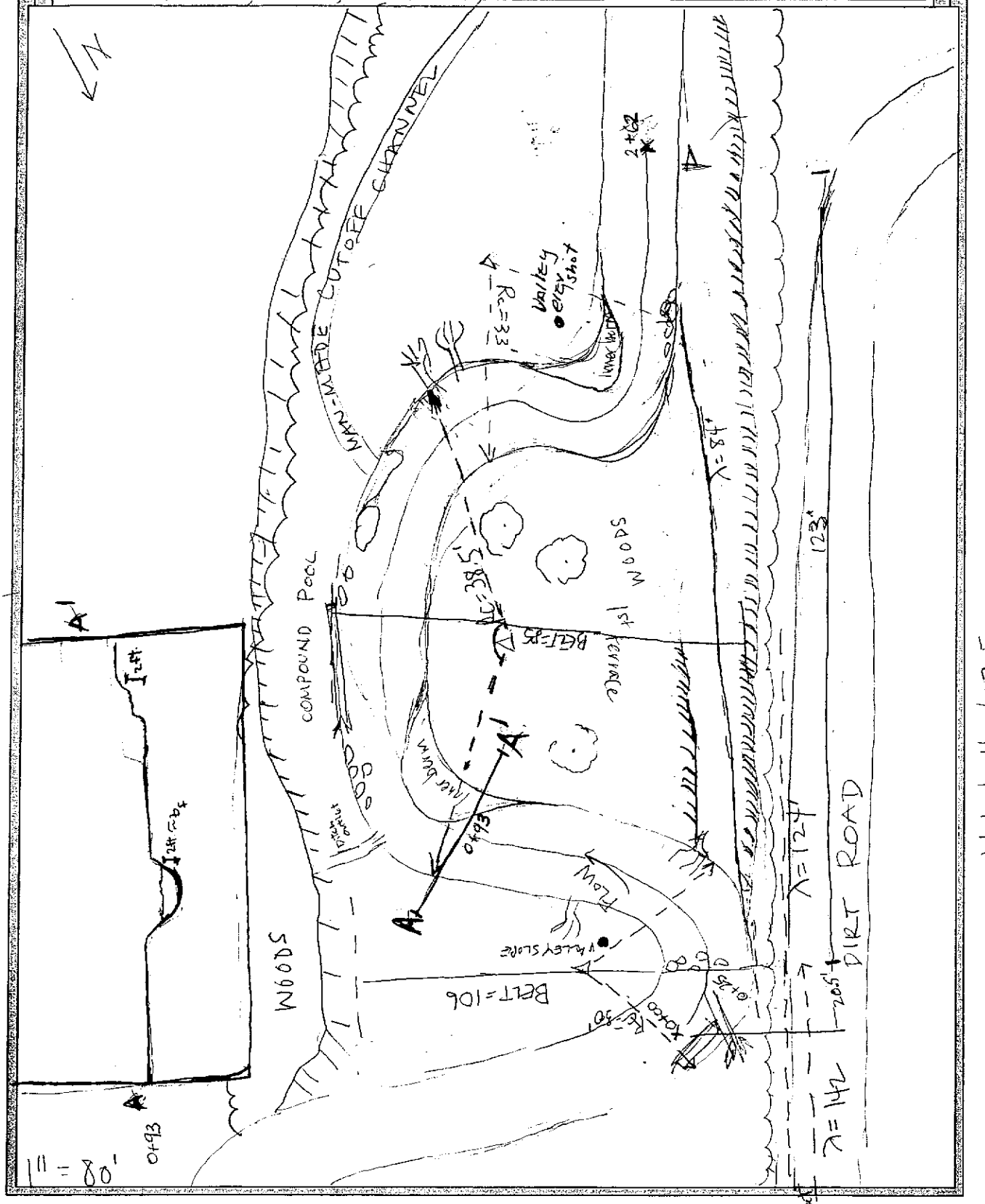
AREA-SITE LOCATION....REACH MAP

Stream: Israel Creek Reach: Team 4 / Reach 4

Drawn By: JK, BW, JJ Date: 4-11-13



Valley length = 1235
Stream Long 1237

Worksheet A-3. Summary of Morphological Variables.

Stream: Israel Creek		Location: Washington Co, MO	
Team: 4 / Reach 4	Date: 4-11-13	Drainage Area: 5.90 mi^2	

Riffle Channel Dimensions

1. Bankfull Width (W_{bkf}) (ft)	18.4	2. Bankfull Mean Depth (d_{bkf}) (ft)	1.77
3. Width/Depth Ratio (W_{bkf} / d_{bkf})	10.40	4. Bankfull Cross-Sectional Area (A_{bkf}) (ft^2)	32.48
5. Bankfull Maximum Depth (d_{max}) (ft)	2.24	6. Width of Flood-Prone Area (W_{fpa}) (ft)	129.5
7. Entrenchment Ratio (ER) (W_{fpa} / W_{bkf})	7.04		

Channel Pattern / **Dimensionless Ratios**

8. Belt Width (W_{blt}) (ft)	Mean	91.3	9. Meander Width Ratio (MWR) (W_{blt} / W_{bkf})	Mean	4.96
	Min	81		Min	4.40
	Max	106		Max	5.76
10. Stream Meander Length (L_m) (ft)	Mean	208.5	11. Meander Length Ratio (MLR) (L_m / W_{bkf})	Mean	11.33
	Min	202		Min	10.98
	Max	215		Max	11.68
12. Linear Wavelength (λ) (ft)	Mean	116.7	13. Linear Wavelength to Bankfull Width (λ / W_{bkf})	Mean	6.34
	Min	84		Min	4.57
	Max	142		Max	7.72
14. Radius of Curvature (R_c) (ft)	Mean	32.63	15. Radius of Curvature to Bankfull Width (R_c / W_{bkf})	Mean	1.77
	Min	29		Min	1.58
	Max	38.5		Max	2.09

Channel Particles

Representative Pebble Count

16. D_{16} (mm)	0.2	17. D_{35} (mm)	0.67	18. D_{50} (mm)	1.8
19. D_{84} (mm)	10.4	20. D_{95} (mm)	70	21. D_{100} (mm)	1024

Active Bed Riffle Pebble Count

22. D_{16} (mm)	1.4	23. D_{35} (mm)	4.5	24. D_{50} (mm)	6.5
25. D_{84} (mm) (12) ~~12.2~~		26. D_{95} (mm)	22.6	27. D_{100} (mm)	362

Classification

28. Sinuosity (k)	1.9	29. Average Water Surface Slope (S)	.00302
30. Stream Type	C5/4	31. Valley Type	VIII(C)

Velocity & Discharge

32. Friction Factor (ū / u*)	12.5	33. Relative Roughness (R / D_{84})	44.8
34. Manning's 'n' from Friction Factor / Relative Roughness	.024	35. Manning's 'n' from Stream Type	~~0.035~~ 0.050
36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec)	5.14	37. Estimated Bankfull Discharge (cfs)	167
38. Estimation Method Selected for Velocity & Discharge	Continuity equation		

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

Stream: ISRAEL CREEK	
Basin: ISREAL CREEK BASIN Drainage Area: 5.40 ~~acres~~	mi²
Location: WASHINGTON Co, MD	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4/9/13
Observers: GROUP 4 / Team 4	Valley Type:

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	18.4	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$).	1.77	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	32.48	ft²
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	10.40	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.	2.24	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.	129.5	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	7.04	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.	1.8	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.	0.0032	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).	1.9	

Stream Type [redacted] incised **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:	Isaac Creek		Location:	Washington Co, WV	
Date:	4-17-13	Stream Type:	C5/4	Valley Type:	VIII (c)
Observers:	CJ / Reach 4		HUC:		

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	32.48	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.77	d_{bkf} (ft)
Bankfull Riffle WIDTH	18.40	W_{bkf} (ft)	Wetted PERIMETER ~ (2 * d_{bkf}) + W_{bkf}	21.94	W_p (ft)
D_{84} at Riffle	12	Dia. (mm)	D_{84} (mm) / 304.8	0.39	D_{84} (ft)
Bankfull SLOPE	.003	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.48	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	37.9	R / D_{84}
Drainage Area	5.4	DA (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	0.39	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $\bar{u} = [\ 2.83 + 5.66 * Log\{ R / D_{84} \}]\ u^*$	4.59	ft / sec	149	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. A-28, A-29) $\bar{u} = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ 0.03	3.5	ft / sec	115	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. A-30) $\bar{u} = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ .05	2.1	ft / sec	69	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 $n =$	N/A	ft / sec	N/A	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	N/A	ft / sec	N/A	cfs
4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$	5.14	ft / sec	167	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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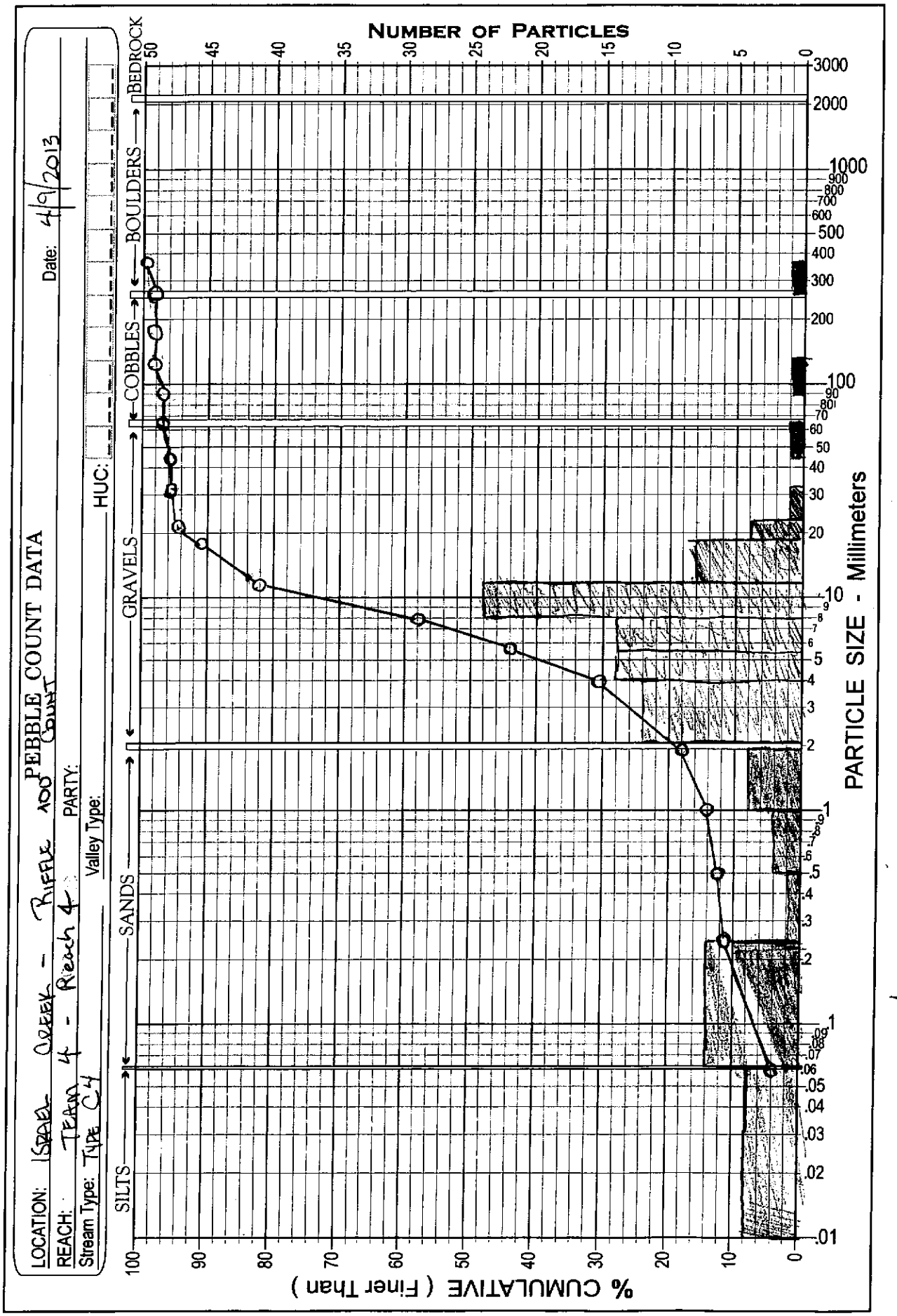

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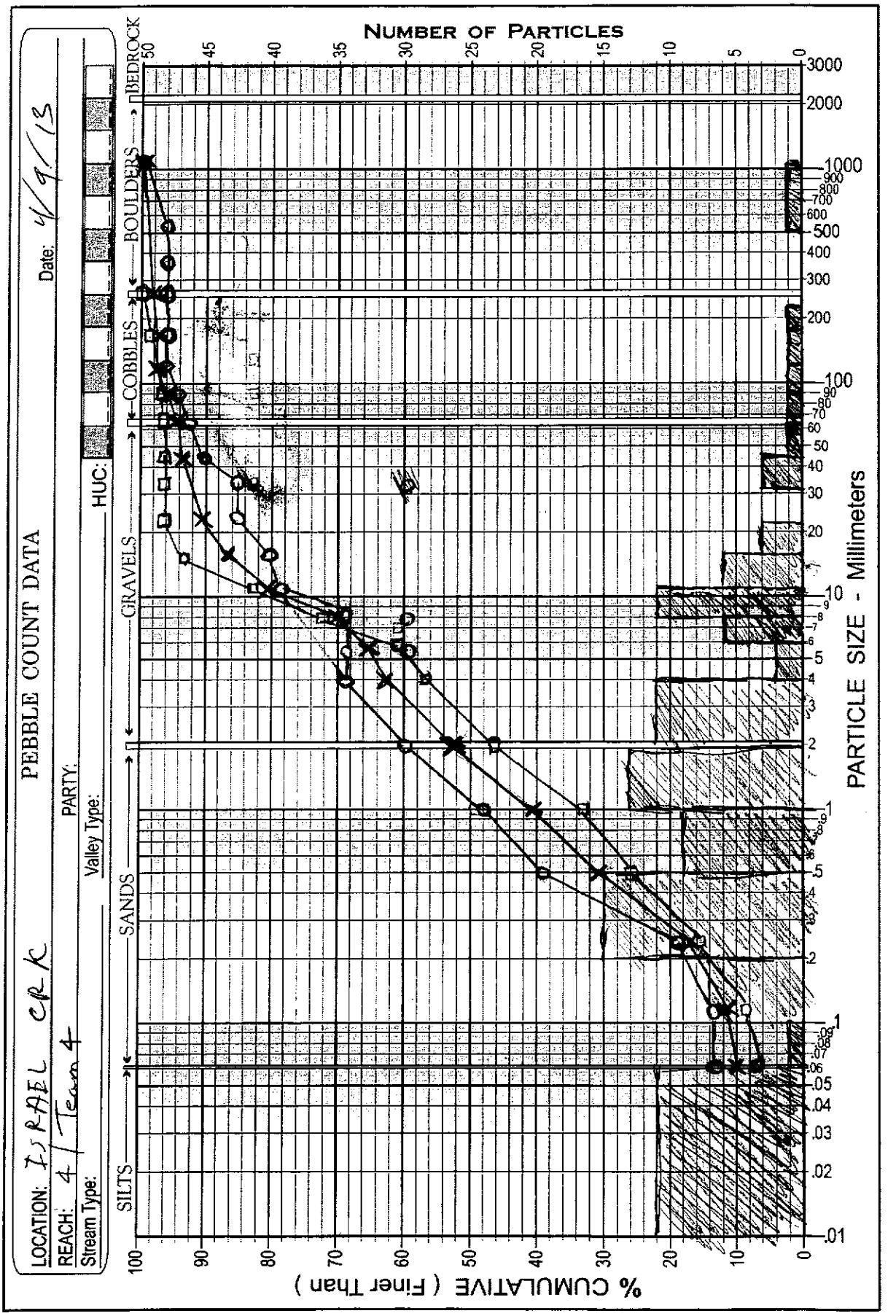

$D_{50} = 18$

⊕ POOL
⊟ NON-POOL
✱ TOTAL

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Non Pool { 345 × ~~160 × 37~~ 504 } Pool { ~~140 × 170 × 45~~ 160 × ~~77~~ × ~~25~~ }

Riffle 165 × Pools 217-247, 171-180

~~12/12/11~~ ~~4/4/13~~ ~~12/11/12~~ 5170

4/9/13

NON Pool → 217-247

POOL/NON-POOL TRANSECTS

Site: ISRAEL CRK

Location: HUC: 1804 9 20 19

Party: #4 / Reach 4

Date:

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				4	7.4	7.4	7	13.5	13.5	11	10.3	10.3
	Very Fine	.062 - .125	SAND				1	1.9	9.3				1	0.9	11.2
	Fine	.125 - .25	SAND				4	7.4	16.7	3	5.8	19.3	7	6.6	17.8
	Medium	.25 - .50	SAND				5	9.3	26.0	10	19.2	38.5	15	14.1	31.9
	Coarse	.50 - 1.0	SAND				4	7.4	33.4	6	9.6	48.1	9	8.5	40.4
.04 - .08	Very Coarse	1.0 - 2	SAND				7	12.9	46.3	6	11.5	59.6	13	12.3	52.7
.08 - .16	Very Fine	2 - 4	GRAVEL				6	11.1	57.4	5	9.6	69.2	11	10.3	63
.16 - .22	Fine	4 - 5.7	GRAVEL				2	3.7	61.1				2	1.9	64.9
.22 - .31	Fine	5.7 - 8	GRAVEL				6	11.1	72.2				6	5.7	70.6
.31 - .44	Medium	8 - 11.3	GRAVEL				6	11.1	83.3	5	9.6	78.8	11	10.3	80.9
.44 - .63	Medium	11.3 - 16	GRAVEL				5	9.3	92.6	1	1.9	80.7	6	5.7	86.6
.63 - .89	Coarse	16 - 22.6	GRAVEL				2	3.7	96.3	2	3.8	84.5	4	3.8	90.4
.89 - 1.3	Coarse	22.6 - 32	GRAVEL												~~90.4~~
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL							3	5.8	90.3	3	2.8	93.2
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL							1	1.9	92.2	1	0.9	94.1
2.5 - 3.5	Small	64 - 90	COBBLE							1	1.9	94.1	1	0.9	95
3.5 - 5.0	Small	90 - 128	COBBLE							2	3.8	97.9	2	1.9	96.9
5.0 - 7.1	Large	128 - 180	COBBLE				1	1.9	98.2				1	0.9	97.8
7.1 - 10.1	Large	180 - 256	COBBLE				1	1.9	100.1				1	0.9	98.7
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512	BOULDER												
20 - 40	Medium	512 - 1024	BOULDER	43						1	1.9	99.8	1	0.9	99.6
40 - 80	Large-Vry Large	1024 - 2048	BOULDER												
	Bedrock		BDRK												
Stream Type:			**Valley Type:**			TOTAL →	54			52			106		

R P R P

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CROSS SECTION
TRANSECT

BRIAN 4/9/2013

Site: Israel Creek Date:
Location: Reach 4 HUC:
Party: Team 4

Dot Count for RIFFLE / RIFFLE / COMP.

Inches	PARTICLE	Millimeters		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:											
	Date:											
	Silt / Clay	< .062	S/C	4	4.1	4.1						
	Very Fine	.062 - .125	SAND									
	Fine	.125 - .25	SAND	7	7.1	11.2						
	Medium	.25 - .50	SAND	1	1.	12.2						
	Coarse	.50 - 1.0	SAND	2	2	14.2						
.04 - .08	Very Coarse	1.0 - 2	SAND	4	4.1	18.3						
.08 - .16	Very Fine	2 - 4	GRAVEL	12	12.2	30.5						
.16 - .22	Fine	4 - 5.7	GRAVEL	14	14.3	44.8						
.22 - .31	Fine	5.7 - 8	GRAVEL	14	14.3	58.1						
.31 - .44	Medium	8 - 11.3	GRAVEL	24	24.5	82.6						
.44 - .63	Medium	11.3 - 16	GRAVEL	8	8.2	90.8						
.63 - .89	Coarse	16 - 22.6	GRAVEL	4	4.1	94.9						
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	1	1	98.9	959					
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL	0	0	~~98.9~~						
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	1	1	96.9						
2.5 - 3.5	Small	64 - 90	COBBLE	0	0	~~96.9~~						
3.5 - 5.0	Small	90 - 128	COBBLE	1	1	97.9						
5.0 - 7.1	Large	128 - 180	COBBLE	0	0	~~97.9~~						
7.1 - 10.1	Large	180 - 256	COBBLE	0	0	~~99~~						
10.1 - 14.3	Small	256 - 362	BOULDER	1	1	99						
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 →	98							

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SURVEY DATA ⟹ **LONGITUDINAL PROFILE 1**

SITE: Irael Creek Date: 4/9/13

Location: Washington Co. Md Team 1 / Reach 4

Party / Notes: John, Ame, BJ HUC: _____

	Distance, Point, or	Back-Sight	Height of Instru-ment	Thalweg		Water Surface		Bankfull		Low Bank HI		NOTES e.g. Riffle Run Pool Glide
				Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	
	STATION	BS	HI	FS	Elev.	FS	Elev.	FS	Elev.	FS	Elev.	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
1	Bm	5.39	105.39									
2	00				95.95		97.05		98.99		100.13	M. Rif
3	23				96.35		97.01					T. Rif
4	28				95.59		96.73					T. Run
5	36				95.48		96.71					T. Pool
6	40				95.05		96.67					Pool
7	50				94.85		96.67					Pool
8	62				94.82		96.71					T. Glide
9	86				96.14		96.68					T. Rif
10	93				96.24				98.50			X-Sec
11	110				95.54		96.43		98.35			T. Pool
12	115				95.48		96.51					Pool
13	121				96.01		96.35					T. Run
14	136				95.34		96.35					Pool
15	146										99.10	LBH
16	150						96.35		98.14			BF
17	153				95.44		96.33					T Glide
18	157						96.39		98.24			BF
19	164				95.80		96.39					T. Run
20	172.5				95.48		96.35					Pool
21	174				95.32							D-Max
22	176				95.55		96.34					T. Glide
23	179						96.31		98.30			BF
24	181				95.76		96.36					T. Run
25	189				95.09		96.36					Pool
26	194				95.26		96.35					T. Glide
27	210				95.73		96.42					T. Run

(WS → BF)

(1.94)

Grade Cont Structure (Rip Rap)

D-MAX

Compound Pool

M. Rif

(1.92)

compound

D.Max

(1.79)

(1.85)

(1.99)

D-Max

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SURVEY DATA → LONGITUDINAL PROFILE 2

SITE: Israel Creek Date: 4/19/2013

Location: Reach 4

Party / Notes: Team 4 HUC:

	Distance, Point, or	Back-Sight	Height of Instru-ment	Thalweg		Water Surface		Bankfull		Low Bank HI		NOTES
				Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	e.g. Riffle Run Pool Glide
	STATION	BS	HI	FS	Elev.	FS	Elev.	FS	Elev.	FS	Elev.	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
28	221.5			10.33	95.06	9.08	96.31	7.10	98.29			Start of Pool (1.98)
29	236			10.55	94.84	9.08	96.31					Pool DMax
30	247			10.45	94.94	(Depth 1.35)	96.33					Top of Glide
31	255			10.00	95.39	9.08	96.31					TOP of Riffle
32	259					9.04	96.35	7.21	98.18	6.18	99.21	LBH/BKF (1.83)
33												
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
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53												
54												

-7/259

.0027

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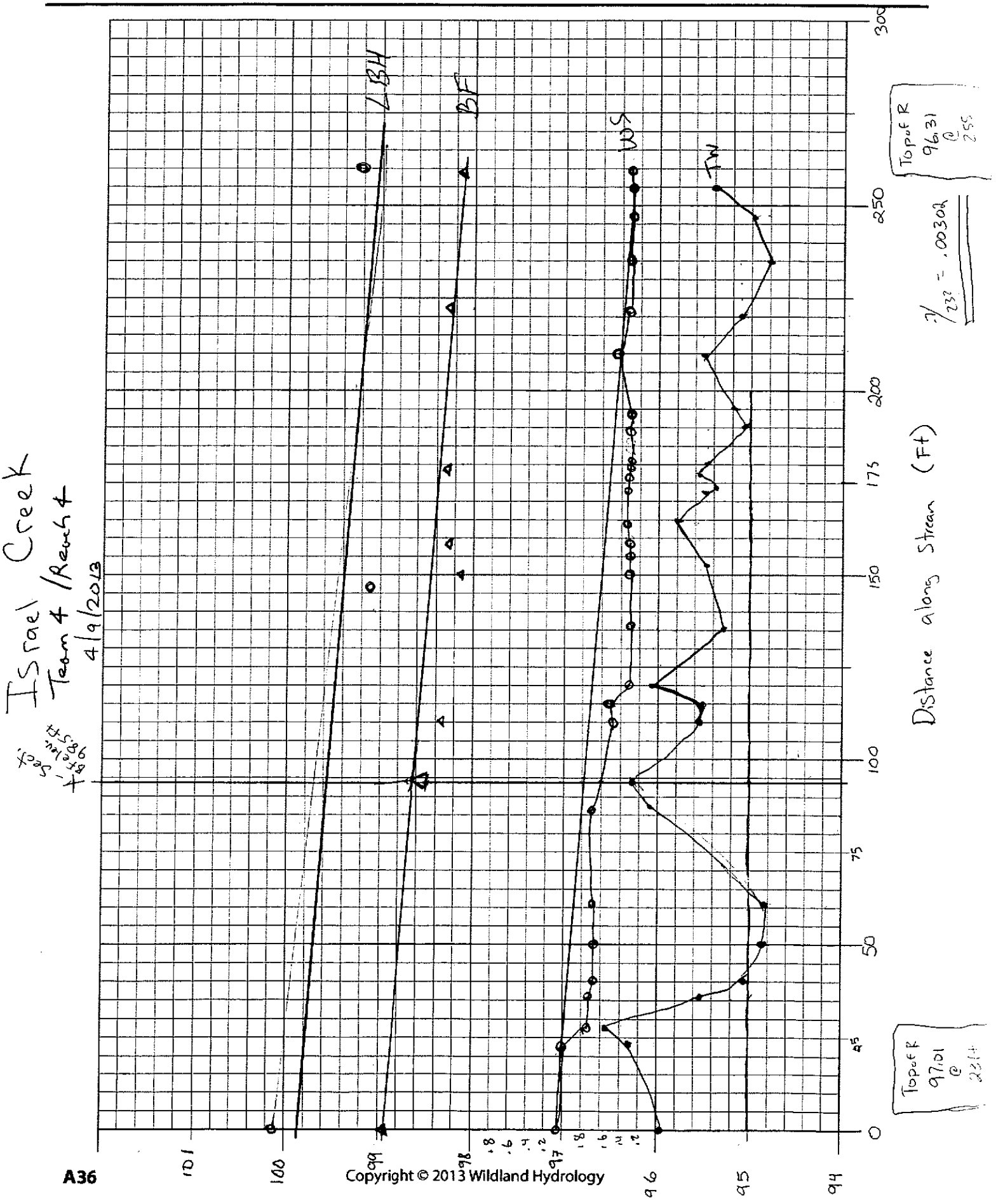

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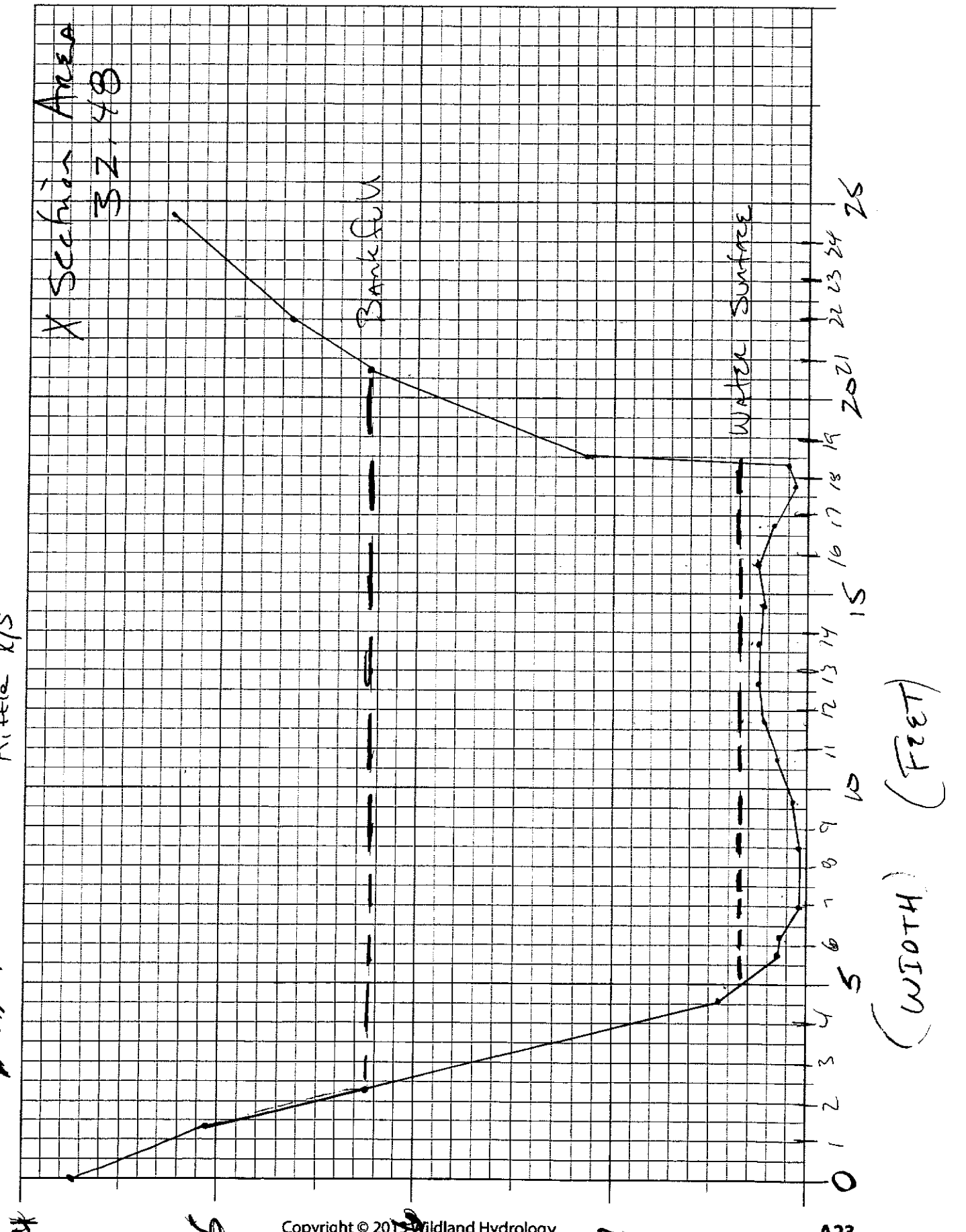

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Team 4/ Reach 4

SURVEY DATA → **CROSS-SECTION 2**

SITE: GROUP 4 ISRAEL CREEK Date: 4/9/13

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	0		108	4.29	[redacted]	LPin top of Bank
30	1.4			4.93	[redacted]	D.S Bank Slope
31	2.2			5.25		L BKF
32	4.51			~~7.54~~	7.65	LEW Toe of Slope
33	5.56			7.84		CB
34	6.10			7.83		CB
35	6.98			7.99	~~99.71~~	Thalweg
36	8.26			7.98		CB
37	9.62			7.92		CB
38	10.68			7.83		CB
39	11.65			7.79		CB
40	12.7			7.76		CB
41	13.7			7.75		CB
42	14.7			7.79		CB
43	15.7			7.76		CB
44	16.7			7.82		CB
45	17.7			7.93		CB
46	18.32			~~7.90~~	7.65	REW
47	19.5			6.88		R Bank Base
48	20.6			5.75		RBKF
49	22.0			5.34		Bank
50	24.53			4.73		R Top of Bank
51						
52						
53						
54						
55						
56						
57						
58						
59						

22

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