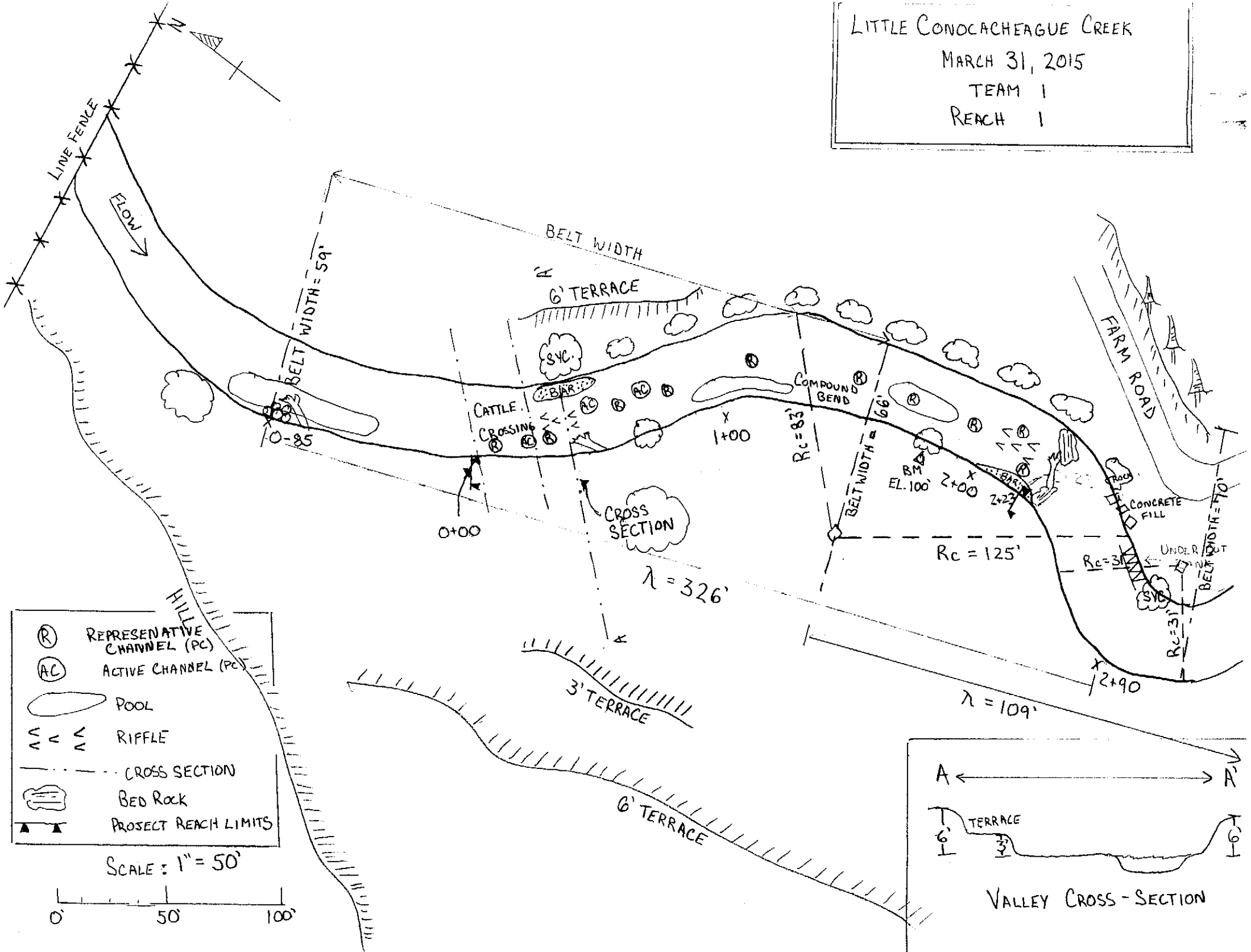
LITTLE CONOCACHEAGUE CREEK
MARCH 31, 2015
TEAM 1
REACH 1



Cross-Sections

Cross-section Overview.....A15

Cross-section Instructions..... A19

Cross-section Forms..... A22

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SURVEY DATA ⟹ CROSS - SECTION 1

SITE: Washington County, Maryland: Little Conococheague cr. **Date:** 03-31-2015

Location: Reach 1, Cross Section 1, Riffle

Party / Notes: Team 1 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	BM	5.36	105.36	-	100	Benchmark
2	0	-	-	5.34	100.02	(L) Top of bank
3	2	-	-	5.47	99.89	(L) Bank
4	3.65	-	-	5.73	99.63	Bank Full
5	4.6	-	-	5.94	99.42	(L) Bank (almost to top)
6	5.1	-	-	6.33	99.03	Edge of L. Bank
7	5.4	-	-	7.41	97.95	(L) Wetted Surface Elev.
8	5.5	-	-	7.80	97.56	Channel Shot
9	7.0	-	-	8.01	97.36	Thalweg
10	8.0	-	-	7.95	97.41	Channel Shot
11	10.0	-	-	7.89	97.47	Channel Shot
12	12.1	-	-	7.93	97.43	Channel Shot
13	14.8	-	-	7.80	97.56	Channel Shot
14	18.2	-	-	7.93	97.43	Channel Shot
15	20.1	-	-	7.65	97.71	Channel Shot
16	21.1	-	-	7.41	97.95	(R) Wetted Surface Elev.
17	21.4	-	-	7.39	97.97	Bottom (R) bank
18	22.7	-	-	7.23	98.13	(R) bank
19	23.9	-	-	7.15	98.21	(R) bank
20	24.8	-	-	6.58	98.78	(R) bank
21	25.7	-	-	5.86	99.50	(R) bottom of debris line
22	26.4	-	-	5.09	100.27	(R) bank
23	27.0	-	-	4.86	100.50	(R) bank
24	28.0	-	-	4.69	100.67	(R.) Top of bank
25						
26						
27						
28						

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SURVEY DATA ⟹ **CROSS - SECTION** 1

SITE: Date:

Location: 2 [illegible] upstream [illegible]

Party / Notes: HUC:

1.8-1.9

ΔBF+ WSE=1.68

2x maxBF 5.06

Floodprone width = 127ft

BF w=22ft

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	BM	5.36	105.36		100	Benchmark
2	0	~~5.34~~	~~[illegible]~~	5.34	100.02	Top of bank ~~LOST~~ LTOB — Maybe too ↑
3	2			5.47	99.89	LB
4	3.65			5.73	99.63	BF
5	4.6			5.94	99.42	LBank almost to top
6	5.1			6.33	99.03	Edge of LBank
7	5.4			7.41	97.95	LEW (L) WSE
8	5.5			7.80	97.56	~~Ground~~ Channel Shot
9	7.0			8.01	97.36	Thalweg
10	8.0			7.95	97.41	~~Ground~~ Channel Shot
11	10.0			7.89	97.47	channel "
12	12.1			7.93	97.43	channel
13	14.3			7.80	97.56	"
14	18.2			7.93	97.43	"
15	20.1			7.65	97.71	"
16	21.1			7.41	97.95	WSE (R)
17	21.4			7.99	97.97	Bottom RBank
18	22.7			7.23	98.13	RBank
19	23.9			7.15	98.21	" "
20	24.8			6.58	98.78	" "
21	25.7			5.86	99.5	Bottom of debris line
22	26.4			5.09	100.27	RBank
23	27.0			4.86	100.5	" "
24	28.0			4.69	100.67	TRBank
25						
26						
27						
28						

→ 7.41 99.63
5.73 97.95
1.68

7.80
5.73
5.94

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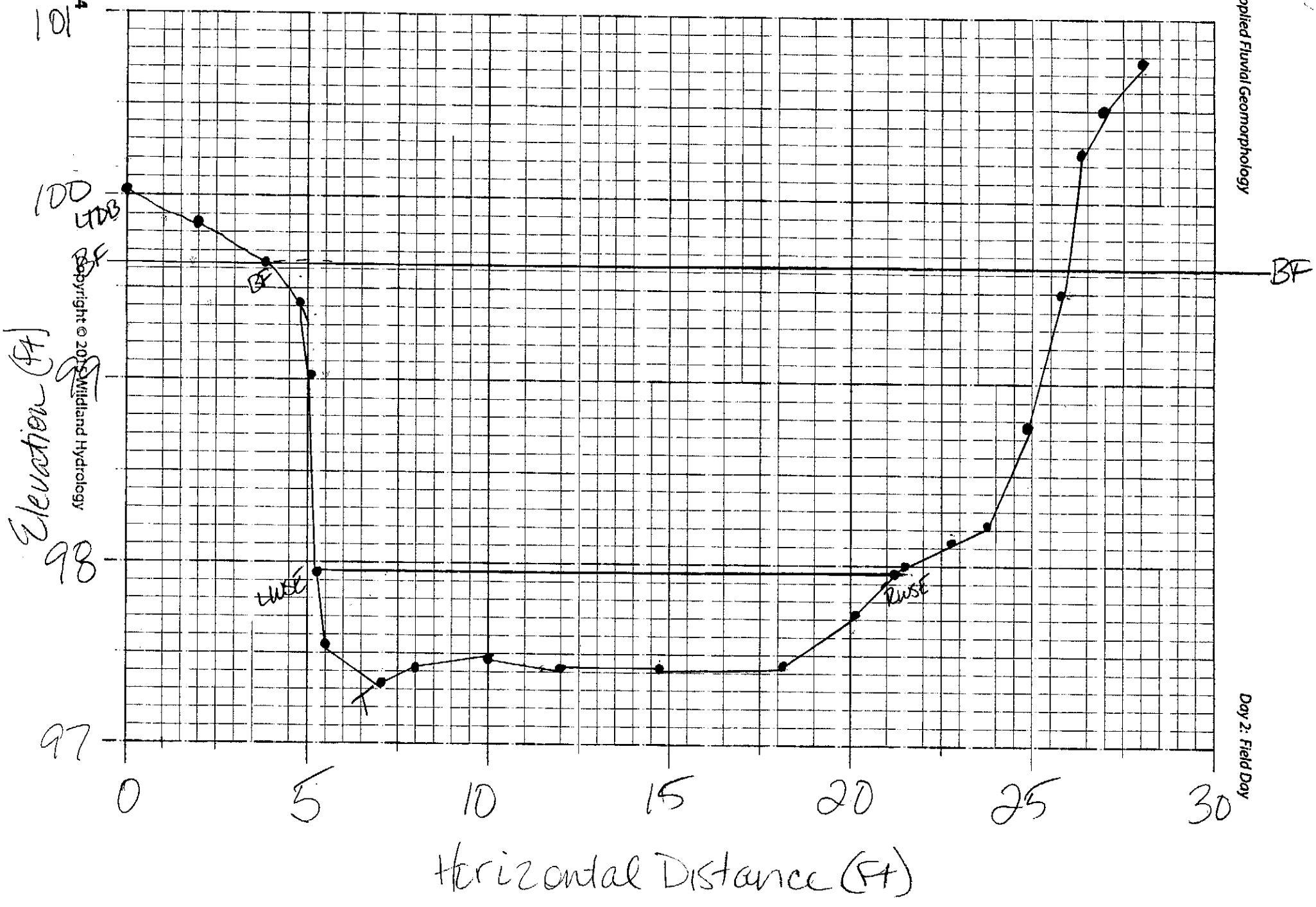
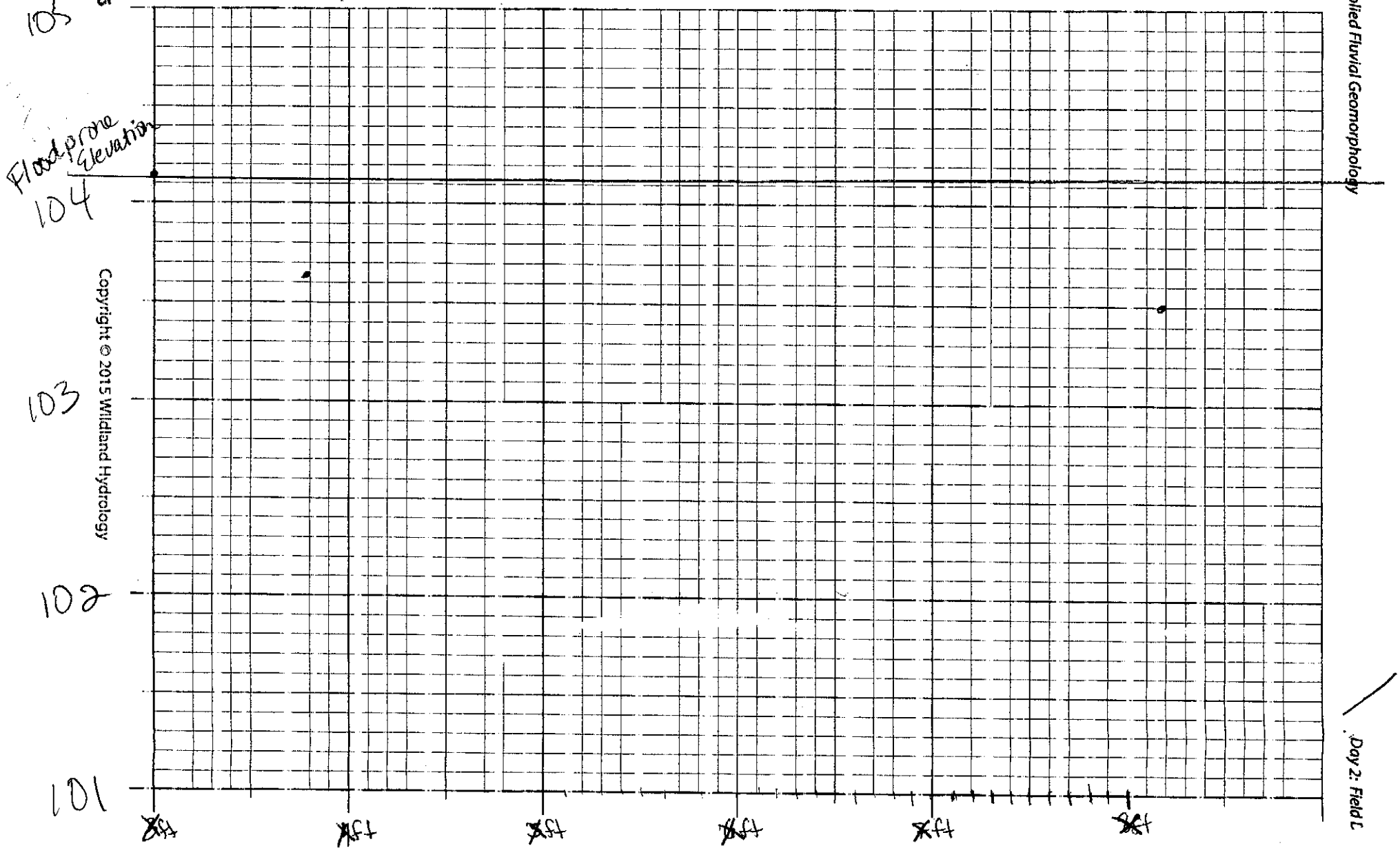
Little Conococheague Team 1 Reach 1

March 31, 2015



W_{BF} = 22 ft D_{BF} = 1.67 ft X-Section Area$_{BF}$ = 49.8 ft^2 W/D = 13.17 D_{max} = 2.27 ft

W_{FPA} = 127 ft ER = 5.77



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Longitudinal Profile

Longitudinal Profile Overview.....A27

Longitudinal Profile Instructions..... A28

Plan and Profile Diagram of Longitudinal Profile..... A29

Low Bank Height & Degree of Channel Incision.....A32

Longitudinal Profile Forms..... A34

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SURVEY DATA → **LONGITUDINAL PROFILE 1**

SITE: Little Conococheague Creek Date: 3/31/16

Location: Washington County, Maryland

Party / Notes: Group 1 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		4.97	104.97										
2	25.5			7.14	97.83	6.78	98.19					BR	
3	39.5									4.93	100.94		
4	43.8							5.49	99.48				
5	47.8			7.61	97.36	6.98	97.99	5.19	99.78			MR	> 1.79
6	~~[illegible]~~												
7	79.6			8.18	96.79	7.49	97.48	5.95	99.02			ER	>1.6
8	85			9.21	95.76	7.49	97.48					U	
9	89			10.16	94.81	7.5	97.47	5.78	99.19			P	>1.7
10	94			10.52	94.45	7.5	97.47					P	
11	99			10.93	94.04	7.49	97.48					P	
12	104			10.5	94.47	7.55	97.42	5.84	99.13			G	>1.7
13	114			8.97	96	7.57	97.4					G	
14	121			8.49	96.48	7.58	97.39	*6.16	98.81			G	>1.42
15	137									4.75	100.22		
16	143					7.58	97.39	5.94*	99.03				>1.65
17	176			8.91	96.06	7.57	97.4	5.77	99.2				>1.8
18	192			8.41	96.56	7.57	97.4			5.22	99.75		
19	202			8.38	96.59	7.6	97.37					BR	
20	210			8.57	96.4	7.66	97.31	5.9	99.07			MR	>1.76
21	223			9.18	95.79	7.89	97.08					EB/GC	
22	~~[illegible]~~												
23	51			7.6	97.37	6.95	98.02	5.3	99.67			XS1	>1.65
24	~~[illegible]~~												
25	21			7.18	97.79	6.65	98.32					BR	
26													
27													

Slope = 0.0066

$\frac{1.2}{181} = 0.66\%$

 XS BKF at 3.6

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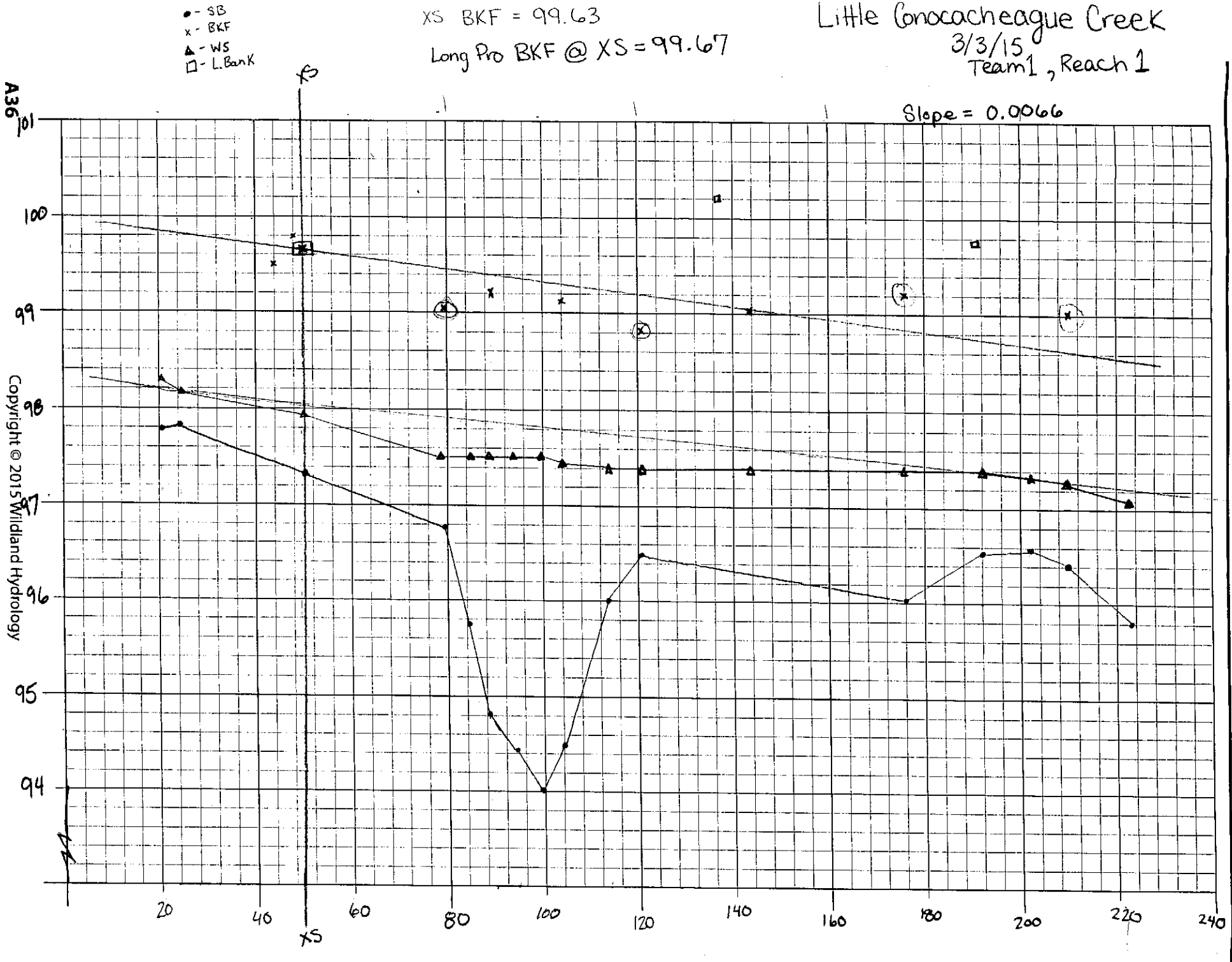
* = QBKF



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Pebble Counts

Pebble Count Overview.....A39

Representative Pebble Count Instructions.....A41

Active Bed Riffle Pebble Count Instructions.....A41

Pebble Count Forms..... A44

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70/30 representative

11' 29' 53' 70' 112' pool 150' pool 162' pool 196' 204' 210'

Site: Little Chapocheague Date: 3/31/15

Location: Reach 1 / Team 1 HUC:

Party:

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
	Silt / Clay	< .062	S/C			3	1	1.4	1.4	2	6.7	6.7	3	3.0	3.0
	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													
.22 - .31	Fine	5.7 - 8				1				1	3.3	10.0	1	1.0	4.0
.31 - .44	Medium	8 - 11.3				2	2	2.9	3.4				2	2.0	6.0
.44 - .63	Medium	11.3 - 16				3	3	4.3	7.7				3	3.0	9.0
.63 - .89	Coarse	16 - 22.6				4	1	1.4	9.1	3	10.0	20.0	4	4.0	13.0
.89 - 1.3	Coarse	22.6 - 32			3	11	8	11.4	20.5	3	10.0	30.0	11	11.0	24.0
1.3 - 1.8	Very Coarse	32 - 45				20	15	21.4	41.9	5	16.7	46.7	20	20.0	44.0
1.8 - 2.5	Very Coarse	45 - 64				23	19	27.1	69.0	4	13.3	60.0	23	23.0	67.0
2.5 - 3.5	Small	64 - 90	COBBLE			17	13	18.6	87.6	4	13.3	73.3	17	17.0	84.0
3.5 - 5.0	Small	90 - 128				10	7	10.0	97.6	3	10.0	83.3	10	10.0	94.0
5.0 - 7.1	Large	128 - 180				1	1	1.4	99.0				1	1.0	95.0
7.1 - 10.1	Large	180 - 256													
10.1 - 14.3	Small	256 - 362	BOULDER			1				1	3.3	86.6	1	1.0	96.0
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK			4				4	13.3	99.9	4	4.0	100.0
Stream Type:			Valley Type:			TOTAL→	70	99.5	99.0	30	99.9	99.9	100	100.0	100.0

70 30 ✓

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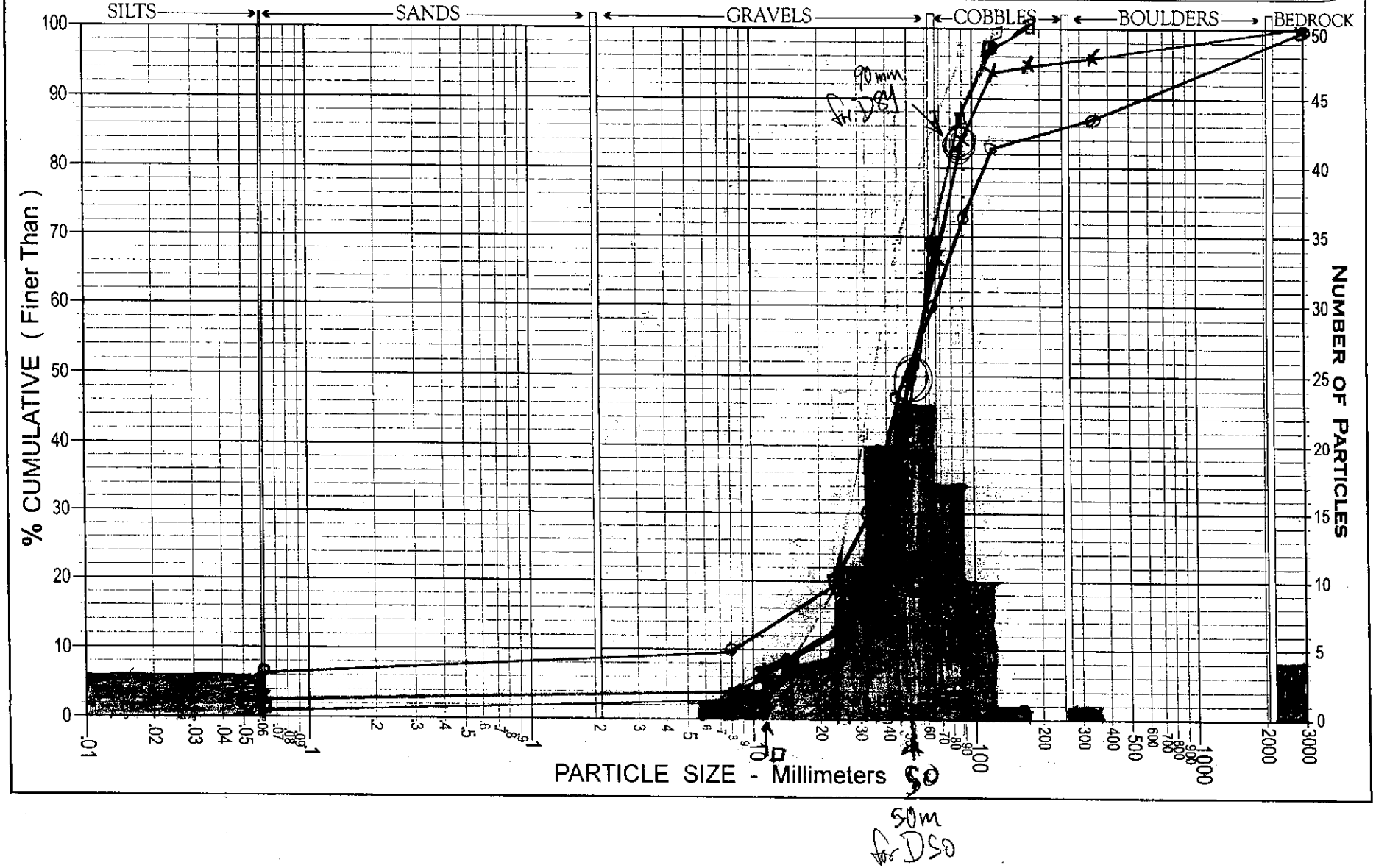
Representative

□ = Riffle
O - Pool
X - Cumulative

PEBBLE COUNT DATA

LOCATION: Little Conococheague Creek
Date: 3/31/15
REACH: 1
PARTY: Team 1
Stream Type:
Valley Type:
HUC:



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Active

23' 51' 67'

Site: Little Cheague Creek Date: 3/31/15

Location: Reach 1/Team 1 HUC:

Party:

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: Date: TOT #	ITEM %	% CUM	POOL (2) Reach: Date: TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: Date: TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C			3	3	3	3				3	3	3
	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				1	1	1	4				1	1	4
.22 - .31	Fine	5.7 - 8				2	2	2	6				2	2	6
.31 - .44	Medium	8 - 11.3				4	4	4	10				4	4	10
.44 - .63	Medium	11.3 - 16				8	8	8	18				8	8	18
.63 - .89	Coarse	16 - 22.6				10	10	10	28				10	10	28
.89 - 1.3	Coarse	22.6 - 32				13	13	13	41				13	13	41
1.3 - 1.8	Very Coarse	32 - 45				18	18	18	59				18	18	59
1.8 - 2.5	Very Coarse	45 - 64				20	20	20	79				20	20	79
2.5 - 3.5	Small	64 - 90	COBBLE			15	15	15	94				15	15	94
3.5 - 5.0	Small	90 - 128				5	5	5	99				5	5	99
5.0 - 7.1	Large	128 - 180				1	1	1	100				1	1	100
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								

Stream Type: **Valley Type:**

25 40 50 51

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Active Riffle

LOCATION: Little Conococheague Creek

PEBBLE COUNT DATA

Date: 3/31/15

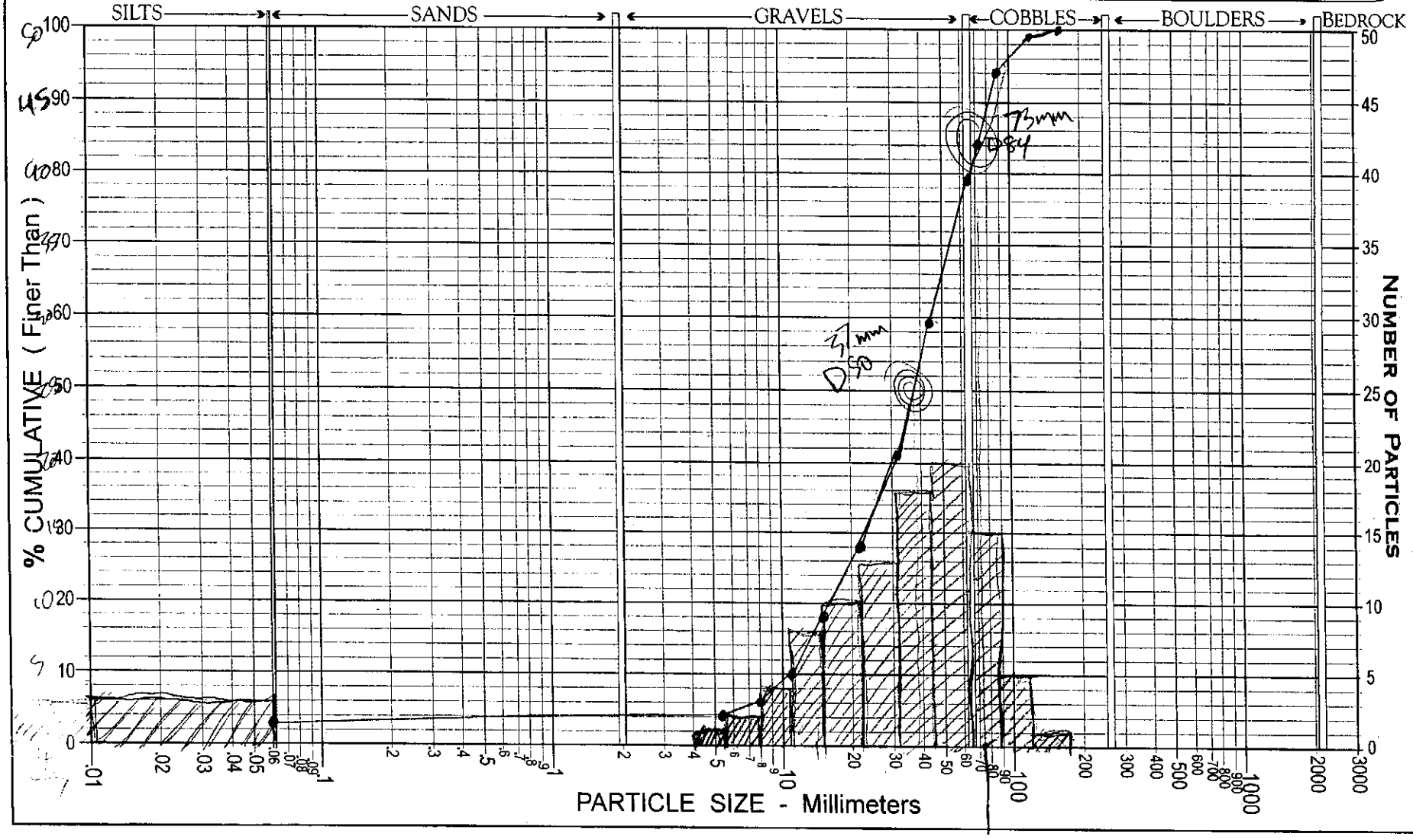
REACH: 1

PARTY: Team 1

Stream Type:

Valley Type:

HUC:



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

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Little Conocacheague Creek	Location:	Washington Co., Maryland
Date:	3/31/15	Stream Type:	C4/1
Valley Type:	Confined Terraced Alluvial		
Observers:	Team 1	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	49.8	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.67	d_{bkf} (ft)
Bankfull Riffle WIDTH	22	W_{bkf} (ft)	Wetted PERIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	25.34	W_p (ft)
D_{84} at Riffle	73	Dia. (mm)	D_{84} (mm) / 304.8	0.239	D_{84} (ft)
Bankfull SLOPE	0.0066	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.97	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	8.24	R / D_{84}
Drainage Area	12	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.647	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness — $\bar{u} = [\,2.83 + 5.66 * Log\{R / D_{84}\}\,]\,u^*$	5.19	ft / sec	258.5	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. A-28, A-29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.037	5.14	ft / sec	255.9	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. A-30) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.04	4.76	ft / sec	236.8	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 Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$ 0.052	3.66	ft / sec	182.3	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 Discharge Q = ____ year		ft / sec		cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	4.02	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-1. Field Form for Level II Stream Classification.

Stream: Little Conocacheague Creek	
Basin:	Drainage Area: acres 12 mi²
Location: Washington Co., Maryland	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 3/31/14
Observers: Team 1	Valley Type:

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	22	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.67	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	49.8	ft²
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	13.17	ft/ft
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.	2.27	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	127	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	5.77	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.	50	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	.0066	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (S_{val} / S).	1.15	

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

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Worksheet A-3. Summary of Morphological Variables.

Stream:	Little Conococheague Creek	Location:	Washington Co, Maryland
Team:	1	Date: 3-31-15	Drainage Area: 12 sq mi

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	22	2. Bankfull Mean Depth (d_{bkf}) (ft)	1.67
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	13.17	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	49.8
5. Bankfull Maximum Depth (d_{max}) (ft)	2.27	6. Width of Flood-Prone Area (W_{fpa}) (ft)	127
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	5.77		

Channel Pattern / *Dimensionless Ratios*

8. Belt Width (W_{blt}) (ft)	Mean	65.5	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	2.98
	Min	59		Min	2.68
	Max	70		Max	3.18
10. Stream Meander Length (L_m) (ft)	Mean	281.5	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	12.8
	Min	188		Min	8.55
	Max	375		Max	17.05
12. Linear Wavelength (λ) (ft)	Mean	217.5	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	9.89
	Min	109		Min	4.95
	Max	326		Max	14.82
14. Radius of Curvature (R_c) (ft)	Mean	67.5	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	3.07
	Min	31		Min	1.41
	Max	125		Max	5.68

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	26	17. D_{35} (mm)	39	18. D_{50} (mm)	50
19. D_{84} (mm)	90	20. D_{95} (mm)	180	21. D_{100} (mm)	Bedrock / 3000

Active Bed Riffle Pebble Count

22. D_{16} (mm)	14	23. D_{35} (mm)	25	24. D_{50} (mm)	38
25. D_{84} (mm)	73	26. D_{95} (mm)	95	27. D_{100} (mm)	180

Classification

28. Sinuosity (k)	1.15	29. Average Water Surface Slope (S)	.0066
30. Stream Type	C4/1	31. Valley Type	VIIIC

Velocity & Discharge

32. Friction Factor ($\bar{u}$ / u^*)	8.02	33. Relative Roughness (R / D_{84})	8.24
34. Manning's 'n' from Friction Factor / Relative Roughness	0.037	35. Manning's 'n' from Stream Type	0.04
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	5.19	37. Estimated Bankfull Discharge (cfs)	258.5
38. Estimation Method Selected for Velocity & Discharge	Friction Factor / Relative Roughness		

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