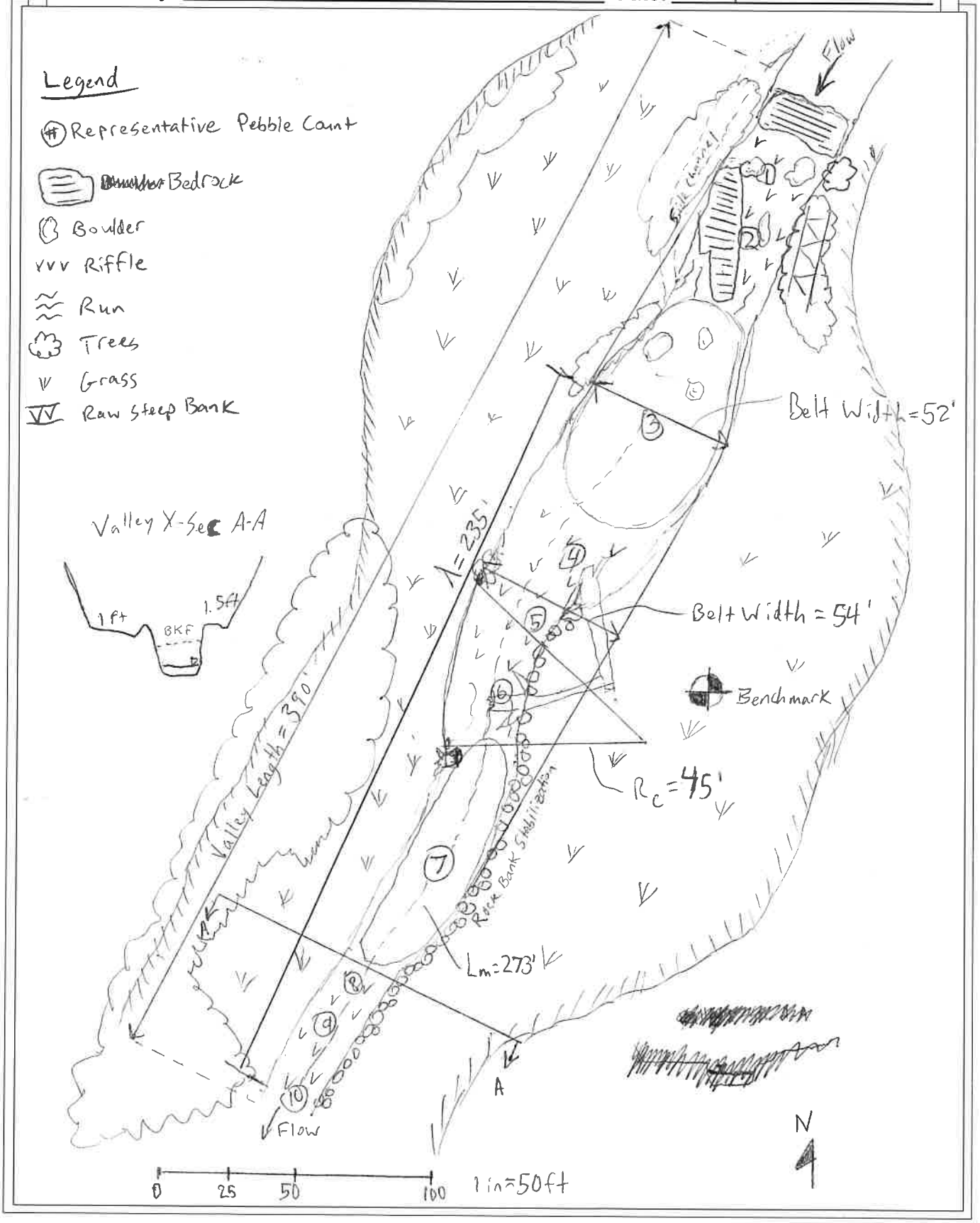
AREA-SITE LOCATION....REACH MAP

Stream: Little Conococheague Creek Reach: 3

Drawn By: Team 3 Date: 4/9/19



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SURVEY DATA → **CROSS - SECTION** 1

SITE: Little Conocacheague Creek Date: 4/9/19

Location: Washington Co., MD

Observers: S. Storrs, B. Farmer, B. Fennell HUC:

BKF -1.55

Item	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instrument HI ft	Fore-Sight FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
1	–	100		2.6	102.60	Benchmark
2	-71.10			0.49	102.11	
3	-54.70			4.50	98.1	
4	-50.80			4.96	97.64	
5	-20.80			5.39	97.21	
6	-12.70			4.92	97.68	
7	-4.70			4.59	98.01	
8	0.00			4.51	98.09	(L) Bank Pin
9	0.80			4.69	97.91	
10	1.40			4.92	97.68	
11	2.40			5.09	97.51	
12	3.10			5.12	97.48	
13	3.70			5.46	97.14	BKF Indicator
14	4.20			5.77	96.83	
15	4.80			5.89	96.71	
16	5.50			5.96	96.64	
17	6.80			7.00	95.60	(L) EOWS (Edge of H_2O Surface)
18	6.80			7.28	95.32	
19	7.50			7.36	95.24	
20	8.10			7.40	95.20	
21	9.20			7.59	95.01	
22	10.70			7.60	95.00	
23	12.20			7.47	95.13	
24	14.30			7.34	95.26	
25	16.40			7.36	95.24	
26	18.10			7.51	95.09	
27	19.50			7.57	95.03	
28	20.10			7.63	94.97	TW

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SURVEY DATA → **CROSS - SECTION 2**

SITE: Date:

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	21.60			7.55	95.05	
30	23.10			7.51	95.09	
31	24.50			7.42	95.18	
32	26.20			7.48	95.12	
33	27.20			7.52	95.08	
34	28.00			7.48	95.12	
35	29.10			7.03	95.57	(R) EOWS
36	29.70			6.48	96.12	
37	30.80			5.86	96.74	
38	31.40			5.74	96.86	[redacted]
39	31.80			5.53	97.07	BKF Indicator > BKF
40	32.30			5.48	97.12	BKF Indicator
41	33.50			5.21	97.39	
42	35.00			4.90	97.70	
43	37.00			4.74	97.86	
44	39.00			4.68	97.92	
45	40.00			4.67	97.93	(R) Bank Pin
46	55.00			4.85	97.75	
47	69.00			5.21	97.39	
48	76.00			4.77	97.83	
49	85.00			4.13	98.47	
50	98.00			3.11	99.49	
51						
52						
53						
54						
55						
56						
57						
58						
59						

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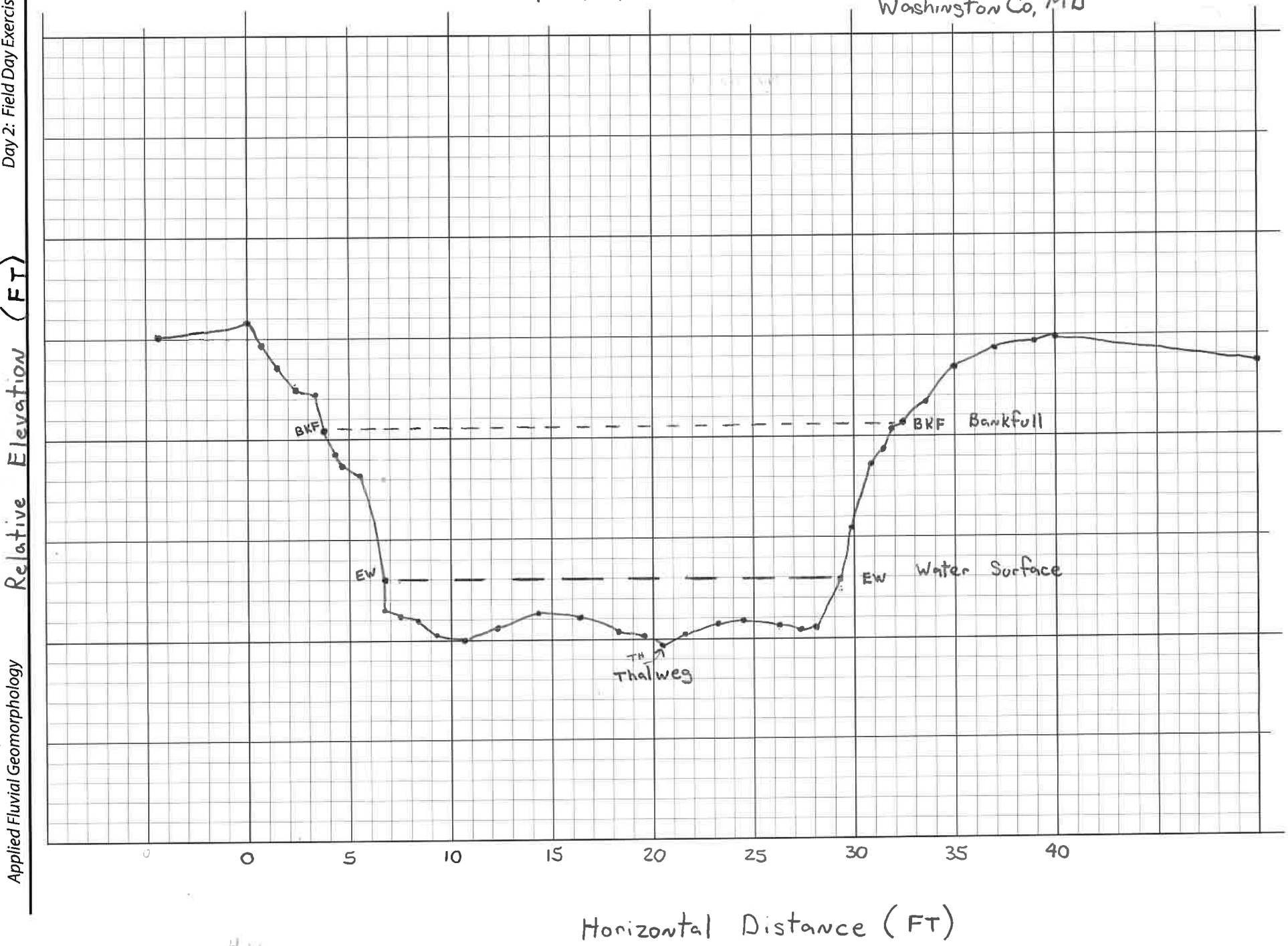
Channel Cross-Sectional Area

Reach 3

Little Conococheague Creek
Washington Co, MD



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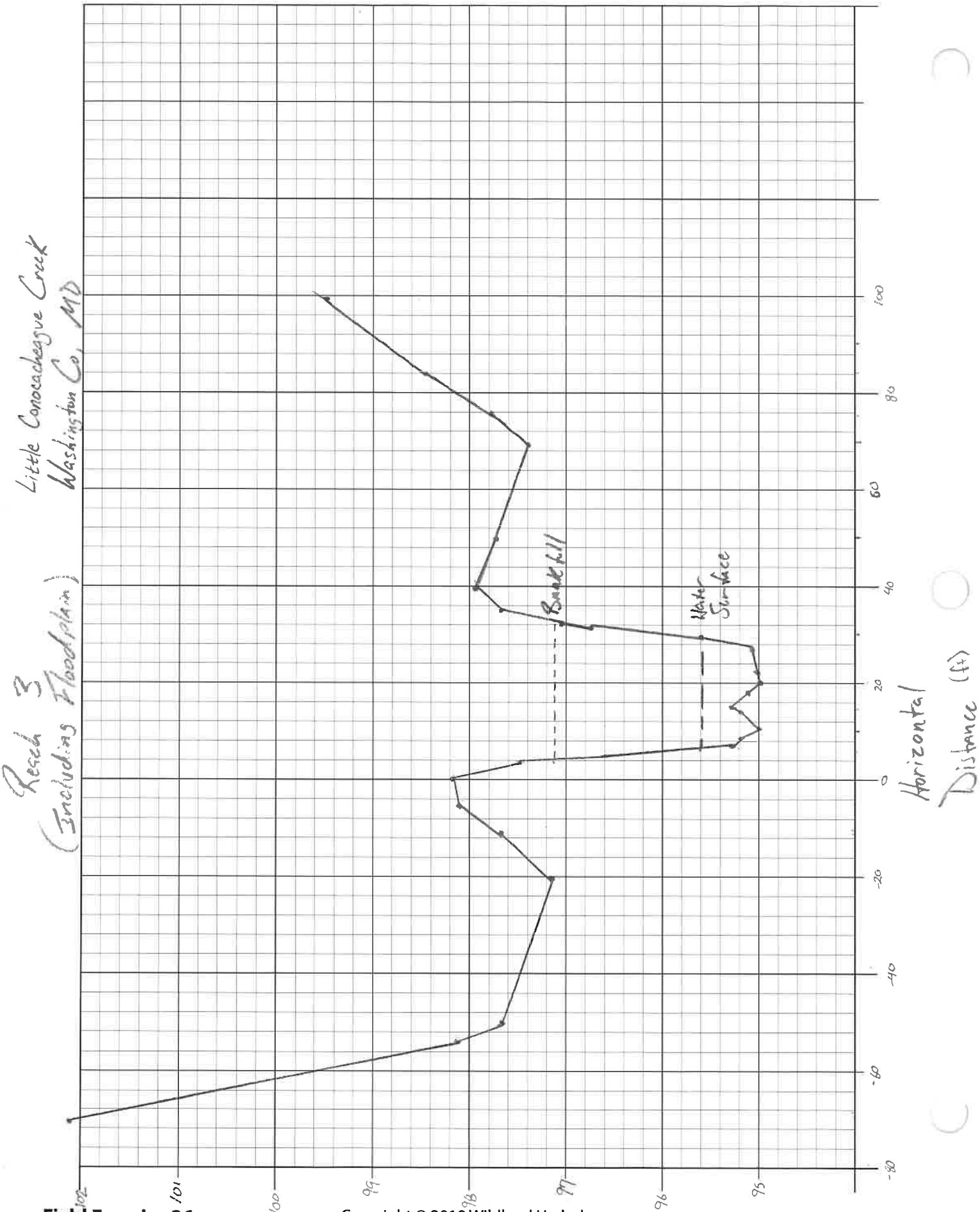

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SURVEY DATA ⟶ **LONGITUDINAL PROFILE 1**

SITE: Little Conococheague Date: 4/9/19

Location: Reach 3

Observers: James, Seth, Sam HUC: _____

	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instrument HI ft	Thalweg Fore-Sight FS ft	Thalweg Elevation Elev. ft	Water Surface Fore-Sight FS ft	Water Surface Elevation Elev. ft	Bankfull Fore-Sight FS ft	Bankfull Elevation Elev. ft	Low Bank HI Fore-Sight FS ft	Low Bank HI Elevation Elev. ft	NOTES e.g. Riffle Run Pool Glide
1	BM1	3.95	103.95		100.0							
2	0.00			7.37	96.58	6.32	97.63	4.72	99.23	N	A	Start Top of Riffle
3	37.0			7.43	96.52	6.88	97.07	5.42	98.53	4.19	99.76	Top of Riffle
4	62.0			8.29	95.66	7.05	96.90			4.76	99.19	Top Run
5	94.0			8.78	95.17	7.10	96.85			5.07	98.88	Middle Pool
6	105.			8.27	95.68	7.13	96.82			5.38	98.57	Middle Pool
7	140			8.05	95.90	7.15	96.80			5.82	98.13	Middle Pool
8	168			7.70	96.25	7.15	96.80			5.74	98.21	Top Riffle
9	224			8.74	95.16	8.12	95.83			5.80	98.15	Bottom Riffle
10	252			10.32	93.63	8.24	95.71			5.58	98.37	Top Pool
11	263			10.77	93.18	8.27	95.68			5.58	98.37	Middle Pool
12	280			10.60	93.35	8.27	95.68	6.90	97.05	5.88	98.07	Middle Pool
13	326			9.95	94.00	8.28	95.67			6.52	97.43	Bottom Pool/Top Glide
14	344			9.16	94.79	8.33	95.62	6.73	97.25	6.13	97.82	Mid Glide
15	354			9.01	94.94	8.41	95.54	6.92	97.03	6.09		Top Riffle
16		LB XS		5.98	97.97			RBX8		6.09	97.86	
17	388			9.83	94.12	8.78	95.17			6.07	97.88	Bottom Riffle
18	412			10.18	93.77	8.85	95.10	7.42	96.53	6.12	97.83	Mid Run
19												
20	BM1	~~3.95~~		3.95	100.00							
21	Close =	0.00										
22												
23												
24												
25												
26												
27												

Best Bankfull 1.43'

Questionable Bankfull

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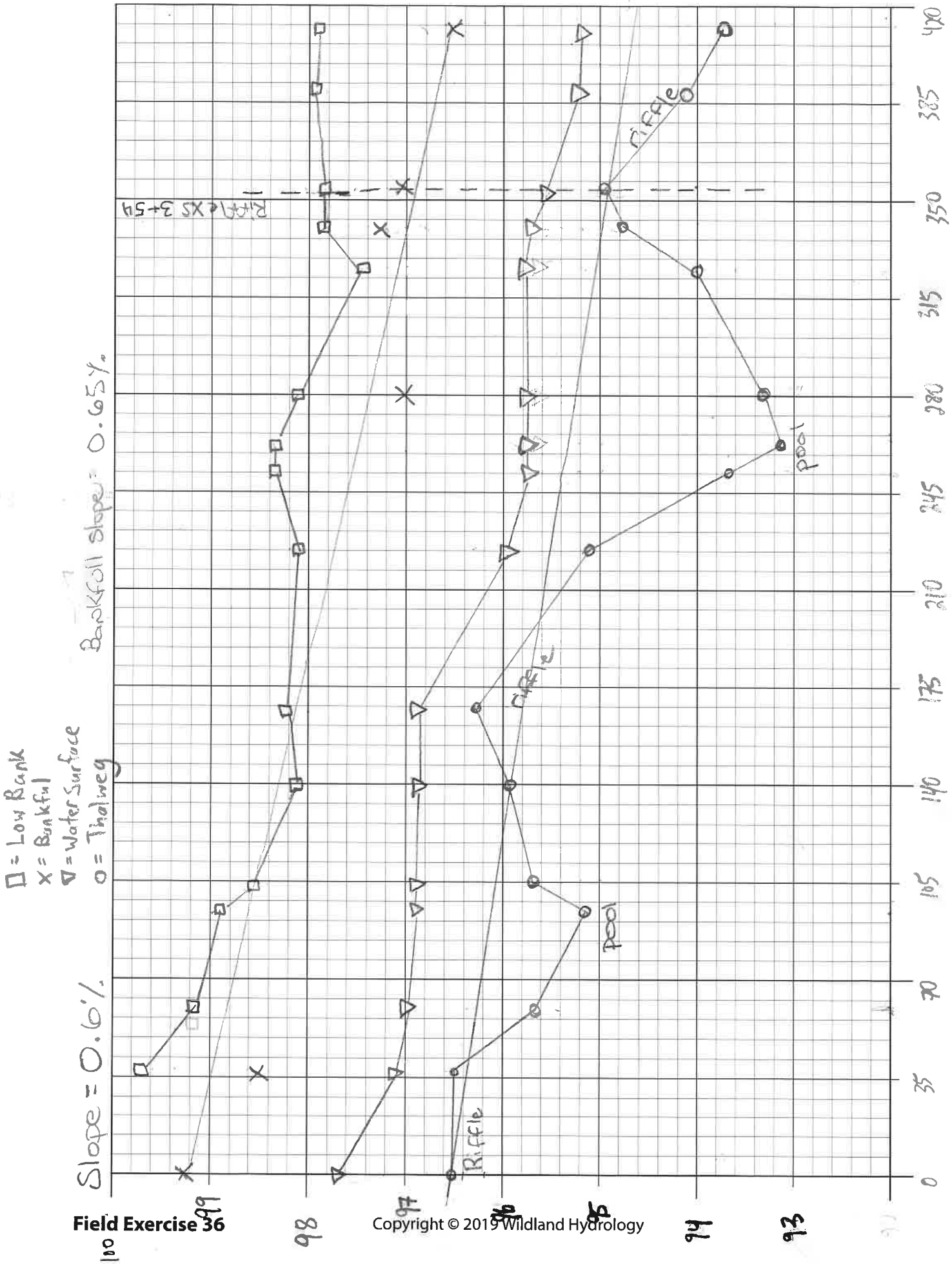
TEAM 3



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TEAM 3

Site:

Location: HUC:

Observers: Group 3, RG, SS, JM

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) TOT #	ITEM %	% CUM	POOL (2) TOT #	ITEM %	% CUM	COMPOSITE (3) TOT #	ITEM %	% CUM
							Reach: 3			Reach: 3			Reach: 3		
							Date: 4/9/19			Date: 4/9/19			Date: 4/9/19		
	Silt / Clay	< .062	S/C	2		5	5	5.6	5.6				5	4.6	4.6
	Very Fine	.062 - .125	SAND	1		1	1	1.1	6.7				1	.9	5.5
	Fine	.125 - .25	SAND	2	2	1	1	1.1	7.8	2	10	10	3	2.8	8.3
	Medium	.25 - .50	SAND	8		1	1	1.1	8.9				1	.9	9.2
	Coarse	.50 - 1.0	SAND												
.04 - .08	Very Coarse	1.0 - 2	SAND												
.08 - .16	Very Fine	2 - 4	GRAVEL			2	2	2.2	11.1				2	1.8	11
.16 - .22	Fine	4 - 5.7	GRAVEL												
.22 - .31	Fine	5.7 - 8	GRAVEL		1	2	2	2.2	13.3	1	5	15	3	2.8	13.8
.31 - .44	Medium	8 - 11.3	GRAVEL	3		1	1	1.1	14.4				1	.9	14.7
.44 - .63	Medium	11.3 - 16	GRAVEL	6	1	1	1	1.1	15.6	1	5	20	2	1.8	16.5
.63 - .89	Coarse	16 - 22.6	GRAVEL	10	2	7	7	7.9	23.4	2	10	30	9	8.3	24.8
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	21		15	15	16.9	40.3				15	13.8	38.6
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	17	2	16	16	18	58.3	2	10	40	18	16.5	55.1
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	20		16	16	18	76.3				16	14.7	69.8
2.5 - 3.5	Small	64 - 90	COBBLE	8		8	8	9	85.3				8	7.3	77.1
3.5 - 5.0	Small	90 - 128	COBBLE	1		2	2	2.2	87.5				2	1.8	78.9
5.0 - 7.1	Large	128 - 180	COBBLE			4	4	4.5	92				4	3.7	82.6
7.1 - 10.1	Large	180 - 256	COBBLE												
10.1 - 14.3	Small	256 - 362	BOULDER	1	1	1	1	1.1	93.1	1	5	45	2	1.8	84.4
14.3 - 20	Small	362 - 512	BOULDER												
20 - 40	Medium	512 - 1024	BOULDER												
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK		11	6	6	6.7	99.8	11	55	100	17	15.6	100
						TOTAL→	89			20			109		

Stream Type: **Landscape Type:**

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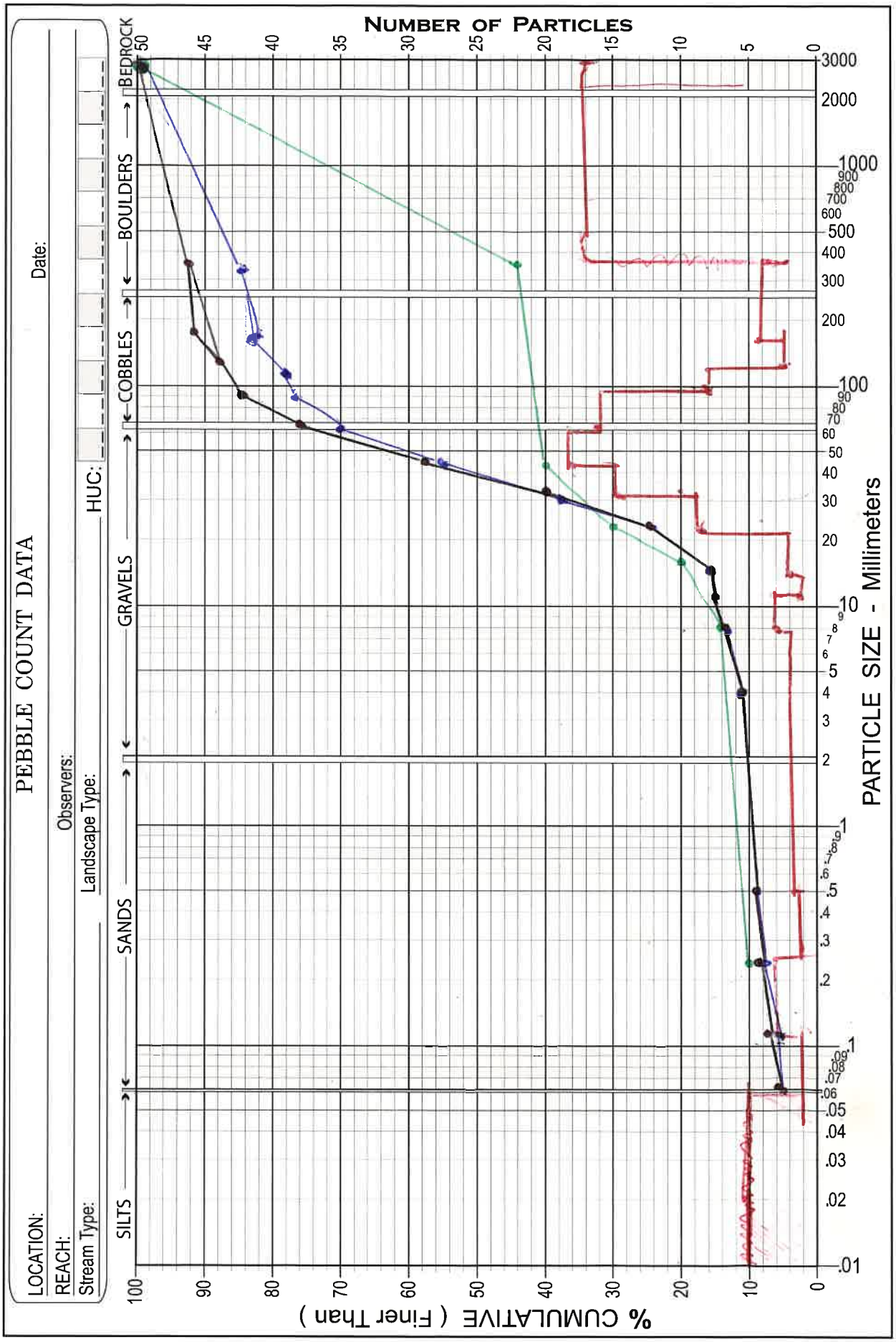
TEAM 3



Blue - combo
Black - riffle
Green - pool

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Worksheet 2. Computations of velocity and discharge using various methods.

Bankfull Velocity and Discharge Estimates

Stream: Little Conococheague	Stream Type: C4
Location: Reach 3	Landscape Type: Confined Alluvial
Observers: Team 3	Date: 4/9/19

Input Variables			Output Variables		
Bankfull Riffle Cross-Sectional Area	50.3	A_{bkf} (ft²)	Bankfull Riffle Mean Depth	1.757	d_{bkf} (ft)
Bankfull Riffle Width	28.6	W_{bkf} (ft)	Wetted Perimeter: $\approx (2 \cdot d_{bkf}) + W_{bkf}$	32.1	W_p (ft)
D_{84} Particle Size at Riffle	90	Dia. (mm)	D_{84} at Riffle (mm to ft): D_{84} (mm) / 304.8	.295	D_{84} (ft)
Bankfull Slope	0.0065	S_{bkf} (ft / ft)	Hydraulic Radius A_{bkf} / W_p	1.57	R (ft)
Gravitational Acceleration	32.2	g (ft / sec²)	Relative Roughness: R (ft) / D_{84} (ft)	5.32	R / D_{84}
Drainage Area	12.0	DA (mi²)	Shear Velocity: $u^* = (gRS)^{1/2}$	.57	u^* (ft/sec)

Estimation Methods	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\,2.83 + 5.66 \cdot \text{Log}\,(R / D_{84})\,]\,u^*$	3.96	ft / sec	199	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figures 28–29) $\bar{u} = 1.49 \cdot R^{2/3} \cdot S^{1/2} / n$ $n =$ 0.034	4.17	ft / sec	236	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Figure 30) $\bar{u} = 1.49 \cdot R^{2/3} \cdot S^{1/2} / n$ $n =$ .040	4.05	ft / sec	203	cfs
2. Roughness Coefficient: c) Manning's n from Jarrett (USGS): $\bar{u} = 1.49 \cdot R^{2/3} \cdot S^{1/2} / n$ $n = 0.39 \cdot S^{0.38} \cdot R^{-0.16}$ Note: This equation is applicable to steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems; i.e., for $n =$	N/A	ft / sec	N/A	cfs
3. Other Methods (e.g., Hey, Darcy-Weisbach, or Chezy C)		ft / sec		cfs
3. Other Methods (e.g., Hey, Darcy-Weisbach, or Chezy C)		ft / sec		cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ Return Period for Bankfull Discharge $Q_{bkf} =$ year		ft / sec		cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	3.98	ft / sec	200	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure **"protrusion heights"** proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

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Worksheet 3. Summary of Morphological Variables.

Stream: Little Conococheague Creek	Location: Washington County, MD
Team: 3	Date: 4/9/2018

Riffle Channel Dimensions

1. Bankfull Width	(W_{bkf}) (ft)	28.62	2. Bankfull Mean Depth	(d_{bkf}) (ft)	1.757
3. Width/Depth Ratio	(W_{bkf}/d_{bkf})	16.28	4. Bankfull Cross-Sectional Area	(A_{bkf}) (ft^2)	50.3
5. Bankfull Maximum Depth	(d_{max}) (ft)	2.16	6. Width of Flood-Prone Area	(W_{fpa}) (ft)	169.1
7. Entrenchment Ratio	(W_{fpa}/W_{bkf})	5.91			

Channel Pattern / Pattern Ratios

8. Belt Width	(W_{blt}) (ft)	Avg:	53	9. Meander Width Ratio (MWR)	(W_{blt}/W_{bkf})	Avg:	1.85
		LL:	52			LL:	N/A
		UL:	54			UL:	N/A
10. Stream Meander Length	(L_m) (ft)	Avg:	273	11. Meander Length Ratio (MLR)	(L_m/W_{bkf})	Avg:	9.55
		LL:	N/A			LL:	N/A
		UL:	N/A			UL:	N/A
12. Linear Wavelength	(λ) (ft)	Avg:	235	13. Linear Wavelength to Bankfull Width	(λ / W_{bkf})	Avg:	8.22
		LL:	N/A			LL:	N/A
		UL:	N/A			UL:	N/A
14. Radius of Curvature	(R_c) (ft)	Avg:	45	15. Radius of Curvature to Bankfull Width	(R_c/W_{bkf})	Avg:	1.57
		LL:	N/A			LL:	N/A
		UL:	N/A			UL:	N/A

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	15	17. D_{35} (mm)	28	18. D_{50} (mm)	40
19. D_{84} (mm)	275	20. D_{95} (mm)	950	21. D_{100} (mm)	Bedrock

Active Bed Riffle Pebble Count

22. D_{16} (mm)	10	23. D_{35} (mm)	28	24. D_{50} (mm)	40
25. D_{84} (mm)	90	26. D_{95} (mm)	700	27. D_{100} (mm)	Bedrock

Channel Sinuosity & Slope

28. Sinuosity	(k)	1.03	29. Average Water Surface Slope	(S)	.006

Classification

30. Stream Type	C4	31. Landscape Type	C-A1-AD

Velocity & Discharge

32. Friction Factor	($\bar{u} / u^*$)	6.95	33. Relative Roughness	(R/D_{84})	5.32
34. Manning's 'n' from R / D_{84}	(n)	0.034	35. Manning's 'n' from Stream Type	(n)	0.040
36. Estimated Bankfull Mean Velocity	($\bar{u}_{bkf}$) (ft/sec)	3.96	37. Estimated Bankfull Discharge	(Q) (cfs)	199
38. Estimation Method Selected for Velocity & Discharge		Friction Factor / Relative Roughness			

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Worksheet 1. Field Form for Level II Stream Classification.

Stream: Little Conococheague Creek	
Location: Washington County, MD	Landscape Type: Confined Alluvial
Observers: Team 3	Riffle Cross-Section:
Date: 4/9/19	Drainage Area: 12 mi^2

Bankfull Riffle Width (W_{bkf}) The surface width of the stream at the bankfull stage elevation.	28.6	ft
Bankfull Riffle Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section at the bankfull stage elevation ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.757	ft
Bankfull Riffle Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section at the bankfull stage elevation ($A_{bkf} = W_{bkf} \bullet d_{bkf}$).	50.30	ft^2
Bankfull Riffle Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Riffle Width* divided by *Bankfull Riffle Mean Depth* that describes the channel shape (large number = wide and shallow channel; small number = narrow and deep channel).	16.28	ft/ft
Bankfull Riffle Maximum Depth (d_{max}) The distance measured between the bankfull stage elevation and the channel Thalweg.	2.16	ft
Flood-Prone Area Width (W_{fpa}) Width at an elevation that is twice the *Bankfull Riffle Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	169.1	ft
Entrenchment Ratio (ER) The vertical containment of a river calculated as *Flood-Prone Area Width* divided by *Bankfull Riffle Width* (W_{fpa} / W_{bkf}).	5.91	ft/ft
Channel Materials (Particle Size Index D_{50}) The median diameter of channel materials within the bankfull channel sampled proportionately through a reach.	40	mm
Average Water Surface Slope (S) Elevation difference of water surface between two similar bed features (e.g., start of riffle to start of last riffe) over the stream length for several riffle–pool or step–pool sequences, representing channel gradient.	.006	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (L_{st} / L_{val}), or from valley slope divided by average water surface slope (S_{val} / S).	1.03	ft/ft

Stream Type C4 **See Classification Key (Figure 2)**

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