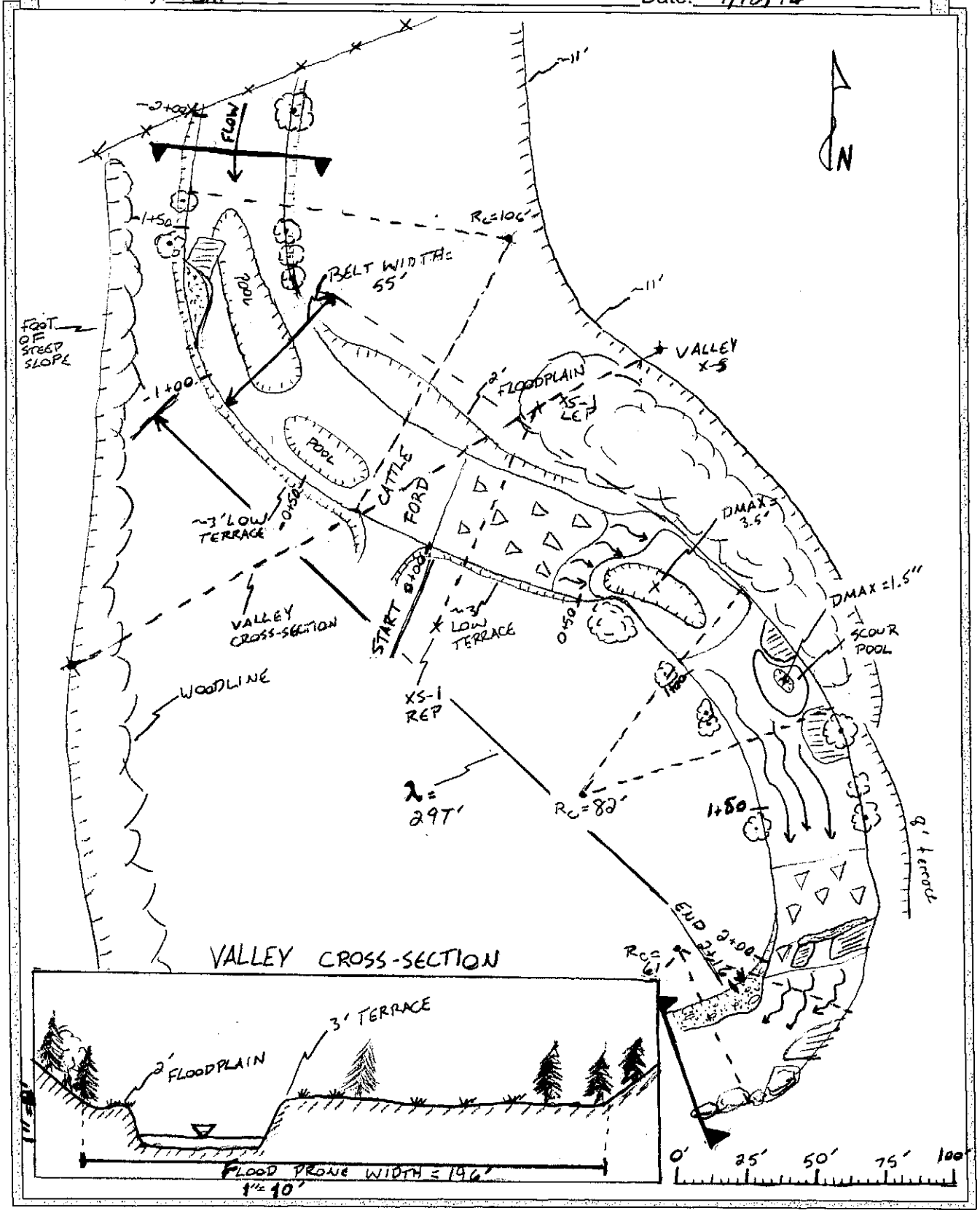
AREA-SITE LOCATION...REACH MAP

Stream/Drainage: LITTLE CONOCACHEAGUE Site/Reach: R-1

Drawn By: TEAM 1 Date: 4/12/16



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Applied Fluvial Geomorphology
Day 2: Field Day

14.8 -> 41.0
p1 of 2

SURVEY DATA ⟹ **CROSS - SECTION 1**

SITE: Little Conococheague Creek Date: 4/12/16

Location:

Party / Notes: TA, NB - Team 1 HUC: 02070004

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	BM	5.24	105.24		100.00	
2	0	~~8.89~~		8.89	96.35	
3	3	~~6.29~~		6.29	98.95	
4	5	~~6.57~~		6.57	98.67	
5	9	~~6.00~~		6.00	99.24	
6	13	~~5.71~~		5.71	99.53	
7	14.8	~~5.94~~		5.94	99.3	LBKFL
8	16.5	~~6.40~~		6.40	98.84	LTB .46
9	17.3	~~7.92~~		7.92	97.32	LEW 1.98
10	~~18~~ 17.3	~~8.03~~		8.03	97.21	LCH 2.1
11	20.0	~~8.07~~		8.07	97.17	2.13
12	22.2			8.21	97.03	2.27
13	24.0			8.24	97.00	2.3
14	26.8			8.23	97.01	~~R 3 = DMAX / THL~~ 2.29
15	29.5			8.19	97.05	2.25
16	32.0			8.28	96.96	THL / Dmax = 2.34
17	34.2			8.27	96.97	2.33
18	36.0			8.04	97.2	RCH 2.1
19	36.0			7.89	97.35	REW 1.95
20	37.0			7.74	97.5	1.8
21	38.0			7.06	98.18	1.12
22	39.0			6.83	98.41	0.89
23	40.0			6.47	98.77	0.53
24	41.0			6.01	99.23	RBKF 26.2 WBF
25	43.0			5.23	100.01	RTB
26	65.0			5.31	99.93	
27				3.6	101.64	200.0 FP width
28		5.24				

— BKF

— BKF

5.94
-2.34
3.60

* SHOULD BE DMAX?

- Floodprone elev. should have been measured @ 4.60 ? (not [illegible])

~~REDO~~

5.9

196

Mean BKF Depth = 1.8

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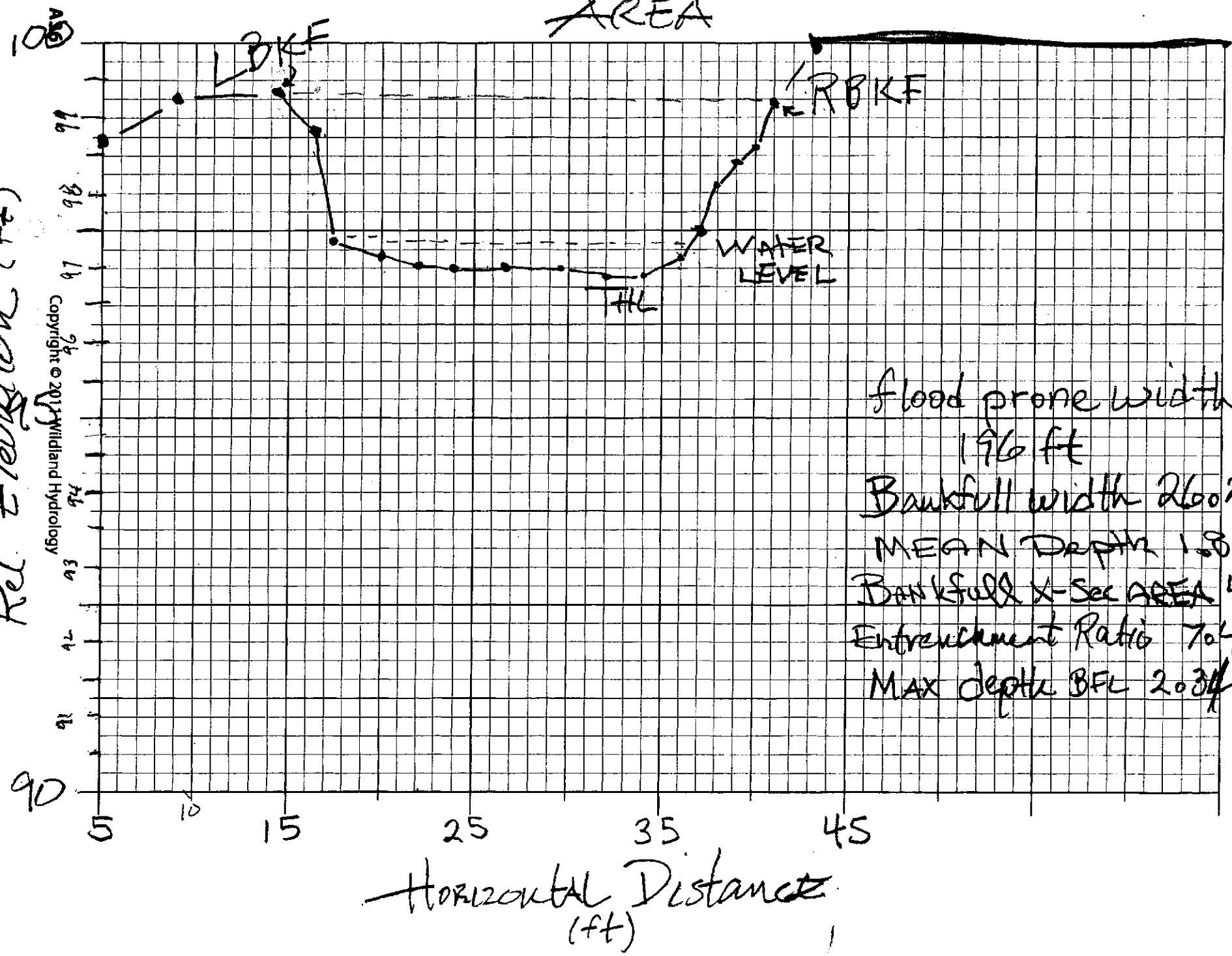
Channel Cross Sectional - Station 15 AREA



flood prone width 196 ft
Bankfull width 26.02 ft
MEAN Depth 1.8 ft
Bankfull X-Sec AREA 47.16 ft
Entrenchment Ratio 7.48 ft/ft
MAX depth BFL 2.34 ft

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SURVEY DATA ⟶ LONGITUDINAL PROFILE 1

SITE: Little Conococheague Creek Date: 04/12/2013

Location: 39.62498°, -77.905495

Party / Notes: Team 1 HUC: 02070004

189.5 / 26.2

	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~~	~~4.05~~	~~104.5~~								~~100~~	
2	~~0~~			~~6.80~~		~~6.45~~		~~4.53~~				
3												
4	BM1	4.30	104.3								100	
5	0			6.96	97.34	6.73	97.57	4.76?	99.54		—	Riffle
6	15			7.35	96.95	6.95	97.35	5.02*	99.28	4.30	100.0	X-sec st^n
7	31.5			7.54	96.76	7.12	97.18	5.22	99.08	4.16	100.14	
8	48			7.77	96.53	7.36	96.94	6.22?	98.08	4.25	100.05	
9	54			8.05	96.25	7.51	96.79	5.62?	98.68	4.48	99.82	Run
10	66			10.93	93.37	~~7.55~~	—	—	—	4.57	99.73	MAX pool depth
11	71			10.74	93.56	~~7.45~~	—	5.64	98.66	4.46	99.84	
12	77			10.69	93.61	7.51	96.79		-	4.39	99.91	
13	84			9.41	94.89	~~7.68~~ 7.53	96.77		-	4.74	99.56	
14	93			8.54	95.76	7.54	96.76		-	4.75	99.55	Glide starts
15	99			8.19	96.11	7.54	96.76		-	4.65	99.65	Run starts
16	115			8.96	95.34	7.59	96.71		-	5.07	99.23	
17	125			8.40	95.90	7.55	96.75		-	—	—	
18	131			8.71	95.59	7.58	96.72	5.53*	98.77	4.66	99.64	
19	140			9.03	95.27	7.56	96.74	5.55	98.75			
20	160			8.38	95.92	7.58	96.72	-	-			
21	168			8.01	96.29	7.60	96.7	5.58*	98.80			Riffle
22	178			8.26	96.04	—	—	5.70	98.6			
23	182.5			8.43	95.87	7.62	96.68	5.79*	98.51			
24	~~192~~ 192			8.97	95.33	~~7.98~~	—	—	-			Turbulent / log
25	197			9.51	94.79	8.41	95.89	6.77	97.53	5.55	98.75	Run
26	202			9.76	94.54	8.38	95.92	-	-			
27	206			9.23	95.07	8.40	95.90	6.51*	97.79	5.57	98.73	

Check WS → 13

Bedrock Constriction → 24

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* = flagged BK Full

SURVEY DATA ⟶ **LONGITUDINAL PROFILE 2**

SITE: Little Conococheague Creek Date: 4-12

Location:

Party / Notes: HUC:

	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instru-ment 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	216			9.59	94.71	8.46	95.84	—	—	5.89	98.41	
29	BM1	4.28										
30												
31												
32												
33												
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												

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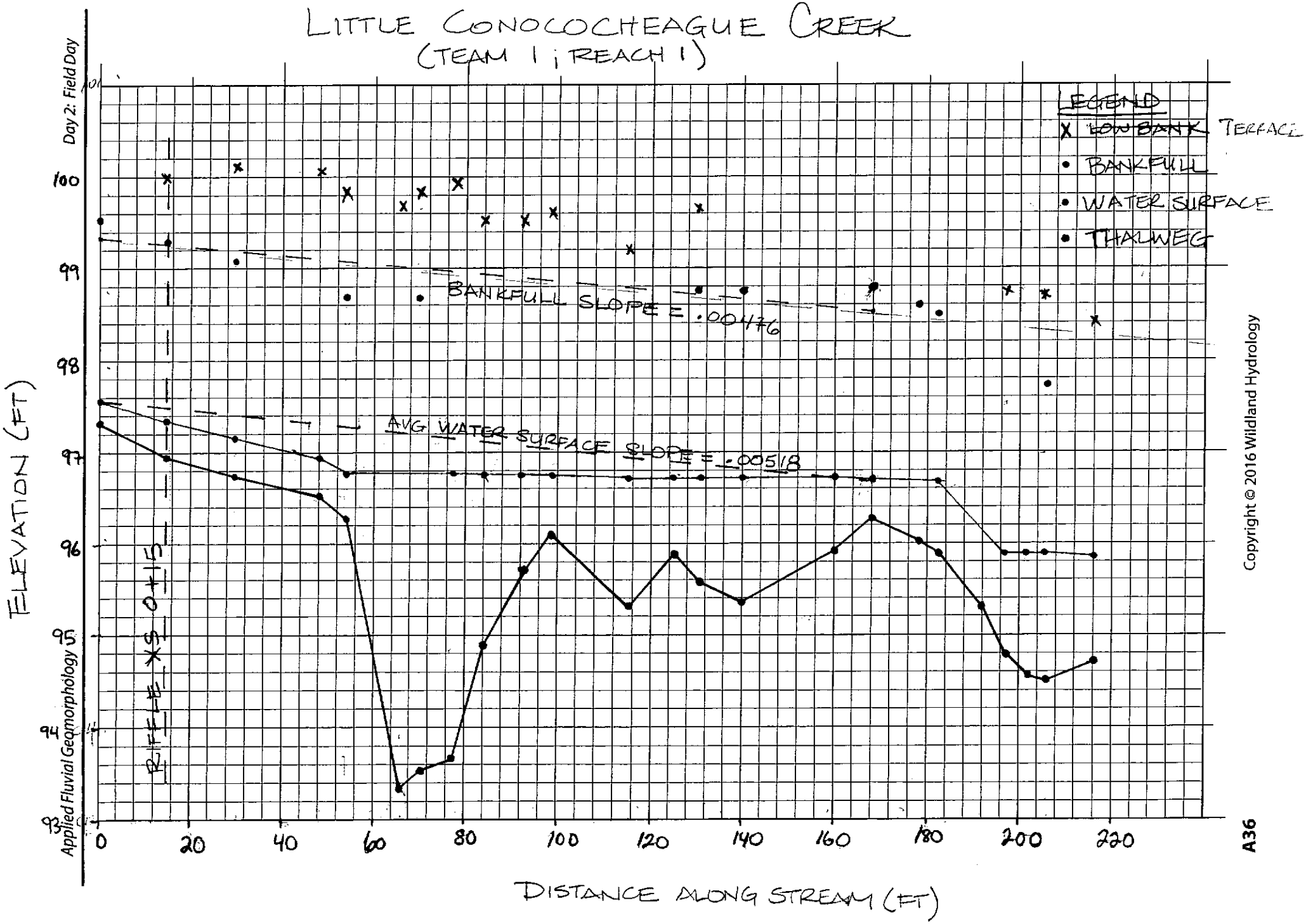
LONGITUDINAL PROFILE

LITTLE CONOCOCHEAGUE CREEK
(TEAM 1; REACH 1)



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Char:

Site: Little Conococheague Creek Date: 4-12-16

Location: Representative HUC: 02070004

Party: Team 1

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: 1			Reach: 1			Reach: 1		
							Date: 4-12-16			Date: 4-12-16			Date: 4-12-16		
	Silt / Clay	< .062	S/C				2	6.6	6.6	8	11.4	11.4	10	10	10
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7					2	6.6	13.2	5	7.1	18.5	7	7	17
.22 - .31	Fine	5.7 - 8					1	3.3	16.5	3	4.3	22.8	4	4	21
.31 - .44	Medium	8 - 11.3					1	3.3	19.9	6	8.6	31.4	7	7	28
.44 - .63	Medium	11.3 - 16					7	23.3	43.1	5	7.1	38.5	12	12	40
.63 - .89	Coarse	16 - 22.6					3	10	53.1	6	8.6	47.1	9	9	49
.89 - 1.3	Coarse	22.6 - 32					1	3.3	56.4	6	8.6	55.7	7	7	56
1.3 - 1.8	Very Coarse	32 - 45					6	20	76.4	2	2.9	58.6	8	8	64
1.8 - 2.5	Very Coarse	45 - 64					3	10	86.4	10	14.3	72.9	13	13	77
2.5 - 3.5	Small	64 - 90	COBBLE				1	3.3	89.7	12	17.1	90.0	13	13	90
3.5 - 5.0	Small	90 - 128					1	3.3	93.0	3	4.3	94.3	4	4	94
5.0 - 7.1	Large	128 - 180													
7.1 - 10.1	Large	180 - 256					1	3.3	96.3				1	1	95
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					1	3.3	99.6				1	1	96
	Bedrock		BDRK							4	5.7	100	4	4	100
						TOTAL→	30			70					

Stream Type: C 4/1/16 **Valley Type:** Confined alluvial

Silty veneer

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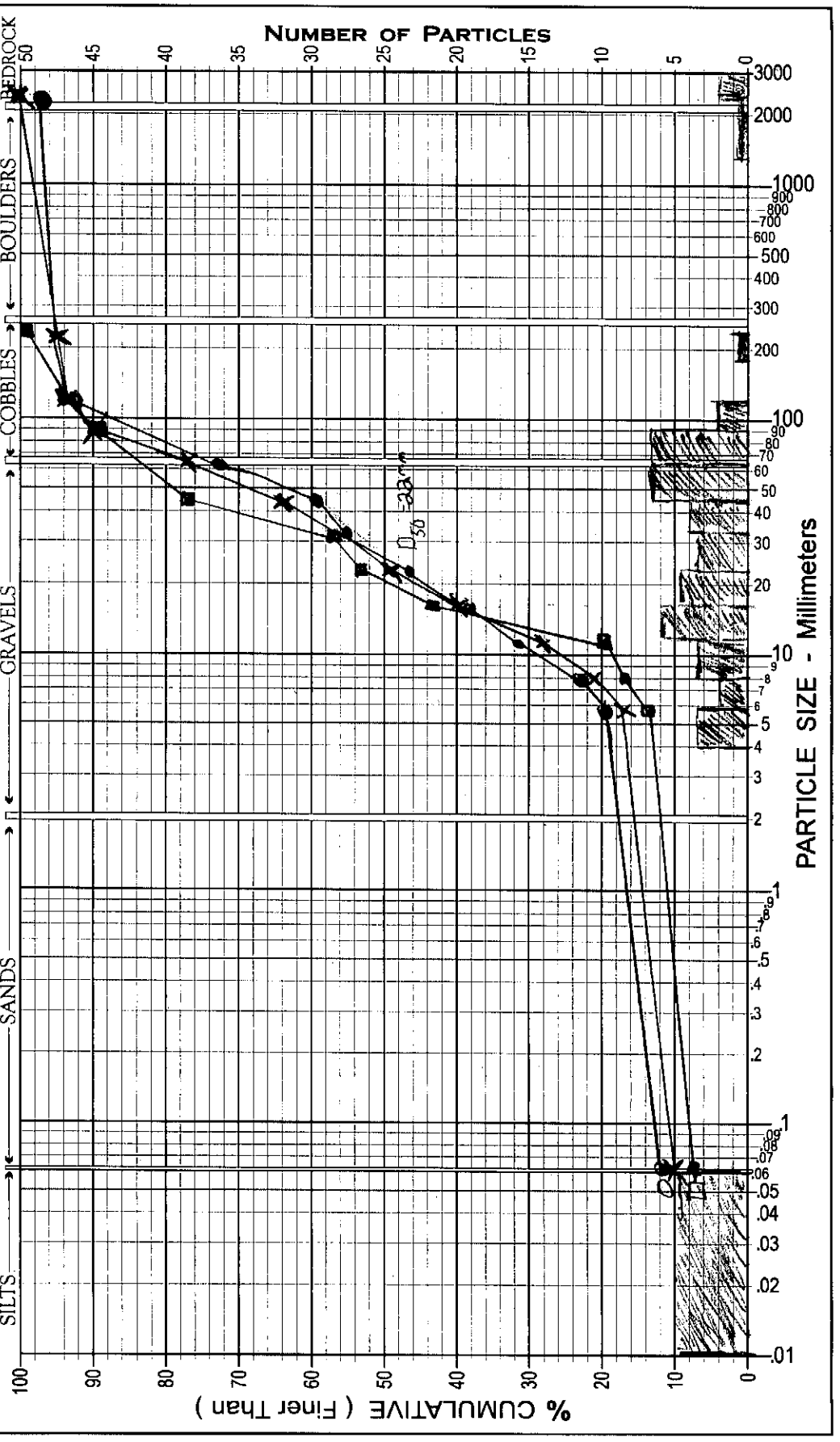
Representative

LOCATION: Little Conococheague Creek PEBBLE COUNT DATA Date: 4-12-16

REACH: 1 PARTY: TEAM 1

Stream Type: C-4/1/6 Valley Type: Confined alluvial HUC: 0 2 0 7 0 0 0 4



X - TOTAL
O - POOL
□ - RIFFLE

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Velocity

Site: Little Conococheague Creek Date: 4-12-16

Location: Active Riffle HUC: 0 2 0 7 0 0 0 4

Party: 1 Team 1

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: 1 Date: 4-12-16 TOT #	ITEM %	% CUM	POOL (2) Reach: Date: TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: Date: TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND				1	1	1						
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7					4	4	5						
.22 - .31	Fine	5.7 - 8					8	8	13						
.31 - .44	Medium	8 - 11.3					6	6	19						
.44 - .63	Medium	11.3 - 16					8	8	27						
.63 - .89	Coarse	16 - 22.6					14	14	41						
.89 - 1.3	Coarse	22.6 - 32					16	16	57						
1.3 - 1.8	Very Coarse	32 - 45					18	18	75						
1.8 - 2.5	Very Coarse	45 - 64					13	13	88						
2.5 - 3.5	Small	64 - 90	COBBLE				11	11	99						
3.5 - 5.0	Small	90 - 128					1	1	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												
Stream Type: C 4/1/6			**Valley Type:** Confined alluvial			TOTAL→	100								

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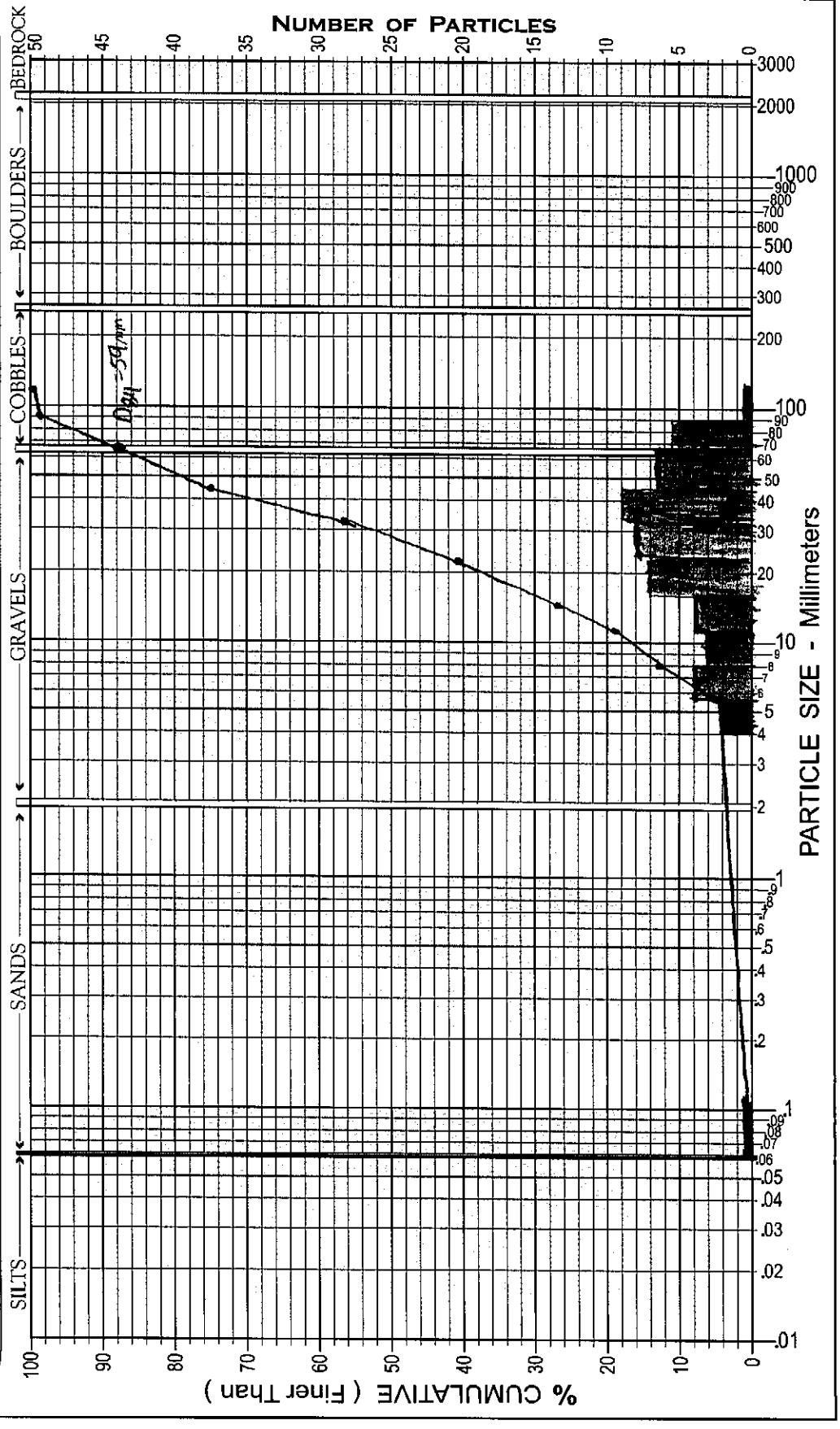
Active Bed RWP

LOCATION: Little Conococheague Creek PEBBLE COUNT DATA Date: 4-12-16

REACH: 1 PARTY: Team 1

Stream Type: C-4/1/b Valley Type: Confined alluvial HUC: 02070004



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

Stream: Little Conococheague Creek	
Basin: Conococheague - Opequon Drainage Area: 7,680 acres	12 mi²
Location: Washington Co, Maryland	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4-12-2016
Observers: Team 1	Landscape Type: Confined alluvial

Bankfull Width (W_{bkf}) The surface width of the stream at bankfull stage elevation, in a riffle section.	26.2	ft
Bankfull Mean Depth (d_{bkf}) Mean depth of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.8	ft
Bankfull Cross-Sectional Area (A_{bkf}) Area of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	47.2	ft²
Width/Depth Ratio (W_{bkf} / d_{bkf}) *Bankfull Width* divided by *Bankfull Mean Depth*, in a riffle section.	14.6	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.	2.34	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.	196	ft
Entrenchment Ratio (ER) The *Flood-Prone Area Width* divided by *Bankfull Width* (W_{fpa} / W_{bkf}), in a riffle section.	7.5	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.	22	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.	0.005	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).	1.2	ft/ft

Stream Type C4/1/6 **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:	Little Conococheague Creek	Location:	
Date:	4-12-2016	Stream Type:	C4/1/6
Landscape Type:	Confined alluvial		
Observers:	Team 1	HUC:	0 2 0 7 0 0 0 4 -- -- --

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional Area	47.16	A_{bkf} (ft^2)	Bankfull Riffle Mean Depth	1.8	d_{bkf} (ft)
Bankfull Riffle Width	26.2	W_{bkf} (ft)	Wetted Perimeter $\approx (2 * d_{bkf}) + W_{bkf}$	29.8	W_p (ft)
D_{84} Particle Size at Riffle	59	D_{84} (mm)	D_{84} Particle Size in Feet D_{84} (mm) / 304.8	0.19	D_{84} (ft)
Bankfull Slope	0.005	S_{bkf} (ft / ft)	Hydraulic Radius A_{bkf} / W_p	1.58	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	8.3	R / D_{84} (ft / ft)
Drainage Area	12	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.5	u^* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [2.83 + 5.66 * Log\{R/D_{84}\}] u^*$	4.0	ft / sec	188.6	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor/Relative Roughness (Figs. A-28, A-29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.031	4.6	ft / sec	217	cfs
2. Roughness Coefficient: b) Manning's n from Stream Type (Fig. A-30) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.031	4.6	ft / sec	217	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	ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	N/A	ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	N/A	ft / sec		cfs
4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ Return Period for Bankfull Q Q = — year	N/A	ft / sec		cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	4	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 A-3. Summary of Morphological Variables.

Stream: Little Conocacheague Creek		**Location:** Washington Co, Maryland	
Team: Team 1	**Date:** 4-12-2016	**Drainage Area:** 12 mi²	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	26.2	2. Bankfull Mean Depth (d_{bkf}) (ft)	1.8
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	14.56	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	47.2
5. Bankfull Maximum Depth (d_{max}) (ft)	2.34	6. Width of Flood-Prone Area (W_{fpa}) (ft)	196
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	7.48		

Channel Pattern UM: Upper Meander LM: Lower — Dimensionless Ratios

8. Belt Width (W_{blt}) (ft)	Mean	53.5	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	2.04
	Min	52 (LM)		Min	1.98 (UM)
	Max	55 (UM)		Max	2.09 (LM)
10. Stream Meander Length (L_m) (ft)	Mean	159.5	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	6.1
	Min	122 (UM)		Min	4.65 (UM)
	Max	197 (LM)		Max	7.51 (LM)
12. Linear Wavelength (λ) (ft)	Mean	297	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	11.33 (expected ≈ 4.5-5)
	Min	–		Min	–
	Max	–		Max	–
14. Radius of Curvature (R_c) (ft)	LM Mean	82	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	3.1
	(add.) Min	61		Min	2.3
	UM Max	106		Max	4.04

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	3	17. D_{35} (mm)	14	18. D_{50} (mm)	22
19. D_{84} (mm)	80	20. D_{95} (mm)	260	21. D_{100} (mm)	2,100

Active Bed Riffle Pebble Count

22. D_{16} (mm)	10	23. D_{35} (mm)	18	24. D_{50} (mm)	29
25. D_{84} (mm)	59	26. D_{95} (mm)	80	27. D_{100} (mm)	115

Classification

28. Sinuosity (k)	1.2	29. Average Water Surface Slope (S)	0.005
30. Stream Type	C4/1/6	31. Landscape Type	confined alluvial

Velocity & Discharge

32. Friction Factor (ū / u*)	8	33. Relative Roughness (R / D_{84})	8
34. Manning's 'n' from Friction Factor / Relative Roughness	0.031	35. Manning's 'n' from Stream Type	0.031
36. Estimated Bankfull Mean Velocity ($ū_{bkf}$) (ft/sec)	4	37. Estimated Bankfull Discharge (cfs)	189
38. Estimation Method Selected for Velocity & Discharge	method 1 - Friction factor/relative roughness		

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~~AREA SITE LOCATION....REACH MAP~~

Stream/Drainage: Little Conococheague ~~Site/Reach~~: Team 1

Drawn By: Date: 4/13/16

Dave's "Peer" Review

Sketch Map -

Excellent map. Add bankfull flow line on Valley X-S

Profile -

Low bank height is only measured if there is not an active floodplain.

Pebble Count -

Write D50 & D84 grain size on graphs

Morphology

Steam meander length (L_m) and Linear wavelength need to be measured over same stream lengths. $L_m > \lambda$

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