsTrib	7	.3	.5
IntsTrib	6.5	Culvert	

IntsTrib	6	.3	.5
IntsTrib	5	.1	.3
IntsTrib	4	.1	.3
IntsTrib	3	.3	.5
IntsTrib	2.5	Culvert	
IntsTrib	2	.3	.5
IntsTrib	1	.1	.3
JonesFalls3	10	.1	.3
JonesFalls3	9	.1	.3
JonesFalls3	8	.1	.3
JonesFalls3	7	.1	.3
JonesFalls3	6	.1	.3
JonesFalls3	5	.3	.5
JonesFalls3	4.5	Culvert	
JonesFalls3	4	.3	.5
JonesFalls3	3.5	.1	.3
JonesFalls3	3	.1	.3
JonesFalls4	2	.1	.3
JonesFalls4	1	.1	.3

HEC-RAS Plan: existing

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
JonesFalls	15	2 Yr	363.30	381.40	384.17	383.83	384.40	0.009027	4.96	139.48	136.40	0.56
JonesFalls	15	10 Yr	798.40	381.40	385.03	384.51	385.31	0.009219	6.14	278.02	359.68	0.60
JonesFalls	15	100 Yr	1593.40	381.40	385.74	385.28	385.98	0.009262	7.02	634.23	440.54	0.62
JonesFalls	14.5	2 Yr	363.30	378.97	381.30	380.96	381.43	0.010588	3.95	199.86	236.31	0.58
JonesFalls	14.5	10 Yr	798.40	378.97	381.88	381.42	382.08	0.012382	5.34	342.69	378.62	0.66
JonesFalls	14.5	100 Yr	1593.40	378.97	382.47	382.00	382.71	0.012862	6.46	632.33	456.61	0.70
JonesFalls	14	2 Yr	363.30	374.70	377.85	377.63	378.05	0.008322	4.76	191.16	206.05	0.54
JonesFalls	14	10 Yr	798.40	374.70	378.79	378.14	378.97	0.006506	5.25	446.32	352.77	0.51
JonesFalls	14	100 Yr	1593.40	374.70	379.78	378.73	379.95	0.005290	5.64	846.33	427.70	0.48
JonesFalls	13.6	2 Yr	363.30	372.77	375.90	375.90	376.42	0.015259	6.55	108.21	113.34	0.73
JonesFalls	13.6	10 Yr	798.40	372.77	376.70	376.70	377.43	0.018267	8.64	214.72	157.95	0.84
JonesFalls	13.6	100 Yr	1593.40	372.77	377.64	377.64	378.54	0.019755	10.63	390.80	216.73	0.91
JonesFalls	13.5	2 Yr	363.30	371.32	374.69	374.33	374.89	0.006220	4.20	130.61	149.40	0.48
JonesFalls	13.5	10 Yr	798.40	371.32	375.37	374.97	375.64	0.006581	5.09	240.71	174.79	0.51
JonesFalls	13.5	100 Yr	1593.40	371.32	376.19	375.61	376.58	0.007109	6.19	397.04	211.20	0.55
JonesFalls	13	2 Yr	363.30	369.84	372.43	372.43	372.77	0.017747	5.44	105.88	141.36	0.76
JonesFalls	13	10 Yr	798.40	369.84	372.95	372.95	373.41	0.019168	6.83	187.75	174.11	0.83
JonesFalls	13	100 Yr	1593.40	369.84	373.52	373.52	374.15	0.021486	8.47	293.48	205.02	0.91
NorthTrib	2	2 Yr	175.50	377.06	379.88	379.88	380.45	0.033869	6.20	30.02	143.82	0.81
NorthTrib	2	10 Yr	459.70	377.06	380.57	380.57	380.63	0.003398	2.39	231.31	206.33	0.27
NorthTrib	2	100 Yr	1025.90	377.06	380.71	380.58	380.96	0.012075	4.67	260.69	209.16	0.51
NorthTrib	1.5	2 Yr	175.50	374.95	377.21	376.91	377.33	0.009009	3.41	75.33	175.38	0.44
NorthTrib	1.5	10 Yr	459.70	374.95	377.51	377.51	377.80	0.018339	5.37	142.43	236.79	0.64
NorthTrib	1.5	100 Yr	1025.90	374.95	377.94	377.94	378.33	0.021317	6.52	254.11	276.51	0.71
NorthTrib	1	2 Yr	175.50	371.49	373.45	373.45	374.06	0.053530	6.29	27.89	125.49	1.00
NorthTrib	1	10 Yr	459.70	371.49	374.31	374.31	374.38	0.003793	2.28	212.41	208.10	0.28
NorthTrib	1	100 Yr	1025.90	371.49	374.32	374.32	374.68	0.018467	5.04	213.96	208.36	0.63
JonesFalls2	12	2 Yr	538.80	366.60	369.72	369.47	369.84	0.006233	3.90	252.74	311.28	0.46
JonesFalls2	12	10 Yr	1258.10	366.60	370.36		370.52	0.006074	4.57	467.36	345.23	0.48

HEC-RAS Plan: existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
JonesFalls2	12	100 Yr	2619.30	366.60	371.42		371.60	0.004511	4.87	869.68	419.98	0.44
JonesFalls2	11	2 Yr	538.80	364.25	368.48	368.48	368.85	0.010906	5.79	182.58	225.79	0.62
JonesFalls2	11	10 Yr	1258.10	364.25	369.41	369.04	369.72	0.008419	6.19	415.18	276.22	0.57
JonesFalls2	11	100 Yr	2619.30	364.25	370.81	369.78	371.06	0.005338	6.13	851.47	349.70	0.48
SouthTrib	8	2 Yr	151.70	388.00	389.03	389.03	389.33	0.056146	4.40	34.45	57.16	1.00
SouthTrib	8	10 Yr	322.20	388.00	389.46	389.46	389.86	0.050150	5.11	63.03	76.80	0.99
SouthTrib	8	100 Yr	622.10	388.00	390.30	389.94	390.59	0.017787	4.33	147.54	139.26	0.65
SouthTrib	7	2 Yr	151.70	384.45	386.87	385.94	387.02	0.006960	3.13	48.49	31.81	0.42
SouthTrib	7	10 Yr	322.20	384.45	388.06	386.70	388.28	0.005918	3.73	86.68	42.04	0.41
SouthTrib	7	100 Yr	622.10	384.45	389.68	387.69	389.98	0.004206	4.36	143.41	51.54	0.38
SouthTrib	6.5		Bridge									
SouthTrib	6	2 Yr	151.70	382.62	385.95	384.86	386.16	0.007976	3.72	40.81	18.22	0.44
SouthTrib	6	10 Yr	322.20	382.62	386.29	385.83	387.02	0.023720	6.83	47.16	19.08	0.76
SouthTrib	6	100 Yr	622.10	382.62	387.35	387.35	388.32	0.021794	8.24	84.28	87.40	0.78
SouthTrib	5	2 Yr	151.70	381.13	383.66	383.66	384.49	0.048871	7.28	20.82	16.21	1.00
SouthTrib	5	10 Yr	322.20	381.13	384.80	384.80	385.12	0.014255	5.45	84.68	107.81	0.59
SouthTrib	5	100 Yr	622.10	381.13	385.16	385.16	385.62	0.018490	6.76	125.97	117.38	0.68
SouthTrib	4	2 Yr	151.70	378.88	381.33	380.62	381.54	0.011132	3.69	42.99	46.96	0.51
SouthTrib	4	10 Yr	322.20	378.88	381.79	381.60	382.23	0.018107	5.56	66.03	55.43	0.68
SouthTrib	4	100 Yr	622.10	378.88	382.52	382.23	383.09	0.017731	6.74	122.40	136.79	0.71
SouthTrib	3	2 Yr	151.70	374.44	376.77	376.77	377.37	0.030554	6.34	28.02	37.79	0.84
SouthTrib	3	10 Yr	322.20	374.44	377.65	377.65	378.07	0.016898	6.16	90.10	106.62	0.66
SouthTrib	3	100 Yr	622.10	374.44	378.16	378.16	378.66	0.019363	7.41	148.71	122.45	0.73
SouthTrib	2	2 Yr	151.70	370.66	373.09		373.17	0.007219	2.92	76.50	116.32	0.41
SouthTrib	2	10 Yr	322.20	370.66	373.46		373.59	0.009721	3.90	127.06	161.84	0.49
SouthTrib	2	100 Yr	622.10	370.66	373.76	373.55	373.98	0.014779	5.28	182.66	206.71	0.62
SouthTrib	1	2 Yr	151.70	366.28	368.61	368.61	369.26	0.046333	6.44	23.58	20.20	1.00
SouthTrib	1	10 Yr	322.20	366.28	369.59	369.59	369.99	0.020928	5.73	100.09	135.21	0.72

HEC-RAS Plan: existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
SouthTrib	1	100 Yr	622.10	366.28	370.51	370.10	370.76	0.010503	5.26	265.52	232.30	0.55
IntsTrib	8	2 Yr	66.30	391.30	392.61	392.61	392.96	0.036162	4.72	14.04	20.65	1.01
IntsTrib	8	10 Yr	138.90	391.30	393.07	393.07	393.55	0.032965	5.52	25.18	27.38	1.01
IntsTrib	8	100 Yr	261.20	391.30	394.73		394.85	0.002938	2.87	100.24	78.31	0.35
IntsTrib	7	2 Yr	66.30	386.20	387.79	387.79	388.31	0.030548	5.85	11.70	12.59	0.93
IntsTrib	7	10 Yr	138.90	386.20	390.11	388.54	390.16	0.001031	2.17	86.64	58.39	0.20
IntsTrib	7	100 Yr	261.20	386.20	394.80	389.18	394.80	0.000035	0.71	464.96	269.56	0.04
IntsTrib	6.5		Culvert									
IntsTrib	6	2 Yr	66.30	378.11	380.04	379.71	380.38	0.012859	4.67	14.21	14.15	0.68
IntsTrib	6	10 Yr	138.90	378.11	380.82	380.43	381.45	0.013753	6.40	21.70	16.29	0.75
IntsTrib	6	100 Yr	261.20	378.11	381.80	381.40	382.89	0.014429	8.36	31.25	18.98	0.82
IntsTrib	5	2 Yr	66.30	376.50	378.60	378.21	378.86	0.012403	4.11	16.12	12.60	0.64
IntsTrib	5	10 Yr	138.90	376.50	379.35	378.91	379.77	0.013043	5.19	26.76	15.42	0.69
IntsTrib	5	100 Yr	261.20	376.50	379.88	379.73	380.73	0.021230	7.40	35.29	17.21	0.91
IntsTrib	4	2 Yr	66.30	369.90	371.45	371.45	371.99	0.033163	5.88	11.27	10.56	1.00
IntsTrib	4	10 Yr	138.90	369.90	372.27	372.27	372.93	0.030337	6.54	21.22	15.81	1.00
IntsTrib	4	100 Yr	261.20	369.90	373.21	373.21	373.79	0.017346	6.23	46.02	44.12	0.80
IntsTrib	3	2 Yr	66.30	363.90	367.36	366.19	367.45	0.003409	2.42	27.39	25.28	0.34
IntsTrib	3	10 Yr	138.90	363.90	369.54	366.96	369.60	0.000701	1.87	74.25	109.70	0.18
IntsTrib	3	100 Yr	261.20	363.90	372.12	367.77	372.12	0.000041	0.63	609.36	280.76	0.05
IntsTrib	2.5		Culvert									
IntsTrib	2	2 Yr	66.30	363.47	365.47	365.19	365.83	0.016496	5.00	14.87	17.64	0.68
IntsTrib	2	10 Yr	138.90	363.47	365.99	365.99	366.52	0.020307	6.36	25.77	74.16	0.78
IntsTrib	2	100 Yr	261.20	363.47	366.55	366.55	367.34	0.022530	7.84	37.97	102.29	0.85
IntsTrib	1	2 Yr	66.30	360.00	360.99	360.99	361.24	0.039364	4.01	16.55	33.41	1.00
IntsTrib	1	10 Yr	138.90	360.00	361.32	361.32	361.69	0.031997	4.88	28.89	40.42	0.98
IntsTrib	1	100 Yr	261.20	360.00	361.74	361.74	362.23	0.027162	5.71	47.53	49.02	0.95

HEC-RAS Plan: existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
JonesFalls3	10	2 Yr	655.40	362.30	366.83	365.98	367.21	0.007734	5.24	192.07	177.03	0.54
JonesFalls3	10	10 Yr	1520.50	362.30	368.18	367.49	368.56	0.006275	6.07	523.94	263.18	0.52
JonesFalls3	10	100 Yr	3144.30	362.30	369.55	368.59	370.06	0.006841	7.63	904.97	293.45	0.57
JonesFalls3	9	2 Yr	655.40	361.08	365.57	364.46	366.14	0.009527	6.46	169.85	149.32	0.61
JonesFalls3	9	10 Yr	1520.50	361.08	366.76	366.61	367.53	0.011192	8.51	379.17	196.38	0.69
JonesFalls3	9	100 Yr	3144.30	361.08	368.31	367.88	369.06	0.009647	9.56	729.17	249.35	0.67
JonesFalls3	8	2 Yr	655.40	359.95	364.96	364.31	365.13	0.004978	4.75	284.48	165.00	0.43
JonesFalls3	8	10 Yr	1520.50	359.95	365.64	365.13	366.03	0.009748	7.44	403.98	182.89	0.62
JonesFalls3	8	100 Yr	3144.30	359.95	366.09	366.09	367.12	0.023572	12.34	489.32	193.98	0.99
JonesFalls3	7	2 Yr	655.40	355.05	359.07	359.07	360.22	0.025875	9.02	90.56	48.88	0.95
JonesFalls3	7	10 Yr	1520.50	355.05	360.52	360.52	361.01	0.010251	7.48	373.81	284.48	0.64
JonesFalls3	7	100 Yr	3144.30	355.05	363.76	361.16	363.84	0.000819	3.08	1436.20	361.17	0.20
JonesFalls3	6	2 Yr	655.40	351.52	356.67	355.73	356.74	0.001507	3.07	635.24	440.29	0.25
JonesFalls3	6	10 Yr	1520.50	351.52	360.41	356.40	360.42	0.000172	1.52	2738.24	599.02	0.09
JonesFalls3	6	100 Yr	3144.30	351.52	363.68	357.13	363.69	0.000141	1.71	4690.01	697.05	0.09
JonesFalls3	5	2 Yr	655.40	351.18	356.46	354.55	356.58	0.002091	2.99	294.36	392.98	0.28
JonesFalls3	5	10 Yr	1520.50	351.18	360.30	355.85	360.38	0.000771	2.61	835.35	619.46	0.17
JonesFalls3	5	100 Yr	3144.30	351.18	363.67	357.27	363.67	0.000123	1.25	5010.39	756.24	0.07
JonesFalls3	4.5		Culvert									
JonesFalls3	4	2 Yr	655.40	352.00	355.40	354.43	355.52	0.002226	3.25	259.09	404.85	0.33
JonesFalls3	4	10 Yr	1520.50	352.00	356.17	355.20	356.48	0.004366	5.29	357.64	559.74	0.48
JonesFalls3	4	100 Yr	3144.30	352.00	357.02	356.21	357.78	0.007893	8.14	467.53	633.07	0.66
JonesFalls3	3.5	2 Yr	655.40	352.00	355.29	354.74	355.41	0.003238	3.32	260.90	387.48	0.36
JonesFalls3	3.5	10 Yr	1520.50	352.00	356.01	355.30	356.26	0.004888	4.77	392.29	501.41	0.46
JonesFalls3	3.5	100 Yr	3144.30	352.00	356.82	356.07	357.37	0.007438	6.78	540.00	588.61	0.58
JonesFalls3	3	2 Yr	655.40	352.00	354.44	353.99	354.68	0.013936	4.93	194.79	292.70	0.68
JonesFalls3	3	10 Yr	1520.50	352.00	354.92	354.84	355.27	0.015908	6.26	351.53	360.59	0.76
JonesFalls3	3	100 Yr	3144.30	352.00	355.45	355.39	356.01	0.018554	7.85	558.20	424.90	0.85

HEC-RAS Plan: existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
JonesFalls4	2	2 Yr	721.70	350.23	352.56	352.43	352.67	0.009899	3.67	278.63	479.52	0.56
JonesFalls4	2	10 Yr	1659.40	350.23	352.97	352.72	353.17	0.009790	4.35	470.41	518.92	0.58
JonesFalls4	2	100 Yr	3405.50	350.23	353.51	353.19	353.79	0.009255	5.06	817.03	623.96	0.59
JonesFalls4	1	2 Yr	721.70	348.88	350.69	350.42	350.76	0.006131	2.61	342.99	523.08	0.43
JonesFalls4	1	10 Yr	1659.40	348.88	351.13	350.72	351.26	0.006135	3.24	583.50	565.06	0.45
JonesFalls4	1	100 Yr	3405.50	348.88	351.71	351.13	351.93	0.006131	3.99	929.09	614.41	0.48

HEC-RAS Plan: existing

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
JonesFalls	15	2 Yr	384.40	384.17	0.23	2.94	0.03	67.38	172.30	123.62	136.40
JonesFalls	15	10 Yr	385.31	385.03	0.28	3.20	0.02	218.07	289.15	291.18	359.68
JonesFalls	15	100 Yr	385.98	385.74	0.24	3.26	0.00	431.01	401.85	760.54	440.54
JonesFalls	14.5	2 Yr	381.43	381.30	0.13	3.37	0.01	24.48	166.36	172.47	236.31
JonesFalls	14.5	10 Yr	382.08	381.88	0.20	3.11	0.01	100.70	314.50	383.21	378.62
JonesFalls	14.5	100 Yr	382.71	382.47	0.24	2.74	0.02	222.61	491.18	879.61	456.61
JonesFalls	14	2 Yr	378.05	377.85	0.21	1.60	0.03	22.48	203.15	137.66	206.05
JonesFalls	14	10 Yr	378.97	378.79	0.18	1.49	0.05	91.58	311.83	394.99	352.77
JonesFalls	14	100 Yr	379.95	379.78	0.16	1.34	0.07	224.27	434.52	934.61	427.70
JonesFalls	13.6	2 Yr	376.42	375.90	0.52	1.08	0.10	1.07	278.06	84.18	113.34
JonesFalls	13.6	10 Yr	377.43	376.70	0.73	1.21	0.14	6.39	484.87	307.14	157.95
JonesFalls	13.6	100 Yr	378.54	377.64	0.90	1.32	0.15	22.11	767.61	803.68	216.73
JonesFalls	13.5	2 Yr	374.89	374.69	0.20	2.10	0.01	124.60	225.49	13.21	149.40
JonesFalls	13.5	10 Yr	375.64	375.37	0.26	2.21	0.02	389.04	350.79	58.56	174.79
JonesFalls	13.5	100 Yr	376.58	376.19	0.39	2.40	0.03	897.17	539.06	157.17	211.20
JonesFalls	13	2 Yr	372.77	372.43	0.34	2.11	0.07	103.10	259.37	0.83	141.36
JonesFalls	13	10 Yr	373.41	372.95	0.46	2.09	0.09	359.66	433.71	5.03	174.11
JonesFalls	13	100 Yr	374.15	373.52	0.64	1.69	0.14	887.66	680.25	25.49	205.02
NorthTrib	2	2 Yr	380.45	379.88	0.57	2.66	0.13		166.78	8.72	143.82
NorthTrib	2	10 Yr	380.63	380.57	0.06	1.11	0.02	346.60	89.25	23.85	206.33
NorthTrib	2	100 Yr	380.96	380.71	0.25	2.62	0.01	783.94	184.82	57.13	209.16
NorthTrib	1.5	2 Yr	377.33	377.21	0.13	3.21	0.05	8.74	47.36	119.40	175.38
NorthTrib	1.5	10 Yr	377.80	377.51	0.29	1.27	0.06	79.70	86.38	293.62	236.79
NorthTrib	1.5	100 Yr	378.33	377.94	0.39	3.52	0.01	314.92	125.29	585.70	276.51
NorthTrib	1	2 Yr	374.06	373.45	0.62	2.12	0.15		175.50		125.49
NorthTrib	1	10 Yr	374.38	374.31	0.07	1.27	0.01	0.15	109.55	350.00	208.10
NorthTrib	1	100 Yr	374.68	374.32	0.36	1.47	0.05	0.34	243.23	782.33	208.36
JonesFalls2	12	2 Yr	369.84	369.72	0.12	0.96	0.03	315.15	216.44	7.21	311.28
JonesFalls2	12	10 Yr	370.52	370.36	0.16	0.79	0.01	893.05	329.19	35.86	345.23
JonesFalls2	12	100 Yr	371.60	371.42	0.18	0.53	0.01	2008.08	480.56	130.66	419.98
JonesFalls2	11	2 Yr	368.85	368.48	0.37	1.44	0.00	140.43	377.44	20.93	225.79
JonesFalls2	11	10 Yr	369.72	369.41	0.30	1.15	0.01	644.04	542.03	72.03	276.22
JonesFalls2	11	100 Yr	371.06	370.81	0.25	0.98	0.03	1632.65	741.99	244.66	349.70
SouthTrib	8	2 Yr	389.33	389.03	0.30	1.22	0.04		151.70		57.16
SouthTrib	8	10 Yr	389.86	389.46	0.41	1.05	0.06		322.20		76.80
SouthTrib	8	100 Yr	390.59	390.30	0.29	0.61	0.00	6.07	615.21	0.82	139.26
SouthTrib	7	2 Yr	387.02	386.87	0.15	0.32	0.07		151.70		31.81
SouthTrib	7	10 Yr	388.28	388.06	0.22	0.29	0.13		321.73	0.47	42.04
SouthTrib	7	100 Yr	389.98	389.68	0.29	0.25	0.28		613.46	8.64	51.54
SouthTrib	6.5		Bridge								
SouthTrib	6	2 Yr	386.16	385.95	0.21	1.51	0.18		151.70		18.22
SouthTrib	6	10 Yr	387.02	386.29	0.73	1.69	0.20		322.20	0.00	19.08
SouthTrib	6	100 Yr	388.32	387.35	0.97	1.89	0.26	63.87	555.83	2.40	87.40
SouthTrib	5	2 Yr	384.49	383.66	0.82	2.51	0.18		151.70		16.21
SouthTrib	5	10 Yr	385.12	384.80	0.32	2.00	0.01	116.12	195.44	10.64	107.81
SouthTrib	5	100 Yr	385.62	385.16	0.46	2.28	0.01	320.18	275.41	26.50	117.38
SouthTrib	4	2 Yr	381.54	381.33	0.21	4.12	0.04	1.96	149.05	0.69	46.96
SouthTrib	4	10 Yr	382.23	381.79	0.44	4.16	0.01	12.08	288.97	21.15	55.43
SouthTrib	4	100 Yr	383.09	382.52	0.58	4.42	0.02	69.78	473.79	78.53	136.79
SouthTrib	3	2 Yr	377.37	376.77	0.60	3.17	0.16	1.11	146.58	4.00	37.79
SouthTrib	3	10 Yr	378.07	377.65	0.42	3.05	0.09	37.68	212.62	71.91	106.62
SouthTrib	3	100 Yr	378.66	378.16	0.51	4.08	0.08	106.58	303.99	211.53	122.45
SouthTrib	2	2 Yr	373.17	373.09	0.08	3.87	0.06	77.04	74.04	0.61	116.32
SouthTrib	2	10 Yr	373.59	373.46	0.13	3.58	0.03	186.67	121.58	13.94	161.84
SouthTrib	2	100 Yr	373.98	373.76	0.23	3.22	0.00	373.11	189.85	59.14	206.71

HEC-RAS Plan: existing (Continued)

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
SouthTrib	1	2 Yr	369.26	368.61	0.64	0.91	0.08	0.00	151.70		20.20
SouthTrib	1	10 Yr	369.99	369.59	0.40	0.69	0.01	54.44	252.08	15.68	135.21
SouthTrib	1	100 Yr	370.76	370.51	0.25	0.68	0.03	193.49	341.86	86.75	232.30
IntsTrib	8	2 Yr	392.96	392.61	0.35	4.45	0.02		66.30		20.65
IntsTrib	8	10 Yr	393.55	393.07	0.47	0.40	0.13		138.90		27.38
IntsTrib	8	100 Yr	394.85	394.73	0.12	0.02	0.04	9.11	248.68	3.41	78.31
IntsTrib	7	2 Yr	388.31	387.79	0.53				65.53	0.77	12.59
IntsTrib	7	10 Yr	390.16	390.11	0.05			9.94	71.78	57.18	58.39
IntsTrib	7	100 Yr	394.80	394.80	0.01			52.13	54.58	154.49	269.56
IntsTrib	6.5		Culvert								
IntsTrib	6	2 Yr	380.38	380.04	0.34	1.49	0.04		66.30		14.15
IntsTrib	6	10 Yr	381.45	380.82	0.64	1.58	0.11		138.90		16.29
IntsTrib	6	100 Yr	382.89	381.80	1.09	2.05	0.12		261.20		18.98
IntsTrib	5	2 Yr	378.86	378.60	0.26	6.84	0.03		66.30		12.60
IntsTrib	5	10 Yr	379.77	379.35	0.42	6.81	0.02		138.90		15.42
IntsTrib	5	100 Yr	380.73	379.88	0.85	6.85	0.08		261.20		17.21
IntsTrib	4	2 Yr	371.99	371.45	0.54	1.62	0.13		66.30		10.56
IntsTrib	4	10 Yr	372.93	372.27	0.67	0.44	0.18		138.90		15.81
IntsTrib	4	100 Yr	373.79	373.21	0.58	0.03	0.17	12.34	248.78	0.08	44.12
IntsTrib	3	2 Yr	367.45	367.36	0.09				66.30		25.28
IntsTrib	3	10 Yr	369.60	369.54	0.05				138.90		109.70
IntsTrib	3	100 Yr	372.12	372.12	0.00			30.59	88.52	142.10	280.76
IntsTrib	2.5		Culvert								
IntsTrib	2	2 Yr	365.83	365.47	0.37	4.53	0.06		62.50	3.80	17.64
IntsTrib	2	10 Yr	366.52	365.99	0.53				105.27	33.63	74.16
IntsTrib	2	100 Yr	367.34	366.55	0.79	4.52	0.15	0.69	164.90	95.60	102.29
IntsTrib	1	2 Yr	361.24	360.99	0.25	5.47	0.04		66.30		33.41
IntsTrib	1	10 Yr	361.69	361.32	0.37	5.32	0.05		137.70	1.20	40.42
IntsTrib	1	100 Yr	362.23	361.74	0.49	4.98	0.07		251.21	9.99	49.02
JonesFalls3	10	2 Yr	367.21	366.83	0.38	1.05	0.02	70.99	578.13	6.28	177.03
JonesFalls3	10	10 Yr	368.56	368.18	0.38	0.99	0.04	368.64	977.45	174.41	263.18
JonesFalls3	10	100 Yr	370.06	369.55	0.50	0.97	0.02	935.21	1621.64	587.45	293.45
JonesFalls3	9	2 Yr	366.14	365.57	0.57	0.89	0.12	38.79	575.37	41.24	149.32
JonesFalls3	9	10 Yr	367.53	366.76	0.77	1.39	0.12	278.15	1014.16	228.19	196.38
JonesFalls3	9	100 Yr	369.06	368.31	0.75	1.91	0.03	799.45	1514.84	830.01	249.35
JonesFalls3	8	2 Yr	365.13	364.96	0.17	4.81	0.10	347.60	279.11	28.69	165.00
JonesFalls3	8	10 Yr	366.03	365.64	0.39	5.00	0.01	872.91	517.24	130.35	182.89
JonesFalls3	8	100 Yr	367.12	366.09	1.03	1.16	0.28	1844.41	946.23	353.66	193.98
JonesFalls3	7	2 Yr	360.22	359.07	1.15	1.82	0.33	62.54	591.25	1.60	48.88
JonesFalls3	7	10 Yr	361.01	360.52	0.49	0.25	0.15	190.17	743.13	587.20	284.48
JonesFalls3	7	100 Yr	363.84	363.76	0.08	0.13	0.02	812.70	538.61	1792.99	361.17
JonesFalls3	6	2 Yr	356.74	356.67	0.07	0.15	0.01	21.20	274.73	359.47	440.29
JonesFalls3	6	10 Yr	360.42	360.41	0.01	0.03	0.01	354.02	241.67	924.81	599.02
JonesFalls3	6	100 Yr	363.69	363.68	0.01	0.01	0.00	879.95	375.73	1888.62	697.05
JonesFalls3	5	2 Yr	356.58	356.46	0.12			2.66	546.16	106.58	392.98
JonesFalls3	5	10 Yr	360.38	360.30	0.08			151.88	1005.02	363.59	619.46
JonesFalls3	5	100 Yr	363.67	363.67	0.01			756.86	751.46	1635.98	756.24
JonesFalls3	4.5		Culvert								
JonesFalls3	4	2 Yr	355.52	355.40	0.12	0.11	0.00	27.73	374.81	252.86	404.85
JonesFalls3	4	10 Yr	356.48	356.17	0.32	0.19	0.03	83.05	762.79	674.66	559.74
JonesFalls3	4	100 Yr	357.78	357.02	0.76	0.31	0.11	197.63	1436.59	1510.08	633.07
JonesFalls3	3.5	2 Yr	355.41	355.29	0.12	0.72	0.01	69.10	330.39	255.91	387.48
JonesFalls3	3.5	10 Yr	356.26	356.01	0.25	0.99	0.01	213.16	602.39	704.96	501.41
JonesFalls3	3.5	100 Yr	357.37	356.82	0.55	1.35	0.00	503.72	1059.23	1581.34	588.61

HEC-RAS Plan: existing (Continued)

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
JonesFalls3	3	2 Yr	354.68	354.44	0.24	1.97	0.04	237.93	322.45	95.03	292.70
JonesFalls3	3	10 Yr	355.27	354.92	0.35	2.07	0.05	615.05	529.72	375.73	360.59
JonesFalls3	3	100 Yr	356.01	355.45	0.56	2.13	0.08	1367.98	831.21	945.11	424.90
JonesFalls4	2	2 Yr	352.67	352.56	0.11	1.90	0.01	260.40	140.82	320.48	479.52
JonesFalls4	2	10 Yr	353.17	352.97	0.20	1.89	0.02	650.92	217.49	790.99	518.92
JonesFalls4	2	100 Yr	353.79	353.51	0.28	1.84	0.02	1333.12	330.68	1741.70	623.96
JonesFalls4	1	2 Yr	350.76	350.69	0.07			118.22	74.43	529.05	523.08
JonesFalls4	1	10 Yr	351.26	351.13	0.13			295.10	127.52	1236.78	565.06
JonesFalls4	1	100 Yr	351.93	351.71	0.21			659.43	214.45	2531.62	614.41

PLAN
SCALE: 1"=100'

100' 0 100' 200'
SCALE: 1"=100'

OWNER /DEVELOPER INFORMATION
MARYLAND TRANSPORTATION AUTHORITY
2310 BROENING HWY
BALTIMORE, MD 21224

MARYLAND COORDINATE SYSTEM - HOR. NAD 83/91 MD STATE PLANE VERT. NAVD 88

GREENSPRING VALLEY ROAD
SW CORNER PARK HEIGHTS AVE
OWINGS MILLS, MD 21117

DESIGN PROFESSIONAL
JEREMY KOSER
JOHNSON, MIRMIRAN & THOMPSON, INC.
40 WIGHT AVENUE, HUNT VALLEY, MD 21030
TEL: 410-329-3100
EMAIL: JKoser@jmt.com

PROFESSIONAL CERTIFICATION
I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 31183 , EXPIRATION DATE: 1/13/2021 .

ECCLESTON MITIGATION SITE

REVISIONS

FLOODPLAIN MAP - EXISTING CONDITIONS

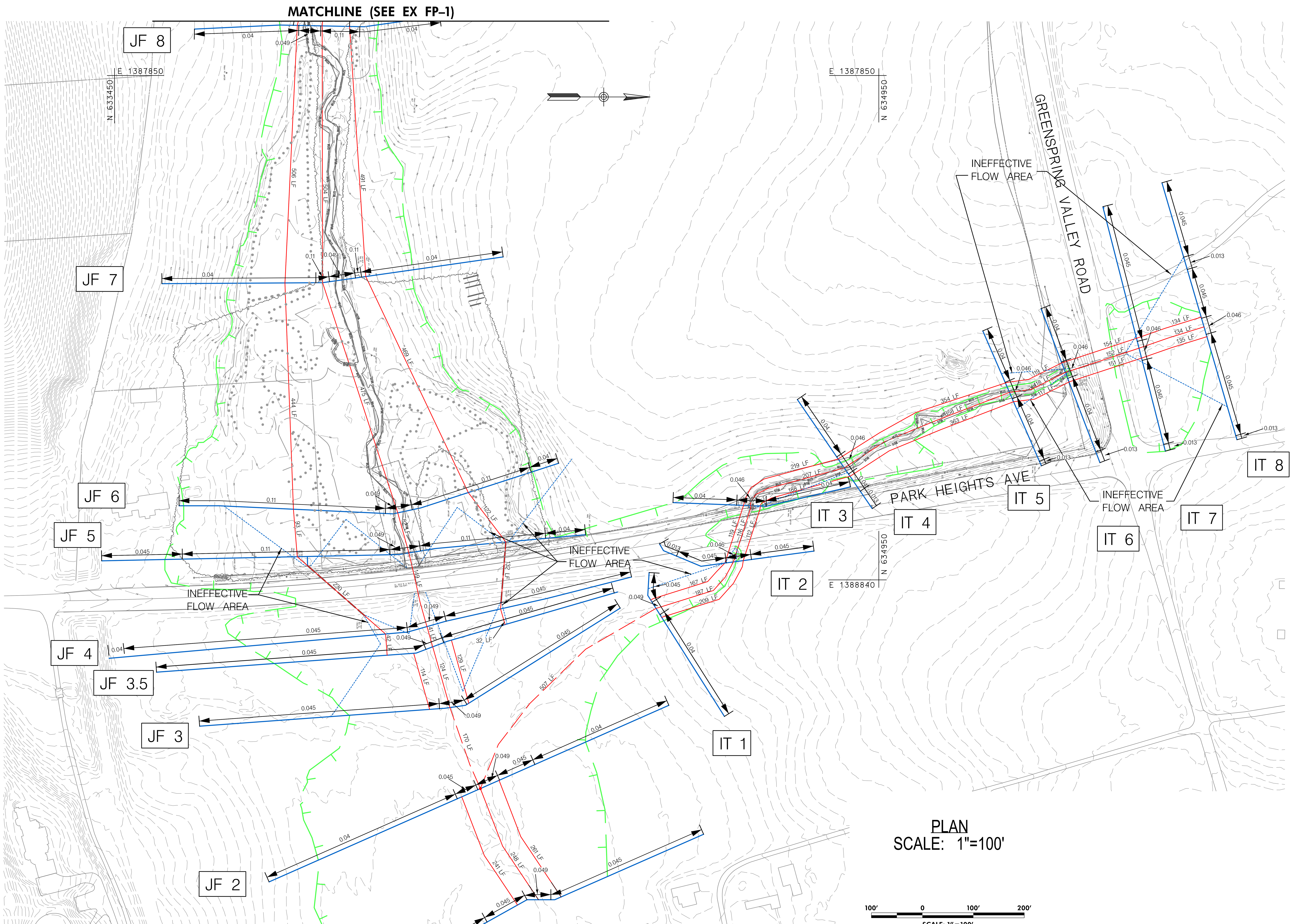
SCALE AS SHOWN	DATE SEPTEMBER, 2020	PROJECT NO.	17-10977-002
MDE PROJECT NO. 21-SF-0044		CONTRACT NO.	KH-3038-0000
DESIGNED BY PVC		COUNTY	BALTIMORE COUNTY
DRAWN BY PVC		LOGMILE	
CHECKED BY JJM /MRG		HORIZONTAL SCALE	N/A
F.A.P. NO. SEE TITLE SHEET		VERTICAL SCALE	N/A

DRAWING NO. EX. FP - 1 OF 2 SHEET NO. xx OF xx

www.jmt.com

BY: MOCCA -

Q:\2017\17-10977_002_Eccleston-PRM_Turnkey\CADD\prFP_EX01_ECCLESTON_20.dgn
Thursday, October 08, 2020 AT 07:57 AM



LEGEND

- REACH LENGTHS
- EXISTING HEC-RAS CROSS SECTIONS
- EXISTING FLOODPLAIN
- INEFFECTIVE FLOW AREA

OWNER /DEVELOPER INFORMATION

MARYLAND TRANSPORTATION AUTHORITY
2310 BROENING HWY
BALTIMORE, MD 21224

MARYLAND COORDINATE SYSTEM - HOR. NAD 83/91 MD STATE PLANE VERT. NAVD 88

GREENSPRING VALLEY ROAD
SW CORNER PARK HEIGHTS AVE
OWINGS MILLS, MD 21117

BY: MOCCA -

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DESIGN PROFESSIONAL

JEREMY KOSER

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ECCLESTON MITIGATION SITE

REVISIONS

FLOODPLAIN MAP – EXISTING CONDITIONS

SCALE	AS SHOWN	DATE	SEPTEMBER, 2020
PROJECT NO.	17-10977-002	MDE PROJECT NO.	21-SF-0044
CONTRACT NO.	KH-3038-0000	DESIGNED BY	PVC
COUNTY	BALTIMORE COUNTY	DRAWN BY	PVC
LOGMILE		CHECKED BY	JJM /MRG
HORIZONTAL SCALE	N/A	F.A.P. NO.	SEE TITLE SHEET
VERTICAL SCALE	N/A		

DRAWING NO. **EX. FP – 2** OF **2** SHEET NO. xx OF xx

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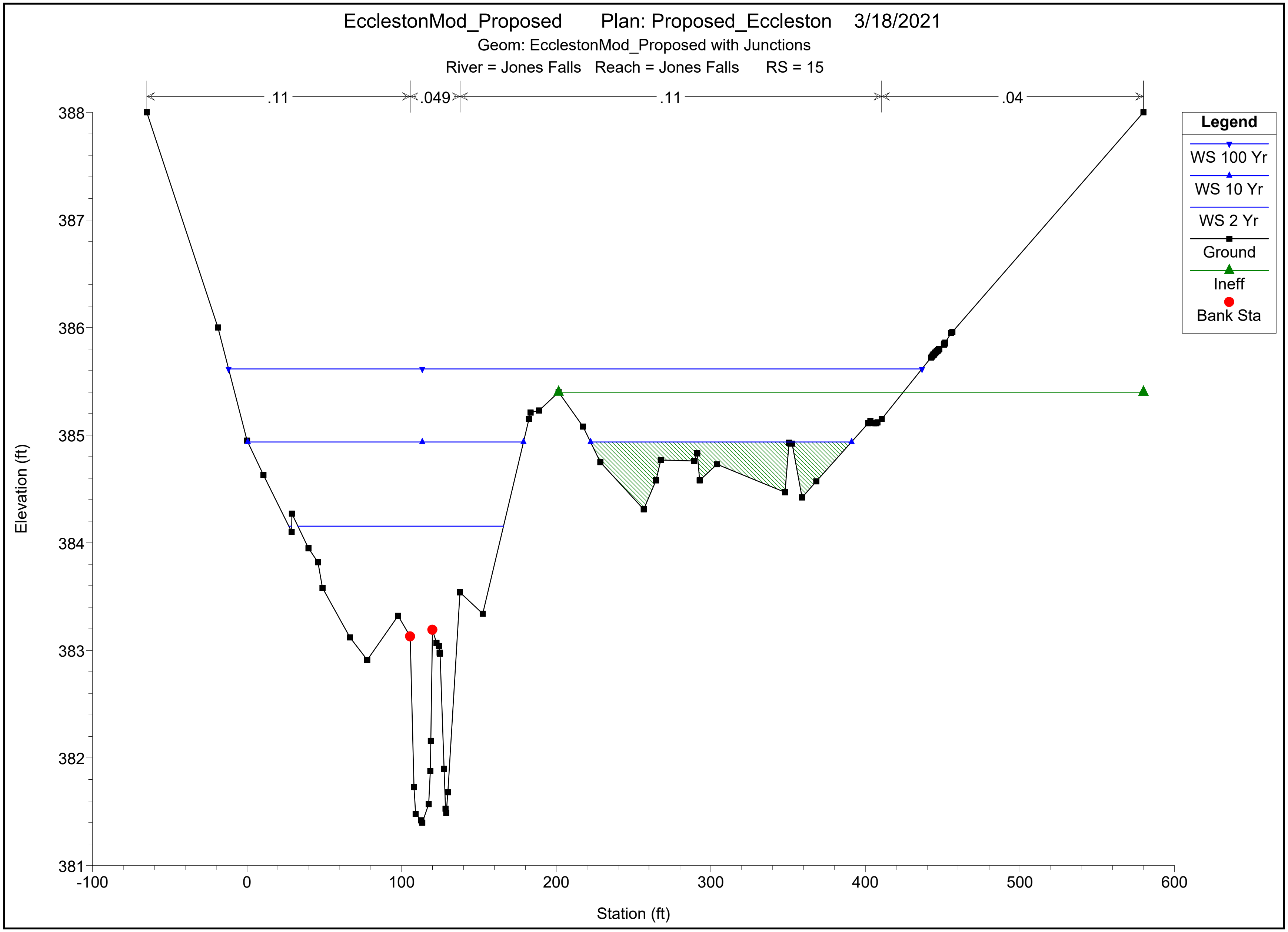
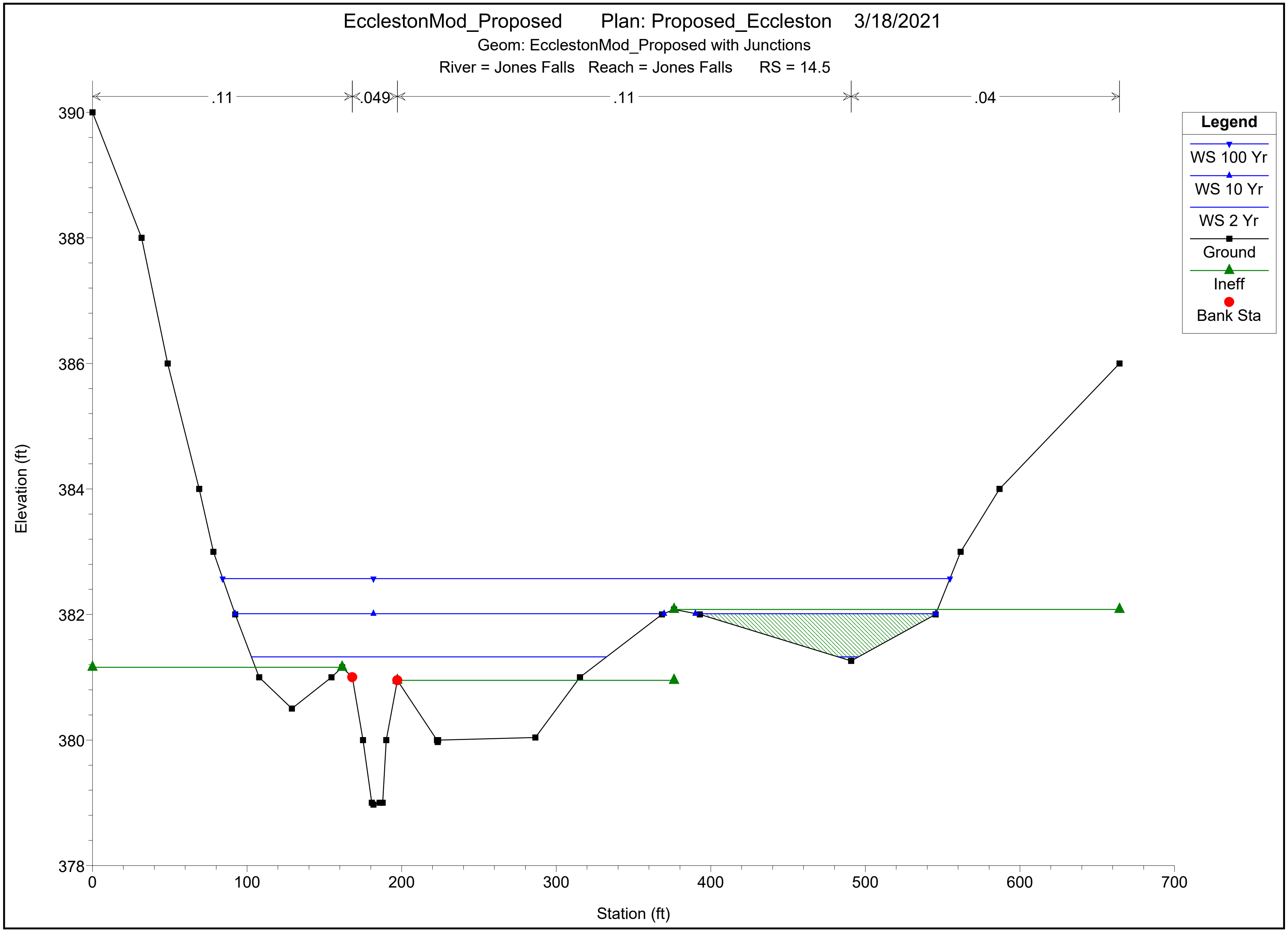

EcclestonMod_Proposed   Plan: Proposed_Eccleston   3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls   Reach = Jones Falls   RS = 15
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
388
387
386
385
384
383
382
381
-100
0
100
200
300
400
500
600
Station (ft)



EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls RS = 14.5
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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388
386
384
382
380
378
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300
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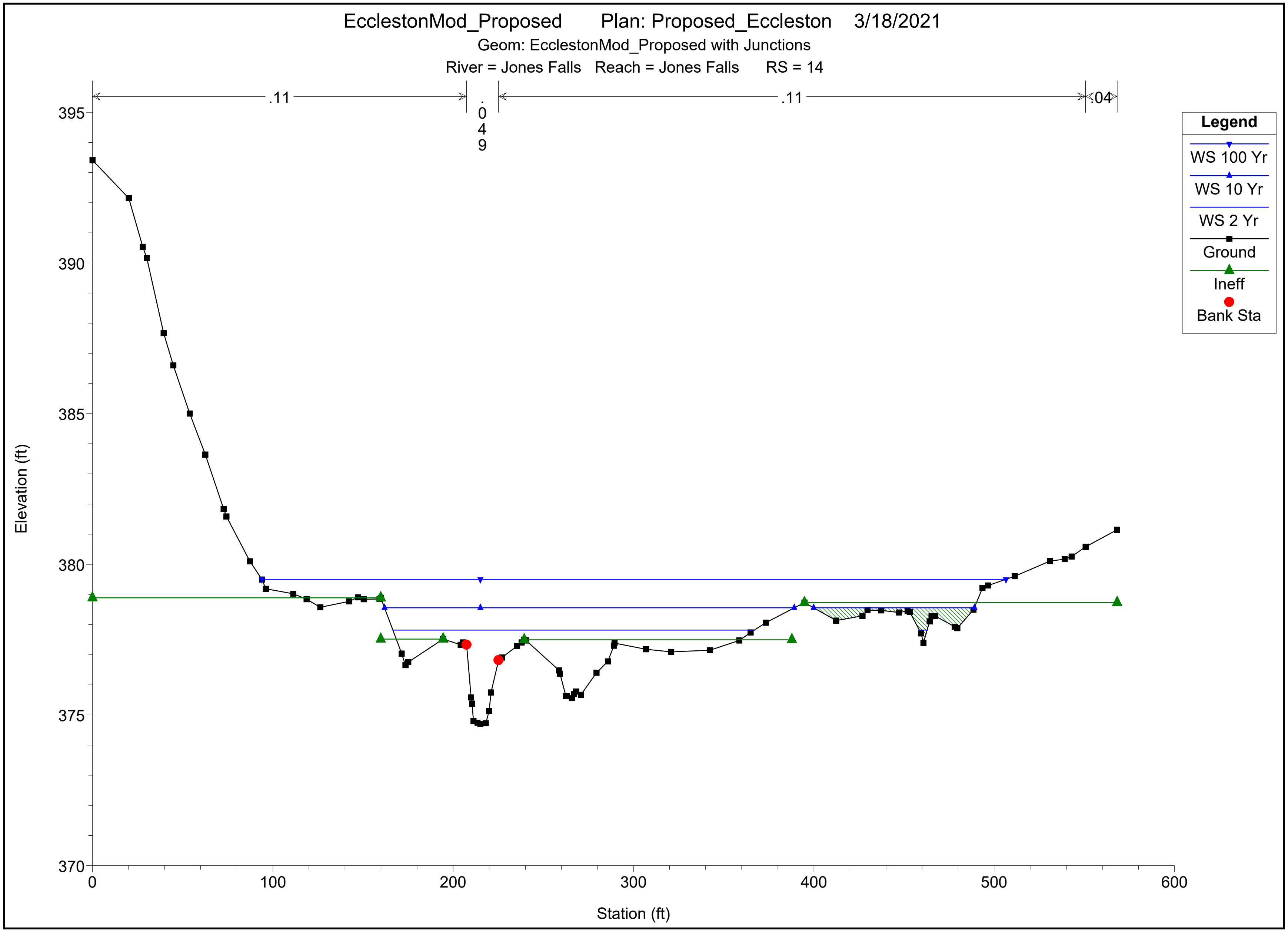
500
600
700



EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls RS = 14
.11
.049
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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385
380
375
370
0
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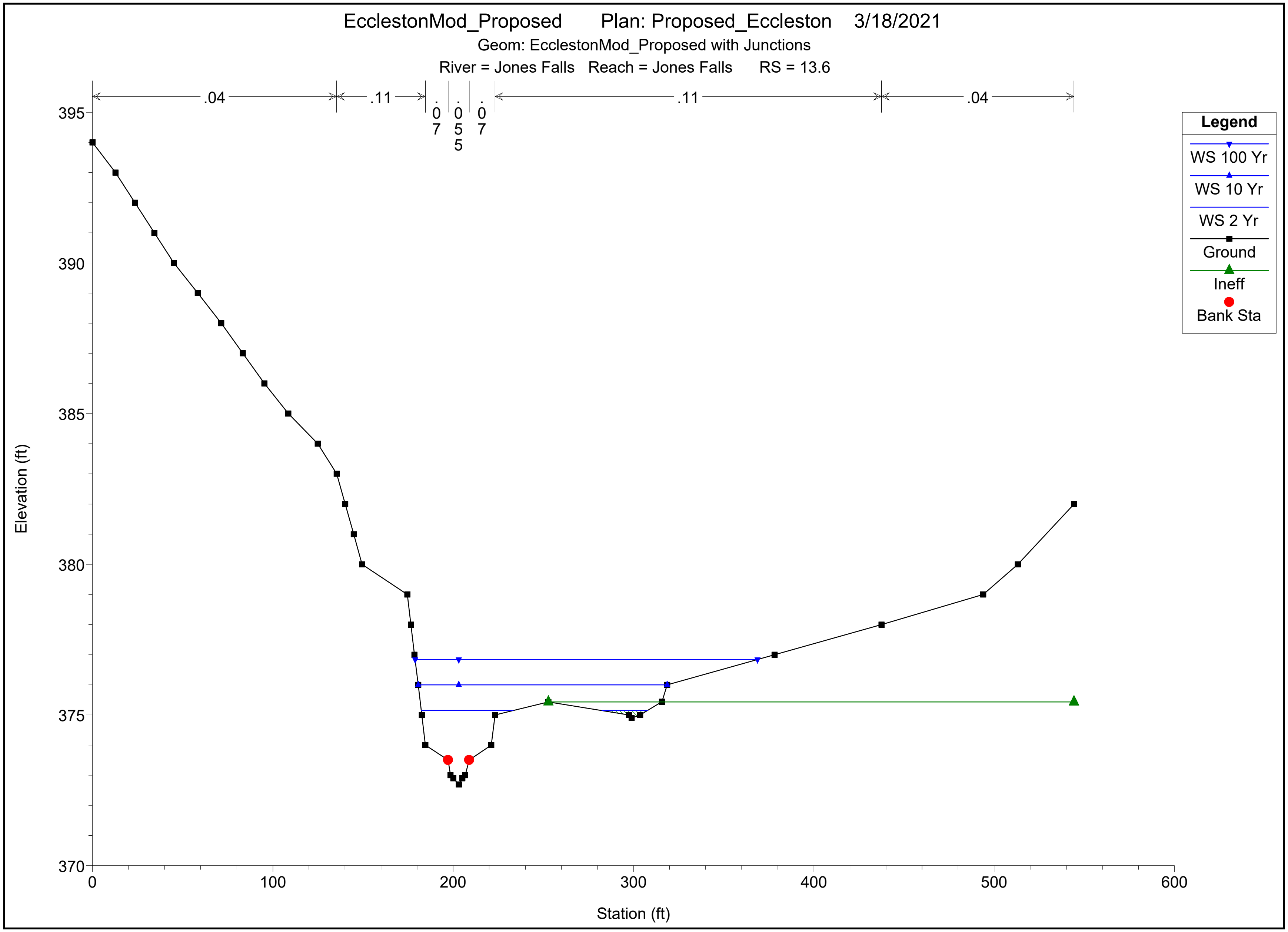
300
400
500
600



EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls RS = 13.6
.04
.11
.07
.055
.07
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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390
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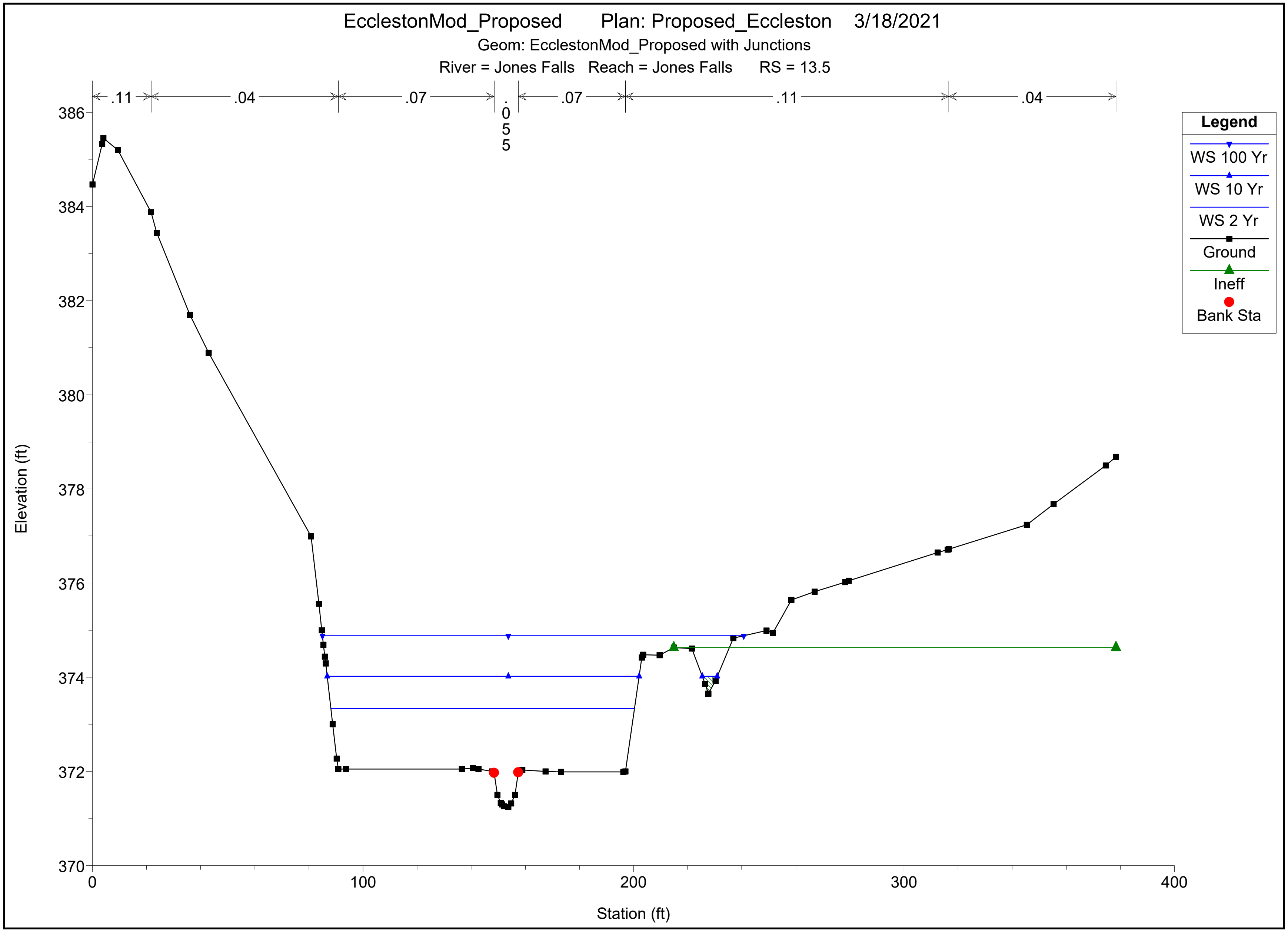
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Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls RS = 13.5
.11
.04
.07
.055
.07
.11
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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384
382
380
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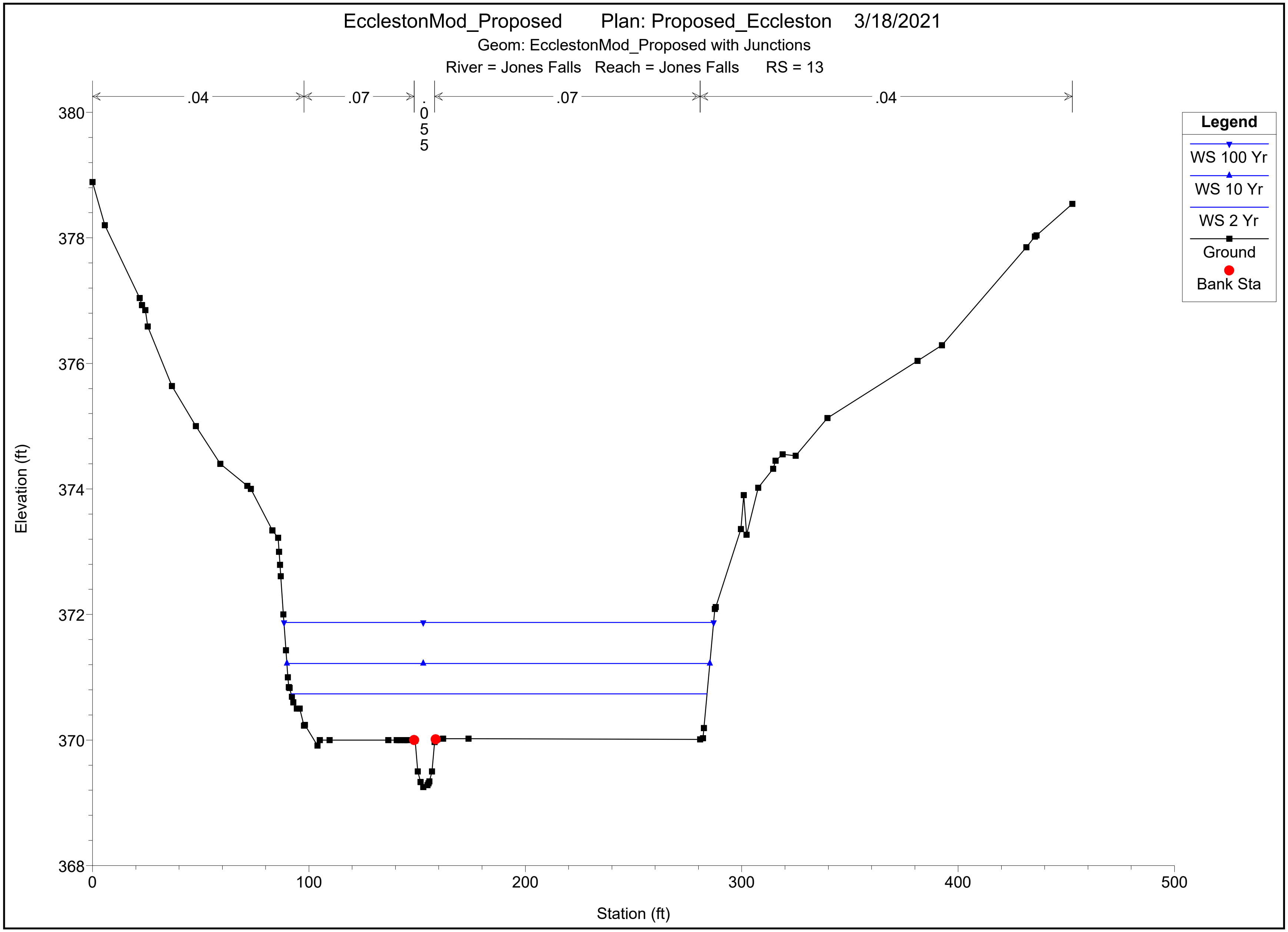

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls RS = 13
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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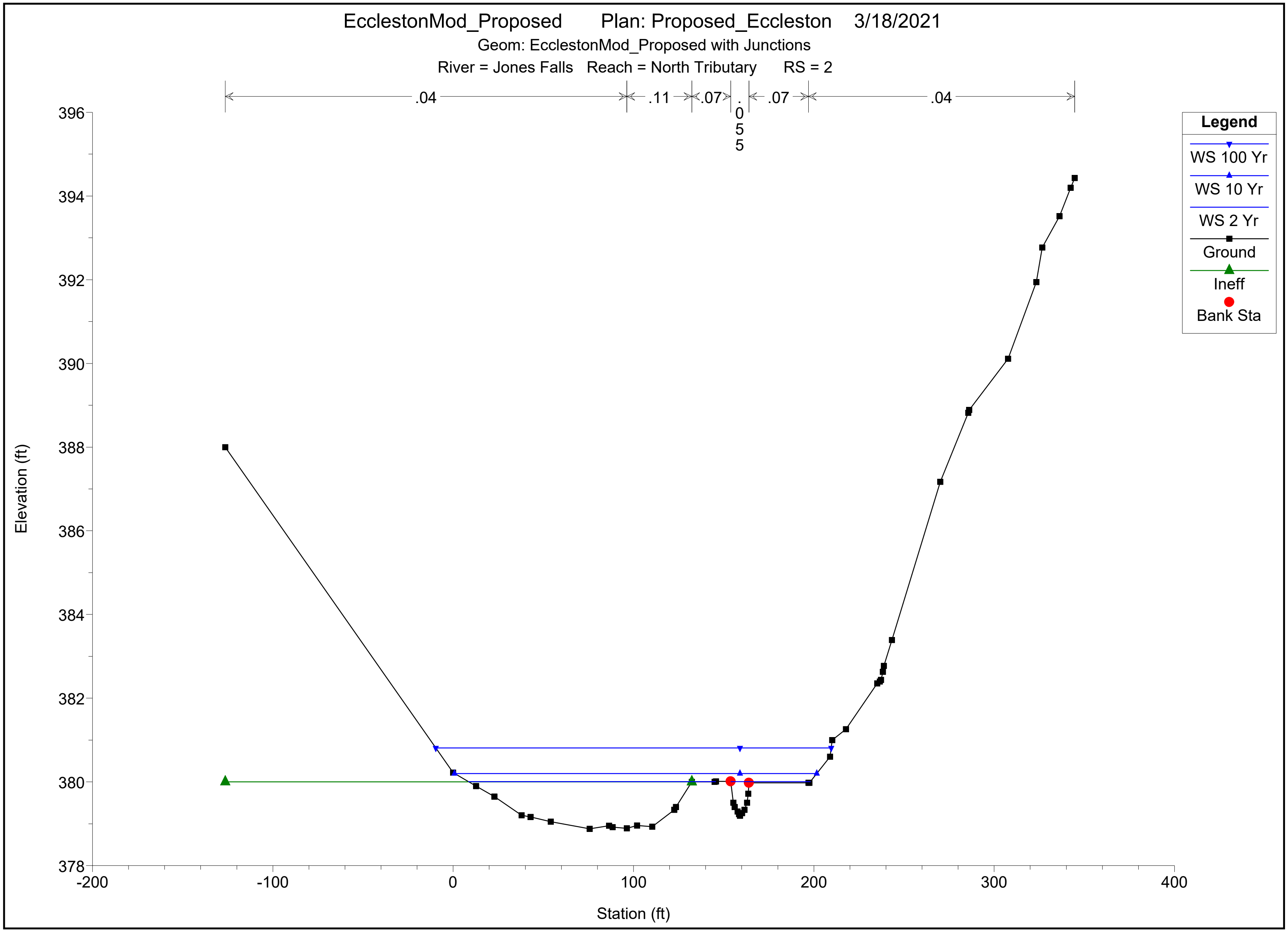
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = North Tributary RS = 2
.04
.11
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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394
392
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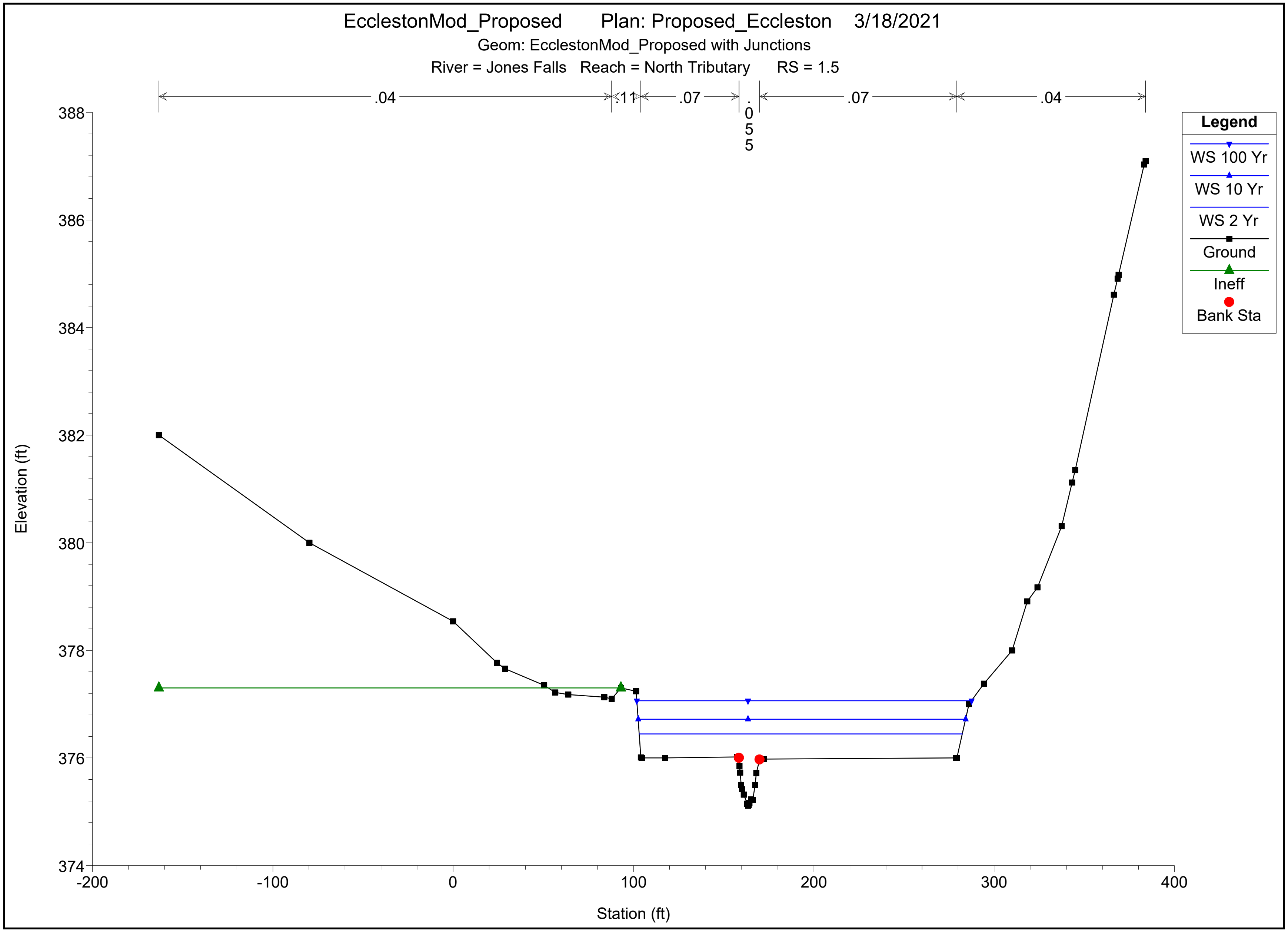

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = North Tributary RS = 1.5
.04
.11
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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386
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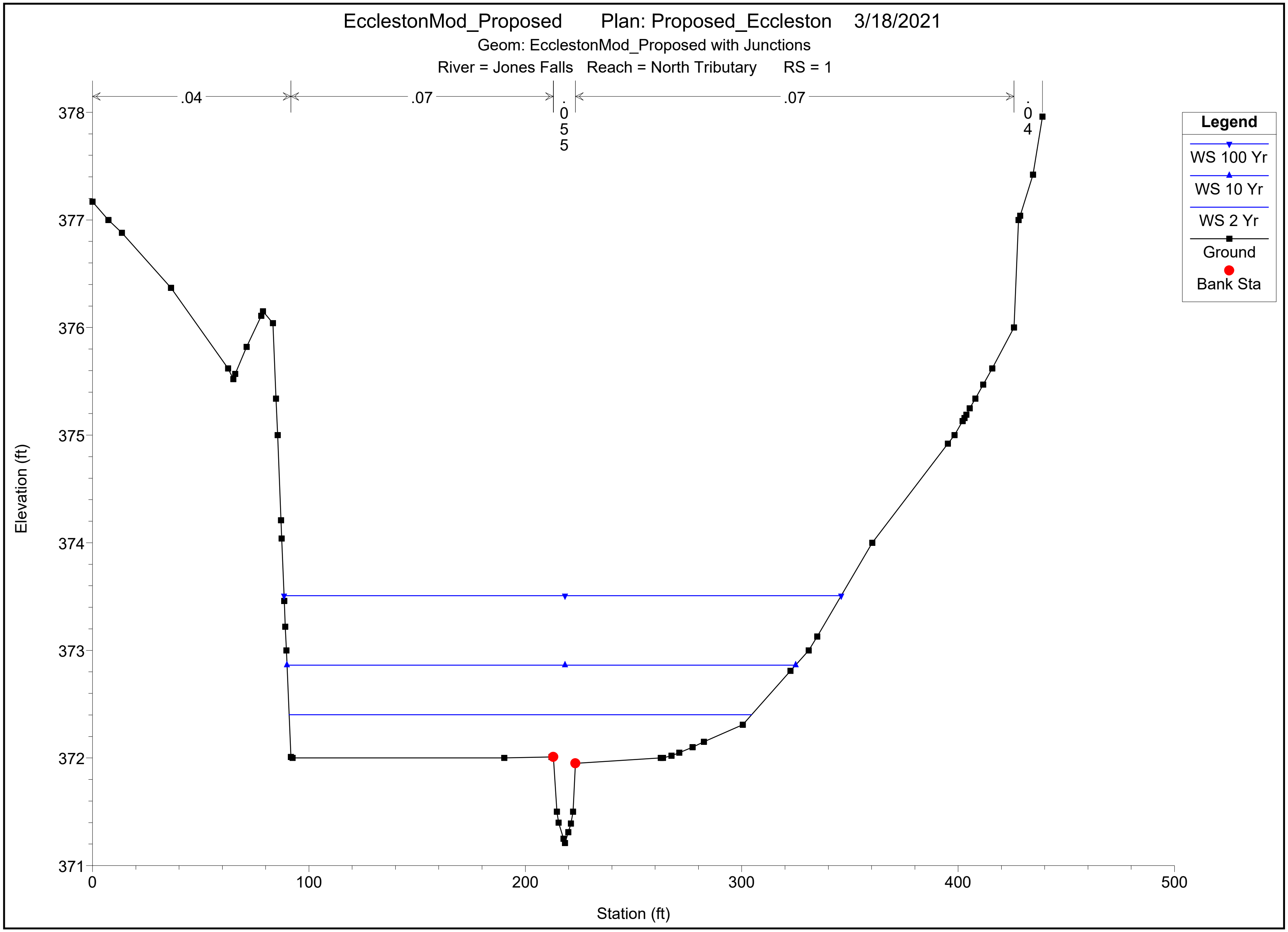

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = North Tributary RS = 1
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
378
377
376
375
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373
372
371
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100
200
300
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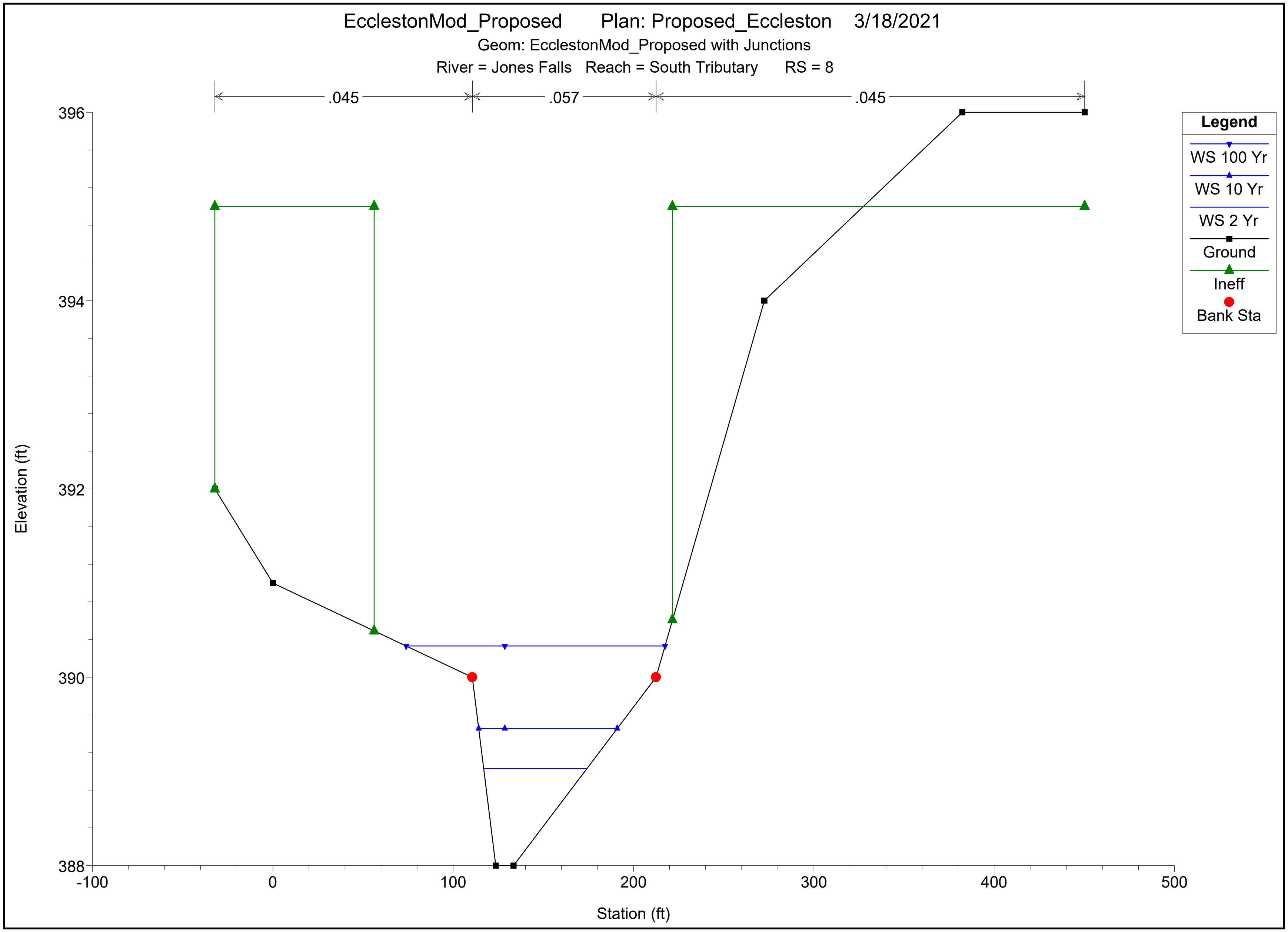
500



EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 8
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
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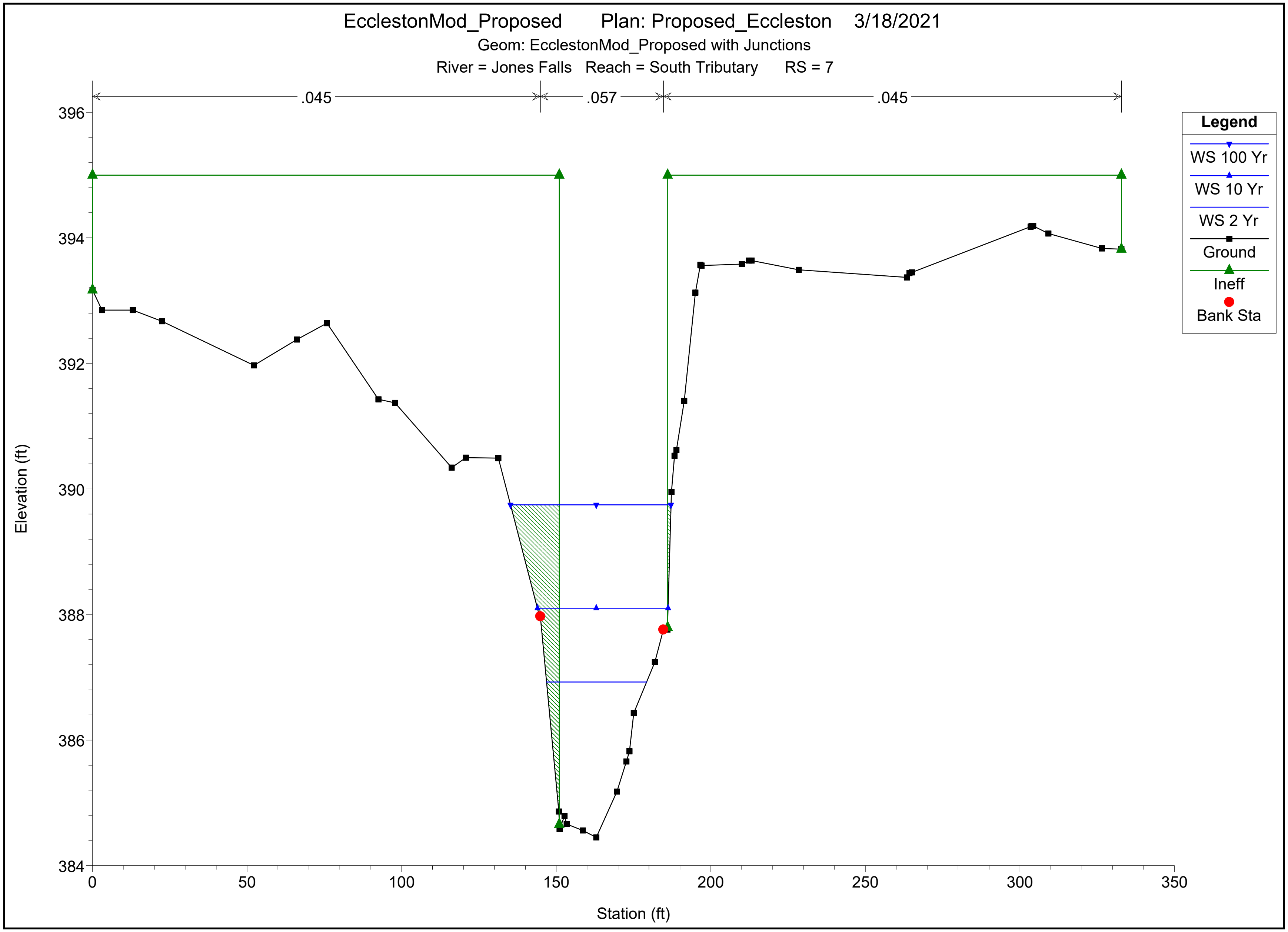
0
100
200
300
400
500
Station (ft)



EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 7
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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386
388
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394
396
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300
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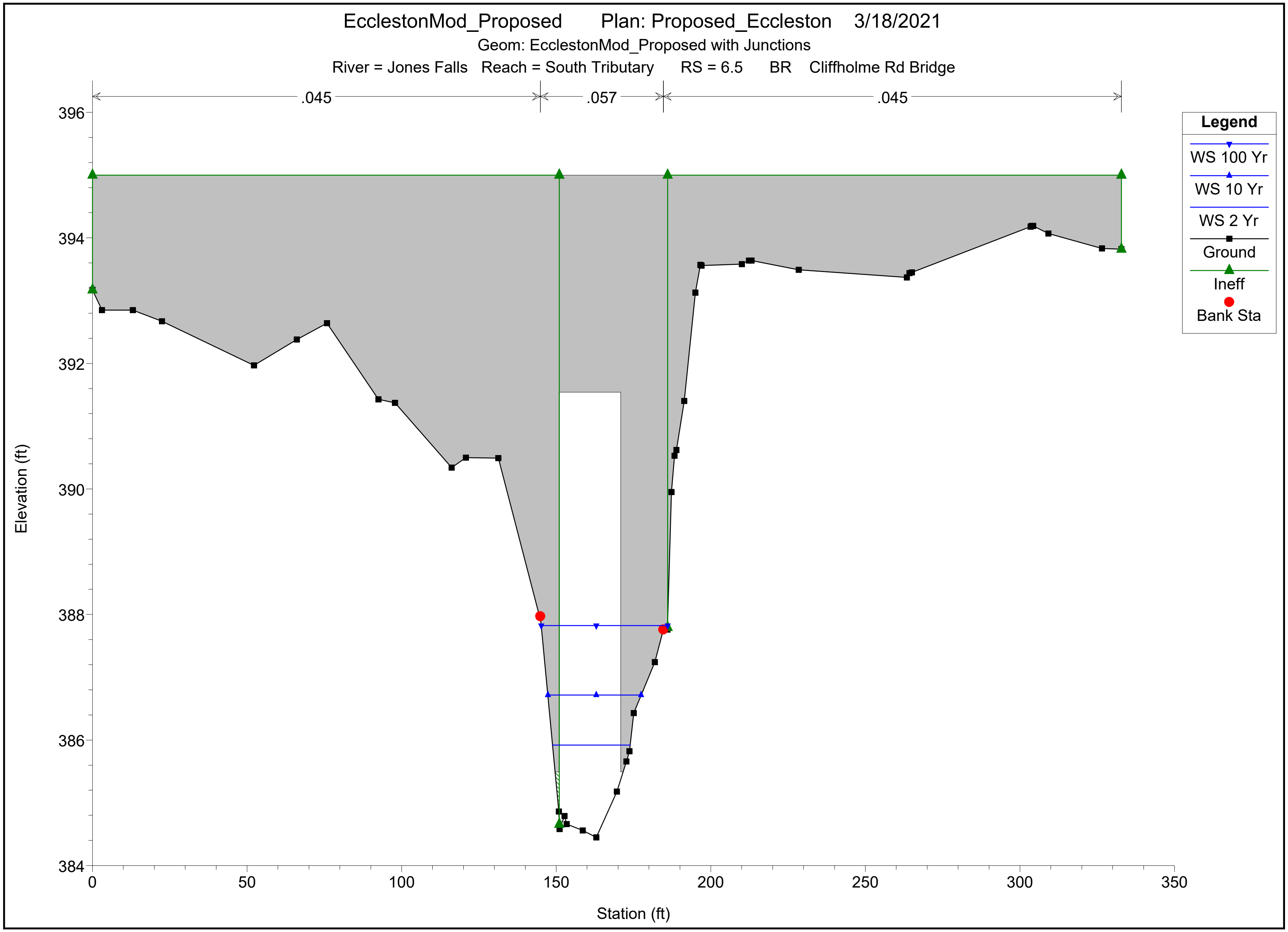
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 6.5 BR Cliffholme Rd Bridge
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
396
394
392
390
388
386
384
0
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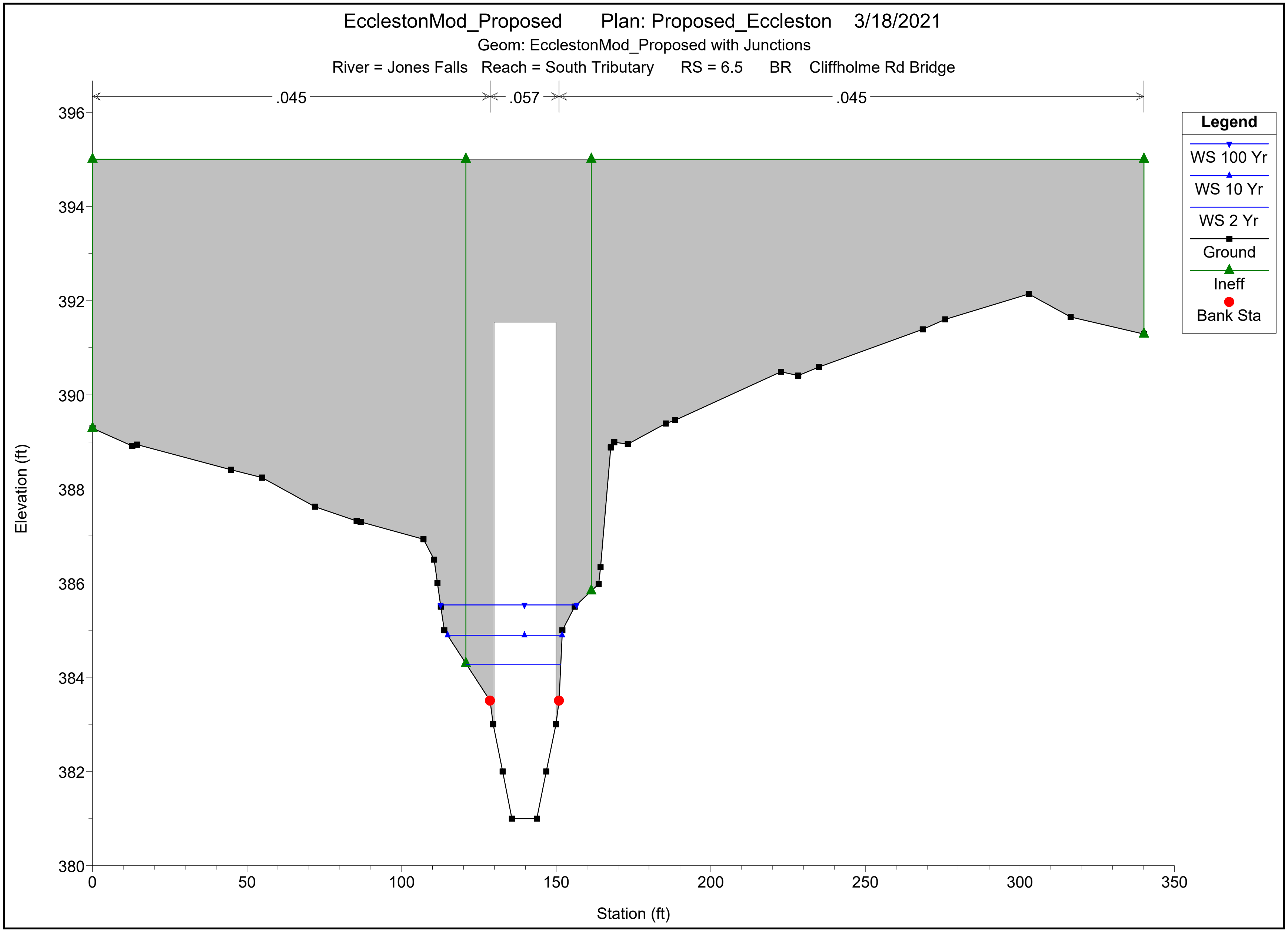
100
150
200
250
300
350


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 6.5 BR Cliffholme Rd Bridge
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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394
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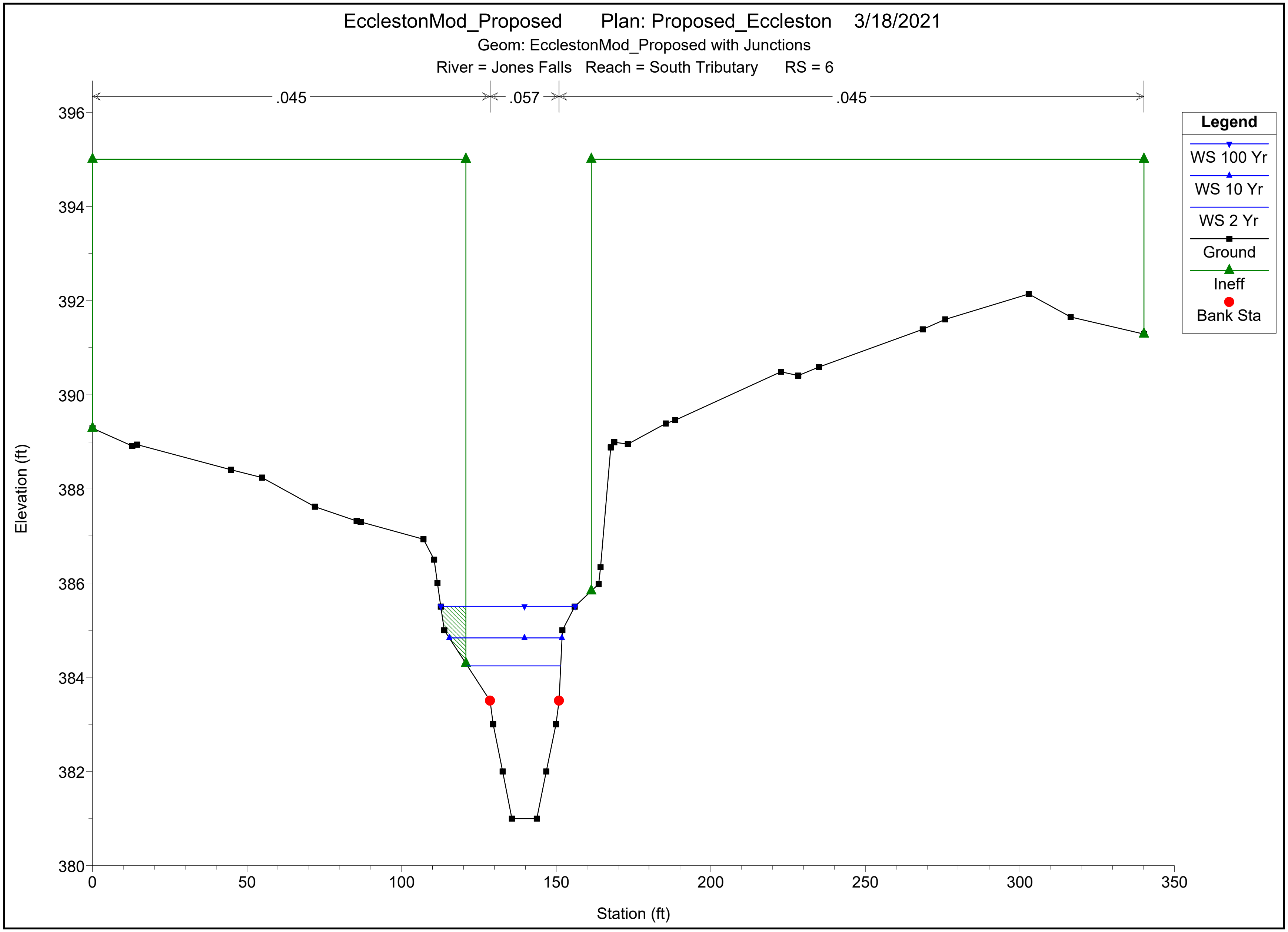

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 6
.045
.057
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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382
384
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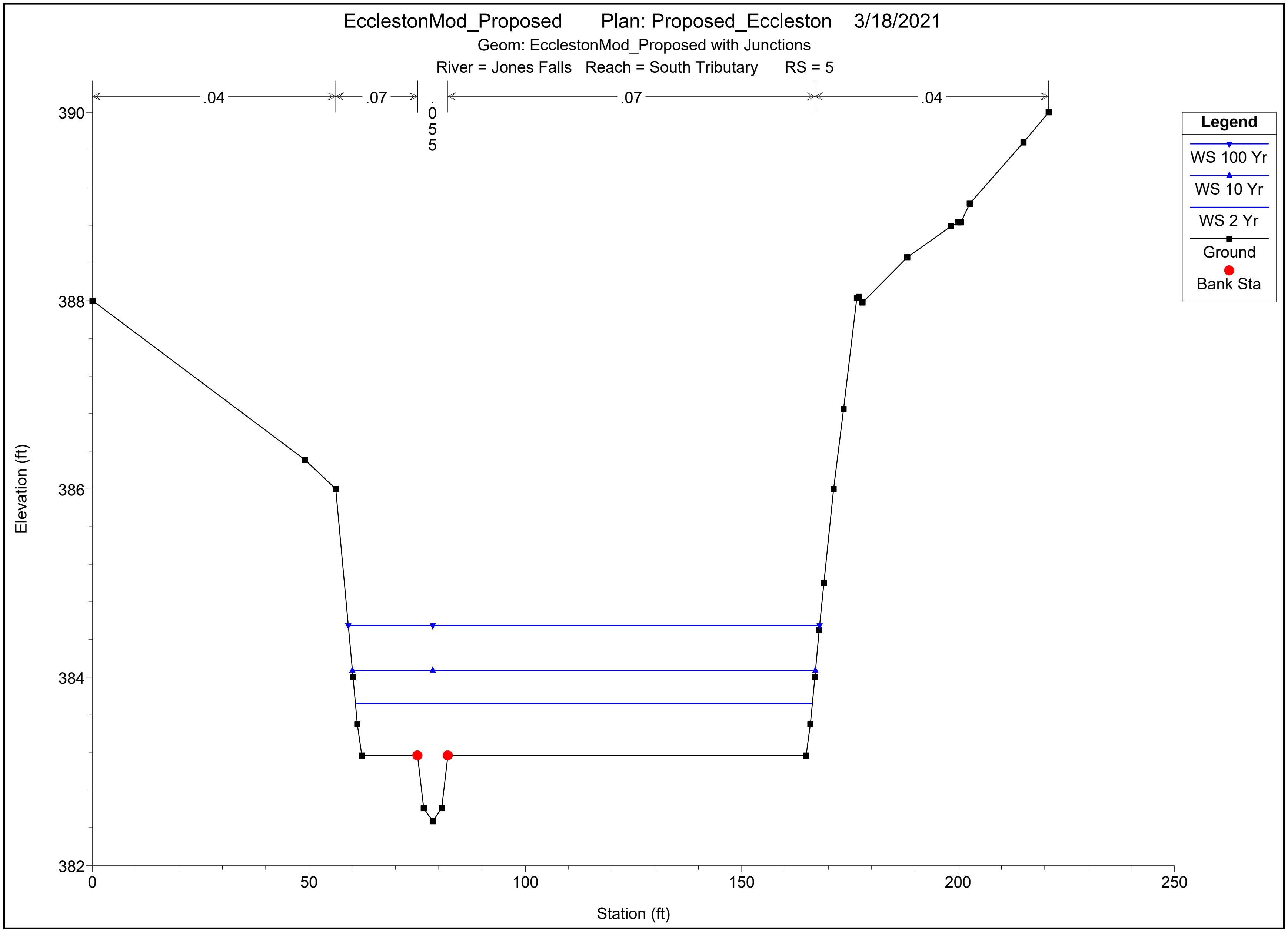

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 5
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
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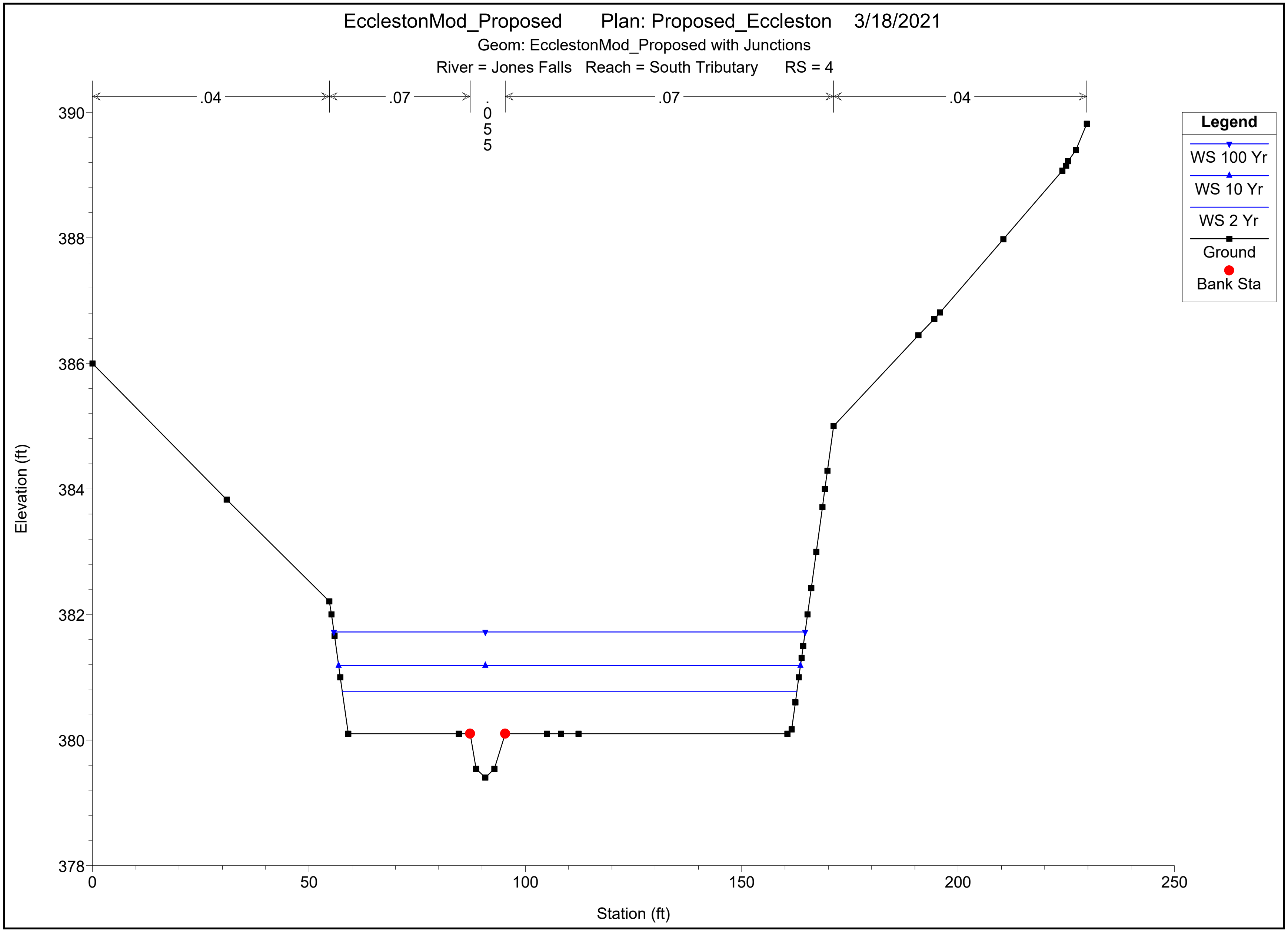
388
386
384
382
0
50
100
150
200
250
Station (ft)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Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 4
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
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150
200
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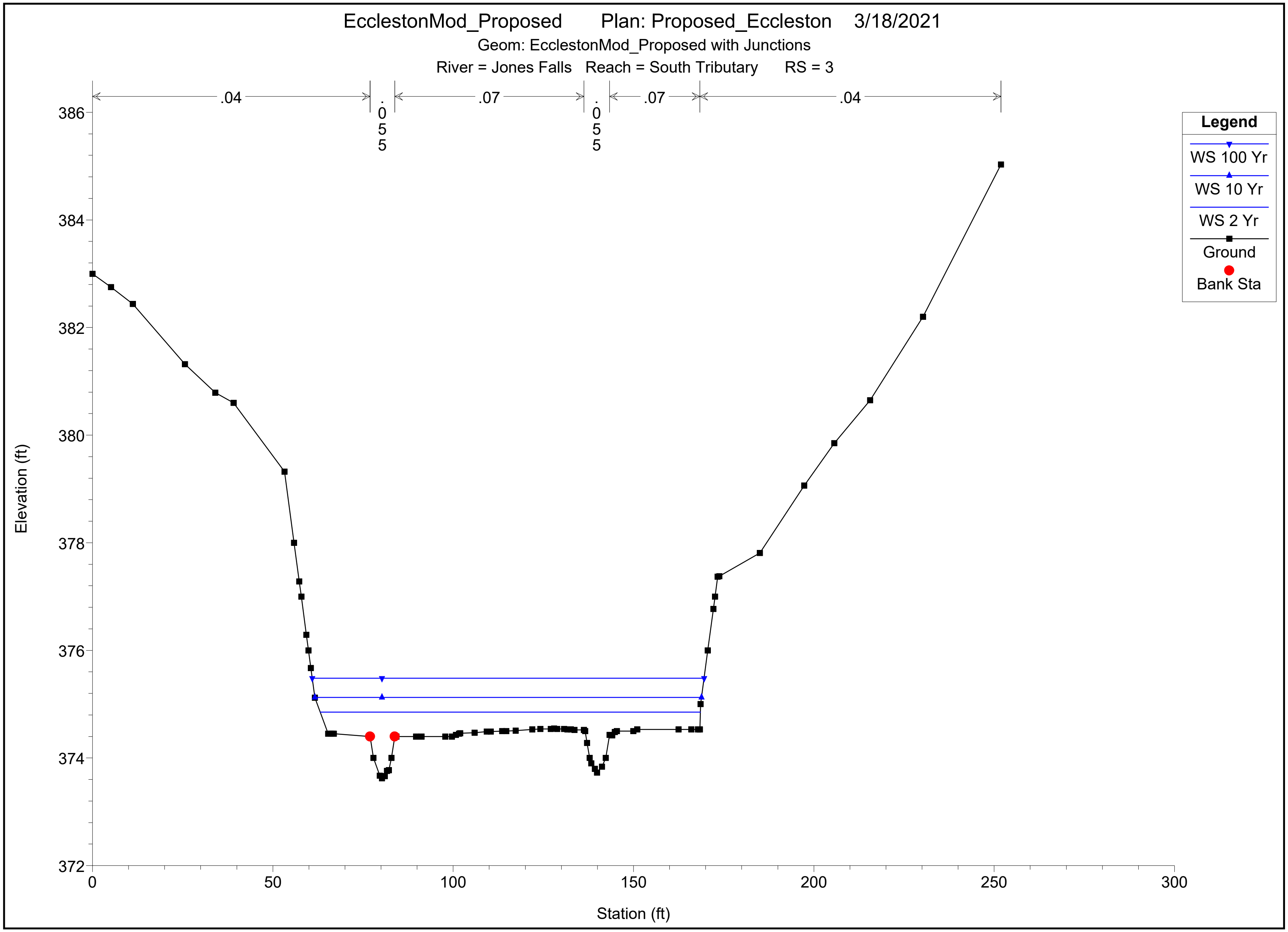
Station (ft)


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 3
.04
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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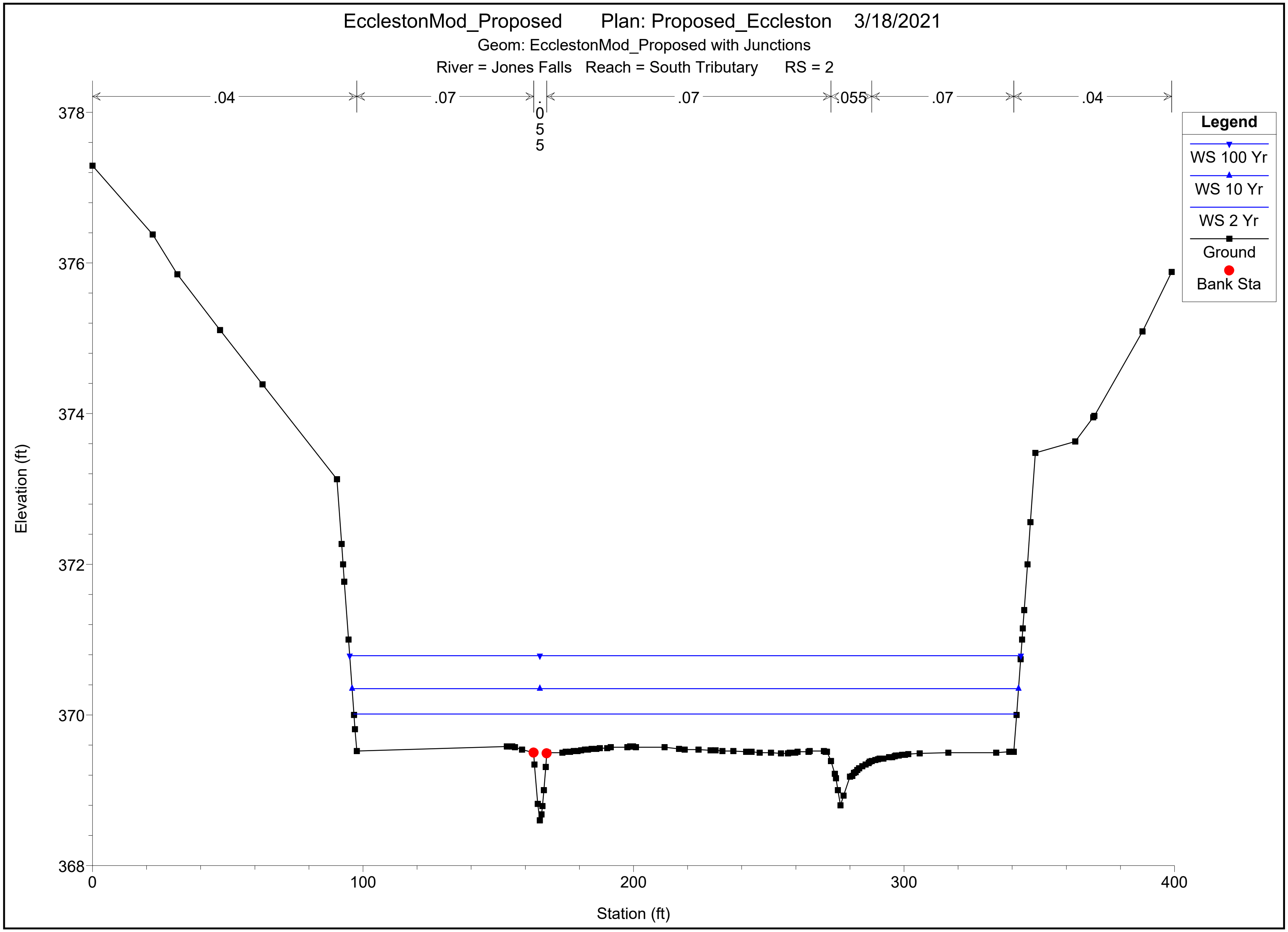
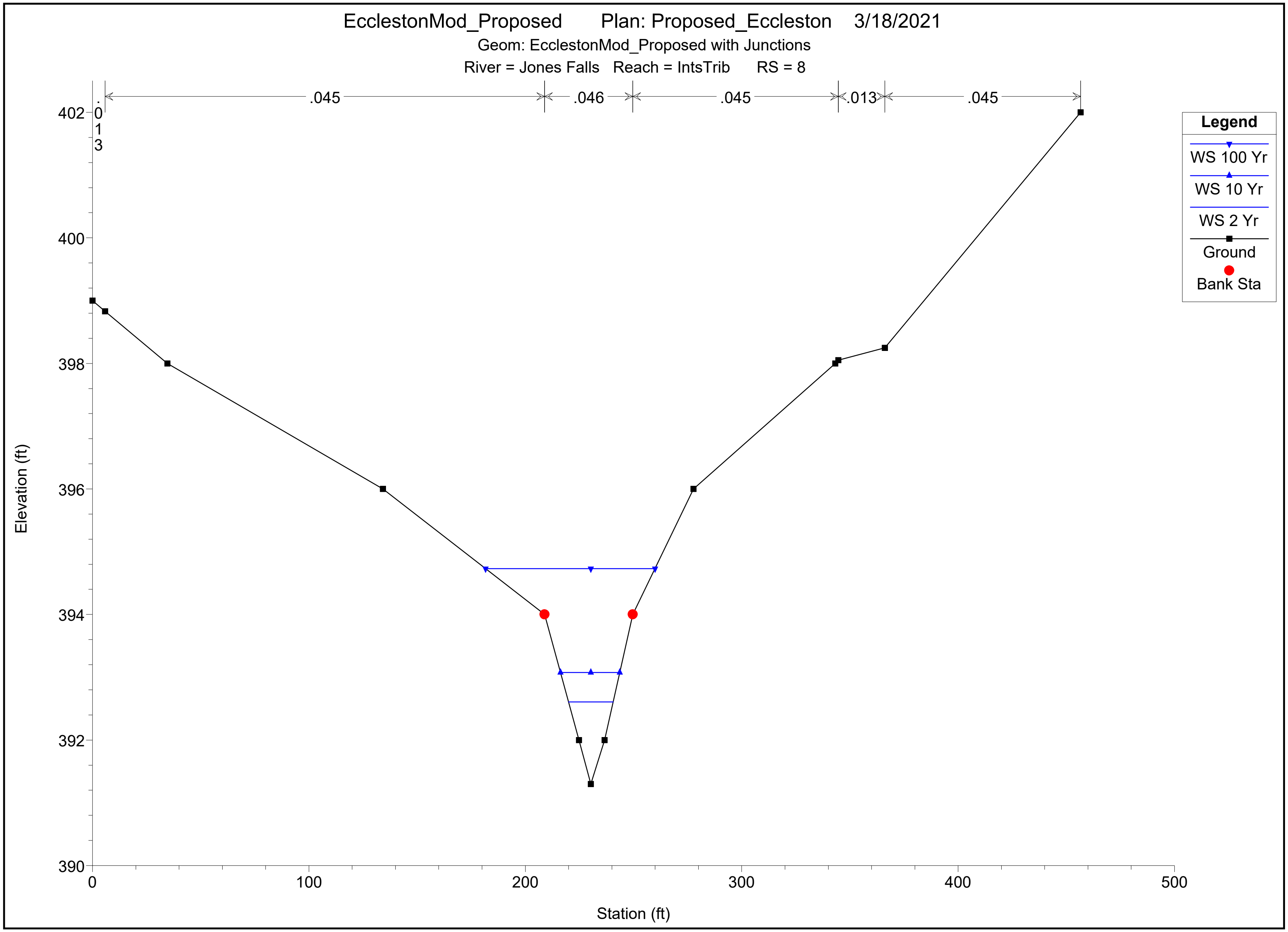


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = South Tributary RS = 2
.04
.07
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
378
376
374
372
370
368
0
100
200
300
400
Station (ft)



EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 8
.013
.045
.046
.045
.013
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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394
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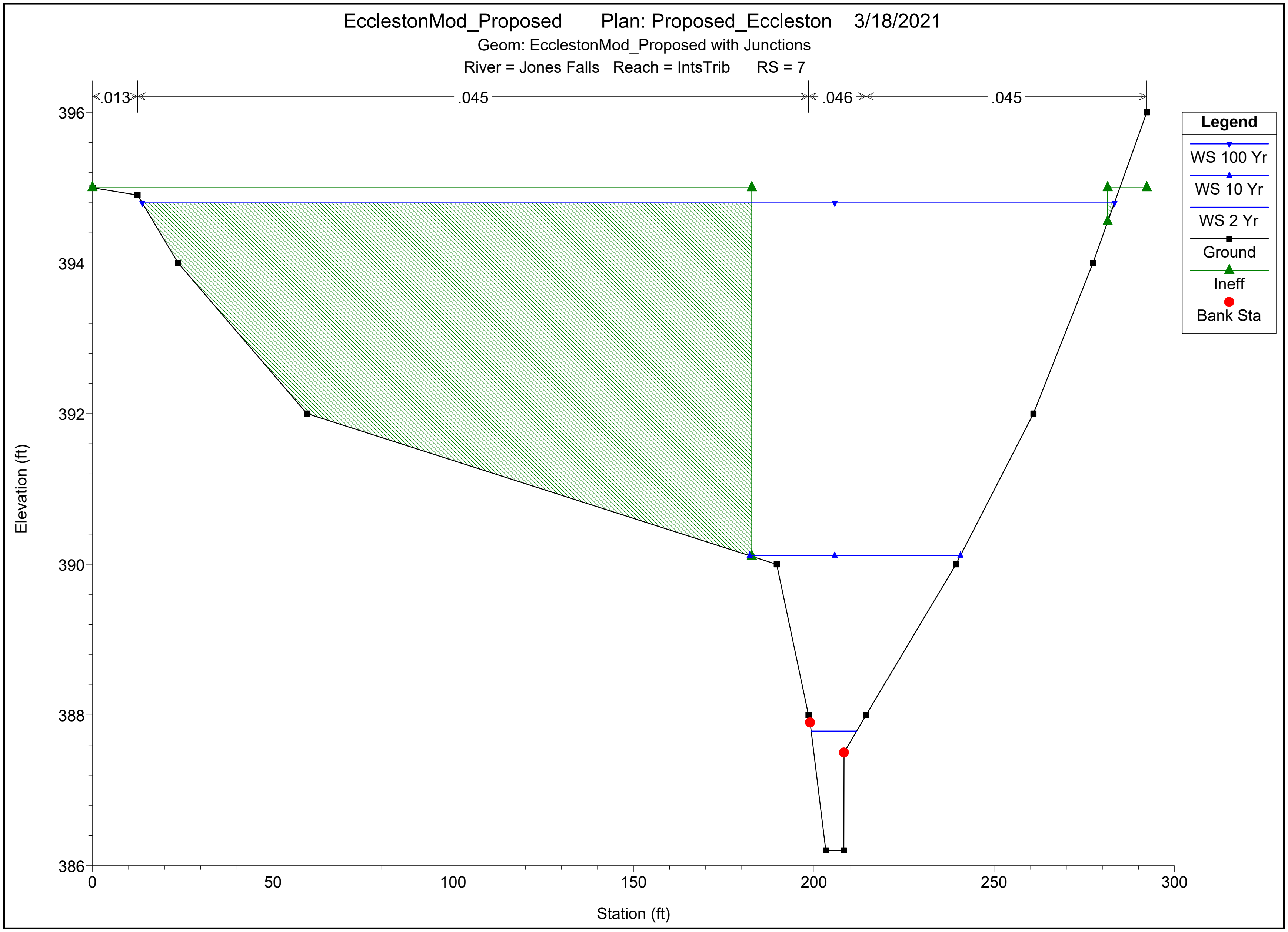

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 7
.013
.045
.046
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
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Station (ft)
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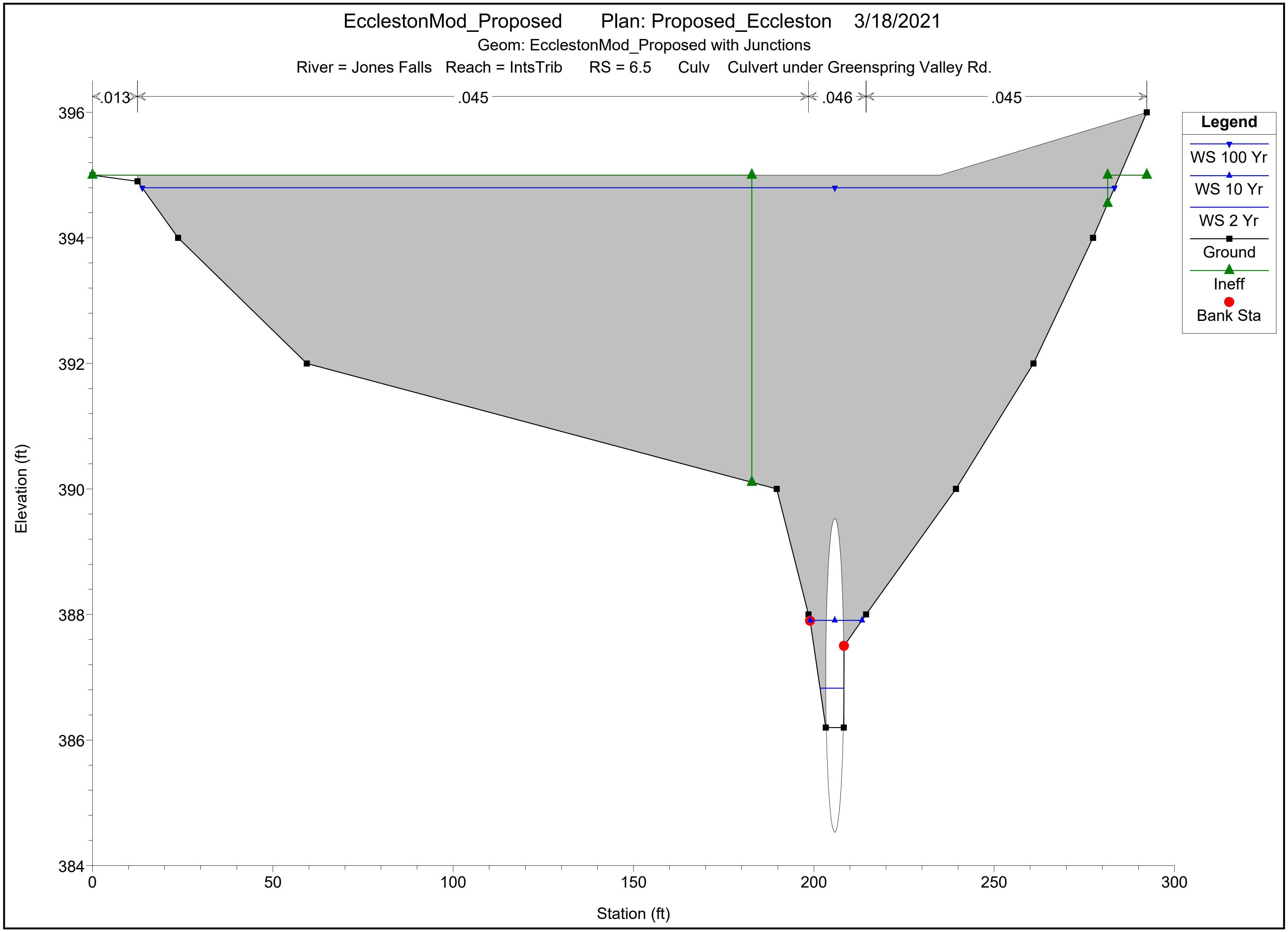

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 6.5 Culv Culvert under Greenspring Valley Rd.
.013
.045
.046
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
396
394
392
390
388
386
384
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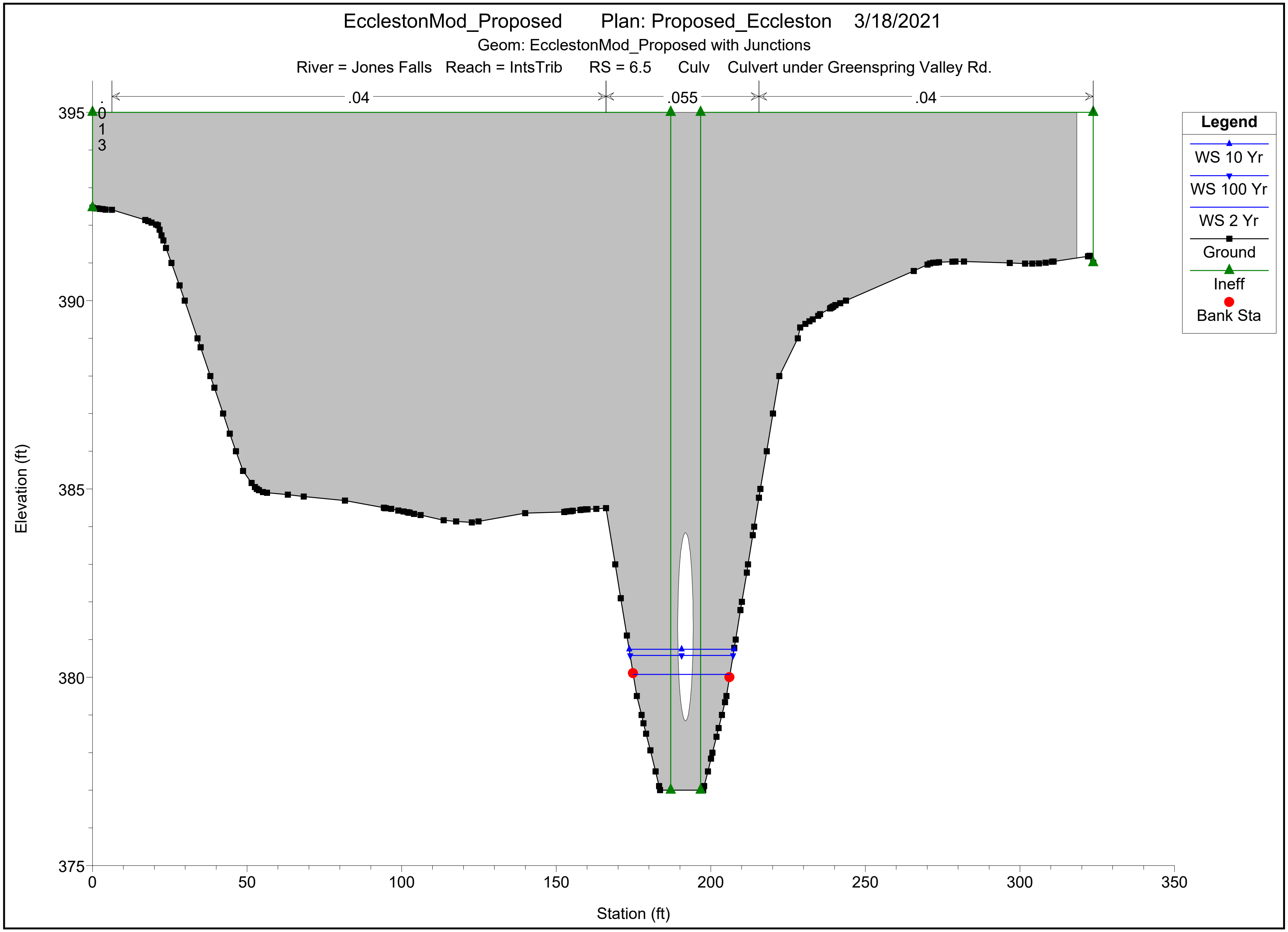
50
100
150
200
250
300
Station (ft)


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 6.5 Culv Culvert under Greenspring Valley Rd.
.04
.055
.04
.013
Legend
WS 10 Yr
WS 100 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
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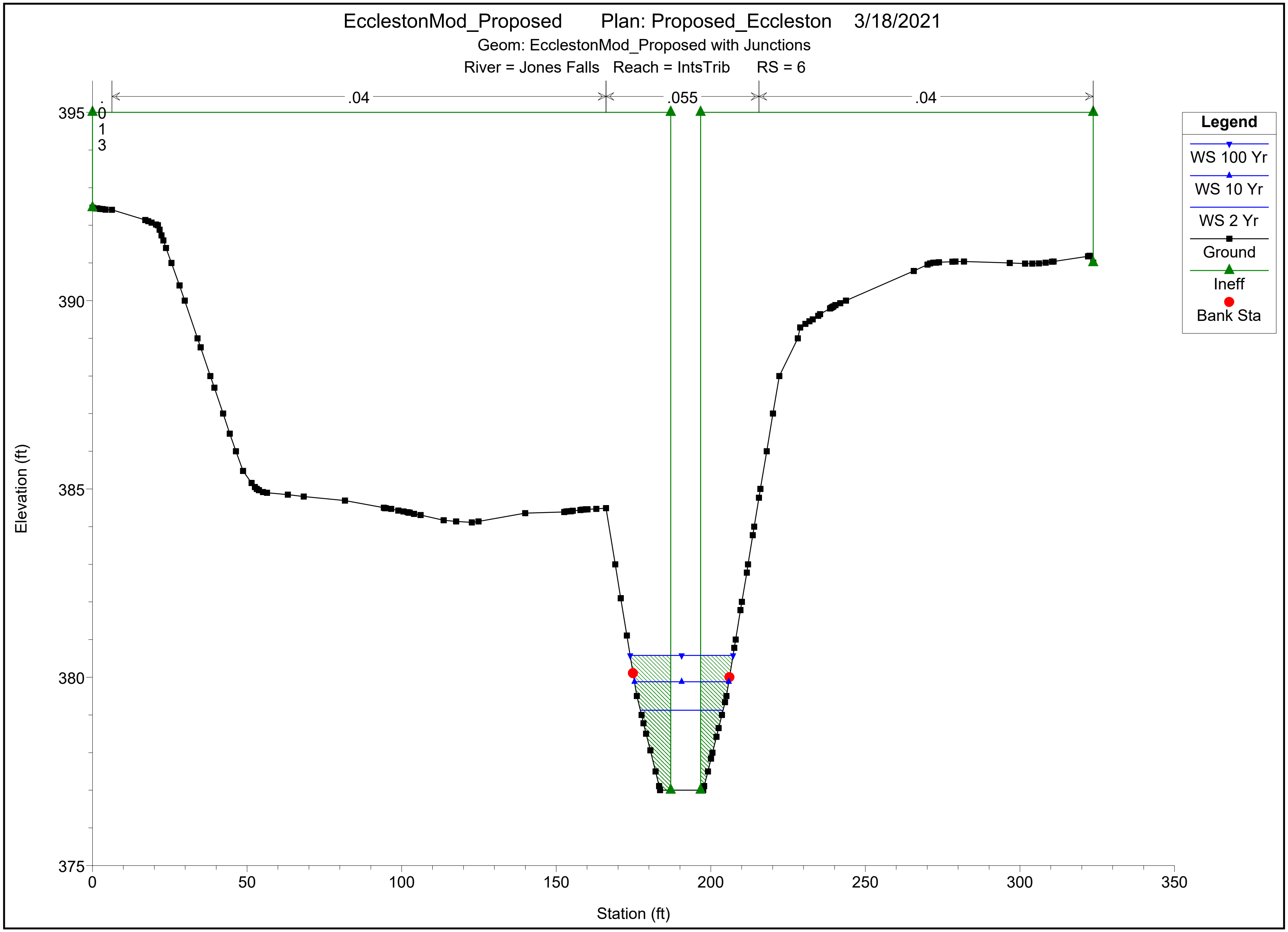
150
200
250
300
350



EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 6
.04
.055
.04
.013
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
0
50
100
150
200
250
300
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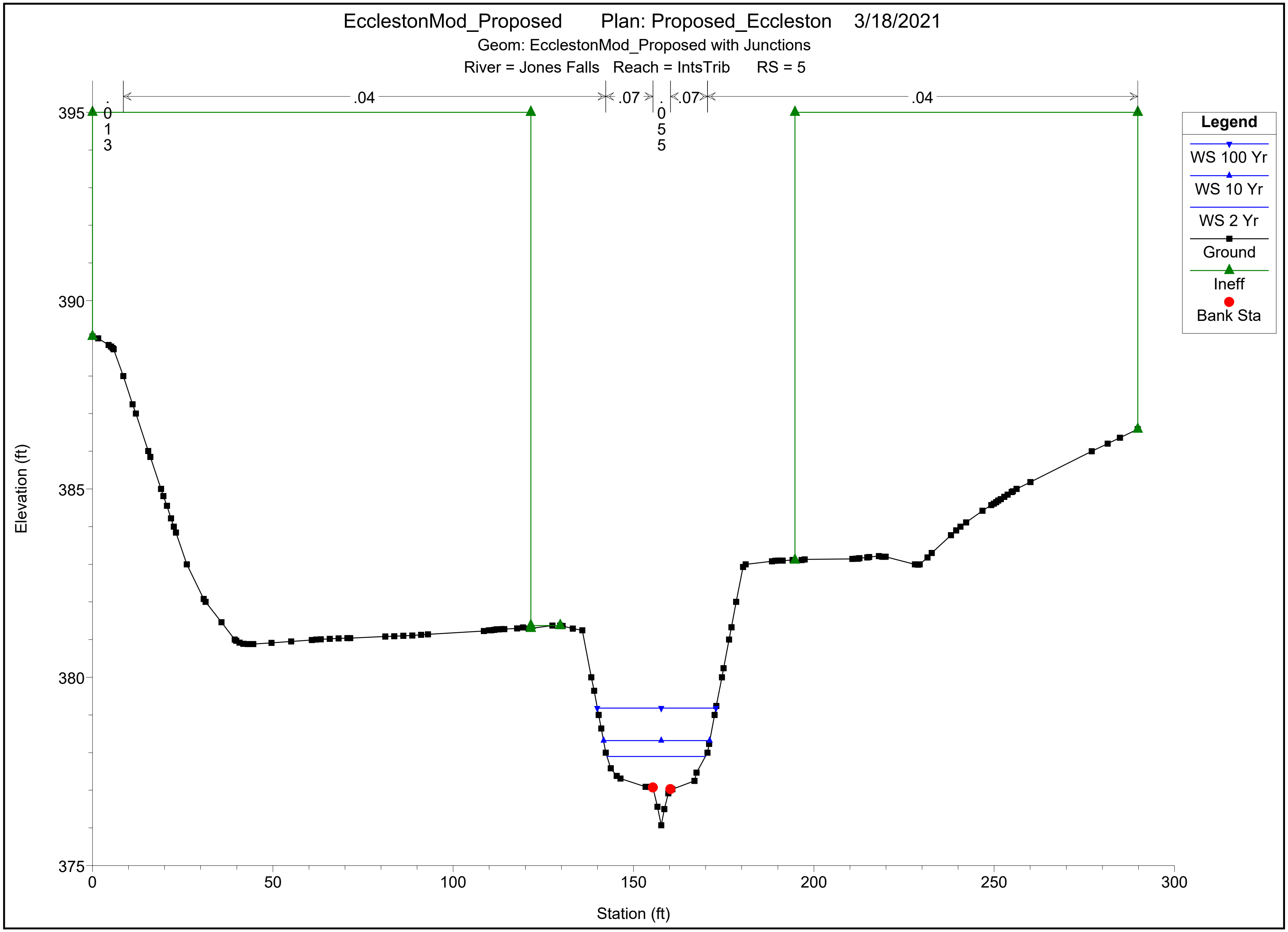
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 5
.04
.07
.07
.04
.013
.055
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
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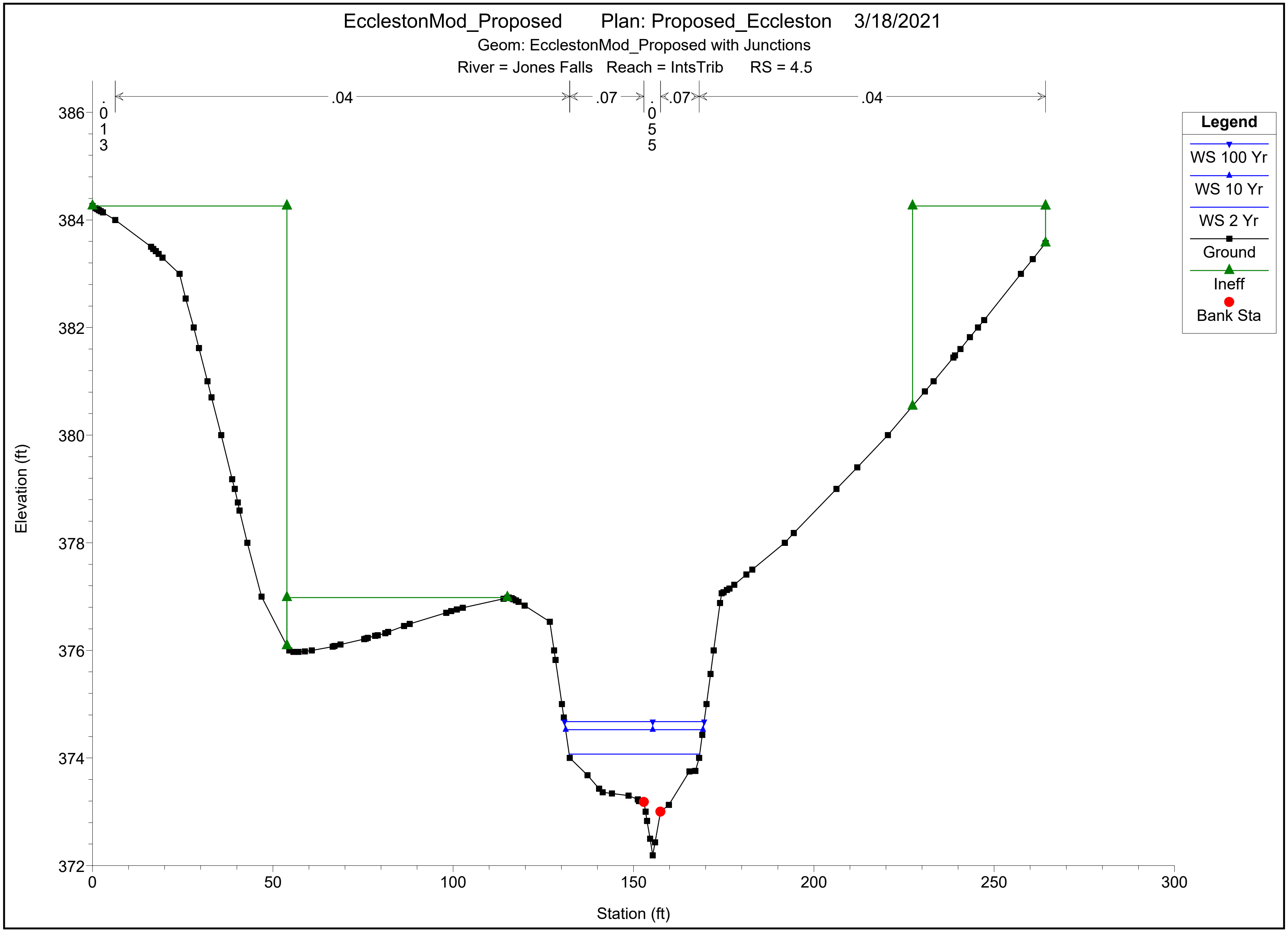
50
100
150
200
250
300



EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
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.013
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
372
374
376
378
380
382
384
386
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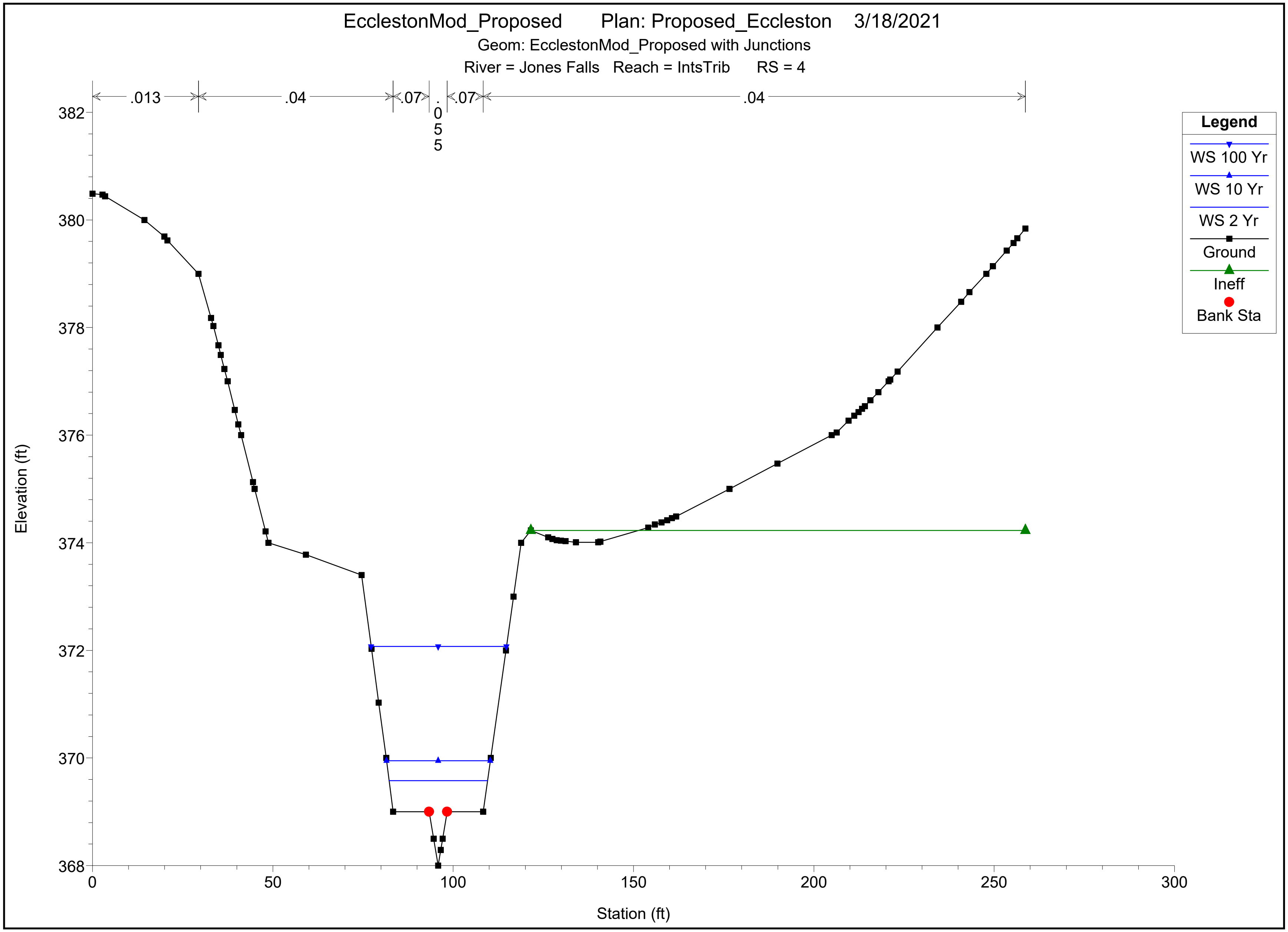
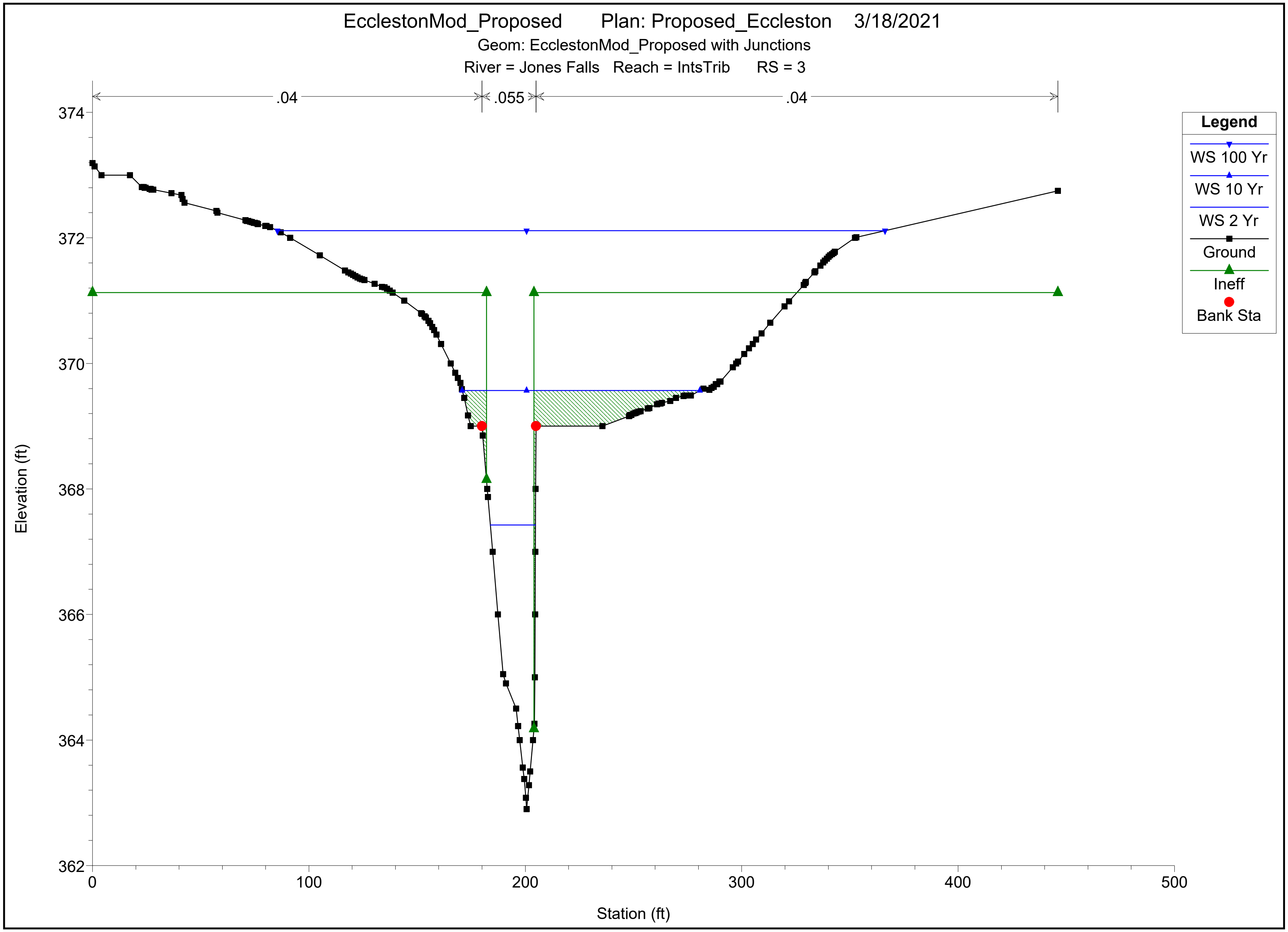
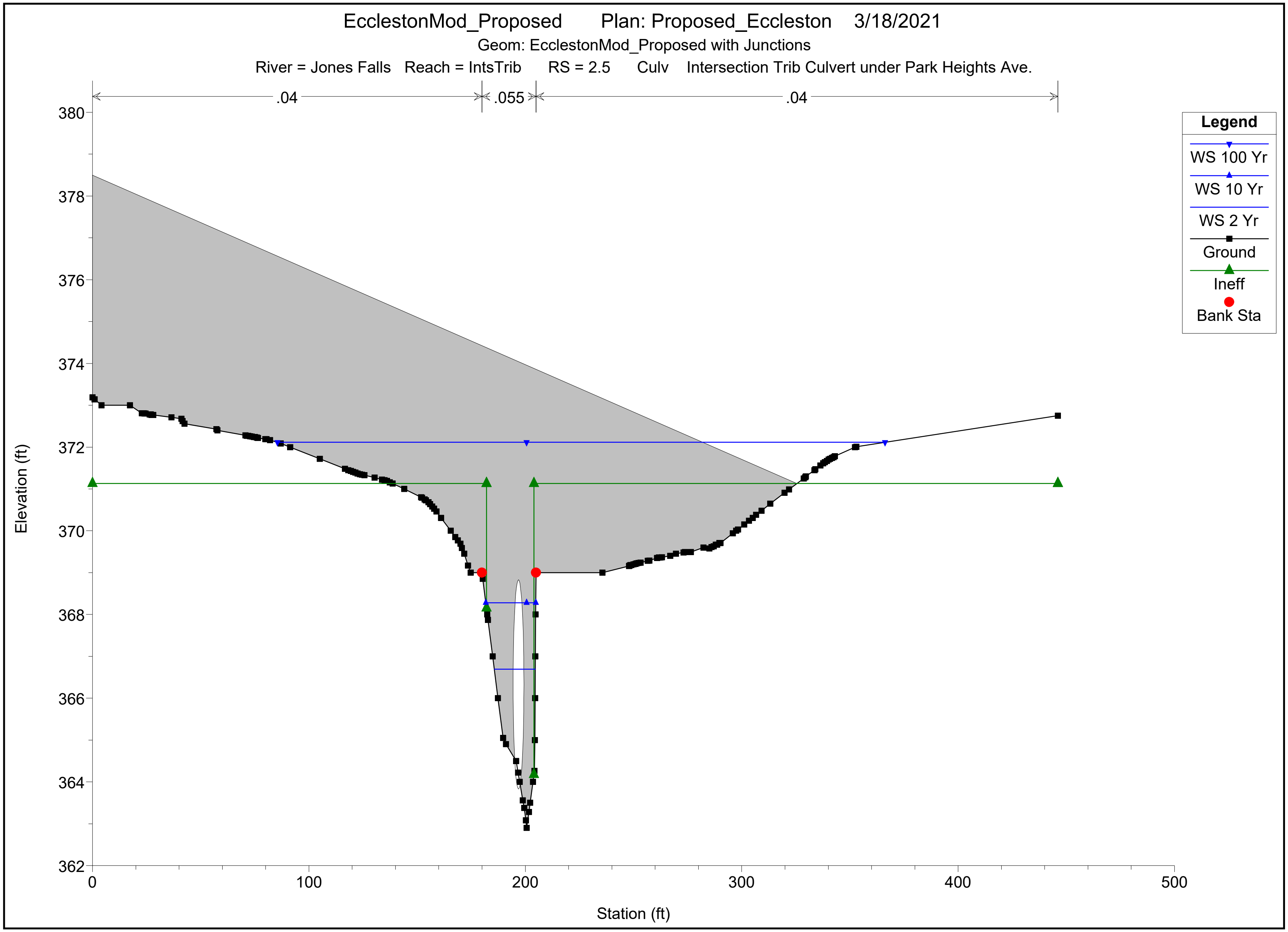
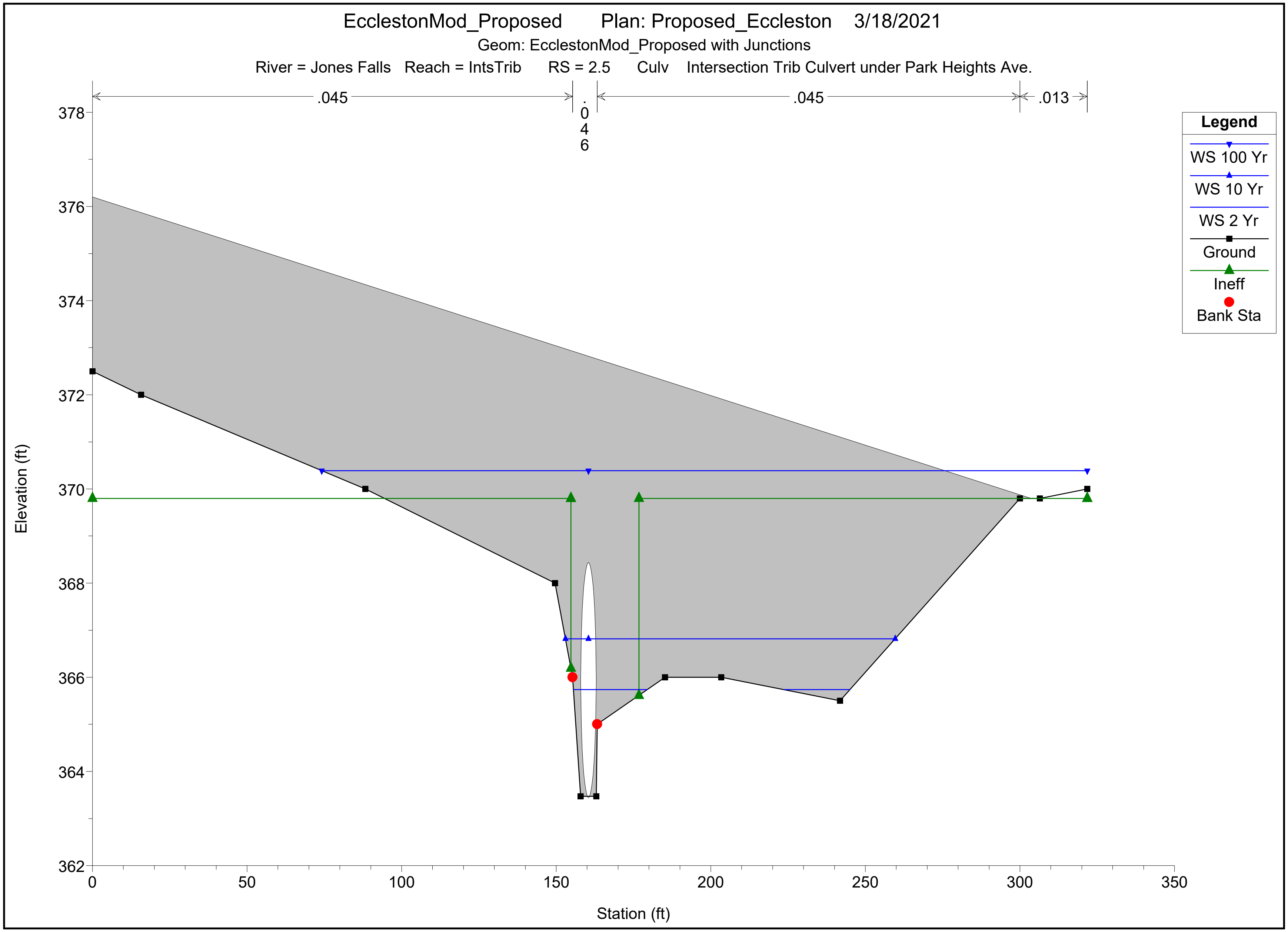
50
100
150
200
250
300



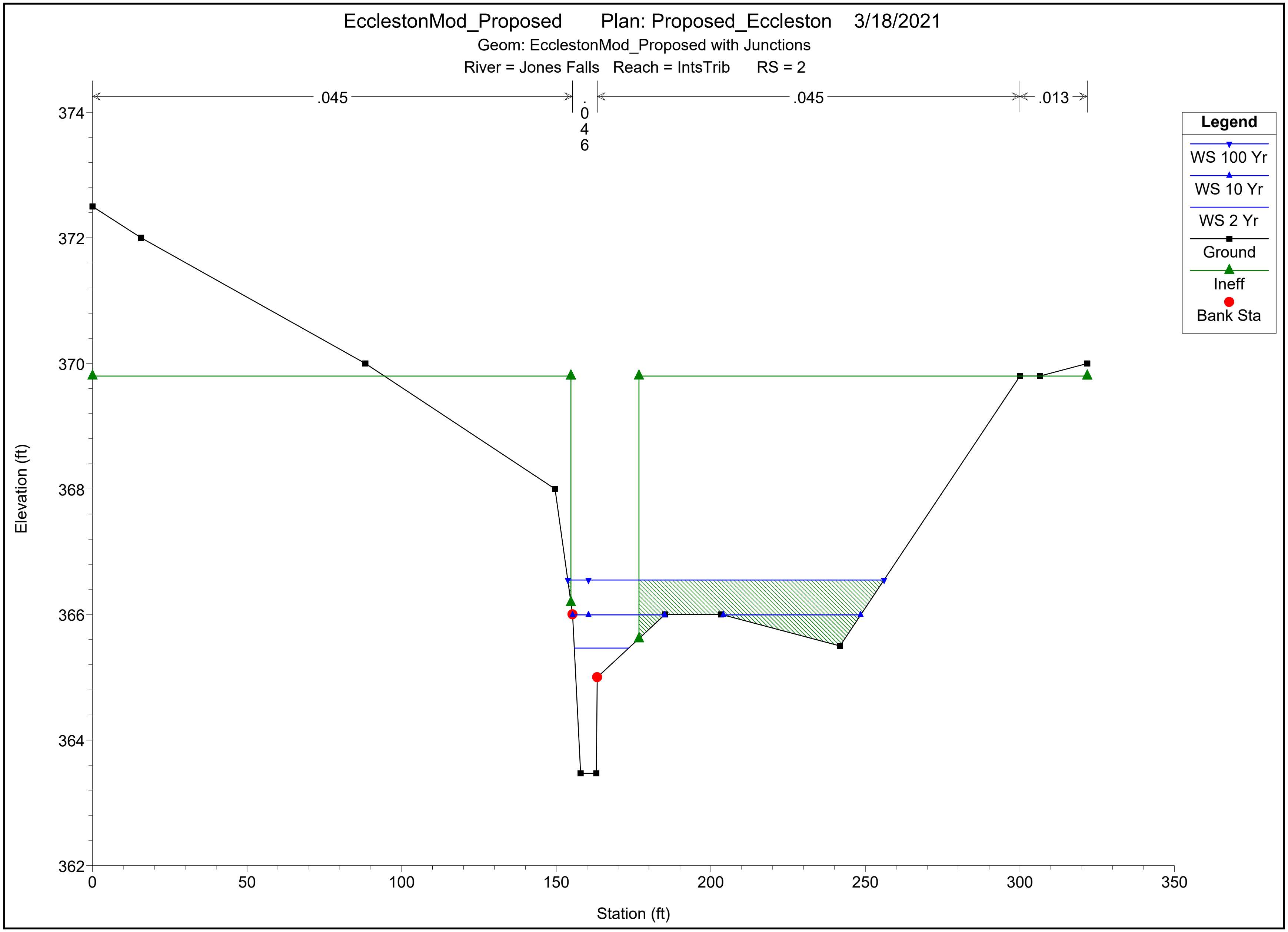
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 4
.013
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
382
380
378
376
374
372
370
368
0
50
100
150
200
250
300


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 3
.04
.055
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
374
372
370
368
366
364
362
0
100
200
300
400
500

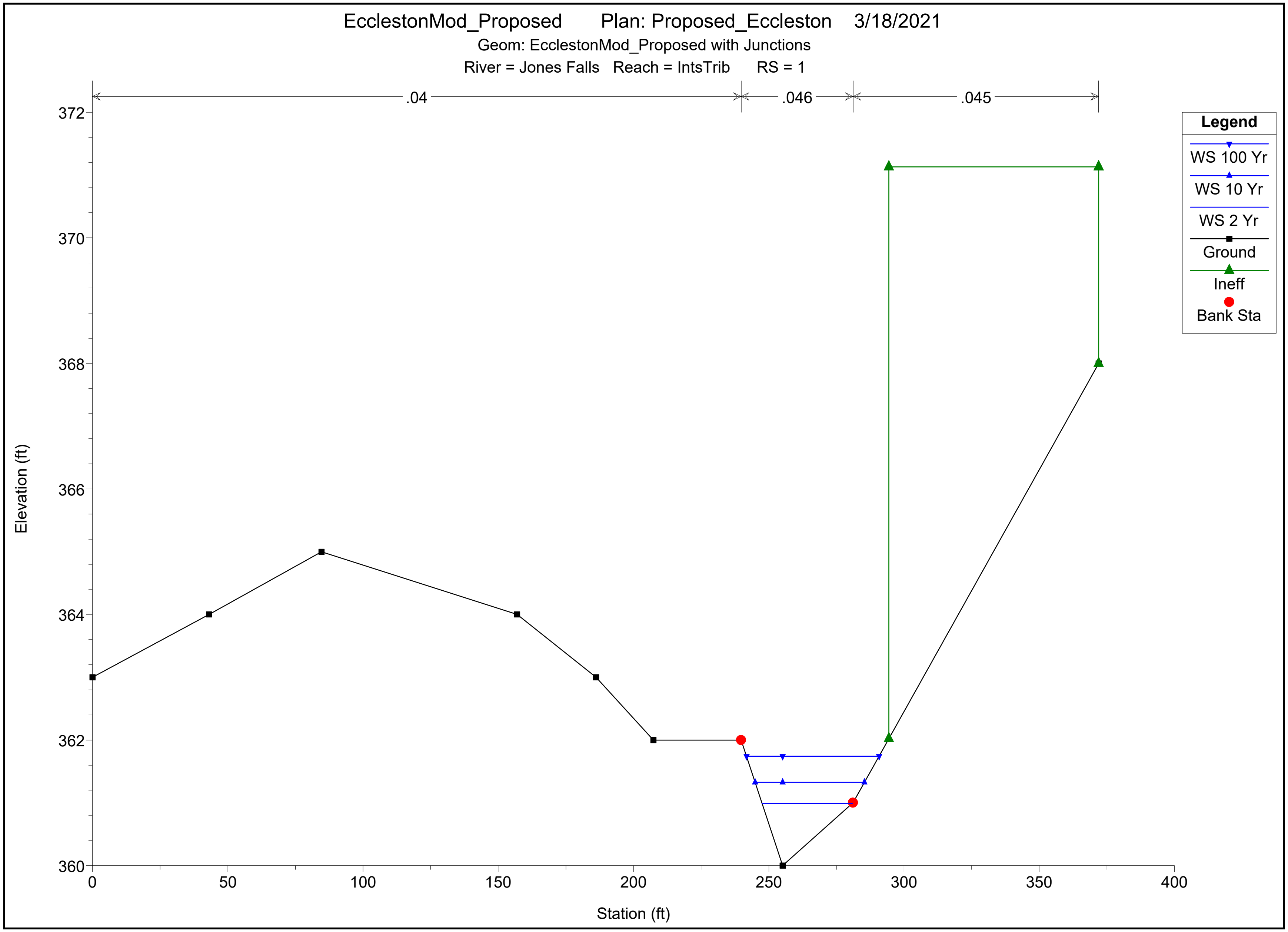

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 2.5 Culv Intersection Trib Culvert under Park Heights Ave.
.04
.055
.04
Elevation (ft)
380
378
376
374
372
370
368
366
364
362
Station (ft)
0
100
200
300
400
500
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta



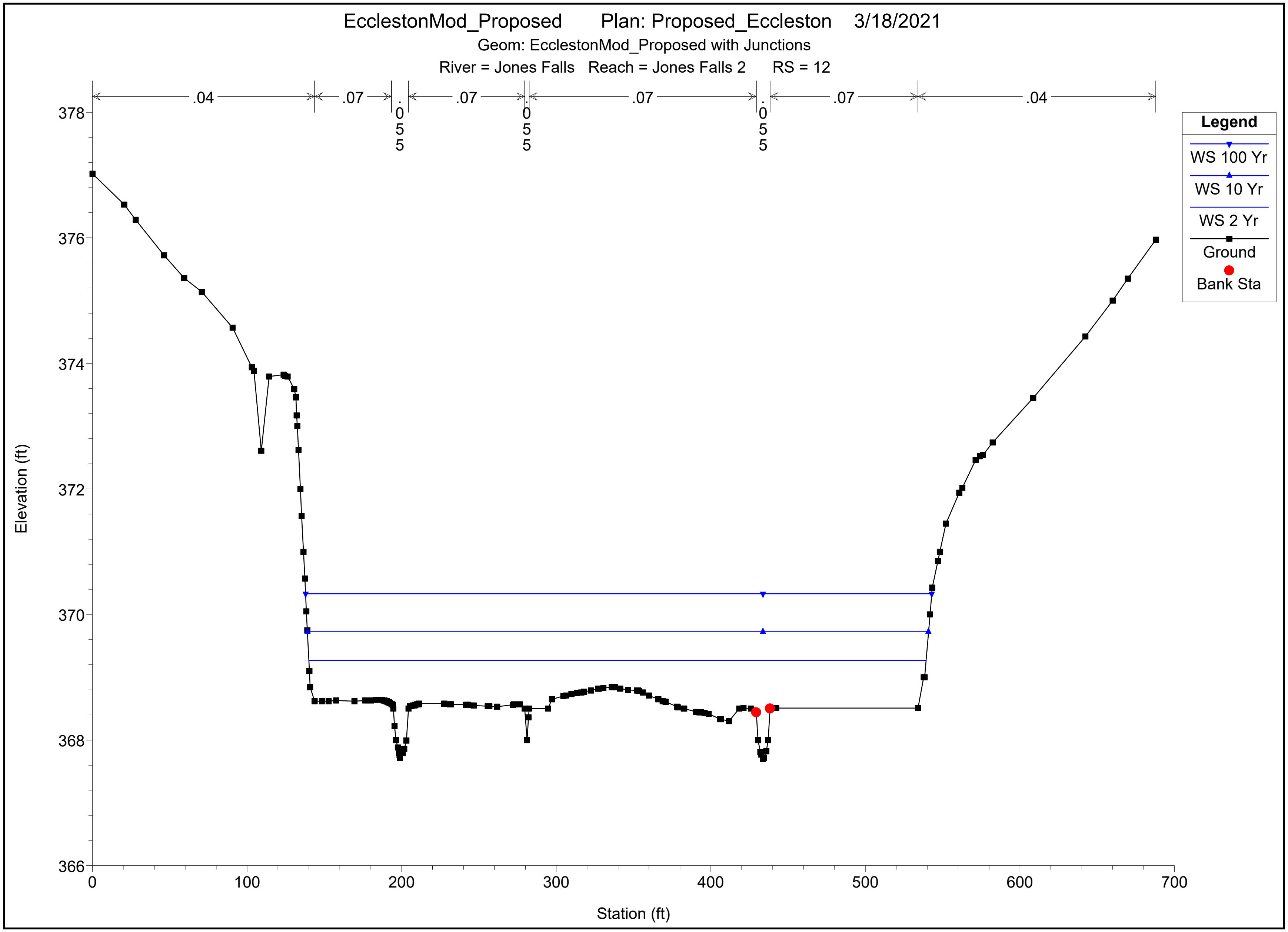
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 2.5 Culv Intersection Trib Culvert under Park Heights Ave.
.045
.046
.045
.013
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
364
362
0
50
100
150
200
250
300
350



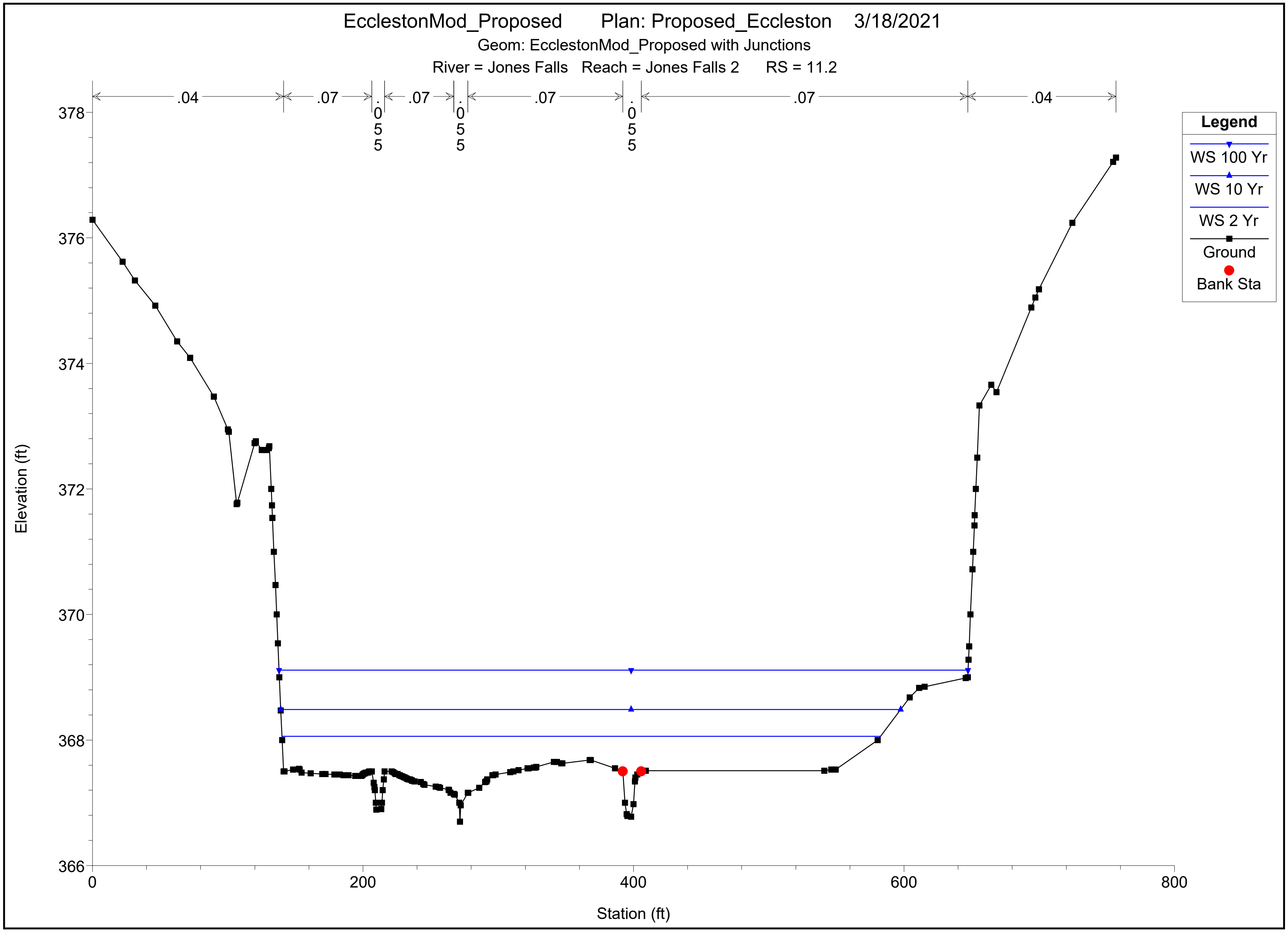
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 2
.045
.046
.045
.013
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
374
372
370
368
366
364
362
0
50
100
150
200
250
300
350



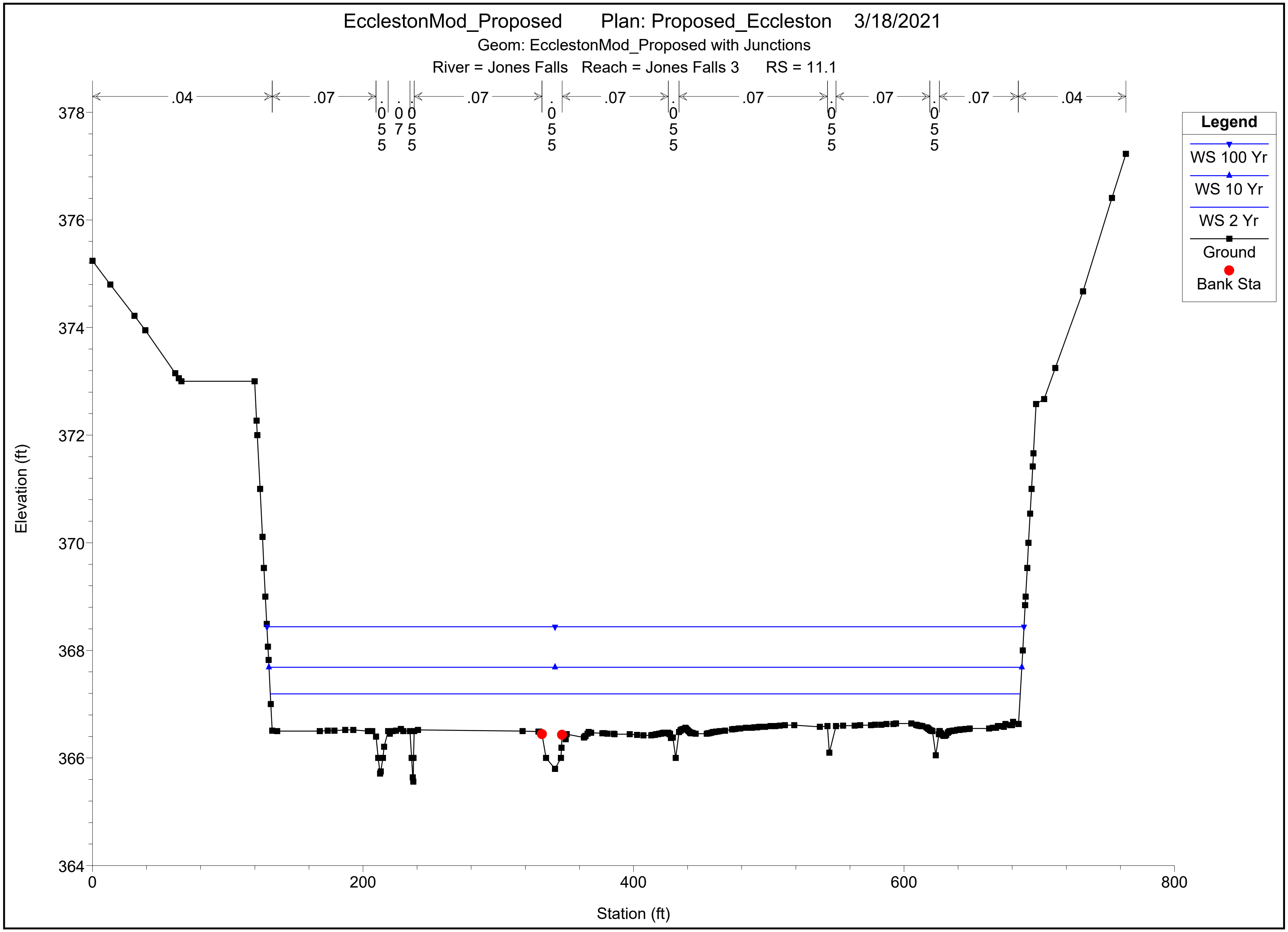
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = IntsTrib RS = 1
.04
.046
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
372
370
368
366
364
362
360
0
50
100
150
200
250
300
350
400

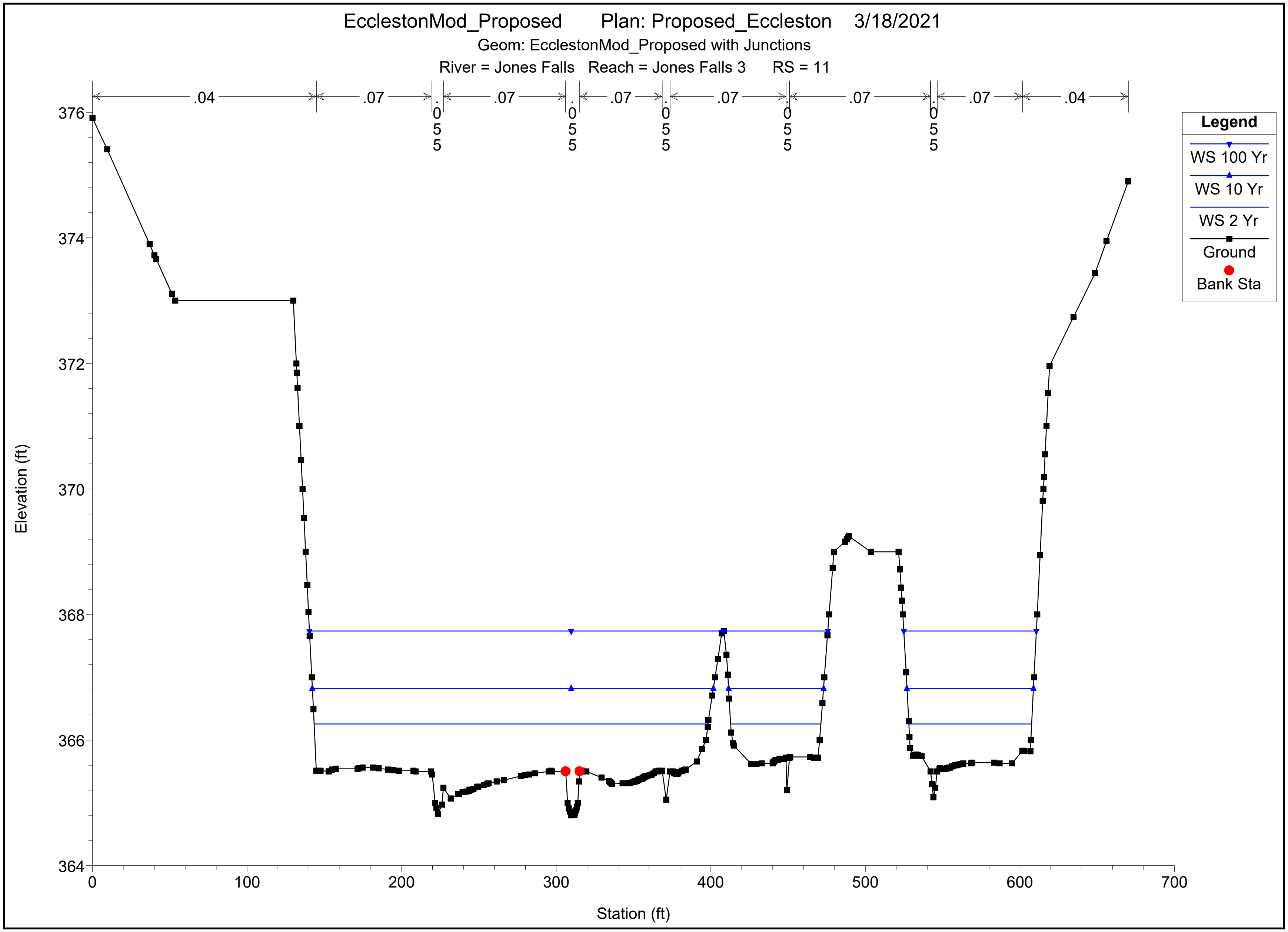


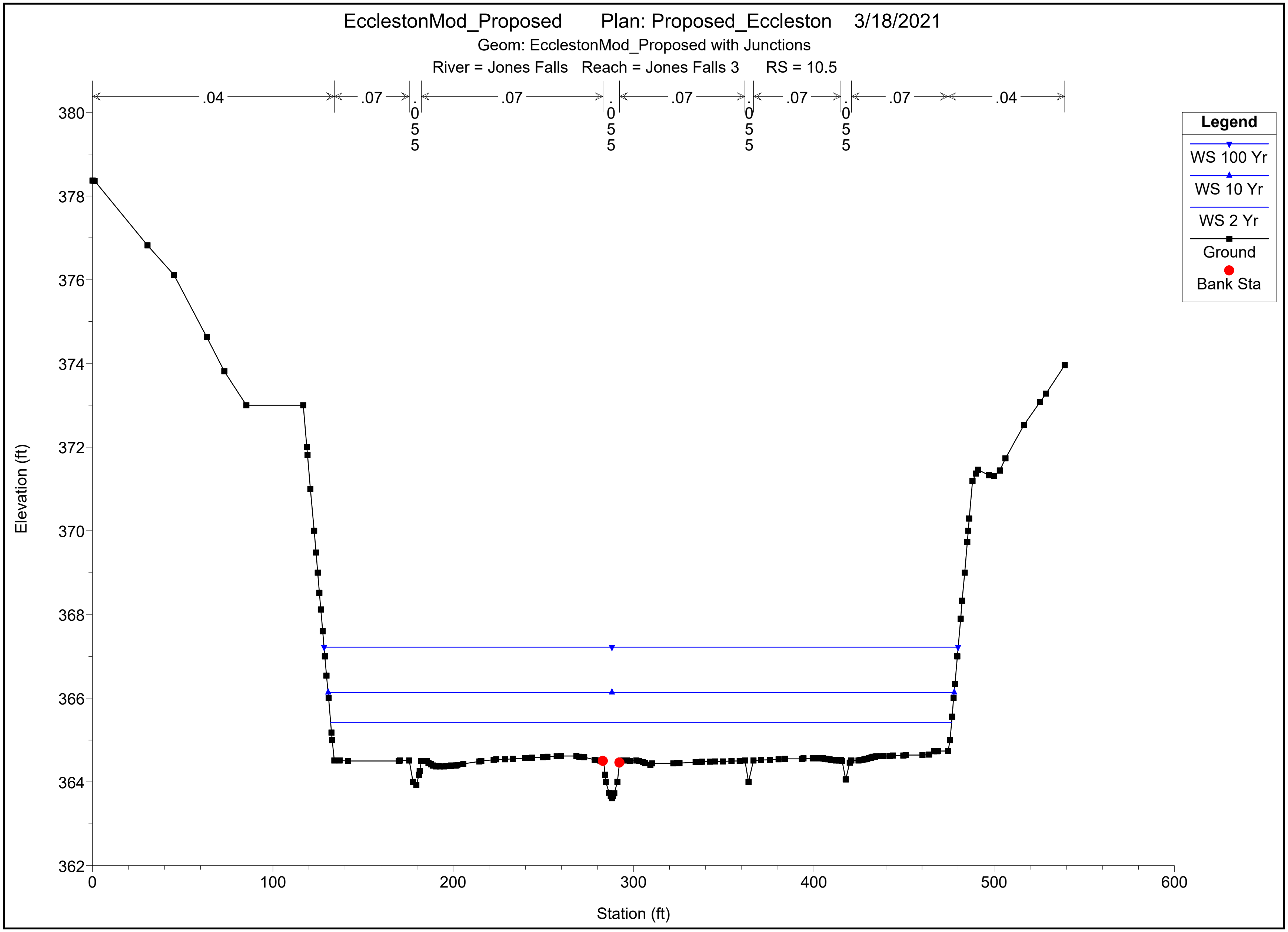
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 2 RS = 12
.04
.07
.055
.07
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
0
100
200
300
400
500
600
700



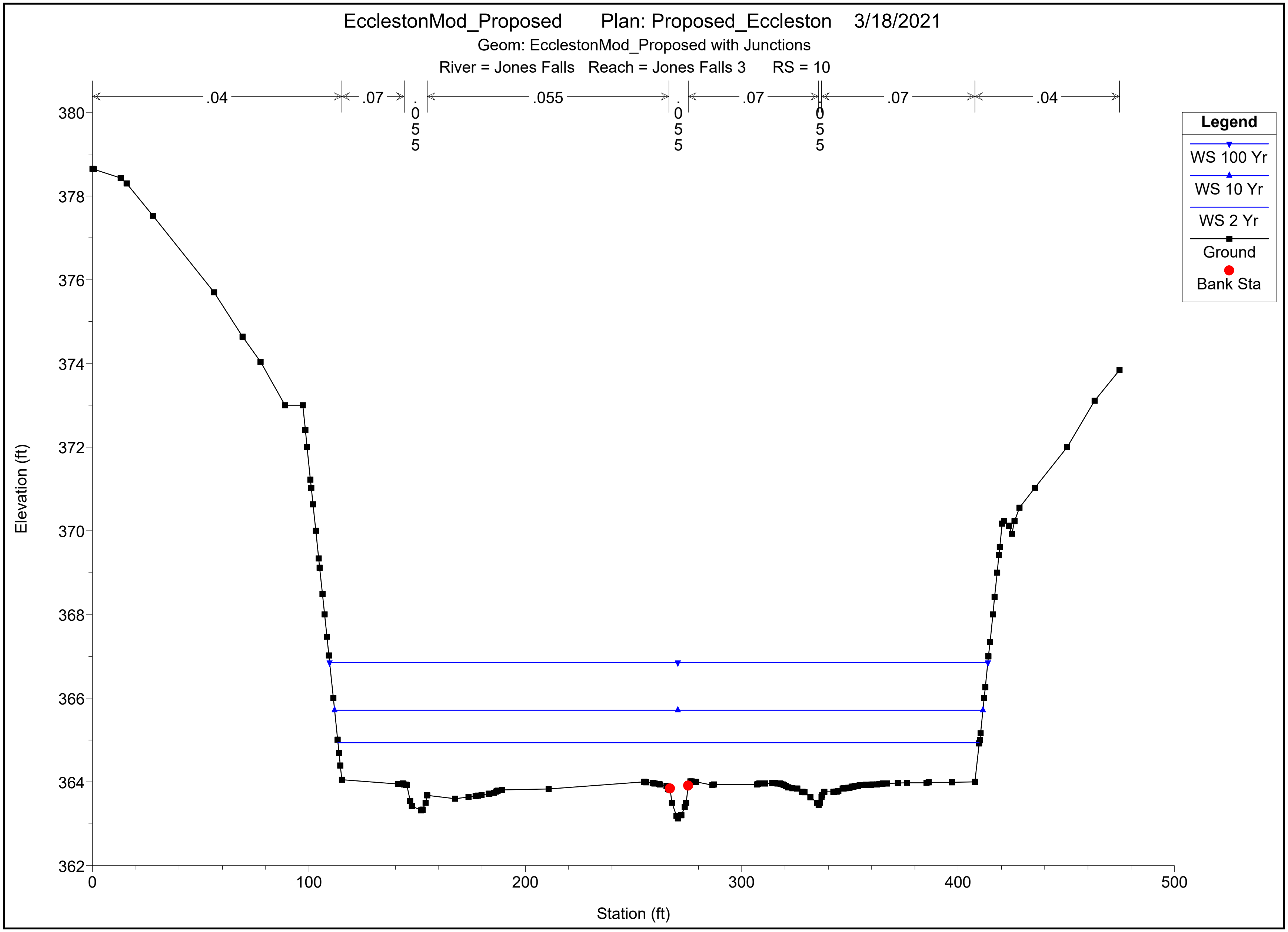
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 2 RS = 11.2
.04
.07
.055
.07
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
0
200
400
600
800


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 11.1
.04
.07
.055
.075
.055
.07
.055
.07
.055
.07
.055
.07
.055
.07
.04
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
364
0
200
400
600
800
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta

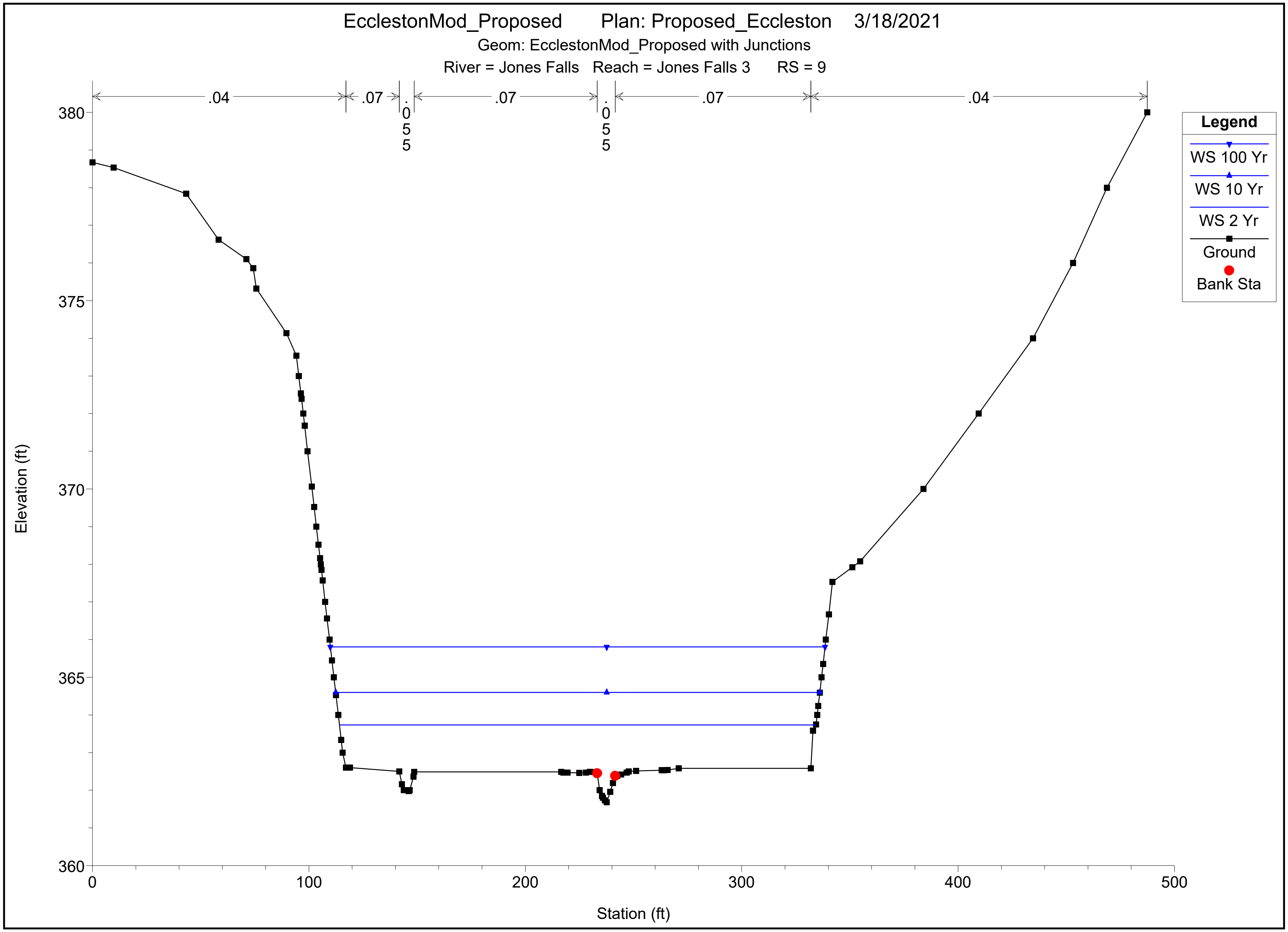

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 11
.04
.07
.055
.07
.055
.07
.055
.07
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
376
374
372
370
368
366
364
Station (ft)
0
100
200
300
400
500
600
700



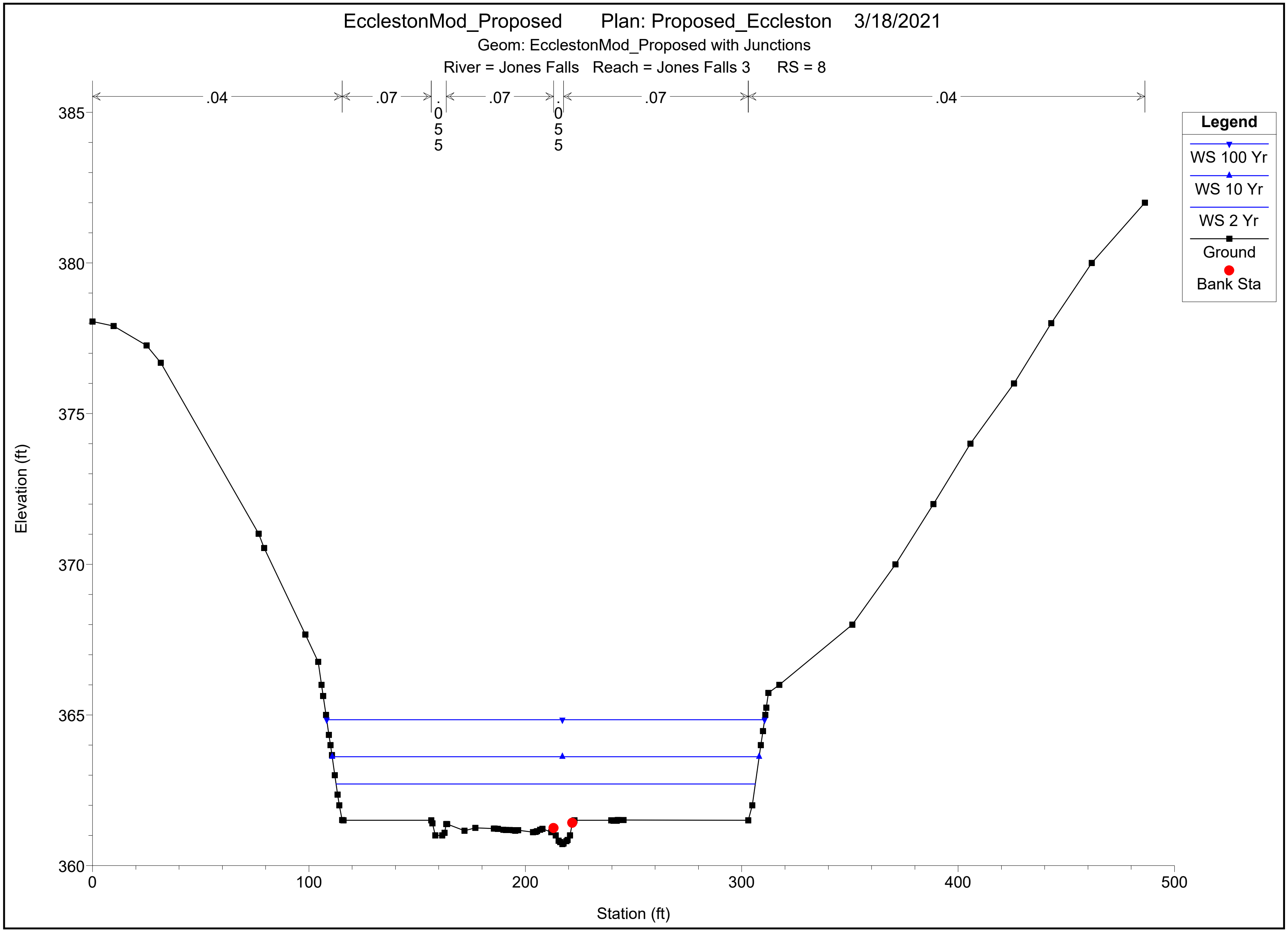
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 10.5
.04
.07
.055
.07
.055
.07
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
362
364
366
368
370
372
374
376
378
380
0
100
200
300
400
500
600



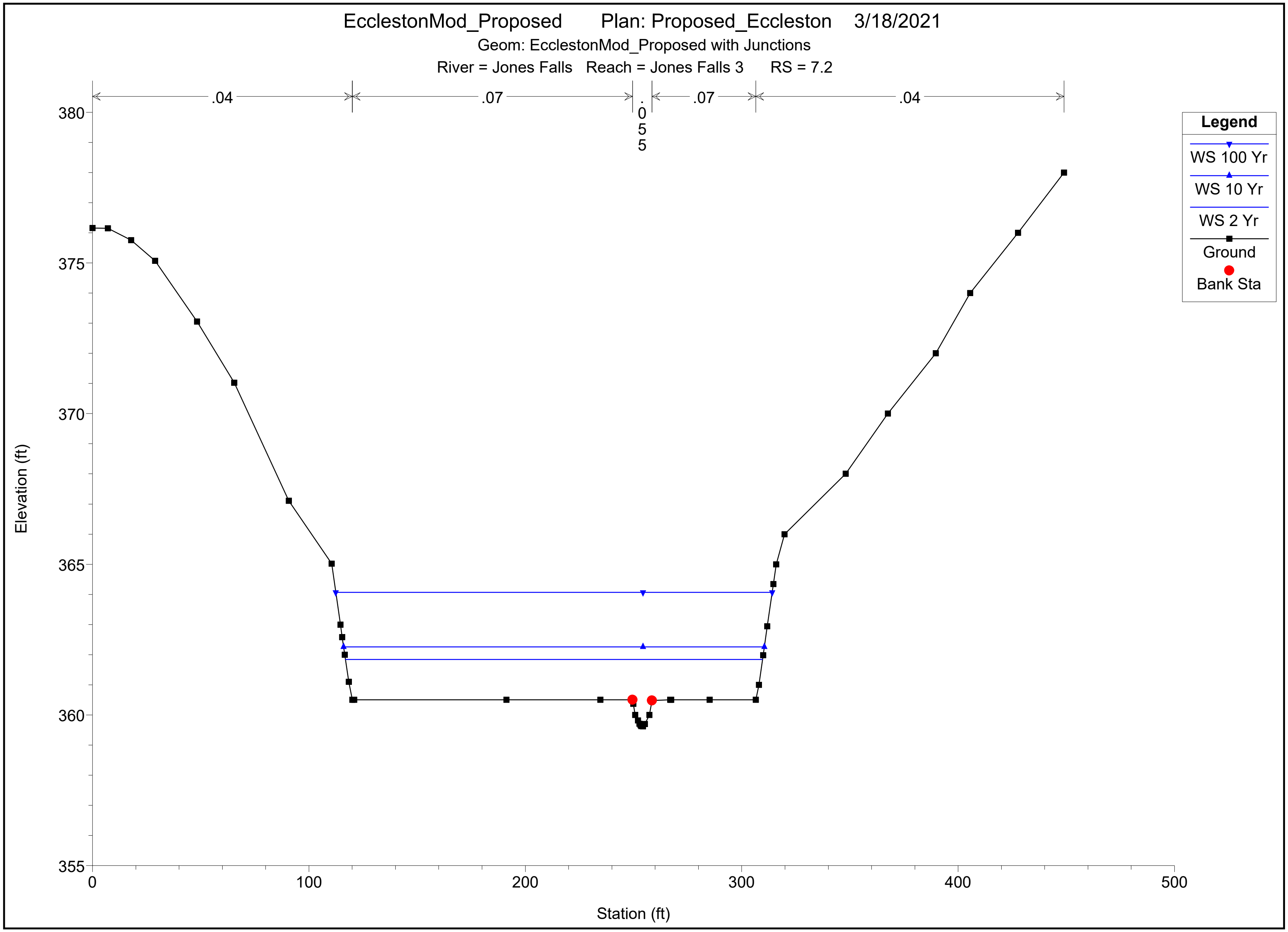
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 10
.04
.07
.055
.055
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
380
378
376
374
372
370
368
366
364
362
0
100
200
300
400
500



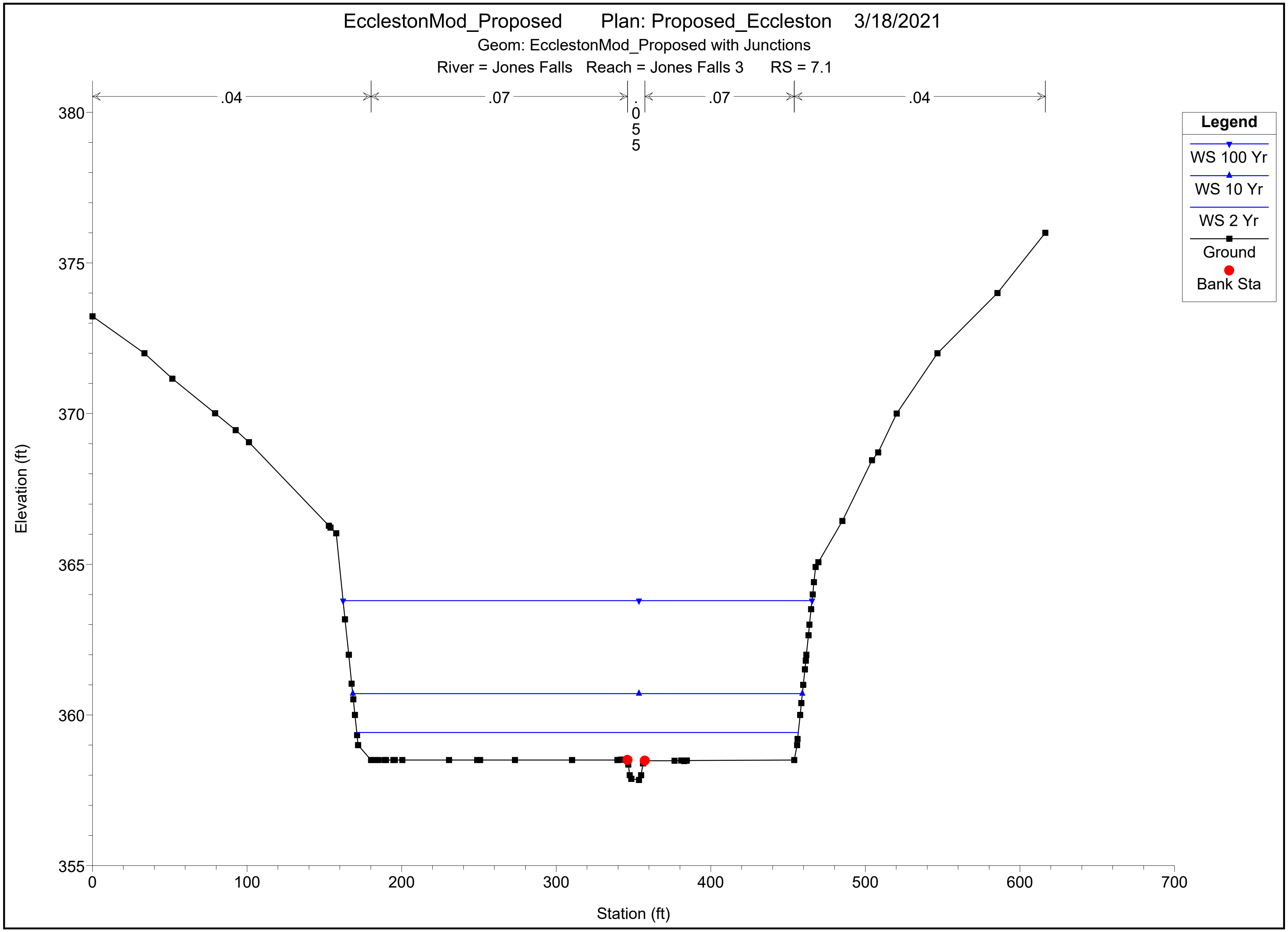
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 9
.04
.07
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
380
375
370
365
360
0
100
200
300
400
500
Station (ft)



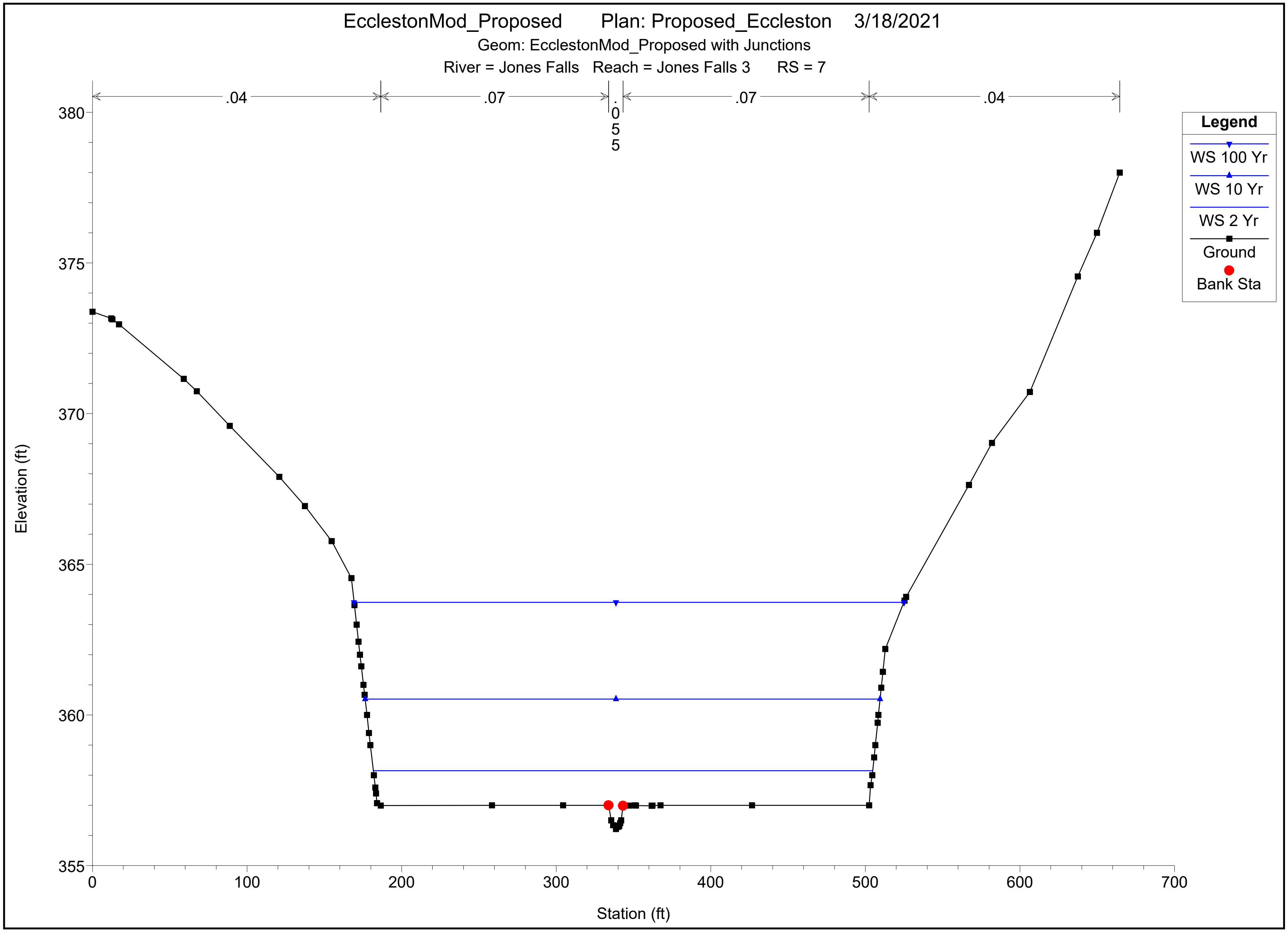
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 8
.04
.07
.055
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
385
380
375
370
365
360
0
100
200
300
400
500
Station (ft)



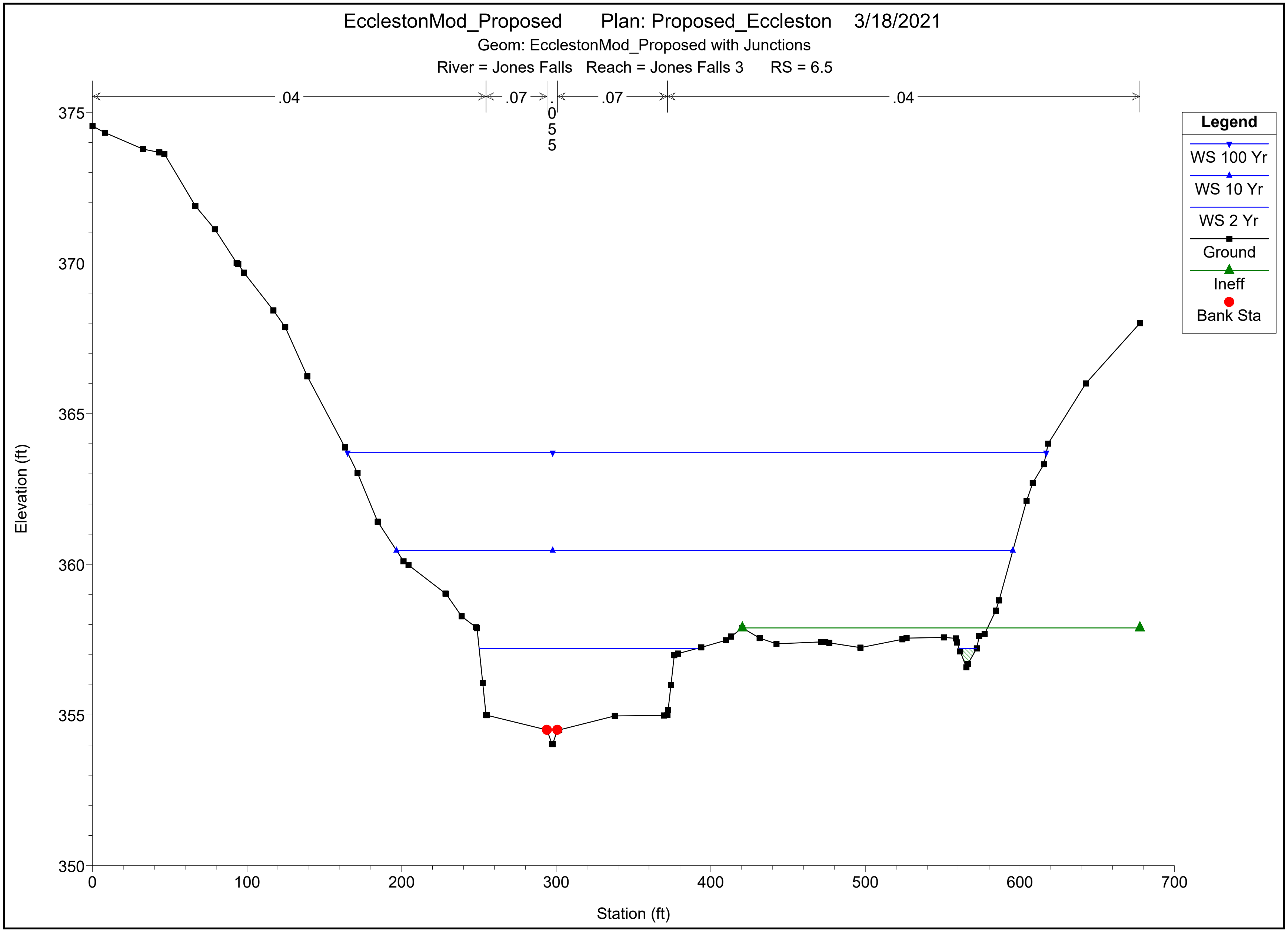
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 7.2
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
380
375
370
365
360
355
0
100
200
300
400
500



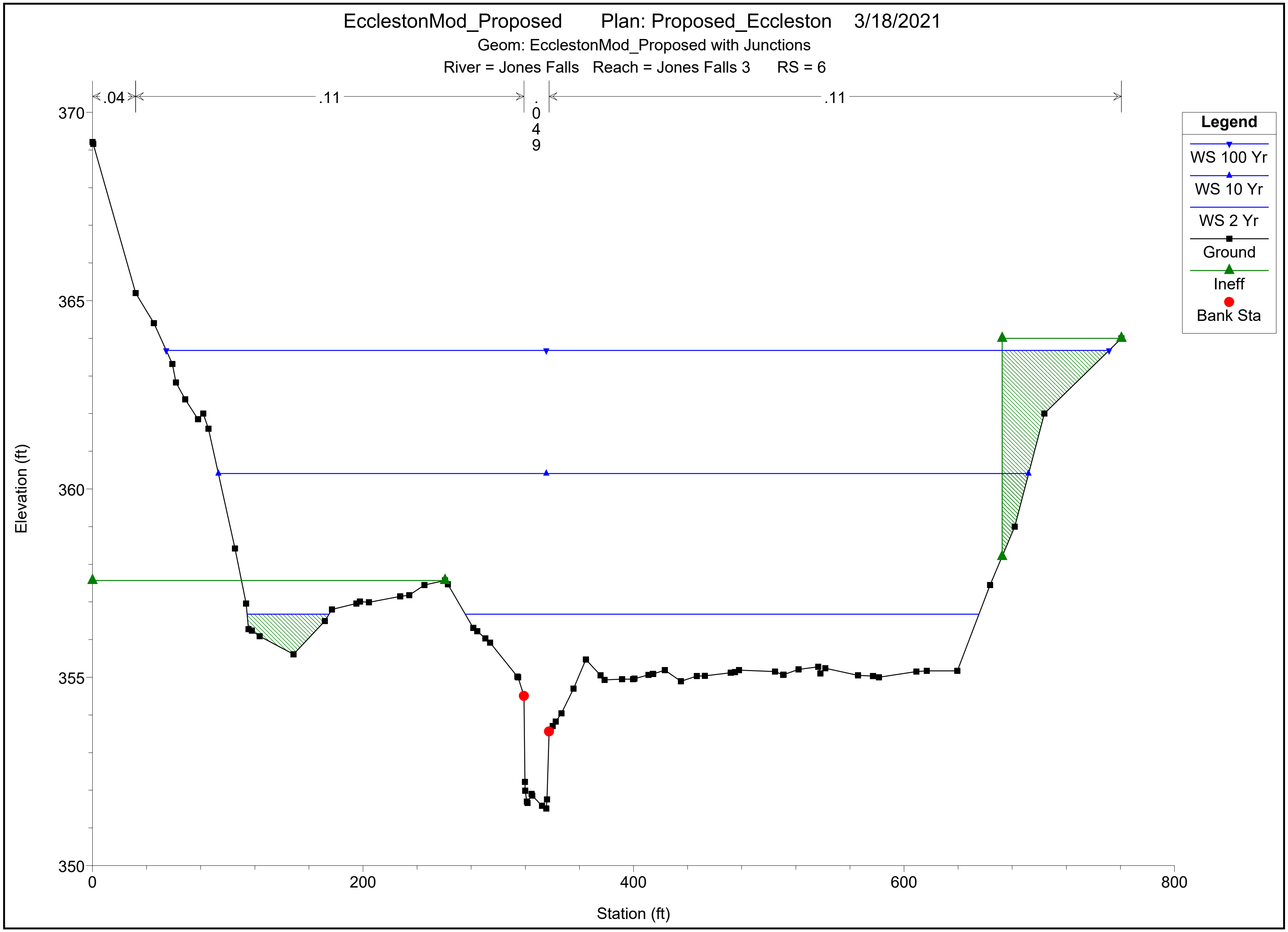
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 7.1
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
380
375
370
365
360
355
0
100
200
300
400
500
600
700
Station (ft)



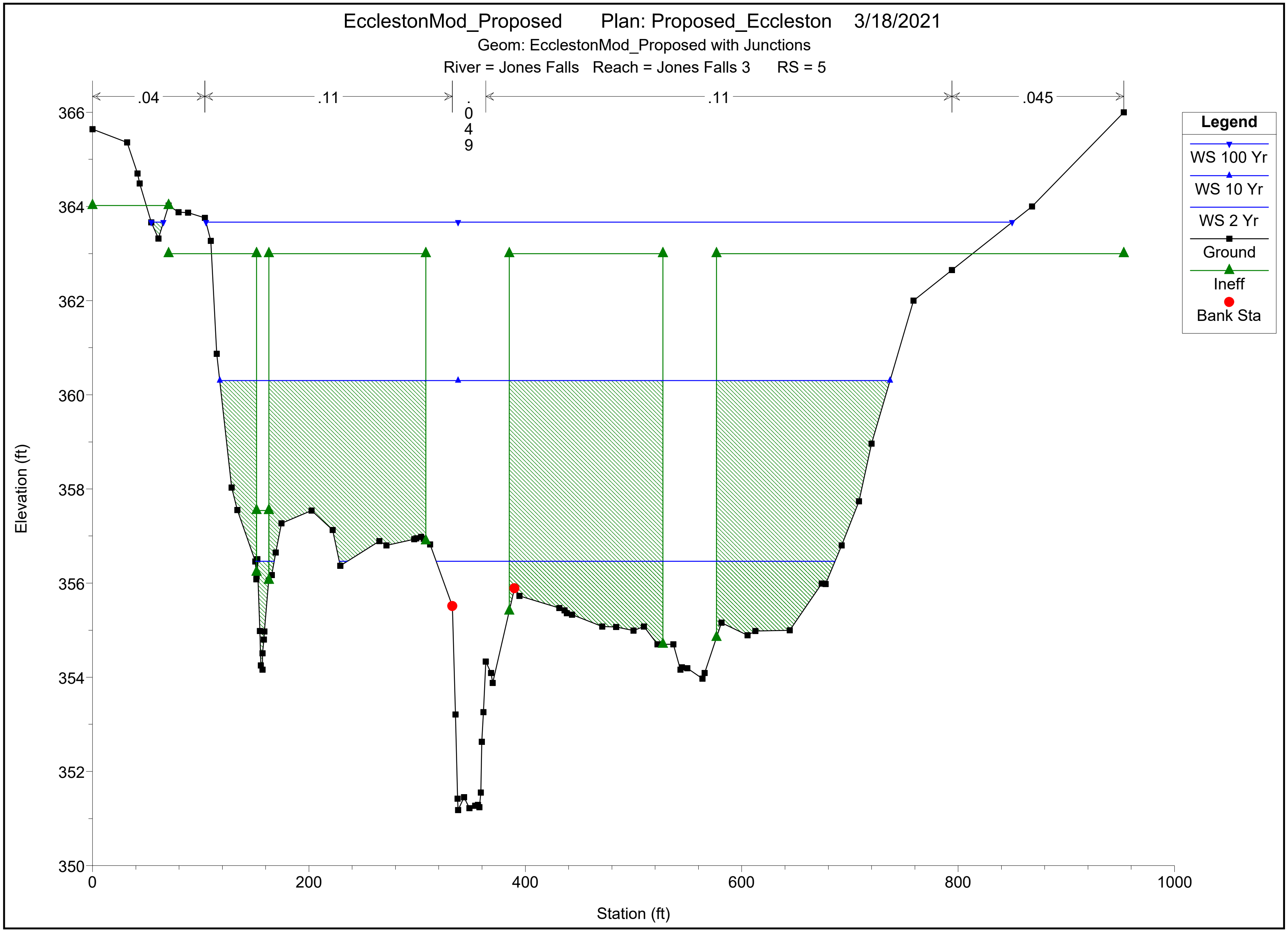
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 7
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
380
375
370
365
360
355
0
100
200
300
400
500
600
700



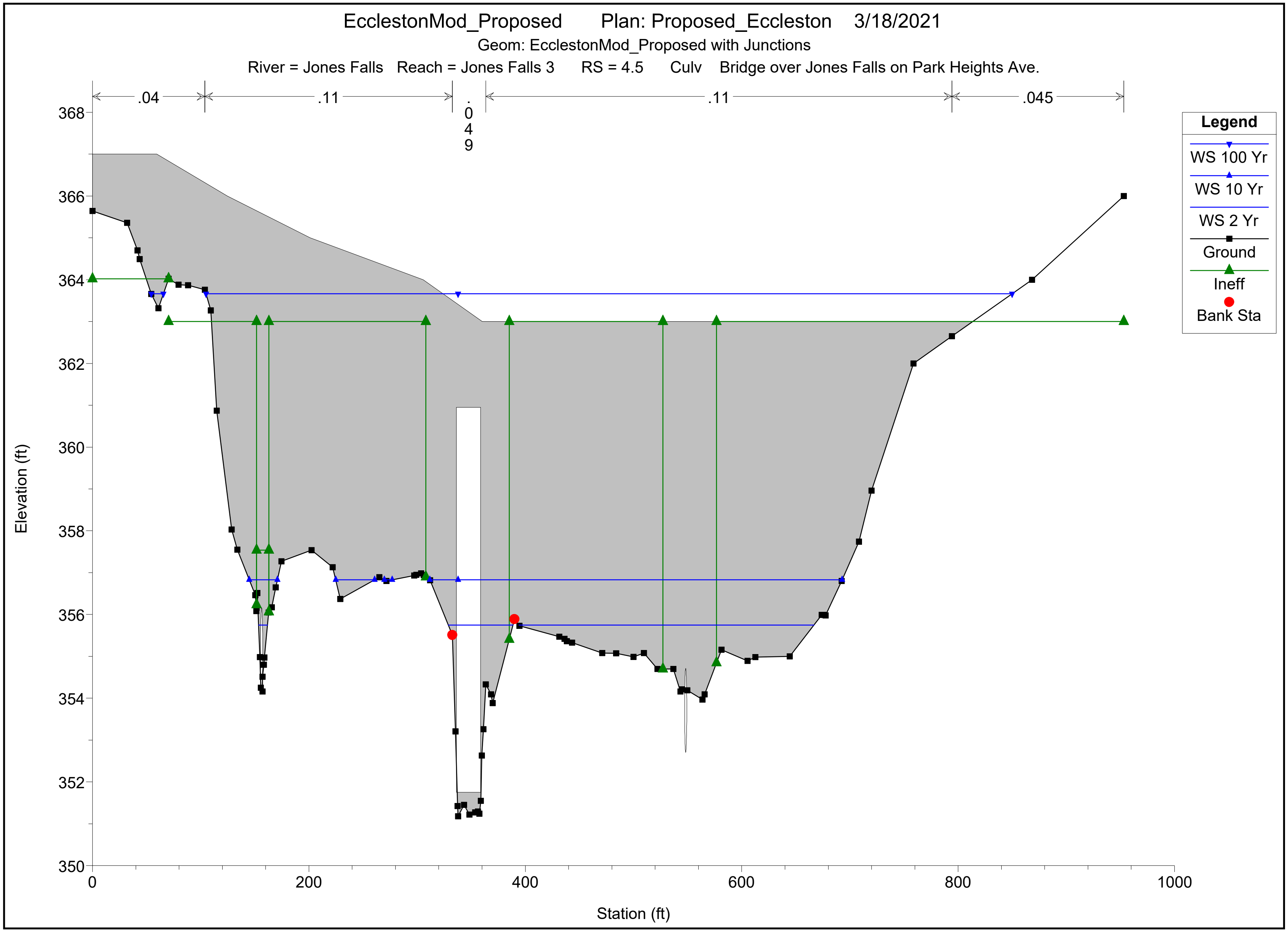
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 6.5
.04
.07
.055
.07
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
375
370
365
360
355
350
0
100
200
300
400
500
600
700



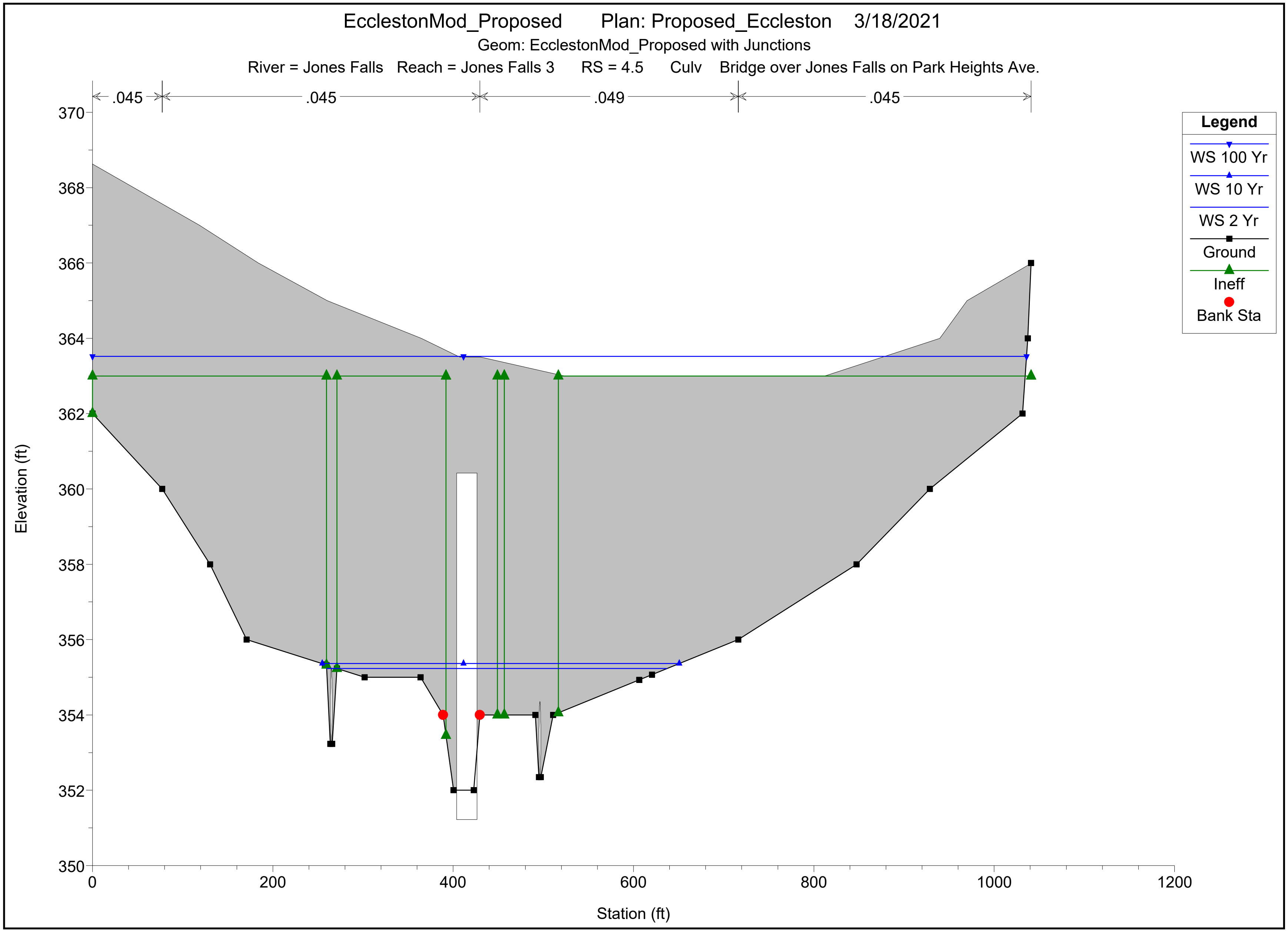
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 6
.04
.11
.049
.11
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
370
365
360
355
350
0
200
400
600
800



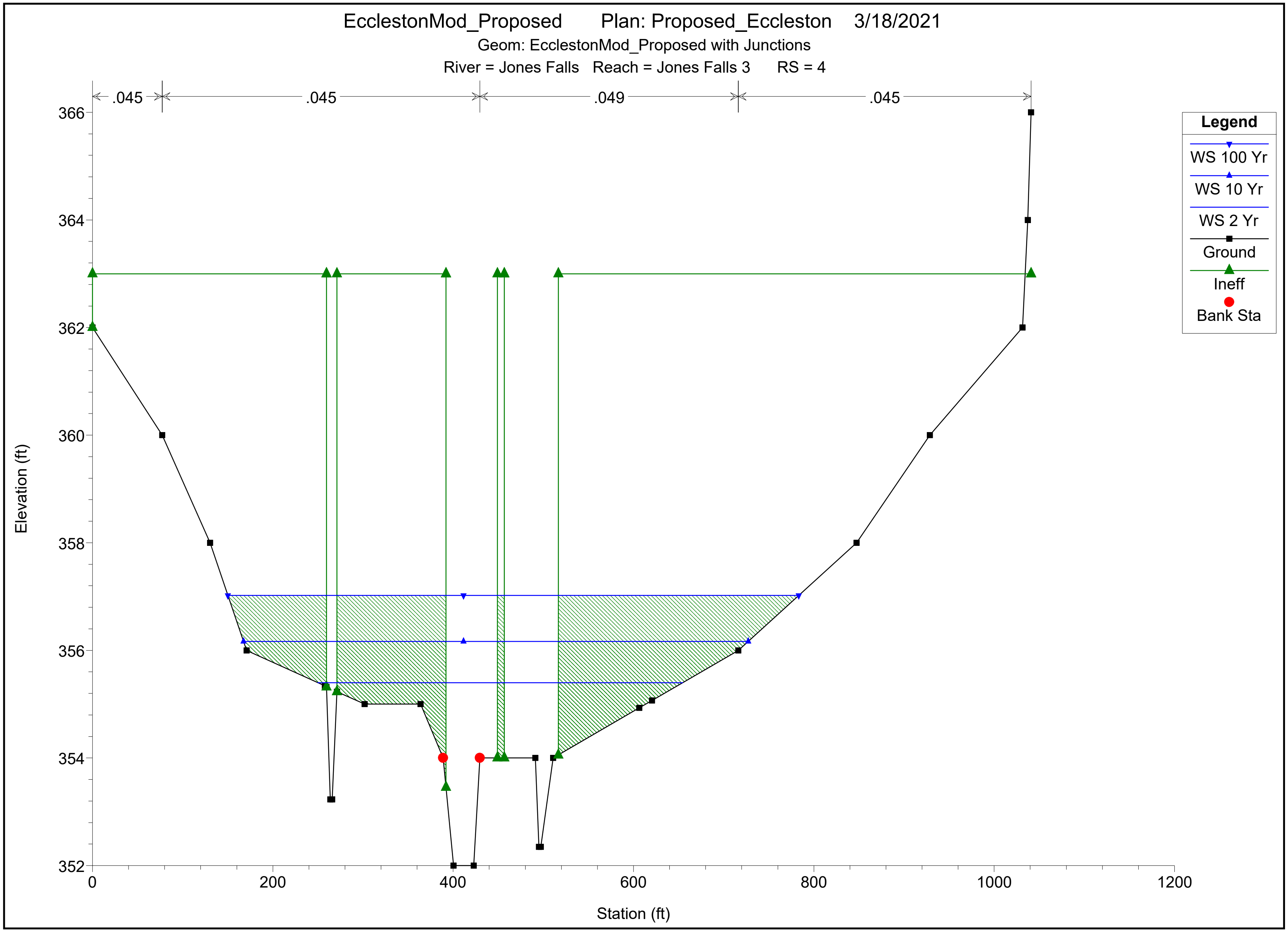
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 5
.04
.11
.049
.11
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
366
364
362
360
358
356
354
352
350
0
200
400
600
800
1000



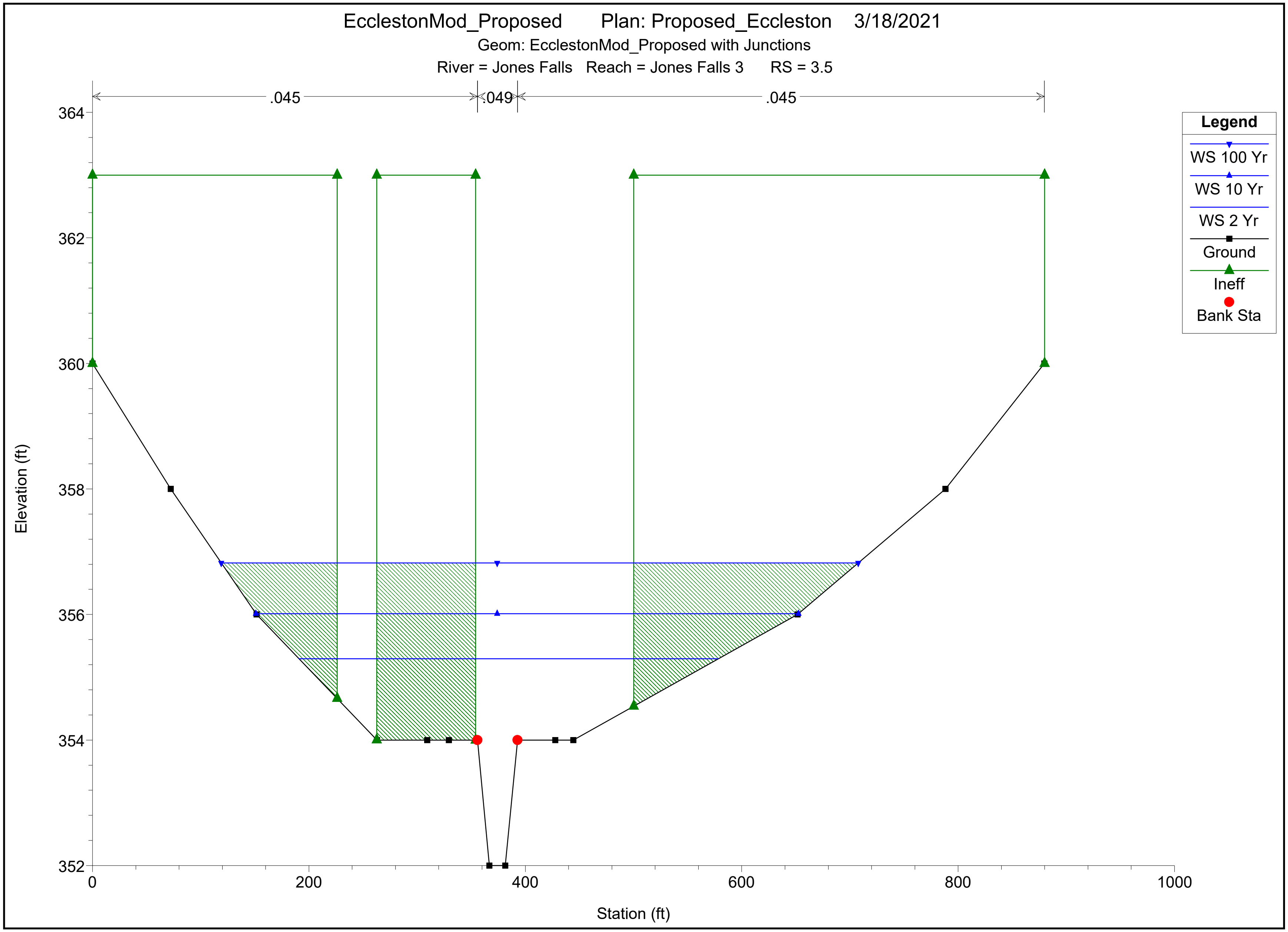
EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 4.5 Culv Bridge over Jones Falls on Park Heights Ave.
.04
.11
.049
.11
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

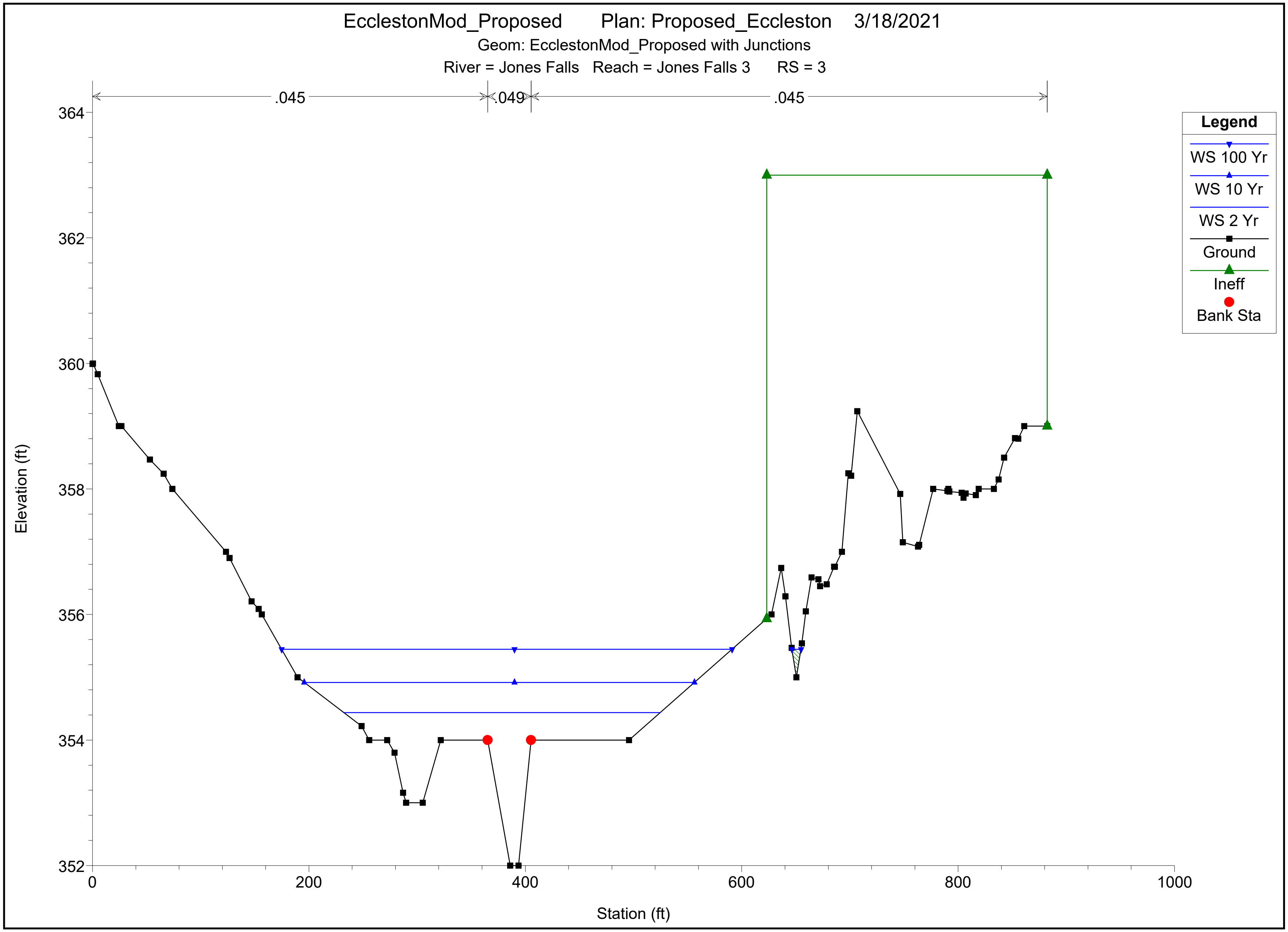


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 4.5 Culv Bridge over Jones Falls on Park Heights Ave.
.045
.045
.049
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
370
368
366
364
362
360
358
356
354
352
350
0
200
400
600
800
1000
1200

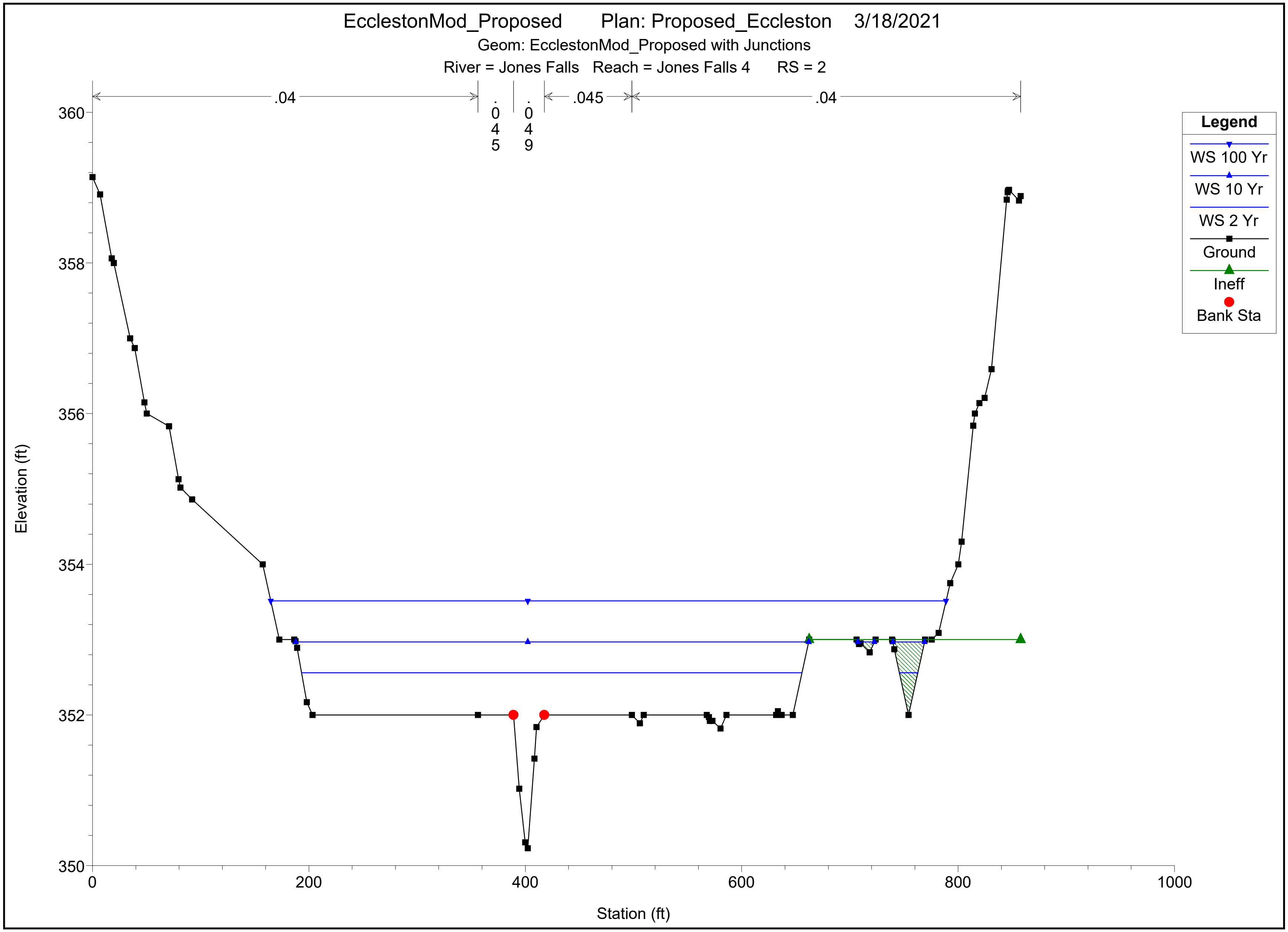


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 4
.045
.045
.049
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
366
364
362
360
358
356
354
352
0
200
400
600
800
1000
1200

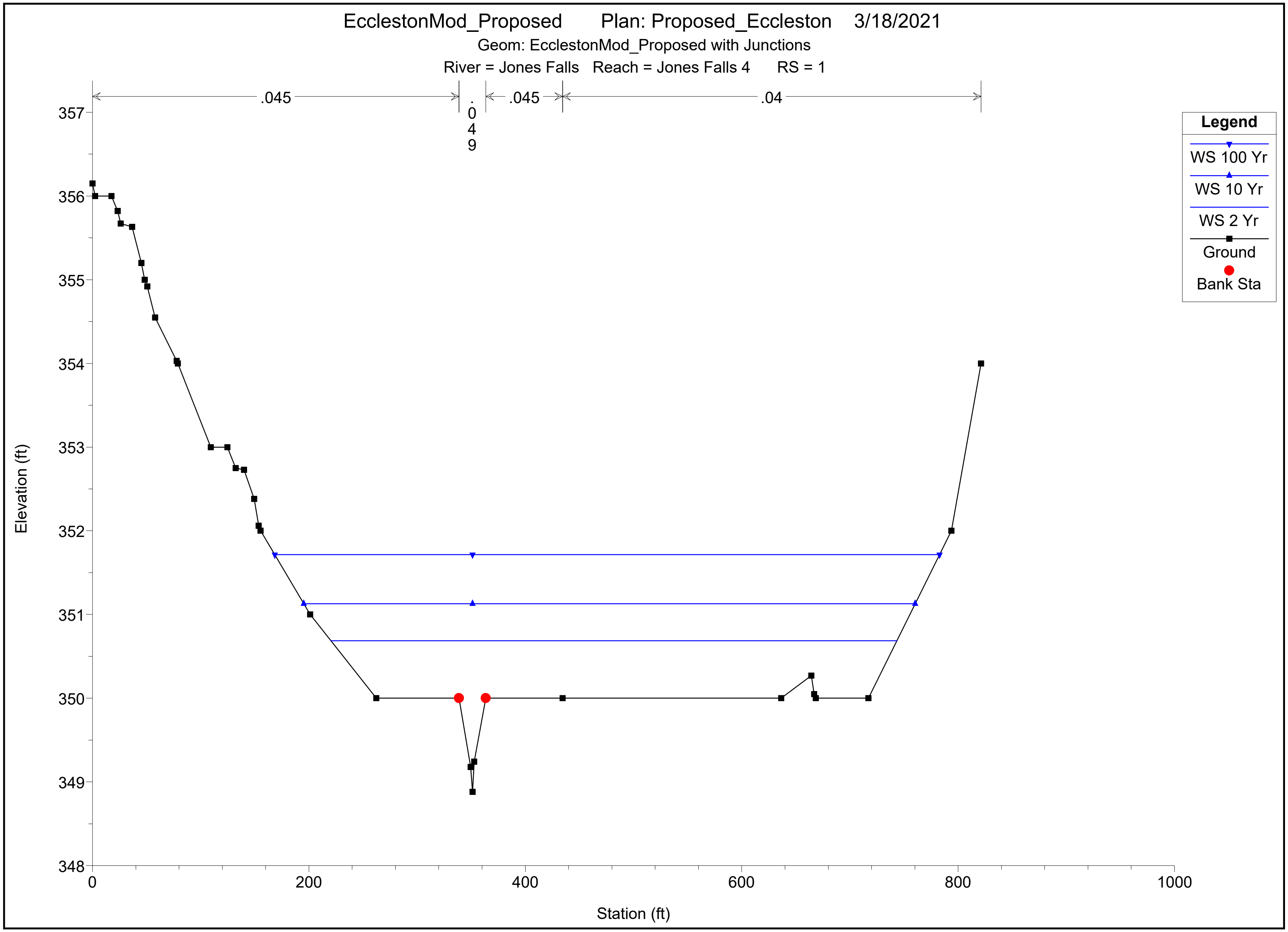

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 3.5
.045
.049
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
364
362
360
358
356
354
352
0
200
400
600
800
1000
Station (ft)

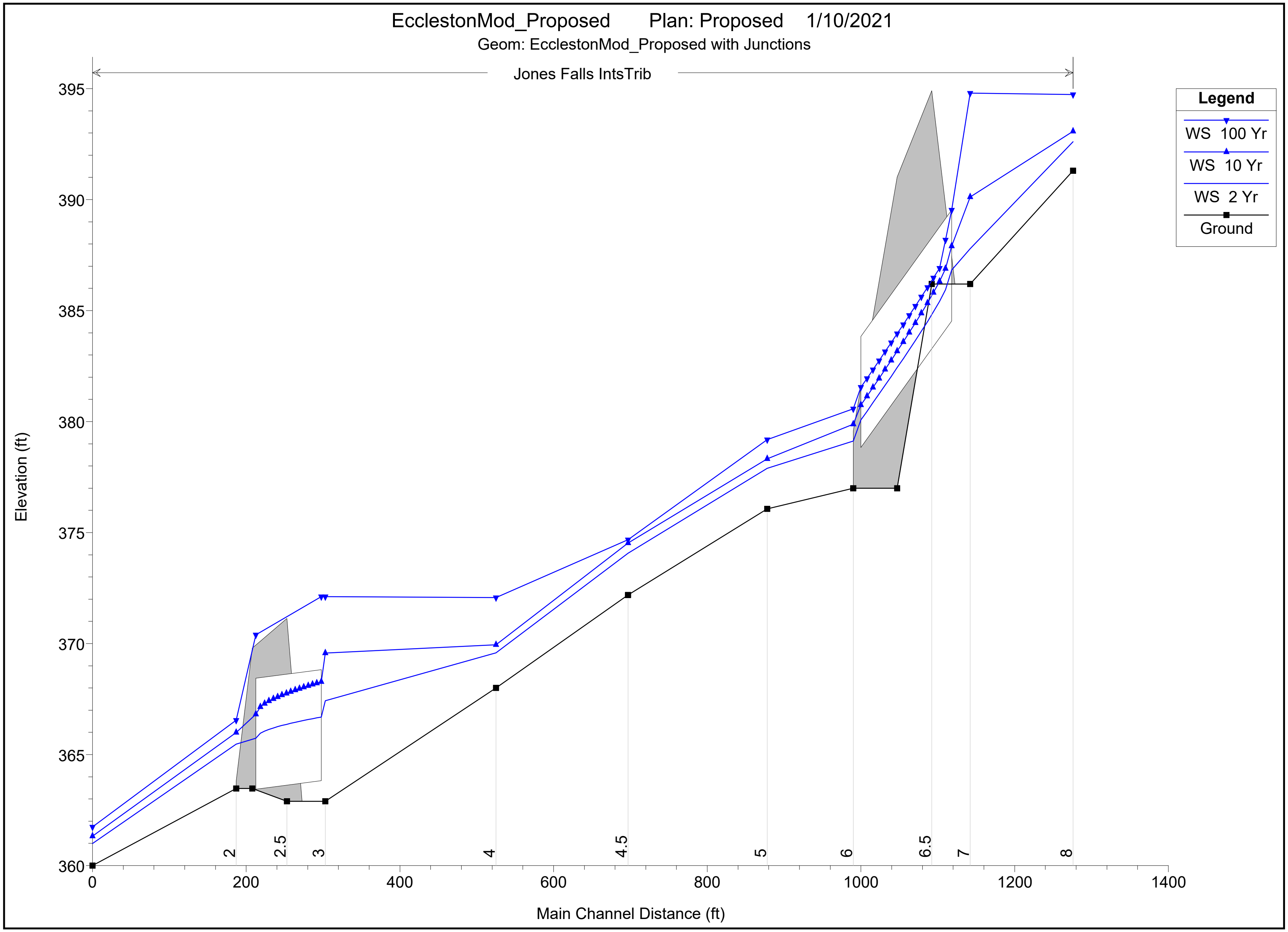


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 3 RS = 3
.045
.049
.045
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
364
362
360
358
356
354
352
0
200
400
600
800
1000

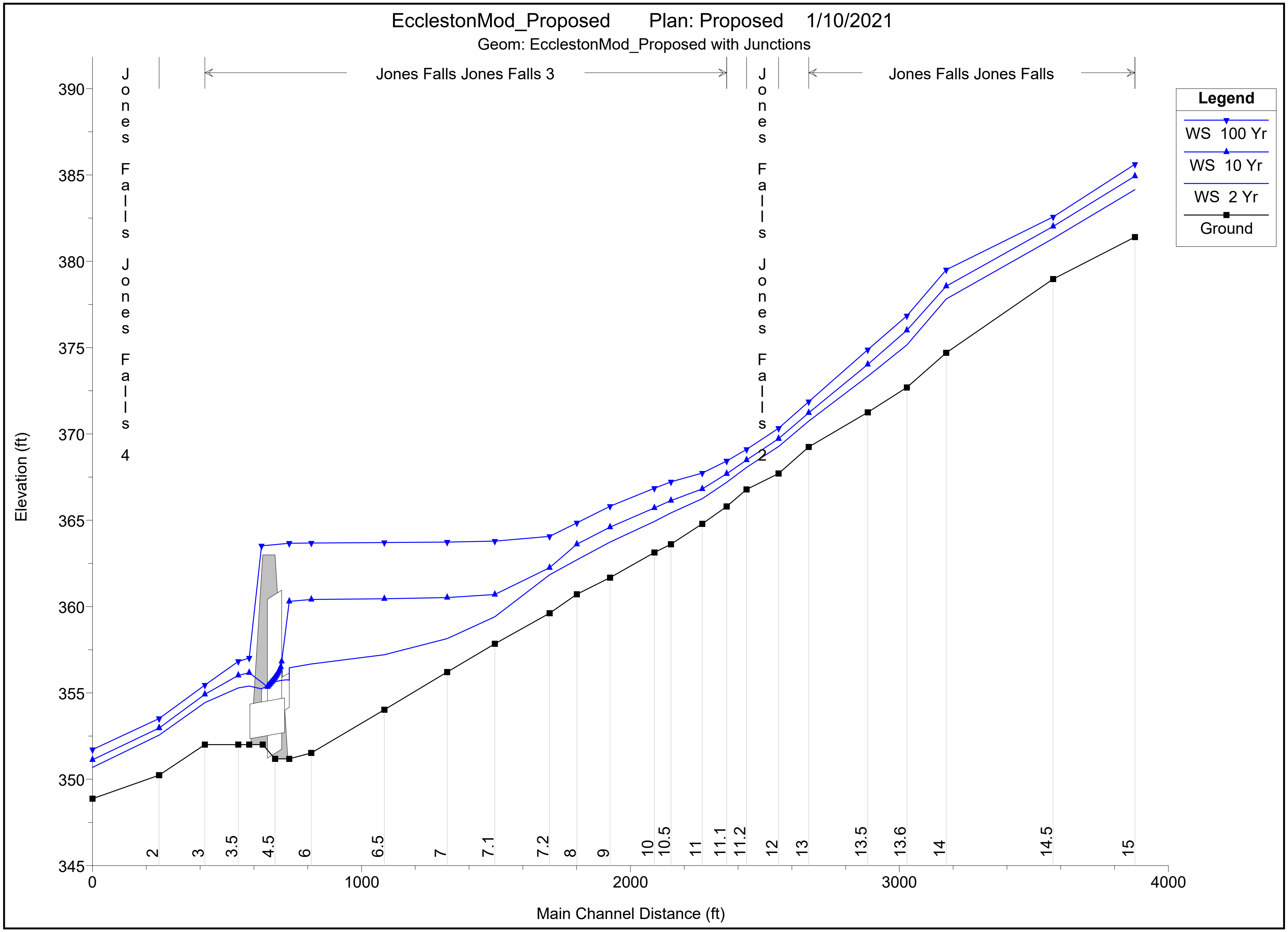


EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 4 RS = 2
.04
.045
.049
.045
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
360
358
356
354
352
350
0
200
400
600
800
1000

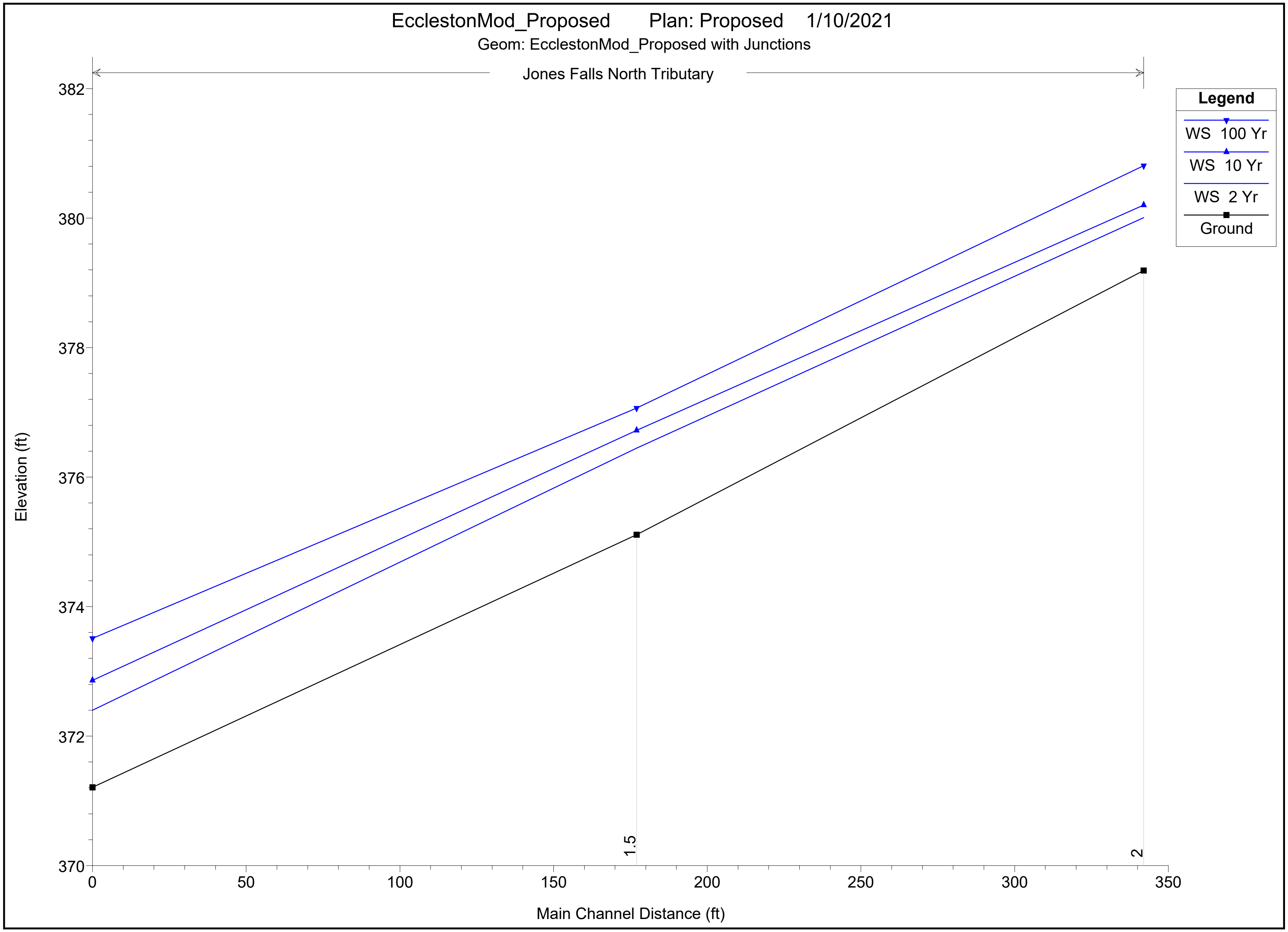

EcclestonMod_Proposed Plan: Proposed_Eccleston 3/18/2021
Geom: EcclestonMod_Proposed with Junctions
River = Jones Falls Reach = Jones Falls 4 RS = 1
.045
.049
.045
.04
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Bank Sta
Elevation (ft)
357
356
355
354
353
352
351
350
349
348
0
200
400
600
800
1000
Station (ft)



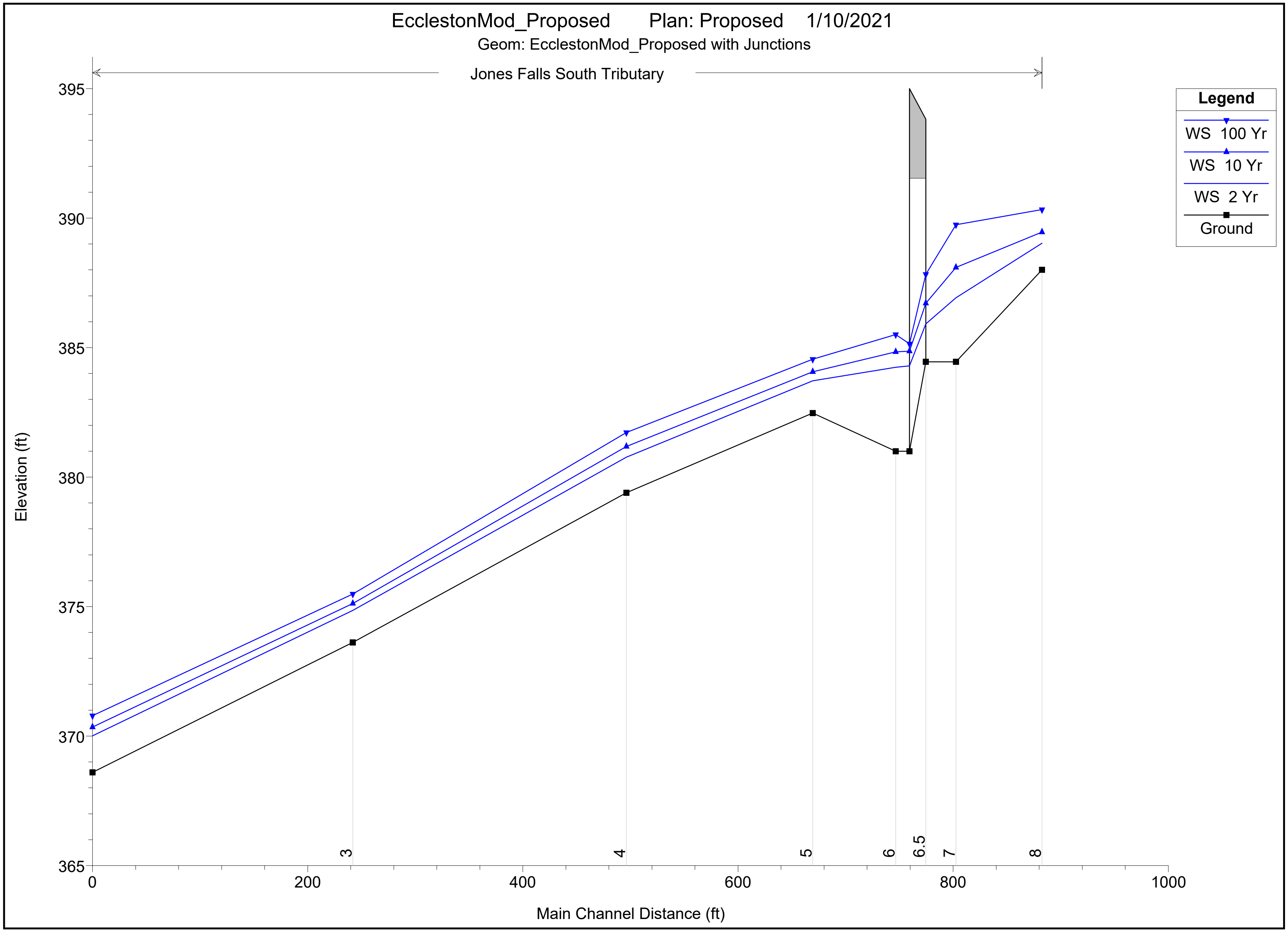
EcclestonMod_Proposed Plan: Proposed 1/10/2021
Geom: EcclestonMod_Proposed with Junctions
Jones Falls IntsTrib
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Elevation (ft)
Main Channel Distance (ft)
395
390
385
380
375
370
365
360
0
200
400
600
800
1000
1200
1400
2
2.5
3
4
4.5
5
6
6.5
7
8



EcclestonMod_Proposed Plan: Proposed 1/10/2021
Geom: EcclestonMod_Proposed with Junctions
Jones Falls Jones Falls 4
Jones Falls Jones Falls 3
Jones Falls Jones Falls 2
Jones Falls Jones Falls
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Elevation (ft)
Main Channel Distance (ft)
390
385
380
375
370
365
360
355
350
345
0
1000
2000
3000
4000
2
3
3.5
4.5
6
6.5
7
7.1
7.2
8
9
10
10.5
11
11.1
11.2
12
13
13.5
13.6
14
14.5
15



EcclestonMod_Proposed Plan: Proposed 1/10/2021
Geom: EcclestonMod_Proposed with Junctions
Jones Falls North Tributary
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Elevation (ft)
382
380
378
376
374
372
370
0
50
100
150
200
250
300
350
1.5
2
Main Channel Distance (ft)



EcclestonMod_Proposed Plan: Proposed 1/10/2021
Geom: EcclestonMod_Proposed with Junctions
Jones Falls South Tributary
Legend
WS 100 Yr
WS 10 Yr
WS 2 Yr
Ground
Elevation (ft)
Main Channel Distance (ft)
395
390
385
380
375
370
365
0
200
400
600
800
1000
3
4
5
6
6.5
7
8

HEC-RAS Plan: Proposed

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	Flow Area	Top Width	Froude # Chl	Shear Total	Shear Chan	Shear LOB	Shear ROB	Vel Total	Vel Chnl	Vel Left	Vel Right
			(cfs)	(ft)	(ft)	(ft)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
Jones Falls	15	2 Yr	363.30	381.40	384.15	383.82	137.29	134.97	0.57	0.59	1.31	0.46	0.55	2.65	5.03	1.13	2.80
Jones Falls	15	10 Yr	798.40	381.40	384.94	384.51	261.29	347.35	0.64	0.97	1.99	0.83	0.96	3.06	6.49	1.61	3.42
Jones Falls	15	100 Yr	1593.40	381.40	385.62	385.28	584.91	448.53	0.68	0.92	2.57	1.24	0.72	2.72	7.62	2.09	2.29
Jones Falls	14.5	2 Yr	363.30	378.97	381.32	380.96	204.32	242.87	0.56	0.55	0.90	0.30	0.60	1.78	3.87	0.82	1.32
Jones Falls	14.5	10 Yr	798.40	378.97	382.01	381.42	379.18	433.23	0.59	0.81	1.26	0.62	0.81	2.11	4.88	1.36	1.62
Jones Falls	14.5	100 Yr	1593.40	378.97	382.57	382.00	694.94	470.44	0.61	0.88	1.59	0.88	0.82	2.29	5.71	1.71	1.89
Jones Falls	14	2 Yr	363.30	374.70	377.82	377.63	185.95	204.85	0.56	0.51	1.24	0.33	0.47	1.95	4.88	0.90	1.13
Jones Falls	14	10 Yr	798.40	374.70	378.55	378.14	342.84	316.25	0.60	0.88	1.72	0.72	0.83	2.33	6.02	1.50	1.65
Jones Falls	14	100 Yr	1593.40	374.70	379.50	378.73	727.24	412.59	0.58	0.87	1.89	0.62	0.90	2.19	6.59	1.39	1.79
Jones Falls	13.6	2 Yr	363.30	372.69	375.14	375.14	63.46	76.06	0.94	2.35	4.08	2.37	1.49	5.72	7.84	4.41	4.20
Jones Falls	13.6	10 Yr	798.40	372.69	376.00	376.00	173.49	138.03	0.91	1.99	4.75	3.01	1.53	4.60	8.94	5.34	2.92
Jones Falls	13.6	100 Yr	1593.40	372.69	376.84	376.84	311.38	189.81	1.00	2.90	6.79	4.41	2.44	5.12	11.14	6.75	3.52
Jones Falls	13.5	2 Yr	363.30	371.25	373.34	372.78	148.28	112.23	0.47	0.68	0.96	0.65	0.66	2.45	3.71	2.29	2.29
Jones Falls	13.5	10 Yr	798.40	371.25	374.02	373.26	226.34	120.86	0.56	1.24	1.61	1.21	1.21	3.53	5.06	3.39	3.31
Jones Falls	13.5	100 Yr	1593.40	371.25	374.88	373.93	343.63	155.77	0.64	1.68	2.59	2.06	1.30	4.64	6.73	4.73	4.07
Jones Falls	13	2 Yr	363.30	369.25	370.73		140.12	192.19	0.69	0.91	1.52	0.84	0.89	2.59	4.35	2.41	2.43
Jones Falls	13	10 Yr	798.40	369.25	371.22		234.08	195.44	0.69	1.36	1.93	1.29	1.35	3.41	5.15	3.29	3.27
Jones Falls	13	100 Yr	1593.40	369.25	371.87		362.65	198.53	0.71	1.97	2.51	1.88	1.96	4.39	6.19	4.33	4.24
North Tributary	2	2 Yr	175.50	379.19	380.01	380.01	106.66	181.11	0.28	0.15	0.15	0.19	0.01	1.65	1.20	1.69	0.13
North Tributary	2	10 Yr	459.70	379.19	380.20	380.01	144.46	200.86	0.53	0.63	0.67	0.74	0.18	3.18	2.67	3.35	0.93
North Tributary	2	100 Yr	1025.90	379.19	380.81	380.45	273.00	219.23	0.53	0.90	0.98	1.00	0.54	3.76	3.56	4.02	2.12
North Tributary	1.5	2 Yr	175.50	375.11	376.45	376.36	86.30	179.18	0.67	0.60	1.24	0.54	0.56	2.03	3.80	1.72	1.78
North Tributary	1.5	10 Yr	459.70	375.11	376.72	376.63	135.86	181.58	0.89	1.53	2.59	1.43	1.46	3.38	5.73	3.04	3.12
North Tributary	1.5	100 Yr	1025.90	375.11	377.07	377.04	198.98	185.57	1.12	3.21	4.82	3.10	3.10	5.16	8.12	4.77	4.88
North Tributary	1	2 Yr	175.50	371.21	372.40		85.13	213.71	0.76	0.65	1.54	0.65	0.54	2.06	4.20	1.87	1.64
North Tributary	1	10 Yr	459.70	371.21	372.86		188.77	235.05	0.63	0.80	1.38	0.85	0.68	2.44	4.25	2.43	2.07
North Tributary	1	100 Yr	1025.90	371.21	373.51		348.39	257.43	0.58	1.00	1.50	1.10	0.86	2.94	4.72	3.05	2.55
South Tributary	8	2 Yr	151.70	388.00	389.03	389.03	34.45	57.16	1.00	2.11	2.11			4.40	4.40		
South Tributary	8	10 Yr	322.20	388.00	389.46	389.46	63.03	76.80	0.99	2.57	2.57			5.11	5.11		
South Tributary	8	100 Yr	622.10	388.00	390.33	389.94	152.27	143.46	0.62	1.08	1.45	0.17	0.17	4.09	4.22	1.27	1.27
South Tributary	7	2 Yr	151.70	384.45	386.93	385.94	49.96	32.36	0.40	0.70	0.70			3.04	3.04		
South Tributary	7	10 Yr	322.20	384.45	388.10	386.70	87.94	42.25	0.40	0.88	0.91		0.12	3.66	3.68		1.20
South Tributary	7	100 Yr	622.10	384.45	389.75	387.69	145.58	51.91	0.37	1.03	1.05		0.49	4.27	4.29		3.27
South Tributary	6.5		Bridge														
South Tributary	6	2 Yr	151.70	381.00	384.24	382.77	58.40	30.17	0.30	0.38	0.49	0.08	0.04	2.60	2.68	0.98	0.67
South Tributary	6	10 Yr	322.20	381.00	384.84	383.64	76.76	36.47	0.44	0.98	1.24	0.39	0.16	4.20	4.40	2.58	1.42
South Tributary	6	100 Yr	622.10	381.00	385.51	384.75	98.72	43.49	0.60	1.95	2.64	1.17	0.29	6.30	6.64	4.90	1.91
South Tributary	5	2 Yr	151.70	382.47	383.72	383.62	60.51	105.56	0.75	0.92	1.61	0.83	0.87	2.51	4.35	2.20	2.27
South Tributary	5	10 Yr	322.20	382.47	384.07	383.86	97.99	106.97	0.78	1.42	2.09	1.29	1.38	3.29	5.20	2.96	3.10
South Tributary	5	100 Yr	622.10	382.47	384.55	384.22	149.92	108.91	0.79	1.99	2.64	1.80	1.97	4.15	6.14	3.74	4.00
South Tributary	4	2 Yr	151.70	379.40	380.77		73.16	105.04	0.56	0.60	0.95	0.56	0.57	2.07	3.39	1.87	1.89
South Tributary	4	10 Yr	322.20	379.40	381.18		117.07	106.72	0.59	0.94	1.30	0.89	0.91	2.75	4.18	2.55	2.59

HEC-RAS Plan: Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	Flow Area	Top Width	Froude # Chl	Shear Total	Shear Chan	Shear LOB	Shear ROB	Vel Total	Vel Chnl	Vel Left	Vel Right
			(cfs)	(ft)	(ft)	(ft)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
South Tributary	4	100 Yr	622.10	379.40	381.72		175.09	108.87	0.63	1.40	1.79	1.33	1.38	3.55	5.15	3.33	3.41
South Tributary	3	2 Yr	151.70	373.62	374.85	374.85	46.06	105.39	0.97	1.20	2.57	1.06	1.11	3.29	5.42	4.14	2.75
South Tributary	3	10 Yr	322.20	373.62	375.12	375.12	75.09	107.19	1.03	1.98	3.41	1.73	1.91	4.29	6.51	5.69	3.74
South Tributary	3	100 Yr	622.10	373.62	375.48	375.48	114.02	108.63	1.07	2.93	4.36	2.61	2.88	5.46	7.67	7.50	4.83
South Tributary	2	2 Yr	151.70	368.60	370.01	369.76	126.25	245.00	0.37	0.21	0.40	0.19	0.22	1.20	2.16	1.04	1.20
South Tributary	2	10 Yr	322.20	368.60	370.35		209.36	246.36	0.37	0.31	0.47	0.29	0.32	1.54	2.45	1.41	1.55
South Tributary	2	100 Yr	622.10	368.60	370.79		317.74	248.13	0.38	0.45	0.59	0.42	0.45	1.96	2.88	1.84	1.97
IntsTrib	8	2 Yr	66.30	391.30	392.61	392.61	13.99	20.62	1.01	1.53	1.53			4.74	4.74		
IntsTrib	8	10 Yr	138.90	391.30	393.07	393.07	25.18	27.38	1.01	1.88	1.88			5.52	5.52		
IntsTrib	8	100 Yr	261.20	391.30	394.73		100.24	78.31	0.35	0.23	0.39	0.07	0.07	2.61	2.87	0.91	0.91
IntsTrib	7	2 Yr	66.30	386.20	387.79	387.79	11.70	12.59	0.93	1.58	2.01		0.27	5.67	5.85		1.54
IntsTrib	7	10 Yr	138.90	386.20	390.11	388.54	86.64	58.39	0.20	0.09	0.19	0.04	0.08	1.60	2.17	0.88	1.35
IntsTrib	7	100 Yr	261.20	386.20	394.80	389.18	464.96	269.56	0.04	0.01	0.02	0.01	0.01	0.56	0.71	0.60	0.51
IntsTrib	6.5		Culvert														
IntsTrib	6	2 Yr	66.30	377.00	379.12	378.12	20.60	26.71	0.39	0.69	0.69			3.22	3.22		
IntsTrib	6	10 Yr	138.90	377.00	379.88	378.85	27.97	30.50	0.52	1.48	1.48			4.97	4.97		
IntsTrib	6	100 Yr	261.20	377.00	380.58	379.82	34.75	33.30	0.70	3.16	3.16			7.52	7.52		
IntsTrib	5	2 Yr	66.30	376.07	377.89	377.81	20.03	27.21	0.78	1.23	2.03	1.06	1.03	3.31	5.02	2.55	2.51
IntsTrib	5	10 Yr	138.90	376.07	378.32	378.22	32.12	29.43	0.85	1.96	2.90	1.79	1.71	4.32	6.29	3.68	3.59
IntsTrib	5	100 Yr	261.20	376.07	379.18	378.70	59.09	32.88	0.67	1.71	2.35	1.63	1.55	4.42	6.05	4.01	3.95
IntsTrib	4.5	2 Yr	66.30	372.19	374.07	373.93	25.60	36.22	0.63	0.75	1.44	0.64	0.66	2.59	4.30	1.99	2.02
IntsTrib	4.5	10 Yr	138.90	372.19	374.52	374.28	42.42	38.11	0.65	1.13	1.81	1.04	1.02	3.27	5.05	2.81	2.83
IntsTrib	4.5	100 Yr	261.20	372.19	374.68	374.68	48.24	38.74	1.01	3.01	4.65	2.80	2.72	5.41	8.20	4.74	4.75
IntsTrib	4	2 Yr	66.30	368.00	369.58	369.58	17.63	27.31	0.93	1.62	2.58	1.40	1.39	3.76	5.49	2.99	3.00
IntsTrib	4	10 Yr	138.90	368.00	369.95	369.95	28.04	28.79	1.01	2.57	3.65	2.34	2.32	4.95	6.87	4.28	4.29
IntsTrib	4	100 Yr	261.20	368.00	372.07	370.43	98.37	37.51	0.31	0.48	0.64	0.46	0.46	2.66	3.34	2.50	2.51
IntsTrib	3	2 Yr	66.30	362.90	367.43	364.99	54.16	20.87	0.13	0.09	0.09			1.22	1.22		
IntsTrib	3	10 Yr	138.90	362.90	369.57	365.58	100.57	109.85	0.11	0.10	0.10			1.38	1.38		
IntsTrib	3	100 Yr	261.20	362.90	372.12	366.32	594.90	280.77	0.04	0.01	0.02	0.00	0.01	0.44	0.59	0.28	0.41
IntsTrib	2.5		Culvert														
IntsTrib	2	2 Yr	66.30	363.47	365.47	365.19	14.87	17.64	0.68	0.78	1.36		0.24	4.46	5.00		1.60
IntsTrib	2	10 Yr	138.90	363.47	365.99	365.99	25.77	74.16	0.78	1.38	2.06		0.87	5.39	6.36		3.65
IntsTrib	2	100 Yr	261.20	363.47	366.55	366.55	37.97	102.29	0.85	2.20	2.89	0.60	1.75	6.88	7.84	2.82	5.73
IntsTrib	1	2 Yr	66.30	360.00	360.99	360.99	16.55	33.41	1.00	1.21	1.21			4.01	4.01		
IntsTrib	1	10 Yr	138.90	360.00	361.32	361.32	28.89	40.42	0.98	1.42	1.55		0.32	4.81	4.88		1.75
IntsTrib	1	100 Yr	261.20	360.00	361.74	361.74	47.53	49.02	0.95	1.64	1.89		0.63	5.50	5.71		2.80
Jones Falls 2	12	2 Yr	538.80	367.70	369.27		287.53	399.32	0.51	0.48	0.87	0.46	0.49	1.87	3.34	1.80	1.83
Jones Falls 2	12	10 Yr	1258.10	367.70	369.72		469.97	401.80	0.56	0.86	1.29	0.84	0.87	2.68	4.27	2.61	2.65
Jones Falls 2	12	100 Yr	2619.30	367.70	370.33		713.51	405.10	0.62	1.42	1.90	1.41	1.42	3.67	5.43	3.61	3.65
Jones Falls 2	11.2	2 Yr	538.80	366.78	368.06		255.95	442.53	0.62	0.64	1.02	0.68	0.55	2.11	3.40	2.19	1.77
Jones Falls 2	11.2	10 Yr	1258.10	366.78	368.49		449.55	458.33	0.63	0.99	1.37	1.06	0.88	2.80	4.20	2.91	2.47

HEC-RAS Plan: Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	Flow Area	Top Width	Froude # Chl	Shear Total	Shear Chan	Shear LOB	Shear ROB	Vel Total	Vel Chnl	Vel Left	Vel Right
			(cfs)	(ft)	(ft)	(ft)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
Jones Falls 2	11.2	100 Yr	2619.30	366.78	369.11		749.49	509.43	0.64	1.35	1.81	1.53	1.15	3.49	5.15	3.75	2.98
Jones Falls 3	11.1	2 Yr	655.40	365.80	367.19		387.36	554.51	0.47	0.40	0.68	0.40	0.38	1.69	2.91	1.68	1.60
Jones Falls 3	11.1	10 Yr	1520.50	365.80	367.69		661.75	556.58	0.48	0.63	0.90	0.64	0.62	2.30	3.54	2.28	2.23
Jones Falls 3	11.1	100 Yr	3144.30	365.80	368.44		1082.38	559.73	0.47	0.87	1.10	0.87	0.86	2.90	4.16	2.89	2.85
Jones Falls 3	11	2 Yr	655.40	364.80	366.26		294.08	392.77	0.58	0.66	1.10	0.73	0.58	2.23	3.73	2.32	2.02
Jones Falls 3	11	10 Yr	1520.50	364.80	366.82		518.48	402.72	0.58	0.99	1.40	1.07	0.91	2.93	4.46	3.03	2.76
Jones Falls 3	11	100 Yr	3144.30	364.80	367.74		895.38	421.01	0.53	1.21	1.55	1.31	1.13	3.51	5.02	3.63	3.35
Jones Falls 3	10.5	2 Yr	655.40	363.61	365.42		315.78	344.31	0.49	0.56	0.89	0.56	0.54	2.08	3.43	2.03	2.00
Jones Falls 3	10.5	10 Yr	1520.50	363.61	366.14		562.99	347.19	0.47	0.80	1.06	0.79	0.78	2.70	4.00	2.66	2.64
Jones Falls 3	10.5	100 Yr	3144.30	363.61	367.22		941.71	351.54	0.45	1.03	1.24	1.03	1.02	3.34	4.62	3.30	3.29
Jones Falls 3	10	2 Yr	655.40	363.13	364.93		317.01	296.30	0.41	0.43	0.62	0.44	0.41	2.07	2.89	2.26	1.75
Jones Falls 3	10	10 Yr	1520.50	363.13	365.71		549.38	299.60	0.41	0.66	0.83	0.67	0.64	2.77	3.57	3.02	2.40
Jones Falls 3	10	100 Yr	3144.30	363.13	366.85		893.48	304.18	0.41	0.91	1.06	0.92	0.89	3.52	4.33	3.83	3.09
Jones Falls 3	9	2 Yr	655.40	361.68	363.73		269.54	220.15	0.49	0.70	0.99	0.71	0.66	2.43	3.73	2.43	2.26
Jones Falls 3	9	10 Yr	1520.50	361.68	364.60		461.20	223.73	0.51	1.08	1.36	1.09	1.05	3.30	4.67	3.29	3.14
Jones Falls 3	9	100 Yr	3144.30	361.68	365.81		734.59	228.59	0.52	1.56	1.84	1.58	1.52	4.28	5.79	4.28	4.12
Jones Falls 3	8	2 Yr	655.40	360.72	362.71		253.70	193.72	0.46	0.77	1.05	0.81	0.70	2.58	3.49	2.65	2.35
Jones Falls 3	8	10 Yr	1520.50	360.72	363.61		430.27	197.37	0.48	1.22	1.50	1.26	1.16	3.53	4.46	3.59	3.34
Jones Falls 3	8	100 Yr	3144.30	360.72	364.84		675.96	202.34	0.50	1.82	2.13	1.85	1.75	4.65	5.64	4.70	4.47
Jones Falls 3	7.2	2 Yr	655.40	359.62	361.84	361.25	260.16	192.72	0.49	0.74	1.03	0.72	0.71	2.52	3.86	2.42	2.43
Jones Falls 3	7.2	10 Yr	1520.50	359.62	362.26		340.49	194.39	0.75	2.12	2.79	2.10	2.05	4.47	6.56	4.32	4.34
Jones Falls 3	7.2	100 Yr	3144.30	359.62	364.07		699.87	201.68	0.53	1.68	1.99	1.69	1.61	4.49	6.09	4.40	4.41
Jones Falls 3	7.1	2 Yr	655.40	357.84	359.41		263.00	285.63	0.59	0.81	1.21	0.79	0.80	2.49	3.96	2.40	2.39
Jones Falls 3	7.1	10 Yr	1520.50	357.84	360.71		635.66	290.85	0.36	0.56	0.68	0.56	0.56	2.39	3.32	2.36	2.33
Jones Falls 3	7.1	100 Yr	3144.30	357.84	363.79		1553.43	303.31	0.19	0.30	0.33	0.30	0.29	2.02	2.63	2.01	1.98
Jones Falls 3	7	2 Yr	655.40	356.21	358.15		373.79	323.12	0.37	0.38	0.55	0.38	0.38	1.75	2.77	1.72	1.70
Jones Falls 3	7	10 Yr	1520.50	356.21	360.53		1154.75	333.19	0.16	0.15	0.17	0.15	0.15	1.32	1.79	1.31	1.30
Jones Falls 3	7	100 Yr	3144.30	356.21	363.74		2252.01	355.74	0.12	0.13	0.15	0.13	0.13	1.40	1.83	1.39	1.37
Jones Falls 3	6.5	2 Yr	655.40	354.03	357.21	355.83	296.72	152.51	0.32	0.42	0.60	0.47	0.39	2.21	3.16	2.20	2.10
Jones Falls 3	6.5	10 Yr	1520.50	354.03	360.45	356.56	1418.32	398.70	0.10	0.05	0.09	0.05	0.05	1.07	1.37	0.94	1.10
Jones Falls 3	6.5	100 Yr	3144.30	354.03	363.70	357.72	2801.52	452.05	0.07	0.04	0.07	0.04	0.05	1.12	1.27	0.96	1.17
Jones Falls 3	6	2 Yr	655.40	351.52	356.67	355.73	635.24	440.29	0.25	0.16	0.40	0.09	0.15	1.03	3.07	0.51	0.71
Jones Falls 3	6	10 Yr	1520.50	351.52	360.41	356.40	2738.29	599.02	0.09	0.05	0.08	0.04	0.06	0.56	1.52	0.42	0.53
Jones Falls 3	6	100 Yr	3144.30	351.52	363.68	357.13	4690.04	697.05	0.09	0.07	0.09	0.05	0.07	0.67	1.71	0.54	0.67
Jones Falls 3	5	2 Yr	655.40	351.18	356.46	354.55	294.36	392.98	0.28	0.32	0.43	0.06	0.28	2.23	2.99	0.38	1.02
Jones Falls 3	5	10 Yr	1520.50	351.18	360.30	355.85	835.37	619.46	0.17	0.28	0.34	0.20	0.29	1.82	2.61	0.97	1.23
Jones Falls 3	5	100 Yr	3144.30	351.18	363.67	357.27	5010.44	756.25	0.07	0.05	0.08	0.05	0.05	0.63	1.25	0.52	0.56
Jones Falls 3	4.5		Culvert														
Jones Falls 3	4	2 Yr	655.40	352.00	355.40	354.43	259.09	404.85	0.33	0.28	0.42	0.17	0.22	2.53	3.25	1.79	1.97
Jones Falls 3	4	10 Yr	1520.50	352.00	356.17	355.20	357.69	559.76	0.48	0.75	1.03	0.53	0.65	4.25	5.29	3.41	3.57
Jones Falls 3	4	100 Yr	3144.30	352.00	357.02	356.21	467.62	633.12	0.66	1.77	2.28	1.35	1.59	6.72	8.14	5.75	5.88

HEC-RAS Plan: Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	Flow Area	Top Width	Froude # Chl	Shear Total	Shear Chan	Shear LOB	Shear ROB	Vel Total	Vel Chnl	Vel Left	Vel Right
			(cfs)	(ft)	(ft)	(ft)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
Jones Falls 3	3.5	2 Yr	655.40	352.00	355.29	354.74	260.90	387.48	0.36	0.29	0.54	0.20	0.23	2.51	3.32	1.85	2.07
Jones Falls 3	3.5	10 Yr	1520.50	352.00	356.01	355.30	392.37	501.46	0.46	0.65	1.03	0.52	0.57	3.88	4.77	3.28	3.51
Jones Falls 3	3.5	100 Yr	3144.30	352.00	356.82	356.07	540.16	588.71	0.58	1.37	1.94	1.16	1.24	5.82	6.78	5.25	5.49
Jones Falls 3	3	2 Yr	655.40	352.00	354.44	353.99	194.79	292.70	0.68	0.58	1.41	0.54	0.34	3.36	4.93	2.85	2.07
Jones Falls 3	3	10 Yr	1520.50	352.00	354.92	354.84	351.45	360.56	0.76	0.97	2.08	0.91	0.73	4.33	6.26	3.94	3.39
Jones Falls 3	3	100 Yr	3144.30	352.00	355.45	355.39	557.73	424.77	0.85	1.55	3.04	1.54	1.25	5.64	7.86	5.43	4.73
Jones Falls 4	2	2 Yr	721.70	350.23	352.56	352.43	278.63	479.52	0.56	0.37	0.83	0.34	0.34	2.59	3.67	2.43	2.41
Jones Falls 4	2	10 Yr	1659.40	350.23	352.97	352.72	470.51	518.95	0.58	0.61	1.07	0.57	0.58	3.53	4.35	3.45	3.41
Jones Falls 4	2	100 Yr	3405.50	350.23	353.51	353.19	817.66	623.99	0.59	0.75	1.32	0.79	0.69	4.16	5.05	4.33	3.92
Jones Falls 4	1	2 Yr	721.70	348.88	350.69	350.42	342.99	523.08	0.43	0.25	0.44	0.22	0.25	2.10	2.61	1.77	2.14
Jones Falls 4	1	10 Yr	1659.40	348.88	351.13	350.72	583.50	565.06	0.45	0.40	0.61	0.33	0.40	2.84	3.24	2.36	2.95
Jones Falls 4	1	100 Yr	3405.50	348.88	351.71	351.13	929.09	614.41	0.48	0.58	0.83	0.49	0.60	3.67	3.99	3.04	3.85

```
                         HEC-RAS HEC-RAS 5.0.7 March 2019
                          U.S. Army Corps of Engineers
                          Hydrologic Engineering Center
                                609 Second Street
                                Davis, California

            X     X  XXXXXX    XXXX        XXXX       XX      XXXX
            X     X  X        X    X       X   X     X  X    X
            X     X  X        X            X   X    X    X   X
            XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
            X     X  X        X            X  X     X    X        X
            X     X  X        X    X       X   X    X    X        X
            X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: EcclestonMod_Proposed
Project File : EcclestonMod_Propos.prj
Run Date and Time: 1/10/2021 1:38:44 PM

Project in English units

PLAN DATA

Plan Title: Proposed
Plan File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Proposed HECRAS Model\EcclestonMod_Propos.p01

Geometry Title: EcclestonMod_Proposed with Junctions
Geometry File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Proposed HECRAS Model\EcclestonMod_Propos.g02

Flow Title   : EccNormalDepth_ULT
Flow File   : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Proposed HECRAS Model\EcclestonMod_Propos.f01

Plan Summary Information:

Number of:	Cross Sections =	44	Multiple Openings =	0
	Culverts =	3	Inline Structures =	0
	Bridges =	1	Lateral Structures =	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01

Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: EccNormalDepth_ULT
Flow File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Proposed HECRAS Model\EcclestonMod_Propos.f01

Flow Data (cfs)

River	Reach	RS	2 Yr	10 Yr	100 Yr
Jones Falls	Jones Falls	15	363.3	798.4	1593.4
Jones Falls	North Tributary	2	175.5	459.7	1025.9
Jones Falls	South Tributary	8	151.7	322.2	622.1
Jones Falls	IntsTrib	8	66.3	138.9	261.2
Jones Falls	Jones Falls 2	12	538.8	1258.1	2619.3
Jones Falls	Jones Falls 3	11.1	655.4	1520.5	3144.3
Jones Falls	Jones Falls 4	2	721.7	1659.4	3405.5

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Jones Falls	Jones Falls 4	2 Yr		Normal S = 0.00613

Jones Falls Jones Falls 4 10 Yr
Normal S = 0.00613
Jones Falls Jones Falls 4 100 Yr
Normal S = 0.00613

GEOMETRY DATA

Geometry Title: EcclestonMod_Proposed with Junctions
Geometry File : q:\2017\1710977_002_Eccelston_PRM_Turnke\Working Data\Design Data\Proposed HECRAS Model\EcclestonMod_Propos.g02

Reach Connection Table

River	Reach	Upstream Boundary	Downstream Boundary
Jones Falls	Jones Falls		North Trib
Jones Falls	North Tributary		North Trib
Jones Falls	South Tributary		South Trib
Jones Falls	IntsTrib		Inters Trib
Jones Falls	Jones Falls 2	North Trib	South Trib
Jones Falls	Jones Falls 3	South Trib	Inters Trib
Jones Falls	Jones Falls 4	Inters Trib	

JUNCTION INFORMATION

Name: South Trib
Description:
Energy computation Method

Length across Junction			Tributary			
River	Reach		River	Reach	Length	Angle
Jones Falls	Jones Falls 2	to	Jones Falls	Jones Falls 3	74	
Jones Falls	South Tributary	to	Jones Falls	Jones Falls 3	327	0

Name: North Trib
Description:
Energy computation Method

Length across Junction			Tributary			
River	Reach		River	Reach	Length	Angle
Jones Falls	Jones Falls	to	Jones Falls	Jones Falls 2	112	
Jones Falls	North Tributary	to	Jones Falls	Jones Falls 2	246	

Name: Inters Trib
Description:

Energy computation Method

Length across Junction River	Reach		Tributary River	Reach	Length	Angle
Jones Falls	IntsTrib	to	Jones Falls	Jones Falls 4	507	
Jones Falls	Jones Falls 3	to	Jones Falls	Jones Falls 4	170	0

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls RS: 15

INPUT
Description:
Station Elevation Data num= 76

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-64.81	388	-18.82	386	0	384.95	10.51	384.63	28.87	384.1
28.94	384.27	39.73	383.95	45.82	383.82	48.75	383.58	66.63	383.12
77.82	382.91	97.75	383.32	105.52	383.13	107.91	381.73	109.11	381.48
112.78	381.42	113.29	381.4	117.45	381.57	118.5	381.88	118.85	382.16
119.91	383.19	122.49	383.07	124.08	383.04	124.54	382.98	124.86	382.97
127.48	381.9	128.4	381.53	128.82	381.49	129.85	381.68	137.78	383.54
152.38	383.34	182.38	385.15	183.51	385.21	188.97	385.23	201.5	385.4
217.33	385.08	228.51	384.75	256.65	384.31	264.53	384.58	267.67	384.77
289.28	384.76	291.21	384.83	292.85	384.58	303.94	384.73	348.05	384.47
350.59	384.93	352.63	384.92	359.02	384.42	368.24	384.57	401.91	385.11
403.25	385.13	405.83	385.11	407.12	385.11	407.75	385.12	410.52	385.15
442.48	385.72	443.04	385.73	443.56	385.74	444.06	385.75	444.53	385.75
444.98	385.76	445.39	385.77	445.8	385.77	446.18	385.78	446.55	385.78
446.9	385.79	447.23	385.79	447.55	385.8	447.85	385.8	450.73	385.84
451.08	385.85	451.41	385.85	451.73	385.86	455.45	385.95	456.22	385.96
579.98	388								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-64.81	.11	105.52	.049	137.78	.11	410.52	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
105.52	119.91	306	304	297	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
201.5	579.98	385.4	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls RS: 14.5

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	390	31.7	388	48.67	386	69.09	384	78.17	383
92.38	382	107.84	381	129.03	380.5	154.65	381	161.43	381.16
168.17	381	175.06	380	180.75	379	181.81	378.97	185.75	379
187.74	379	189.99	380	197.29	380.95	222.86	380	223.27	379.97
223.67	380	286.46	380.04	315.37	381	368.42	382	376.18	382.08
392.93	382	490.79	381.26	545.4	382	561.64	383	586.8	384
664.47	386								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.11	168.17	.049	197.29	.11	490.79	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
168.17	197.29	422	398	305	.1	.3

Ineffective Flow num= 3

Sta L	Sta R	Elev	Permanent
0	161.43	381.16	F
197.29	376.18	380.95	F
376.18	664.47	382.08	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls RS: 14

INPUT
Description:
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	393.41	20.17	392.15	27.9	390.54	30.04	390.17	39.43	387.67
44.83	386.6	53.87	385	62.57	383.64	72.64	381.84	74.22	381.59
87.3	380.1	94.05	379.49	96.13	379.19	111.3	379.02	118.68	378.84
126.34	378.57	142.18	378.77	147.29	378.9	150.41	378.84	159.21	378.85
159.87	378.89	171.47	377.04	173.59	376.65	175.12	376.75	194.4	377.52
204.12	377.33	205.53	377.41	207.44	377.33	209.93	375.58	210.41	375.38
211.32	374.79	213.49	374.74	215.02	374.7	218.14	374.72	219.9	375.13
220.95	375.75	225.2	376.82	227	376.9	235.42	377.29	238	377.41
239.38	377.49	240.43	377.47	258.76	376.48	259.19	376.37	262.57	375.62
263.06	375.63	265.85	375.56	266.95	375.69	268.21	375.78	270.83	375.67
279.55	376.4	285.8	376.78	289.08	377.3	289.5	377.38	307.02	377.18
320.85	377.09	342.33	377.15	358.57	377.47	365	377.74	373.4	378.06
394.81	378.73	412.38	378.13	427.04	378.29	429.77	378.48	437.37	378.47
447.09	378.4	452.03	378.45	453.19	378.42	459.45	377.71	460.79	377.39
464.24	378.11	465.27	378.27	467.4	378.28	478.15	377.93	479.58	377.88
488.54	378.49	493.54	379.21	496.61	379.3	511.35	379.6	531.03	380.11

```
   539.1  380.17  542.93  380.26   550.7  380.58  568.17  381.15

Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .11  207.44    .049   225.2     .11   550.7     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        207.44   225.2              145     146     147              .1       .3
Ineffective Flow     num=       4
   Sta L   Sta R    Elev  Permanent
       0  159.87  378.89       F
  159.87   194.4  377.52       F
  239.38  387.85  377.49       F
  394.81  568.17  378.73       F

CROSS SECTION


RIVER: Jones Falls
REACH: Jones Falls        RS: 13.6

INPUT
Description:
Station Elevation Data    num=      41
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     394   12.73     393   23.59     392   34.32     391   45.06     390
   58.43     389   71.33     388   83.31     387   95.36     386  108.62     385
  124.87     384  135.45     383  140.16     382  144.82     381  149.48     380
  174.54     379  176.57     378  178.58     377  180.59     376   182.6     375
  184.61     374  197.14   373.5  198.47     373  200.08   372.9   203.1  372.69
  205.09   372.9   206.7     373  208.88   373.5  221.18     374   223.2     375
  252.87  375.43  297.54     375  298.96   374.9  303.71     375  315.82  375.44
  318.62     376  378.18     377  437.47     378  493.97     379  513.08     380
  544.28     382

Manning's n Values        num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .04  135.45     .11  184.61     .07  197.14    .055  208.88     .07
   223.2     .11  437.47     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        197.14  208.88              133     146     114              .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
  252.87  544.28  375.43       F

CROSS SECTION


RIVER: Jones Falls
```

REACH: Jones Falls   RS: 13.5

INPUT
Description:
Station Elevation Data   num=   58

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	384.47	3.6	385.33	4.06	385.45	9.41	385.2	21.69	383.88
23.74	383.44	35.99	381.7	42.94	380.89	80.81	376.99	83.66	375.56
84.77	375	85.39	374.69	85.91	374.44	86.21	374.29	88.78	373
90.24	372.27	90.91	372.05	93.71	372.05	136.56	372.05	140.57	372.07
142.72	372.05	147.74	372	148.49	371.97	149.68	371.5	150.94	371.33
151.43	371.3	152.07	371.26	153.7	371.25	154.75	371.32	156.19	371.5
157.38	371.98	158.88	372.03	167.5	372	173.22	371.99	196.2	371.99
196.99	372	203.06	374.42	203.55	374.48	209.68	374.47	214.9	374.63
221.52	374.61	226.51	373.86	227.72	373.65	230.29	373.93	236.91	374.83
249.15	374.99	251.55	374.94	258.37	375.64	266.93	375.82	278.23	376.02
279.55	376.05	312.46	376.65	316.16	376.71	316.55	376.72	345.44	377.24
355.33	377.68	374.6	378.5	378.37	378.68				

Manning's n Values   num=   7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.11	21.69	.04	90.91	.07	148.49	.055	157.38	.07
196.99	.11	316.55	.04						

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
148.49	157.38	196	219	219	.1	.3

Ineffective Flow   num=   1

Sta L	Sta R	Elev	Permanent
214.9	378.37	374.63	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls   RS: 13

INPUT
Description:
Station Elevation Data   num=   71

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	378.89	5.68	378.2	21.77	377.04	22.92	376.93	24.39	376.85
25.53	376.59	36.71	375.64	47.72	375	59.08	374.4	71.55	374.05
73.21	374	83.14	373.34	85.75	373.22	86.18	373	86.62	372.79
86.97	372.61	88.21	372	89.39	371.43	90.25	371	90.67	370.84
91.01	370.83	92.12	370.69	92.77	370.6	94.44	370.5	95.79	370.5
97.76	370.23	98.21	370.24	103.96	369.91	105.03	370	109.57	370
136.7	370	140.61	370	141.32	370	142.19	370	143.95	370
144.5	370	145.43	370	148.69	370	149.09	369.99	150.34	369.5
151.6	369.33	152.86	369.25	154.77	369.28	155.28	369.31	155.66	369.34
156.87	369.5	158.05	369.97	158.61	370.01	159.28	370.01	162.06	370.02

173.72	370.02	280.79	370.01	282.05	370.03	282.49	370.19	287.59	372.09
288.02	372.12	299.68	373.36	300.99	373.9	302.21	373.27	307.65	374.02
314.53	374.32	315.57	374.45	318.94	374.55	324.97	374.53	339.64	375.13
381.22	376.04	392.56	376.29	431.54	377.85	435.5	378.02	436.23	378.04
452.78	378.54								

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	97.76	.07	148.69	.055	158.05	.07	280.79	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
148.69	158.61	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: North Tributary RS: 2

INPUT
Description:
Station Elevation Data num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-126.44	388	0	380.22	12.77	379.9	22.81	379.65	37.96	379.2
42.95	379.16	54.09	379.05	75.73	378.88	86.45	378.95	88.4	378.92
96.27	378.89	101.95	378.96	110.35	378.93	122.55	379.33	123.54	379.4
132.31	380	144.93	380	145.74	380.01	153.96	380.01	155.32	379.5
156.14	379.4	157.66	379.29	158.46	379.23	159.09	379.19	160.19	379.25
161.53	379.33	163	379.5	163.58	379.72	164.06	379.98	197.03	379.98
197.51	379.98	209	380.6	210.23	381	217.77	381.26	235.13	382.35
236.65	382.4	237.21	382.44	238.24	382.63	238.78	382.77	243.35	383.39
270.15	387.17	285.59	388.82	286.17	388.89	307.68	390.11	323.36	391.94
326.67	392.77	336.21	393.52	342.47	394.2	344.59	394.43		

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-126.44	.04	96.27	.11	132.31	.07	153.96	.055	164.06	.07
197.03	.04								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
153.96	164.06	164	165	175	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
-126.44	132.31	380	F

CROSS SECTION

RIVER: Jones Falls
REACH: North Tributary RS: 1.5

INPUT
Description:
Station Elevation Data   num=   47

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-163.18	382	-79.65	380	0	378.54	24.34	377.77	28.79	377.66
50.42	377.35	56.67	377.22	63.87	377.18	83.78	377.13	87.93	377.1
93.02	377.3	101.5	377.24	104.06	376.01	104.61	376	117.48	376
157.34	376.02	158.44	376	158.81	375.85	159.12	375.73	159.7	375.5
160.25	375.42	161.17	375.32	163.09	375.15	163.49	375.11	163.86	375.13
164.23	375.16	165.19	375.23	166.13	375.22	167.5	375.5	168.08	375.72
169.93	375.97	172.32	375.98	278.94	376	279.38	376	286.01	377
294.3	377.38	309.99	378	318.34	378.91	324.06	379.17	337.47	380.31
343.27	381.12	344.96	381.35	366.36	384.61	368.48	384.91	369	384.98
383.2	387.03	383.97	387.09						

Manning's n Values   num=   6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-163.18	.04	87.93	.11	104.06	.07	158.44	.055	169.93	.07
279.38	.04								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
158.44	169.93	173	177	182	.1	.3

Ineffective Flow   num=   1

Sta L	Sta R	Elev	Permanent
-163.18	93.02	377.3	F

CROSS SECTION

RIVER: Jones Falls
REACH: North Tributary   RS: 1

INPUT
Description:
Station Elevation Data   num=   56

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	377.17	7.39	377	13.62	376.88	36.29	376.37	62.64	375.62
65.09	375.52	65.91	375.57	71.21	375.82	77.97	376.11	78.8	376.15
83.33	376.04	84.8	375.34	85.53	375	87.04	374.21	87.38	374.04
88.6	373.46	89.1	373.22	89.56	373	91.66	372.01	92.42	372
190.31	372	212.12	372.01	213.02	372.01	214.59	371.5	215.42	371.4
217.65	371.25	218.3	371.21	219.88	371.31	221.06	371.39	222.05	371.5
223.17	371.95	262.63	372	263.6	372	267.58	372.02	271.14	372.05
277.33	372.1	282.56	372.15	300.54	372.31	322.57	372.81	330.98	373
334.85	373.13	360.31	374	395.29	374.92	398.34	375	402.05	375.13
402.94	375.16	403.82	375.19	405.38	375.25	407.95	375.34	411.58	375.47
415.77	375.62	425.87	376	427.87	377	428.72	377.04	434.55	377.42
439.01	377.96								

```
Manning's n Values         num=        5
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val
       0     .04    91.66     .07   213.02    .055   223.17     .07   425.87     .04

Bank Sta: Left   Right    Coeff Contr.   Expan.
        213.02  223.17             .1       .3

CROSS SECTION


RIVER: Jones Falls
REACH: South Tributary    RS: 8

INPUT
Description:
Station Elevation Data    num=        9
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
   -32.1     392        0     391    110.6     390   123.66     388   133.45     388
  212.45     390   272.51     394   382.34     396    450.2     396

Manning's n Values         num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
   -32.1    .045    110.6    .057   212.45    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         110.6  212.45               75      80      75              .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
   -32.1   56.22     395       F
  221.59   450.2     395       F

CROSS SECTION


RIVER: Jones Falls
REACH: South Tributary    RS: 7

INPUT
Description:
Station Elevation Data    num=       47
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0  393.17     3.09  392.85    13.01  392.85     22.5  392.67    52.26  391.97
   66.09  392.38    75.87  392.64     92.5  391.43    97.86  391.37   116.16  390.34
   120.8   390.5   131.27  390.49   144.57  387.98   144.89  387.97   150.82  384.86
  151.07  384.58   152.67  384.79   153.39  384.66   158.59  384.56   162.95  384.45
  169.66  385.18   172.67  385.66   173.69  385.82   175.08  386.43   181.89  387.24
  184.64  387.76   185.99  387.76   187.24  389.95    188.3  390.53    188.9  390.62
  191.39   391.4   195.03  393.13   196.64  393.57      197  393.56   210.05  393.58
  212.34  393.64   213.21  393.64   228.47  393.49   263.39  393.37    264.3  393.44
  265.06  393.45   303.46  394.18   303.79  394.19   304.29  394.19   309.17  394.07
```

326.52	393.83	332.83	393.82

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	144.89	.057	184.64	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
144.89	184.64	65	56	49	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	151	395	F
186.01	332.83	395	F

BRIDGE

RIVER: Jones Falls
REACH: South Tributary RS: 6.5

INPUT
Description: Cliffholme Rd Bridge
Distance from Upstream XS = 28
Deck/Roadway Width = 15.25
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	395	385.492	150.892	395	385.492	150.892	395	391.54
170.892	395	391.54	170.892	395	385.492	332.826	395	385.492

Upstream Bridge Cross Section Data
Station Elevation Data num= 47

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	393.17	3.09	392.85	13.01	392.85	22.5	392.67	52.26	391.97
66.09	392.38	75.87	392.64	92.5	391.43	97.86	391.37	116.16	390.34
120.8	390.5	131.27	390.49	144.57	387.98	144.89	387.97	150.82	384.86
151.07	384.58	152.67	384.79	153.39	384.66	158.59	384.56	162.95	384.45
169.66	385.18	172.67	385.66	173.69	385.82	175.08	386.43	181.89	387.24
184.64	387.76	185.99	387.76	187.24	389.95	188.3	390.53	188.9	390.62
191.39	391.4	195.03	393.13	196.64	393.57	197	393.56	210.05	393.58
212.34	393.64	213.21	393.64	228.47	393.49	263.39	393.37	264.3	393.44
265.06	393.45	303.46	394.18	303.79	394.19	304.29	394.19	309.17	394.07
326.52	393.83	332.83	393.82						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	144.89	.057	184.64	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
144.89	184.64	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	151	395	F
186.01	332.83	395	F

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	395	383.862	146.652	395	383.862	146.652	395	391.54
166.652	395	391.54	166.652	395	383.862	416.81	395	383.862

Downstream Bridge Cross Section Data
Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	389.29	12.9	388.91	14.45	388.94	44.82	388.41	54.81	388.24
71.93	387.62	85.4	387.32	86.73	387.3	107.09	386.93	110.5	386.5
111.58	386	112.66	385.5	113.8	385	128.62	383.5	129.63	383
132.65	382	135.68	381	143.73	381	146.77	382	149.9	383
150.95	383.5	151.99	385	156	385.5	163.73	385.98	164.34	386.34
167.64	388.88	168.77	388.99	173.15	388.95	185.41	389.39	188.48	389.46
222.71	390.49	228.29	390.41	234.95	390.59	268.52	391.39	275.81	391.6
302.82	392.14	316.4	391.65	340.08	391.29				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	128.62	.057	150.95	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
128.62	150.95	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	120.81	395	F
161.38	340.08	395	F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

```
Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Jones Falls
REACH: South Tributary    RS: 6

INPUT
Description:
Station Elevation Data    num=      38
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  389.29    12.9  388.91   14.45  388.94   44.82  388.41   54.81  388.24
   71.93  387.62    85.4  387.32   86.73   387.3  107.09  386.93   110.5   386.5
  111.58     386  112.66   385.5   113.8     385  128.62   383.5  129.63     383
  132.65     382  135.68     381  143.73     381  146.77     382   149.9     383
  150.95   383.5  151.99     385     156   385.5  163.73  385.98  164.34  386.34
  167.64  388.88  168.77  388.99  173.15  388.95  185.41  389.39  188.48  389.46
  222.71  390.49  228.29  390.41  234.95  390.59  268.52  391.39  275.81   391.6
  302.82  392.14   316.4  391.65  340.08  391.29

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045  128.62    .057  150.95    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        128.62  150.95          98.7695 77.1617  53.891             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  120.81     395       F
  161.38  340.08     395       F

CROSS SECTION


RIVER: Jones Falls
REACH: South Tributary    RS: 5

INPUT
Description:
Station Elevation Data    num=      28
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     388    49.1  386.31   56.19     386    60.2     384    61.2   383.5
    62.2  383.17    75.1  383.17    76.5  382.61    78.6  382.47    80.7  382.61
```

82.1	383.17	164.89	383.17	165.89	383.5	166.89	384	167.89	384.5
168.98	385	171.21	386	173.55	386.85	176.61	388.03	177.1	388.04
177.93	387.98	188.26	388.46	198.4	388.79	199.97	388.83	200.64	388.83
202.67	389.03	215.11	389.68	220.93	390				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	56.19	.07	75.1	.055	82.1	.07	166.89	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
75.1	82.1	200.66	173.213	148	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: South Tributary RS: 4

INPUT
Description:
Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	386	31.01	383.83	54.7	382.21	55.22	382	55.91	381.66
57.22	381	59.09	380.1	84.61	380.1	87.24	380.1	88.64	379.54
90.74	379.4	92.84	379.54	95.34	380.1	105.03	380.1	108.26	380.1
112.3	380.1	160.57	380.1	161.53	380.17	162.39	380.6	163.2	381
163.82	381.31	164.2	381.5	165.21	382	166.06	382.42	167.21	383
168.64	383.71	169.23	384	169.8	384.29	171.22	385	190.86	386.45
194.51	386.71	195.83	386.81	210.46	387.98	224.08	389.07	224.95	389.15
225.42	389.22	227.2	389.4	229.72	389.82				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	54.7	.07	87.24	.055	95.34	.07	171.22	.04

Bank Sta: Left	Right	Lengths: Left Channel Right	Coeff Contr.	Expan.
87.24	95.34	254.6731254.1741253.6741	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: South Tributary RS: 3

INPUT
Description:
Station Elevation Data num= 81

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	383	5.1	382.75	11.15	382.44	25.65	381.32	34.08	380.79
39.13	380.6	53.24	379.32	55.88	378	57.33	377.28	57.89	377

59.32	376.29	59.89	376	60.56	375.67	61.65	375.12	65.34	374.45
66.04	374.45	66.61	374.45	66.94	374.45	76.98	374.4	77.9	374
79.69	373.67	80.27	373.62	81.08	373.66	81.61	373.76	82.16	373.77
82.86	374	83.79	374.4	84.3	374.4	89.73	374.4	91.26	374.4
97.8	374.4	99.66	374.4	100.77	374.43	101.61	374.45	101.98	374.46
105.99	374.47	109.3	374.49	110.46	374.49	113.6	374.5	114.67	374.5
117.36	374.51	121.92	374.53	124.2	374.54	127.03	374.54	127.95	374.55
128.86	374.54	130.71	374.54	131.67	374.53	132.65	374.53	133.64	374.52
136.24	374.52	136.57	374.5	137.13	374.28	137.81	374	138.3	373.9
139.28	373.8	139.9	373.73	141.25	373.84	142.3	374	143.39	374.43
144.06	374.42	144.84	374.48	145.43	374.5	149.94	374.5	151.08	374.53
162.47	374.53	166.05	374.53	167.91	374.53	168.39	374.53	168.59	375
170.6	376	172.13	376.77	172.61	377	173.33	377.37	173.79	377.38
185.02	377.81	197.34	379.06	205.66	379.85	215.57	380.65	230.29	382.2
251.86	385.03								

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	76.98	.055	83.79	.07	136.24	.055	143.39	.07
168.39	.04								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
76.98	83.79	220	242	244	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: South Tributary RS: 2

INPUT
Description:
Station Elevation Data num= 113

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	377.29	22.27	376.38	31.38	375.85	47.14	375.11	62.86	374.39
90.36	373.13	92.1	372.27	92.63	372	93.08	371.77	94.64	371
96.64	370	97.02	369.81	97.68	369.52	153.24	369.58	155.09	369.58
156.15	369.57	158.83	369.54	163.09	369.5	163.33	369.34	164.59	368.82
165.34	368.6	165.96	368.68	166.32	368.79	166.89	369	167.54	369.31
167.94	369.49	168.37	369.5	173.7	369.5	174.95	369.51	176.5	369.51
177.92	369.52	179.3	369.52	180.65	369.53	181.99	369.54	183.16	369.54
184.53	369.55	186.28	369.55	187.58	369.56	190.23	369.56	191.56	369.57
197.72	369.57	198.76	369.58	199.8	369.58	200.84	369.57	211.44	369.57
216.8	369.55	218.89	369.54	224.03	369.54	228.51	369.53	230.3	369.53
232.85	369.52	236.86	369.52	241.62	369.51	243.68	369.51	246.6	369.5
250.83	369.5	254.47	369.49	257.13	369.49	257.73	369.5	259.79	369.5
260.67	369.51	264.69	369.51	265.08	369.52	270.39	369.52	270.99	369.51
271.51	369.51	272.99	369.39	274.41	369.22	274.85	369.16	275.56	369
276.53	368.8	277.66	368.93	280.02	369.18	280.92	369.19	281.49	369.23
282.13	369.24	282.76	369.27	283.43	369.29	284.57	369.32	285.78	369.34

286.91	369.36	287.32	369.38	288.09	369.39	289.39	369.4	290.37	369.41
290.95	369.42	292.39	369.42	294.5	369.44	295.6	369.44	296.55	369.45
296.89	369.46	298.05	369.46	299.28	369.47	300.38	369.47	301.55	369.48
305.79	369.49	316.38	369.5	334.05	369.5	338.95	369.51	340.55	369.51
341.6	370	343.1	370.74	343.61	371	343.92	371.15	344.4	371.39
345.62	372	346.75	372.56	348.59	373.48	363.28	373.63	369.97	373.95
370.39	373.97	388.17	375.09	398.97	375.88				

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	97.68	.07	163.09	.055	167.94	.07	272.99	.055
288.09	.07	340.55	.04						

Bank Sta: Left	Right	Coeff Contr.	Expan.
163.09	167.94	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: IntsTrib RS: 8

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	399	5.8	398.83	34.6	398	134.2	396	208.9	394
224.8	392	230.3	391.3	236.6	392	249.7	394	277.7	396
343.2	398	344.7	398.05	366.1	398.25	456.6	402		

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	5.8	.045	208.9	.046	249.7	.045	344.7	.013
366.1	.045								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
208.9	249.7	135	134	134	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: IntsTrib RS: 7

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	395	12.5	394.9	23.7	394	59.4	392	189.7	390
198.5	388	199	387.9	203.3	386.2	208.3	386.2	208.4	387.5

```
   214.5     388   239.4     390   260.9     392   277.4     394   292.3     396

Manning's n Values         num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .013    12.5    .045   198.5    .046   214.5    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           199   208.4              150     152     154              .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  182.82     395       F
  281.48   292.3     395       F

CULVERT


RIVER: Jones Falls
REACH: IntsTrib            RS: 6.5

INPUT
Description: Culvert under Greenspring Valley Rd.
Distance from Upstream XS =      50
Deck/Roadway Width        =    44.8
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=       3
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    12.5     395             235     395           292.3     396

Upstream Bridge Cross Section Data
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     395    12.5   394.9    23.7     394    59.4     392   189.7     390
   198.5     388     199   387.9   203.3   386.2   208.3   386.2   208.4   387.5
   214.5     388   239.4     390   260.9     392   277.4     394   292.3     396

Manning's n Values         num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .013    12.5    .045   198.5    .046   214.5    .045

Bank Sta: Left   Right    Coeff Contr.   Expan.
           199   208.4             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  182.82     395       F
  281.48   292.3     395       F

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
```

0	395	318.418	395

Downstream Bridge Cross Section Data

Station Elevation Data   num=   134

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	392.47	.83	392.45	1.52	392.45	2.37	392.44	3.27	392.43
4.22	392.42	6.27	392.41	17.13	392.14	18.01	392.11	19.09	392.07
20.56	392.02	21.15	392	21.7	391.88	22.34	391.73	22.95	391.6
23.8	391.4	25.57	391	28.18	390.4	29.86	390	33.99	389
34.99	388.76	38.12	388	39.4	387.69	42.25	387	44.42	386.47
46.38	386	48.73	385.48	51.45	385.16	52.53	385.05	53.16	385
53.85	384.97	55.11	384.92	56.42	384.9	63.19	384.85	68.29	384.8
81.65	384.69	94.26	384.5	94.56	384.49	94.86	384.49	96.6	384.47
98.92	384.43	100.61	384.4	101.95	384.38	102.27	384.37	102.59	384.37
104.01	384.34	106.1	384.31	113.59	384.17	117.63	384.14	122.67	384.11
124.85	384.14	139.99	384.36	152.61	384.39	153.33	384.4	154.02	384.41
154.69	384.41	155.34	384.42	157.83	384.44	158.42	384.45	159	384.45
159.56	384.46	160.12	384.46	162.98	384.47	166.11	384.49	169.1	383
170.89	382.1	172.88	381.11	174.87	380.11	176.1	379.5	177.6	379
178.24	378.78	179.1	378.5	180.43	378.06	182.1	377.5	183.27	377.11
183.6	377	197.56	377	197.89	377.11	199.06	377.5	200.08	377.84
200.57	378	201.82	378.42	202.51	378.65	203.57	379	204.58	379.34
205.07	379.5	206.06	380	207.63	380.78	208.06	381	209.62	381.78
210.07	382	211.62	382.78	212.07	383	213.61	383.77	214.07	384
215.6	384.77	216.06	385	218.06	386	220.07	387	222.16	388
228.17	389	228.93	389.29	230.63	389.38	231.92	389.45	232.97	389.5
234.77	389.6	235.33	389.64	238.59	389.79	238.97	389.81	239.37	389.83
239.68	389.85	240.31	389.88	241.88	389.93	243.7	390	265.64	390.79
270.06	390.96	270.93	390.99	271.91	391.01	272.85	391.01	273.74	391.02
278.18	391.03	279.17	391.04	281.94	391.04	296.67	391	301.69	390.98
303.96	390.98	306.13	390.99	308.31	391.01	310.35	391.03	310.91	391.04
322.01	391.18	322.5	391.19	322.86	391.18	323.67	391.01		

Manning's n Values   num=   4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	6.27	.04	166.11	.055	215.6	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
174.87	206.06	.3	.5

Ineffective Flow   num=   2

Sta L	Sta R	Elev	Permanent
0	187.03	395	F
196.73	323.67	395	F

Upstream Embankment side slope = 3.5 horiz. to 1.0 vertical
Downstream Embankment side slope = 5 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =

```
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
GrnsprngVal     Circular       5
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
                 24  118.04     .013     .013        0                   .5
      1
Upstream   Elevation =  384.53
           Centerline Station =  205.8
Downstream Elevation =  378.84
           Centerline Station =  191.8

CULVERT OUTPUT  Profile #100 Yr  Culv Group:  GrnsprngVal

  Q Culv Group (cfs)        261.20    Culv Full Len (ft)
  # Barrels                      1    Culv Vel US (ft/s)         13.30
  Q Barrel (cfs)            261.20    Culv Vel DS (ft/s)         24.10
  E.G. US. (ft)             394.80    Culv Inv El Up (ft)       384.53
  W.S. US. (ft)             394.80    Culv Inv El Dn (ft)       378.84
  E.G. DS (ft)              381.46    Culv Frctn Ls (ft)          2.86
  W.S. DS (ft)              380.58    Culv Exit Loss (ft)         9.11
  Delta EG (ft)              13.34    Culv Entr Loss (ft)         1.38
  Delta WS (ft)              14.22    Q Weir (cfs)
  E.G. IC (ft)              394.80    Weir Sta Lft (ft)
  E.G. OC (ft)              393.63    Weir Sta Rgt (ft)
  Culvert Control            Inlet    Weir Submerg
  Culv WS Inlet (ft)        389.53    Weir Max Depth (ft)
  Culv WS Outlet (ft)       381.54    Weir Avg Depth (ft)
  Culv Nml Depth (ft)         2.37    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)         4.49    Min El Weir Flow (ft)     395.01


Warning: Since the culvert has supercritical flow, the program should be run in
mixed flow in order to check if the cross section
         downstream of the culvert has supercritical flow.
Note:    The flow in the culvert is entirely supercritical.

CROSS SECTION


RIVER: Jones Falls
REACH: IntsTrib           RS: 6

INPUT
```

Description:
Station Elevation Data num= 134

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	392.47	.83	392.45	1.52	392.45	2.37	392.44	3.27	392.43
4.22	392.42	6.27	392.41	17.13	392.14	18.01	392.11	19.09	392.07
20.56	392.02	21.15	392	21.7	391.88	22.34	391.73	22.95	391.6
23.8	391.4	25.57	391	28.18	390.4	29.86	390	33.99	389
34.99	388.76	38.12	388	39.4	387.69	42.25	387	44.42	386.47
46.38	386	48.73	385.48	51.45	385.16	52.53	385.05	53.16	385
53.85	384.97	55.11	384.92	56.42	384.9	63.19	384.85	68.29	384.8
81.65	384.69	94.26	384.5	94.56	384.49	94.86	384.49	96.6	384.47
98.92	384.43	100.61	384.4	101.95	384.38	102.27	384.37	102.59	384.37
104.01	384.34	106.1	384.31	113.59	384.17	117.63	384.14	122.67	384.11
124.85	384.14	139.99	384.36	152.61	384.39	153.33	384.4	154.02	384.41
154.69	384.41	155.34	384.42	157.83	384.44	158.42	384.45	159	384.45
159.56	384.46	160.12	384.46	162.98	384.47	166.11	384.49	169.1	383
170.89	382.1	172.88	381.11	174.87	380.11	176.1	379.5	177.6	379
178.24	378.78	179.1	378.5	180.43	378.06	182.1	377.5	183.27	377.11
183.6	377	197.56	377	197.89	377.11	199.06	377.5	200.08	377.84
200.57	378	201.82	378.42	202.51	378.65	203.57	379	204.58	379.34
205.07	379.5	206.06	380	207.63	380.78	208.06	381	209.62	381.78
210.07	382	211.62	382.78	212.07	383	213.61	383.77	214.07	384
215.6	384.77	216.06	385	218.06	386	220.07	387	222.16	388
228.17	389	228.93	389.29	230.63	389.38	231.92	389.45	232.97	389.5
234.77	389.6	235.33	389.64	238.59	389.79	238.97	389.81	239.37	389.83
239.68	389.85	240.31	389.88	241.88	389.93	243.7	390	265.64	390.79
270.06	390.96	270.93	390.99	271.91	391.01	272.85	391.01	273.74	391.02
278.18	391.03	279.17	391.04	281.94	391.04	296.67	391	301.69	390.98
303.96	390.98	306.13	390.99	308.31	391.01	310.35	391.03	310.91	391.04
322.01	391.18	322.5	391.19	322.86	391.18	323.67	391.01		

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	6.27	.04	166.11	.055	215.6	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
174.87	206.06	116	112	107	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	187.03	395	F
196.73	323.67	395	F

CROSS SECTION

RIVER: Jones Falls
REACH: IntsTrib RS: 5

INPUT
Description:

Station Elevation Data num= 130

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	389.05	1.56	389	4.48	388.82	5.1	388.78	5.56	388.74
5.87	388.71	8.54	388	11.14	387.25	12.01	387	15.44	386.01
16.02	385.85	19	385	19.68	384.81	20.61	384.55	21.79	384.22
22.57	384	23.15	383.84	26.16	383	30.84	382.08	31.38	382
35.75	381.46	39.47	381	39.83	380.97	40.76	380.92	41.83	380.89
43.08	380.88	44.56	380.88	49.66	380.91	55.1	380.95	60.79	380.99
62	381	63.32	381.01	65.77	381.02	68.21	381.03	70.64	381.04
71.43	381.04	81.18	381.08	83.67	381.09	86.17	381.1	88.65	381.11
91.1	381.13	92.99	381.14	108.51	381.23	109.93	381.25	110.58	381.25
111.35	381.26	112.07	381.27	112.77	381.27	113.47	381.28	114.16	381.28
117.71	381.3	119.39	381.32	120.95	381.29	127.55	381.37	129.69	381.37
130.03	381.36	130.35	381.36	133.17	381.29	135.83	381.25	138.33	380
139.06	379.64	140.33	379	141.05	378.64	142.33	378	143.67	377.58
145.32	377.38	146.37	377.31	153.38	377.09	154.37	377.09	155.38	377.07
156.65	376.56	157.67	376.07	158.57	376.5	159.66	376.92	160.24	377.03
160.76	377.03	166.87	377.25	167.46	377.47	170.49	378	170.95	378.23
172.49	379	172.96	379.24	174.49	380	174.97	380.24	176.49	381
177.14	381.33	178.49	382	180.35	382.93	181.06	383	188.36	383.08
189.28	383.09	190.08	383.1	191.37	383.1	194.09	383.11	196.61	383.11
197.46	383.13	210.7	383.14	211.67	383.15	212.16	383.15	212.65	383.16
214.8	383.18	215.33	383.19	218.05	383.22	218.98	383.2	219.9	383.2
228.02	383	228.85	382.99	229.32	383	231.48	383.18	232.72	383.3
238.03	383.77	239.48	383.9	240.62	384	242.24	384.11	246.79	384.42
249.21	384.57	249.9	384.61	250.57	384.65	251.1	384.69	251.82	384.73
252.82	384.79	253.73	384.85	254.85	384.92	255.17	384.94	256.25	385
260.02	385.18	277.04	386	281.45	386.2	284.89	386.36	289.82	386.59

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	8.54	.04	142.33	.07	155.38	.055	160.24	.07
170.49	.04								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
155.38	160.24	179	181	181	.1	.3

Ineffective Flow num= 3

Sta L	Sta R	Elev	Permanent
0	121.57	395	F
121.57	129.69	381.37	F
194.76	289.82	395	F

CROSS SECTION

RIVER: Jones Falls
REACH: IntsTrib RS: 4.5

INPUT
Description:

```
Station Elevation Data    num=     106
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  384.26     .87  384.22    1.32   384.2     1.8  384.18    2.31  384.16
    2.86  384.14    6.28     384   16.24   383.5   16.84  383.46   17.54  383.42
   18.36  383.37   19.36   383.3   24.13     383   25.86  382.54   28.07     382
   29.53  381.62   31.87     381   32.99   380.7   35.66     380   38.72  379.18
   39.43     379   40.27  378.75   40.76   378.6   42.93     378   46.86     377
   54.58     376   55.74  375.97   57.15  375.97   58.91  375.98   60.82     376
   66.57  376.07   67.11  376.08   68.78  376.11   75.31  376.21    75.8  376.22
   76.34  376.23   78.38  376.27   79.05  376.28   81.15  376.32   81.95  376.34
    86.4  376.45   87.97  376.49   98.07   376.7   99.46  376.73     101  376.76
  102.67  376.79  113.96  376.96  115.05  376.98   115.4  376.98   116.2  376.97
  116.66  376.95  117.38  376.93  118.11   376.9  119.84  376.83   126.8  376.53
  127.96     376  128.35  375.82  130.14     375  130.68  374.75  132.31     374
  137.22  373.68  140.48  373.43  141.47  373.36  144.02  373.34  148.65   373.3
  151.19  373.23  151.53   373.2  152.87  373.18  153.33     373  153.76  372.83
  154.59   372.5  155.34  372.19  155.97  372.43  157.49     373  159.77  373.13
  165.53  373.75  167.17  373.76  168.23     374  169.09  374.43  170.23     375
  171.34  375.56  172.23     376  173.99  376.88  174.45  377.06  174.96  377.08
  175.91  377.12  176.62  377.15  177.91  377.22   181.3  377.41  182.94   377.5
  191.93     378  194.46  378.18  206.26     379  212.02   379.4  220.54     380
   230.8  380.81   233.2     381  238.64  381.44  239.11  381.48  240.65   381.6
  243.27  381.82  245.48     382  247.24  382.14  257.43     383   260.7  383.27
  264.26  383.57

Manning's n Values        num=       6
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .013    6.28     .04  132.31     .07  152.87    .055  157.49     .07
  168.23     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        152.87  157.49               162     172     179              .1       .3
Ineffective Flow     num=       3
   Sta L   Sta R    Elev  Permanent
       0   53.91  384.26        F
   53.91  115.05  376.98        F
  227.38  264.26  384.26        F

CROSS SECTION


RIVER: Jones Falls
REACH: IntsTrib           RS: 4

INPUT
Description:
Station Elevation Data    num=      75
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  380.49    2.78  380.47    3.46  380.44   14.42     380   19.89  379.69
   20.78  379.62   29.35     379   32.88  378.18   33.54  378.03   34.88  377.67
```

35.59	377.49	36.56	377.23	37.44	377	39.43	376.47	40.44	376.2
41.21	376	44.48	375.13	44.98	375	47.96	374.21	48.76	374
59.16	373.78	74.62	373.4	77.35	372.03	79.37	371.03	81.44	370
83.32	369	93.31	369	94.57	368.5	95.82	368	96.54	368.29
97.07	368.5	98.32	369	108.32	369	110.43	370	114.63	372
116.73	373	118.84	374	121.55	374.23	126.36	374.1	127.49	374.07
128.68	374.05	129.9	374.04	131.16	374.03	134.01	374.01	140.19	374.01
140.78	374.02	154.08	374.28	155.91	374.34	157.74	374.38	159.31	374.42
160.66	374.46	161.8	374.49	176.64	375	189.9	375.47	204.96	376
206.35	376.05	209.64	376.27	211.19	376.36	212.41	376.43	213.39	376.49
214.17	376.54	215.68	376.65	217.89	376.8	220.72	377	221.17	377.03
223.22	377.18	234.29	378	240.86	378.48	243.17	378.66	247.79	379
249.65	379.14	253.49	379.43	255.37	379.57	256.45	379.66	258.67	379.84

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.013	29.35	.04	83.32	.07	93.31	.055	98.32	.07
108.32	.04								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
93.31	98.32	202	222	233	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
121.55	258.67	374.23	F

CROSS SECTION

RIVER: Jones Falls
REACH: IntsTrib RS: 3

INPUT
Description:
Station Elevation Data num= 148

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	373.19	1.01	373.14	4.2	373	17.26	373	22.84	372.81
23.68	372.81	24.13	372.8	24.59	372.8	26.42	372.78	26.86	372.78
27.28	372.77	28.09	372.77	36.45	372.71	41.06	372.68	41.64	372.62
42.5	372.56	57.3	372.43	57.77	372.4	70.69	372.28	71.37	372.27
72.03	372.27	72.82	372.26	73.63	372.25	74.46	372.24	75.04	372.24
75.87	372.23	76.42	372.22	79.86	372.19	80.37	372.19	82.06	372.17
86.98	372.09	91.37	372	105.06	371.72	116.72	371.48	118.17	371.45
119.45	371.43	120.4	371.41	121.54	371.39	122.52	371.37	123.55	371.35
124.56	371.34	125.63	371.33	130.35	371.27	133.77	371.22	134.92	371.21
136.11	371.19	137.35	371.16	138.68	371.13	144.05	371	151.8	370.8
152.23	370.79	153.47	370.75	154.04	370.73	155.2	370.68	155.97	370.64
157	370.58	157.86	370.53	158.94	370.46	161.05	370.31	165.48	370
167.65	369.85	168.83	369.77	169.99	369.69	170.68	369.59	171.79	369.45
173.56	369.17	174.71	369	179.95	369	180.32	368.85	182.44	368
182.76	367.87	184.89	367	187.35	366	189.72	365.05	191.1	364.9

195.78	364.5	196.7	364.22	197.44	364	198.89	363.56	199.49	363.38
200.22	363.08	200.63	362.9	201.66	363.28	202.23	363.5	203.54	364
204.24	364.26	204.39	365	204.53	366	204.66	367	204.8	368
204.97	369	235.63	369	247.89	369.16	248.23	369.17	248.6	369.18
249.02	369.18	249.98	369.2	250.91	369.21	251.43	369.22	252.35	369.23
253.24	369.24	256.57	369.28	257.35	369.29	260.89	369.35	261.68	369.36
262.45	369.36	263.19	369.37	266.93	369.4	269.66	369.45	273.09	369.48
273.8	369.49	276.53	369.49	282.27	369.6	285.09	369.58	286.01	369.61
286.99	369.63	288.04	369.67	288.62	369.67	289.71	369.71	290.22	369.71
295.92	369.94	297.44	370	298.26	370.03	301.11	370.15	303.31	370.24
305.08	370.31	306.68	370.38	309.12	370.48	313.21	370.65	319.83	370.91
321.86	370.99	328.67	371.25	329.28	371.28	329.64	371.3	333.56	371.45
334.01	371.47	336.29	371.56	337.68	371.61	338.36	371.64	339.43	371.67
340.11	371.7	340.86	371.72	341.67	371.74	342.41	371.76	343.06	371.78
352.37	372	352.99	372.01	446.13	372.75				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	179.95	.055	204.97	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
179.95	204.97	112	116	119	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	182.06	371.13	F
204.02	446.13	371.13	F

CULVERT

RIVER: Jones Falls
REACH: IntsTrib RS: 2.5

INPUT
Description: Intersection Trib Culvert under Park Heights Ave.
Distance from Upstream XS = 50
Deck/Roadway Width = 45
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	378.5		446.13	368.4	

Upstream Bridge Cross Section Data
Station Elevation Data num= 148

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	373.19	1.01	373.14	4.2	373	17.26	373	22.84	372.81
23.68	372.81	24.13	372.8	24.59	372.8	26.42	372.78	26.86	372.78
27.28	372.77	28.09	372.77	36.45	372.71	41.06	372.68	41.64	372.62
42.5	372.56	57.3	372.43	57.77	372.4	70.69	372.28	71.37	372.27

72.03	372.27	72.82	372.26	73.63	372.25	74.46	372.24	75.04	372.24
75.87	372.23	76.42	372.22	79.86	372.19	80.37	372.19	82.06	372.17
86.98	372.09	91.37	372	105.06	371.72	116.72	371.48	118.17	371.45
119.45	371.43	120.4	371.41	121.54	371.39	122.52	371.37	123.55	371.35
124.56	371.34	125.63	371.33	130.35	371.27	133.77	371.22	134.92	371.21
136.11	371.19	137.35	371.16	138.68	371.13	144.05	371	151.8	370.8
152.23	370.79	153.47	370.75	154.04	370.73	155.2	370.68	155.97	370.64
157	370.58	157.86	370.53	158.94	370.46	161.05	370.31	165.48	370
167.65	369.85	168.83	369.77	169.99	369.69	170.68	369.59	171.79	369.45
173.56	369.17	174.71	369	179.95	369	180.32	368.85	182.44	368
182.76	367.87	184.89	367	187.35	366	189.72	365.05	191.1	364.9
195.78	364.5	196.7	364.22	197.44	364	198.89	363.56	199.49	363.38
200.22	363.08	200.63	362.9	201.66	363.28	202.23	363.5	203.54	364
204.24	364.26	204.39	365	204.53	366	204.66	367	204.8	368
204.97	369	235.63	369	247.89	369.16	248.23	369.17	248.6	369.18
249.02	369.18	249.98	369.2	250.91	369.21	251.43	369.22	252.35	369.23
253.24	369.24	256.57	369.28	257.35	369.29	260.89	369.35	261.68	369.36
262.45	369.36	263.19	369.37	266.93	369.4	269.66	369.45	273.09	369.48
273.8	369.49	276.53	369.49	282.27	369.6	285.09	369.58	286.01	369.61
286.99	369.63	288.04	369.67	288.62	369.67	289.71	369.71	290.22	369.71
295.92	369.94	297.44	370	298.26	370.03	301.11	370.15	303.31	370.24
305.08	370.31	306.68	370.38	309.12	370.48	313.21	370.65	319.83	370.91
321.86	370.99	328.67	371.25	329.28	371.28	329.64	371.3	333.56	371.45
334.01	371.47	336.29	371.56	337.68	371.61	338.36	371.64	339.43	371.67
340.11	371.7	340.86	371.72	341.67	371.74	342.41	371.76	343.06	371.78
352.37	372	352.99	372.01	446.13	372.75				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	179.95	.055	204.97	.04

Bank Sta: Left Right Coeff Contr. Expan.

Left	Right	Contr.	Expan.
179.95	204.97	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	182.06	371.13	F
204.02	446.13	371.13	F

Downstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	376.2		303.7	369.8	

Downstream Bridge Cross Section Data
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	372.5	15.7	372	88.3	370	149.6	368	155.3	366
157.93	363.47	162.93	363.47	163.3	365	185.2	366	203.4	366
241.82	365.5	300	369.8	306.44	369.8	321.8	370		

```
Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045   155.3    .046   163.3    .045     300    .013

Bank Sta: Left   Right    Coeff Contr.   Expan.
         155.3   163.3             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  154.76   369.8       F
  176.73   321.8   369.8       F

Upstream Embankment side slope              =     2.4 horiz. to 1.0 vertical
Downstream Embankment side slope            =     3.5 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
ParkHgtsAve     Circular       5
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
               5.44   84.85     .024     .024        0                   .5
      1
Upstream   Elevation =  363.83
           Centerline Station =  196.84
Downstream Elevation =  363.44
           Centerline Station =  160.43

CULVERT OUTPUT  Profile #100 Yr  Culv Group:  ParkHgtsAve

  Q Culv Group (cfs)       200.51    Culv Full Len (ft)         54.89
  # Barrels                     1    Culv Vel US (ft/s)         10.21
  Q Barrel (cfs)           200.51    Culv Vel DS (ft/s)         11.79
  E.G. US. (ft)            372.12    Culv Inv El Up (ft)       363.83
  W.S. US. (ft)            372.12    Culv Inv El Dn (ft)       363.44
  E.G. DS (ft)             367.34    Culv Frctn Ls (ft)          1.67
  W.S. DS (ft)             366.55    Culv Exit Loss (ft)         2.30
  Delta EG (ft)              4.78    Culv Entr Loss (ft)         0.81
  Delta WS (ft)              5.57    Q Weir (cfs)               60.69
  E.G. IC (ft)             371.99    Weir Sta Lft (ft)         283.46
  E.G. OC (ft)             372.12    Weir Sta Rgt (ft)         362.14
  Culvert Control          Outlet    Weir Submerg                0.00
  Culv WS Inlet (ft)       368.83    Weir Max Depth (ft)         0.95
```

Culv WS Outlet (ft)	367.48	Weir Avg Depth (ft)	0.42
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	32.89
Culv Crt Depth (ft)	4.04	Min El Weir Flow (ft)	371.14

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CROSS SECTION

RIVER: Jones Falls
REACH: IntsTrib RS: 2

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	372.5	15.7	372	88.3	370	149.6	368	155.3	366
157.93	363.47	162.93	363.47	163.3	365	185.2	366	203.4	366
241.82	365.5	300	369.8	306.44	369.8	321.8	370		

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.045	155.3	.046	163.3	.045	300	.013

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
155.3	163.3	209	187	167	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	154.76	369.8	F
176.73	321.8	369.8	F

CROSS SECTION

RIVER: Jones Falls
REACH: IntsTrib RS: 1

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	363	43.1	364	84.7	365	156.97	364	186.15	363
207.34	362	239.78	362	255.12	360	281.17	361	371.98	368

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	239.78	.046	281.17	.045

Bank Sta: Left Right Coeff Contr. Expan.

Left	Right	Contr.	Expan.
239.78	281.17	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
294.42	371.98	371.13	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 2 RS: 12

INPUT
Description:
Station Elevation Data num= 152

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	377.02	20.49	376.53	27.96	376.29	46.34	375.72	59.4	375.36
70.73	375.14	90.58	374.57	103.06	373.94	104.46	373.88	109.15	372.61
114.32	373.79	123.55	373.82	124.48	373.8	126.29	373.79	130.45	373.59
131.55	373.46	132.13	373.17	132.48	373	133.24	372.62	134.49	372
135.35	371.57	136.5	371	137.36	370.57	138.42	370.05	139.01	369.75
140.31	369.1	140.85	368.84	143.75	368.62	148.53	368.62	152.77	368.62
157.67	368.63	169.45	368.62	176.5	368.63	180.15	368.63	183.63	368.64
187.37	368.64	188.33	368.63	188.82	368.63	189.55	368.62	190.38	368.62
190.84	368.61	191.41	368.6	191.85	368.6	192.36	368.59	193.46	368.57
193.83	368.57	194.29	368.56	194.69	368.5	195.38	368.22	196.35	368
197.52	367.88	198.24	367.8	198.6	367.76	199	367.72	200.83	367.79
201.67	367.86	203.09	367.99	204.4	368.5	205.49	368.54	206.25	368.54
207.24	368.55	208.34	368.55	208.88	368.56	209.92	368.57	210.93	368.57
211.34	368.58	227.66	368.58	231.38	368.57	231.96	368.57	241.66	368.56
243.05	368.56	246.6	368.55	255.74	368.54	256.76	368.54	261.83	368.53
272.07	368.56	272.75	368.57	276.31	368.57	279.66	368.5	281.21	368
282.07	368.36	282.51	368.5	294.62	368.5	297.28	368.65	304.65	368.7
306.4	368.71	309.8	368.73	313.46	368.75	316.23	368.76	318.09	368.77
322.62	368.79	327.22	368.82	327.78	368.82	330.45	368.83	335.82	368.84
337.82	368.84	341.43	368.82	346.53	368.8	352.26	368.79	353.01	368.79
353.53	368.78	355.99	368.76	360	368.71	366.06	368.65	368.8	368.62
370.65	368.61	378.02	368.53	378.69	368.52	382.46	368.5	382.81	368.5
390.44	368.45	392.43	368.44	393.54	368.44	396.08	368.43	398.59	368.42
406.19	368.33	406.67	368.33	411.84	368.3	418.41	368.5	421.2	368.51
425.98	368.5	427.94	368.47	429.46	368.44	430.57	368	432.02	367.81
432.69	367.77	433.76	367.7	434.32	367.72	435.83	367.82	437.16	368
438.42	368.5	438.86	368.5	442.36	368.51	534	368.51	537.7	369
538.36	369	541.81	370	543.3	370.43	546.96	370.85	548.21	371
552.1	371.45	560.73	371.94	562.68	372.02	571.38	372.46	574.08	372.52
576.03	372.54	582.37	372.74	608.52	373.45	642.4	374.43	659.9	375
669.78	375.35	687.83	375.97						

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	143.75	.07	193.46	.055	204.4	.07	279.66	.055
282.51	.07	429.46	.055	438.42	.07	534	.04		

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
429.46	438.42	71	119	122	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 2   RS: 11.2

INPUT
Description:
Station Elevation Data   num=   157

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	376.29	22.28	375.62	31.37	375.32	46.47	374.92	62.56	374.35
72.17	374.09	89.78	373.47	100.07	372.95	100.83	372.91	106.66	371.76
107.05	371.78	119.95	372.73	120.83	372.76	125.13	372.62	128.49	372.62
130.46	372.65	130.81	372.68	132.17	372	132.69	371.74	133.08	371.54
134.18	371	135.24	370.47	136.17	370	137.1	369.54	138.17	369
139.24	368.47	140.18	368	141.2	367.5	141.9	367.5	148.3	367.53
152.72	367.54	153.21	367.53	154.61	367.48	161.28	367.47	169.91	367.46
172.39	367.46	178.83	367.45	182.85	367.45	185.55	367.44	189.3	367.44
194.16	367.43	198.85	367.43	199.43	367.44	199.88	367.45	200.41	367.46
200.94	367.47	201.63	367.47	202.18	367.48	203.44	367.48	204.04	367.49
204.48	367.5	206.44	367.5	207.91	367.32	208.37	367.25	208.79	367.2
209.45	367	209.89	366.89	213.56	366.9	214.04	367	214.55	367.2
215.36	367.37	215.93	367.5	221.24	367.5	222.5	367.49	223.56	367.47
224.14	367.46	225.59	367.46	226.84	367.44	227.18	367.44	228.02	367.43
229.14	367.42	230.19	367.41	231.04	367.4	232.12	367.39	232.83	367.38
233.88	367.37	234.69	367.37	235.77	367.36	236.54	367.35	238.27	367.34
242.76	367.33	244.58	367.3	245.37	367.29	253.87	367.26	255.97	367.25
257.04	367.24	263.25	367.21	263.6	367.2	264.7	367.16	267.21	367.14
267.92	367.13	271.08	367	271.69	366.7	272.28	366.96	277.46	367.16
277.85	367.16	285.89	367.24	290.35	367.33	290.98	367.34	291.36	367.34
291.84	367.37	295.63	367.44	296.17	367.44	297.94	367.45	308.93	367.49
311.16	367.5	315.02	367.52	321.72	367.55	322.45	367.55	326.43	367.56
327.51	367.56	328.09	367.57	341.15	367.65	343.34	367.65	346.49	367.63
347.35	367.63	367.54	367.68	368.4	367.68	386.33	367.55	392.15	367.5
393.65	367	394.98	366.82	395.53	366.79	398.27	366.78	400.04	366.98
401.08	367.34	401.38	367.4	402.78	367.45	405.87	367.5	409.03	367.51
541.12	367.51	546.19	367.53	549.55	367.53	580.58	368	604.22	368.68
611.19	368.83	615.2	368.85	645.62	368.99	647.14	369	647.72	369.28
648.13	369.49	649.15	370	650.58	370.72	651.15	371	651.99	371.42
652.31	371.58	653.16	372	654.15	372.5	655.82	373.33	664.56	373.66
668.29	373.54	694.11	374.89	697.12	375.05	699.75	375.18	724.41	376.24
754.67	377.21	756.67	377.28						

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	141.2	.07	206.44	.055	215.93	.07	267.21	.055
277.46	.07	392.15	.055	405.87	.07	647.14	.04		

Bank Sta: Left	Right	Coeff Contr.	Expan.
392.15	405.87	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 11.1

INPUT
Description:
Station Elevation Data num= 214

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	375.24	13.07	374.8	31.03	374.22	39.02	373.95	61.25	373.15
63.89	373.06	65.68	373	119.83	373	121.29	372.27	121.84	372
123.84	371	125.62	370.11	126.78	369.53	127.84	369	128.87	368.49
129.69	368.07	130.21	367.82	131.84	367	132.81	366.51	136.58	366.5
168.16	366.5	173.84	366.51	178.73	366.51	186.85	366.52	192.74	366.52
203.74	366.5	206.86	366.5	209.63	366.4	211.21	366	212.54	365.71
213.11	365.75	214.74	366	215.53	366.21	218.65	366.5	219.84	366.45
221.85	366.5	224.38	366.51	228.03	366.54	229.79	366.5	234.67	366.5
235.9	366	236.8	365.64	237.11	365.56	237.42	366	237.79	366.5
240.7	366.52	317.92	366.5	329.76	366.49	330.19	366.49	330.71	366.48
332.36	366.44	335.34	366	342.05	365.8	346.37	366	346.78	366.19
347.3	366.43	349.83	366.35	350.62	366.44	363.45	366.38	363.85	366.4
364.68	366.41	366	366.45	366.86	366.48	368.65	366.47	377.1	366.46
378.38	366.46	380.66	366.45	385.47	366.45	385.97	366.44	397.28	366.44
402.7	366.43	407.35	366.42	413.23	366.42	414.16	366.43	415.83	366.43
416.59	366.44	418.18	366.44	419.01	366.45	420.35	366.45	420.84	366.46
421.77	366.46	422.17	366.47	423.16	366.47	424.19	366.46	424.75	366.46
425.47	366.47	425.82	366.47	426.67	366.44	427.06	366.45	427.65	366.37
428.39	366.38	429.03	366.38	431.25	366	433.65	366.48	434.77	366.51
435.13	366.52	435.83	366.53	436.87	366.54	437.35	366.54	438.35	366.56
438.77	366.55	439.15	366.54	439.88	366.52	440.74	366.5	441.52	366.48
441.92	366.47	442.47	366.46	442.78	366.47	443.12	366.47	444.08	366.46
445.94	366.45	454.16	366.45	455.17	366.46	456.15	366.46	457.44	366.47
458.67	366.48	459.88	366.48	461.04	366.49	462.22	366.49	463.83	366.5
467.65	366.51	472.99	366.53	474.24	366.54	475.46	366.54	477.79	366.55
478.9	366.55	483.11	366.56	487.44	366.56	489.16	366.57	491.49	366.57
493.02	366.58	497.23	366.58	501.24	366.59	504.78	366.59	508.11	366.6
511.82	366.61	518.79	366.61	537.73	366.58	543.39	366.59	544.87	366.1
549.77	366.59	555.01	366.6	563.48	366.6	567.51	366.61	575.59	366.61
578.55	366.62	583.12	366.62	587.06	366.63	592.07	366.63	594.03	366.64
605.43	366.64	608.95	366.62	609.79	366.61	610.66	366.6	611.56	366.6
612.5	366.59	613.45	366.59	616.5	366.57	617.38	366.56	617.7	366.55

618.17	366.54	619.17	366.52	619.96	366.51	620.56	366.51	621.07	366.5
623.53	366.05	625.68	366.44	626.18	366.5	626.53	366.5	627.6	366.46
628.51	366.43	629.36	366.41	630.23	366.41	631.28	366.43	632.51	366.47
633.01	366.48	633.69	366.5	635.08	366.5	636.12	366.51	637.33	366.51
639.26	366.52	640.9	366.52	641.55	366.53	643.94	366.53	645.38	366.54
647.84	366.54	648.6	366.55	662.93	366.55	665.53	366.56	667.99	366.56
669.44	366.59	671.68	366.59	673.75	366.58	674.95	366.63	678.45	366.61
679.79	366.61	680.66	366.67	684.48	366.63	684.74	366.63	687.74	368
689.56	368.84	689.92	369	691.07	369.53	692.1	370	693.29	370.54
694.28	371	695.2	371.42	695.73	371.66	697.58	372.58	703.54	372.67
711.78	373.25	732.36	374.67	753.71	376.41	764.06	377.23		

Manning's n Values num= 15

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	132.81	.07	209.63	.055	218.65	.07	234.67	.055
237.79	.07	332.36	.055	347.3	.07	425.82	.055	433.65	.07
543.39	.055	549.77	.07	619.17	.055	626.18	.07	684.48	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
332.36	347.3	112	91	53	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 11

INPUT
Description:
Station Elevation Data num= 233

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	375.91	9.58	375.41	36.89	373.9	40.01	373.72	41.2	373.66
51.45	373.11	53.59	373	129.85	373	131.85	372	132.16	371.85
132.64	371.61	133.86	371	134.92	370.46	135.86	370	136.79	369.54
137.87	369	138.92	368.47	139.78	368.04	140.55	367.66	141.87	367
142.89	366.49	144.83	365.51	147.61	365.51	152.75	365.5	153.07	365.5
155.01	365.53	157.36	365.54	171.47	365.54	172.5	365.55	174.7	365.56
181.47	365.56	185.15	365.55	191.19	365.53	194.61	365.52	198.22	365.51
207.74	365.51	209.09	365.5	218.99	365.5	219.8	365.45	221.67	365
222.51	364.92	223.53	364.82	226.03	364.97	226.94	365.24	231.76	365.07
236.6	365.14	237.09	365.14	239.47	365.17	241.84	365.18	243.39	365.19
243.83	365.2	244.23	365.21	244.67	365.21	246.45	365.22	248.75	365.25
249.61	365.26	253.19	365.28	255.11	365.3	256.07	365.31	261.43	365.34
266.15	365.36	277.29	365.43	279.95	365.44	282.35	365.45	286.15	365.47
295.09	365.5	296.52	365.51	297.24	365.5	306.15	365.5	307.42	365
308.13	364.91	308.85	364.86	309.64	364.8	311.85	364.81	312.29	364.84
312.95	364.88	313.35	364.93	313.9	365	314.79	365.34	315.19	365.5
316.36	365.51	316.73	365.51	319.46	365.5	329.36	365.4	334.03	365.35
334.92	365.33	335.39	365.32	336.11	365.3	342.88	365.31	346.5	365.31
347.41	365.32	347.97	365.32	349.43	365.33	350.06	365.33	350.67	365.34

351.22	365.34	352.21	365.35	352.81	365.36	353.12	365.36	353.64	365.37
354.88	365.38	355.31	365.38	355.88	365.39	356.43	365.4	357.09	365.41
357.65	365.42	358.21	365.42	358.89	365.43	360.47	365.44	361.23	365.44
361.87	365.45	363.09	365.47	364.26	365.5	365.58	365.5	366.2	365.51
368.52	365.51	371.11	365.05	373.55	365.5	375.66	365.5	376.31	365.47
376.79	365.47	377.37	365.46	378.34	365.46	378.88	365.47	379.62	365.49
381.22	365.51	382.61	365.52	383.8	365.53	390.93	365.66	394.26	365.86
396.96	366	398.01	366.21	398.54	366.32	400.98	366.71	402.75	367
404.57	367.29	407.08	367.7	408.41	367.74	410.07	367.36	410.97	367.04
411.87	366.66	413.13	366.12	414.45	365.95	414.92	365.91	426.08	365.62
429.56	365.62	432.96	365.63	440.01	365.63	440.48	365.65	441.07	365.66
441.92	365.68	443.4	365.68	444.47	365.7	447.45	365.7	448.67	365.72
449.17	365.2	450.93	365.72	451.37	365.73	464.29	365.73	466.67	365.72
469.28	365.72	470.47	366	472.27	366.59	473.51	367	475.53	367.67
476.55	368	478.8	368.74	479.59	369	486.81	369.16	488.01	369.2
488.96	369.23	489.34	369.25	503.59	369	521.46	369	522.36	368.72
523.15	368.43	523.66	368.22	524.16	368	526.33	367.08	528.02	366.3
528.56	366.05	528.97	365.87	530.9	365.75	531.26	365.76	532.94	365.77
533.62	365.76	534.13	365.76	534.63	365.75	535.29	365.75	536.37	365.74
542.18	365.5	543.09	365.3	544.05	365.09	545.3	365.24	546.53	365.5
548	365.54	548.52	365.55	549.25	365.54	551.78	365.54	552.83	365.55
554.25	365.56	554.77	365.56	555.98	365.58	557.13	365.59	558.26	365.6
559.11	365.6	560.25	365.61	561.53	365.62	562.97	365.62	563.28	365.63
568.34	365.63	569.12	365.64	583.27	365.64	586.88	365.63	594.93	365.63
601.49	365.83	602.53	365.83	606.71	365.82	607.05	366	609.09	367
611.12	368	613.04	368.95	614.79	369.81	615.18	370	615.58	370.19
616.31	370.55	617.21	371	618.28	371.53	619.16	371.96	634.67	372.74
648.57	373.44	655.93	373.95	670.07	374.9				

Manning's n Values num= 13

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	144.83	.07	218.99	.055	226.94	.07	306.15	.055
315.19	.07	368.52	.055	373.55	.07	448.67	.055	450.93	.07
542.18	.055	546.53	.07	601.49	.04				

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
306.15	315.19	80	116	60	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 10.5

INPUT
Description:
Station Elevation Data num= 175

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	378.37	1.15	378.36	30.47	376.82	45.17	376.11	63.35	374.63
73.05	373.81	85.31	373	116.88	373	118.88	372	119.27	371.81

120.88	371	122.88	370	123.93	369.48	124.89	369	125.86	368.52
126.65	368.12	127.71	367.6	128.9	367	129.82	366.54	130.9	366
132.55	365.18	132.91	365	134.08	364.51	136.99	364.51	141.69	364.5
169.84	364.5	170.53	364.51	175.62	364.51	177.8	364	179.64	363.92
181.06	364.17	181.41	364.26	182.36	364.5	185.4	364.5	186.3	364.45
187.74	364.42	188.75	364.39	190.35	364.37	190.74	364.38	191.94	364.38
192.75	364.37	194.79	364.37	196.17	364.38	198.63	364.38	198.96	364.39
201.37	364.39	202.27	364.4	205.65	364.43	214.59	364.49	215.6	364.5
222.4	364.53	223.86	364.54	228.71	364.54	233.1	364.55	239.95	364.57
240.7	364.57	243.67	364.58	249.82	364.59	252.3	364.6	257.37	364.61
259.79	364.62	268.28	364.62	270.01	364.6	272.64	364.59	278.47	364.53
281.31	364.51	282.05	364.51	283.09	364.5	283.42	364.5	284.23	364.17
284.66	364	286.5	363.74	287.44	363.66	287.98	363.61	288.54	363.66
289.34	363.73	291.12	364	292.26	364.46	292.96	364.51	296.14	364.51
297.88	364.5	301.53	364.51	303.12	364.5	305.16	364.47	306.35	364.45
309.32	364.41	310.4	364.44	322.04	364.44	324.05	364.45	325.52	364.45
334.39	364.47	337.12	364.47	338.13	364.48	342.32	364.48	345.2	364.49
349.52	364.49	354.28	364.5	358.88	364.5	361.73	364.51	363.77	364
366.46	364.51	370.76	364.52	375.57	364.53	380.43	364.54	383.96	364.55
393.36	364.55	394.22	364.56	399.37	364.56	400.19	364.57	401.88	364.57
402.63	364.56	404.85	364.56	405.98	364.55	406.84	364.55	407.74	364.54
408.67	364.54	409.62	364.53	409.97	364.53	410.62	364.52	411.64	364.52
412.18	364.51	413.9	364.51	414.57	364.52	414.99	364.52	415.67	364.5
417.64	364.06	419.89	364.46	420.77	364.51	424.81	364.51	425.85	364.52
427.03	364.53	428	364.54	428.35	364.54	428.93	364.55	429.57	364.55
430.54	364.57	431.61	364.58	432.54	364.59	432.84	364.6	433.79	364.6
434.68	364.61	436.98	364.61	438.73	364.62	442.11	364.62	443.79	364.63
449.58	364.63	450.86	364.64	460.31	364.64	463.94	364.65	466.64	364.73
468.3	364.73	468.98	364.74	474.4	364.74	475.53	365	476.65	365.56
477.54	366	478.24	366.34	479.56	367	481.39	367.9	482.24	368.33
483.6	369	485.08	369.73	485.61	370	486.19	370.29	488.01	371.19
489.97	371.37	491.04	371.46	497.09	371.33	499.9	371.31	503.12	371.44
506.27	371.73	516.56	372.53	525.51	373.08	528.72	373.28	539.11	373.96

Manning's n Values num= 11

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	134.08	.07	175.62	.055	182.36	.07	283.09	.055
292.26	.07	361.73	.055	366.46	.07	414.99	.055	420.77	.07
474.4	.04								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
283.09	292.26	78	62	43	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 10

INPUT

Description:
Station Elevation Data num= 152

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	378.65	.55	378.64	13	378.43	15.74	378.3	27.99	377.53
56.19	375.7	69.37	374.64	77.63	374.04	88.91	373	97.14	373
98.33	372.41	99.16	372	100.73	371.22	101.13	371.03	101.93	370.63
103.2	370	104.54	369.34	104.98	369.12	106.25	368.49	107.24	368
108.32	367.47	109.22	367.02	111.28	366	113.29	365.01	113.93	364.69
114.53	364.39	115.23	364.05	141.12	363.95	143.44	363.96	144.1	363.94
144.79	363.93	145.25	363.92	146.75	363.55	147.58	363.42	151.72	363.32
152.45	363.34	153.97	363.5	154.69	363.68	167.49	363.6	173.71	363.64
177.06	363.66	178.01	363.67	179.78	363.69	183.02	363.72	183.34	363.72
185.54	363.74	186.55	363.77	186.88	363.78	187.27	363.79	189.28	363.81
210.8	363.83	254.85	364	255.23	364	255.86	363.99	258.88	363.97
259.65	363.96	261.77	363.95	262.29	363.94	265.28	363.9	265.89	363.83
266.33	363.82	266.9	363.84	267.75	363.5	269.83	363.19	270.5	363.13
272.14	363.2	273.62	363.4	274.3	363.5	275.33	363.91	276.29	364.01
276.83	364.01	278.93	364	286.51	363.92	287.14	363.94	307.05	363.94
307.66	363.95	308.12	363.96	310.84	363.96	314.12	363.97	315.46	363.97
316.5	363.96	317.82	363.96	318.17	363.95	318.87	363.94	319.53	363.92
320.33	363.9	321.54	363.87	323.44	363.85	325.75	363.84	327.75	363.76
328.28	363.76	328.96	363.75	331.76	363.63	334.91	363.5	335.55	363.45
336.23	363.5	336.87	363.64	337.2	363.69	338.17	363.76	342.3	363.76
342.71	363.76	343.46	363.77	344.06	363.77	344.69	363.78	346.65	363.84
347.09	363.84	347.4	363.85	348.03	363.85	348.99	363.86	349.8	363.86
350.78	363.89	351.62	363.89	352.46	363.9	353.63	363.9	354.51	363.92
356.8	363.92	357.28	363.93	359.8	363.93	360.43	363.94	362.56	363.94
363.56	363.95	364.65	363.95	365.15	363.96	367.06	363.96	372.2	363.97
376.34	363.98	385.43	363.98	386.41	363.99	397.12	363.99	407.8	364
409.68	364.92	410.03	365	410.36	365.16	412.03	366	412.54	366.26
414.03	367	414.72	367.34	416.04	368	416.88	368.42	418.04	369
418.87	369.42	419.25	369.61	420.39	370.17	421.21	370.24	423.46	370.12
424.84	369.93	426.1	370.23	428.34	370.55	435.42	371.03	450.33	372
463.05	373.11	474.62	373.84						

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	115.23	.07	144.1	.055	154.69	.055	266.33	.055
275.33	.07	335.55	.055	336.87	.07	407.8	.04		

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
266.9	275.33	140	165	170	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 9

INPUT

Description:
Station Elevation Data num= 85

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	378.67	9.78	378.53	43.31	377.84	58.23	376.62	71.1	376.1
74.31	375.86	75.67	375.32	89.64	374.14	94.24	373.54	95.34	373
96.27	372.54	96.58	372.39	97.37	372	98.01	371.68	99.39	371
101.29	370.06	102.39	369.52	103.44	369	104.42	368.52	105.15	368.16
105.47	368	105.78	367.85	106.33	367.57	107.49	367	108.38	366.56
109.52	366	110.63	365.45	111.54	365	112.49	364.53	113.57	364
114.91	363.34	115.59	363	117.13	362.6	119.02	362.6	141.72	362.5
142.96	362.16	143.89	362	146.19	361.98	146.61	362	148.31	362.36
148.69	362.49	216.61	362.49	217.61	362.47	219.56	362.47	224.88	362.46
227.98	362.47	229.74	362.49	230.18	362.49	233.19	362.45	234.33	362
235.42	361.85	235.86	361.8	236.79	361.73	237.58	361.68	239.23	361.96
240.5	362.19	241.57	362.38	242.44	362.38	244.25	362.42	246.87	362.47
247.77	362.5	251.23	362.51	263.08	362.53	264.14	362.53	265.79	362.54
270.93	362.58	331.92	362.58	332.89	363.58	334.4	363.75	334.89	364
335.38	364.24	336.07	364.59	336.89	365	337.6	365.35	338.89	366
340.23	366.67	341.96	367.53	351.1	367.92	354.78	368.08	383.98	370
409.52	372	434.59	374	453.16	376	468.82	378	487.44	380

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	117.13	.07	141.72	.055	148.69	.07	233.19	.055
241.57	.07	331.92	.04						

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
233.19	241.57	93	123	130	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 8

INPUT
Description:
Station Elevation Data num= 77

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	378.06	9.78	377.91	24.98	377.26	31.55	376.69	76.81	371.01
79.31	370.54	98.37	367.67	104.3	366.76	105.86	366	106.62	365.63
107.9	365	109.26	364.34	109.95	364	110.62	363.67	111.99	363
113.31	362.35	114.03	362	115.34	361.51	116.04	361.5	156.58	361.5
157.08	361.4	158.43	361	161.55	361	162.65	361.09	163.48	361.38
163.87	361.38	171.94	361.16	176.89	361.25	185.45	361.23	185.94	361.23
187.34	361.22	189.85	361.19	191.09	361.18	192.85	361.18	194.43	361.17
195.36	361.16	196.61	361.17	203.58	361.11	204.77	361.12	205.45	361.14
206.85	361.19	207.91	361.22	211.95	361.11	212.53	361.24	213.09	361.24
214.08	361	215.4	360.83	216.13	360.78	217.11	360.72	217.72	360.73
218.99	360.81	219.5	360.85	220.65	361	221.72	361.42	222.69	361.5

239.74	361.5	240.76	361.49	242.22	361.49	242.57	361.51	242.96	361.51
245.37	361.51	303.05	361.5	304.87	362	308.87	364	309.8	364.46
310.87	365	311.35	365.24	312.33	365.73	317.35	366	351.17	368
371.09	370	388.6	372	405.71	374	425.87	376	443.07	378
461.81	380	486.33	382						

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	115.34	.07	156.58	.055	163.48	.07	213.09	.055
217.72	.07	303.05	.04						

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
213.09	221.72	109	102	67	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 7.2

INPUT
Description:
Station Elevation Data num= 43

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	376.16	7.08	376.15	17.84	375.76	28.97	375.07	48.26	373.06
65.48	371.03	90.66	367.11	110.49	365.02	114.57	363	115.41	362.58
116.57	362	118.39	361.1	120.04	360.5	120.94	360.5	191.28	360.5
234.61	360.5	249.56	360.5	249.88	360.37	250.82	360	252.05	359.82
252.76	359.71	253.25	359.66	253.63	359.63	254.39	359.62	255.25	359.7
257.37	360	258.59	360.48	267.01	360.5	267.43	360.5	285.18	360.5
306.51	360.5	307.92	361	309.89	361.98	311.82	362.94	314.62	364.34
315.95	365	319.79	366	348.06	368	367.55	370	389.66	372
405.57	374	427.67	376	448.9	378				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	120.04	.07	249.56	.055	258.59	.07	306.51	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
249.56	258.59	220	203	229	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 7.1

INPUT
Description:
Station Elevation Data num= 69

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	373.23	33.53	372	51.65	371.16	79.25	370.01	92.6	369.45
101.24	369.05	152.88	366.28	154.06	366.22	157.67	366.03	163.41	363.17
165.77	362	167.7	361.04	168.74	360.52	169.8	360	171.14	359.33
171.8	359	180.18	358.5	182.09	358.5	184.88	358.5	188.84	358.5
189.86	358.5	194.67	358.5	195.55	358.5	200.46	358.5	230.72	358.5
248.95	358.5	250.81	358.5	273.24	358.5	310.3	358.5	339.51	358.5
339.96	358.5	341.97	358.52	343.59	358.51	346.21	358.5	346.63	358.35
347.62	358	348.6	357.88	353.5	357.84	354.93	358	356.07	358.39
357.34	358.48	376.48	358.48	380.86	358.49	382.81	358.47	383.83	358.48
384.53	358.49	454.05	358.5	455.78	359	456.18	359.2	457.8	360
458.58	360.39	459.82	361	460.84	361.51	461.45	361.8	461.84	362
463.14	362.64	463.86	363	464.9	363.51	465.88	364	466.7	364.41
467.72	364.91	469.59	365.07	485.13	366.44	504.37	368.45	508.29	368.71
520.23	370	546.62	372	585.38	374	616.46	376		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	180.18	.07	346.21	.055	357.34	.07	454.05	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
346.21	357.34	147	177	171	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 7

INPUT
Description:
Station Elevation Data num= 64

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	373.38	12.14	373.16	12.95	373.13	17.18	372.96	59.12	371.15
67.45	370.74	88.82	369.59	120.8	367.9	137.36	366.93	154.78	365.77
167.41	364.54	169.43	363.64	170.86	363	172.12	362.43	173.08	362
173.96	361.61	175.31	361	176.06	360.67	177.55	360	178.89	359.4
179.78	359	182.01	358	182.93	357.59	183.37	357.39	184.06	357.07
186.44	356.99	258.45	357	304.38	357	333.32	357	333.96	357
335.51	356.5	336.74	356.34	338.63	356.21	339.94	356.28	340.42	356.31
340.75	356.33	341.38	356.41	342.03	356.5	343.23	356.98	347.34	356.99
351	357	351.55	356.99	361.74	356.98	362.34	356.99	367.49	357
426.75	357	502.51	357	503.41	357.67	504.5	358	505.68	358.59
506.51	359	507.98	359.74	508.51	360	510.3	360.9	511.37	361.43
512.9	362.19	525.38	363.79	526.4	363.92	567.05	367.63	581.86	369.03
606.44	370.72	637.38	374.55	649.9	376	664.56	378		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	186.44	.07	333.96	.055	343.23	.07	502.51	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
333.96	343.23	213	234	230	.1	.3

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3   RS: 6.5

INPUT
Description:
Station Elevation Data   num=   68

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	374.54	8.08	374.32	32.74	373.78	43.18	373.67	46.53	373.62
66.59	371.89	79.18	371.12	93.25	370	94.27	369.96	98.02	369.68
117.07	368.43	124.62	367.87	139	366.24	163.32	363.88	171.42	363.03
184.51	361.41	201.18	360.1	204.42	359.97	228.36	359.03	228.68	359.02
238.79	358.27	247.95	357.91	248.73	357.88	252.42	356.06	254.57	355
255.13	354.99	293.28	354.51	293.97	354.5	297.26	354.04	297.77	354.03
300.76	354.5	301.99	354.5	337.84	354.97	369.77	354.98	371.93	355
372.35	355.16	374.25	356	376.45	356.98	378.8	357.04	393.88	357.24
409.81	357.48	413.16	357.6	420.33	357.89	431.66	357.55	442.47	357.36
471.28	357.42	474.12	357.42	476.69	357.39	496.79	357.23	523.89	357.51
526.63	357.55	550.81	357.57	558.58	357.54	559.2	357.41	561.4	357.11
565.4	356.58	566.27	356.69	572.08	357.21	573.67	357.62	577.15	357.69
584.3	358.46	586.57	358.8	604.26	362.11	608.32	362.7	615.45	363.32
618.32	364	642.63	366	677.67	368				

Manning's n Values   num=   5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	254.57	.07	293.97	.055	300.76	.07	371.93	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
293.97	300.76	273	271	241	.1	.3

Ineffective Flow   num=   1

Sta L	Sta R	Elev	Permanent
420.33	677.67	357.89	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3   RS: 6

INPUT
Description:
Station Elevation Data   num=   81

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	369.21	.44	369.16	31.84	365.2	45.45	364.4	58.99	363.32

61.77	362.83	68.58	362.38	78.06	361.85	81.92	362	85.78	361.6
105.28	358.42	113.57	356.96	115.29	356.28	117.75	356.24	123.55	356.09
148.61	355.61	171.77	356.49	176.97	356.8	195.14	356.96	197.78	357.01
204.4	356.99	227.46	357.15	234.14	357.18	245.38	357.45	260.69	357.57
262.71	357.47	281.48	356.31	284.5	356.22	290.47	356.03	293.88	355.92
314.03	355.02	314.58	355	319.02	354.5	319.76	352.22	319.97	351.99
321.14	351.7	321.57	351.66	324.58	351.9	325.21	351.86	332.41	351.59
335.5	351.52	336.05	351.76	337.65	353.56	338.63	353.61	340.26	353.7
342.46	353.82	346.69	354.04	355.6	354.7	364.82	355.47	375.63	355.05
378.57	354.93	391.58	354.95	399.63	354.95	400.65	354.96	411.03	355.06
414.21	355.09	414.59	355.09	423.2	355.19	435.1	354.89	446.74	355.03
452.75	355.04	471.93	355.12	474.95	355.14	478	355.19	504.7	355.15
510.63	355.06	511.02	355.07	522.06	355.21	536.46	355.28	538.09	355.1
541.87	355.24	566.01	355.05	577.12	355.03	581.35	355	609.07	355.15
616.82	355.17	639.36	355.17	663.67	357.45	681.8	359	703.74	362
760.76	364								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	31.84	.11	319.02	.049	337.65	.11

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
319.02	337.65	122	82	93	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	260.69	357.57	F
672.5	760.76	364	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 5

INPUT
Description:
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	365.64	31.93	365.36	41.59	364.7	43.55	364.49	54.4	363.66
60.83	363.32	70.36	364.02	79.54	363.88	88.3	363.87	103.77	363.76
109.4	363.27	114.85	360.87	128.72	358.03	133.94	357.55	150.5	356.46
151.42	356.08	151.54	356.16	152.32	356.51	154.71	354.98	155.46	354.25
157.15	354.16	157.16	354.51	158.44	354.8	158.8	354.97	162.81	356.05
165.6	356.17	169.47	356.65	174.56	357.27	202.46	357.54	221.96	357.13
229.01	356.37	265.13	356.89	271.6	356.8	297.25	356.93	299.31	356.95
303.73	356.98	306.05	356.94	312.06	356.82	332.55	355.51	335.48	353.21
337.33	351.42	337.88	351.18	343.34	351.45	348.32	351.22	353.53	351.27
356.18	351.29	357.52	351.24	358.81	351.55	359.78	352.63	361.37	353.26
363.42	354.33	368.32	354.09	369.82	353.88	389.94	355.89	394.61	355.73
431.33	355.47	436.16	355.42	438.49	355.36	443.36	355.33	471.08	355.08

484.01	355.07	500.1	354.99	509.6	355.08	522.13	354.7	536.9	354.7
543.3	354.16	544.67	354.21	549.67	354.19	563.81	353.97	565.69	354.09
581.39	355.16	605.31	354.89	612.72	354.98	644.44	355	673.96	355.99
675.6	355.99	677.42	355.98	692.34	356.8	708.36	357.74	719.93	358.96
758.69	362	794.3	362.65	868.21	364	953.07	366		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	103.77	.11	332.55	.049	363.42	.11	794.3	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
332.55	389.94	132	149	230	.3	.5

Ineffective Flow num= 6

Sta L	Sta R	Elev	Permanent
0	70.36	364.02	F
70.36	151.7	363	F
151.7	163.09	357.54	F
163.09	308.17	363	F
385.08	527.24	363	F
576.78	953.07	363	F

CULVERT

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 4.5

INPUT
Description: Bridge over Jones Falls on Park Heights Ave.
Distance from Upstream XS = 53
Deck/Roadway Width = 46
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 14

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	367		27.063	367		59.34	367	
124.7	366		201.23	365		305.74	364	
360.23	363		360.23	363		382.84	363	
382.84	363		464.76	363		736.72	363	
839	363		883.95	364				

Upstream Bridge Cross Section Data
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	365.64	31.93	365.36	41.59	364.7	43.55	364.49	54.4	363.66
60.83	363.32	70.36	364.02	79.54	363.88	88.3	363.87	103.77	363.76
109.4	363.27	114.85	360.87	128.72	358.03	133.94	357.55	150.5	356.46
151.42	356.08	151.54	356.16	152.32	356.51	154.71	354.98	155.46	354.25
157.15	354.16	157.16	354.51	158.44	354.8	158.8	354.97	162.81	356.05
165.6	356.17	169.47	356.65	174.56	357.27	202.46	357.54	221.96	357.13

229.01	356.37	265.13	356.89	271.6	356.8	297.25	356.93	299.31	356.95
303.73	356.98	306.05	356.94	312.06	356.82	332.55	355.51	335.48	353.21
337.33	351.42	337.88	351.18	343.34	351.45	348.32	351.22	353.53	351.27
356.18	351.29	357.52	351.24	358.81	351.55	359.78	352.63	361.37	353.26
363.42	354.33	368.32	354.09	369.82	353.88	389.94	355.89	394.61	355.73
431.33	355.47	436.16	355.42	438.49	355.36	443.36	355.33	471.08	355.08
484.01	355.07	500.1	354.99	509.6	355.08	522.13	354.7	536.9	354.7
543.3	354.16	544.67	354.21	549.67	354.19	563.81	353.97	565.69	354.09
581.39	355.16	605.31	354.89	612.72	354.98	644.44	355	673.96	355.99
675.6	355.99	677.42	355.98	692.34	356.8	708.36	357.74	719.93	358.96
758.69	362	794.3	362.65	868.21	364	953.07	366		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	103.77	.11	332.55	.049	363.42	.11	794.3	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
332.55	389.94	.3	.5

Ineffective Flow num= 6

Sta L	Sta R	Elev	Permanent
0	70.36	364.02	F
70.36	151.7	363	F
151.7	163.09	357.54	F
163.09	308.17	363	F
385.08	527.24	363	F
576.78	953.07	363	F

Downstream Deck/Roadway Coordinates
num= 16

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-67	370		-27	369		118.54	367	
183.84	366		260.22	365		364.65	364	
407.21	363.5		407.21	363.5		430.39	363.5	
430.39	363.5		523.52	363		793.58	363	
812.03	363		939.68	364		970	365	
1041.63	366							

Downstream Bridge Cross Section Data
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	362	77.33	360	130.4	358	170.95	356	257.66	355.34
259.53	355.32	263.78	353.23	265.78	353.23	271.18	355.23	301.91	355
363.95	355	388.75	354	400.53	352	422.68	352	429.75	354
491.27	354	495.18	352.35	497.18	352.35	510.8	354	606.35	354.93
620.43	355.07	716.33	356	847.36	358	928.57	360	1031.52	362
1037.3	364	1040.91	366						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.045	77.33	.045	429.75	.049	716.33	.045

```
Bank Sta: Left   Right    Coeff Contr.   Expan.
        388.75  429.75             .3       .5
Ineffective Flow     num=       4
   Sta L   Sta R    Elev  Permanent
       0  259.53     363       F
  271.18  391.95     363       F
  449.03  456.73     363       F
  516.56 1040.91     363       F

Upstream Embankment side slope              =       4 horiz. to 1.0 vertical
Downstream Embankment side slope            =       4 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =     363
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  3

Culvert Name     Shape      Rise    Span
Culvert #4      Circular       2
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
                 0  103.71     .013     .013        0                  .5
      1
Upstream   Elevation =  354.16
           Centerline Station =  156.31
Downstream Elevation =  353.23
           Centerline Station =  264.78

Culvert Name     Shape      Rise    Span
PHAve 24 N           Box     9.2    22.5
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
              28.7    52.9     .013     .013        0                  .4
      1
Upstream   Elevation =  351.75
           Centerline Station =  347.47
Downstream Elevation =  351.22
           Centerline Station =  415.1

Culvert Name     Shape      Rise    Span
PHAve 24 S      Circular       2
```

```
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
              18.14  128.15     .013     .013        0                   .5
      1
Upstream   Elevation =  352.71
           Centerline Station =  548.25
Downstream Elevation =  352.35
           Centerline Station =  496.18

CULVERT OUTPUT  Profile #100 Yr  Culv Group:  Culvert #4

  Q Culv Group (cfs)         38.92    Culv Full Len (ft)        103.71
  # Barrels                      1    Culv Vel US (ft/s)         12.39
  Q Barrel (cfs)             38.92    Culv Vel DS (ft/s)         12.39
  E.G. US. (ft)             363.67    Culv Inv El Up (ft)       354.16
  W.S. US. (ft)             363.67    Culv Inv El Dn (ft)       353.23
  E.G. DS (ft)              357.78    Culv Frctn Ls (ft)          3.07
  W.S. DS (ft)              357.02    Culv Exit Loss (ft)         1.62
  Delta EG (ft)               5.89    Culv Entr Loss (ft)         1.19
  Delta WS (ft)               6.64    Q Weir (cfs)              701.55
  E.G. IC (ft)              361.60    Weir Sta Lft (ft)         323.09
  E.G. OC (ft)              363.67    Weir Sta Rgt (ft)         850.78
  Culvert Control           Outlet    Weir Submerg                0.00
  Culv WS Inlet (ft)        356.16    Weir Max Depth (ft)         0.68
  Culv WS Outlet (ft)       355.23    Weir Avg Depth (ft)         0.63
  Culv Nml Depth (ft)         2.00    Weir Flow Area (sq ft)    334.27
  Culv Crt Depth (ft)         2.00    Min El Weir Flow (ft)     363.01


Note:    The normal depth exceeds the height of the culvert.  The program assumes
that the normal depth is equal to the
         height of the culvert.
Note:    Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT  Profile #100 Yr  Culv Group:  PHAve 24 N

  Q Culv Group (cfs)       2366.86    Culv Full Len (ft)
  # Barrels                      1    Culv Vel US (ft/s)         15.01
  Q Barrel (cfs)           2366.86    Culv Vel DS (ft/s)         17.90
  E.G. US. (ft)             363.67    Culv Inv El Up (ft)       351.75
  W.S. US. (ft)             363.67    Culv Inv El Dn (ft)       351.22
  E.G. DS (ft)              357.78    Culv Frctn Ls (ft)          0.18
  W.S. DS (ft)              357.02    Culv Exit Loss (ft)         4.29
  Delta EG (ft)               5.89    Culv Entr Loss (ft)         1.42
  Delta WS (ft)               6.64    Q Weir (cfs)              701.55
  E.G. IC (ft)              363.67    Weir Sta Lft (ft)         323.09
  E.G. OC (ft)              363.66    Weir Sta Rgt (ft)         850.78
```

Culvert Control	Inlet	Weir Submerg	0.00
Culv WS Inlet (ft)	358.76	Weir Max Depth (ft)	0.68
Culv WS Outlet (ft)	357.10	Weir Avg Depth (ft)	0.63
Culv Nml Depth (ft)	4.31	Weir Flow Area (sq ft)	334.27
Culv Crt Depth (ft)	7.01	Min El Weir Flow (ft)	363.01

Warning: Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section
downstream of the culvert has supercritical flow.
Note: The flow in the culvert is entirely supercritical.

CULVERT OUTPUT Profile #100 Yr Culv Group: PHAve 24 S

Q Culv Group (cfs)	36.96	Culv Full Len (ft)	128.15
# Barrels	1	Culv Vel US (ft/s)	11.77
Q Barrel (cfs)	36.96	Culv Vel DS (ft/s)	11.77
E.G. US. (ft)	363.67	Culv Inv El Up (ft)	352.71
W.S. US. (ft)	363.67	Culv Inv El Dn (ft)	352.35
E.G. DS (ft)	357.78	Culv Frctn Ls (ft)	3.42
W.S. DS (ft)	357.02	Culv Exit Loss (ft)	1.39
Delta EG (ft)	5.89	Culv Entr Loss (ft)	1.08
Delta WS (ft)	6.64	Q Weir (cfs)	701.55
E.G. IC (ft)	359.56	Weir Sta Lft (ft)	323.09
E.G. OC (ft)	363.67	Weir Sta Rgt (ft)	850.78
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	354.71	Weir Max Depth (ft)	0.68
Culv WS Outlet (ft)	354.35	Weir Avg Depth (ft)	0.63
Culv Nml Depth (ft)	2.00	Weir Flow Area (sq ft)	334.27
Culv Crt Depth (ft)	2.00	Min El Weir Flow (ft)	363.01

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the
height of the culvert.
Note: Culvert critical depth exceeds the height of the culvert.

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 4

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	362	77.33	360	130.4	358	170.95	356	257.66	355.34
259.53	355.32	263.78	353.23	265.78	353.23	271.18	355.23	301.91	355
363.95	355	388.75	354	400.53	352	422.68	352	429.75	354

491.27	354	495.18	352.35	497.18	352.35	510.8	354	606.35	354.93
620.43	355.07	716.33	356	847.36	358	928.57	360	1031.52	362
1037.3	364	1040.91	366						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.045	77.33	.045	429.75	.049	716.33	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
388.75	429.75	32	41	42	.3	.5

Ineffective Flow num= 4

Sta L	Sta R	Elev	Permanent
0	259.53	363	F
271.18	391.95	363	F
449.03	456.73	363	F
516.56	1040.91	363	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 3.5

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	360	72.39	358	151.55	356	263.03	354	309.27	354
329.24	354	355.77	354	366.7	352	381.39	352	392.81	354
427.66	354	444.38	354	651.69	356	788.38	358	879.65	360

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	355.77	.049	392.81	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
355.77	392.81	129	124	114	.1	.3

Ineffective Flow num= 3

Sta L	Sta R	Elev	Permanent
0	226.12	363	F
262.79	354.06	363	F
500.22	879.95	363	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 3 RS: 3

INPUT

Description:
Station Elevation Data num= 64

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	359.99	.34	360	4.87	359.83	24.26	359	26.66	359
52.98	358.47	65.8	358.24	73.86	358	123.46	357	126.73	356.9
147.04	356.21	153.61	356.09	156.52	356	189.59	355	248.58	354.22
255.72	354	272.26	354	279.04	353.8	287.01	353.16	289.84	353
305.32	353	321.86	354	365.33	354	386.15	352	393.78	352
405.44	354	495.82	354	627.55	356	636.55	356.74	640.53	356.29
646.19	355.47	650.59	355	655.67	355.54	659.28	356.05	664.62	356.59
670.81	356.56	672.36	356.45	678.66	356.48	685.44	356.76	685.95	356.76
692.7	357	698.53	358.25	701.09	358.21	706.73	359.24	746.51	357.92
748.84	357.15	762.88	357.08	763.95	357.11	776.92	358	790.11	357.97
790.96	358	791.93	357.96	803.2	357.94	804.99	357.86	807.07	357.93
816.28	357.9	819.03	358	833.07	358	837.35	358.15	842.45	358.5
852.49	358.81	855.53	358.8	861.14	359	882.29	359		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	365.33	.049	405.44	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
365.33	405.44	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
623.22	882.29	363	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 4 RS: 2

INPUT
Description:
Station Elevation Data num= 67

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	359.14	7.06	358.91	17.67	358.06	19.63	358	34.93	357
38.91	356.87	47.9	356.15	50.24	356	70.75	355.83	79.5	355.13
81.37	355.02	91.99	354.86	157.37	354	172.68	353	186.5	353
187.53	352.98	189.15	352.89	198.15	352.17	203.29	352	356.33	352
389.23	352	394.41	351.02	399.85	350.31	402.25	350.23	408.45	351.42
410.46	351.84	417.55	352	498.36	352	506.01	351.89	509.38	352
567.66	352	569.7	351.97	570.6	351.92	572.93	351.92	580.32	351.82
585.91	352	631.82	352	633.4	352.05	636.96	352	647.13	352
662.43	353	706.27	353	708.35	352.94	709.99	352.95	718.33	352.83
723.65	353	738.96	353	739.56	352.98	740.92	352.87	754.26	352
769.57	353	775.57	353	782.02	353.09	792.64	353.75	800.17	354
803.25	354.3	813.87	355.84	815.48	356	819.64	356.14	824.48	356.21
830.78	356.59	844.87	358.84	845.72	358.94	846.09	358.96	847.05	358.97

856.33	358.83	857.88	358.89

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	356.33	.045	389.23	.049	417.55	.045	498.36	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
389.23	417.55	261	248	241	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
662.43	857.88	353	F

CROSS SECTION

RIVER: Jones Falls
REACH: Jones Falls 4 RS: 1

INPUT
Description:
Station Elevation Data num= 34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	356.15	2.31	356	17.6	356	23.22	355.82	26.04	355.67
36.66	355.63	45.22	355.2	48.19	355	50.53	354.92	57.9	354.55
77.84	354.03	78.78	354	109.37	353	124.67	353	132.26	352.75
139.96	352.73	149.5	352.38	153.5	352.06	155.26	352	201.14	351
262.33	350	338.83	350	349.44	349.18	351.13	348.88	352.83	349.24
363.44	350	434.53	350	636.49	350	664.25	350.27	667.02	350.05
668.56	350	717.1	350	793.76	352	821.31	354		

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.045	338.83	.049	363.44	.045	434.53	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
338.83	363.44	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Jones Falls

Reach River Sta. n1 n2 n3 n4 n5
n6 n7 n8 n9 n10 n11 n12 n13
n14 n15

Jones Falls	15	.11	.049	.11	.04			
Jones Falls	14.5	.11	.049	.11	.04			
Jones Falls	14	.11	.049	.11	.04			
Jones Falls	13.6	.04	.11	.07	.055	.07	.11	.04
Jones Falls	13.5	.11	.04	.07	.055	.07	.11	.04
Jones Falls	13	.04	.07	.055	.07	.04		
North Tributary	2	.04	.11	.07	.055	.07	.04	
North Tributary	1.5	.04	.11	.07	.055	.07	.04	
North Tributary	1	.04	.07	.055	.07	.04		
South Tributary	8	.045	.057	.045				
South Tributary	7	.045	.057	.045				
South Tributary	6.5	Bridge						
South Tributary	6	.045	.057	.045				
South Tributary	5	.04	.07	.055	.07	.04		
South Tributary	4	.04	.07	.055	.07	.04		
South Tributary	3	.04	.055	.07	.055	.07	.04	
South Tributary	2	.04	.07	.055	.07	.055		

.07 .04

IntsTrib 8 .013 .045 .046 .045 .013
.045

IntsTrib 7 .013 .045 .046 .045

IntsTrib 6.5 Culvert

IntsTrib 6 .013 .04 .055 .04

IntsTrib 5 .013 .04 .07 .055 .07
.04

IntsTrib 4.5 .013 .04 .07 .055 .07
.04

IntsTrib 4 .013 .04 .07 .055 .07
.04

IntsTrib 3 .04 .055 .04

IntsTrib 2.5 Culvert

IntsTrib 2 .045 .046 .045 .013

IntsTrib 1 .04 .046 .045

Jones Falls 2 12 .04 .07 .055 .07 .055
.07 .055 .07 .04

Jones Falls 2 11.2 .04 .07 .055 .07 .055
.07 .055 .07 .04

Jones Falls 3 11.1 .04 .07 .055 .07 .055
.07 .055 .07 .055 .07 .055 .07 .055
.07 .04
Jones Falls 3 11 .04 .07 .055 .07 .055
.07 .055 .07 .055 .07 .055 .07 .04

Jones Falls 3 10.5 .04 .07 .055 .07 .055
.07 .055 .07 .055 .07 .04

Jones Falls 3	10	.04	.07	.055	.055	.055	.07	.055	.07	.04
Jones Falls 3	9	.04	.07	.055	.07	.055	.07	.04		
Jones Falls 3	8	.04	.07	.055	.07	.055	.07	.04		
Jones Falls 3	7.2	.04	.07	.055	.07	.04				
Jones Falls 3	7.1	.04	.07	.055	.07	.04				
Jones Falls 3	7	.04	.07	.055	.07	.04				
Jones Falls 3	6.5	.04	.07	.055	.07	.04				
Jones Falls 3	6	.04	.11	.049	.11					
Jones Falls 3	5	.04	.11	.049	.11	.045				
Jones Falls 3	4.5	Culvert								
Jones Falls 3	4	.045	.045	.049	.045					
Jones Falls 3	3.5	.045	.049	.045						
Jones Falls 3	3	.045	.049	.045						
Jones Falls 4	2	.04	.045	.049	.045	.04				
Jones Falls 4	1	.045	.049	.045	.04					

SUMMARY OF REACH LENGTHS

River: Jones Falls

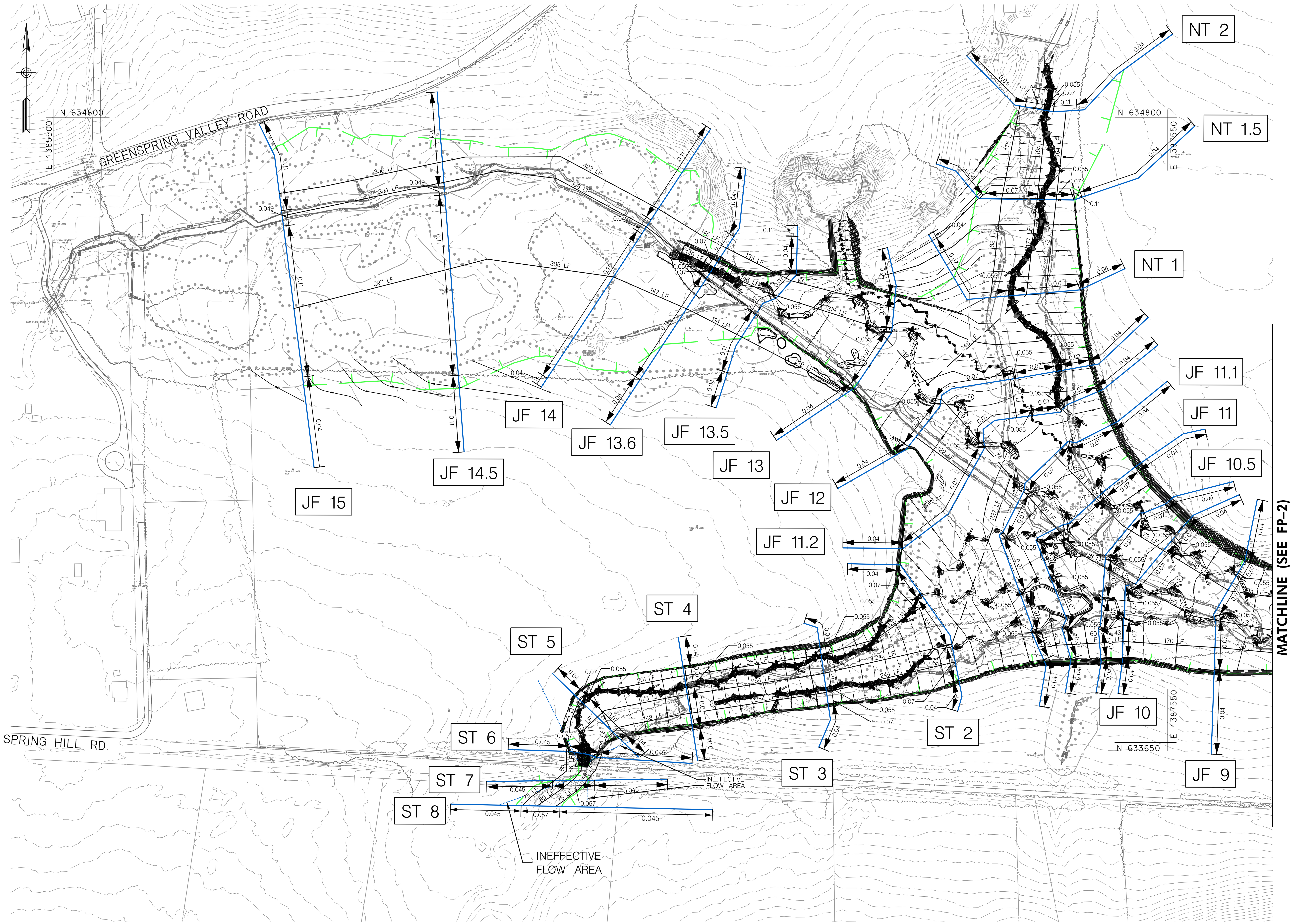
Reach	River Sta.	Left	Channel	Right
Jones Falls	15	306	304	297
Jones Falls	14.5	422	398	305
Jones Falls	14	145	146	147
Jones Falls	13.6	133	146	114
Jones Falls	13.5	196	219	219
Jones Falls	13			
North Tributary	2	164	165	175
North Tributary	1.5	173	177	182
North Tributary	1			
South Tributary	8	75	80	75
South Tributary	7	65	56	49
South Tributary	6.5	Bridge		
South Tributary	6	98.7695	77.1617	53.891
South Tributary	5	200.66	173.213	148
South Tributary	4	254.6731	254.1741	253.6741
South Tributary	3	220	242	244
South Tributary	2			
IntsTrib	8	135	134	134
IntsTrib	7	150	152	154
IntsTrib	6.5	Culvert		
IntsTrib	6	116	112	107
IntsTrib	5	179	181	181
IntsTrib	4.5	162	172	179
IntsTrib	4	202	222	233
IntsTrib	3	112	116	119
IntsTrib	2.5	Culvert		
IntsTrib	2	209	187	167
IntsTrib	1			
Jones Falls 2	12	71	119	122
Jones Falls 2	11.2			
Jones Falls 3	11.1	112	91	53
Jones Falls 3	11	80	116	60
Jones Falls 3	10.5	78	62	43
Jones Falls 3	10	140	165	170
Jones Falls 3	9	93	123	130
Jones Falls 3	8	109	102	67
Jones Falls 3	7.2	220	203	229
Jones Falls 3	7.1	147	177	171
Jones Falls 3	7	213	234	230
Jones Falls 3	6.5	273	271	241
Jones Falls 3	6	122	82	93
Jones Falls 3	5	132	149	230
Jones Falls 3	4.5	Culvert		

Jones Falls 3	4	32	41	42
Jones Falls 3	3.5	129	124	114
Jones Falls 3	3			
Jones Falls 4	2	261	248	241
Jones Falls 4	1			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Jones Falls

Reach	River Sta.		Contr.	Expan.
Jones Falls	15		.1	.3
Jones Falls	14.5		.1	.3
Jones Falls	14		.1	.3
Jones Falls	13.6		.1	.3
Jones Falls	13.5		.1	.3
Jones Falls	13		.1	.3
North Tributary	2		.1	.3
North Tributary	1.5		.1	.3
North Tributary	1		.1	.3
South Tributary	8		.1	.3
South Tributary	7		.3	.5
South Tributary	6.5	Bridge		
South Tributary	6		.3	.5
South Tributary	5		.1	.3
South Tributary	4		.1	.3
South Tributary	3		.1	.3
South Tributary	2		.1	.3
IntsTrib	8		.1	.3
IntsTrib	7		.3	.5
IntsTrib	6.5	Culvert		
IntsTrib	6		.3	.5
IntsTrib	5		.1	.3
IntsTrib	4.5		.1	.3
IntsTrib	4		.1	.3
IntsTrib	3		.3	.5
IntsTrib	2.5	Culvert		
IntsTrib	2		.3	.5
IntsTrib	1		.1	.3
Jones Falls 2	12		.1	.3
Jones Falls 2	11.2		.1	.3
Jones Falls 3	11.1		.1	.3
Jones Falls 3	11		.1	.3
Jones Falls 3	10.5		.1	.3
Jones Falls 3	10		.1	.3
Jones Falls 3	9		.1	.3

Jones Falls 3	8	.1	.3
Jones Falls 3	7.2	.1	.3
Jones Falls 3	7.1	.1	.3
Jones Falls 3	7	.1	.3
Jones Falls 3	6.5	.1	.3
Jones Falls 3	6	.1	.3
Jones Falls 3	5	.3	.5
Jones Falls 3	4.5	Culvert	
Jones Falls 3	4	.3	.5
Jones Falls 3	3.5	.1	.3
Jones Falls 3	3	.1	.3
Jones Falls 4	2	.1	.3
Jones Falls 4	1	.1	.3



LEGEND

REACH LENGTHS

PROPOSED HEC-RAS CROSS SECTIONS

PROPOSED FLOODPLAIN

INEFFECTIVE FLOW AREA

OWNER /DEVELOPER INFORMATION

MARYLAND TRANSPORTATION AUTHORITY
2310 BROENING HWY
BALTIMORE, MD 21224

MARYLAND COORDINATE SYSTEM – HOR. NAD 83/91 MD STATE PLANE VERT. NAVD 88

GREENSPRING VALLEY ROAD
SW CORNER PARK HEIGHTS AVE
OWINGS MILLS, MD 21117

PLAN
SCALE: 1"=100'

100' 0 100' 200'
SCALE: 1"=100'

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JEREMY KOSER
JOHNSON, MIRMIRAN & THOMPSON, INC.
40 WIGHT AVENUE, HUNT VALLEY, MD 21030
TEL: 410-316-2360
EMAIL: JKoser@jmt.com

PROFESSIONAL CERTIFICATION
I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 31183, EXPIRATION DATE: 1/13/2023.

ECCLESTON MITIGATION SITE

REVISIONS

95% SUBMISSION

NOT FOR CONSTRUCTION

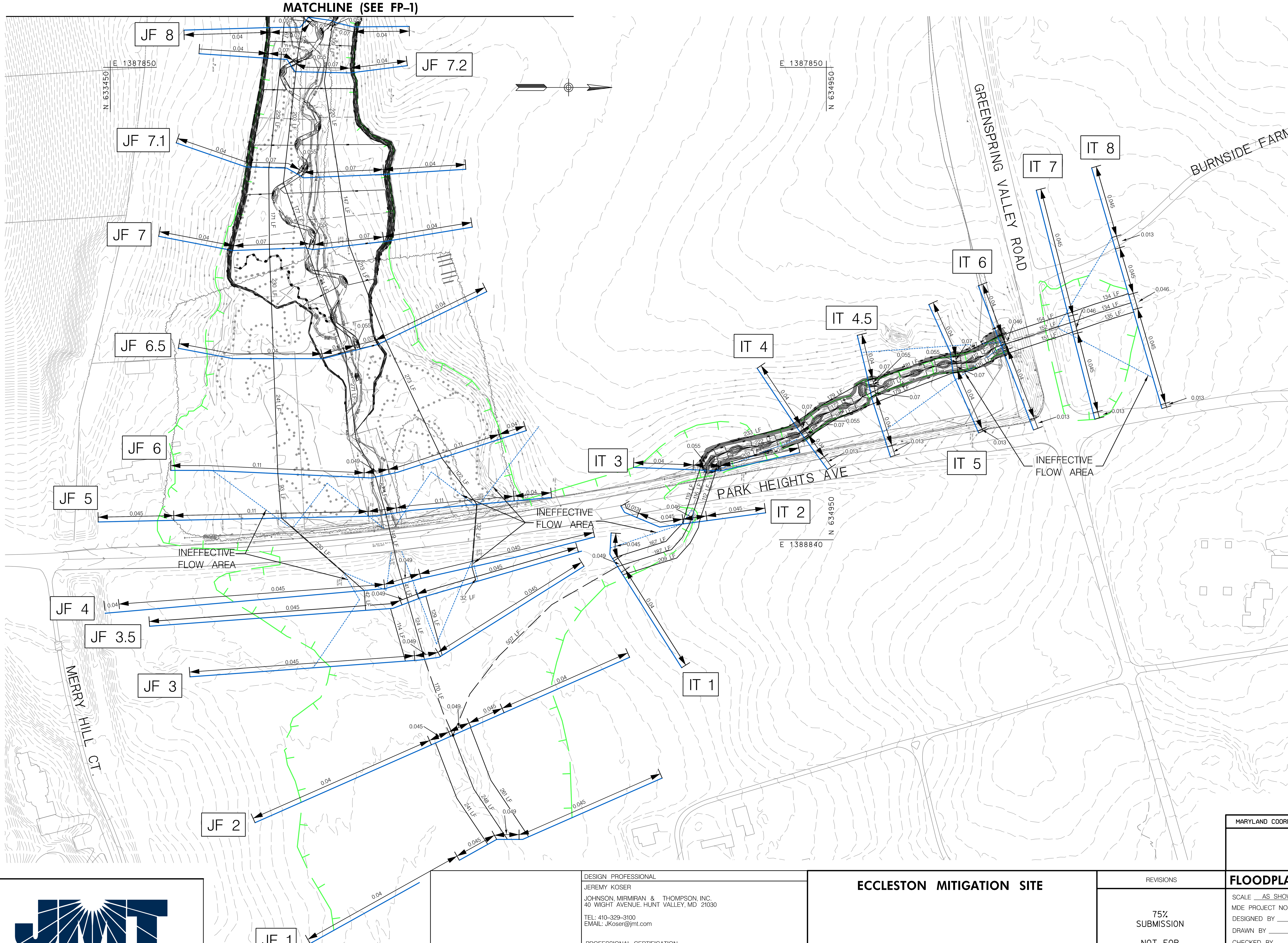
FLOODPLAIN MAP – PROPOSED CONDITIONS

SCALE AS SHOWN	DATE JANUARY, 2021	PROJECT NO. 17-10977-002	
MDE PROJECT NO. 21-SF-0044		CONTRACT NO. KH-3038-0000	
DESIGNED BY PVC		COUNTY BALTIMORE COUNTY	
DRAWN BY PVC		LOGMILE	
CHECKED BY JJM /MRG		HORIZONTAL SCALE N/A	
F.A.P. NO. N/A		VERTICAL SCALE N/A	

DRAWING NO. FP – 1 OF 2 SHEET NO. OF 86

BY: PCrawford –

Tuesday, March 23, 2021 AT 03:24 PM



LEGEND

REACH LENGTHS
PROPOSED HEC-RAS CROSS SECTIONS
PROPOSED FLOODPLAIN
INEFFECTIVE FLOW AREA

PLAN
SCALE: 1"=100'

100' 0 100' 200'
SCALE: 1"=100'

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40 WIGHT AVENUE. HUNT VALLEY, MD 21030

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EMAIL: JKoser@jmt.com

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ECCLESTON MITIGATION SITE

REVISIONS

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OWNER /DEVELOPER INFORMATION

MARYLAND TRANSPORTATION AUTHORITY
2310 BROENING HWY
BALTIMORE, MD 21224

MARYLAND COORDINATE SYSTEM - HOR. NAD 83/91 MD STATE PLANE VERT. NAVD 88

GREENSPRING VALLEY ROAD
SW CORNER PARK HEIGHTS AVE
OWINGS MILLS, MD 21117

FLOODPLAIN MAP - PROPOSED CONDITIONS

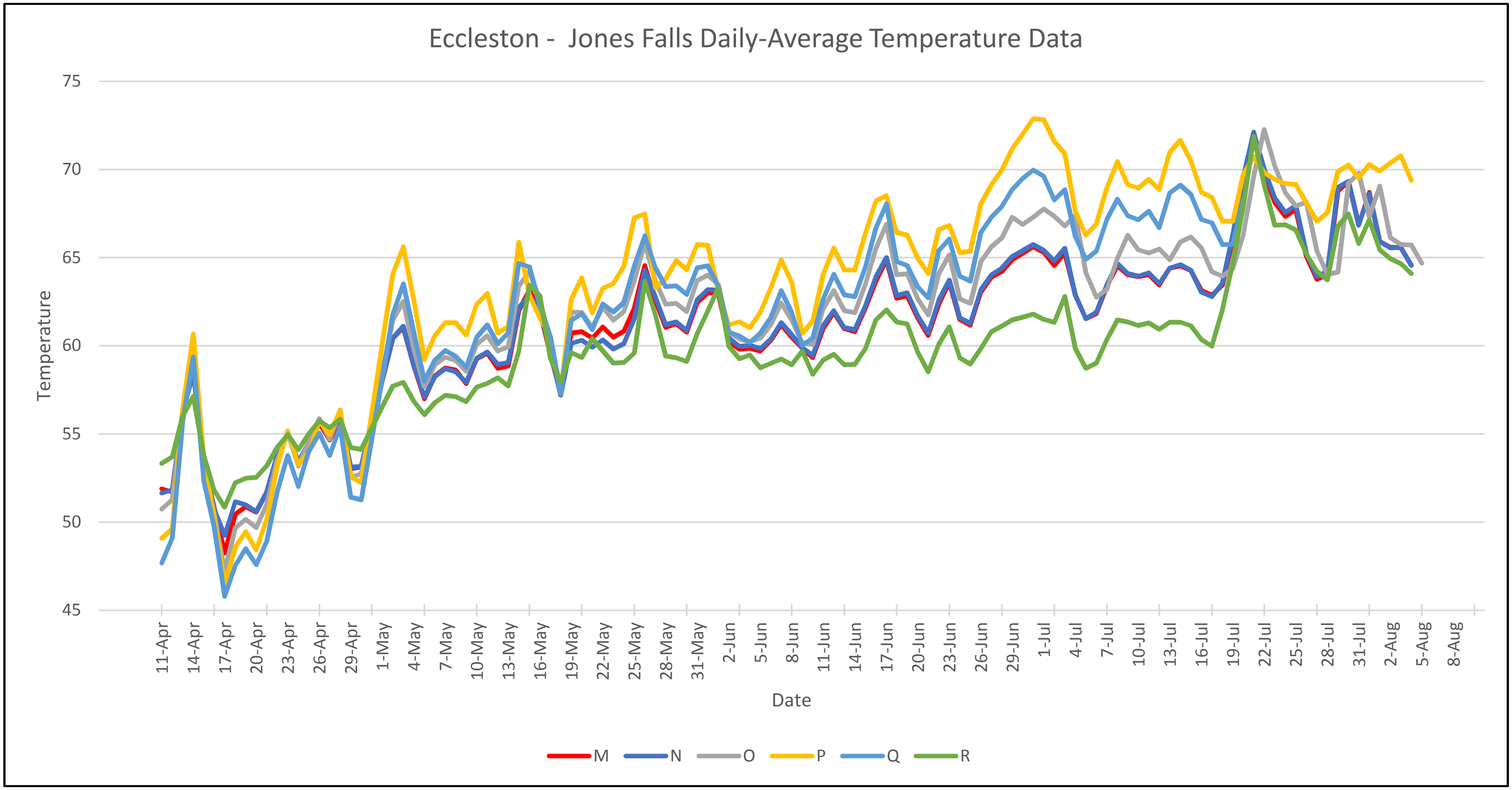
SCALE: AS SHOWN	DATE: SEPTEMBER, 2020
PROJECT NO.: 17-10977-002	
MDE PROJECT NO.: 21-SF-0044	CONTRACT NO.: KH-3038-0000
DESIGNED BY: PVC	COUNTY: BALTIMORE COUNTY
DRAWN BY: PVC	LOGMILE:
CHECKED BY: JJM /MRG	HORIZONTAL SCALE: N/A
F.A.P. NO.: SEE TITLE SHEET	VERTICAL SCALE: N/A

DRAWING NO. FP - 2 OF 2 SHEET NO. OF 49

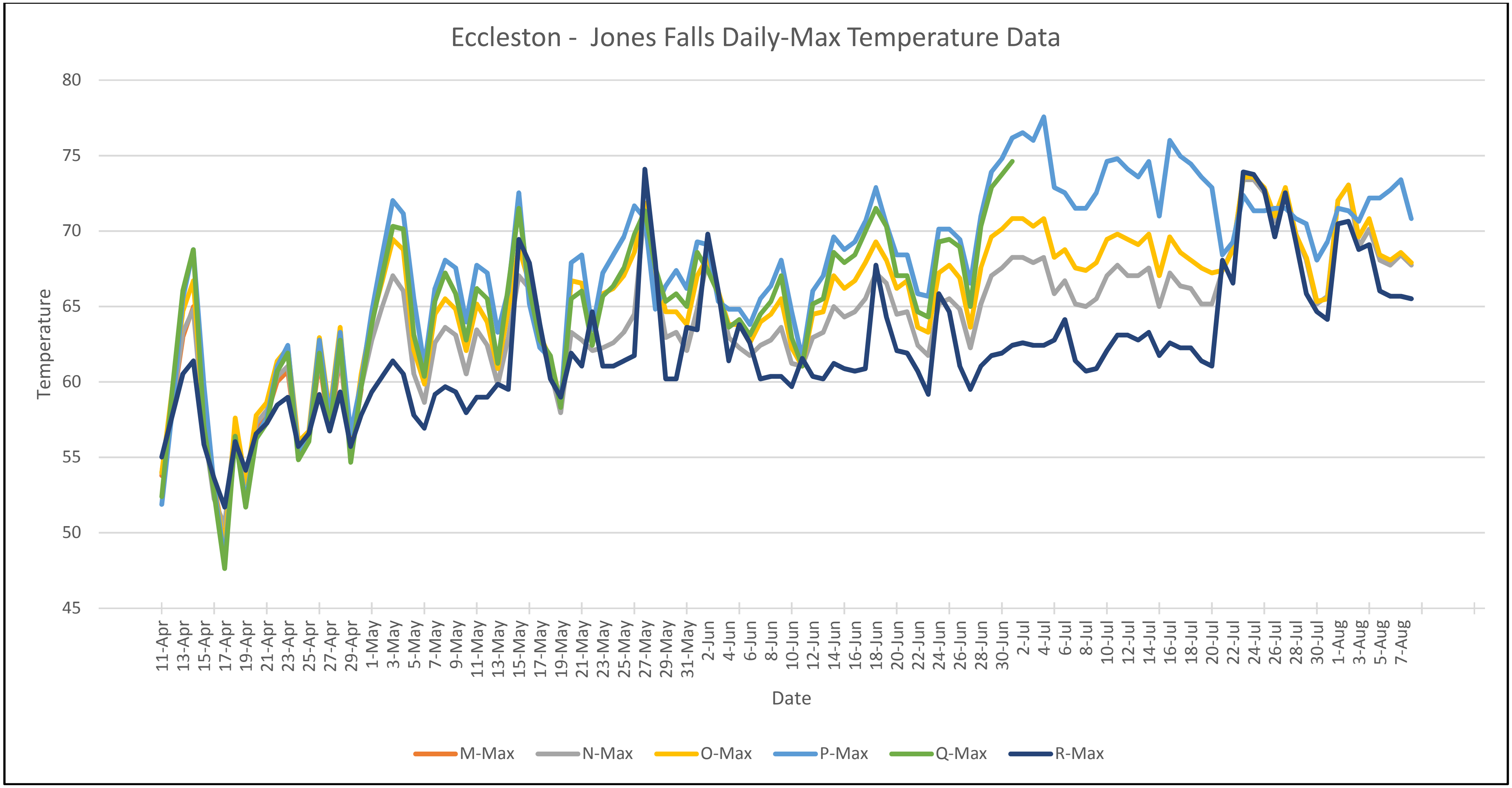
Q:\2017\1710977_002_Eccelston_PRM_Turnke\CADD\pFP_P002_ECCELSTON_2D.dgn
Thursday, October 08, 2020 AT 08:03 AM

BY: MOCCA -

APPENDIX I
Temperature Gauge Locations Map and Data



Eccleston - Jones Falls Daily-Average Temperature Data
75
70
65
60
55
50
45
Temperature
11-Apr
14-Apr
17-Apr
20-Apr
23-Apr
26-Apr
29-Apr
1-May
4-May
7-May
10-May
13-May
16-May
19-May
22-May
25-May
28-May
31-May
2-Jun
5-Jun
8-Jun
11-Jun
14-Jun
17-Jun
20-Jun
23-Jun
26-Jun
29-Jun
1-Jul
4-Jul
7-Jul
10-Jul
13-Jul
16-Jul
19-Jul
22-Jul
25-Jul
28-Jul
31-Jul
2-Aug
5-Aug
8-Aug
Date
M
N
O
P
Q
R



Eccleston - Jones Falls Daily-Max Temperature Data
80
75
70
65
60
55
50
45
Temperature
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
2-Jun
4-Jun
6-Jun
8-Jun
10-Jun
12-Jun
14-Jun
16-Jun
18-Jun
20-Jun
22-Jun
24-Jun
26-Jun
28-Jun
30-Jun
2-Jul
4-Jul
6-Jul
8-Jul
10-Jul
12-Jul
14-Jul
16-Jul
18-Jul
20-Jul
22-Jul
24-Jul
26-Jul
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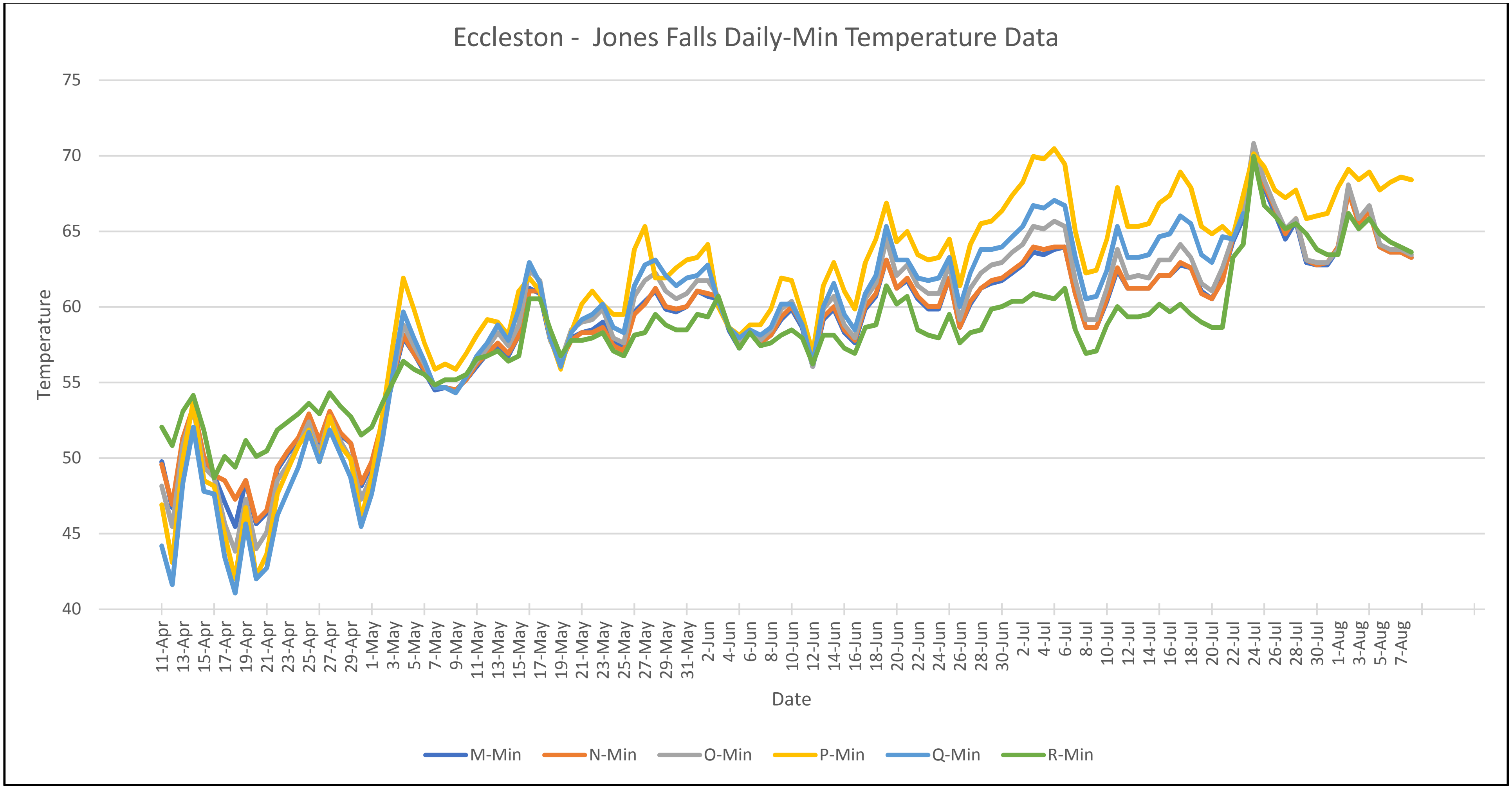
O-Max
P-Max
Q-Max
R-Max



Eccleston - Jones Falls Daily-Min Temperature Data
75
70
65
60
55
50
45
40
Temperature
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
2-Jun
4-Jun
6-Jun
8-Jun
10-Jun
12-Jun
14-Jun
16-Jun
18-Jun
20-Jun
22-Jun
24-Jun
26-Jun
28-Jun
30-Jun
2-Jul
4-Jul
6-Jul
8-Jul
10-Jul
12-Jul
14-Jul
16-Jul
18-Jul
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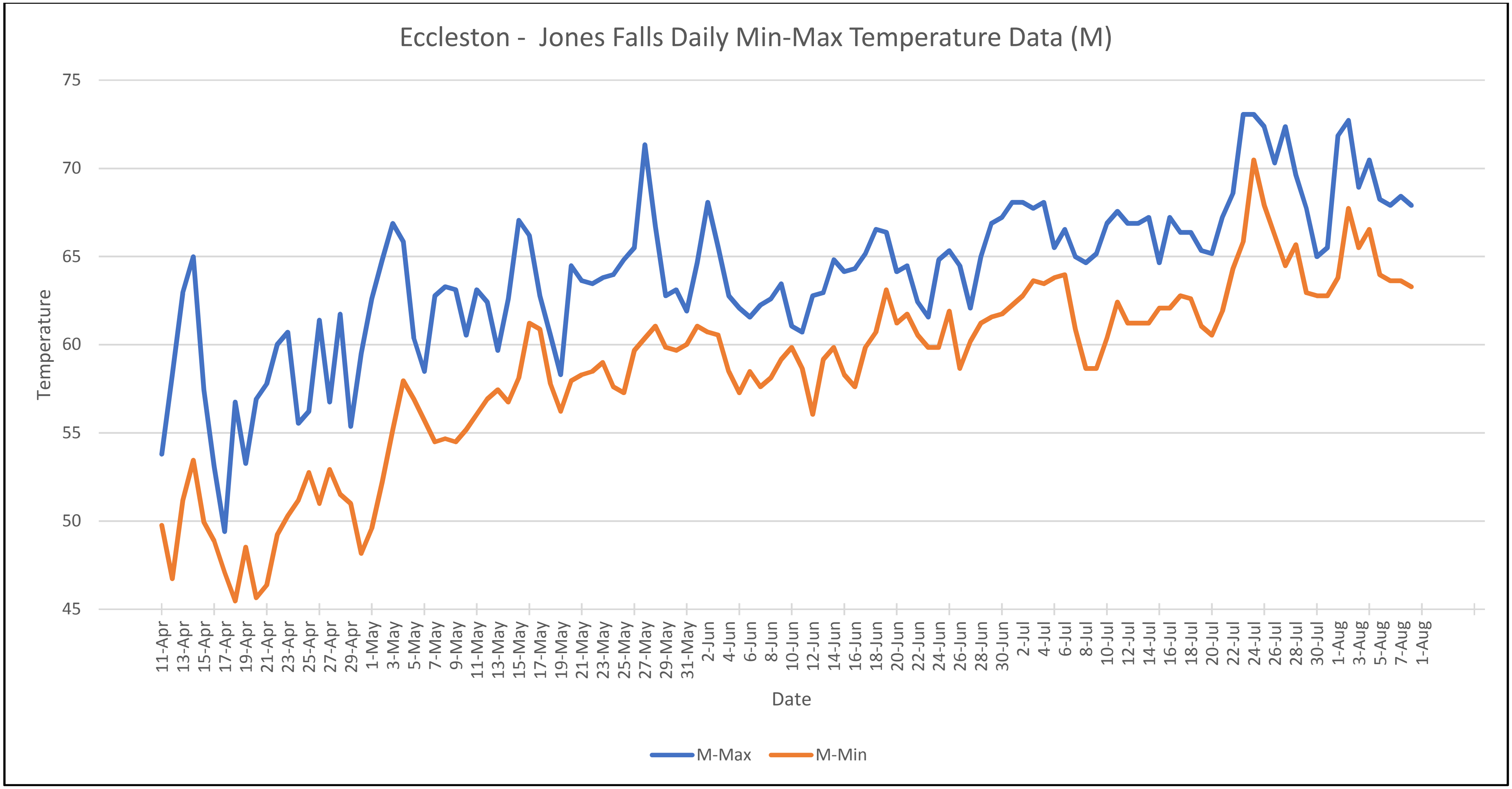
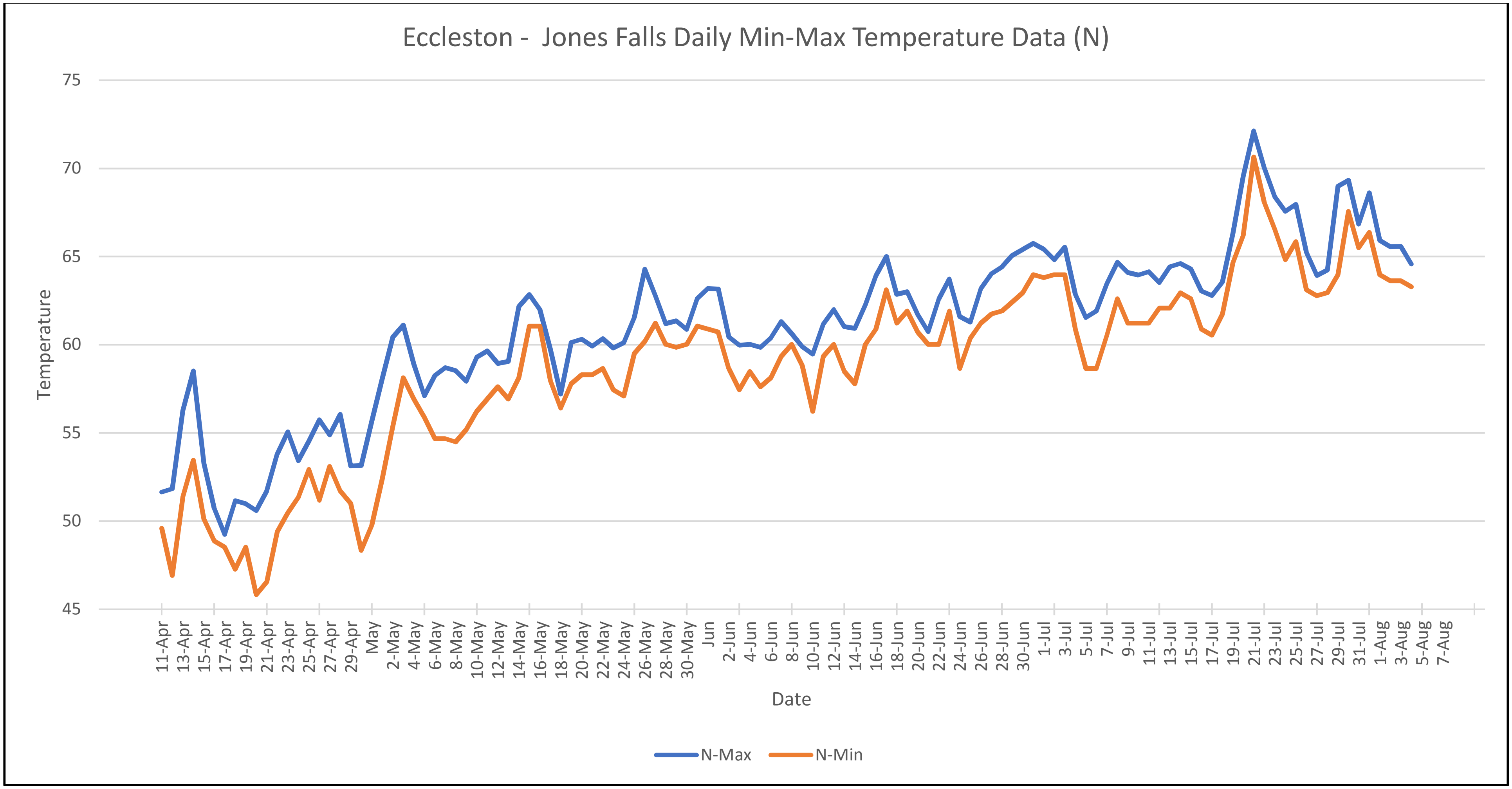
P-Min
Q-Min
R-Min


Eccleston - Jones Falls Daily Min-Max Temperature Data (M)
75
70
65
60
55
50
45
Temperature
Date
M-Max
M-Min



Eccleston - Jones Falls Daily Min-Max Temperature Data (N)
75
70
65
60
55
50
45
Temperature
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
May
2-May
4-May
6-May
8-May
10-May
12-May
14-May
16-May
18-May
20-May
22-May
24-May
26-May
28-May
30-May
Jun
2-Jun
4-Jun
6-Jun
8-Jun
10-Jun
12-Jun
14-Jun
16-Jun
18-Jun
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17-Jul
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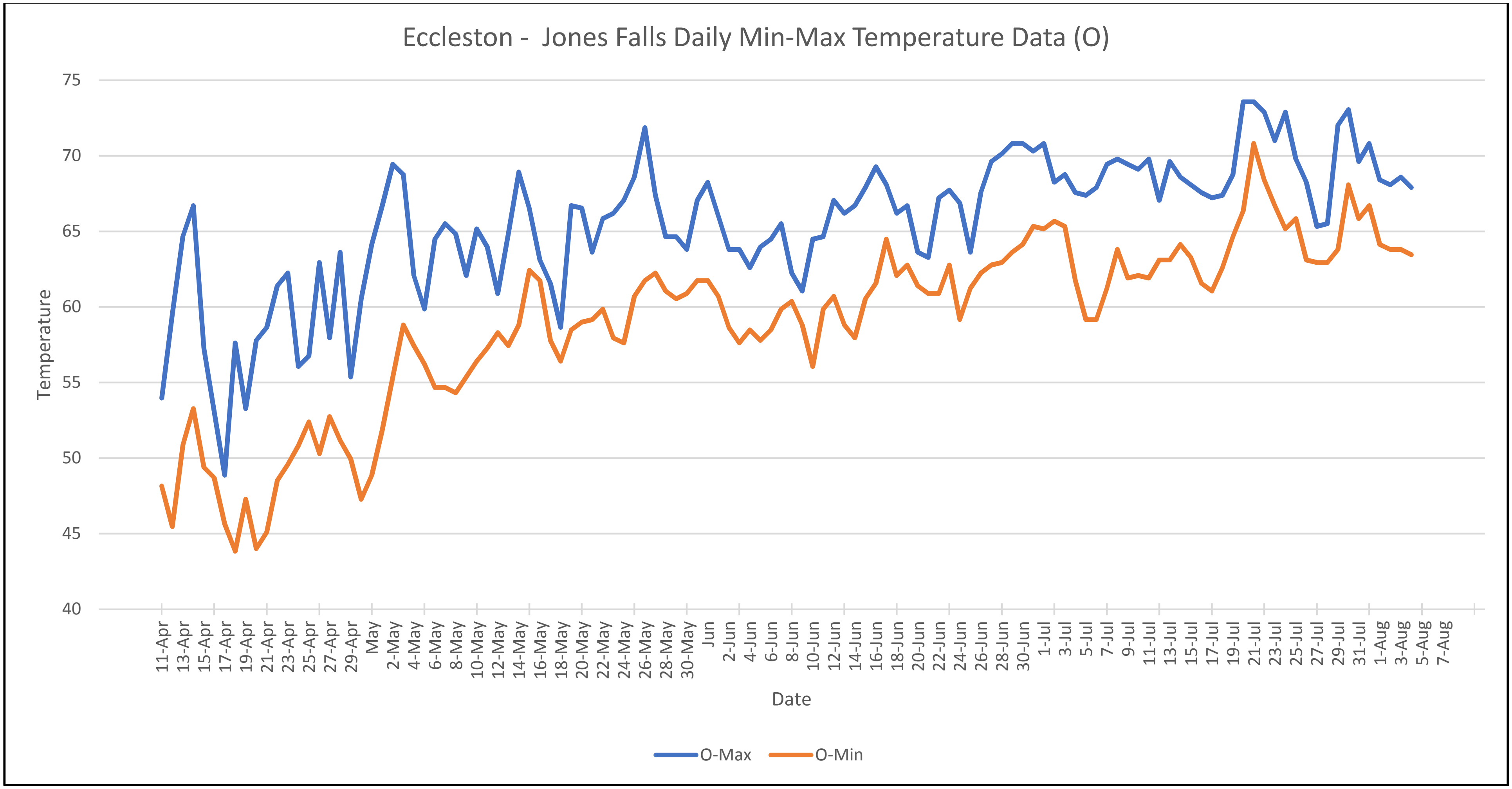
Date
N-Max
N-Min


Eccleston - Jones Falls Daily Min-Max Temperature Data (O)
Temperature
75
70
65
60
55
50
45
40
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
May
2-May
4-May
6-May
8-May
10-May
12-May
14-May
16-May
18-May
20-May
22-May
24-May
26-May
28-May
30-May
Jun
2-Jun
4-Jun
6-Jun
8-Jun
10-Jun
12-Jun
14-Jun
16-Jun
18-Jun
20-Jun
22-Jun
24-Jun
26-Jun
28-Jun
30-Jun
1-Jul
3-Jul
5-Jul
7-Jul
9-Jul
11-Jul
13-Jul
15-Jul
17-Jul
19-Jul
21-Jul
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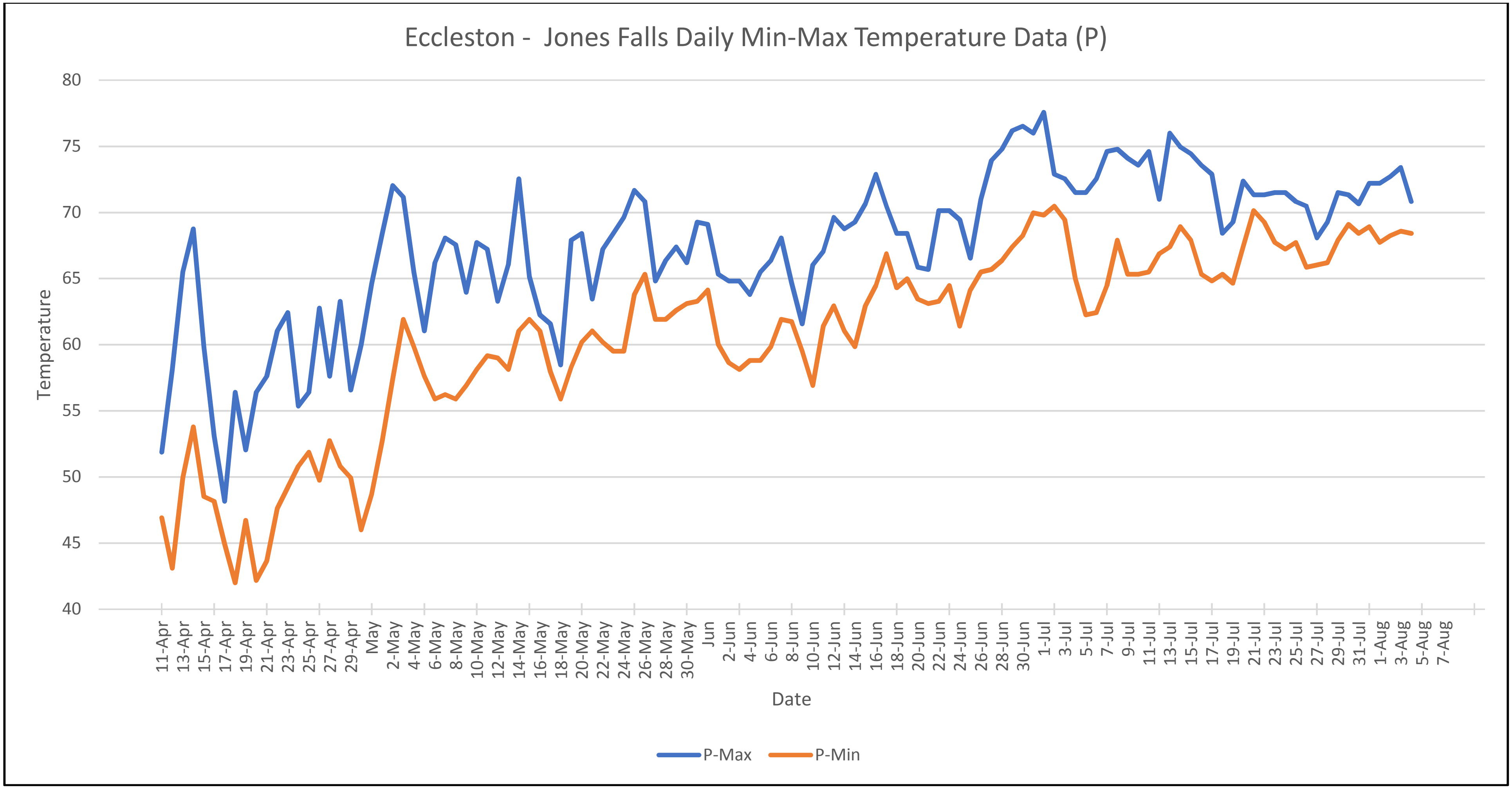
5-Aug
7-Aug
Date
O-Max
O-Min



Eccleston - Jones Falls Daily Min-Max Temperature Data (P)
Temperature
80
75
70
65
60
55
50
45
40
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
May
2-May
4-May
6-May
8-May
10-May
12-May
14-May
16-May
18-May
20-May
22-May
24-May
26-May
28-May
30-May
Jun
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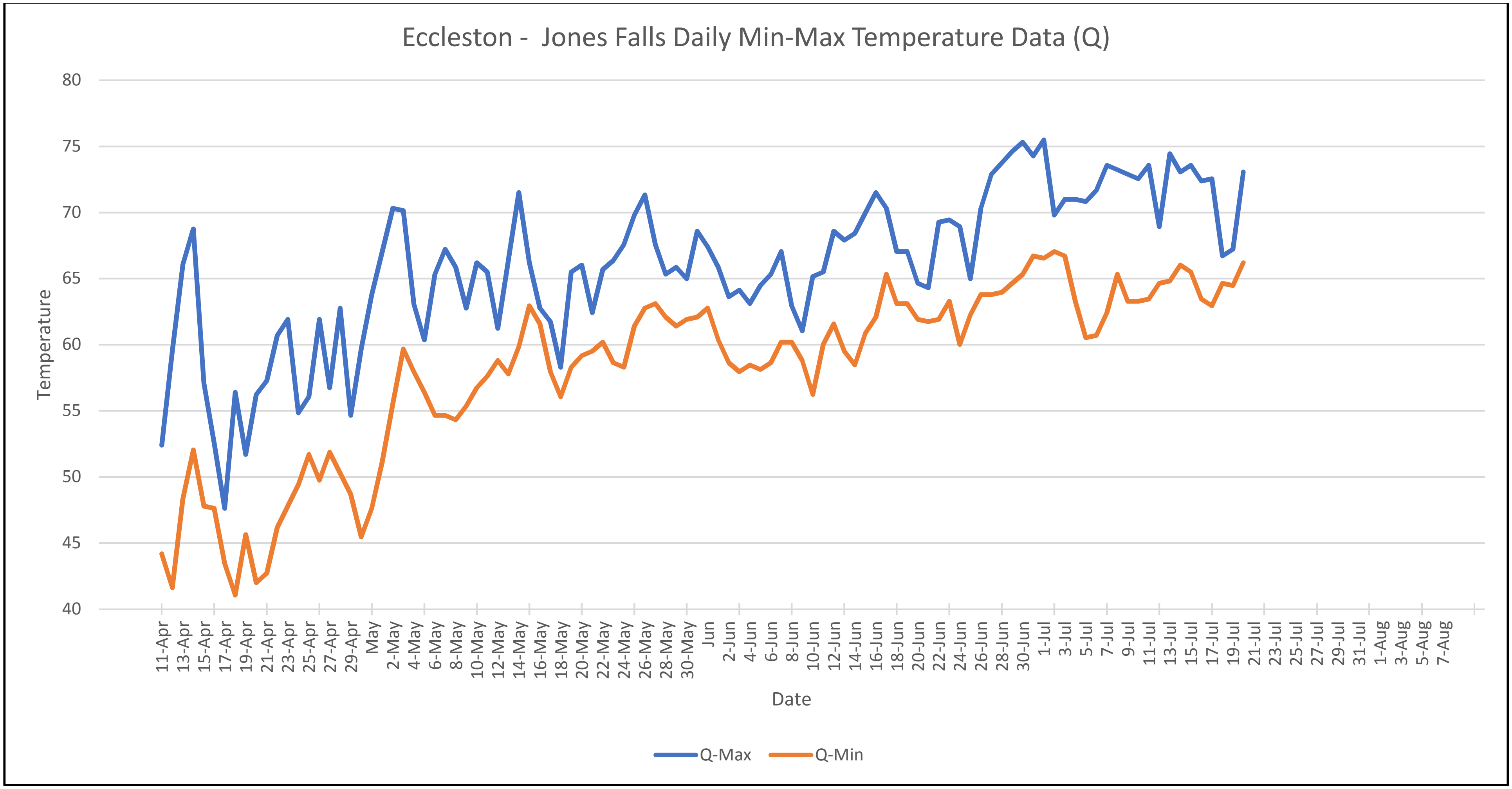
Eccleston - Jones Falls Daily Min-Max Temperature Data (Q)
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Temperature
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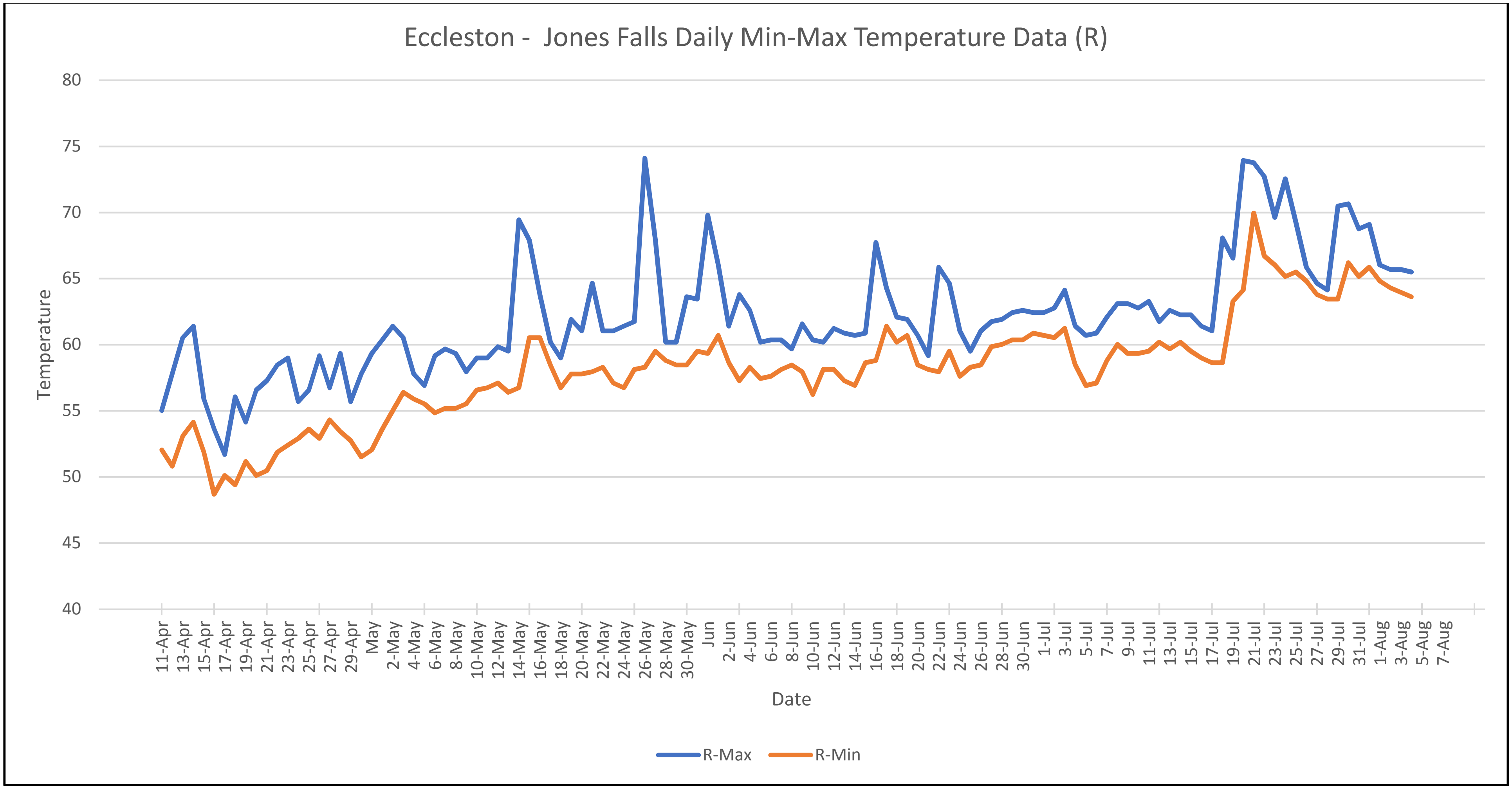
Eccleston - Jones Falls Daily Min-Max Temperature Data (R)
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Temperature
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5-Aug
7-Aug
Date
R-Max
R-Min


Eccleston Temperature Gauge Locations
R
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Q
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APPENDIX J
Design Plans
(under separate cover)

APPENDIX K
MAINTENANCE PLAN

MAINTENANCE PLAN

The Maintenance Plan is a description and schedule of maintenance requirements to ensure the continued viability of the mitigation resources. The site owner shall continue with such maintenance activities until the Long-Term Steward assumes their responsibilities.

The following regular maintenance and bookkeeping will be conducted for the site, at a minimum:

- Conduct regular inspections of all mitigation areas, particularly during non-reporting years of site operation (annual inspections recommended, at a minimum).
- Maintain and repair all mitigation areas to meet or exceed the objectives and functions of the site, including all mitigation-related berms and structures.
- Proactively manage invasive species on the property.
- Ensure that no trespass, illegal dumping, or trash accumulation occurs on the property.
- Post and repair site / property limit and conservation easement signs.
- Maintain, repair, and/or replace gates and fences, as necessary.
- Maintain and repair direct access roads, as necessary.
- Other maintenance responsibilities to site operation and adaptive management.
- <u>Remediation of Wetland Areas</u>
    i. Describe any problems observed within the mitigation site, such as excessive inundation, insufficient hydrology, seasonal drought conditions, invasion by undesirable species of plants or wildlife, disease condition for plants, poor plant establishment, adverse water quality impacts (i.e. excessive sediment loading, water pollution, etc.), human encroachment, and slope failures or erosion problems.
    ii. Describe the proposed remedial measures to address the problems noted above.
    iii. Remedial measures proposed are subject to review and approval by the regulatory agencies prior to implementation. In the event that remedial measures are implemented, the monitoring period may be extended on a case-by-case basis. The treatment of non-native invasive plant species does not need the approval of the agencies but should be completed at the correct time of year by someone with a current pesticide applicator certification and the required MDE toxic materials permit.
- <u>Remediation of Buffer Areas</u>
    i. Describe any problems observed within the upland buffer, such as invasion by undesirable species of plants or wildlife, disease condition for plants, poor plant establishment, human encroachment, and slope failures or erosion problems.
    ii. Describe the proposed remedial measures to address the problems noted above.
    iii. Remedial measures proposed are subject to review and approval by the regulatory agencies prior to implementation. In the event that remedial measures are implemented, the monitoring period may be extended on a case-by-case basis. The treatment of non-native invasive plant species does not need the approval of the agencies but should be completed at the correct time of year by someone with a current pesticide applicator certification and the required MDE toxic materials permit.

APPENDIX L
MONITORING REQUIREMENTS AND PERFORMANCE STANDARDS

ECOLOGICAL PERFORMANCE STANDARDS AND MONITORING PROTOCOL FOR PERMITTEE-RESPONSIBLE NONTIDAL WETLAND MITIGATION SITES IN MARYLAND

October 30, 2020

Nontidal wetland permittee-responsible mitigation sites shall conform to the following performance standards by the end of the monitoring period, unless otherwise determined by the Maryland Department of the Environment (MDE) and the U.S. Army Corps of Engineers (Corps).

I. Performance Standards: All required documentation, including monitoring reports, construction completion reports, and as-built surveys shall be submitted to MDE and the Corps. MDE and the Corps will use visual observations during site visits and monitoring reports to evaluate attainment of performance standards and performance-based milestones and in determining whether part of or the entire mitigation site is successful or whether corrective actions are warranted. With the exception of standards for Invasive Species and Wetland Species Richness, success will be determined on a plot, well, field, or cell basis. Presenting averages or means of plot data across a site is not satisfactory to demonstrate success. All of the following standards and milestones will be used to assess project success and must be achieved each monitoring year.

A. Wetland Area(s):

1. **Wetland Vegetation Dominance:** Wetland vegetation dominance, defined as a vegetation community where more than 50% of all dominant plant species across all strata are rated obligate ("OBL"), facultative wet ("FACW"), or facultative ("FAC"), using the vegetation sampling procedures as described in the appropriate regional supplement to the Corps of Engineers Wetland Delineation Manual, must be achieved; and

2. **Aerial Cover Vegetative Standards:**
   a) For sites that require monitoring in year one, a minimum of 50% of the mitigation site shall be vegetated (either by planted or volunteer plants) by native (FAC or wetter) species.
   b) By the end of year two, a minimum of 60% of the mitigation site shall be vegetated (either by planted or volunteer plants) by native (FAC or wetter) species.
   c) By the end of year three, a minimum of 70% of the mitigation site shall be vegetated (either by planted or volunteer plants) by native (FAC or wetter) species.
   d) By the end of year five and each monitoring year thereafter, a minimum of 85% of the mitigation site shall be vegetated (either by planted or volunteer plants) by native (FAC or wetter) species.
   e) Volunteer species should support functions consistent with the project design goals; and

3. **Non-Native and Invasive Species:** The goal of any mitigation site is to have no non-native or invasive species. However, if non-native or invasive species are present, no more than 10% of relative plant cover[1] over the entire mitigation site shall be made up by non-native or invasive species, with no individual colony greater than or equal to 5% of relative plant cover. No more than 5% of relative plant cover over the entire site shall be made up of

[1] "Relative plant cover" is defined as the cover of a particular species as a percentage of total plant cover. Thus, relative cover will always total 100%, even when total absolute cover is quite low.

Phragmites australis[2], *Persicaria perfoliata*, or *Lythrum salicaria*. Invasive species are identified on the 2010 National Park Service/U.S. Fish and Wildlife Service document *Plant Invaders of Mid Atlantic Natural Areas*[3] and the Maryland Invasive Species Council Invasive Species of Concern in Maryland[4]. Native status will be based on the Natural Resources Conservation Service Plants Database[5]. *Phalaris arundinacea* and *Typha* spp. may also be considered as invasive species by MDE and the Corps. Alternatively, the Permittee may propose appropriate reference sites as justification for MDE and the Corps to consider different site-specific standards for non-native and invasive species; and

4. **Wetland Species Richness:**
   a) For scrub/shrub wetlands, establish a minimum of three species of native wetland shrubs (FAC or wetter) with no more than 75% relative cover of one species, over the entire mitigation site. Loblolly pine cannot be more than 35% relative cover.
   b) For forested wetlands, establish a minimum of three species of native wetland trees and two species of native wetland shrubs (FAC or wetter) with no more than 75% relative cover of one species, over the entire mitigation site. Loblolly pine cannot be more than 35% relative cover; and

5. **Wetland Vegetation Density for Scrub-Shrub and Forested Wetlands:** For scrub-shrub or forested wetlands, native wetland (FAC or wetter) plant density of at least 435 living trees/shrubs per acre with a minimum height of 10 inches shall be achieved by the end of the first year a monitoring report is required and maintained each monitoring year thereafter through the end of the monitoring period; and

6. **Wetland Vegetation Cover for Forested Wetlands:** For forested wetlands, average tree height of tallest five native wetland (FAC or wetter) trees within each sample plot shall be at least three feet in height at year three and at least five feet in height at year five and each monitoring year thereafter. Canopy cover[6] of native wetland (FAC or wetter) trees and shrubs must be at least 30% by the end of the monitoring period; and

7. **Wetland Hydrology:** Wetland hydrology, defined as 14 consecutive days of flooding or ponding, or a water table 12 inches (30 cm) or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10 (50 percent or higher probability). For the purpose of this determination, the growing season should be based on median dates (i.e., 50 percent probability) of 28ºF air temperatures in spring and fall, based on the long-term data for the nearest appropriate weather station, as recorded in the WETS tables available from the NRCS National Water and Climate Center (https://www.wcc.nrcs.usda.gov/climate/navigate_wets.html), or as specified in the appropriate regional supplement to the Corps of Engineers Wetland Delineation Manual; and

8. **Wetland Soils:** The entire wetland restoration or creation area must meet the Hydric Soil Technical Standard (Technical Note 11) developed by the National Technical Committee for

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[2] American Common Reed, *Phragmites australis* subsp. *americanus*, while uncommon, is not considered to be an invasive plant.
[3] https://www.invasive.org/alien/pubs/midatlantic/midatlantic.pdf
[4] http://mdinvasives.org/species-of-concern/
[5] https://plants.sc.egov.usda.gov/
[6] "Canopy cover" is defined as the percentage of ground covered by tree and shrub leaves, when the edges of the leaves are mentally projected down to the ground surface.

Hydric Soils for saturated conditions and anaerobic conditions:

a) Free water must exist within 10 inches (25 cm) of the ground surface for at least 14 consecutive days; and

b) Anaerobic conditions must exist within 10 inches (25 cm) of the ground surface for at least 14 consecutive days. Anaerobic conditions may be determined by one of the following methods, as detailed in the Hydric Soil Technical Standard:

(1) Positive reaction to alpha-alpha dipyridyl, determined as least weekly.

(2) Reduction of iron determined with IRIS devices (tubes or films) installed for 30 days.

(3) Measurement of redox potential (Eh) using platinum electrodes, determined at least weekly.

9. **Delineation of Aquatic Resources:** At the mid-term monitoring year (year 3 for a 5-year monitoring period and year 5 for a 10-year monitoring period) and at the final year of the monitoring period, the wetland boundary area (established/re-established/restored/enhanced/preserved) as shown on the approved mitigation plan, shall be delineated using the wetland criteria outlined in the Corps of Engineers Wetlands Delineation Manual (1987) and appropriate regional supplement(s)). Delineated wetlands shall be broken into projected vegetative type (e.g., emergent, scrub-shrub, forested) based on species present and density. In addition, all special aquatic sites, other waters, such as lakes and ponds, and all streams, within the approved mitigation site shall be identified and delineated. The delineated aquatic resource mitigation areas as verified by the MDE and/or Corps shall be consistent with the approved mitigation plan and contain at least as much wetland acreage and waterway linear feet as required in the permit. Deep water habitats and unvegetated areas that do not meet wetland criteria shall not be included in area measurements.

10. **Wetland function assessment:** An assessment of the specific wetland functions and values being provided should be conducted.

B. Buffer Area(s): The Buffer Area Performance Standards are only required to be met if the buffer is getting mitigation credit:

1. **Aerial Cover Vegetative Standards:**

a) For sites that require monitoring in year one, a minimum of 50% of the mitigation site shall be vegetated (either by planted or volunteer plants) by native species.

b) By the end of year two, a minimum of 60% of the mitigation site shall be vegetated (either by planted or volunteer plants) by native species.

c) By the end of year three, a minimum of 70% of the mitigation site shall be vegetated (either by planted or volunteer plants) by native species.

d) By the end of year five and each monitoring year thereafter, a minimum of 85% of the mitigation site shall be vegetated (either by planted or volunteer plants) by native species.

e) Volunteer species should support functions consistent with the project design goals; and

2. **Non-Native and Invasive Species:** The goal of any mitigation site is to have no non-native or invasive species. However, if non-native or invasive species are present, no more than 10% of relative plant cover[1] over the entire site shall be made up by non-native or invasive species, with no individual colony greater than or equal to 5% of relative plant cover. No more than 5% of relative plant cover over the entire site shall be made up of *Phragmites australis*[2], *Persicaria perfoliata*, or *Pueraria montana*. Invasive species are identified on the

2010 National Park Service/U.S. Fish and Wildlife Service document *Plant Invaders of Mid Atlantic Natural Areas*[7] and the Maryland Invasive Species Council Invasive Species of Concern in Maryland[8]. Native status will be based on the Natural Resources Conservation Service Plants Database[9]. Alternatively, the Permittee may propose appropriate reference sites as justification for the IRT to consider different site-specific standards for non-native and invasive species; and

3. **Vegetation Density for Forested Buffers:** For forested buffers, native plant density of at least 435 living trees/shrubs per acre with a minimum height of 10 inches shall be achieved by the end of the first year a monitoring report is required and maintained each monitoring year thereafter through the end of the monitoring period.

II. Monitoring Timeframe:

A. The Permittee will be responsible for monitoring the mitigation site for a period of time specified in the Phase II Mitigation Plan Approval Letter, approved final mitigation plan, or the special conditions of the Permit. The Corps of Engineers' 2008 Mitigation Rule requires compensatory mitigation projects to have a minimum monitoring period of five years (33 CFR 332.6(b)). However, longer monitoring periods of more than 5 years are warranted for aquatic resources with slow development rates (e.g., vernal pools, riparian forest, forested wetlands, and coastal salt marsh).

B. The monitoring period begins the year the mitigation planting occurs, unless planting occurs after April 15, in which case the monitoring period will not begin until the following year. For each monitoring report, vegetative monitoring shall be conducted between May 1 and September 30 for forested/scrub-shrub systems and between June 15 and September 30 for emergent systems. Site visits should preferably be during a period with normal precipitation and groundwater levels.

C. Monitoring must be conducted a minimum of once per year during the years that monitoring reports are required. Certain mitigation projects may require more frequent monitoring (e.g., twice a year during spring and fall) and reporting during the early stages of development to quickly identify and address problems and/or concerns. The extent of monitoring may be terminated or reduced no earlier than the end of the fifth monitoring year over part or the entire site upon a determination by the Corps and MDE (as applicable) that the wetland mitigation site has achieved all performance-based milestones each monitoring year and all final performance standards for two consecutive monitoring events. Conversely, MDE and the Corps (as applicable) may extend the original monitoring period upon a determination that performance standards have not been met, the mitigation site is not on track to meet them (e.g., remediation or adaptive management required), or in consideration of the amount and distribution of precipitation prior to and during the growing season compared with a "typical year"[10]. If a natural disaster occurs during the monitoring period, remediation or adaptive management may

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[7] https://www.invasive.org/alien/pubs/midatlantic/midatlantic.pdf

[8] http://mdinvasives.org/species-of-concern/

[9] https://plants.sc.egov.usda.gov/

[10] "Typical year" is calculated by considering normal precipitation and other climatic factors over a rolling 30-year period at or near the project location. Determination of "typical year" should follow the methods described in the U.S. Environmental Protection Agency/Corps factsheet entitled "Typical Year and the Navigable Waters Protection Rule," including use of the antecedent precipitation tool (APT) (https://github.com/jDeters-USACE/Antecedent-Precipitation-Tool).

be required and the monitoring period may be extended.

III. Monitoring Reports: Monitoring reports should be concise and effectively provide the information necessary to assess the status of the compensatory mitigation project. Reports should provide information necessary, including supporting data such as plans, maps, and photographs, to illustrate site conditions and whether the compensatory mitigation project is meeting its objectives and performance standards. In accordance with federal requirements, all monitoring of mitigation sites required by the Corps must adhere to the minimum standards provided in Regulatory Guidance Letter 08-03 (attached).

A. Monitoring reports, a paper copy and an electronic version, must be submitted to MDE and the Corps by December 31 of each monitoring year. If five years of monitoring is required, monitoring reports shall be submitted annually. If ten years of monitoring is required, monitoring reports shall be submitted for years 2, 3, 5, 7, and 10 ("monitoring years") following completion of construction and planting of the mitigation site or phase thereof.

B. Content: The following information must be included with the monitoring report:

1. **Monitoring and Performance Standards Summary Table** comparing the required performance standards to the conditions and status of the developing mitigation site must be completed and attached to the beginning of the Monitoring Report. The table will list the monitoring requirements and performance standards, as specified in the Phase II Wetland Mitigation Plan Approval Letter, and/or special conditions of the permit and evaluate whether the compensatory mitigation project site, including each area (plot, well, field or cell as appropriate), is successfully achieving the approved performance standards or trending towards success.

2. **Project Overview / Background Data:**

a) Title page indicating the permit name, permit tracking number (Corps permit number and MDE NT number), mitigation site name (if applicable), phase (if applicable), monitoring year, and preparer identification (name, address, phone number, and email address).

b) Written description of the location, any identifiable landmarks of the mitigation site, including information to locate the site perimeter(s), and coordinates of the mitigation site (expressed as latitude and longitude).

c) Date(s) of site inspections.

d) A brief paragraph describing the goals and objectives of the mitigation site, including the authorized impact acreage and type of aquatic resource impacted, proposed mitigation acreage and aquatic resource type approved as part of the Phase II Wetland Mitigation Plan or Permit. Include the dates the mitigation construction was started and the planting was completed.

e) A brief narrative description of the mitigation site addressing its position in the landscape, adjacent waterbodies, and adjacent land use.

f) Describe methods used to evaluate performance standards. Plot locations should be clearly identified on the appropriate maps.

g) A short statement on whether the performance standards are being met.

h) A narrative description of existing mitigation site conditions and functions and how the mitigation site has or has not achieved the goals, objectives and performance standards established for the project.

i) Dates of any recent corrective or maintenance activities conducted since the previous report submission.

j) If monitoring or site inspections were conducted between years of required monitoring (e.g., year four in a 10-year monitoring period), this data should also be included.

k) Specific recommendations for any additional corrective or remedial actions.

l) Estimate the percent of the mitigation site that is establishing into wetland and the type of wetland system (ex: forested, scrub-shrub, emergent). If this differs from what was planned, show the boundaries of the actual wetland area/types on the plans or maps.

m) Estimate the percent of the mitigation site buffer that is establishing into forested buffer. If this differs from what was planned, show the boundaries of the actual forested buffer area on the plans or maps.

n) Discussion of growing season and how it was determined for this site.

3. **Summary data:** Summary data should be provided to substantiate the success and/or potential challenges associated with the compensatory mitigation project. Refer to Section IV below for monitoring report measurements to include for the overall site.

4. **Photographs:** Take one set of photographs from established photographic points any time between May 1 and September 30 of each monitoring year (pictures should be taken at the same time of year when possible). Photo location points should be identified on the appropriate maps and labeled with the direction in which the photo was taken. Submitted photos should be formatted to print on a standard 8.5 by 11-inch piece of paper, dated, and clearly labeled with the direction from which the photo was taken. It is highly recommended that aerial photos are also provided, as these are good indicators of hydrology and vegetative cover.

5. **Maps and Plans:** Maps should be provided to show the location of the compensatory mitigation site relative to other landscape features, habitat types, locations of photographic reference points, transects, sampling data points (e.g., vegetation plots, wells, soil samples, etc.), and/or other features pertinent to the mitigation plan. GPS coordinates should be shown on the plans for each photographic reference point and sample plot. In addition, the submitted maps and plans should clearly delineate the mitigation site perimeter(s), which will assist the project managers in locating the mitigation area(s) during subsequent site inspections. Each map or diagram should be formatted to print on a standard 8.5 by 11-inch piece of paper and include a legend and the location of any photos submitted for review. As-built plans should be included if they were not already submitted to MDE and the Corps.

6. **Conclusions:** A general statement shall be included that describes the conditions of the compensatory mitigation project. If performance standards are not being met, a brief explanation of the difficulties and potential remedial actions proposed by the Permittee, including a timetable, must be provided. MDE and the Corps will ultimately determine if the mitigation site is successful for a given monitoring period.

IV. Monitoring Report Measurements. Monitoring reports should include all of the following information for the overall site, and each plot, well, field or cell:

A. Wetland Area(s):

1. Vegetation:

a) Estimate the actual and relative percent cover by plant species, in order of dominance, across all strata for each plot. Include this information in a table. For each species listed in the table include native/non-native status and wetland indicator status. Summarize the data by plot, field/cell and overall site.

b) For scrub-shrub or forested wetlands, estimate the percent survival of planted trees and number of native wetland (FAC or wetter) trees/shrubs per acre (including volunteer woody species at least ten inches). Data should be summarized for each plot and also by field/cell and overall site. Please note that projects where the vegetation is inconsistent throughout the site may not meet the performance standards (e.g. a site where some portions have high densities of woody species but other portions have low densities).

c) For scrub-shrub or forested wetlands, measure the height of the tallest five trees within each sample plot in each monitoring year. In the final year of monitoring, measure canopy cover of native wetland (FAC or wetter) trees and shrubs.

d) Summarize the results from the vegetation plot study, including how the vegetation meets/does not meet performance standards. Data should be summarized for each plot, by field/cell, and for the entire site. Include a discussion of water movement into and through the site. **Do not include the raw plot data in your monitoring report.**

2. Hydrology:

a) Estimate percent of site that is inundated or saturated to the surface on the dates of the site visits.

b) Monitoring data for surface water and groundwater, including hydrograph of measured depth to water table, after calibrating for above-ground height of well. Data should be included for each well separately.

c) Discuss how precipitation during this monitoring year compares with historical precipitation data for that location.

d) Summarize results of the hydrology monitoring for each well, by field/cell, and for the entire site, including if each meets/does not meet the performance standards. Estimate percent of site that has wetland hydrology.

3. Soils:

a) Monitoring data to determine if hydric soils are actively developing. Data should be included for each sample location. This must include evidence that saturated and anaerobic soil conditions are being met, as measured by alpha-alpha dipyridyl, IRIS devices (tubes or films), or platinum electrodes.

b) Provide a soil profile description with accompanying soil photos for each soil location tested above.

c) Summarize results of the soil monitoring for each sample location, by field/cell, and for the entire site, including if each meets/does not meet the performance standards.

4. Remediation:

a) Describe any problems observed within the mitigation site, such as: excessive inundation, insufficient hydrology, seasonal drought conditions, invasion by undesirable species of plants or wildlife, disease condition for plants, poor plant establishment, adverse water quality impacts (i.e., excessive sediment loading, water pollution, etc.), human encroachment, and slope failures or erosion problems.

b) Describe any proposed or implemented remedial measures to address the problems noted above.

c) Remedial measures proposed by the Permittee are subject to review and approval by MDE and the Corps prior to implementation. In the event that remedial measures are implemented, the monitoring period may be extended on a case-by-case basis. The treatment of non-native invasive plant species does not need the approval of MDE and the Corps, but should be completed at the correct time of year by someone with a current pesticide applicator certification and the required MDE toxic materials permit.

B. Buffer Area(s):

1. Vegetation:

a) Estimate the actual and relative percent cover by plant species across all strata for each plot. Include this information in a table. For each species listed in the table, include native/non-native status. Summarize the data by plot, field/cell and overall site.

b) For scrub-shrub or forested buffers, estimate the percent survival of trees and the number of native trees/shrubs per acre (including planted or volunteer woody species at least ten inches). Data should be summarized for each plot and also by field/cell and overall site. Please note that projects where the vegetation is inconsistent throughout the site may not meet the performance standards (e.g. a site where some portions have high densities of woody species but other portions have low densities).

c) Measurements of vegetation based upon performance standard and methods used to evaluate the vegetative success of the mitigation site. **Do not include the raw plot data in your monitoring report.**

2. Remediation:

a) Describe any problems observed within the upland buffer, such as: invasion by undesirable species of plants or wildlife, disease condition for plants, poor plant establishment, human encroachment, and slope failures or erosion problems.

b) Describe the proposed remedial measures to address the problems noted above.

c) Remedial measures proposed by the Permittee are subject to review and approval by MDE and the Corps prior to implementation. In the event that remedial measures are implemented, the monitoring period may be extended on a case-by-case basis. The treatment of non-native invasive plant species does not need the approval of MDE and the Corps, but should be completed at the correct time of year by someone with a current pesticide applicator certification and the required MDE toxic materials permit.

V. Adaptive Management Review

A. The Permittee assumes all liability for performing approved measures through adaptive management strategies or alternative mitigation should MDE and the Corps or the Permittee determine the compensatory mitigation project is not meeting performance standards or satisfying the objectives of the compensatory mitigation project. The approved adaptive management plan will guide decisions for revising mitigation plans and implementing measures to address circumstances (foreseeable and unforeseen) that adversely affect compensatory mitigation success. Any deviations from the approved mitigation plan requires approval from the Corps and MDE.

B. The Permittee must include appropriate information in the monitoring reports about performance issues and implementation of approved adaptive management measures to allow the Corps and MDE to assess how the project is progressing. The Permittee must notify the Corps and MDE as soon as possible if the compensatory mitigation project is not achieving its performance standards as anticipated. The Corps and MDE, in coordination with the Permittee and other appropriate agencies, will evaluate any deficiencies and determine if proposed measures will address those deficiencies and/or require modification of the approved mitigation plan(s). The proposed measures must be designed to ensure that the modified compensatory mitigation project provides aquatic resource functions comparable to those described in the mitigation plan objectives. The Permittee shall implement the strategies in the adaptive management plan until the compensatory mitigation project has been determined by the Corps and MDE to have met its goals, objectives, and performance standards and the long-term management plan is initiated.

RECOMMENDED METHODS FOR MONITORING VEGETATION, HYDROLOGY, AND SOILS IN WETLAND MITIGATION SITES IN MARYLAND

Below are the recommended techniques for monitoring mitigation sites. Alternate techniques may be considered, but must be approved in writing by the MDE and the Corps prior to the commencement of the monitoring period.

Recommended Wetland Vegetation Density Measurement Technique

a. The following method for measuring the success of the vegetative colonization should be conducted once between May 1 and September 30 for forested/shrub-shrub systems and between June 15 and September 30 for emergent systems during each year requiring submittal of a monitoring report, unless an alternate schedule is agreed upon by MDE and the Corps.
b. Vegetation sample plots shall be located on a stratified random basis over the site in order to sample all areas of wetlands at locations adjacent to each photo location marker. Plots should be located within each planned and actual vegetative type and hydrologic regime. Plot locations should be determined prior to construction and shown on the mitigation plan. Once the sample plots are approved as part of the mitigation plan, they should be stationary, unless the Permittee recommends, and MDE and the Corps agree to moving the sample plots. Potential justification for moving sample plots may include that the plot location is an outlier or the actual vegetative type/hydrologic regime differs from what was planned, resulting in some representative areas not being monitored. The following minimum numbers of samples will be required:
    i. If the site is < 5 acres, then a minimum of 3 plots/acre is necessary.
    ii. If the site is > 5 acres but less than 20 acres, then a minimum of 3 plots/acre is required for the first 5 acres, then 2 plots/acre is required for the remaining acreage.
    iii. If the site is > 20 acres, then a minimum of 2 plots/acre is required for the first 20 acres, then 1 plot/acre is required for the remaining acreage.
    iv. All cells, fields, or blocks shall be sampled. A targeted vegetation monitoring approach that correlates monitoring stations with vegetative signatures on aerial photography may be useful for larger mitigation sites.
c. Each plot shall be of a size no less than 400 square feet for woody plants and 3'x3' for herbaceous plants (or circular with approximately the same surface area). The vegetation data shall be collected during the growing season and shall include:
    i. Dominant vegetative species identification
    ii. Percent ground cover assessment
    iii. Number of woody plant stems greater than 10 inches in height (total and #/acre)
    iv. The percentage of dominant species FAC or wetter
    v. Percent survival by planted species
    vi. A non-native/invasive species assessment including percent cover

Recommended Buffer Vegetation Density Measurement Technique

a. The following method for measuring the success of the vegetative colonization should be conducted once between May 1 and September 30 of each year requiring submittal of a monitoring report, unless an alternate schedule is agreed upon by MDE and the Corps.
b. Vegetation sample plots shall be located on a stratified random basis over the site in order to sample all areas of wetland buffer at locations adjacent to each photo location marker. Plots should be located within each planned and actual vegetative type and hydrologic regime. Plot locations should be

determined prior to construction and shown on the mitigation plan. Once the sample plots are approved as part of the mitigation plan, they should be stationary, unless the Permittee recommends, and MDE and the Corps agree to moving the sample plots. Potential justification for moving sample plots may include that the plot location is an outlier or the actual vegetative type differs from what was planned, resulting in some representative areas not being monitored. The following minimum numbers of samples will be required:

i. If the site is < 5 acres, then a minimum of 3 plots/acre is necessary.
ii. If the site is > 5 acres but less than 20 acres, then a minimum of 3 plots/acre is required for the first 5 acres, then 2 plots/acre is required for the remaining acreage.
iii. If the site is > 20 acres, then a minimum of 2 plots/acre is required for the first 20 acres, then 1 plot/acre is required for the remaining acreage.
iv. All cells, fields, or blocks shall be sampled. A targeted vegetation monitoring approach that correlates monitoring stations with vegetative signatures on aerial photography may be useful for larger mitigation sites.

c. Each plot shall be of a size no less than 400 square feet for woody plants (or circular with approximately the same surface area). The vegetation data shall be collected during the growing season and shall include:
   i. Total actual and relative percent cover of native plant species.
   ii. Number of native woody plant stems greater than 10 inches in height (total and #/acre).
   iii. A non-native/invasive species assessment including relative percent cover.

<u>Recommended Groundwater Well Placement and Data Collection</u>

a. Determine if this wetland is groundwater fed or has a perched water table. Soil profile descriptions must be assessed prior to well installation to identify any restrictive layers to downward water movement. Wells should be installed so they do not penetrate the restrictive layer, but are instead no deeper than the top of the restrictive layer (as discussed in the 2005 Corps document entitled *Technical Standard for Water-Table Monitoring of Potential Wetland Sites ERDC TN-WRAP-05-02*). In most cases, a standard monitoring well installed to 15 inches below the soil surface should be used. Shallower installation depths should be utilized if restrictive soil depths are located within 15 inches of the soil surface. Well design and installation shall be consistent with current Corps' guidance.
b. Specific details on the groundwater monitoring wells and locations shall be provided in the mitigation plan, and must be approved by MDE and the Corps.
c. The following minimum numbers of groundwater wells will generally be required. The Permittee may propose alternate well requirements as part of the mitigation plan, based on justification from the proposed mitigation design:
   i. If the site is < 10 acres, then a minimum of 1 well/acre is necessary.
   ii. If the site is 10 to 20 acres, then a minimum of 1 well/acre is necessary for the first 10 acres, then 1 well/2 acres is necessary for the remaining acreage.
   iii. If the site is > 20 acres, then a minimum of 1 well/acre is necessary for the first 10 acres, 1 well/2 acres is necessary for the next 10 acres, and 1 well/5 acres is necessary for the remaining acreage.
   iv. Hydrologic zones differentiated by a 1-foot change in elevation should have a minimum of one groundwater monitoring well installed.
   v. For sites with multiple cells, each cell should have at least one well.
d. Begin the collection of groundwater well data within fourteen days of the start of the growing season. Take groundwater well readings once every 7 days for the first two months of the growing season and every 30 days for the remainder of the growing season. Record to the nearest inch. Well data should be collected every year during the monitoring period. If well data confirms the presence of wetland hydrology during multiple years of monitoring, the Permittee may request that well data not be required

every year. MDE and the Corps will consider the evidence of hydrology, based on the monitoring reports, site visits, and local precipitation, to approve or deny this request.

e. The growing season should be based on median dates (i.e., 50 percent probability) of 28ºF air temperatures in spring and fall, based on the long-term data for the nearest appropriate weather station, as recorded in the WETS tables available from the NRCS National Water and Climate Center (https://www.wcc.nrcs.usda.gov/climate/navigate_wets.html), or as specified in the appropriate regional supplement to the Corps of Engineers Wetland Delineation Manual.
f. Measure and record any surface water present at the monitoring wells.
g. Include a copy of the plan showing the location of the wells and surface elevation beside each well. Summarize the information regarding groundwater and surface water elevations, and provide monthly rainfall data for the areas.

Indicator of Saturated and Anaerobic Conditions to Demonstrate the Presence of Active Hydric Soil Conditions

a. The Hydric Soil Technical Standard (HSTS) developed by the National Technical Committee for Hydric Soils (Technical Note 11) requires documentation of anaerobic conditions and saturated conditions for a soil to be considered hydric:
   i. For a soil to meet the Saturated Conditions part of the HSTS, free water must exist within 10 inches (25 cm) of the ground surface for at least 14 consecutive days; and
   ii. Anaerobic conditions must exist within 10 inches (25 cm) of the ground surface for at least 14 consecutive days. Anaerobic conditions may be determined by one of the following methods, as detailed in the HSTS:
      (1) Positive reaction to alpha-alpha-dipyridyl, determined at least weekly.
      (2) Reduction of iron determined with IRIS devices (tubes or films) installed for 30 days.
      (3) Measurement of redox potential (Eh) using platinum electrodes, determined at least weekly.

   Methods to demonstrate the presence of anaerobic conditions are outlined at (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051608.pdf).
b. If using alpha-alpha dipyridyl to show soil reduction, soils should be measured at least weekly during the growing season, at a depth of six inches. Note that alpha-alpha dipyridyl is also available as paper strips for easier measurement.
b. Soil testing should be conducted during the time of the growing season anticipated to have the highest amount of soil reduction (often in the early growing season).
c. Samples should be taken in a representative portion of the mitigation site with similar micro topography, vegetative community, etc., rather than in the lowest/wettest areas. Some samples should also include the areas with higher elevations. Additional tests should be taken for larger sites and sites with higher changes in elevation.
d. Plot locations shall be determined after baseline hydrology data are collected for two years to select areas that represent various hydroperiods. At least one soil sample plot location should be established for each hydroperiod present at the mitigation site. Soil sample plots shall be located within five feet of the monitoring well, and shall be performed during each monitoring year. Additional soil monitoring plots may need to be established where saturation occurs between 5% and 12.5% of the growing season to provide corroborative evidence that wetland hydrology is present. Additional soil monitoring may also be required if soil monitoring occurs during extremely wet or dry years.
d. Include a copy of the plan showing the location of the soil data collection, summarize the information, and provide monthly rainfall data for the area.
e. If soil testing confirms the presence of actively reducing soil conditions during multiple years of monitoring, the Permittee may request that soil testing not be required every year. MDE and the

Corps will consider the evidence of anaerobic soil conditions, based on the monitoring reports, site visits, and local precipitation, to approve or deny this request.

Recommended Method of Indicator of Reduction in Soils (IRIS) Film Placement and Data Collection.

a. Label Fe-coated films.
b. Roll one Fe-coated film into 1" clear polycarbonate delivery tube, with Fe-coating facing out.
c. Create a pilot hole in the soil using a 1" push probe. The hole should be slightly deeper (1-2") than final depth of film.
d. Insert rod into the delivery tube, being sure to hook the rod into the hole at the bottom of the film.
e. Insert the "loaded" delivery tube into the hole until the mark on the tube is at the soil surface (50 cm).
f. Holding the rod to ensure the film stays in the soil, pull out the delivery tube.
g. Pull out the rod, being careful not to pull out the film.
h. Insert foam plug into the top of the film, using two O-rings to secure the film around the plug.
i. If the films are installed to shallower depths (e.g., gravel layer inhibits full depth for pilot hole), mark the depth of the soil surface on the films with a permanent marker.
j. Install five replicates, up to a meter apart, within the study area.
k. Films should be left in place for two to four weeks and then should be removed and replacement films can be installed in the same holes for an additional two to four weeks. Films left in for longer than four weeks cannot be used to meet required performance standards.
l. Gently wash off any adhering soil from the films.
m. Estimate the amount of paint removed from each film by overlaying with a mylar grid and marking and counting the grid[11], or by using some other IRT-approved procedure.
n. Find a six-inch area on the film, entirely within the upper 12 inches, with the most paint removed. Estimate the percentage of paint removed from this six-inch area and document the depth of this six-inch area.
o. To meet the Technical Standard for reducing soil conditions as currently specified in the National Technical Committee on Hydric Soils, 30% or more of paint within this six-inch section must be removed.
p. At least three of the five replicates must show this paint removal for the soil to demonstrate that it is reducing.

Recommended Method of Indicator of Reduction in Soils (IRIS) Tube Placement and Data Collection (summarized from the 2008 document entitled *Protocol for Using and Interpreting IRIS Tubes*).

a. Create a pilot hole in the soil using a 7/8" push probe. The hole should be slightly deeper (1-2") than final depth of tube.
b. Be sure tubes are labeled.
c. Insert the IRIS tube into the hole until the mark on the tube is at the soil surface (50 cm). If they are installed to shallower depths, mark the depth of the soil surface with a permanent marker.
d. Install five replicates, up to a meter apart, within the study area.
e. Tubes should be left in place for two to four weeks and then should be removed and replacement tubes can be installed in the same holes for an additional two to four weeks. Tubes left in for longer than four weeks cannot be used to meet required performance standards.
f. Gently wash off any adhering soil from the tubes.

[11] Rabenhorst, M.C. 2012. Simple and Reliable Approach for Quantifying IRIS Tube Data. Soil Sci. Soc. Am. J. 76: 307-308.

g. Estimate the amount of paint removed from each tube by wrapping a mylar grid around tube and by marking and counting the grid, or by using some other IRT-accepted procedure.
h. If visual estimations are used, to improve accuracy, have two (or more) people estimate the amount of paint removed, then average the two sets of data.
i. Find a six-inch area on the tube, entirely within the upper 12 inches, with the most paint removed. Estimate the percentage of paint removed from this six-inch area and document the depth of this six-inch area.
j. To meet the Technical Standard for reducing soil conditions as currently specified in the National Technical Committee on Hydric Soils, 30% or more of paint within this six-inch section must be removed.
k. At least three of the five replicates must show this paint removal for the soil to demonstrate that it is reducing.

Recommended Method of Application of the Alpha-Alpha Dipyridyl Paper Test Strips

a. To meet the anaerobic condition requirement using alpha-alpha dipyridyl test strips, tests should show positive reaction to alpha-alpha dipyridyl at least three times in a row (e.g., sample on Day 1, sample a week later, sample another week later).
b. Excavate a soil pit to a depth of at least 14-16 inches*. A fresh slice of the profile should be cut from the side of the pit and laid out for observation and characterization. Apply the test strips to the targeted layer(s) at several locations within the representative area to ensure that the majority of the layer is reduced. Document at what depth the positive reaction(s) to the test occurred. The procedure for problematic soils (Step 4d) discussed in Chapter 5 of the Regional Supplements requires that at least 60% of a layer 4 inches or more thick and located within 12 inches of the surface, react positively from liquid alpha-alpha dipyridyl solution. **Note: The depth of soil excavations for profile characterization can be much deeper depending upon the required depth and thickness requirements of some hydric soil indicators.*
c. It is important that the test strips are applied only to a fresh, broken face of the desired layer(s). Do not add moisture to soil samples or rub soil against or on to the paper, simply press the paper against a fresh, broken ped face on the soil sample(s). Be sure not to test soil samples that have been exposed to digging equipment to prevent false positive reactions. Record all observations of soil moisture, limit of saturation and the depth to water table on a data form and or in your notes.
d. A positive reaction on the paper (turning pink or red) should occur in a few moments but can take longer especially during colder periods. The manufacturer indicates that the reaction normally takes place within about 30 seconds.
e. To increase the validity of your findings, test the targeted layers at several different locations within the same representative area and any other layers which meet an indicator.
f. Testing multiple samples can exhaust your supply quickly but you can double your reserves by cutting the strips in half. Be careful not to use cutting instruments that could contaminate a sample.
g. The test should be performed as soon as you remove the sample and all information (depths, layers, etc.) recorded in the appropriate fields of the data form (i.e. hydrology remarks, soil layer comments, soil remarks, etc.). Your soil profile description should also be performed as soon as possible using one of the representative pits. In addition to photo documenting your soil profile, document the application of the strips before and after any potential reaction.
h. If the soil is allowed to dry before implementing the test strips or characterization of the profile, dig another representative pit and start over.

STREAM ECOLOGICAL MONITORING REQUIREMENTS AND PERFORMANCE STANDARDS FOR ECCLESTON MITIGATION SITE

The submission of monitoring reports will be required for a period of ten years from the completion of the construction of the mitigation site or phase thereof. Monitoring reports should be concise and effectively provide the information necessary to assess the status of the compensatory mitigation project. Reports should provide information necessary, including supporting data such as plans, maps, and photographs, to illustrate site conditions and whether the compensatory mitigation project is meeting its objectives and performance standards. Monitoring reports shall be submitted for years 2, 3, 5, 7, and 10 ("monitoring years") following completion of construction and planting of the mitigation site or phase thereof. Monitoring reports, both paper copies and an electronic version, must be submitted to the agencies by December 31 of each monitoring year. Monitoring must be conducted a minimum of once per year during the monitoring years following construction of any phase of the project site.

Monitoring may be terminated or the extent of monitoring may be reduced over part or the entire site at the discretion of MDE and the Corps. Conversely, the agencies may extend the original monitoring period upon a determination that performance standards have not been met or the project is not on track to meet them.

If all performance criteria have not been met in the tenth year, then a monitoring report shall be required for each consecutive year until two sequential annual reports indicate that all criteria have been successfully satisfied.

An as-built report/survey will be provided to the agencies within 60 days following completion of construction and planting.

Monitoring Report Requirements:

In addition to the wetland monitoring report requirements, stream monitoring report requirements much detail the following:

As-Built Report: The as-built report shall include comparisons of the design plan to the as-built plan, using the following report components:

1. Plan view of the constructed/restored wetlands, streams, habitat features, and adjacent buffers with location of all permanent sampling stations, photo stations, monitoring wells, instream and stream bank structures, and all permanent cross-section and profile locations

2. Photographs of the completed mitigation taken from permanent photo stations. Photos from each station must be grouped with corresponding photos from previous monitoring reports

3. Longitudinal stream profiles taken from permanent locations, and inlaid with and compared to design profiles

4. Cross-sections taken at permanent locations and inlaid with and compared to design cross-sections

5. Pebble counts from each station that are grouped with corresponding pebble counts from previous monitoring reports

6. Summary stream geomorphologic data presented in a side by side analysis for the design, reference, and as-built channels

7. Planting composition, locations, phases, and densities

8. Stream gage locations

9. Site boundaries

10. As-built elevations

Monitoring Report Measurements:

Stream Area(s)

After Year 2, physical monitoring of stream condition (e.g. Longitudinal profiles, cross-sections, channel Width and Depth) may be conducted outside of the growing season.

Stream chemical (i.e. temperature) monitoring will occur continuously, year-round. For stream biological monitoring, event shall occur consistently within the index period as required by the Maryland Biological Stream Survey (MBSS); between March 1 and April 30 for benthos sampling and between June 1 and September 30 for fish sampling. For any year in which planting was conducted, monitoring of woody vegetation shall take place no earlier than October and at least 6 months following planting. Monitoring of vegetation (herbaceous and woody species) shall be conducted during the growing season.

a. Stream Channel Preservation: Limits will be visually monitored and documented with photographs on an annual basis.

b. Stream Restoration: For the linear footage of stream with stream enhancement activities, the following monitoring will occur in addition to those outlined for Stream Preservation areas:
   i. Reach-wide data will be collected including the following:
      - Bank Erodibility Hazard Index (BEHI) will be assessed to provide a representative reach assessment.
      - Beginning with Year 3, The U.S. Forest Service Stream Reach Inventory and Channel Stability Evaluation (Pfankuch, 1975) will be performed on each reach to provide a representative assessment.
      - Monitoring of the pre- and post-restoration instream habitat using the Rapid Bioassessment Method
      - Radius of curvature shall be assessed within a representative reach.
      - Sinuosity shall be assessed in a representative reach.
      - Percent estimated canopy coverage over restored streams
   ii. Permanent cross-sections shall be established to ensure that the same locations

are used each monitoring year. Representative cross-sections (with permanent markers established during the first monitoring interval) will be surveyed at intervals on a representative sample of riffles and pools. The total number required will vary depending on project length and complexity. Additional cross-sections may be required to show areas where aggradation, degradation, erosion, and mid-channel bars have developed. The following cross-section data will be collected:

- Bankfull width/depth ratio
- Bank/height ratio and entrenchment ratio
- Baseflow discharge measured at least once during both the wet and dry seasons
- Photographs documenting the structural integrity and function at each habitat structure
- Documentation of structure use by intended species. Each instream structure shall have the following data collected:
  - Photographs documenting structural integrity and function.
  - Surveyed profile documenting invert elevation

iii. A surveyed longitudinal profile of the stream within the thalweg with measurements of the locations, depths, and slopes of riffles, runs, pools, and glides. A separate profile will be prepared depicting all previous longitudinal profiles superimposed.
iv. Stream classification pebble count
v. Bar sample or pavement sample
vi. Wetted-perimeter cross-section pebble count of representative riffles
vii. The D50 analysis of the pebble count data

Chemical and Biological Monitoring: Monitoring events shall occur in years 2, 3, 5, 7, and 10 and consistently in either spring or fall of each monitoring year. Stream chemical (i.e. temperature) monitoring will occur continuously, year-round. For stream biological monitoring, event shall occur consistently within the index period as required by the MBSS; between March 1 and April 30 for benthos sampling and between June 1 and September 30 for fish sampling. The number and location of monitoring stations shall be determined, and approved by the agencies, on a case-specific basis and shall remain consistent throughout the monitoring period. Surveys of other biota (e.g. fish, waterfowl, amphibians, etc.) should occur on a case-by-case basis.

Scientific Collection permits for conducting benthic and fish sampling will be coordinated with the Maryland Department of Natural Resources (DNR). All field sampling as well as laboratory sample processing shall be performed by or under supervision of a professional aquatic biologist.

i. Chemistry – Temperature shall be collected at each designated monitoring location site using a HOBO data logger.
ii. Biological – A quantitative survey for benthic macroinvertebrates and fish habitat assessment shall be conducted at designated monitoring locations using a modified MBSS methodology.

Habitat Assessment: A habitat assessment shall be conducted at each identified site using the Rapid Bioassessment methodology.

Performance Standards

All required documentation, including monitoring reports, semi-annual ledgers, and as-built surveys shall be submitted to Maryland Department of the Environment (MDE) and the Army Corps of Engineers (Corps). MDE and the Corps will use best professional judgment, visual observation, and monitoring reports to evaluate attainment of performance standards and in determining whether part of or the entire Project is successful or whether corrective actions are warranted. Success will be determined on a plot, well, field, cell, area, or reach basis. Presenting averages or means of plot data across a project site is not satisfactory to demonstrate success. All of the following standards will be used to assess project success and credit releases and must be achieved each monitoring year.

The project shall conform to the following performance standards by the end of the monitoring period, unless otherwise determined by MDE and the Corps.

Performance Standards and success criteria have been put into table format to easily determine if performance standards have been met. Tables 1 and 2 can be found below and should be used to determine if performance standards have been met for each monitoring year.

Stream Area(s)

The overall objective for the stream compensation is to ensure that the dimension, pattern, and profile of the stream enhancement and restoration areas: 1) remain within the natural range of variability present in the reference data obtained for the design; 2) remain stable; 3) exhibit appropriate habitat diversity; 4) have healthy viable riparian buffers; and 5) improve biological communities.

Stream Restoration/Enhancement Areas

For the linear footage of stream with stream restoration activities, the following Performance Standards will apply:

a. Dimension: The analysis of representative riffle cross-sections shall indicate that they have not aggraded, degraded, widened, or narrowed to the point where they have become unstable or will cause instability. The following measurements will be used to aid in making this determination each monitoring year:
   i. The Width/Depth Ratio Stability Rating (measured Width/Depth Ratio divided by the approved as-built Width/Depth Ratio) shall not be greater than 1.3. If the channel is incising, then the Width/Depth Ratio Stability Rating shall not be less than 0.7.
   ii. The Bank Height Ratio shall not increase or decrease by an amount greater than 0.2 of the approved as-built Bank Height Ratio.

a. Stream Reach Stability: The analysis of the streambank from the top of the bank to the ordinary high-water mark presence of natural protection to prevent streambank erosion that could jeopardize the stability of the streambank or the stream reach. The following measurements will be used to aid in making this determination each monitoring year:
   i. The individual Index Values of Bank Erodibility Hazard Index (BEHI) rating for any identified reach shall be equal to or less than the previous year's Index Value. In

addition, the Total Score shall be equal to or less than the previous year's Total Score, and shall have a Total Score of "Moderate" by monitoring Year 3, and a Total Score of "Low" by monitoring Year 5, and maintained at "Low" throughout the remainder of the monitoring period.

ii. The U.S Forest Service Stream Reach Inventory and Channel Stability Evaluation (Pfankuch, 1975) rating shall be "Good" each monitoring year, beginning with Year 3.

b. Pattern: The analysis of the plan-view survey or field measurements shall indicate that the stream is not migrating to the point where it will cause bank erosion and instability. The following criteria will be used to aid in making this determination each monitoring year:

i. The sinuosity of the stream does not increase or decrease by an amount greater than 0.1 of the approved as-built pattern.

ii. The thalweg of each channel cross-section does not move by more than 10% of the width of the approved as-built channel width in any given year.

iii. The radius of Curvature/Bankfull Width Ratio does not increase or decrease by an amount greater than 0.2 of the as-built condition. For instance, if the as-built ratio is 3.0, the acceptable ratio shall be 2.8 to 3.2 to remain within the range of variability present in the reference data.

c. Structures: The analysis of each instream structure shall indicate that it is performing its intended function, and not adversely affecting the stream. The following measurements will be used to aid in making this determination each monitoring year:

i. Absence of significant under cutting, washing around, or erosion of the bank or streambed associated with any instream structure, excluding any minor channel scour within the thalweg immediately downstream of a structure caused by its intended redirection of flow.

ii. The invert elevation (controlling elevation) of the header rocks or logs of any vane, j-hook, cross-vane, W-weir, or other structure shall not vary more than 0.2 feet from the approved as-built.

d. Materials: The analysis of the pebble count data shall not show a significant change in streambed materials to the point that indicates a shift in bedload material due to stream instability. The following measurement will be used to aid in making this determination each monitoring year:

i. The D50 size particle remains within its approved as-built size class (silt, sand, gravel, cobble, or boulder).

e. Profile: The analysis of the longitudinal profile shall indicate that the bed elevation has neither aggraded nor degraded to the point where it will cause instability. The following criteria will be used to aid in making this determination each monitoring year:

i. The analysis of the Longitudinal Profile does not indicate significant alterations in the locations, depths, and slopes of stream features (riffle, run, pool, and glide).

Functional Uplift Goals

The overall project should meet functional uplift goals. These are directly and indirectly related to the wetland and stream performance standards. The corresponding Functional Uplift Goals table has anticipated goals and actual goals for each monitoring year. MDE and the Corps will use best professional judgment, visual observations and monitoring reports to evaluate attainment of wetland and stream functional uplift goals and whether corrective actions are warranted.

1. **Increase Stream Sinuosity**
   a. Sinuosity
2. **Reconnect Stream to Basal Gravel Layer**
   a. Pebble Counts (D50)
3. **Reconnect Streams to Floodplain**
   a. Bank/ height ratio
   b. Entrenchment ratio
4. **Reconnect Streams to Floodplain, Increase Flood flow Attenuation**
   a. Frequency of flooding (modeled with corroborating visual observations)
5. **Increase Flood flow Attenuation**
   a. Area of floodplain
6. **Reconnect Streams to Floodplain, Increase Flood flow Attenuation, Remove Wetland Drains, Improve Habitat**
   a. Acreage of floodplain wetlands
7. **Restore Diverted Stream Baseflow**
   a. Baseflow discharge and physical destruction of pipe
8. **Increase Upland Riparian Buffer, Improve Upland Habitat**
   a. Acreage of upland riparian buffer
9. **Improve In-Stream Habitat**
   a. Bed diversity
   b. Riffle habitat area
   c. Pool habitat area
   d. LF of stream
   e. Channel overhead cover area/ LWD frequency
10. **Invasive Species Controls**
    a. Decrease in invasive species relative cover
11. **Improve Aquatic Organism Passage**
    a. Remove Dam(s)
12. **Decrease Stream Bank Erosion**
    a. BEHI score
13. **Maintain or Improve Fauna Presence**
    a. Trout (presence, absence, age classes)
    b. Macroinvertebrates (B-IBI scores, taxa diversity)

Table 1: Eccleston Stream Performance Standards

Eccleston Stream Performance Standards - Restoration											
Parameters	Measurement	Year 2 Monitoring		Year 3 Monitoring		Year 5 Monitoring		Year 7 Monitoring		Year 10 Monitoring	
		Antic.	Actual	Antic.	Actual	Antic.	Actual	Antic.	Actual	Antic.	Actual
Dimension	Width/depth ratio stability rating (measured w/d divided by as-built w/d)	≥ 0.7, ≤ 1.3		≥ 0.7, ≤ 1.3		≥ 0.7, ≤ 1.3		≥ 0.7, ≤ 1.3		≥ 0.7, ≤ 1.3	
	Bank height ratio	≤ 0.2 ± as-built		≤ 0.2 ± as-built		≤ 0.2 ± as-built		≤ 0.2 ± as-built		≤ 0.2 ± as-built	
Stability	BEHI (Index value for any identified reach)	Not applicable		≤Previous year's index value		≤Previous year's index value		≤Previous year's index value		≤Previous year's index value	
	BEHI (Total score)	Not applicable		≤Previous year's total score; Moderate		≤Previous year's total score; Low		≤Previous year's total score; Low		≤Previous year's total score; Low	
	USFS Stream Reach Inventory and Channel Stability Evaluation	Not applicable		Good		Good		Good		Good	
Pattern	Sinuousity	≤ 0.1 ± as-built		≤ 0.1 ± as-built		≤ 0.1 ± as-built		≤ 0.1 ± as-built		≤ 0.1 ± as-built	
	Thalweg movement of each channel cross-section	≤ 10% width of approved as-built channel per year		≤ 10% width of approved as-built channel per year		≤ 10% width of approved as-built channel per year		≤ 10% width of approved as-built channel per year		≤ 10% width of approved as-built channel per year	
	Radius of curvature/bankfull width ratio	≤ 0.2 ± as-built		≤ 0.2 ± as-built		≤ 0.2 ± as-built		≤ 0.2 ± as-built		≤ 0.2 ± as-built	
Structures	"Significant undercutting/ erosion of bank or streambed associated with structure "	Absent		Absent		Absent		Absent		Absent	
	Invert elevation of header rocks/logs of structure (eg vane, j-hook)	≤ 0.2 ft ± as-built		≤ 0.2 ft ± as-built		≤ 0.2 ft ± as-built		≤ 0.2 ft ± as-built		≤ 0.2 ft ± as-built	
Materials	D50	Remains within approved as-built size class		Remains within approved as-built size class		Remains within approved as-built size class		Remains within approved as-built size class		Remains within approved as-built size class	
Profile	Significant alterations in locations, depths, and slopes of stream features	Absent		Absent		Absent		Absent		Absent	

Table 2: Eccleston Functional Uplift Goals

Functional Uplift Goals*													
Functional Uplift/Impairment Reduction Goal	Measurement	Baseline	Year 2 Monitoring		Year 3 Monitoring		Year 5 Monitoring		Year 7 Monitoring		Year 10 Monitoring	
			Antic.	Actual.	Antic.	Actual.	Antic.	Actual.	Antic.	Actual.	Antic.	Actual.
Increase stream sinuosity	Sinuosity												
Reconnect streams to basal gravel layer	Pebble Counts (D50)												
Reconnect streams to floodplain	Bank/height ratio												
	Entrenchment ratio												
Reconnect streams to floodplain, increase floodflow attenuation	Frequency of flooding (modeled w/ corroborating observations)												
Increase floodflow attenuation	Area of floodplain												
Reconnect streams to floodplain, increase floodflow attenuation, remove wetland drains, improve habitat	Acreage of floodplain wetlands												
Restore diverted stream baseflow	Baseflow discharge and physical destruction of pipe												
Increase upland riparian buffer, improve upland habitat	Acreage of upland riparian buffer												
Improve in-stream habitat	Bed diversity												
	Riffle habitat area												
	Pool habitat area												
	LF of stream												
	Channel overhead cover area / LWD frequency												
Invasive species control	Decrease in invasive species relative cover												
Improve aquatic organism passage	Remove Dam												
Decrease stream bank erosion	BEHI score												
Maintain or improve fauna presence	Trout (presence, absence, age classes)												
	Macroinvertebrates (B-IBI scores, taxa diversity)												

* Anticipated quantitative goals for each measurement type are TBD.

APPENDIX M
LONG-TERM MANAGEMENT PLAN

LONG-TERM MANAGEMENT PLAN

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1. Introduction

A. Purpose of Establishment

The Eccleston Mitigation Project (Site) was established to compensate for unavoidable impacts to, and to conserve and to protect, waters of the U.S. The site property includes preserved wetlands enhanced wetlands, created or restored wetlands, out-of-kind stream mitigation, created or restored stream channel, preserved stream channel, enhanced buffer, and preserved buffer. Table 1 – Site Resources includes the total acreage and linear footage per resource type requiring long-term management. The Baltimore District of the U.S. Army Corps of Engineers and the Maryland Department of the Environment (MDE) constitute the regulatory agencies with authority over this mitigation site, and will be consulted concerning site adjustments. Terms used in this management plan have the same meaning as defined in the Compensatory Mitigation Plan (CMP).

Table 1 - Site Resources

Wetlands	
Preserved	5.68 acres
Enhanced	3.09 acres
Restored	13.08 acres
Total	**21.85 acres**
Streams	
Preserved	1,437 linear feet
Restored	7,486 linear feet
Created	1,118 linear feet
Total	**10,041 linear feet**
Buffer	
Preserved	8.61 acres
Enhanced	18.29 acres
Total	**26.90 acres**

B. Purpose of this Long-term Management Plan

The purpose of this long-term management plan is to ensure the Site is managed, monitored, and maintained in perpetuity. This management plan establishes objectives, priorities and tasks to monitor, manage, maintain and report on the waters of the U.S., covered species and covered habitat on the Site. This management plan is a binding and enforceable instrument, implemented in accordance with the CMP and the real estate protection instrument (conservation easement or declaration of restrictions) covering the Site property.

C. Long-Term Steward and Responsibilities

The Long-Term Steward is North American Land Trust. The Long-Term Steward, and subsequent Long-Term Stewards upon transfer, shall implement this long-term management plan, managing and monitoring the site property in perpetuity to preserve its habitat and conservation values in accordance with the Site's plan and conservation easement and/or declaration of restrictions, and the long-term management plan. Long- term management tasks shall be funded through the Long-Term

Management Fund. The Long-Term Steward must maintain a copy of the final plan including all deed restrictions and easements. The Long-Term Steward shall be responsible for providing an annual report to the regulatory agencies detailing the time period covered, an itemized account of the management tasks and total amount expended. Any subsequent grading, or alteration of the site's hydrology and/or topography by the Long-Term Steward or its representatives must be approved by the regulatory agencies and the necessary permits, such as a Section 404 permit and/or Maryland Nontidal Wetlands Permit, must be obtained if required.

D. Eminent Domain

If the site is taken in whole or in part through eminent domain, the Long-Term Steward shall use all monies received as compensation for lands and all associated services and values taken to provide replacement compensation within the same service area, subject to regulatory agency approval. The agencies shall have the right to participate in any proceeding associated with the determination of the amount of such compensation. Replacement compensation may be determined in consultation with the regulatory agencies.

2. Property Description

A. Setting and Location

The Site is located at the southwest corner of Park Heights Avenue and Greenspring Valley Road in Baltimore County, in the State of Maryland, designated as Parcel No. 154. The Property is shown on the Vicinity and Location Map (Exhibit A) of the Mitigation Site. Exhibit A shows the Site location in relation to cities, towns, or major roads, and other distinguishable landmarks. The Site easement plat is included as **Appendix A** to this plan.

B. History and Land Use

Publicly available historic aerials have been researched for this project site, including 1927 and 1953 photography. Previous land use for the site was high-density agricultural, with dairy cows and livestock grazing. Agriculture has shifted to grain farming with no livestock component. Current surrounding land uses include agricultural and low-density residential. The project site and uses are well-depicted in these data and demonstrate that the Jones Falls was straightened multiple times and was almost completely deforested approximately 60 years ago. Other evidence of drain tile, wetland drainage, dams, stream diversion and piping, and construction activities is noted in these photographs. Grazing and land clearing are evident in these aerials, supporting the documentation that the site was used for a dairy operation.

C. Cultural Resources

No known protected historic, archaeological, or cultural resources are present on the site within the proposed work areas. Per standard protocols, if the discovery of resources on the site is made, MDE/MHT will immediately be contacted. No additional studies are proposed at this time.

D. Hydrology and Topography

Investigation of the site has shown that the lowland floodplain areas of the site were most likely

Piedmont emergent/scrub shrub/forested mosaic wetlands highly connected to a basal gravel layer within the valley. A buried hydric soil layer is present, indicating persistent groundwater at that location. This was the dominant, climax hydrological surface/groundwater regime until European settlement, deforestation, and impoundment of Jones Falls. Groundwater historically would have been at or near the ground surface, and is impacted now by channel straightening, legacy sediment, and drain tile, resulting in sporadic wetland conditions adjacent to the stream. Groundwater has been characterized through observation of redoximorphic features observed during the basal gravel investigation. Basal gravel at the site along with the buried hydric soil layer above it is known to be in the ground water table seasonal range based on soil indicators. Streams classify as perennial B4 or C4 Rosgen streams.

E. Soils

Existing soils on the site and specific to the Site include MmA, QM, and WhA. MmA (Merrimac fine sandy loam) has slopes of 0 to 3 percent and is commonly found in major stream valleys.

F. Existing Easements

Current zoning of the property and proposed Site lands is RC-2. Surrounding lands of the proposed Site are also zoned RC-2. A title report was obtained, and additional title research has been conducted for the property revealing that no encumbrances, liens, or easements noted affect the Site. The edges of the property contact road, utility, and railroad right of ways that will not impact or affect the proposed Site. No known mortgages, liens, rights-of-ways, servitudes, easements, mineral rights, etc., other than those previously stated, are known on the property.

G. Adjacent Land Uses

Current surrounding land uses include agricultural and low density residential. Though previous agricultural usage included dairy cows and livestock grazing, current agriculture is strictly grain farming.

3. Habitat and Species Descriptions

A. Baseline Description of Biological Resources on Site

The Rapid Bioassessment Protocol was used to assess the baseline for each stream resource. MBSS Protocols have also been conducted to assess the baseline for macroinvertebrates and fish species within the project limits.

Existing site wetlands functions and values have been assessed using New England Highway methodology.

Baseline invasive plant species and cover percentages have been assessed and documented at the site.

B. Summary of Site Development Plan

Mitigation Credit Map and/or As-built drawings are included as **Appendix B** to this plan.

C. Endangered and Threatened Species

There are no State or Federally Endangered or Threatened Species that currently exist on the Site; however, any species that may eventually occupy the site will be identified and documented on a yearly basis. Elements A.2 and A.3 below may need to be updated should a new species be identified on the site after construction/during the post-construction monitoring period.

D. Rare Species and Species of Special Concern

There are no State or Federally Rare or Species of Special Concern that currently exist on the Site; however, any species that may eventually occupy the site will be identified and documented on a yearly basis. Elements A.2 and A.3 below may need to be updated should a new species be identified on the site after construction/during the post-construction monitoring period.

4. Management and Monitoring

The overall goal of long-term management is to foster the long-term viability of the site's waters of the U.S., and any listed species/habitat. Routine monitoring and minor maintenance tasks are intended to assure the viability of the site in perpetuity.

A. Biological Resources

The approach to the long-term management of the site's biological resources is to conduct annual site examinations and monitoring of selected characteristics to determine stability and ongoing trends of the preserved, restored, enhancement, and created waters of the U.S., including wetlands and streams. Annual monitoring will assess the Site's condition, degree of erosion, establishment of invasive or non-native species, water quality, fire hazard, and/or other aspects that may warrant management actions. While it is not anticipated that major management actions will be needed, an objective of this long-term management plan is to conduct monitoring to identify any issues that arise and using adaptive management to determine what actions might be appropriate. Those chosen to accomplish monitoring responsibilities will have the knowledge, training, and experience to accomplish monitoring responsibilities.

Adaptive management means an approach to natural resource management which incorporates changes to management practices, including corrective actions as determined to be appropriate by the regulatory agencies in discussion with the Long-Term Steward. Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural events. Before considering any adaptive management changes to the long-term management plan, the regulatory agencies will consider whether such actions will help ensure the continued viability of Site's biological resources.

The Long-Term Steward for the site shall implement the following:

Element A. 1 Waters of the U.S., including wetlands

Objective: Monitor, conserve and maintain the site's waters of the U.S., including wetlands and streams. Limit any impacts to waters of the U.S. from vehicular travel or other adverse impacts.

Task: At least one annual walk-through survey will be conducted to qualitatively monitor the general condition of these habitats. General topographic conditions, hydrology, general vegetation cover and composition, invasive species, and erosion will be noted, evaluated, and mapped during a site examination. Notes to be made will include observations of species encountered, water quality, general extent of wetlands and streams, and any occurrences of erosion, structure failure, or invasive or non-native species establishment.

Task: Establish reference sites for photographs and prepare a site map showing the reference sites for the Site file. Alternatively, utilize photographic reference sites, if any, developed during the active and interim site management period. Reference photographs will be taken of the overall site at least every five years from the beginning of the long-term management, with selected reference photos taken on the ground more frequently, one time per year ***(if applicable)***.

Special attention should be paid to any area adjacent to or draining from non-site lands. Streams and wetlands should be observed near site boundaries to observe if increased sediment deposition has occurred. The report should provide a discussion of any recent changes in the watershed (i.e., subdivision being developed upstream of stream site).

Element A. 2 Threatened/Endangered Plant Species Monitoring *(if applicable)*

Objective: Monitor population status and trends.

Objective: Manage to maintain habitat for *Not Applicable (N/A)*

Task: Monitor status every year by conducting population assessment surveys. The annual survey dates will be selected during the appropriate period as identified by the regulatory agencies and will generally occur from ____N/A__ through ____N/A___ each year. Occupied habitat will be mapped and numbered to allow repeatable data collection over subsequent survey years. Abundance will be assessed semi-quantitatively using broad abundance categories, i.e., 0, 1 - 100, 101 - 500, 501 - 1,000, and >1,000 plants.

Task: Visually observe for changes to occupied habitat, such as changed hydrology or vegetation composition. Record any observed changes. Size of population (1 acre, etc).

Task: Implement other tasks that enhance or monitor habitat characteristics _____N/A______.

Element A. 3 Threatened/Endangered Animal Species Monitoring *(if applicable)*

Objective: Monitor population status and trends.

Objective: Manage to maintain habitat for _____N/A________.

Task: Monitor status every year by conducting population assessment surveys. [*The annual survey dates will be selected during the appropriate period each year*.]

Task: Implement other tasks that enhance or monitor habitat characteristics for _______N/A___.

Element A. 4 Invasive Species

Invasive species threaten the diversity or abundance of native species through competition for resources, predation, parasitism, interbreeding with native populations, transmitting diseases, or causing physical or chemical changes to the invaded habitat.

Objective: Monitor and maintain control over invasive species that diminish site quality for which the site was established. The Long-Term Steward shall consult the Maryland Department of Natural Resources at *dnr.maryland.gov* for guidance on what species may threaten the site and on management of those species.

Task: Mapping of invasive species cover or presence shall occur before the site is constructed to establish a baseline. During the active monitoring period, performance standards include an invasive species cover component. Maps and other data will be available that will detail where invasive species presently occur. If a map is not available, mapping shall be accomplished through use of available technologies, such as GIS and aerial photography.

Task: Each year's annual walk-through survey (or a supplemental survey) will include a qualitative assessment (e.g. visual estimate of cover) of invasive species. Additional actions to control invasive species will be evaluated and prioritized in coordination with the regulatory agencies

Element A. 5 Vegetation Management

Objective: Analyze effects of any authorized silvicultural manipulations on the wetland, streams, and buffers on the site. If determined appropriate, develop and implement specific silvicultural manipulations (e.g. selective thinning) in coordination with the regulatory agencies. (Site specific targets for vegetation may be specified here and task revised or added to achieve those targets.)

Objective: Adaptively manage vegetation based on site conditions and data acquired through monitoring to maintain biological values.

Task: Review and explore potential vegetation management regimes as proposals and/or opportunities and funding arise. If determined to potentially maintain site quality, develop specific silvicultural practices, amend this long-term management plan with the agencies' approval to reflect those practices, and implement silvicultural actions as funding allows.

Task: Implement vegetation management techniques, if determined beneficial and as funding allows, to allow development of vegetation as identified in the CMP. Implementation of vegetation management techniques must be approved by the regulatory agencies.

B. Security, Safety, and Public Access

The Site will be fenced or appropriately marked and shall have no general public access, nor any regular public use. Research and/or other educational programs or efforts, hunting, fishing, birdwatching and passive recreational activities may be allowed on the site as deemed appropriate by the regulatory agencies, but are not specifically funded or a part of this long-term management plan.

Potential mosquito abatement issues will be addressed through the development of a plan by the Long-Term Steward and any local mosquito control district or local health department in coordination with and approved by the regulatory agencies.

Potential wildfire fuels will be reduced as needed where approved by the regulatory agencies.

Element B.1 Trash and trespass

Objective: Monitor sources of trash and trespass.

Objective: Collect and remove trash, repair vandalized structures, and rectify trespass impacts.

Task: During each site visit, record occurrences of trash and/or trespass. Record type, location, and management mitigation recommendations to avoid, minimize, or rectify a trash and/or trespass impact.

Task: At least once yearly collect and remove as much trash as possible and repair and rectify vandalism and trespass impacts.

Element B.2 Fire Hazard Reduction

Objective: Maintain the site as required for fire control while limiting impacts to biological values.

Task: Reduce vegetation in any areas recommended by authorities, and as approved by the agencies, for fire control.

C. Infrastructure and Facilities

[*Fence and gate maintenance and repair frequency will be dependent on trespass and access control issues, as well as whether grazing is utilized as a vegetation management technique and to what extent.]*

Element C.1 Fences, Gates, Signage, Crossings, and Property Boundaries

Objective: Monitor condition of fences, gates, signage, crossings, and property boundaries.

Objective: Maintain fences, gates, signage, crossings and property boundaries to prevent casual trespass, allow necessary access, and [*if applicable:* facilitate management.]

Task: During each site visit, record condition of fences, gates, signs, crossings, and property boundaries. Record location, type, and recommendations to implement repair or replacement to fence, gate, signage, crossings or property boundary markers, if applicable.

Task: Maintain fences, gates, signs, crossings, and property boundary markers as necessary by replacing posts, wire, gates, and signs. Replace fences and/or gates, as necessary, and as funding allows. Note any trespass by livestock.

Element C.2 Berms, Structures, and Roads

Objective: Monitor condition of berms, structures, and roads.

Objective: Maintain berms, structures, and roads to facilitate management and maintain conditions of wetlands and streams.

Task: During each site visit, record condition of berms, structures, and roads. Record location, type, and recommendations to implement repair or replacement to berms, structures, and roads, if applicable.

Task: Maintain berms, structures, and roads as necessary. Replace berms, structures, and roads as necessary, and as funding allows.

D. Reporting and Administration

Element D. 1 Annual Report

Objective: Provide annual report on all management tasks conducted and general site conditions to the regulatory agencies and any other appropriate parties. Each report shall include a cover page with the following information: the site name; Long-Term Steward (name, address, phone number, and email address); monitoring year; and any requested action (e.g. funding release, maintenance recommendations requiring agency approval).

Task: Prepare annual report and any other additional documentation. Include a summary. Complete and circulate to the regulatory agencies and other parties by December 31 of each year. Reports should be distributed electronically.

Task: Make recommendations with regard to (1) any enhancement measures deemed to be warranted; (2) any problems that need near-, short-, and long-term attention (e.g., weed removal, fence repair, erosion control); and (3) any changes in the monitoring or management program that appear to be warranted based on monitoring results to date. Provide documentation of the cost of any recommended maintenance and repairs.

5. Transfer, Replacement, Amendments, and Notices

A. Transfer

Any subsequent transfer of responsibilities under this long-term management plan to a different Long-Term Steward shall be requested by the Long-Term Steward in writing to the regulatory agenices, shall require written approval by the agencies, and shall be incorporated into this long-term management plan by amendment.

The Long-Term Steward shall be required to ensure that any subsequent property owners (if not identified as the long-term steward) are notified of the deed restriction, conservation easement, purpose and location of the site lands, and requirement for long-term stewardship.

B. Replacement

If the Long-Term Steward fails to implement the tasks described in this long-term management plan and is notified of such failure in writing by any of the regulatory agencies, the Long-Term Steward shall have 90 days to cure such failure. If failure is not cured within 90 days, the Long-Term Steward may request a meeting with the regulatory agencies to resolve the failure. Such meeting shall occur within 30 days or a longer period if approved by the regulatory agencies. Based on the outcome of the meeting, or if no meeting is requested, the regulatory agencies may designate a replacement Long-Term Steward in writing by amendment of this long-term management plan. If the Long-Term Steward fails to designate a replacement Long-Term Steward, then such public or private land or resource management organization acceptable to and as directed by the regulatory agencies may enter onto the Site property in order to fulfill the purposes of this long-term management plan.

C. Amendments

The Long-Term Steward, property owner, and the regulatory agencies may meet and confer from time to time, upon the request of any one of them, to revise the long-term management plan to better meet management objectives and preserve the conservation values of the Site property. Any proposed changes to the long-term management plan shall be discussed with the regulatory agencies and the Long-Term Steward. Any proposed changes will be designed with input from all parties. Amendments to the long-term management plan shall be approved by the regulatory agencies in writing shall be required management components and shall be implemented by the Long-Term Steward.

If the MD DNR or United States Fish and Wildlife Service (USFWS) determine, in writing, that continued implementation of the long-term management plan would jeopardize the continued existence of a state or federally listed species, any written amendment to this long-term management plan, determined by either the MD DNR or USFWS as necessary, shall be a required management component and shall be implemented by the Long-Term Steward.

D. Notices

Any notices regarding this long-term management plan shall be directed as follows:

Long-Term Steward: **North American Land Trust**
100 Hickory Hill Road
PO Box 467
Chadds Ford, PA 19317
610-388-3670 (phone)
610-388-3673 (fax)

Property Owner: **Eccleston Land Company**
112 Castlewood Road
Baltimore, MD 21210
410-435-2664 (phone)

USACE: **U.S. Army Corps of Engineers, Baltimore District**
2 Hopkins Plaza
Baltimore, MD 21201
1-800-434-0988 (phone)

MDE: **Maryland Department of the Environment**
1800 Washington Boulevard
Baltimore, MD 21230
410-537-3000 (phone)

6. Funding and Task Prioritization

A. Funding

The Long-Term Management Fund Derivation table included with this plan summarizes the anticipated costs of long-term management for the Site. These costs include estimates of time and funding needed to conduct the basic monitoring site visits and reporting, trash removal, fence repair, etc. and a prorated calculation of funding needed to fully repair and/or replace fences and other structures every year. The total annual funding anticipated is approximately $_2,508.00__, therefore, with the current annual estimated capitalization rate of __4%____ the total endowment amount (the Long-Term Management Fund) required will be $__62,700.00__. A detailed breakdown of the cost can be found in **Appendix C**.

North American Land Trust shall hold the endowment principal and interest monies (the Long-Term Management Fund) as required in the CMP, which consists of monies that are paid into it in trust, and is appropriated to fulfill the purposes for which payments into it are made. These interest monies will fund the long-term management, enhancement, and monitoring activities on Site lands in a manner consistent with this long-term management plan.

B. Task Prioritization

Due to unforeseen circumstances, prioritization of tasks, including tasks resulting from new requirements, may be necessary if insufficient funding is available to accomplish all tasks. The Long-Term Steward and the regulatory agencies shall discuss task priorities and funding availability to determine which tasks will be implemented. In general, tasks are prioritized in this order: 1) required by a local, state, or federal agency; 2) tasks necessary to maintain or remediate the Site (including unauthorized impacts); and 3) tasks that monitor resources, particularly if past monitoring has not shown downward trends. Equipment and materials necessary to implement priority tasks will also be considered priorities. Final determination of task priorities in any given year of insufficient funding will be determined in consultation with the regulatory agencies and as authorized by the regulatory agencies in writing.

C. Enforcement

The regulatory agencies and its authorized agents shall have the right to inspect the Property and take actions necessary to verify compliance with this Long-Term Management Plan. The Long-Term Management Plan herein shall be enforceable by any proceeding at law or in equity or administrative proceeding by the regulatory agencies. Failure by any agency (or owner) to enforce the Long-Term Management Plan contained herein shall in no event be deemed a waiver of the right to do so thereafter.

Signatures

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the date herein below last written.

______________________________ _________________

Long-Term Steward Date

USACE

______________________________ _________________

U.S. Army Corps of Engineers, Baltimore District Date

By: _____________________ Its: _____________________

MDE

______________________________ _________________

Maryland Department of the Environment Date

By: _____________________ Its: _____________________