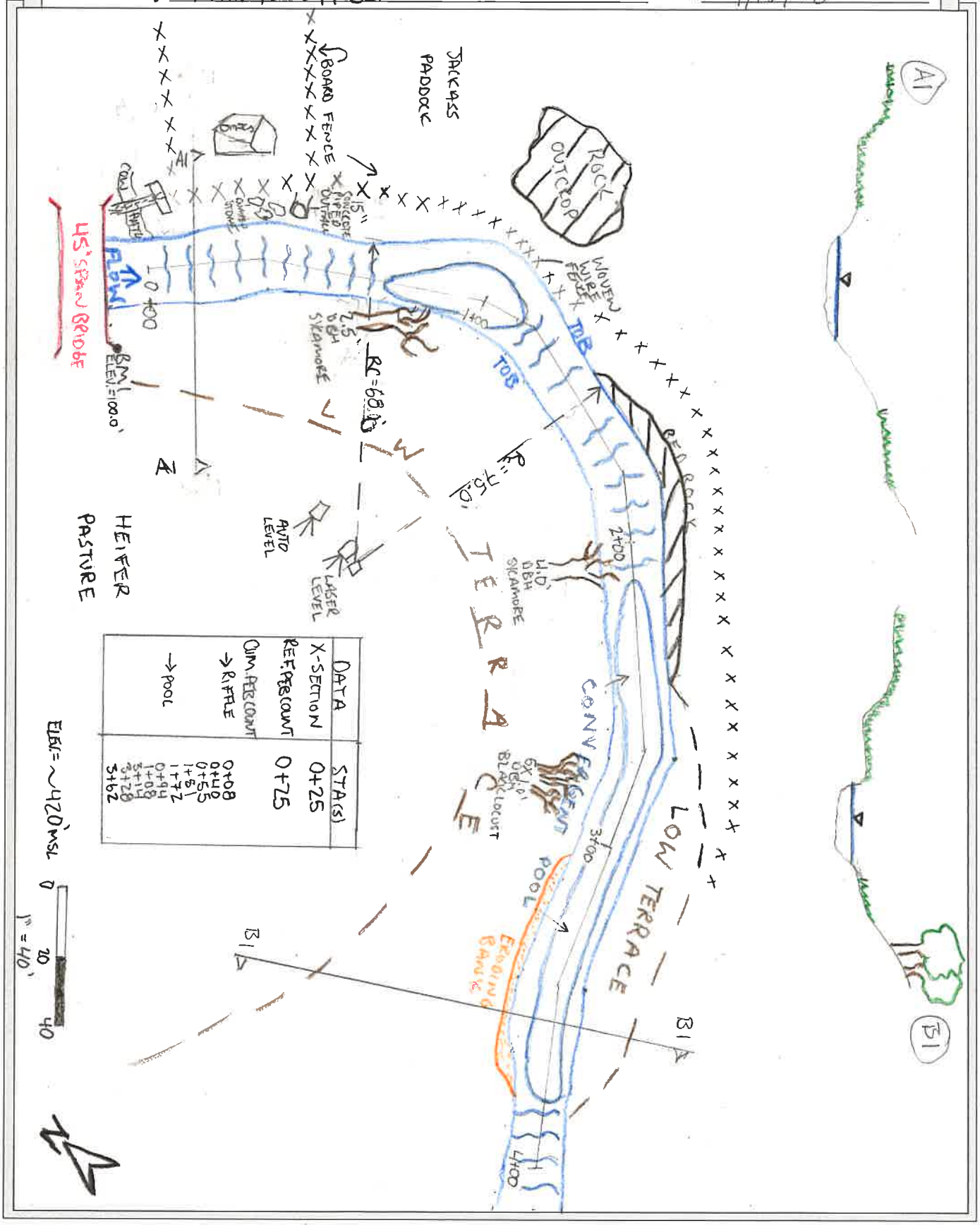
AREA-SITE LOCATION....REACH MAP

Stream/Drainage: LITTLE CONOCACHEAGUE CREEK Site/Reach: REACH 4

Drawn By: MIKE, LEE, & BEN Date: 4/10/18

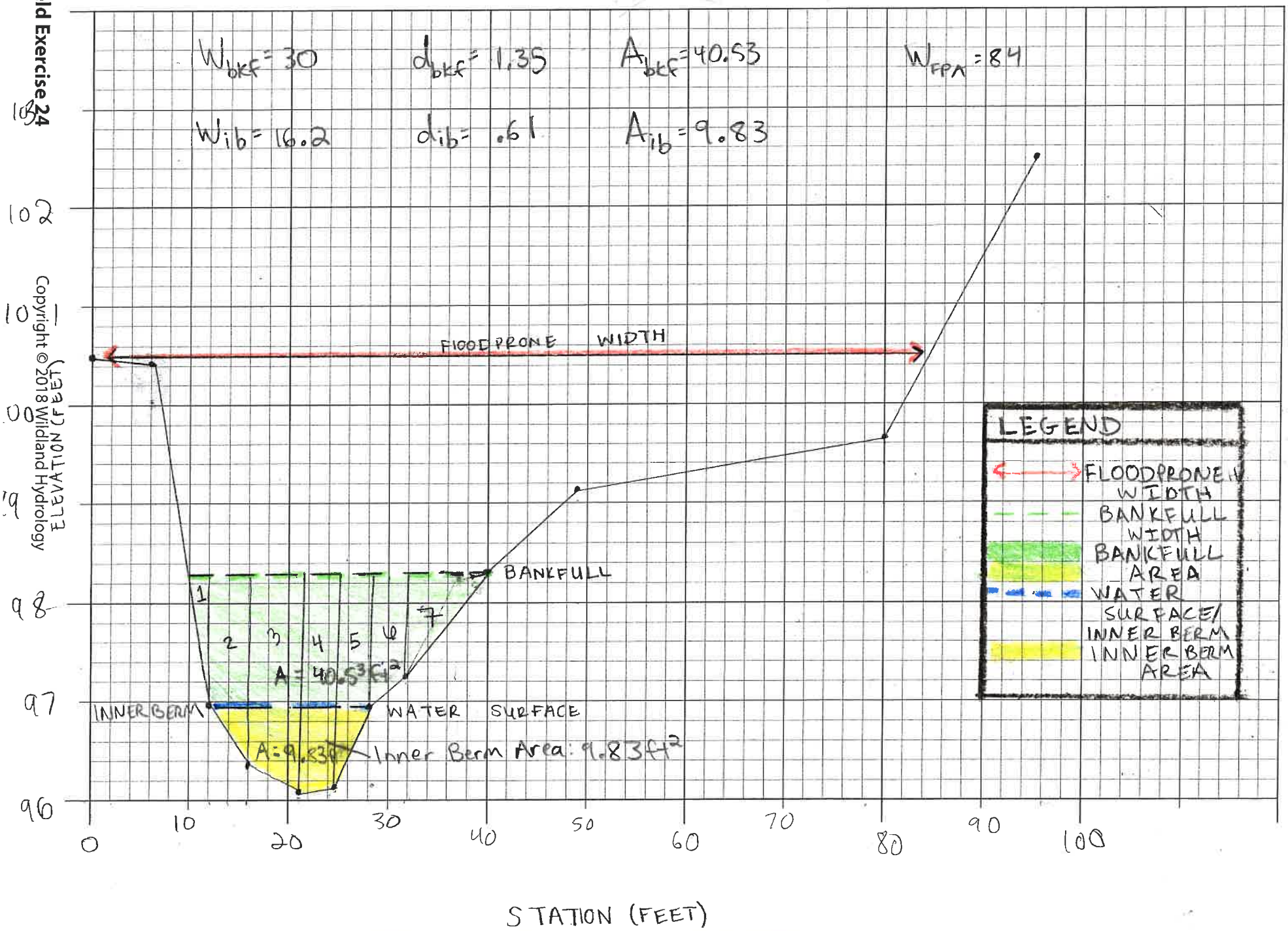


DATA	STA(s)
X-SECTION	0+25
REF. PER COUNT	0+75
CUM. PER COUNT	
→ RIFFLE	0+08
	0+40
	0+55
	1+51
	1+72
	0+94
	1+08
	3+40
	3+28
	3+62
→ POOL	

*BELT WIDTH, WAVELENGTH WORK PARTLY CALCULATED W/ DATA FROM OUTSIDE REACH. SEE DATA SHEET FOR DETAILS

April 10, 2018

RIFFLE CROSS-SECTION: STATION 29, REACH 4, CONOCACHEAGUE CREEK



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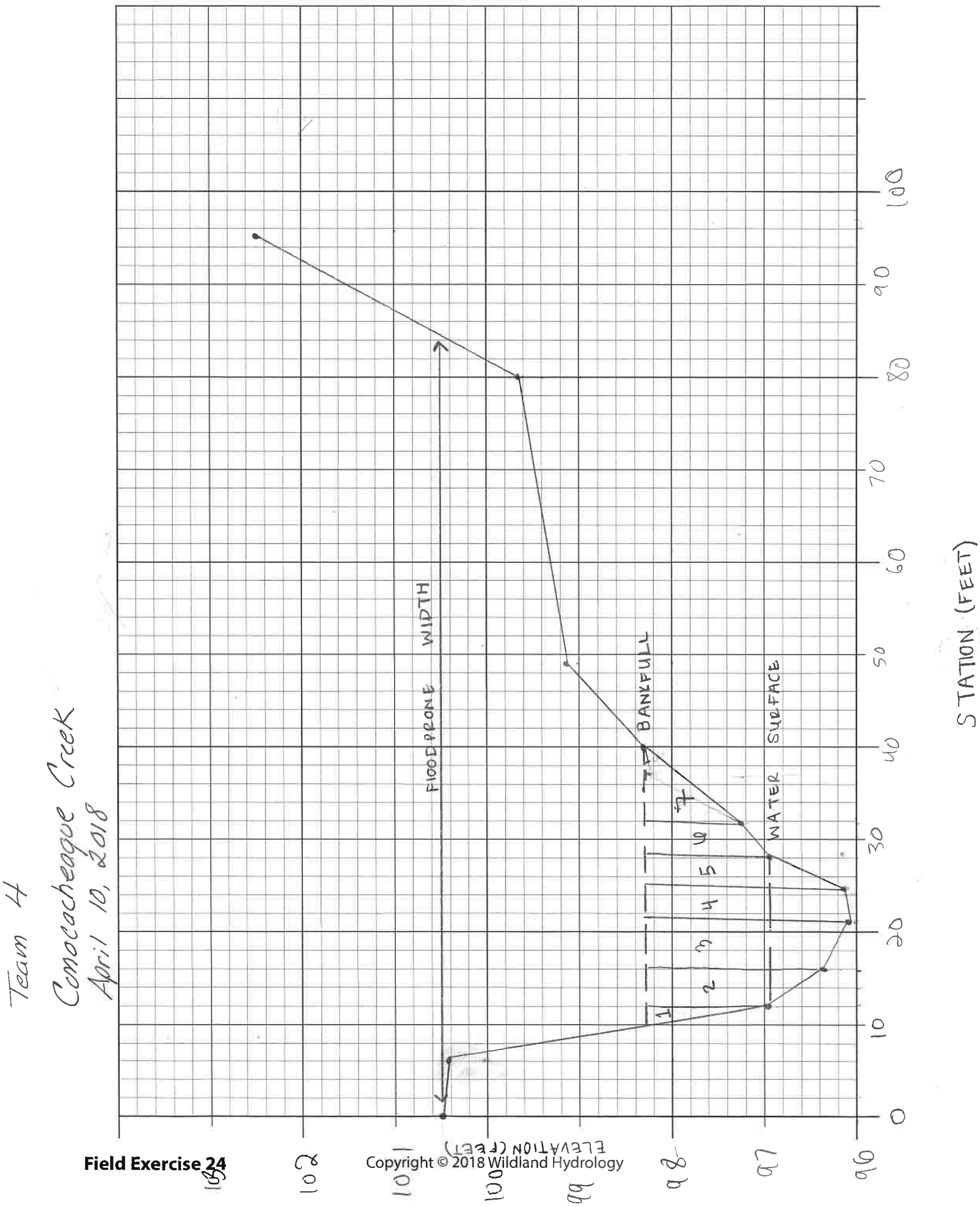

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SURVEY DATA ⟹ CROSS - SECTION 1

SITE: 25 Date: 4/10/18

Location: LITTLE CONOCACHEAGUE CRK, MD.

Observers: HUC:

Item	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instrument HI ft	Fore-Sight FS ft	Elevation ft	REMARKS / COMMENTS / NOTES
1		7.26	107.26		100	Benchmark
2	0		6.74	6.74	100.52	LPIN
3	6		6.79	6.79	100.47	LTOB
4	12.0		10.27	10.27	96.99	LEW
5	16		10.89	10.89	96.37	
6	21.1		11.16	11.16	96.10	TW?
7						
8	24.7		11.08	11.08	96.18	TW?
9						
10	28.2		10.40	10.40	96.86	REW
11						
12	30.9		9.98	9.98	97.28	
13						
14	36.9		9.02	9.02	98.24	~~Bankfull (R)~~ Original BKF
15	40.0			8.95	98.31	(R) Actual BKF
16	49		8.09	8.09	99.17	
17						Toe of Slope
18	80.4		7.64	7.64	99.62	Toe of Slope
19						
20	97		4.79	4.79	102.47	TOP of Slope / RPIN
21						
22			7.05	7.26	100	Benchmark
23						
24						
25						
26						
27						
28						

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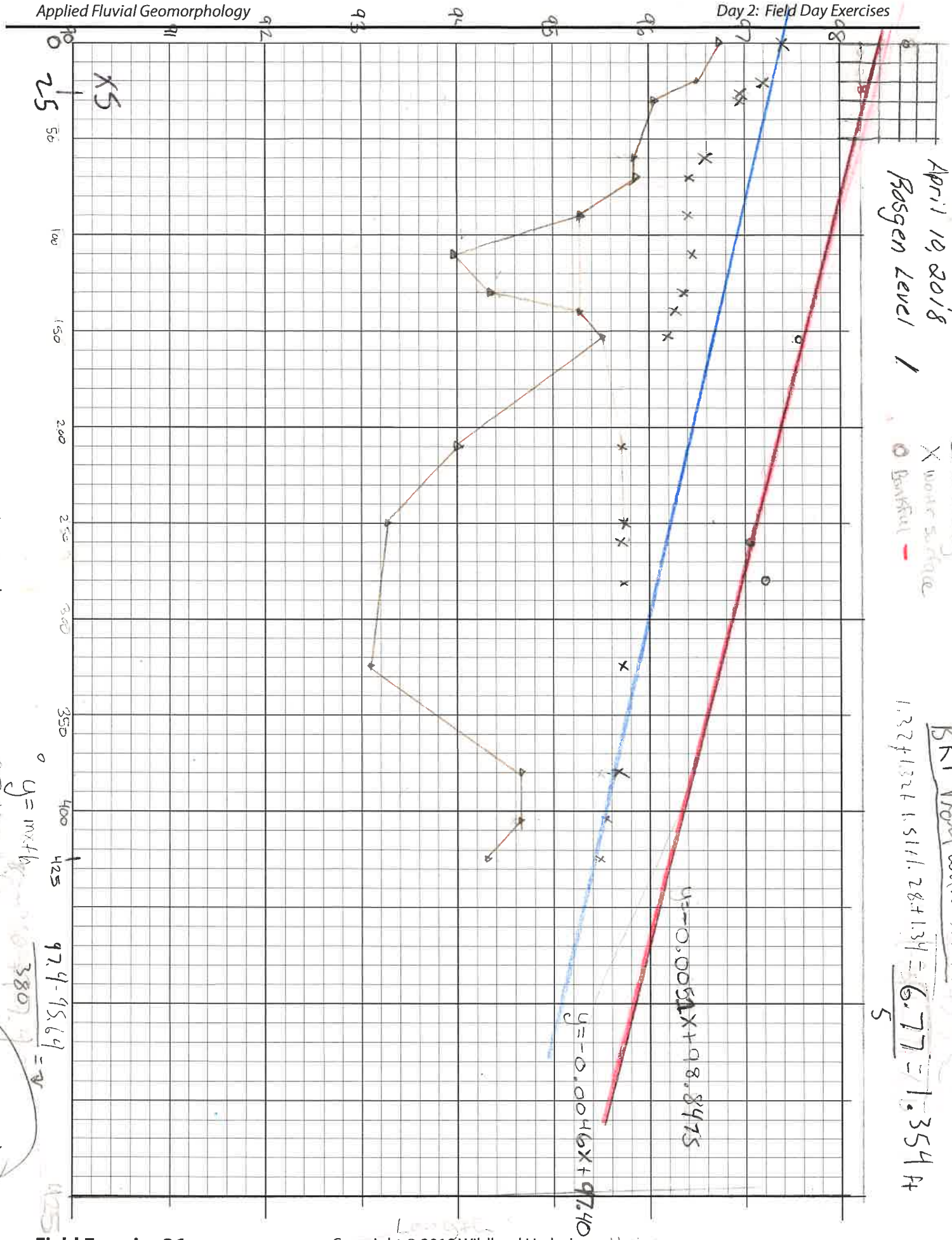

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SURVEY DATA ⟶ **LONGITUDINAL PROFILE 1**

SITE: Team 4 — Date: 4/10/18

Location: Little Conocacheague Creek

Observers: — 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	TBM 100	5.95	105.95	9.22								
2	0			9.22	96.73	8.55	97.4	7.24	98.72			
3												
4	10			9.23		8.76						
5												
6	20			9.44	96.51	8.75	97.2					
7							↓96.92					
8	25					9.03	[illegible]	7.71	98.29			xsection
9												
10	30			9.80	96.15	9.05	96.9					
11												
12	40			10.22		9.23						
13												
14	50			10.10		9.17						
15												
16	60			10.10	95.85	9.35	96.6					
17												
18	70			10.10	95.85	9.54	96.41					
19												
20	80			13.02		9.58						
21												
22	90			12.22	93.73	9.55	96.4					
23												
24	100			11.81	94.14	9.56	96.39					curve
25												
26	110			11.97	93.98	9.53	96.42					curve
27	118					9.64		8.50				

BKF

1.32

1.32

1.3 - 1.6 BF

10.25
8.73
1.52

9.64
8.50
1.14

9.54

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SURVEY DATA ⟶ **LONGITUDINAL PROFILE 2**

SITE: Team 4 — Date: 4/10/18

Location: Little Conochaque Creek

Observers: BB — 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
~~28~~	120			11.54	94.41	9.54	96.41					
29												
30	130			11.61	94.34	9.58	96.37					Glide
31												
32	140			10.58	95.37	9.68	96.27					
33												
34	154			10.40	95.55	9.75	96.2	8.47	97.48			TWG → Bed Rock
35												
36	210			11.95	94.0	10.22	95.73					
37												
38	250			12.74	93.21	10.23	95.72					
39	260					10.26	95.69	8.92	97.03			
40	325			12.82	93.13	10.26	95.69					
41												
42	380			11.30	94.65	10.31	95.64					
43												
44	407			11.31	94.64	10.47	95.48					
45												
46	425			11.64	94.31	10.53	95.42					
47												
48												
49												
50												
51												
52												
53												
54												

105.95

BKF

BKF

C

1.28

Bed Rock

Rocks Silt

1.34

TOR

10.26
8.92
1.34

283

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10.25/95.78 8.74/97.21 = 1.51

Site: Little Conocacheague Creek, Washington County, Maryland

Location: Reach 4 HUC: ___

Observers:

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) TOT #	RIFFLE (1) ITEM %	RIFFLE (1) % CUM	POOL (2) TOT #	POOL (2) ITEM %	POOL (2) % CUM	COMPOSITE (3) TOT #	COMPOSITE (3) ITEM %	COMPOSITE (3) % CUM
							Reach: 4			Reach:			Reach:		
							Date: April 10, 2018			Date:			Date:		
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2		•			1	1	1						
.08 - .16	Very Fine	2 - 4	GRAVEL	•			1	1	2						
.16 - .22	Fine	4 - 5.7		•			1	1	3						
.22 - .31	Fine	5.7 - 8		⁞			5	5	8						
.31 - .44	Medium	8 - 11.3		⁞			5	5	13						
.44 - .63	Medium	11.3 - 16		⊠⁞			15	15	28						
.63 - .89	Coarse	16 - 22.6		⊠ ⊏			17	17	45						
.89 - 1.3	Coarse	22.6 - 32		⊠⊠			20	20	65						
1.3 - 1.8	Very Coarse	32 - 45		⊠ ⊡			18	18	83						
1.8 - 2.5	Very Coarse	45 - 64		⊏			7	7	90						
2.5 - 3.5	Small	64 - 90	COBBLE	⊏⁞			6	6	96						
3.5 - 5.0	Small	90 - 128		⁞⁞			4	4	100						
5.0 - 7.1	Large	128 - 180													
7.1 - 10.1	Large	180 - 256													
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
						TOTAL→	100	100	100						

Stream Type: **Landscape Type:** Confined alluvial

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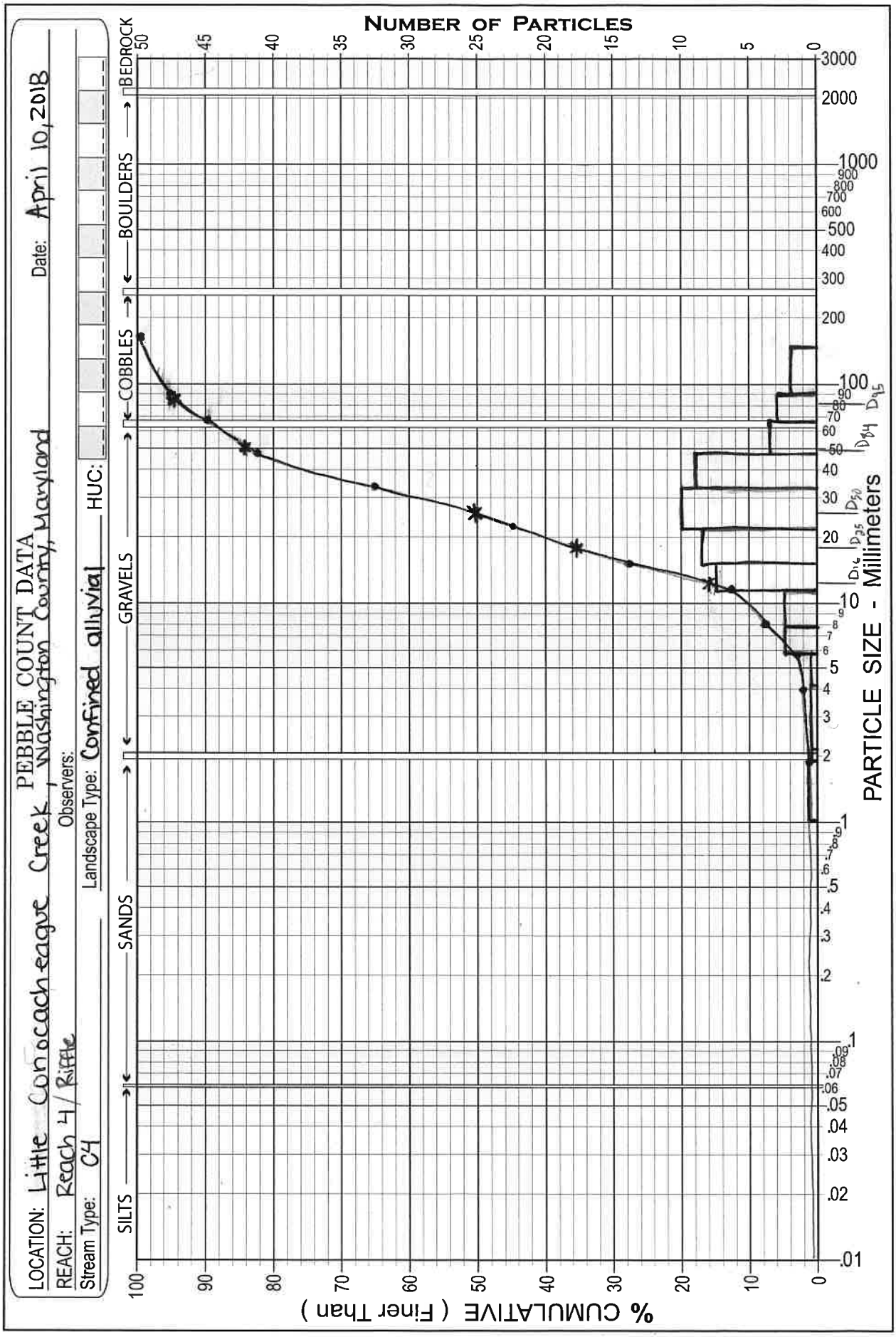

$D_{50} = 25.5$ $D_{16} = 13$

$D_{84} = 50$ $D_{35} = 17.5$

$D_{95} = 89$

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Site: Little Conocacheague Creek, Washington County, Maryland

Location: Reach 4 HUC:

Observers:

				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: 4			Reach:			Reach:		
							Date: 4/10/2018			Date:			Date:		
Inches	PARTICLE	Millimeters													
	Silt / Clay	< .062	S/C			•• •	3						3	3	3
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25				••	2						2	2	5
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2				•	1						1	1	6
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7													
.22 - .31	Fine	5.7 - 8													
.31 - .44	Medium	8 - 11.3				⊓	7						7	7	13
.44 - .63	Medium	11.3 - 16				⁝⁝	4						4	4	17
.63 - .89	Coarse	16 - 22.6				⊓	7						7	7	24
.89 - 1.3	Coarse	22.6 - 32				▮	10						10	10	34
1.3 - 1.8	Very Coarse	32 - 45				⊠⊠ •	21						21	21	55
1.8 - 2.5	Very Coarse	45 - 64				⊠⊠ ⁝⁝	24						24	24	79
2.5 - 3.5	Small	64 - 90	COBBLE			⊠							10	10	89
3.5 - 5.0	Small	90 - 128				⊓	8						8	8	97
5.0 - 7.1	Large	128 - 180													
7.1 - 10.1	Large	180 - 256				••	2						2	2	99
10.1 - 14.3	Small	256 - 362	BOULDER			•	1						1	1	100
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type:			**Landscape Type:** Confined alluvial			TOTAL→							100	100	100

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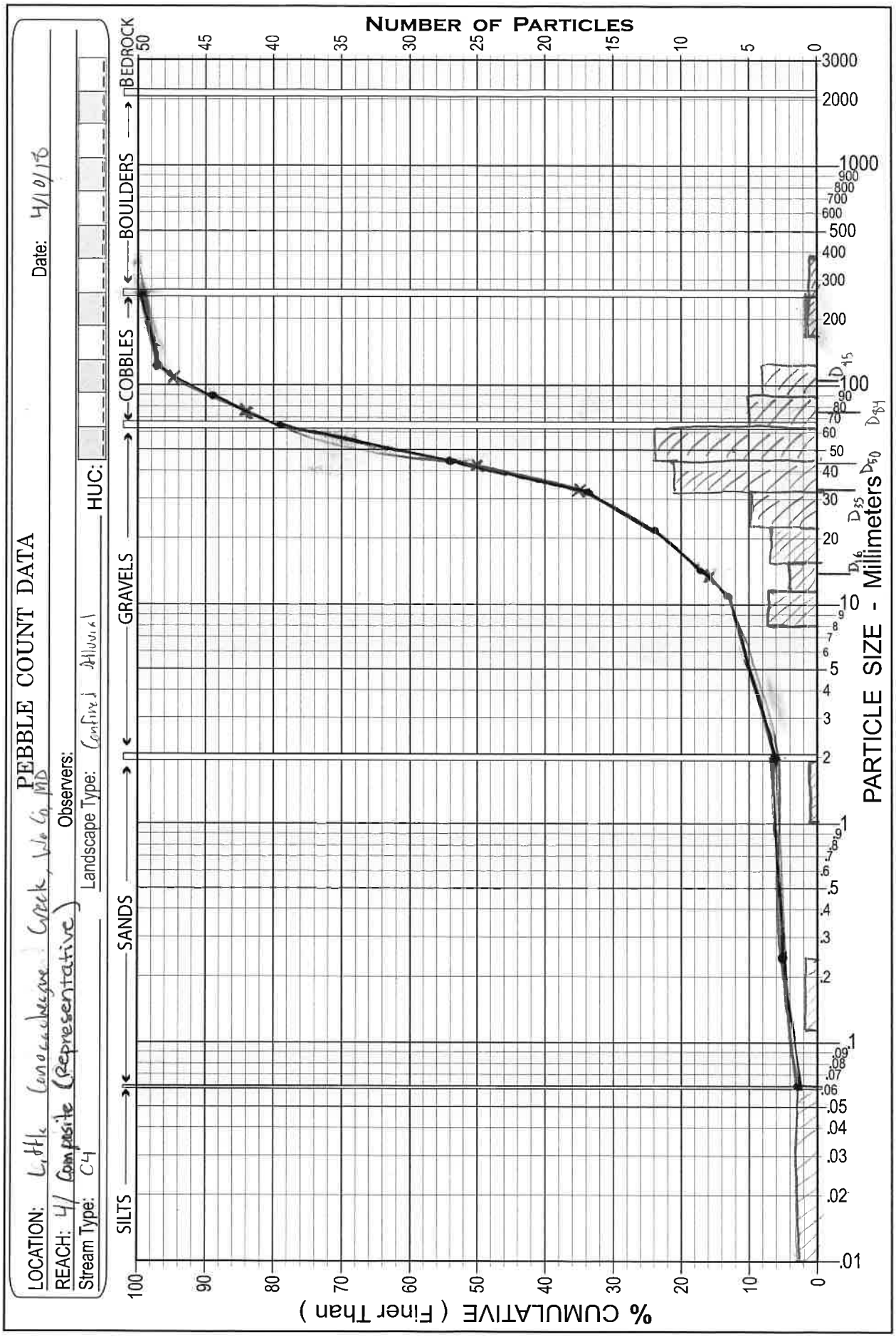

$D_{50} = 44$ $D_{16} = 14$

$D_{84} = 75$ $D_{35} = 33$

$D_{95} = 105$

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

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	LITTLE CONOCACHEAGUE	Location:	REACH 4
Date: 4/10/18	Stream Type: C4	Landscape Type:	GAL-AD
Observers:	TEAM 4	HUC:	-- -- -- -- -- -- -- -- -- -- --

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	40.53	A_{bkf} (ft^2)	Bankfull Riffle Mean Depth	1.35	d_{bkf} (ft)
Bankfull Riffle Width	30.0	W_{bkf} (ft)	Wetted Perimeter $\approx (2 * d_{bkf}) + W_{bkf}$ 2.7	32.7	W_p (ft)
D_{84} Particle Size at Riffle	50	D_{84} (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	.164	D_{84} (ft)
Bankfull Slope	0.0051	S_{bkf} (ft / ft)	Hydraulic Radius A_{bkf} / W_p	1.24	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	7.56	R / D_{84} (ft / ft)
Drainage Area	12	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$ .18	.451	u* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\,2.83 + 5.66 * Log\{R / D_{84}\}\,]\,u^*$	3.52	ft / sec	142.62	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor/Relative Roughness (Figures 27–28) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .033	3.68 3.72	ft / sec	149.14	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Figure 29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .04	3.07	ft / sec	124.44	cfs
2. Roughness Coefficient: c) Manning's n from Jarrett (USGS): $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n = 0.39*S^{0.38}*R^{-0.16}$ Note: This equation is applicable to steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems; i.e., for $n =$ N/A	N/A	ft / sec	N/A	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	N/A	ft / sec	N/A	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	N/A	ft / sec	N/A	cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ Return Period for Bankfull Q: Q = 200 year		ft / sec		cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	4.93	ft / sec	200	cfs

*Regional Curve

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 1. Field Form for Level II Stream Classification.

Stream: LITTLE CONOCACHEAGUE CREEK	
Basin:	Drainage Area: acres 12 mi²
Location: WASHINGTON CTY, MD / REACH 4	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4/10/18
Observers: TEAM 4	Landscape Type: C-A L-A D

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	30	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.35	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	40.53	ft²
Bankfull Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	22.22	ft/ft
Bankfull Maximum Depth (d_{max}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	2.21	ft
Flood-Prone Area Width (W_{fpa}) Width of the channel at an elevation that is twice the *Bankfull Maximum Depth*, measured perpendicular to the fall line of the valley in a riffle section.	84	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	2.8	ft/ft
Channel Materials (Particle Size Index D_{50}) The D_{50} particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface between the bankfull stage and Thalweg elevations.	44.0	mm
Average Water Surface Slope (S) The elevation difference of water surface measurements over the stream length between two similar bed features (e.g., start of riffle to start of last riffle) for several riffle–pool or step–pool sequences, representing channel gradient.	.46% .0046	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).	1.4	ft/ft

Stream Type C4/1 **See Classification Key (Figure 2)**

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Worksheet 3. Summary of Morphological Variables.

Stream: LITTLE CONOCACHEAGUE CRK		**Location:** WASHINGTON CO, MD/REACH 4	
Team: 4	**Date:** 4/10/18	**Drainage Area:** 12 mi²	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	30	2. Bankfull Mean Depth (d_{bkf}) (ft)	1.35
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	22.22	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft²)	40.53
5. Bankfull Maximum Depth (d_{max}) (ft)	2.21	6. Width of Flood-Prone Area (W_{fpa}) (ft)	84
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	2.8		

Channel Pattern / *Pattern Ratios*

8. Belt Width (W_{blt}) (ft)	Mean:	298	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean:	9.9
	Min:	160		Min:	5.3
	Max:	410		Max:	13.6
10. Stream Meander Length (L_m) (ft)	Mean:	635	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean:	21.2
	Min:	540		Min:	18
	Max:	730		Max:	24.3
12. Linear Wavelength (λ) (ft)	Mean:	510	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean:	17
	Min:	490		Min:	16.3
	Max:	530		Max:	17.6
14. Radius of Curvature (R_c) (ft)	Mean:	58.9	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean:	1.96
	Min:	64.2		Min:	2.14
	Max:	69.5		Max:	2.32

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	14	17. D_{35} (mm)	33	18. D_{50} (mm)	44
19. D_{84} (mm)	75	20. D_{95} (mm)	105	21. D_{100} (mm)	362

Active Bed Riffle Pebble Count

22. D_{16} (mm)	13	23. D_{35} (mm)	17.5	24. D_{50} (mm)	25.5
25. D_{84} (mm)	50	26. D_{95} (mm)	88	27. D_{100} (mm)	128

Classification

28. Sinuosity (k)	1.4	29. Average Water Surface Slope (S)	.0046 (.46%)
30. Stream Type	C4/1	31. Landscape Type	C-AL-AD

Velocity & Discharge

32. Friction Factor ($\bar{u}$ / u^*)	7.8	33. Relative Roughness (R / D_{84})	7.56
34. Manning's 'n' from Friction Factor / Relative Roughness	.033	35. Manning's 'n' from Stream Type	.04
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	3.72	37. Estimated Bankfull Discharge (cfs)	149.14
38. Estimation Method Selected for Velocity & Discharge	ROUGHNESS COEFFICIENT/MANNING'S N		

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