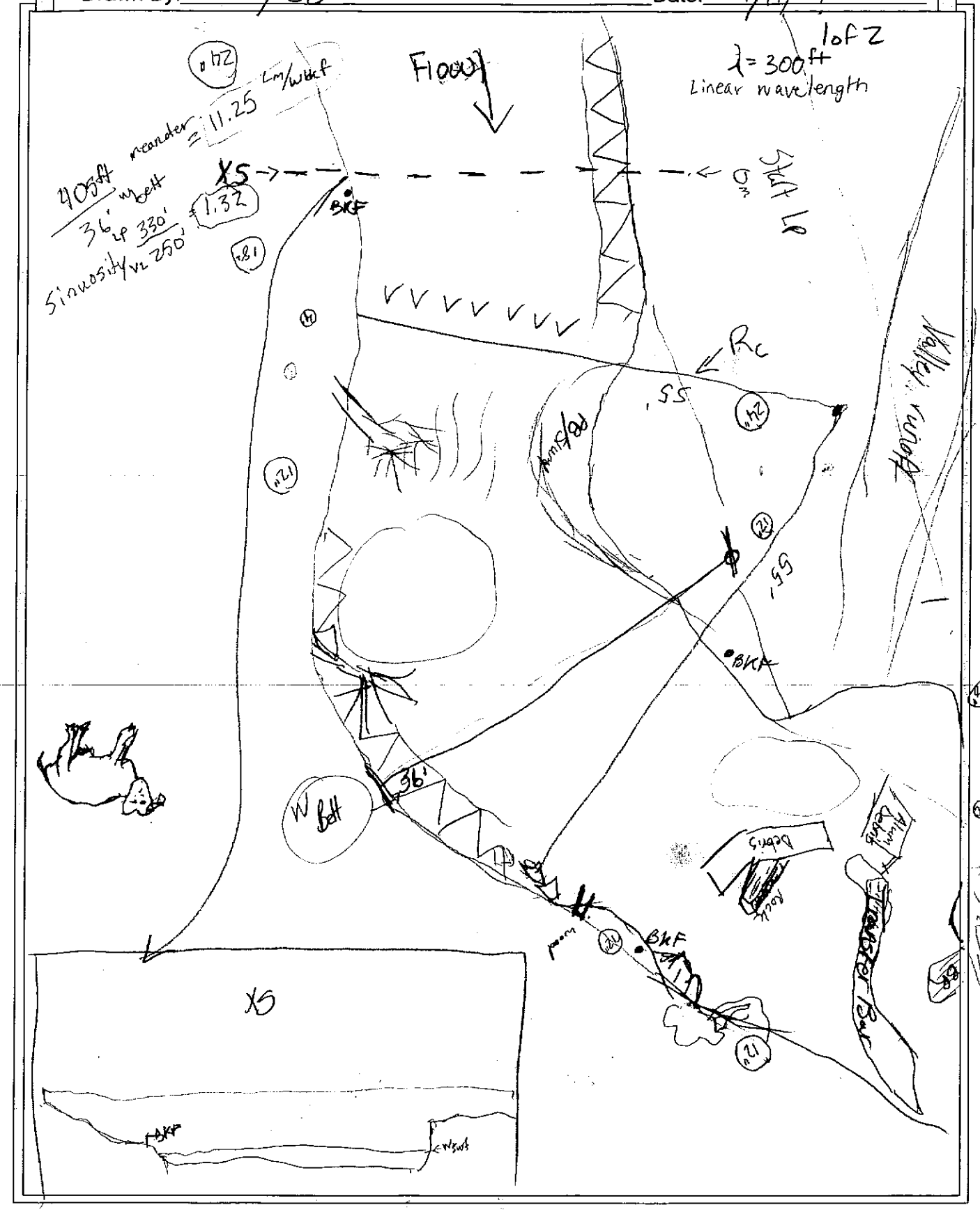
AREA-SITE LOCATION....REACH MAP

Stream/Drainage: Little Conococheague Creek Site/Reach: 3

Drawn By: DS/SD Date: 4/11/17

1 of 2



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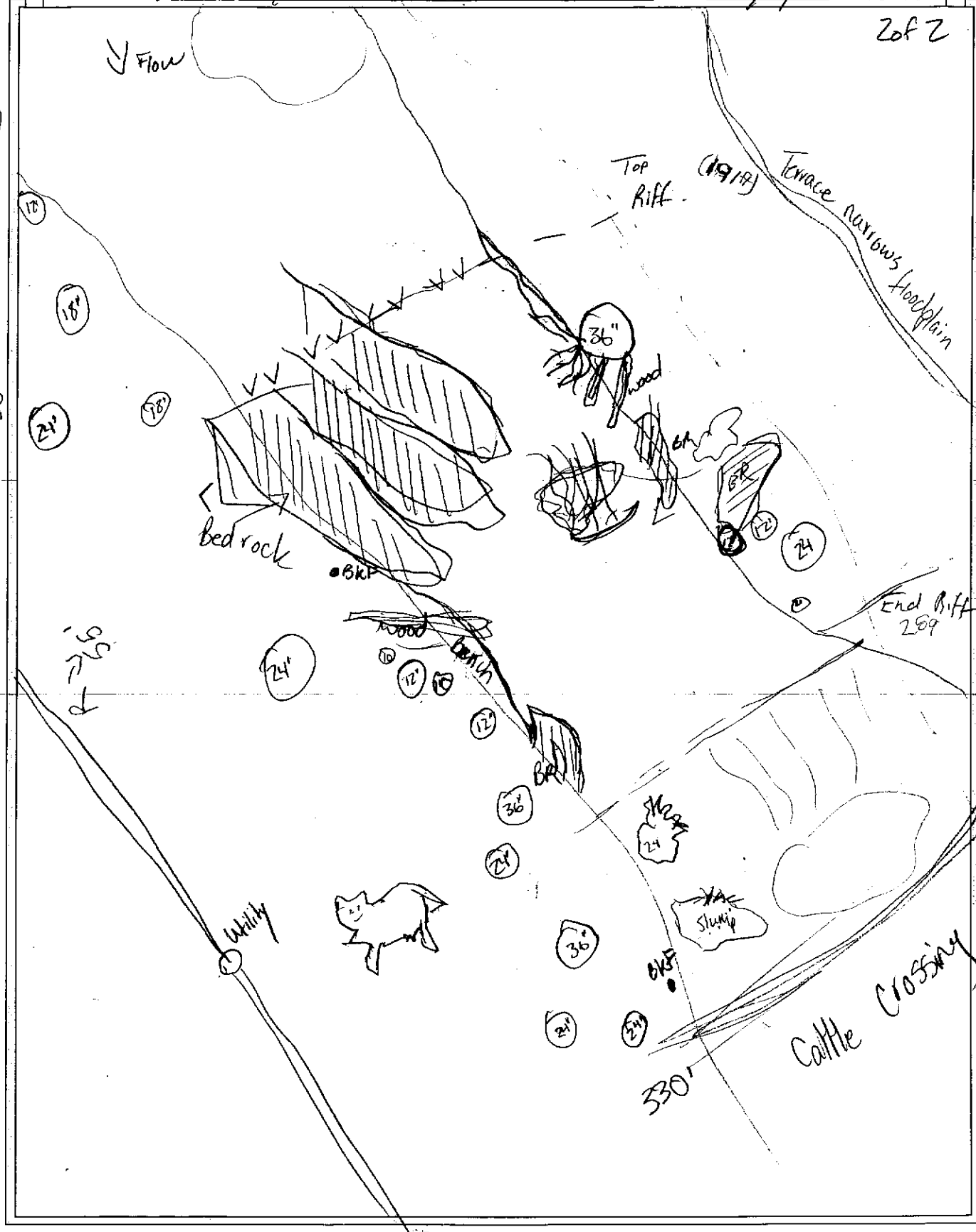
AREA-SITE LOCATION....REACH MAP

Stream/Drainage: Little Conococheague Creek Site/Reach: 3

Drawn By: DS/SD Date: 4/11/14

2 of 2



Sinuosity $\frac{LP - 330}{VL - 250} = 1.32$

Belt width = 36'

Stream meander ratio = $\frac{405ft}{36ft} = 11.25$ = 9.17

SURVEY DATA → **CROSS - SECTION 1**

SITE: Little Conococheague Creek **Date:** 4/11/17

Location: Riffle 1

Observers: TEAM #3 HUC:

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		5.94			105.94	BENCHMARK - ROCK	
2	0			5.22	100.72		
3	4			5.22	100.72		
4	8			5.56	100.38	Left Bank	
5	9.9			7.32	98.62	Left Min	
6	10.75			8.0	97.94	LEW Water	
7	11.55			8.72	97.22	1.9	
8	12.85			8.91	97.03	1 2.09	
9	13.9			8.98	96.96	2.16	
10	16.0			8.92	97.02	2.1	
11	17.85			8.79	97.15	1.97	
12	19.65			8.70	97.24	1.88	
13	21.3			8.48	97.46	1.66	
14	22.45			8.74	97.20	1.92	
15	24.50			8.96	96.98	2.14	
16	27.00			8.95	96.99	2.13	
17	29.25			9.14	96.8	THL 2.32	
18	30.5			9.14	96.8	2.32	
19	32.35			8.94	97.0	2.12	
20	33.6			8.75	97.19	1.93	
21	34.5			8.58	97.36	R-TOC @ Edge	1.76
22	34.7			7.96	97.98	REW Water	
23	34.9			7.74	98.20		30.4 / 15
24	37.1			6.82	99.12	RBKF	
25	39.6			6.58	99.36	Break	
26	42.75			6.03	99.91		
27	47.00			5.14	100.8		2.03
28	51.00			4.73	101.21	End of Tape	

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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	61.			3.98	101.96	(I ELEV 105.94)
30	73			3.40	102.54	Slope Break
31	86			1.48	104.46	
32						
33	-5			4.48	101.01	
34	-7.1			5.88	100.06	Local Depression
35	-15			5.60	100.34	
36	-20			5.72	100.[illegible]	
37	-25			5.9	100.04	
38	-27.5			6.16	99.78	
39	-32.7			6.98	98.96	Side Channel Bottom R
40	-36.2			6.96	98.98	Side channel bottom L
41	-39.2			6.34	99.6	
42	-43.7			4.98	100.96	Break
43	50.			4.20	101.74	
44						
45						
46						
47						
48						
49						
50						
51		6.82			TTL	= 9.24
52		2.42			RBKF	6.82
53		4.40				2.42
54					2x	= 4.84
55		Floodprone				
56						
57						
58						
59						

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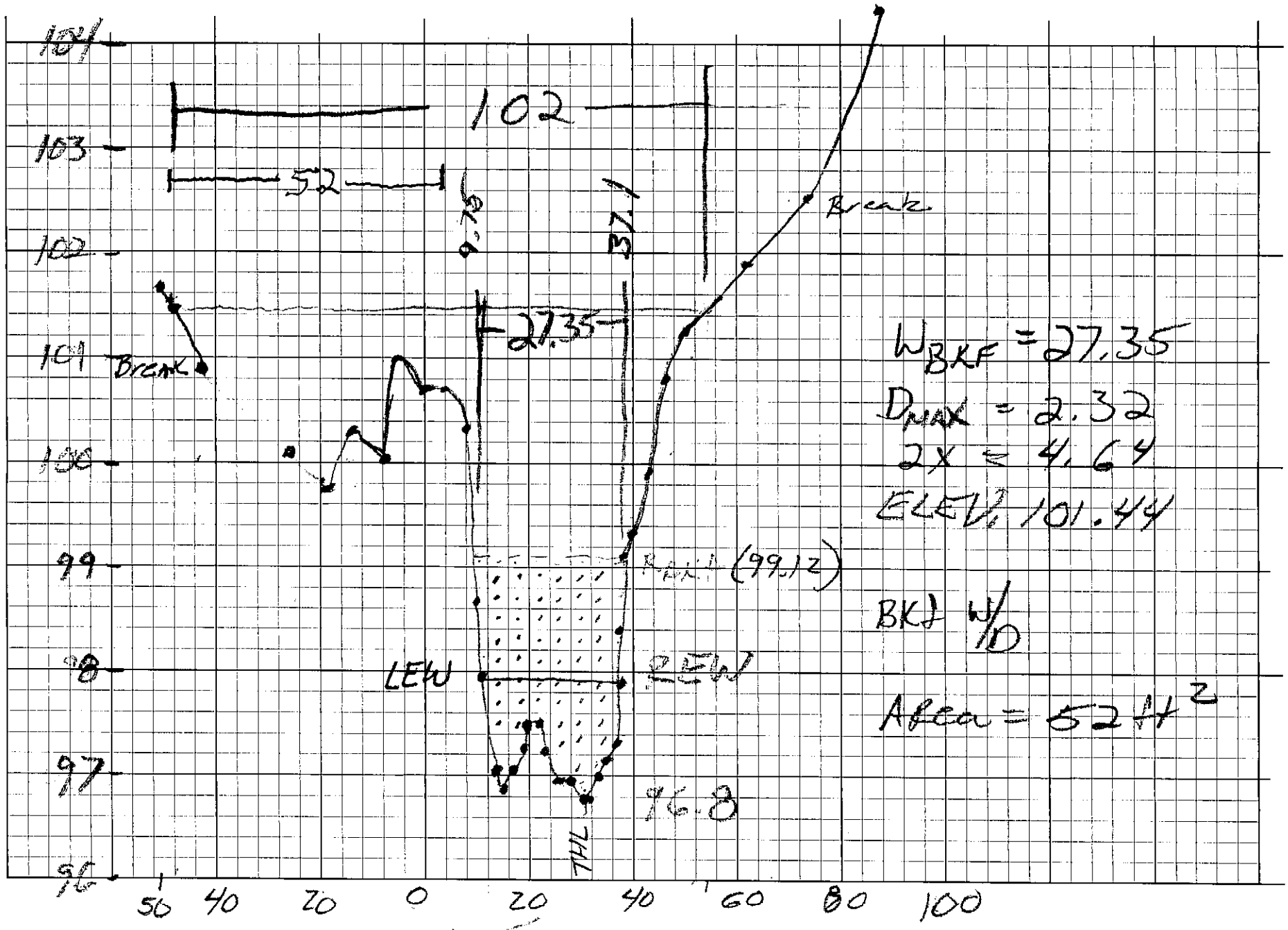
APR 11, 2017
TEAM #3



-48

51 4 3 4 3 65

54 48 102

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SURVEY DATA ⟶ **LONGITUDINAL PROFILE 1**

SITE: CONOCACHEAGUE CK Date: APR 11, 2017

Location: REACH #3

Observers: TEAM #3 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	BM	5.50	ELEV 100.0									
2	XS 1	4.85	ELEV 100.65									XS @ 0.00 L. END
3	XS 2	4.48	ELEV 101.02									XS @ 0.00 R. END
4	0.0			8.86	96.70	7.60	97.90	6.47	99.03			RIFFLE
5	35.0			8.64	96.86	7.79	97.71					
6	78.0			9.68	95.82	8.04	97.46					POOL
7	82.0			9.93	95.57	8.06	97.44	6.97	98.53			
8	109.0			10.83	94.67	8.01	97.49			6.89	98.61	
9	119.3			9.57	95.93	7.96	97.54	7.11	98.39			
10	190.3			8.55	96.95	8.15	97.35					RIFFLE
11	201.5					8.48	97.02	7.13	98.37			~ IFFY BKFL
12	222			9.31	96.19	8.82	96.68					
13	266.2			10.68	94.82	9.24	96.26					~ POOL
14	273			10.62	94.88	9.20	96.30					
15	279			10.47	95.03	9.20	96.30					
16	323.9					9.23	96.27	(D=1.10)	97.27			
17	354			9.60	95.90	9.45	96.05					RIFFLE
18	BM	5.56	99.94									
19												
20												
21												
22												
23												
24												
25												
26												
27												

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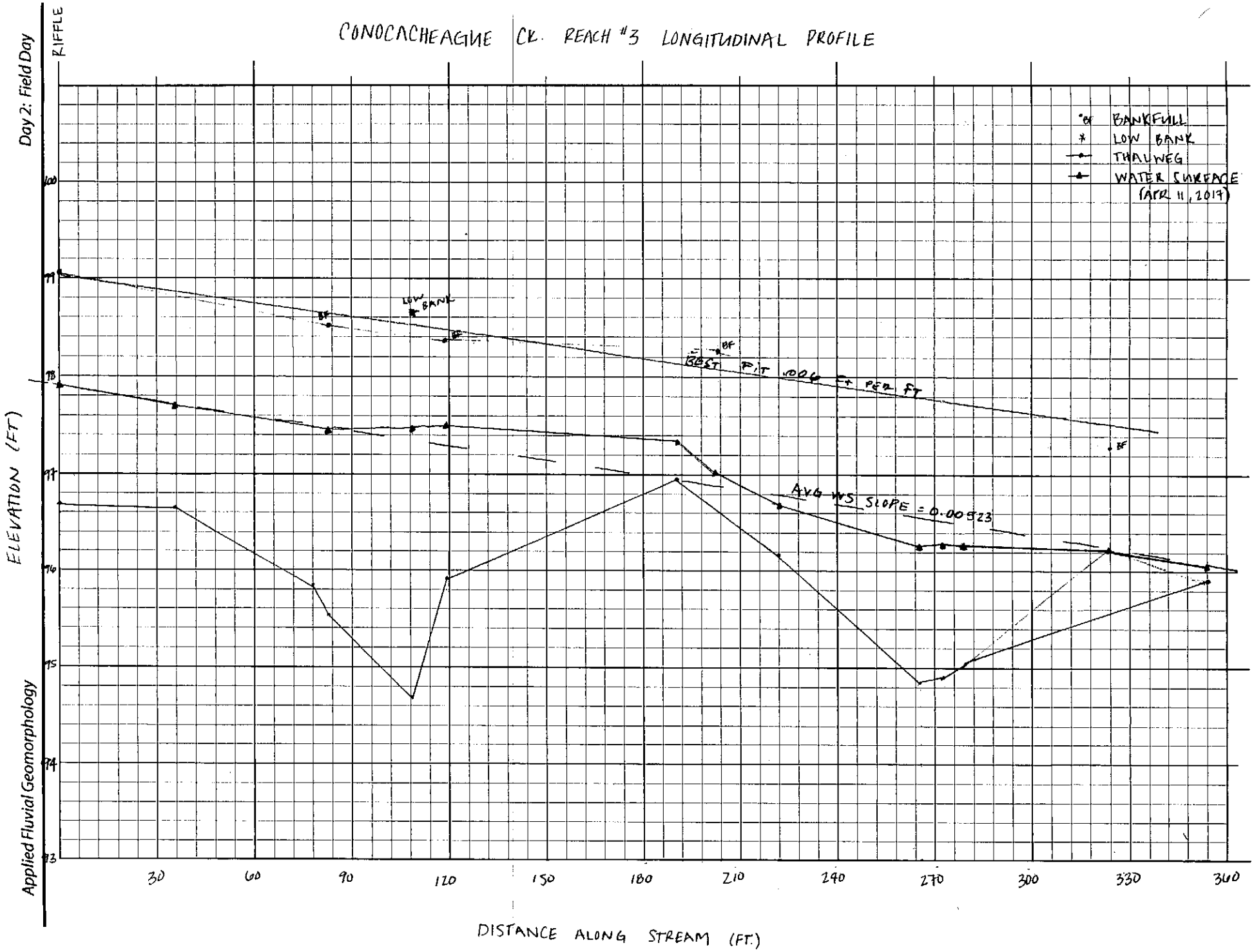
APR 11, 2017
REACH #3

CONOCACHEAGUE CR. REACH #3 LONGITUDINAL PROFILE



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representative

Site: CONOCACHEAGUE CK

Location: REACH #3 HUC:

Observers: TEAM #3

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: #3 Date: APR 11, 2017 TOT #	ITEM %	% CUM	POOL (2) Reach: #3 Date: APR 11, 2017 TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: #3 Date: APR 11, 2017 TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND				0	0	0	1	4	4	1	1	1
	Fine	.125 - .25					5	6.7	6.7	0	0	4	5	5	6
	Medium	.25 - .50					0	0	6.7	0	0	4	0	0	6
	Coarse	.50 - 1.0					0	0	6.7	6	24	28	6	6	12
.04 - .08	Very Coarse	1.0 - 2					3	4	10.7	0	0	28	3	3	15
.08 - .16	Very Fine	2 - 4	GRAVEL				0	0	10.7	0	0	28	0	0	15
.16 - .22	Fine	4 - 5.7					0	0	10.7	1	4	32	1	1	16
.22 - .31	Fine	5.7 - 8					3	4	14.7			32	3	3	19
.31 - .44	Medium	8 - 11.3					1	1.3	16			32	1	1	20
.44 - .63	Medium	11.3 - 16					0	0	16	2	8	40	2	2	22
.63 - .89	Coarse	16 - 22.6					6	8	24	5	20	60	11	11	33
.89 - 1.3	Coarse	22.6 - 32					4	5.3	29.3	3	12	72	7	7	40
1.3 - 1.8	Very Coarse	32 - 45					3	4	33.3	3	12	84	6	6	46
1.8 - 2.5	Very Coarse	45 - 64					8	10.7	44	2	8	92	10	10	56
2.5 - 3.5	Small	64 - 90	COBBLE				4	5.3	49.3				4	4	60
3.5 - 5.0	Small	90 - 128					0	0	49.3	1	4	96	1	1	61
5.0 - 7.1	Large	128 - 180					0	0	49.3				0	0	61
7.1 - 10.1	Large	180 - 256					1	1.3	50.6				1	1	62
10.1 - 14.3	Small	256 - 362	BOULDER				0	0	50.6						
14.3 - 20	Small	362 - 512					0	0	50.6						
20 - 40	Medium	512 - 1024					0	0	50.6						
40 - 80	Large-Vry Large	1024 - 2048					0	0	50.6						
	Bedrock		BDRK				37	49.3	100	1	4	100	38	38	100
Stream Type: C4 - 1			**Landscape Type:** C-AL-AD			TOTAL→	75			25					

reach 2

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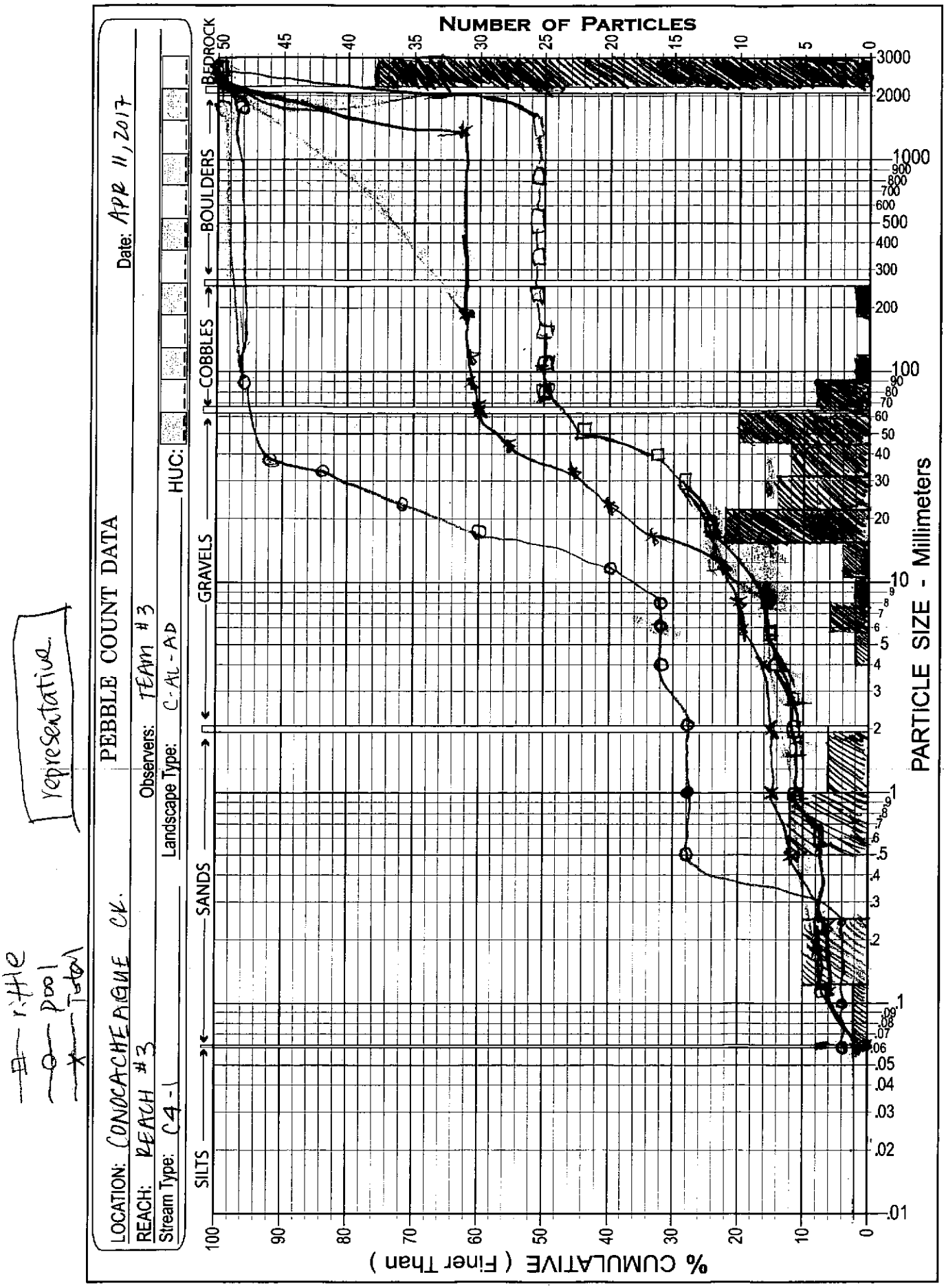

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Active Riffle

Site: Bank Full 1 (Farm Creek) CONOCACHEAGUE CK

Location: REACH #3 HUC:

TEAM #3

Observers: Yinting, Bobby, Matt

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:			Reach:		
							Date: 4/11/17			Date:			Date:		
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND				1	1	1						
	Fine	.125 - .25					0	0	1						
	Medium	.25 - .50					0	0	1						
	Coarse	.50 - 1.0					2	2	3						
.04 - .08	Very Coarse	1.0 - 2							3						
.08 - .16	Very Fine	2 - 4	GRAVEL						3						
.16 - .22	Fine	4 - 5.7							3						
.22 - .31	Fine	5.7 - 8					1	1	4						
.31 - .44	Medium	8 - 11.3					4	4	8						
.44 - .63	Medium	11.3 - 16					8	8	16						
.63 - .89	Coarse	16 - 22.6					11	11	27						
.89 - 1.3	Coarse	22.6 - 32					13	13	40						
1.3 - 1.8	Very Coarse	32 - 45					16	16	56						
1.8 - 2.5	Very Coarse	45 - 64					21	21	77						
2.5 - 3.5	Small	64 - 90	COBBLE				6	6	83						
3.5 - 5.0	Small	90 - 128					6	6	89						
5.0 - 7.1	Large	128 - 180					4	4	93						
7.1 - 10.1	Large	180 - 256					3	3	96						
10.1 - 14.3	Small	256 - 362	BOULDER				1	1	97						
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK				3	3	100						
Stream Type:	C4 - 1		**Landscape Type:**	CAL - AD		TOTAL→	100								

1* Bedrock exteed 62mm above the bed
2 35mm
110mm

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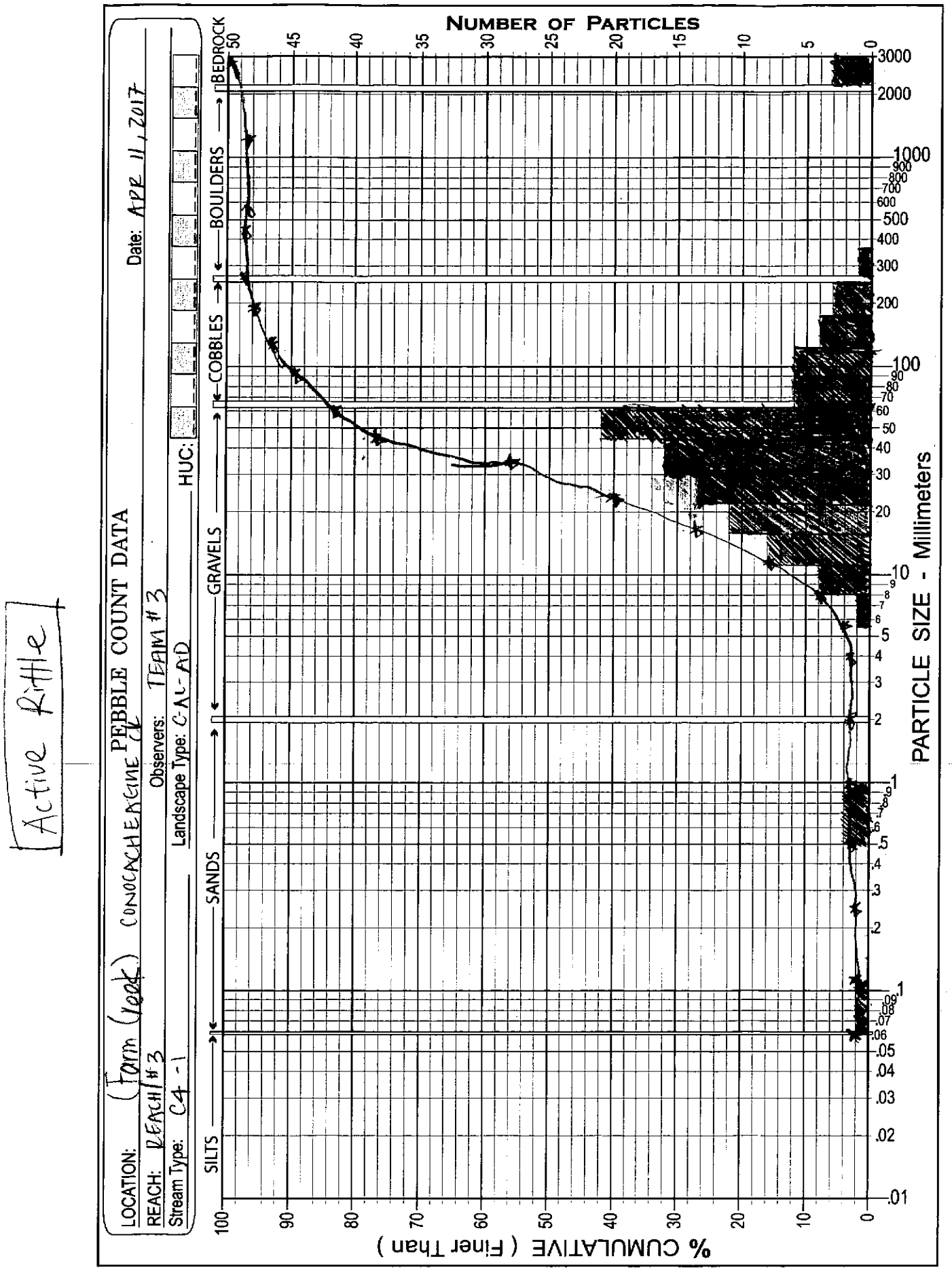

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Table A-1. List of morphological relations and variables to estimate.

Estimate the Following Morphological Relations and Variables			
1. Bankfull Riffle Width (W_{bkf}) (ft)	30	2. Bankfull Riffle Mean Depth (d_{bkf})	1.5
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	20	4. Bankfull Riffle Cross-Sectional Area (A_{bkf})	45
5. Width of Flood-Prone Area (W_{fpa})	100	6. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	3.3
7. Sinuosity (k)	1.2	8. Average Water Surface Slope (S)	0.005
9. D_{50} Particle Size for Reach	60 mm	10. Bankfull Discharge (Q_{bkf})	2200
11. Landscape Type	C-AL-AD	12. Stream Type	C4-1

Level II Stream Classification

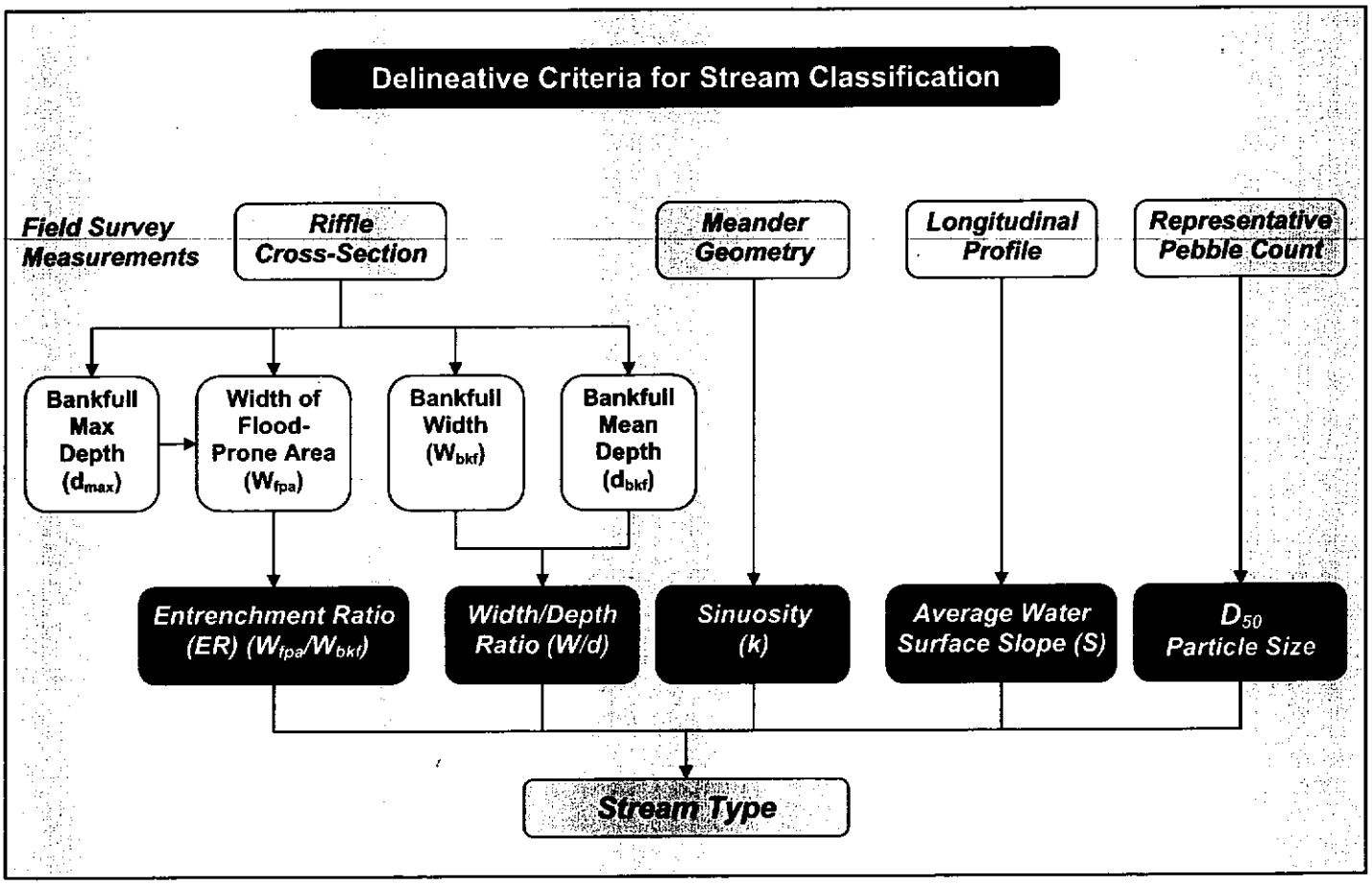

Figure A-1. Field survey methods to obtain delineative criteria for stream classification.

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Worksheet A-1. Field Form for Level II Stream Classification.

Stream: CONOCACHEAGUE CK.			
Basin:	Drainage Area:	~~acres~~ 12	mi^2
Location: BEACH #3			
Twp.&Rge:	Sec.&Qtr.:		
Cross-Section Monuments (Lat./Long.):		Date: APR 11, 2017	
Observers: TEAM #3		Landscape Type: C-AL-AD	

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	27.35	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	2.03	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	52	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	13.5	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.	2.32	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.	102	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	3.73	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.	31.	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.	0.00523	ft/ft
Channel Sinuosity (k) An index of channel pattern determined from stream length divided by valley length (SL / VL), or from valley slope divided by average water surface slope (S_{val} / S).	1.32	ft/ft

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

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

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	CONOCACHEAGUE CK	Location:	BEACH #3
Date:	APR 11, 2017 — Stream Type: C4-1	Landscape Type:	C-AL-AD
Observers:	TEAM #3	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	52	A_{bkf} (ft^2)	Bankfull Riffle Mean Depth	2.03	d_{bkf} (ft)
Bankfull Riffle Width	27.35	W_{bkf} (ft)	Wetted Perimeter $\approx (2 * d_{bkf}) + W_{bkf}$	31.41	W_p (ft)
D_{84} Particle Size at Riffle	55	D_{84} (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	0.18	D_{84} (ft)
Bankfull Slope	0.006	S_{bkf} (ft / ft)	Hydraulic Radius A_{bkf} / W_p	1.65	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	9.20	R / D_{84} (ft / ft)
Drainage Area	12	DA (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	0.56	u* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\,2.83 + 5.66 * Log\{R / D_{84}\}\,]\,u^*$	4.64	ft / sec	241	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor/Relative Roughness (Figs. A-27, A-28) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.035	4.60	ft / sec	239	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. A-29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.031	5.20	ft / sec	270	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 $n =$ 0.052	3.10	ft / sec	161	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	—	ft / sec	—	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	—	ft / sec	—	cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ Return Period for Bankfull Q: Q = — year	—	ft / sec	—	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$ A = 50 Q = 70	4.23	ft / sec	220	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 A-3. Summary of Morphological Variables.

Stream: CONOCACHEAGUE CK.		**Location:** REACH #3	
Team: 3	**Date:** APR 11, 2017	**Drainage Area:** 12 mi2	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	27.35	2. Bankfull Mean Depth (d_{bkf}) (ft)	2.03
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	13.5	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	52
5. Bankfull Maximum Depth (d_{max}) (ft)	2.32	6. Width of Flood-Prone Area (W_{fpa}) (ft)	102
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	3.73		

Channel Pattern / Dimensionless Ratios

8. Belt Width (W_{blt}) (ft)	Mean	36	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	1.31
	Min	36		Min	1.31
	Max	36		Max	1.31
10. Stream Meander Length (L_m) (ft)	Mean	405	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	14.80
	Min	405		Min	14.80
	Max	405		Max	14.80
12. Linear Wavelength (λ) (ft)	Mean	300	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	10.96
	Min	300		Min	10.96
	Max	300		Max	10.96
14. Radius of Curvature (R_c) (ft)	Mean	55	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	2.01
	Min	55		Min	2.01
	Max	55		Max	2.01

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	0.35	17. D_{35} (mm)	20	18. D_{50} (mm)	35
19. D_{84} (mm)	1500	20. D_{95} (mm)	1500	21. D_{100} (mm)	2750

Active Bed Riffle Pebble Count

22. D_{16} (mm)	12	23. D_{35} (mm)	20	24. D_{50} (mm)	29
25. D_{84} (mm)	55	26. D_{95} (mm)	180	27. D_{100} (mm)	2700

Classification

28. Sinuosity (k)	1.32	29. Average Water Surface Slope (S)	0.00523
30. Stream Type	C4-1	31. Landscape Type	C-AL-AD

Velocity & Discharge

32. Friction Factor ($\bar{u}$ / u^*)	8.3	33. Relative Roughness (R / D_{84})	9.20
34. Manning's 'n' from Friction Factor / Relative Roughness	0.035	35. Manning's 'n' from Stream Type	0.031
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	4.6	37. Estimated Bankfull Discharge (cfs)	239
38. Estimation Method Selected for Velocity & Discharge	Manning's w/ n from Fig A-27, A-28 (friction factor / relative roughness)		

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