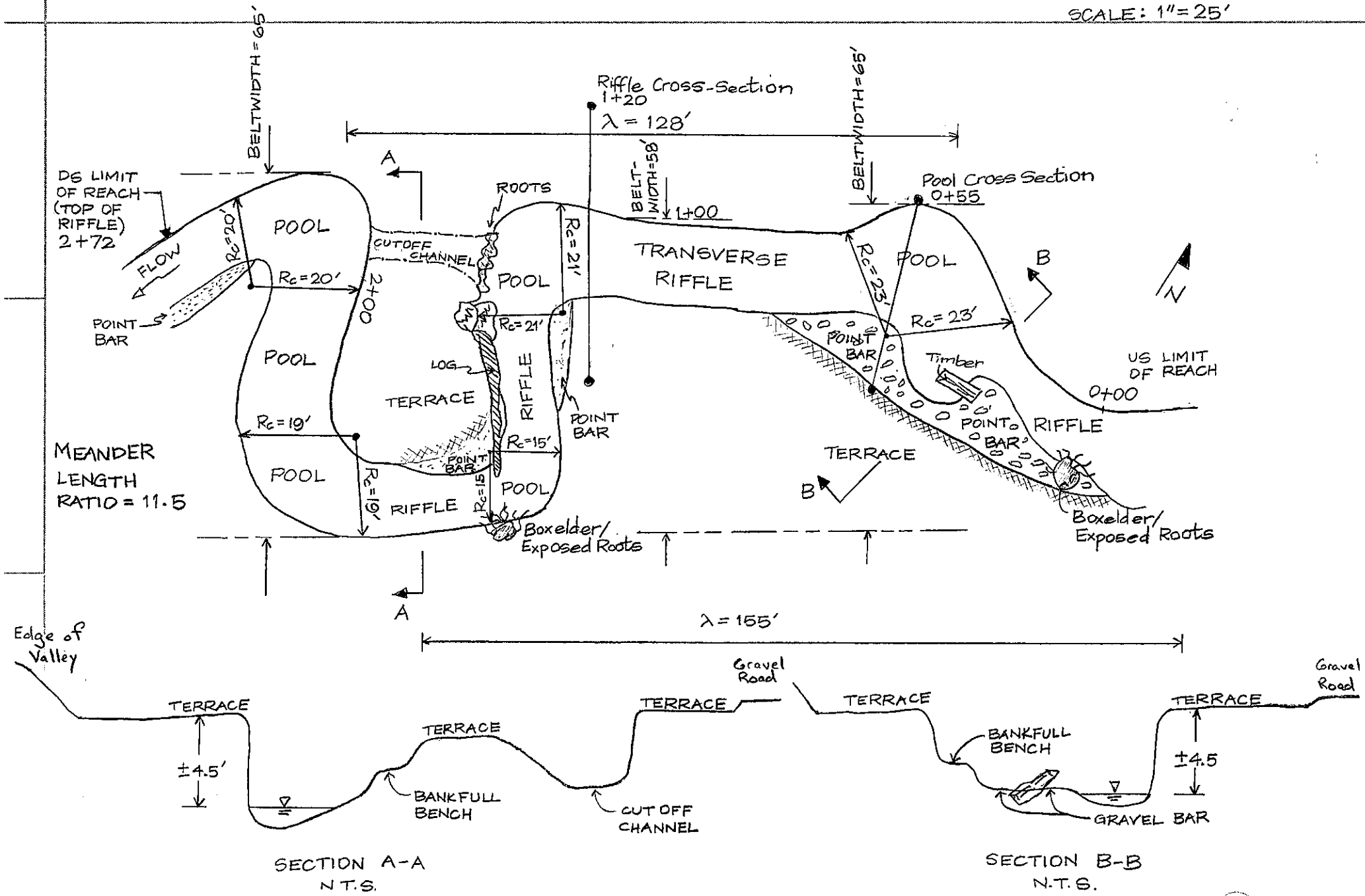
Presentation Order
Applied Fluvial Geomorphology

- 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)

Area-Site Location ... Reach Map

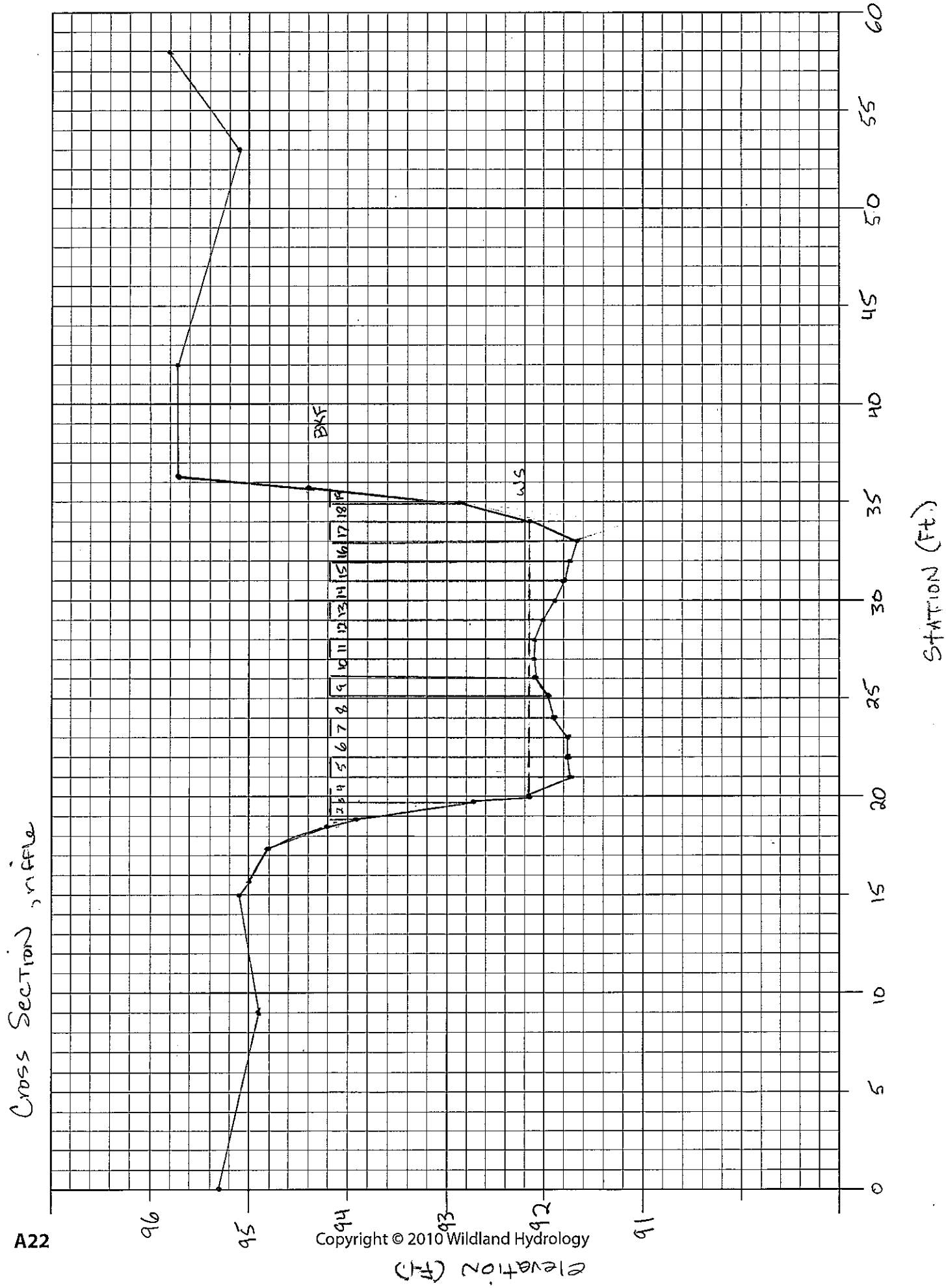
ISRAEL CREEK
REACH 3, TEAM 3
APRIL 20, 2010

SCALE: 1" = 25'



SECTION A-A
N.T.S.

SECTION B-B
N.T.S.



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SURVEY DATA → CROSS - SECTION 1

SITE: Israel Creek Date: 4/20/10

Location: Reach 3 Riffle (119.3) (Level 1)

Party / Notes: Oakes, Tarrie, Miranda 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	0.00			4.70	95.30	L bank flood prone
2	9.00			5.10	94.90	
3	15.00			4.87	95.13	Top L bank
4	15.75			5.00	95.00	
5	17.25			5.20	94.80	
6	18.40			5.81	94.19	Bank full
7	18.80			6.10	93.90	
8	19.70			7.24	92.76	Bank full Low
9	20.00			7.81	92.19	LEW
10	21.00			8.26	91.74	
11	22.00			8.22	91.78	
12	23.00			8.22	91.78	
13	24.00			8.09	91.91	
14	25.20			8.02	91.98	
15	26.00			7.89	92.11	
16	27.00			7.87	92.13	
17	28.00			7.90	92.10	
18	29.00			7.96	92.04	
19	30.00			8.07	91.93	
20	31.00			8.20	91.80	
21	32.00			8.22	91.78	
22	33.00			8.33	91.67	THL
23	34.20			7.82	92.18	REW
24	35.00			7.10	92.90	
25	35.80			5.81	94.19	
26	36.30			4.26	95.74	Top R bank
27	42.00			4.25	95.75	
28	53.00			4.90	95.10	

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SURVEY DATA → **CROSS - SECTION 2**

SITE: Israel Creek, Reach 3 (Level 1) Date: 4/20/10

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	58.00			4.18	95.82	R bank flood prone
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
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58						
59						

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Israel Creek
Team 3

[Cross Section Area Worksheet]

4/20/10

Applied Fluvial Geomorphology

BKF X-S Area = 35.214

Day 2: Field Day

SURVEY DATA → **CROSS - SECTION 2**

SITE: ISRAEL CREEK, TEAM 3, RIFFLE

Date: 4/20/10

Item	STATION ft	~~B S~~ ELEV. ft	~~H I~~ DEPTH ft	~~F S~~ CELL WIDTH ft	Elevation AVE. CELL DEPTH ft	NOTES COMMENTS REMARKS	
29	0	95.30	0			INCREMENTAL AREA	CELL #
30	9	94.9			.2		
31	15	95.13	95.13-95.17 0	0	.285		
32	15.75	95.0	.13	.75	.065	.0486	
33	17.25	94.8	.33	1.5	.23	0.345	
34	18.4	94.19	0	1.15			BANKFULL
35	18.8	93.9	.29	.4	.145	0.058	1
36	19.7	92.76	1.43	.9	.86	0.774	2
37	20	92.19	2	.3	1.715	0.5145	3
38	21	91.74	2.45	1	2.225	2.225	4
39	22	91.78	2.41	1	2.43	2.43	5
40	23	91.78	2.41	1	2.41	2.41	6
41	24	91.91	2.28	1	2.345	2.345	7
42	25.2	91.98	2.21	1.2	2.245	2.694	8
43	26	92.11	2.08	.8	2.145	1.716	9
44	27	92.13	2.06	1	2.07	2.07	10
45	28	92.10	2.09	1	2.08	2.08	11
46	29	92.04	2.15	1	2.12	2.12	12
47	30	91.93	2.26	1	2.205	2.205	13
48	31	91.8	2.39	1	2.325	2.325	14
49	32	91.78	2.41	1	2.4	2.4	15
50	33	91.67	2.52	1	2.465	2.465	16
51	34.2	92.18	2.01	1.2	2.265	2.718	17
52	35	92.9	1.29	.8	1.65	1.32	18
53	36.8	94.19	* 0	.8	.43	0.344	19
54	36.3	95.74		.5			TOP RB
55	42	95.75		5.7			Flood Prone
56	53	95.1					
57	58	95.82				X-sectional =	35.2135
58						AREA	
59							

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SURVEY DATA → **LONGITUDINAL PROFILE 1**

SITE: ISRAEL CREEK Team 3 Date: 04/20/10

Location: 0+00 THRU 2+70

Party / Notes: Sheet 1 of 2 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	WS-BF
1			100										
2	0+02			8.26	91.74	7.50	92.5					TRIF	
3	0+11			8.28	91.72	7.60	92.4	5.35*	94.65	4.56	95.44	BRIF	2.25
4	15.5			8.66	91.34	7.61	92.39						
5	17.6			8.75	91.25	7.56	92.44						
6	24.7			8.72	91.28	7.64	92.36						
7	32			8.75	91.25	7.60	92.4	(6.31)	93.69				1.29
8	36			9.09	90.91	7.62	92.38						
9	45			8.51	91.49	7.65	92.35						POOL TOB-TC
10	54			9.90	90.10	7.65	92.35	(6.22)	93.78			XS-PL	1.43
11	68			8.95	91.05	7.53	92.47	(6.10)	93.90				1.43
12	79			8.26	91.74	7.56	92.44						
13	81			7.87	92.13								
14	88			8.91	91.09	7.60	92.4	5.84	94.16				1.76
15	101			8.35	91.65	7.71	92.29	(6.88)	93.12				0.83
16	108			8.22	91.78	7.70	92.3					TRIF	
17	119.7			8.33	91.67	7.81	92.19	5.81	94.19	5.22	94.78	XS-RF	58 LB-15' RH-22'
18	129			8.42	91.48	7.82	92.18						
* 19	138	CUT	OFF	CHANNEL									
20	146			9.10	90.9	7.82	92.18						
21	151			9.50	90.5	7.89	92.11						
22	164			8.59	91.41	7.98	92.02	5.87	94.13	5.89	94.11		2.11
23	172			8.61	91.39	8.00	92						
24	174			10.44	89.56	~~8.94~~ 8.4	91.06					DMAX	
25	176			9.23	90.77	8.05	91.95	(6.66) 5.99	(93.34) 94.01				2.06
26	183			9.44	90.56	8.07	91.93	6.22	93.78				1.95
27	193			9.36	90.64	8.08	91.92	6.34	93.66				1.74

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SURVEY DATA → **LONGITUDINAL PROFILE 2**

SITE: ISRAEL CREEK Team 3 Date: 04/20/10

Location:

Party / Notes: Sheet 2 of 2 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 Hl Fore-Sight FS ft	Low Bank Hl Elevation Elev. ft	NOTES e.g. Riffle Run Pool Glide	WS-BF
28	196			10.10	89.9	8.13	91.87						
29	199			9.22	90.78	8.11	91.89	6.29	93.71				1.82
30	201			9.98	90.02	8.11	91.89	6.29	93.71				1.82
31	232			10.17	89.83	8.09	91.91	6.48	93.52				1.61
32	248			9.34	90.66	8.10	91.90	(7.13)	92.87				1.03
33	272			8.89	91.11	8.22	91.78	6.42 (7.65)	93.58 (92.35)				6.22 (0.57)
34	END	OF REACH											
35						8.35	91.65	6.89	93.11				
* 36	55			9.83	90.17	7.54	92.46					XS-PL	
37													
38													
39													
40													
41													
42													
43													
44													
45													
46													
47													
48													
49													
50													
51													
52													
53													
54													

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1 cm | 1 m / 100 cm | 1000 m / 1 m

1 cm = 10 mm

LEVEL I

Site: ISRAEL CREEK Date: 4/20

Location: REP. PEBBLE COUNT HUC:

Party: TEAM 3

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:			Reach:			Reach:		
							Date:			Date:			Date:		
	Silt / Clay	< .062	S/C				1	2%	2%	Ø	0	0	1	1%	1%
	Very Fine	.062 - .125	SAND				Ø	0	2%	Ø	0	0	0	0	1%
	Fine	.125 - .25					Ø	0	2%	1	2%	2	1	1%	2%
	Medium	.25 - .50					3	6%	8%	4	8%	10	7	7%	9%
	Coarse	.50 - 1.0					1	2%	10%	3	6%	16	4	4%	13%
.04 - .08	Very Coarse	1.0 - 2					3	6%	16%	7	14%	30	10	10%	23%
.08 - .16	Very Fine	2 - 4	GRAVEL				8	16%	32%	9	18%	48	17	17%	40%
.16 - .22	Fine	4 - 5.7					6	12%	44%	10	20%	68	16	16%	56%
.22 - .31	Fine	5.7 - 8					4	8%	52%	2	4%	72	6	6%	62%
.31 - .44	Medium	8 - 11.3					8	16%	68%	8	16%	88	16	16%	78%
.44 - .63	Medium	11.3 - 16					7	14%	82%	4	8%	96	11	11%	89%
.63 - .89	Coarse	16 - 22.6					6	12%	94%	2	4%	100	8	8%	97%
.89 - 1.3	Coarse	22.6 - 32					2	4%	98%	Ø	0	0	2	2%	99%
1.3 - 1.8	Very Coarse	32 - 45					1	2%	100%	Ø	0	0	1	1%	100%
1.8 - 2.5	Very Coarse	45 - 64													
2.5 - 3.5	Small	64 - 90	COBBLE												
3.5 - 5.0	Small	90 - 128													
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→	50			50					

Stream Type: **Valley Type:**

3 RIF./GLIDE/RUN

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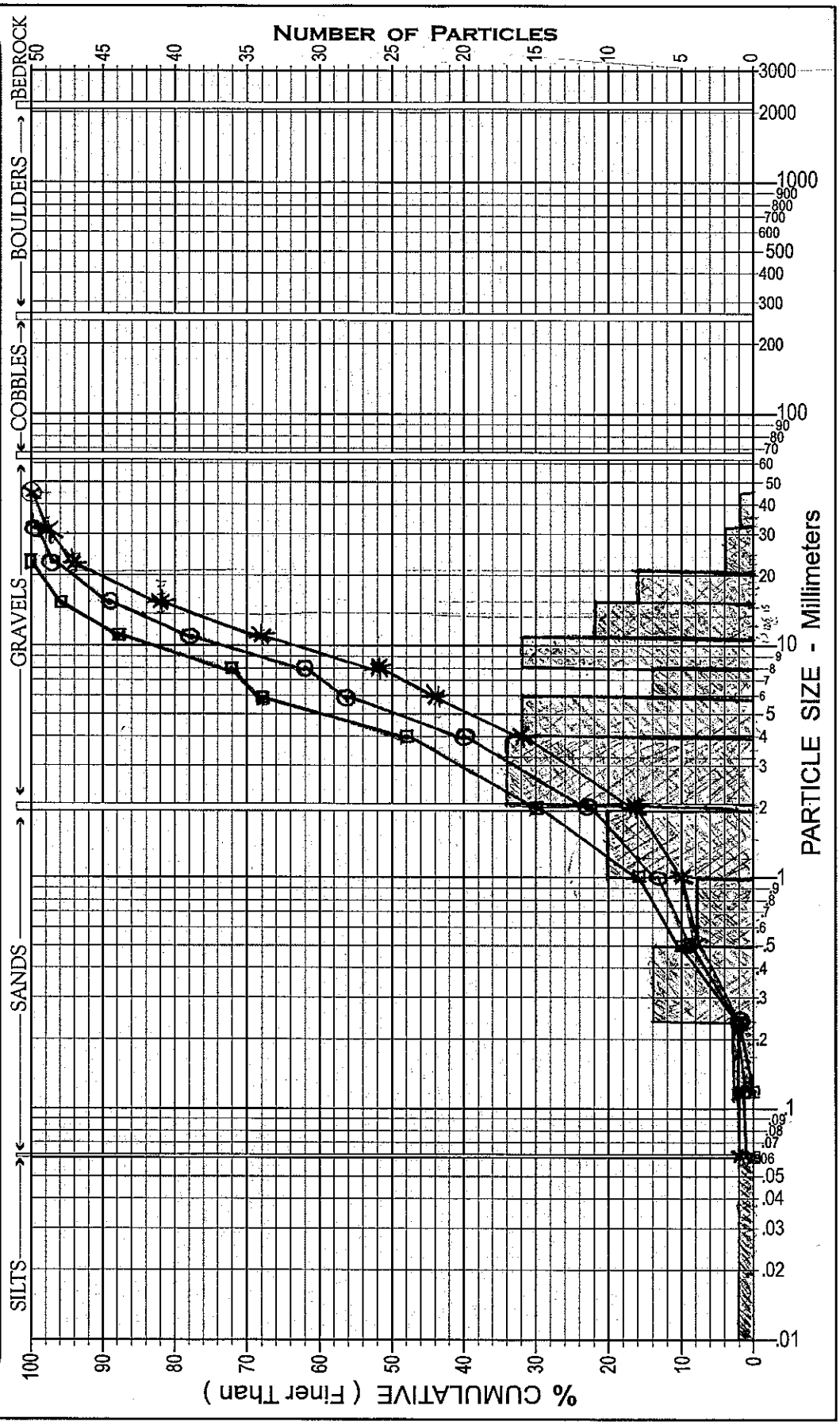
LEVEL I

PEBBLE COUNT DATA

LOCATION: ISRAEL CREEK
REACH: REF. PEBBLE COUNT
Stream Type:
Valley Type:
HUC:
PARTY: TEAM 3
Date: 4/20/10



D_{16} = 1.25 mm
D_{35} = 3.25 mm
D_{50} = 5.00 mm FINE GRAVEL
D_{84} = 13.75 mm
D_{95} = 21.00 mm

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LEVEL I

Site: ISRAEL CREEK Date: 4/20

Location: RIFFLE XS HUC:

Party: TEAM 3

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:			Reach:			Reach:		
							Date:			Date:			Date:		
	Silt / Clay	< .062	S/C				2	2.0	2.0						
	Very Fine	.062 - .125	SAND				1	1.0	3.0						
	Fine	.125 - .25					0		3.0						
	Medium	.25 - .50					1	1.0	4.0						
	Coarse	.50 - 1.0					0		4.0						
.04 - .08	Very Coarse	1.0 - 2					6	6.0	10.0						
.08 - .16	Very Fine	2 - 4	GRAVEL				15	14.7	24.7						
.16 - .22	Fine	4 - 5.7					18	17.6	42.3						
.22 - .31	Fine	5.7 - 8					20	19.6	61.9						
.31 - .44	Medium	8 - 11.3					22	21.6	83.5						
.44 - .63	Medium	11.3 - 16					9	8.8	92.3						
.63 - .89	Coarse	16 - 22.6					6	6.0	98.3						
.89 - 1.3	Coarse	22.6 - 32					2	2.0	100.3						
1.3 - 1.8	Very Coarse	32 - 45	COBBLE												
1.8 - 2.5	Very Coarse	45 - 64													
2.5 - 3.5	Small	64 - 90													
3.5 - 5.0	Small	90 - 128													
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:			**Valley Type:**			TOTAL→	102								

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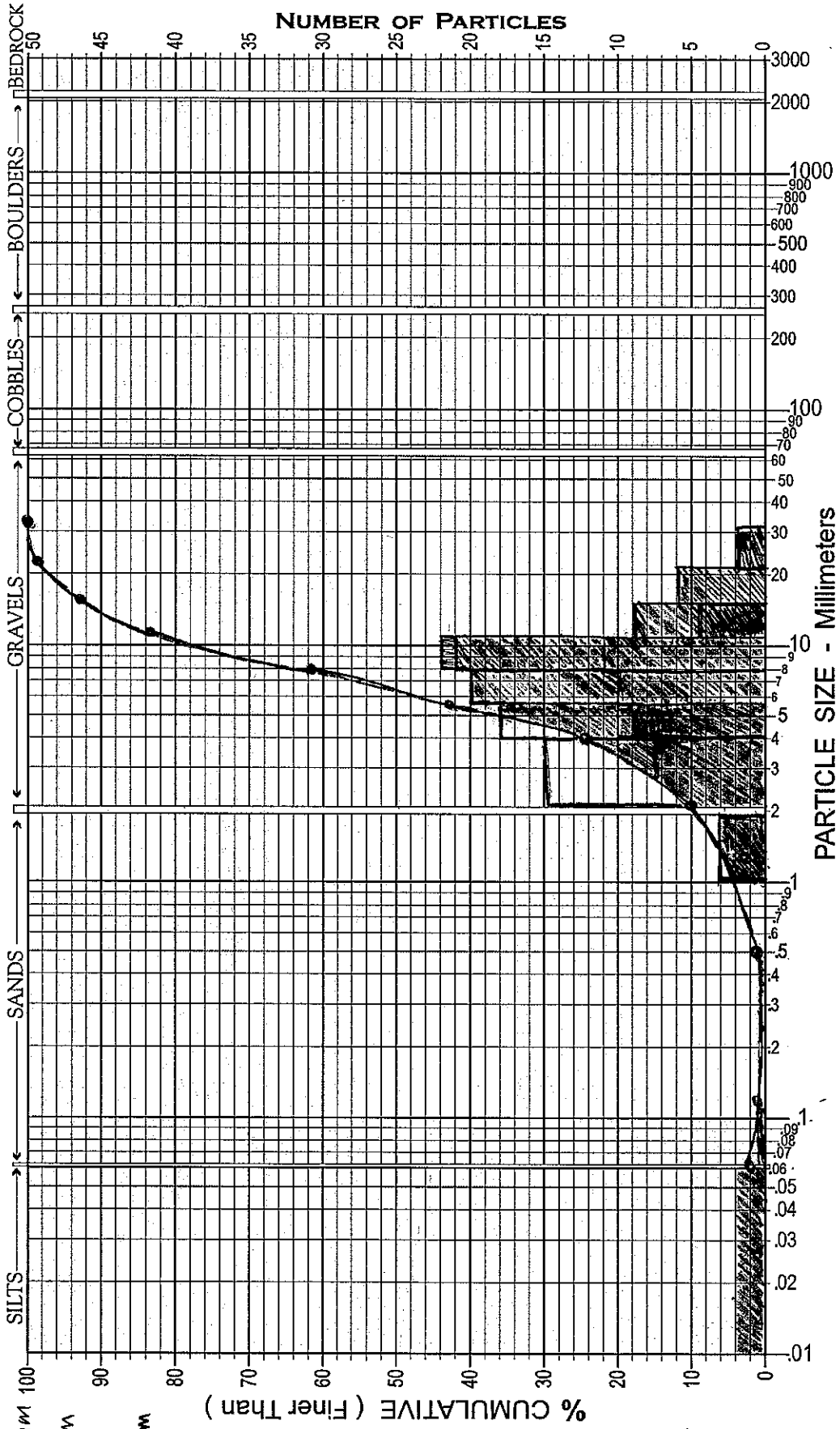
LEVEL I

PEBBLE COUNT DATA

LOCATION: Israel Creek
REACH: Riffle 1.5
Stream Type:

Date: 4/20/10
PARTY: TEAM 3
Valley Type:
HUC:



D_{100} = 32 mm
D_{95} = 17 mm
D_{84} = 11.5 mm
D_{50} = 6.2 mm
D_{35} = 4.7 mm
D_{16} = 2.9 mm

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

Bankfull VELOCITY / DISCHARGE Estimates

Site:	ISRAEL CREEK	Location:	TEAM 3 REACH
Date: 4/20/10	Stream Type: E4-C4	Valley Type:	8
Observers:	Team 3	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-sectional AREA	35.2	A_{bkf} (ft^2)	Bankfull Mean DEPTH	2.02	d_{bkf} (ft)
Bankfull WIDTH	17.4	W_{bkf} (ft)	Wetted PERIMETER ~ $2 * d_{bkf} + W_{bkf}$	21.4	W_p (ft)
D_{84} @ Riffle	11.5	Dia. (mm)	D_{84} mm / 304.8 =	.038	D_{84} (ft)
Bankfull SLOPE	.0027	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.64	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	43.16	
Drainage AREA	5.35	DA (mi^2)	Shear Velocity $u^* = \sqrt{gRS}$	.38	u^* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 \text{ Log } \{R / D_{84}\}] u^*$	4.59	ft / sec	161	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 = .024	4.49	ft / sec	158	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 = .038 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.	2.83	ft / sec	99.6	cfs
2. Roughness Coefficient: $u = 1.49 * R^{2/3} * S^{1/2} / n$ c) Manning's 'n' from Stream Type n = .038	2.83	ft / sec	99.6	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	4.69	ft / sec	165	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$		ft / sec		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		
Basin:	Drainage Area: acres	5.35 mi^2
Location: Team 3		
Twp. & Rge:	Sec. & Qtr.:	
Cross-Section Monuments (Lat./Long.):		Date: 4/20/10
Observers: Team3		Valley Type: VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	17.4	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	2.02	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	35.2	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	8.61	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.	2.52	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.	248	ft * used mean depth 2.02
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	14.2	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.	5	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.	.0027	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).	1.54	

Stream Type E4 - C4 **See Classification Key (Figure A-1)**

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Worksheet A-3. Summary of Morphological Variables.

Stream: Israel Creek		Location: Team 3 Reach	
Team: Team 3	Date: 4/20/10	Drainage Area: 5.35 mi²	

Riffle Channel Dimensions

1. Bankfull Riffle Width (W_{bkf}) (ft)	17.4	2. Mean Bankfull Riffle Depth (d_{bkf}) (ft)	2.02
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	8.61	4. Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	35.2
5. Maximum Bankfull Riffle Depth (d_{max}) (ft)	2.52	6. Width of Flood-Prone Area (W_{fpa}) (ft)	248
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	14.2		

Channel Pattern / Dimensionless Ratios

8. Belt Width (W_{blt}) (ft)	Mean	61	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	3.4
	Min	59		Min	3.3
	Max	65		Max	3.6
10. Stream Meander Length (L_m) (ft)	Mean	206	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	11.5
	Min	198		Min	11.1
	Max	215		Max	12.0
12. Linear Wavelength (λ) (ft)	Mean	142	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	7.9
	Min	128		Min	7.2
	Max	155		Max	8.6
14. Radius of Curvature (R_c) (ft)	Mean	20	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	1.1
	Min	15		Min	0.8
	Max	23		Max	1.3

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	1.25	17. D_{35} (mm)	3.25	18. D_{50} (mm)	5.00
19. D_{84} (mm)	13.75	20. D_{95} (mm)	21.00	21. D_{100} (mm)	32.00

Active Bed Riffle Pebble Count

22. D_{16} (mm)	2.9	23. D_{35} (mm)	4.7	24. D_{50} (mm)	6.2
25. D_{84} (mm)	11.5	26. D_{95} (mm)	17	27. D_{100} (mm)	32

Classification

28. Sinuosity (k)	1.54	29. Average Water Surface Slope (S)	.0027
30. Stream Type	E4-C4	31. Valley Type	VIII

Velocity & Discharge

32. Friction Factor (u / u*)	12	33. Relative Roughness (R / D_{84})	43.16
34. Manning's "n" from Friction Factor / Relative Roughness	.024	35. Manning's "n" from Stream Type	.038
36. Estimated Mean Velocity (u_{bkf}) (ft/sec)	4.59	37. Estimated Bankfull Discharge (cfs)	161
38. Estimation Method Selected for Velocity & Discharge	relative roughness / friction factor		

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