Presentation Order
Applied Fluvial Geomorphology

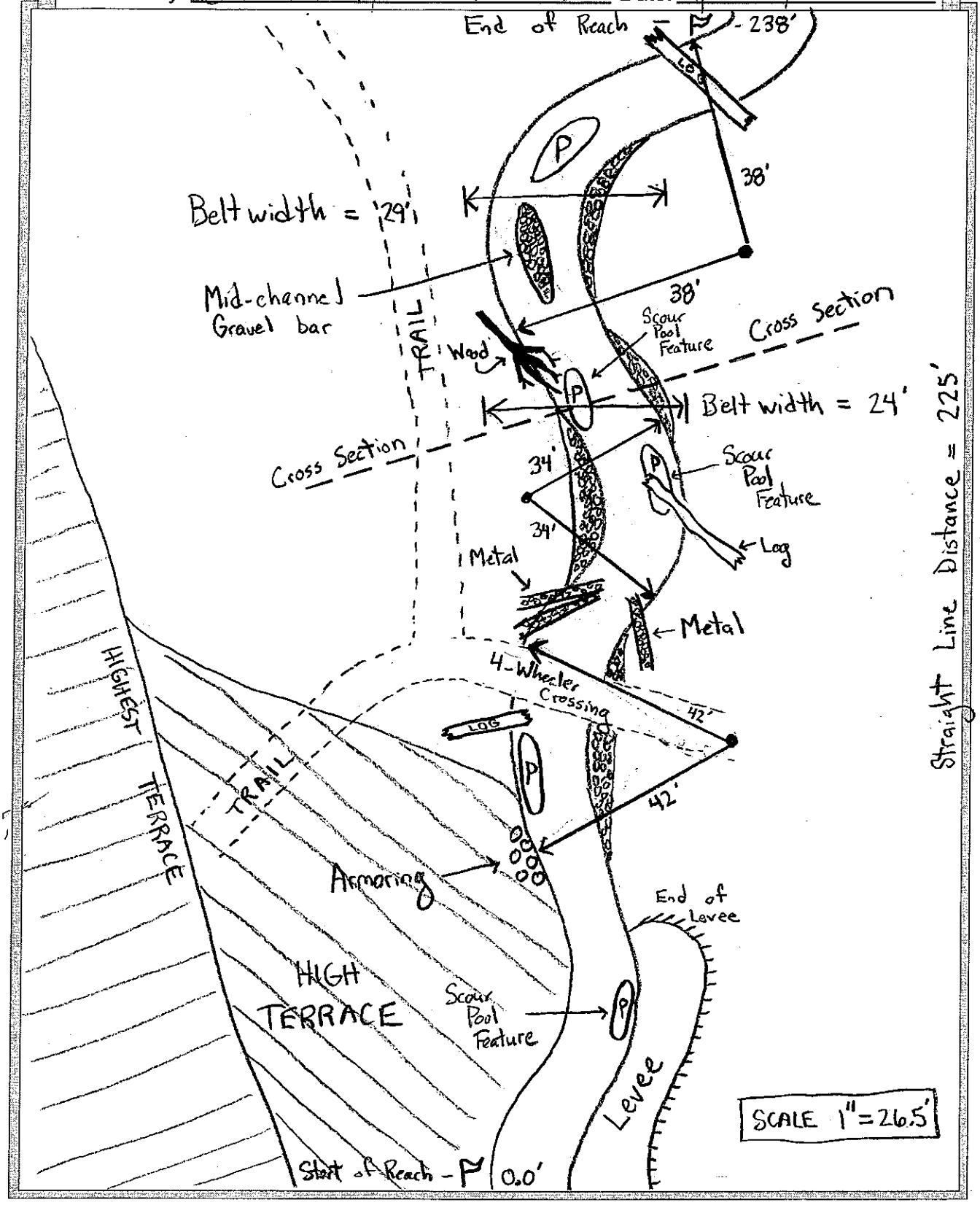
- Sketch Map
- Cross-Section
- Longitudinal Profile
- Pebble Counts
  - Representative Pebble Count
  - Active Bed Riffle Pebble Count
- Velocity Computations (Worksheet A-2)
- Stream Classification (Worksheet A-1)
- Summary of Morphological Variables (Worksheet A-3)

TEAM #1

AREA-SITE LOCATION....REACH MAP

Stream: Tributary to Israel Creek Reach:

Drawn By: David Parker, Sheela Johnson Date: April 20, 2010



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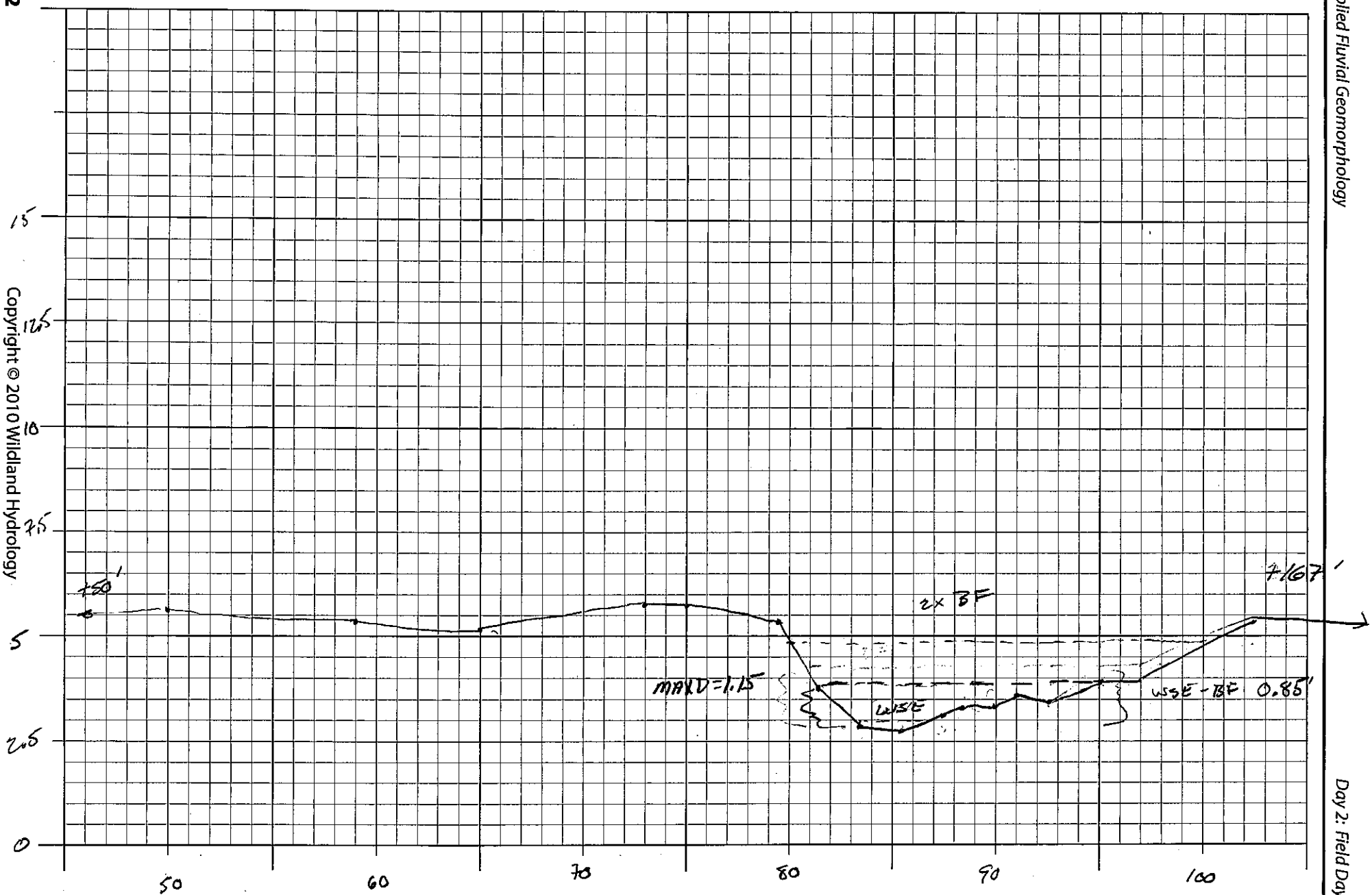
Team 1 X-sec Dread Creek (small trib) 9-20-2010

Riffle



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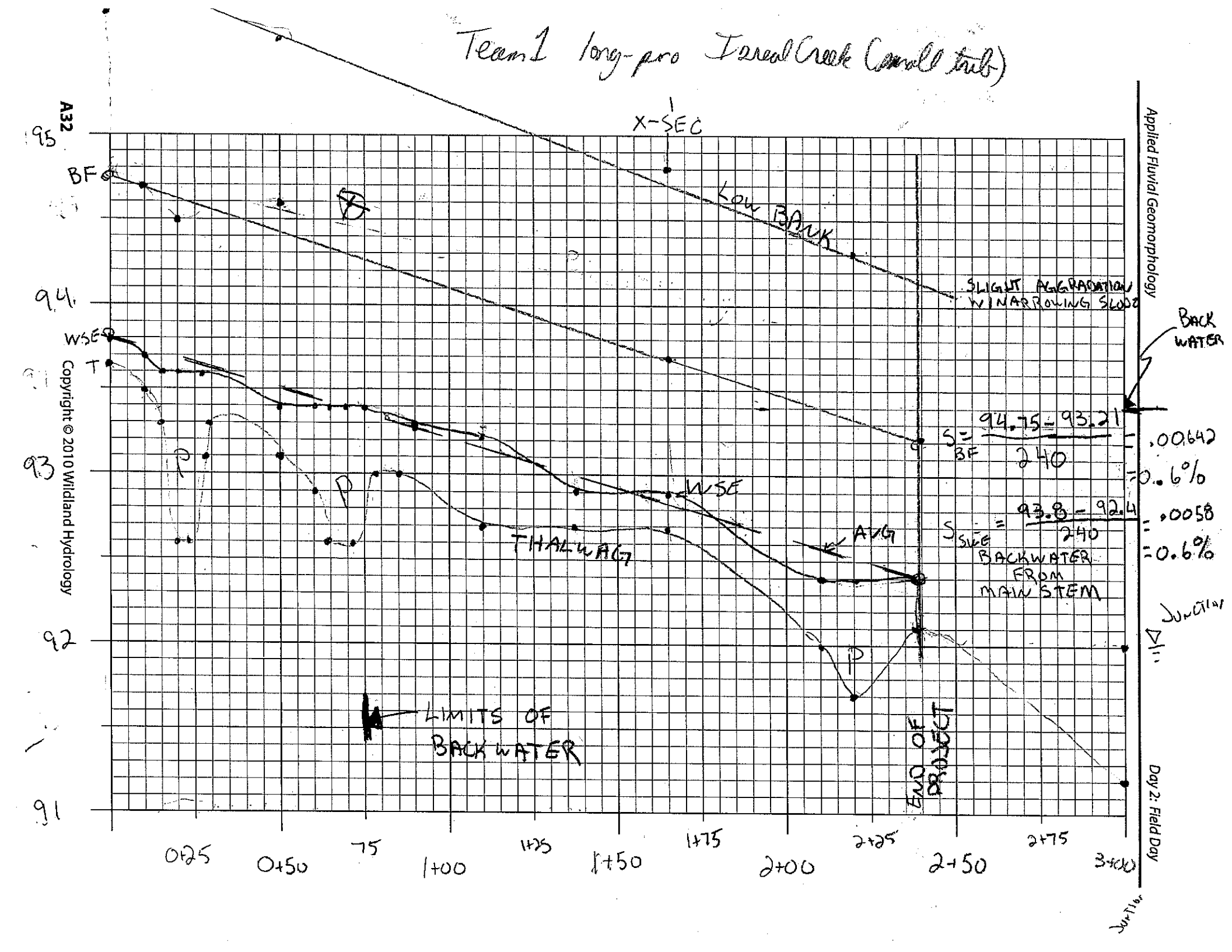
Team 1 long-pro Izaul Creek (Canal tab)
A32
X-SEC
95
94
93
92
91
BF
WSE
T
LOW BANK
SLIGHT AGGRADATION
W NARROWING SLOPE
BACK WATER
S = 94.75 - 93.21 / 240 = .00642 = 0.6%
BF
WSE
AVG
THALWAG
S = 93.8 - 92.4 / 240 = .0058 = 0.6%
SLOPE
BACKWATER FROM MAIN STEM
JUNCTION
LIMITS OF BACKWATER
END OF PROJECT
0+25
0+50
75
1+00
1+25
1+50
1+75
2+00
2+25
2+50
2+75
3+00
Applied Fluvial Geomorphology
Day 2: Field Day
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SURVEY DATA → CROSS - SECTION 1

SITE: Israel Creek Tributary (Team 1) Date: 4-20-2010

Location: riffle Xsection 1644'

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	NOTES / COMMENTS / REMARKS
1	00			4.0'	6	
2	7.00			4.8'	5.2	
3	9.00			5.6'	4.4	
4	50.00			4.45'	5.55	
5	59.00			4.65'	5.35	road (left)
6	65.00			4.85'	5.15	road (right)
7	73.00			4.25'	5.75	top of bank
8	75.50			4.3'	5.7	pin
9	79.50			4.65'	5.35	top bank — Depth to BF
10	81.50			6.25'	3.75	-0.05
11	83.75			7.15'	2.85	water level — 0.85 — 7.15
12	83.50			7.35'	2.65	depth 0.25 — 1.05 — 7.45
13	85.50			7.45'	2.55	1.15
14	87.50			7.40	2.6	1.1
15	89.50			7.30	2.7	1.1
16	90.00			7.15'	2.85	righted edge WL — 0.85
17	91.00			6.90'	3.1	0.6
18	92.75			7.05	2.95	0.75
19	95.20			6.30'	3.7	
20	95.70			6.30'	3.7	bankfull
21	97.00			6.10'	3.9	
22	102.50			4.65	5.35	top of bank
23	106.50			4.80'	5.2	
24	176.50			5.70	4.3	
25	244.50			6.00	4	
26	265.50			6.3	3.7	
27	269.50			6.4	3.8	top of levee
28						

Max D = 1.15
Mean D = 0.95

6.3

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SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: Date: 4/20

Location: Isreal Creek (Small Trib)

Party / Notes: Team 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 ft	Low Bank HI Fore-Sight FS ft	Low Bank HI Elevation Elev. ft	NOTES e.g. Riffle Run Pool Glide
1	0+00		100.00	6.33	93.67	6.19	93.81			3.56	96.44	TOP RIFFLE TOP RUN
2	0+10.6		"	6.46	93.54	6.31	93.69	5.32	94.68			RIFFLE @ BANKFULL
3	15.1			6.67	93.33	6.41	93.59					POOL START
4	20.5			7.37	92.63	6.41	93.59	5.52	94.48			DEEP POOL
5	27.8			6.90	93.10	6.42	93.58					END POOL
6	28.2			6.69	93.31	6.43	93.57					RIFFLE
7	49.5			6.88	93.12	6.61	93.39	5.40	94.60	4.42	95.58	RIFFLE @ BANKFULL
8	60.7			7.13	92.87	6.62	93.38					TOP OF POOL → START OF BREAK
9	69.2			7.38	92.62	TBD	93.37					POOL DEEP
10	71.2			7.45	92.55	6.65	93.35	5.44	94.56			POOL DEEP
11	77.7			7.04	92.96	6.65	93.35					MID POOL ON RISE UP
12	86.2			7.04	92.96	6.70	93.30			5.10	94.90	BEGIN RIFFLE
13	1+10.6			7.29	92.71	6.89	93.31					MID RIFFLE
14	1+37.5			7.29	92.71	7.09	92.91					RIFFLE POINT
15	165			7.32	92.68	7.12	92.88	6.29	93.71	5.20	94.80	RIFFLE POINT AT X-SECTI
16	188.7					~~7.33~~						POINT BAR → DON'T PLOT
17	203.5					~~7.65~~						POINT BAR → DON'T PLOT
18	209.7			8.02	91.98	7.62	92.38					POOL
19	220			8.28	91.72	7.62	92.38			5.68	94.32	END POOL
20	238			7.89	92.11	7.63	92.37					START RIFFLE
21												
22	AT JUNCTION			8.75	91.25	7.89	92.11					JUNCTION
23												
24												
25												
26												
27												

8.28 − 0.68 = 7.60

7.60 / 3 = 2.53

7.89 − .02 = 7.13

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Representative Pebble Count Team 1 4-20-2010

Site: Israel Creek Tributary Date: 4-20-2010

Location: Maryland HUC: _____

Party: J. Phillips A. Voorhees

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:			Reach:			Reach:		
					Date: 4/20/10			Date: 4/20/10			Date: 4/20/10		
	Silt / Clay	< .062	S/C	11	8	8.9	8.9	3	30.0	30.0	11	11	11
	Very Fine	.062 - .125	SAND	9	8	8.9	12.8	1	10.0	40.0	9	9	20
	Fine	.125 - .25	SAND	1	1	1.1	18.9	0	0	40.0	1	1	21
	Medium	.25 - .50	SAND	5	2	2.2	21.1	3	30.0	70.0	5	5	26
	Coarse	.50 - 1.0	SAND	3	3	3.3	24.4	0	0	70.0	3	3	29
.04 - .08	Very Coarse	1.0 - 2	SAND	4	4	4.4	28.8	0	0	70.0	4	4	33
.08 - .16	Very Fine	2 - 4	GRAVEL	5	4	4.4	33.2	1	10.0	80.0	5	5	38
.16 - .22	Fine	4 - 5.7	GRAVEL	5	5	5.6	38.8	0	0	80.0	5	5	43
.22 - .31	Fine	5.7 - 8	GRAVEL	10	9	10.0	48.8	1	10.0	90.0	10	10	53
.31 - .44	Medium	8 - 11.3	GRAVEL	17	16	17.8	66.6	1	10.0	100.0	17	17	70
.44 - .63	Medium	11.3 - 16	GRAVEL	6	6	6.7	73.3	0	0		6	6	76
.63 - .89	Coarse	16 - 22.6	GRAVEL	5	5	5.6	78.9	0	0		5	5	81
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	6	6	6.7	85.6	0	0		6	6	87
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	7	7	7.8	93.4	0	0		7	7	94
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	4	4	4.4	97.8	0	0		4	4	98
2.5 - 3.5	Small	64 - 90	COBBLE	1	1	1.1	98.9	0	0		1	1	99
3.5 - 5.0	Small	90 - 128	COBBLE	1	1	1.1	100.0	0	0		1	1	100
5.0 - 7.1	Large	128 - 180	COBBLE										
7.1 - 10.1	Large	180 - 256	COBBLE										
10.1 - 14.3	Small	256 - 362	BOULDER										
14.3 - 20	Small	362 - 512	BOULDER										
20 - 40	Medium	512 - 1024	BOULDER										
40 - 80	Large-Vry Large	1024 - 2048	BOULDER										
	Bedrock		BDRK										
Stream Type:		**Valley Type:**		TOTAL→	90			10			100		

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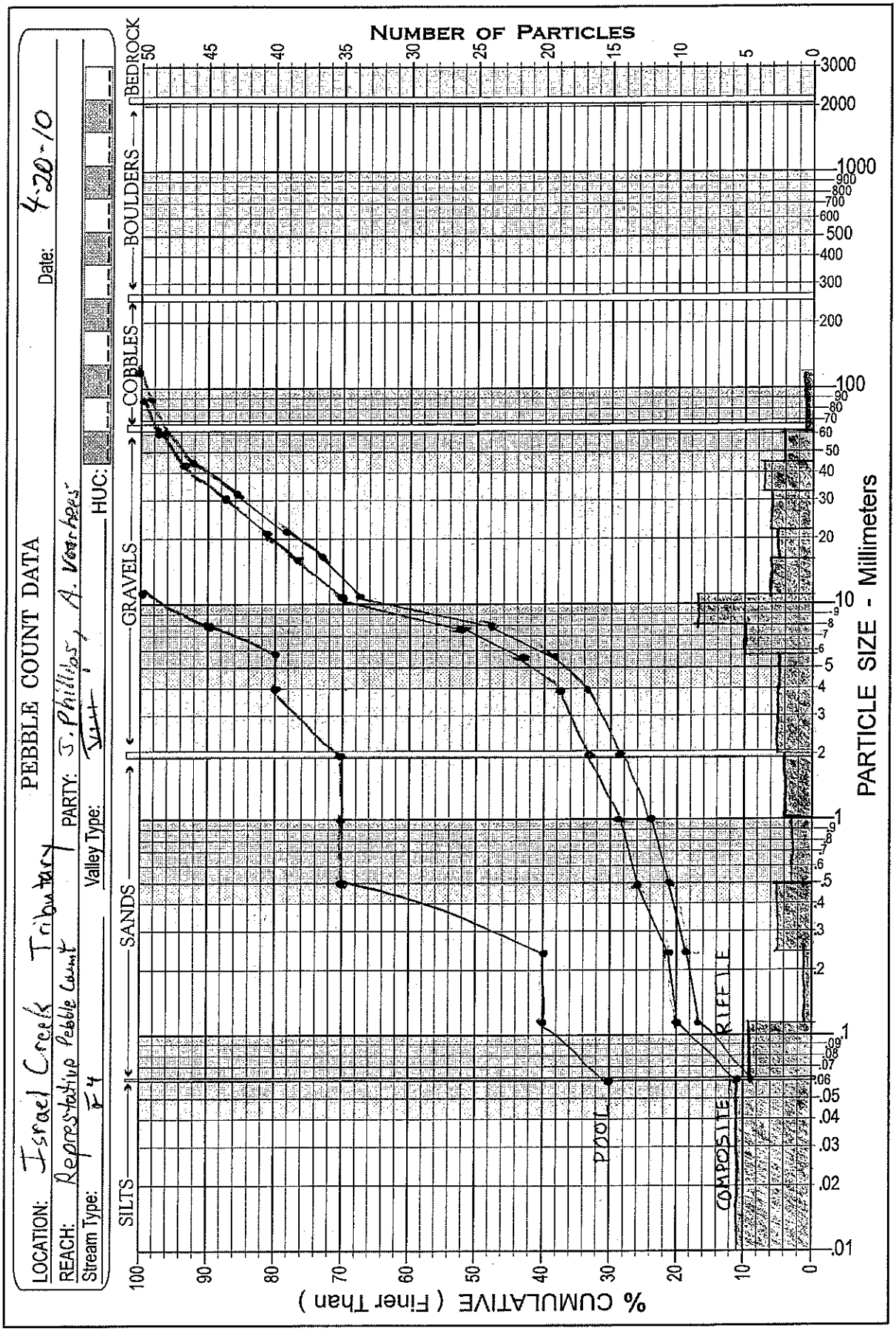

Team 1

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Team 1

Active Bed Riffle Count

Site: Trib to Israel Creek Date: 4-20-2010

Location: Maryland HUC:

Party: J. Phillips / A. Voorhees

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			5	5	5/100 = 5%	5						
	Very Fine	.062 - .125	SAND			3	3	3.0	5+3= 8						
	Fine	.125 - .25	SAND			1	1	1.0	9						
	Medium	.25 - .50	SAND			4	4	4.0	13						
	Coarse	.50 - 1.0	SAND												
.04 - .08	Very Coarse	1.0 - 2	SAND			7	7	7.0	20						
.08 - .16	Very Fine	2 - 4	GRAVEL			11	11	11.0	31						
.16 - .22	Fine	4 - 5.7	GRAVEL			8	8	8.0	39						
.22 - .31	Fine	5.7 - 8	GRAVEL			17	17	17.0	56						
.31 - .44	Medium	8 - 11.3	GRAVEL			19	19	19.0	75						
.44 - .63	Medium	11.3 - 16	GRAVEL			12	12	12.0	87						
.63 - .89	Coarse	16 - 22.6	GRAVEL			4	4	4.0	91						
.89 - 1.3	Coarse	22.6 - 32	GRAVEL			4	4	4.0	95						
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL			2	2	2.0	97						
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL			1	1	1.0	98						
2.5 - 3.5	Small	64 - 90	COBBLE			1	1	1.0	99						
3.5 - 5.0	Small	90 - 128	COBBLE												
5.0 - 7.1	Large	128 - 180	COBBLE			1	1	1.0	100						
7.1 - 10.1	Large	180 - 256	COBBLE												
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512	BOULDER												
20 - 40	Medium	512 - 1024	BOULDER												
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK												
Stream Type:			Valley Type:			TOTAL→	100								

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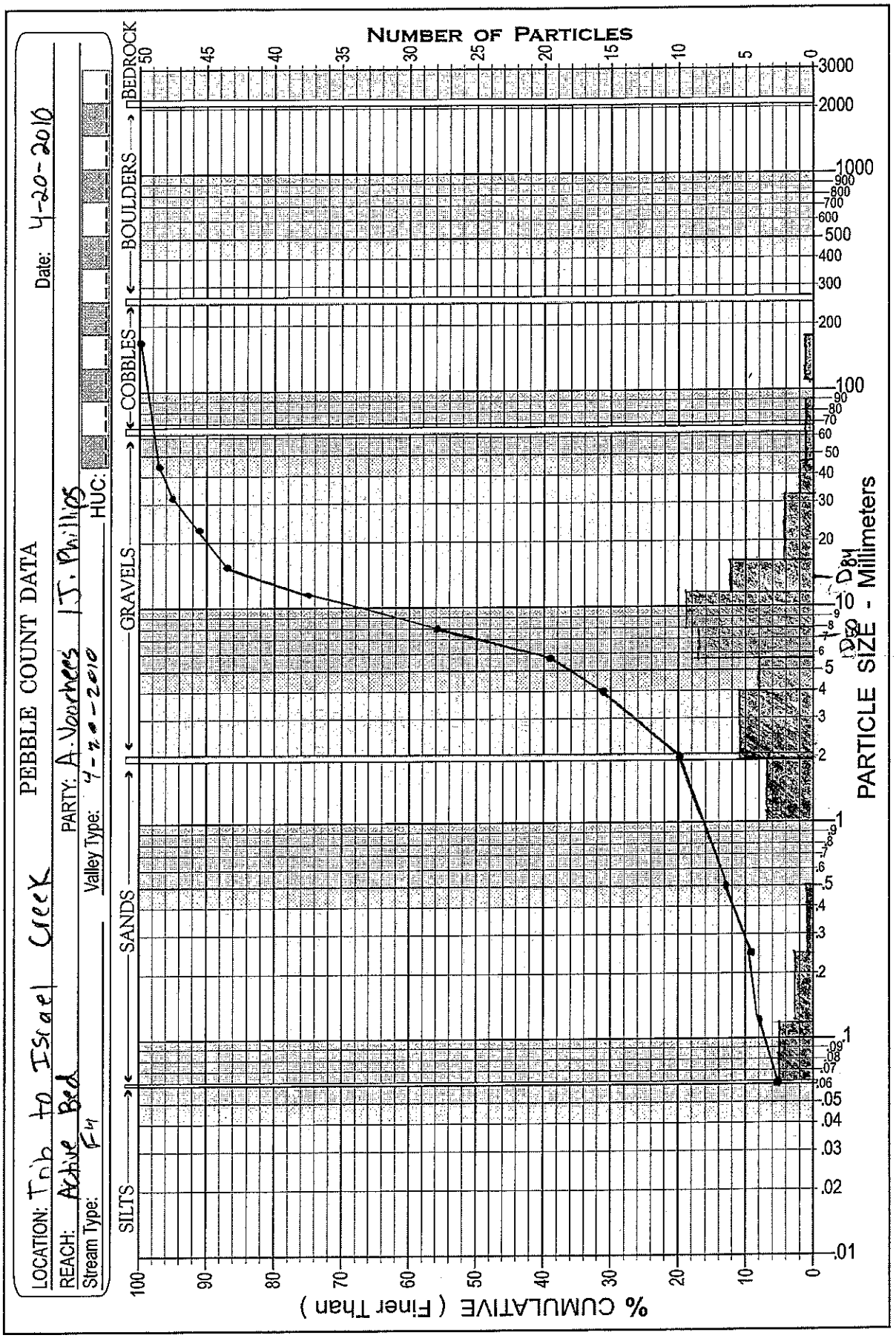
Team 1



D84 = 14mm

D50 = 7mm

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

Bankfull VELOCITY / DISCHARGE Estimates

Site:	Israel Creek tributary	Location:	Washington Cty, MD
Date:	4-20-2010	Stream Type:	F4
Valley Type:	VIII		
Observers:	Team 1	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-sectional AREA	12.8	A_{bkf} (ft^2)	Bankfull Mean DEPTH	0.92	d_{bkf} (ft)
Bankfull WIDTH	14.2	W_{bkf} (ft)	Wetted PERIMETER ~ $2 * d_{bkf} + W_{bkf}$	16.04	W_p (ft)
D_{84} @ Riffle	14	Dia. (mm)	D_{84} mm / 304.8 =	0.046	D_{84} (ft)
Bankfull SLOPE	0.006	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	0.80	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	17.39	
Drainage AREA	1.1	DA (mi^2)	Shear Velocity $u^* = \sqrt{gRS}$	0.39	u^* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 \text{ Log } \{ R / D_{84} \}] u^*$	3.84	ft / sec	49.2	cfs
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness (Figs. A-19, A-20) $u = 1.49 * R^{2/3} * S^{1/2} / n$ n = .029	3.4	ft / sec	43.5	cfs
2. Roughness Coefficient: $u = 1.49 * R^{2/3} * S^{1/2} / n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39 S^{.38} R^{-.16}$ n = .0515	1.72	ft / sec	22.0	cfs
Note: This equation is for applications involving steep, step-pool, high boundary roughness, cobble- and boulder-dominated stream systems., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.				
2. Roughness Coefficient: $u = 1.49 * R^{2/3} * S^{1/2} / n$ c) Manning's 'n' from Stream Type n = .05	1.99	ft / sec	25.5	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) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge Q = ____ Year	2.6	ft / sec	33.20	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$ DA=1.5mi² lowest data point on MD Piedmont Curve	3.2	ft / sec	40.9	cfs

Options for Using the D_{84} Term in the Relative Roughness Relation (R/D_{84}) when Using 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 the 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 sufaces above channel bed elevations. 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: Israel Creek (small trib)	
Basin:	Drainage Area: 704 acres 1.1 mi²
Location: Washington Cty, MD	
Twp. & Rge:	Sec. & Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4-20-10
Observers: Group 1	Valley Type: VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	14.2	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	0.92	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	12.78	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	15.43	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.	1.15	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{max}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	20.5	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	1.44	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	7	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.	0.006 or 0.6 %	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 (VS / S).	1.06	

Stream Type E4 **See Classification Key (Figure A-1)**

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Worksheet A-3. Summary of Morphological Variables.

Stream: Israel Creek (Small trib) Location: Washington Cty, MD

Team: Team 1 Date: 4-20-2010 Drainage Area: 1.1 mi²

Riffle Channel Dimensions					
1. Bankfull Riffle Width (W_{bkf}) (ft)	14.2		2. Mean Bankfull Riffle Depth (d_{bkf}) (ft)	0.92	
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	15.43		4. Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	12.78	
5. Maximum Bankfull Riffle Depth (d_{max}) (ft)	1.15		6. Width of Flood-Prone Area (W_{fpa}) (ft)	20.5	
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	1.44				
Channel Pattern			**Dimensionless Ratios**		
8. Belt Width (W_{blt}) (ft)	Mean 26.5 Min 24.0 Max 29.0		9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean 1.87 Min 1.69 Max 2.04	
10. Stream Meander Length (L_m) (ft)	Mean 106.4 Min 105.5 Max 107.2		11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean 7.49 Min 7.43 Max 7.55	
12. Linear Wavelength (λ) (ft)	Mean 96.1 Min 92.8 Max 99.4		13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean 6.77 Min 6.54 Max 7.0	
14. Radius of Curvature (R_c) (ft)	Mean 38.0 Min 34.0 Max 42.0		15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean 2.68 Min 2.39 Max 2.96	
Channel Particles					
Representative Pebble Count					
16. D_{16} (mm)	0.09	17. D_{35} (mm)	2.5	18. D_{50} (mm)	7.0
19. D_{84} (mm)	25	20. D_{95} (mm)	50	21. D_{100} (mm)	90
Active Bed Riffle Pebble Count					
22. D_{16} (mm)	0.95	23. D_{35} (mm)	5.7	24. D_{50} (mm)	7.0
25. D_{84} (mm)	14	26. D_{95} (mm)	32	27. D_{100} (mm)	180
Classification					
28. Sinuosity (k)	1.06		29. Average Water Surface Slope (S)	0.006	
30. Stream Type	F4		31. Valley Type	VIII	
Velocity & Discharge					
32. Friction Factor (u / u*)	9.7		33. Relative Roughness (R / D_{84})	17.4	
34. Manning's "n" from Friction Factor / Relative Roughness	0.029		35. Manning's "n" from Stream Type	0.05	
36. Estimated Mean Velocity (u_{bkf}) (ft/sec)	3.4		37. Estimated Bankfull Discharge (cfs)	43.5	
38. Estimation Method Selected for Velocity & Discharge	F Roughness Coefficient				

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