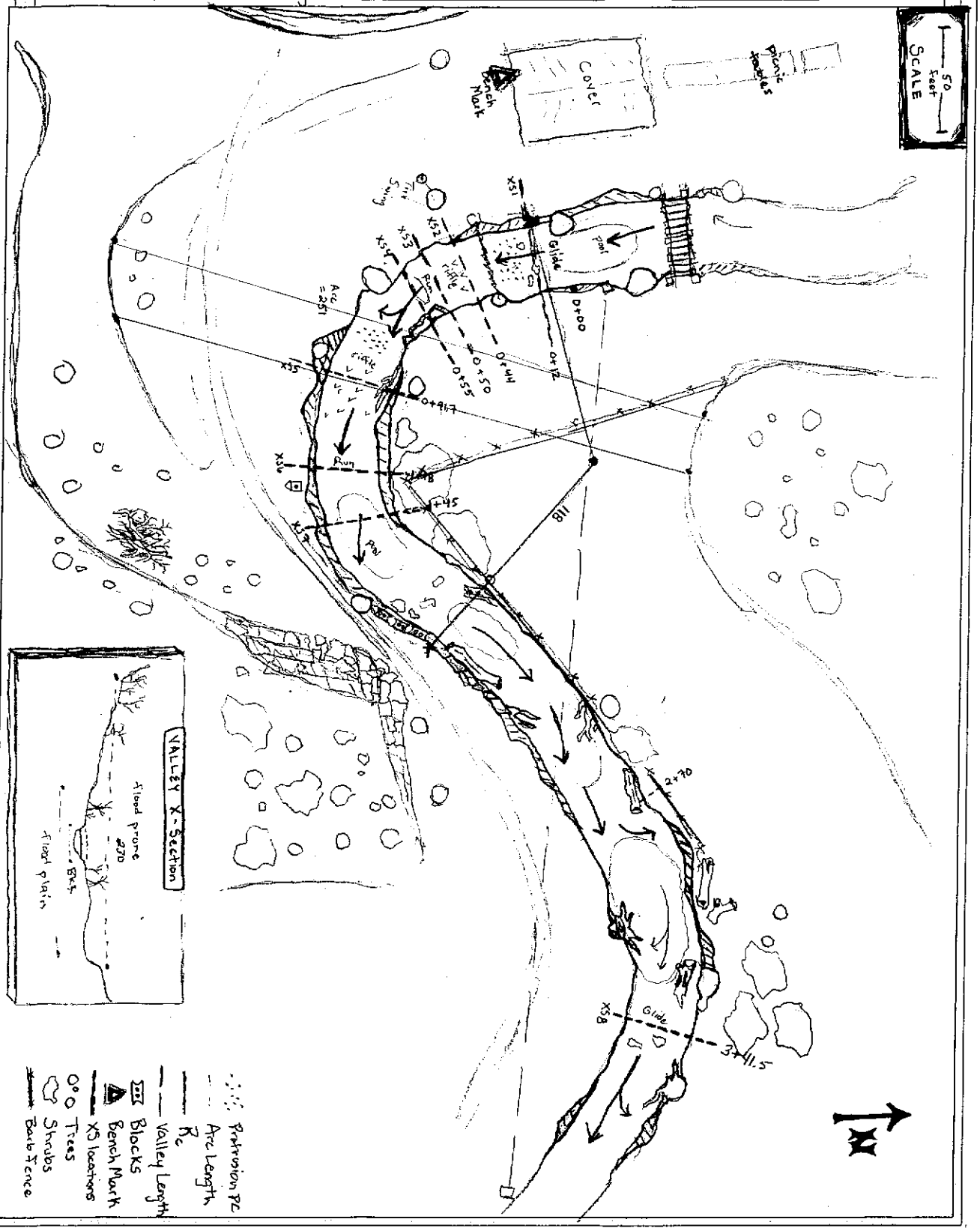
AREA-SITE LOCATION....REACH MAP

Stream: MARSH RUN @ GRIMES Reach: 4

Drawn By: Tina Krueger Date: 4-17-14



XS1 - Rep Rif Protrusion
0+71 Rep Rif Protrusion

Flood Prone
XS 2 - 231

N

1 0+12 G
2 0+44 R
3 0+50 U
4 0+55 P
5 0+97 R
6 1+80.5 U
7 1+45 P
8 3+11.5 G

10 Protrusion
7b Protrusion
1+45 Pool
2.33 Pool
3+25 Pool

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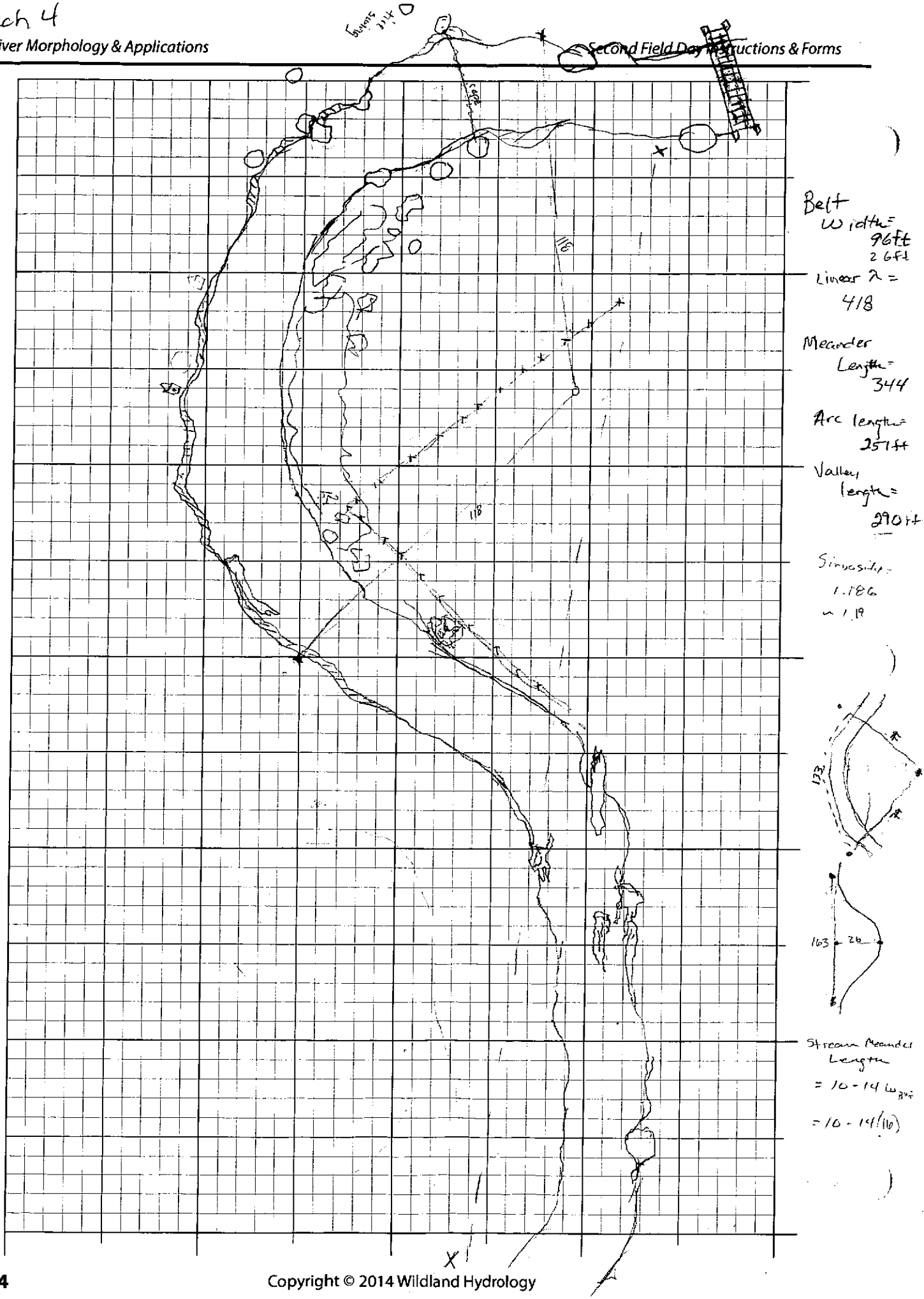

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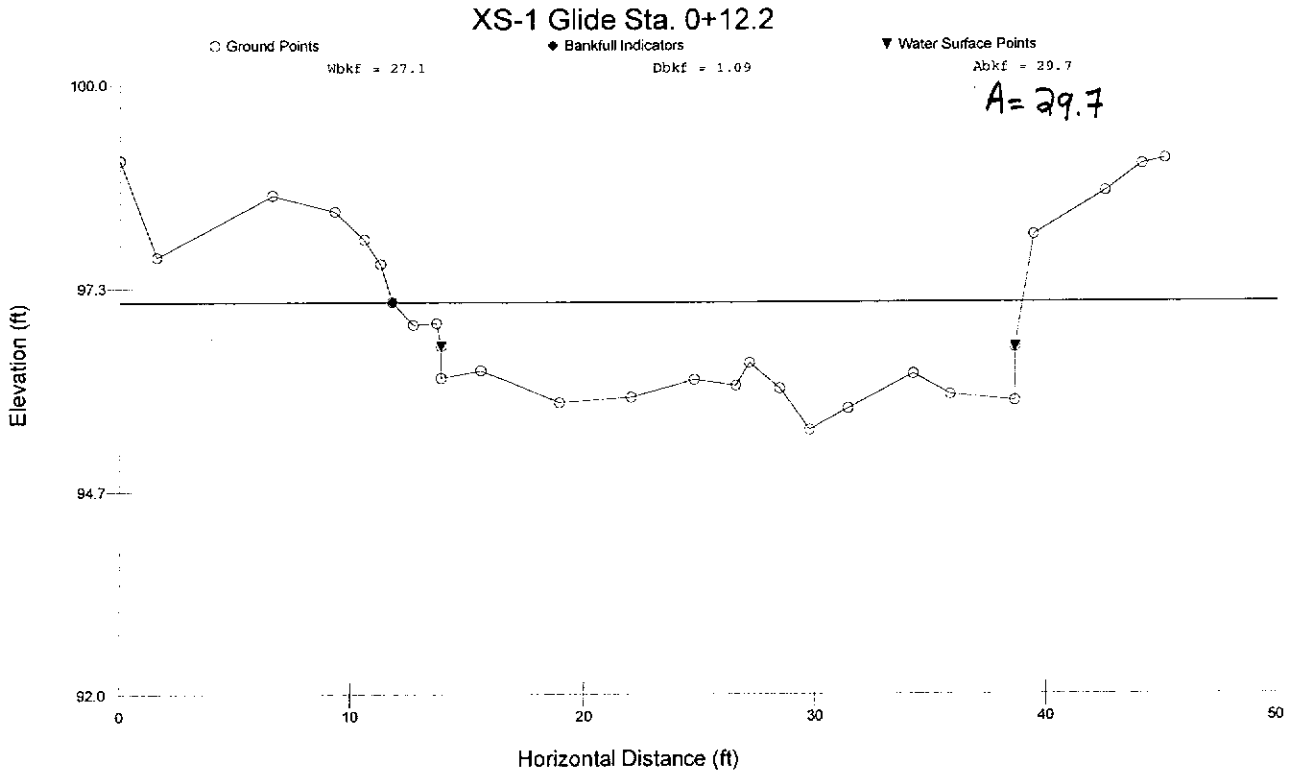
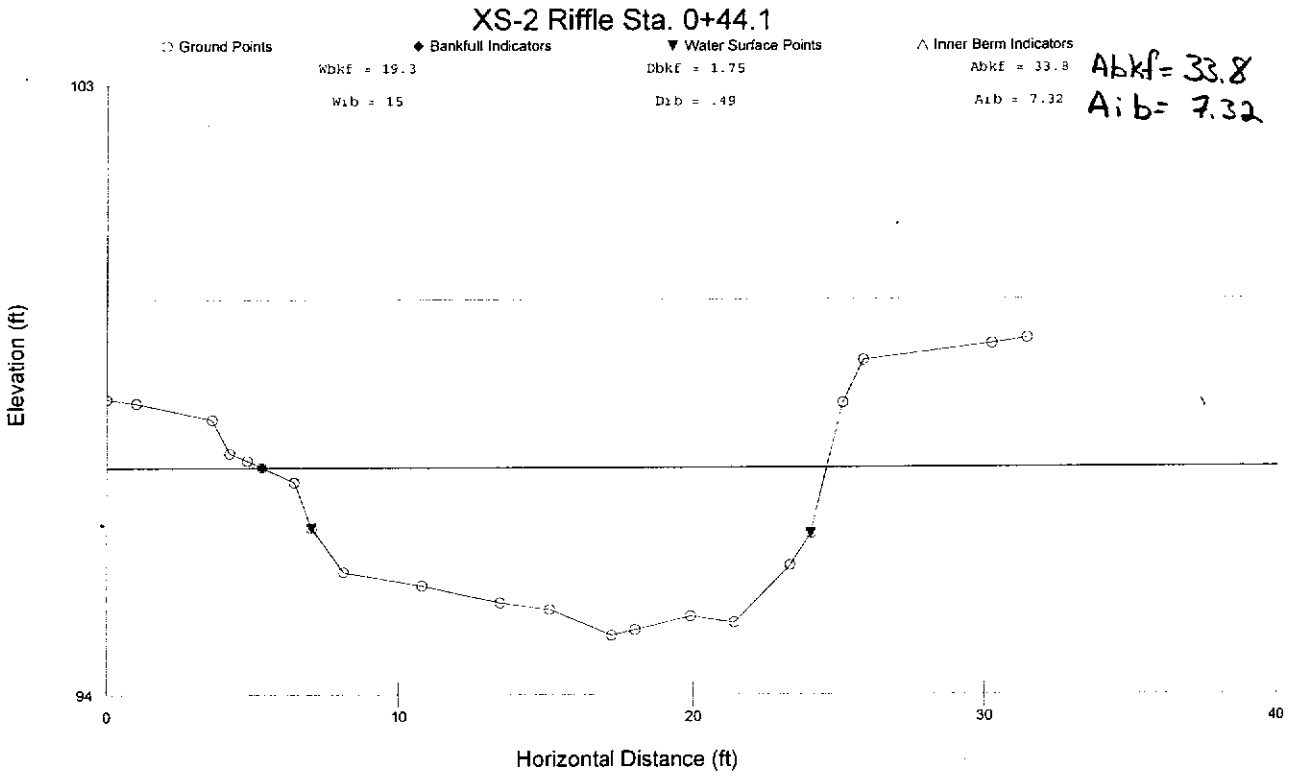
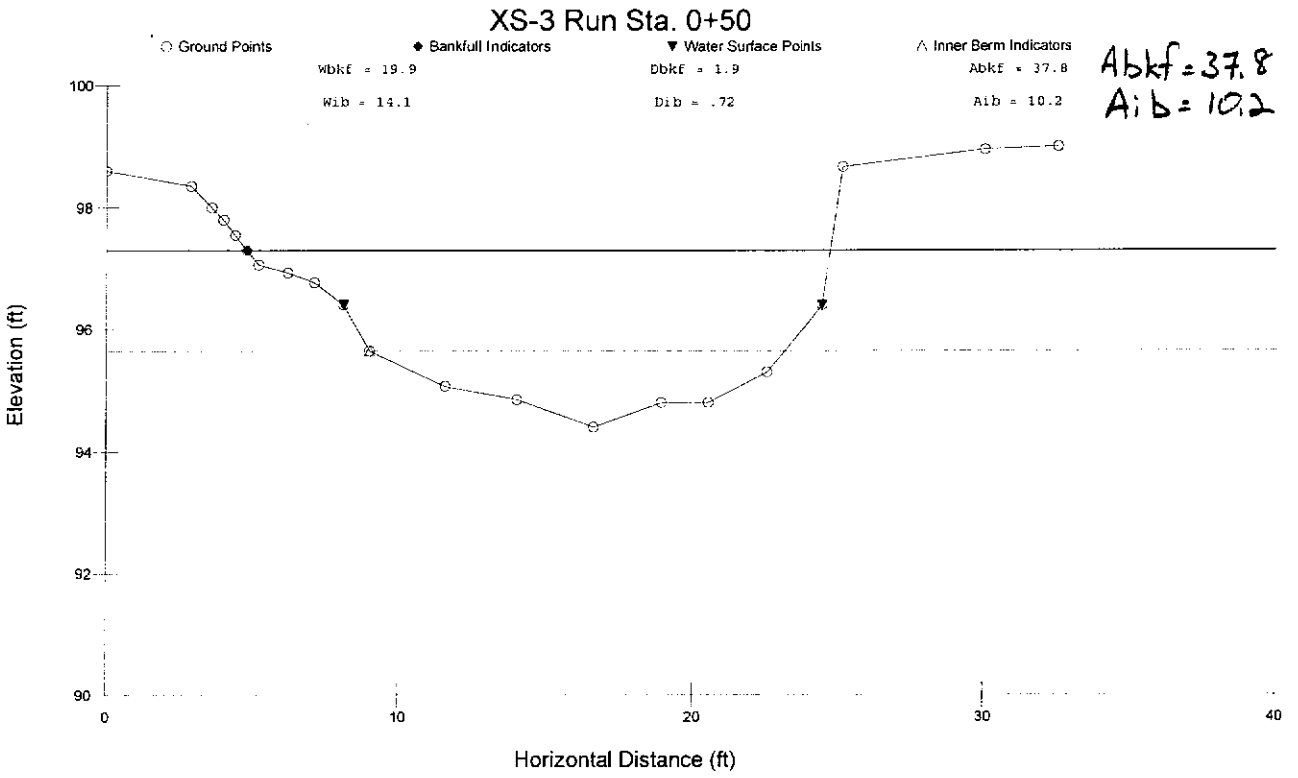
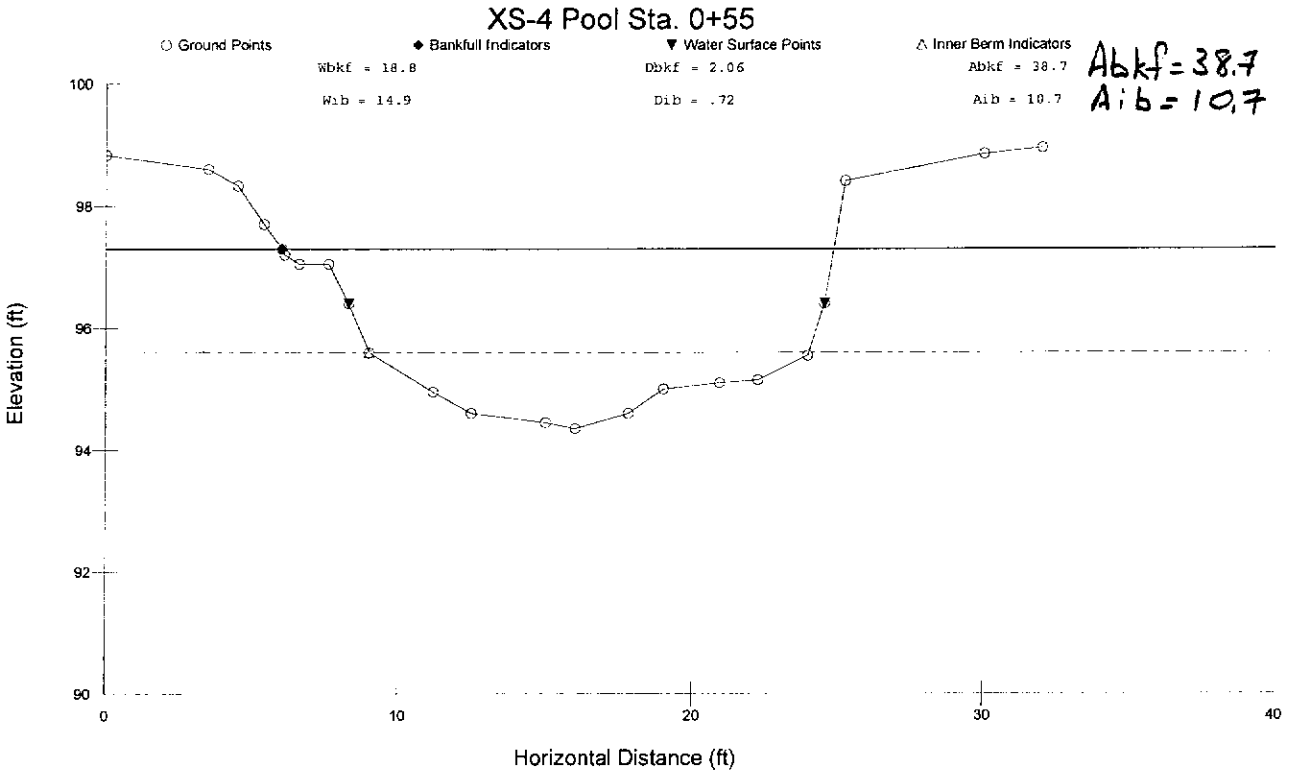
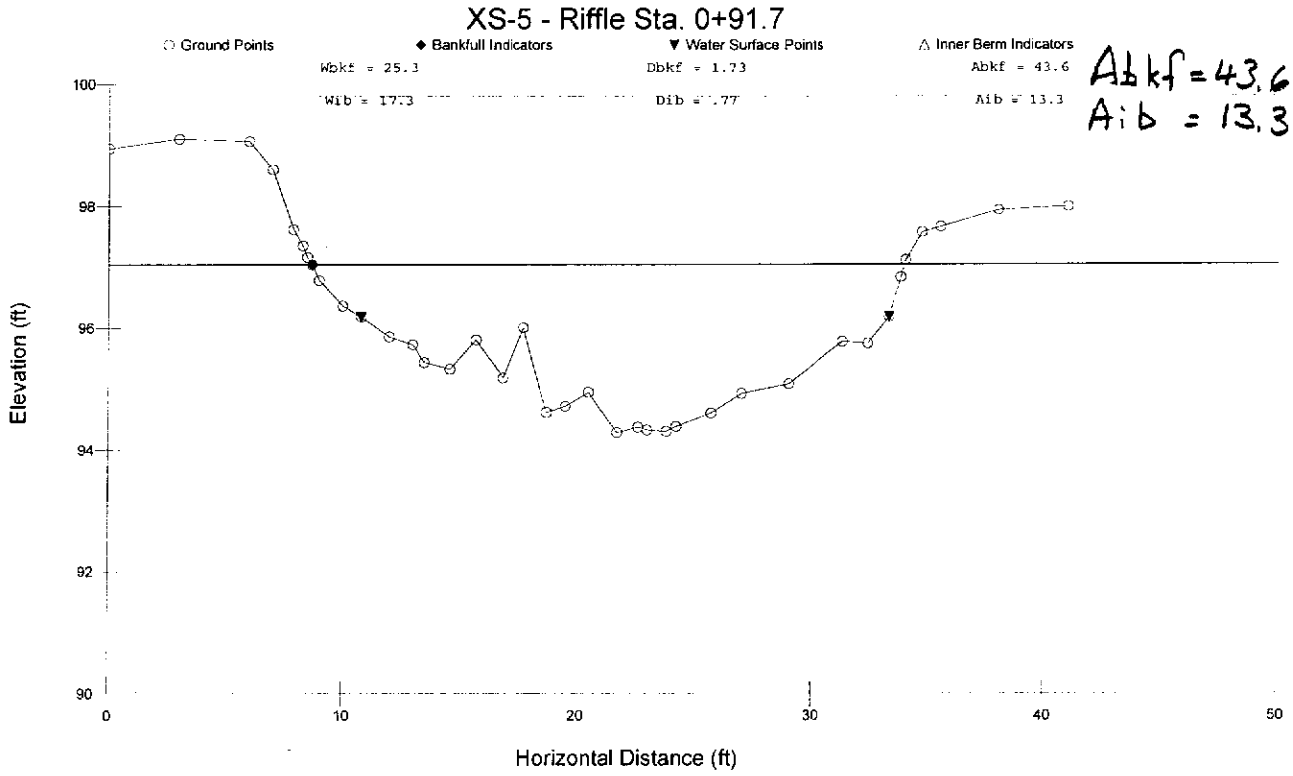

XS-1 Glide Sta. 0+12.2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 27.1
Dbkf = 1.09
Abkf = 29.7
A= 29.7
100.0
97.3
94.7
92.0
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)


XS-2 Riffle Sta. 0+44.1
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 19.3
Wib = 15
Dbkf = 1.75
Dib = .49
Abkf = 33.8
Aib = 7.32
Abkf = 33.8
Aib = 7.32
Elevation (ft)
103
94
0
10
20
30
40
Horizontal Distance (ft)


XS-3 Run Sta. 0+50
Ground Points
Bankfull Indicators
Water Surface Points
Inner Berm Indicators
Wbkf = 19.9
Wib = 14.1
Dbkf = 1.9
Dib = .72
Abkf = 37.8
Aib = 10.2
Abkf = 37.8
Aib = 10.2
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
Horizontal Distance (ft)


XS-4 Pool Sta. 0+55
○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
△ Inner Berm Indicators
Wbkf = 18.8
Wib = 14.9
Dbkf = 2.06
Dib = .72
Abkf = 38.7
Aib = 10.7
Abkf = 38.7
Aib = 10.7
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
Horizontal Distance (ft)



Abkf = 43.6
Aib = 13.3

SURVEY DATA ⟹ **CROSS-SECTION 1**

SITE: MARSH RUN AT GRIMES XS-1 GLIDE Date: 4/18/14

Location: WASH. CO. MARYLAND REACH 4 STA +12.2

Party / Notes: NS MD 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	4.65	104.165		100	
2	0			5.65		TOB / FP
3	1.6			6.91		
4	6.6			6.10		
5	9.3			6.31		
6	10.6			6.68		
7	11.3			7.0		EST BKF - Likely not valid
8	11.8			7.5		EST BKF - Likely no valid
9	12.7			7.82		
10	13.7			7.78		
11	13.9			8.50		EEW
12	13.9			8.08		WSE
13	15.6			8.4		
14	18.9			8.82		
15	22.0			8.75		
16	24.7			8.52		Boulder
17	26.5			8.60		
18	27.1			8.30		BOULDER
19	28.4			8.64		BOULDER
20	29.7			9.18		
21	31.4			8.9		
22	34.2			8.45		
23	35.8			8.72		
24	38.6			8.80		REW
25	38.6			8.10		WSE
26	39.4			6.62		
27	42.5			6.05		
28	44.1			5.70		

1.58

8.05
7.00
1.05

415.1

5.63 TOB

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SURVEY DATA ⟹ **CROSS - SECTION 2**

SITE: MARSH RUN @ GRIMES XS-2 RIFFLE STA 0+44 Date: 4/17/14 STA 0+44.1

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	BM	4.65	104.65		100	
30	0			6.29		
31	1			6.35		
32	3.6			6.59		TOB
33	4.2			7.09		
34	4.8			7.2		
35	5.3			7.3		BKF * 0.9
36	6.4			7.52		~~BKF ?~~
37	7.0			8.2		WSE / LEW 8.2 − 7.3 = 0.9
38	8.1			8.85		
39	10.8			9.05		
40	13.4			9.30		
41	15.1			9.40		
42	17.2			9.78		THAL
43	18			9.70		
44	19.9			9.50		
45	21.4			9.59		
46	23.3			8.75		
47	24.0			8.28		RAW / WSE
48	25.1			6.35		
49	25.8			5.72		TOB
50	30.2			5.48		
51	31.4			5.40		
52						FPA:
53						2.48 MAX DEPTH (BKF)
54						2 × 4.96'
55						= 4.82 ROD READING
56						Right Bank 108'
57						Left Bank 101' = 209' + 22.2 = 231.2
58						
59						

8.2

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SURVEY DATA → **CROSS-SECTION** 3

SITE: Marsh Run @ Corms RUN XS 3 STA+50 Date: 4/17/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	Bm	4.65	104.65			
30	0			6.05		
31	2.9			6.3		
32	3.6			6.65		
33	4.0			6.85		BKF ?
34	4.4			7.1		
35	4.8			7.35		BKF *
36	5.2			7.59		
37	6.2			7.72		
38	7.1			7.88		
39	8.1			8.25		LEW
40	9.0			9.0		
41	11.6			9.58		
42	14.0			9.80		
43	16.6			10.25		
44	18.9			9.85		
45	20.5			9.85		
46	22.5			9.35		
47	24.4			8.25		RFW / WSE
48	25.1			5.98		
49	30			5.70		
50	32.5			5.65		—
51						
52						
53						
54						
55						
56						
57						
58						
59						

8.25
7.35
.90

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SURVEY DATA ⟹ **CROSS-SECTION** 4

SITE: MARSH RUN XS 4 POOL STA 55 Date: 4/15/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	BM	4.65				
30	0			5.82		
31	3.5			6.05		
32	4.5			6.32		
33	5.4			6.95		BKF?
34	6.0 6.1			7.35 7.45		BKF
35	6.6			7.60		
36	7.6			7.60		
37	8.3			8.25		LEW
38	9.0			9.05		
39	11.2			9.70		
40	12.5			10.05		
41	15.0			10.2		
42	16.0			10.3		
43	17.8			10.05		bottom pt bar →
44	19.0			9.65		
45	20.9			9.55		
46	22.2			9.5		
47	23.9			9.1		
48	24.5			8.25		REW
49	25.2			6.24		
50	30			5.8		
51	32			5.7		
52						
53						
54						
55						
56						
57						
58						
59						

^8.25
7.35
1.80

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SURVEY DATA ⟹ **CROSS - SECTION 5**

SITE: Riffle 2 Reach 4 Date: 4-17-14

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES / COMMENTS / REMARKS
29		4.08	104.08		100.00	TBM
30	0			5.14		hi bk Long Pro 91.7
31	3			4.98		hi bk
32	6			5.02		Top hi bk
33	7			5.46		
34	7.9			6.46		
35	8.3			6.73		
36	9.0 ← 8.5 8.7			7.30 ← 6.92 7.04		BFL?
37	10.0			7.72		side bar
38	10.8			7.90		LEW
39	12.0			8.23		→ BFL
40	13.0			8.36		
41	13.5			8.65		
42	14.6			8.76		
43	15.7			8.28		
44	16.8			8.90		
45	17.7			8.08		
46	18.7			9.47		
47	19.5			9.37		
48	20.5			9.14		
49	21.7			9.80		Thlweg
50	22.6			9.71		
51	23.0			9.76		
52	23.8			9.78		
53	24.2			9.70		
54	25.7			9.48		
55	27.0			9.16		
56	29.0			9.00		
57	31.3			8.31		
58	32.4			8.34		
59	33.3			7.90		REW

33.8	7.25
34.	6.97
34.7	6.51
	Top of Pipe
35.5	6.42
	Terrace
38.0	6.15
41.0	6.09

9.80 - 5.52 = 4.28

FP width 199 ft

199/23 = 8

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SURVEY DATA → **CROSS - SECTION 6**

SITE: Run 2 Reach 4 1+18.5 Date: 4/17/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29		4.08	104.08		100.0	
30	0			5.15		tape
31	2.6			5.5		tape
32	4.0			5.79		L slope
33	5.0			5.89		"
34	6.0			6.14		"
35	6.5			6.31		"
36	7.0			6.54		"
37	7.5			6.94		BKF? (1.01)
38	7.6			7.45		L slope
39	7.9			7.68		L slope
40	9.1			~~Bot~~	7.95	LEW
41	9.8			8.36		bed
42	10.8			8.65		"
43	11.6			8.9		"
44	12.2			9.1		" (bedrock)
12.7 45	~~8.7~~			9.1		"
46	13.0			8.98		" 29.0 / 8.26 bed (bedrock)
47	14.0			8.98		" 29.2 / ~~8.96~~ REW 7.95
48	16.8			9.12		" 29.4 / 7.78 R slope
49	17.9			9.25		" 29.9 / 7.28 "
50	19.0			9.3		" 30.5 / 6.57 "
51	19.8			9.36		" 30.7 / 6.36 "
52	20.2			9.1		" 31.0 / 5.85 Top of Rock
53	21.0 21.6			9.04 9.08		" 31.5 / 5.8 "
54	22.0 23.0			9.16 9.24		" 32.7 / 5.76
55	24.8? 23.8 25.8			9.19 9.18		" 35.3 / 5.83
56	25.4 25.7			9.15 9.17		" 36.0 / 5.82
57	26.0 26.4			9.11 9.17		"
58	27.5 28.0			9.13 9.09		"
59	28.5? 21.5 28.7			9.0 8.74		"

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SURVEY DATA → **CROSS - SECTION 7**

SITE: Pool 2 Reach 4 Date: 9/17/14

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	0			5.18		Long Pro 145 top of bank slope toe of High terrace
30	1.0			5.73		
31	2.0			6.05		slope
32	2.5			6.14		
33	2.8			6.30		
34	3.0			6.52		
35	3.3			6.74		
36	3.6			6.95		~ 154
37	3.8			7.15		
38	4.0			7.32		
39	4.5			7.44		
40	5.0			7.61		
41	5.5			7.68		
42	6.0			7.82		
43	6.8			7.98		LEW
44	7.0			8.11		
45	8.0			8.54		
46	11.0			9.09		
47	13.0			9.24		
48	15.0			9.24		
49	17.0			9.25		
50	19.0			9.40		thalweg
51	20.0			9.21		
52	20.8			9.12		
53	21.8			9.13		
54	22.2			8.89		cobble
55	TP1	5.20		6.13	7.04	IH = 103.15
56	22.5			7.98	8.91	
57	22.8			7.58	8.51	
58	23.3			7.51	8.44	
59	23.6			7.04	7.97	REW

104.68
6.13
97.55
5.70
103.15

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23.7	6.83	7.76
24.1	6.26	7.19
24.4	5.79	6.72
24.8	5.60	6.61
25.4	5.54	6.47
26.0	5.40	6.33
26.8	5.29	6.22 Top of Bank
27.5	5.05	6.18
29.0	5.18	6.11
33.0	5.20	6.13

HI = 51.201

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SURVEY DATA ⟹ **CROSS - SECTION 8**

SITE: Glade 2 XS 8 STA: 3+41.5 Date: ~~3+41.5~~ 4/17/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	BM	2.8	102.8			
30	0			5.3		L terrace
31	2.0			5.5		
32	3.4			5.8		
33	4.5 4.8			6.05 6.22		BKF ~~BKF~~
34	5.6 5.8			6.62 7.22		
35	5.8 7.1			6.88 7.42		LEW
36	8.2 9.17			~~7.65~~ 7.65	7.62	
37	10.2 10.8			7.00 7.95		Bidet
38	14.3 17.0			~~7.55~~ 7.62		
39	19.6 21.8			7.68 7.65		
40	23.5 24.5			7.48 7.55		
41	25.5 25.8			7.20 6.85		REW
42	26.1 26.6			6.55 ~~6.32~~		~~BKF~~ 2
43	27.9 30.0			6.14 6.01		
44	29.0			6.09		
45	31.0			5.95		
46	34.9			5.85		
47	37			5.65		
48	43			5.68		—
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						

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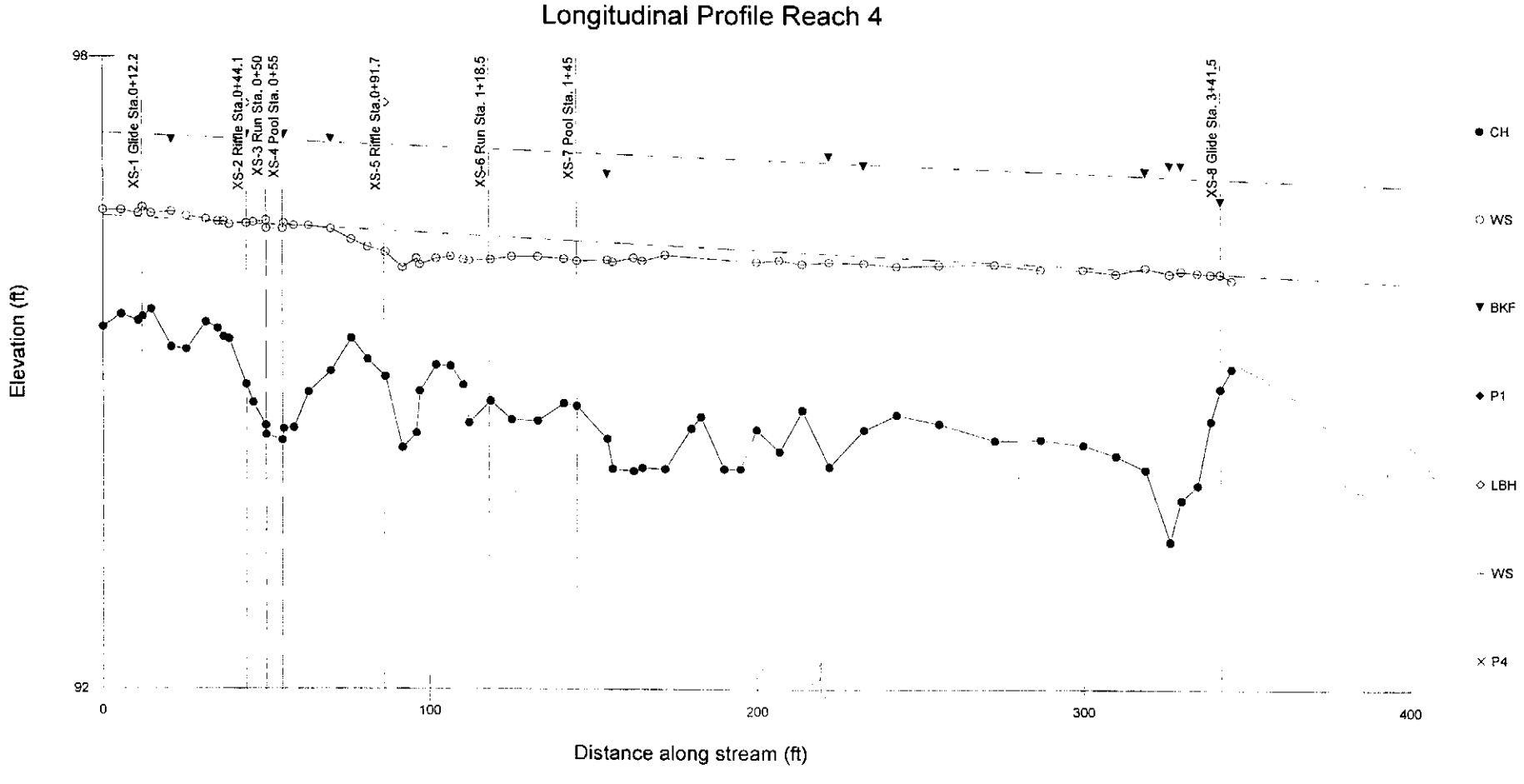
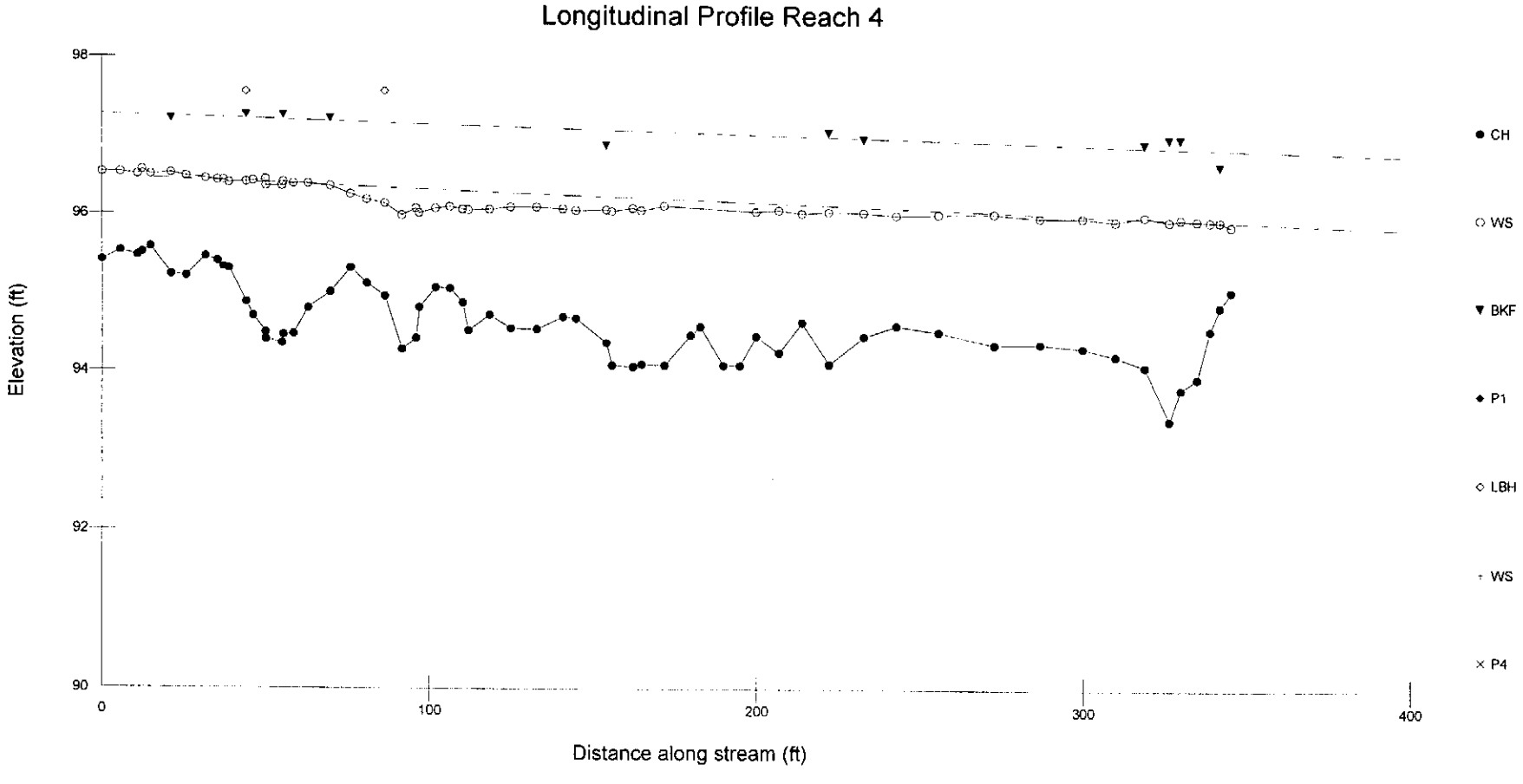


WS Slope = 0.0158
BNKF Slope = 0.0123


Longitudinal Profile Reach 4
Elevation (ft)
98
96
94
92
90
0
100
200
300
400
Distance along stream (ft)
CH
WS
BKF
P1
LBH
WS
P4

SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: Marsh Run @ Grimes Date: 4/17/14

Location: Reach 4

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 Elev. ft	Low Bank HI Fore-Sight FS ft	Low Bank HI Elevation Elev. ft	NOTES e.g. Riffle Run Pool Glide
1	BM	3.22	103.22									~~GLIDE~~
2	0			7.81		6.89						GLIDE
3	5.6			7.69		6.69						
4	10.1			7.15		6.64		5.38	1.26			
5	10.8			6.93		6.72						ROCK RIFFLE
XS1 6	12.2			7.71		6.66						RIFFLE XS←
7	14.8			7.64		6.72						
8	21			8.00		6.70		6.01? 5.46!	0.69 1.3			
9	25.6			8.02		6.74						
10	31.6			7.76		6.77						Rocks @ Bore
11	35.2			7.82		6.79						
12	37.0			7.90		6.79						BEFORE RIFFLE
13	38.7			7.92		6.82						RIFFLE TOP RIFFLE
XS2 14	44			7.97		6.81		5.96	0.85			XSECT.
15	46.1			8.52		6.8						
XS3 16	49.9			8.73		6.78						
XS4 17	55.4			8.76		6.81		5.96	0.85			
18	58.5			8.75		6.83						GLIDE
19	63.0			8.42		6.83		5.56 6.11?	1.27 0.72			
20	69.8			8.22		6.86		6.00	0.84			RIFFLE
21	76			7.91		6.96						ERODED BANKS
22	81			8.11		7.03						
23	86.5			8.13		7.08						
XS5 HIKE BACK → 24	91.7			8.87		7.23						XSECT RIFFLE 2
25	96			8.80		7.14						~~BEDROCK~~
26	102			8.16		7.14						ROCK ACROSS THE FLAT CUTOFF AREA
27	106.4			8.17		7.12						

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SURVEY DATA → LONGITUDINAL PROFILE 2

SITE: Marsh Run @ Grimes Date: 4/17/14

Location: Reach 4

Party / Notes: Team 1 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	110.3			8.35		7.15						
29	112			8.70		7.16						
XS6 30	118.5			8.76		7.15						
31	125			8.67		7.12						
32	133			8.68		7.12		6.60?				
33	141			8.52		7.14						
34	154.3			8.85		✓7.15		6.33	0.82			
35	156			9.13		7.17						
36	162.4			9.15		7.13		6.44?	0.69			
37	165			9.12		✓7.16						
38	172			9.13		7.1						
39	180			8.75								
40	183			8.64								
41	190			9.13								
42	195			9.13								
43	200			8.76		7.17						
44	207			8.97		7.15						
45	214			8.58		7.19						
46	222.3			9.19		7.17		6.16	.99			
47	233			8.76		7.18		6.25?	6.71 .97			
48	243			8.62		7.21						
49	256			8.70		7.2						
50	273			8.86		7.19						
51	287			8.85		7.24						
52	300			8.90		7.24		6.67	0.57			
53	310			9.0		7.28						
54	319			9.13		7.22		6.3	.76			

BEDROCK BOTTOM

RUN #1 2XS BEDROCK BOTTOM

POOL ? XS

OUTSIDE BEND

BLOCK WALL RIGHT BANK

ROCK OUT CROPPING

END BLOCK WALL

GRAVELLY / MUD

6.46?

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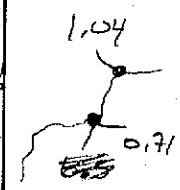
SURVEY DATA ⟹ **LONGITUDINAL PROFILE 3**

SITE: Marsh Run @ Grimes Date: 4/17/14

Location: Reach 4

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 Elev. (ft)	Low Bank HI Fore-Sight FS (ft)	Low Bank HI Elevation Elev. (ft)	NOTES e.g. Riffle Run Pool Glide
55	326.5			9.81		7.28		6.24 6.57	1.04 0.71			
56	330			9.42		7.28		6.24 6.54	0.71			
57	335			9.28		7.27						
58	339			8.67		7.28						
59	342			8.17		7.28						
XS 6 60	345.4			8.18		7.34		6.58	0.76			
61												
62												
63												
64												
65												
66												
67												
68												
69												
70												
71												
72												
73												
74												
75	145			8.45		7.16		6.47	0.69			
76	50			8.81		6.86						
77	55			8.69		6.86						
78	97			8.41		7.20						
79												
80												
81												



@ GLIDE XS
RIFFLE

XS
RUN

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Potrusion Height ~ Representative Riffle

4/17/14

1

Site: Marsh Run						Date: 4/17/14	RIFFLE (1)			~~POOL~~ (2)			COMPOSITE (3)		
Location: Grimes			HUC:				Reach: 4			Reach: 4			Reach:		
Party: Team 1				Dot Count for			Date: 4/17/14			Date: 4/17/14			Date:		
Inches	PARTICLE	Millimeters		RIFFLE 1	~~POOL~~ Riffle 2	COMP. 3	TOT #	ITEM %	% CUM	TOT #	ITEM %	% CUM	TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C	STA 0+10	0+74										
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 2								2		2			
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7													
.22 - .31	Fine	5.7 - 8													
.31 - .44	Medium	8 - 11.3					1								
.44 - .63	Medium	11.3 - 16					1								
.63 - .89	Coarse	16 - 22.6					3								
.89 - 1.3	Coarse	22.6 - 32					3			6		8			
1.3 - 1.8	Very Coarse	32 - 45					3			3		11			
1.8 - 2.5	Very Coarse	45 - 64					11			14		25			
2.5 - 3.5	Small	64 - 90	COBBLE				16			10		35			
3.5 - 5.0	Small	90 - 128					27			24		59			
5.0 - 7.1	Large	128 - 180					21			20		69			
7.1 - 10.1	Large	180 - 256					12			17		96			
10.1 - 14.3	Small	256 - 362	BOULDER				2			2		98			
14.3 - 20	Small	362 - 512								1		99			
20 - 40	Medium	512 - 1024								1		100			
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type:			**Valley Type:** V 111			TOTAL→	100								

Alluvial Unconfined

Dot = 150

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Two Protrusion Riffles

Reach Average - Reach 4

Site: Marsh Run Date: 4/17/14

Location: Grimes Gage HUC:

Party: Team1 BB / MB

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	(rank 2)			2		2	2		2			
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25	SAND				1		3						
	Medium	.25 - .50	SAND												
	Coarse	.50 - 1.0	SAND												
.04 - .08	Very Coarse	1.0 - 2	SAND				3		6	1		3			
.08 - .16	Very Fine	2 - 4	GRAVEL				1		7						
.16 - .22	Fine	4 - 5.7	GRAVEL				1		8	1		4			
.22 - .31	Fine	5.7 - 8	GRAVEL				1		9						
.31 - .44	Medium	8 - 11.3	GRAVEL				1		10						
.44 - .63	Medium	11.3 - 16	GRAVEL												
.63 - .89	Coarse	16 - 22.6	GRAVEL												
.89 - 1.3	Coarse	22.6 - 32	GRAVEL												
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL				1		11						
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL				1		12						
2.5 - 3.5	Small	64 - 90	COBBLE				1								
3.5 - 5.0	Small	90 - 128	COBBLE												
5.0 - 7.1	Large	128 - 180	COBBLE				3		15	1		5			
7.1 - 10.1	Large	180 - 256	COBBLE				5		20						
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512	BOULDER				1		21						
20 - 40	Medium	512 - 1024	BOULDER				1		22						
40 - 80	Large-Vry Large	1024 - 2048	BOULDER							35					
	Bedrock		BDRK				38		60			40			
Stream Type:			**Valley Type:**		40	TOTAL→									

Pool 2 (1.45)
3" silt veneer above bedrock

Pool 3 (2.23)
10" silt over bedrock on left
25%

Pool 1111
LF 11|11

Pool 4 (3.25)
3" silt veneer on L 10%
of bank

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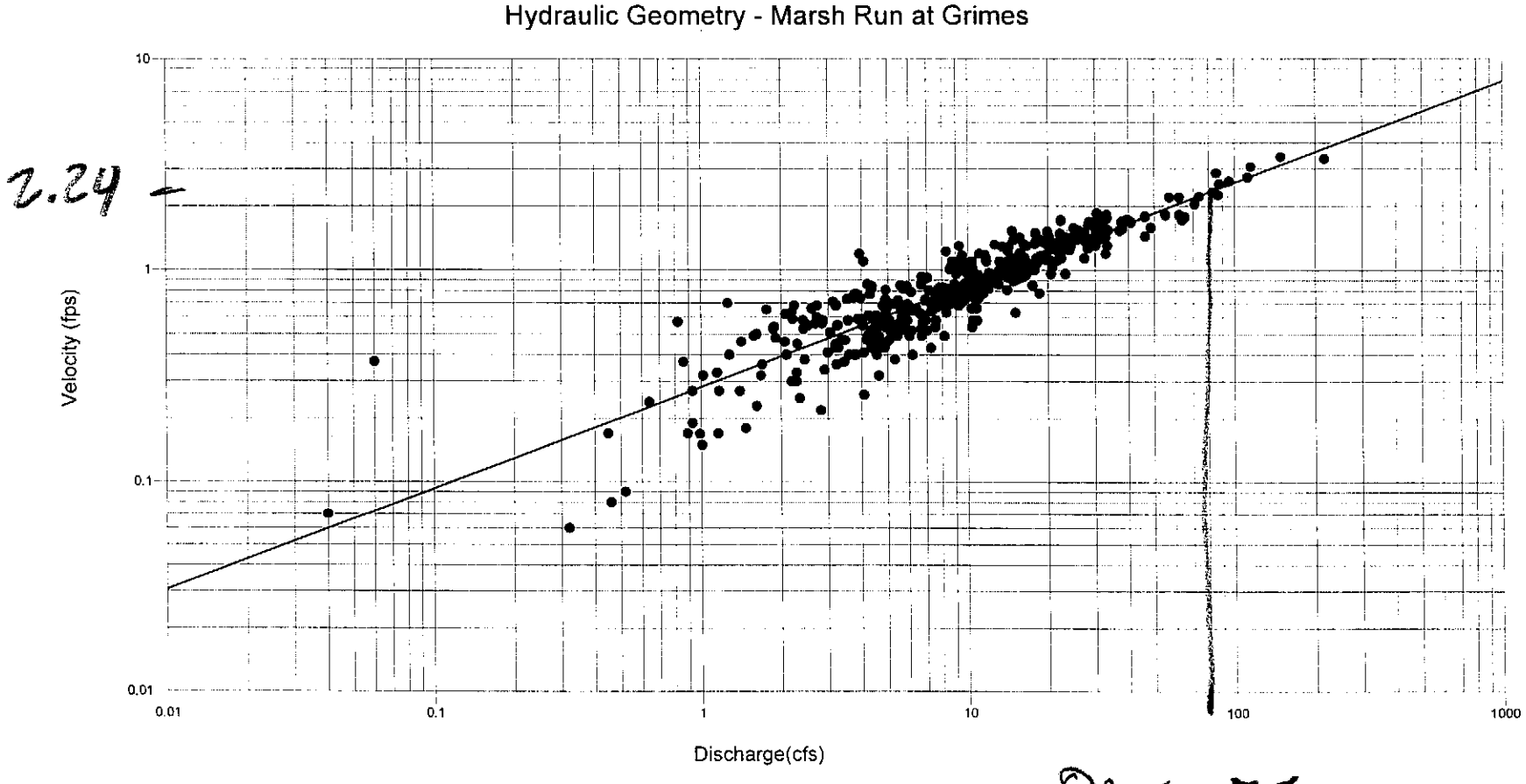
$V = 0.2997 Q^{0.4622}$

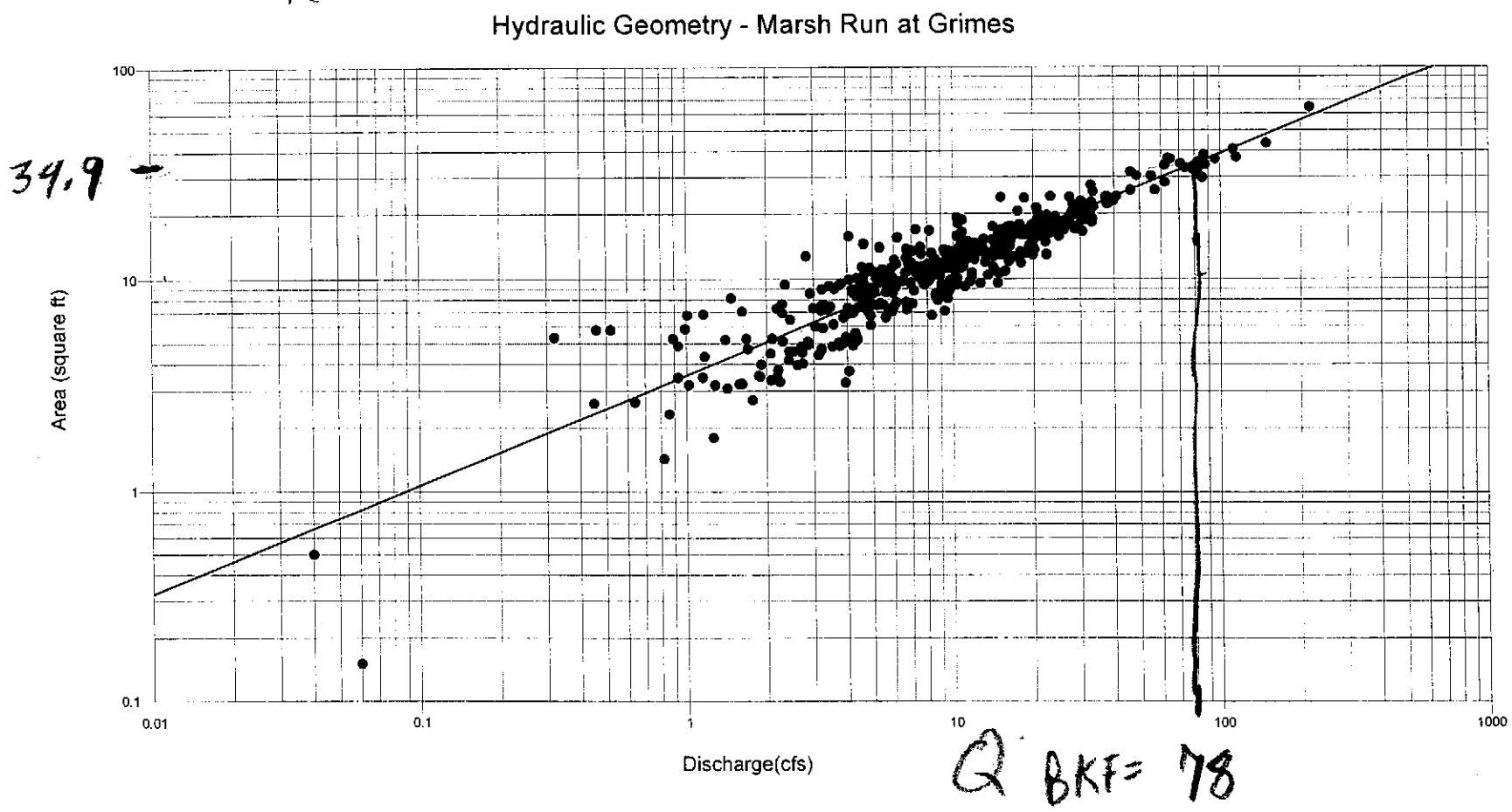
$V(78) = 2.24$



$Q_{BKF} = 78$

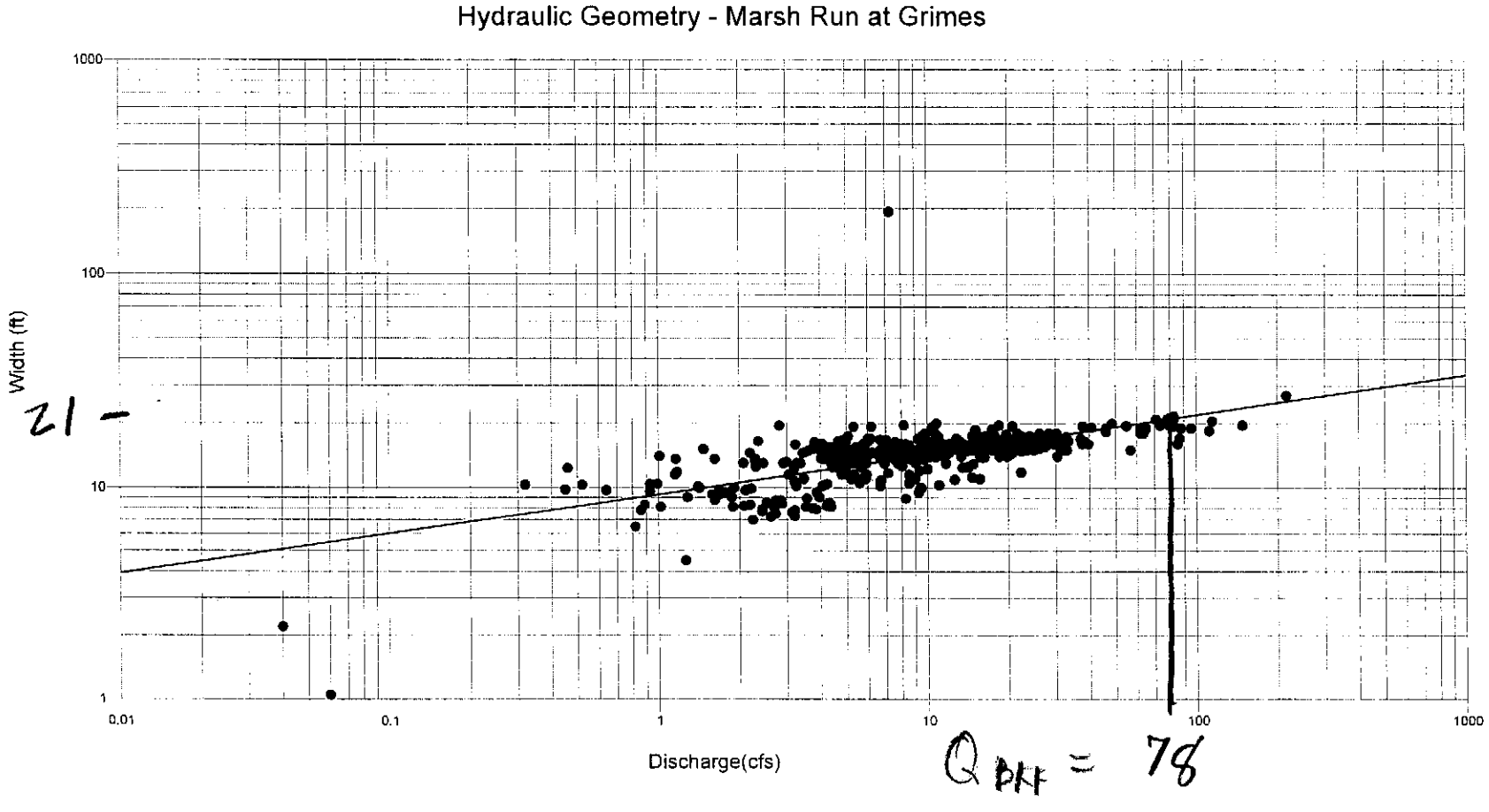
$A = 3.3158 Q^{0.5404}$

$A(78) = 34.9\ ft^2$



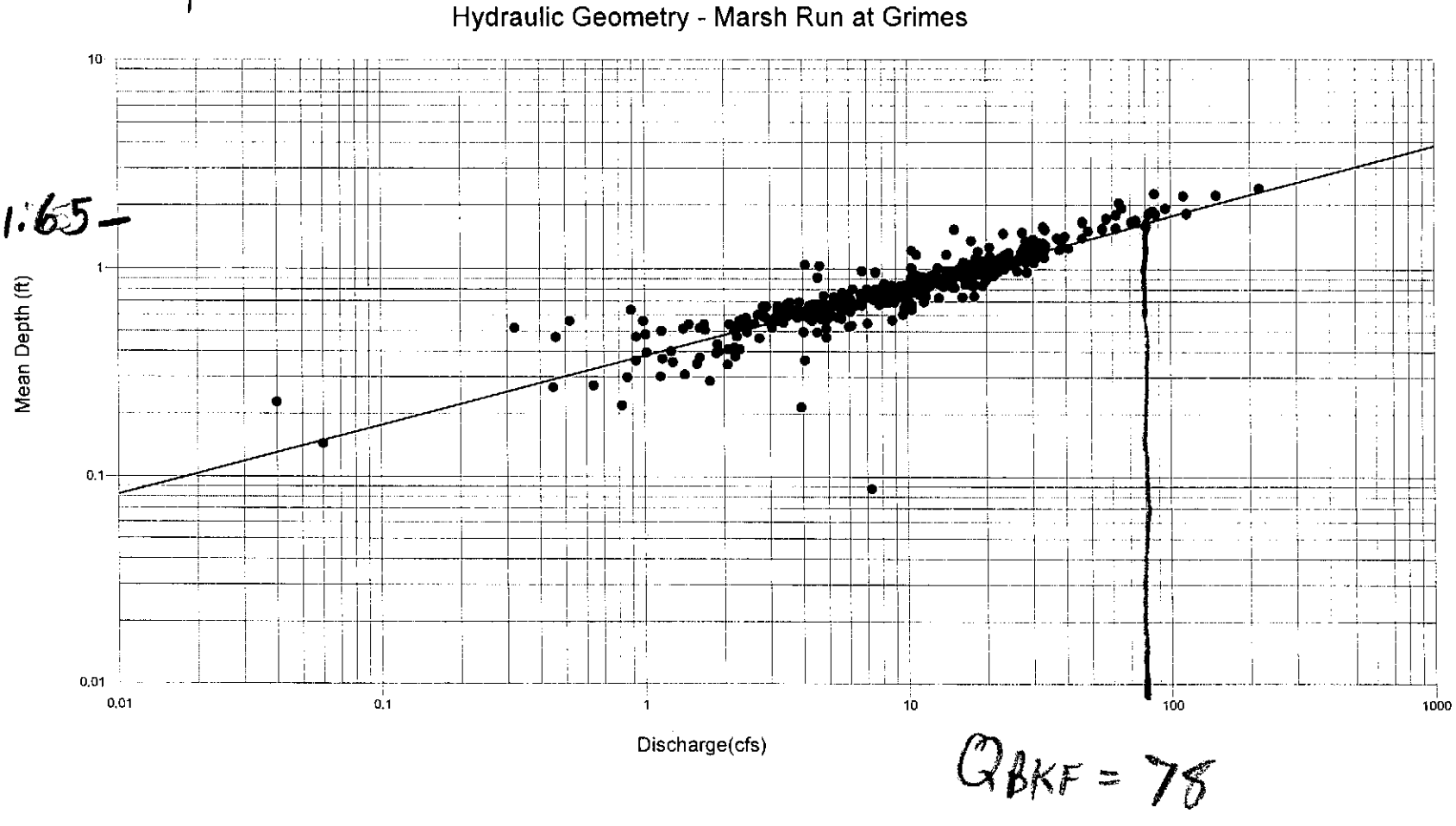
$W = 8.9353\, Q^{0.1968}$

$W(78) = 21.1$ ft

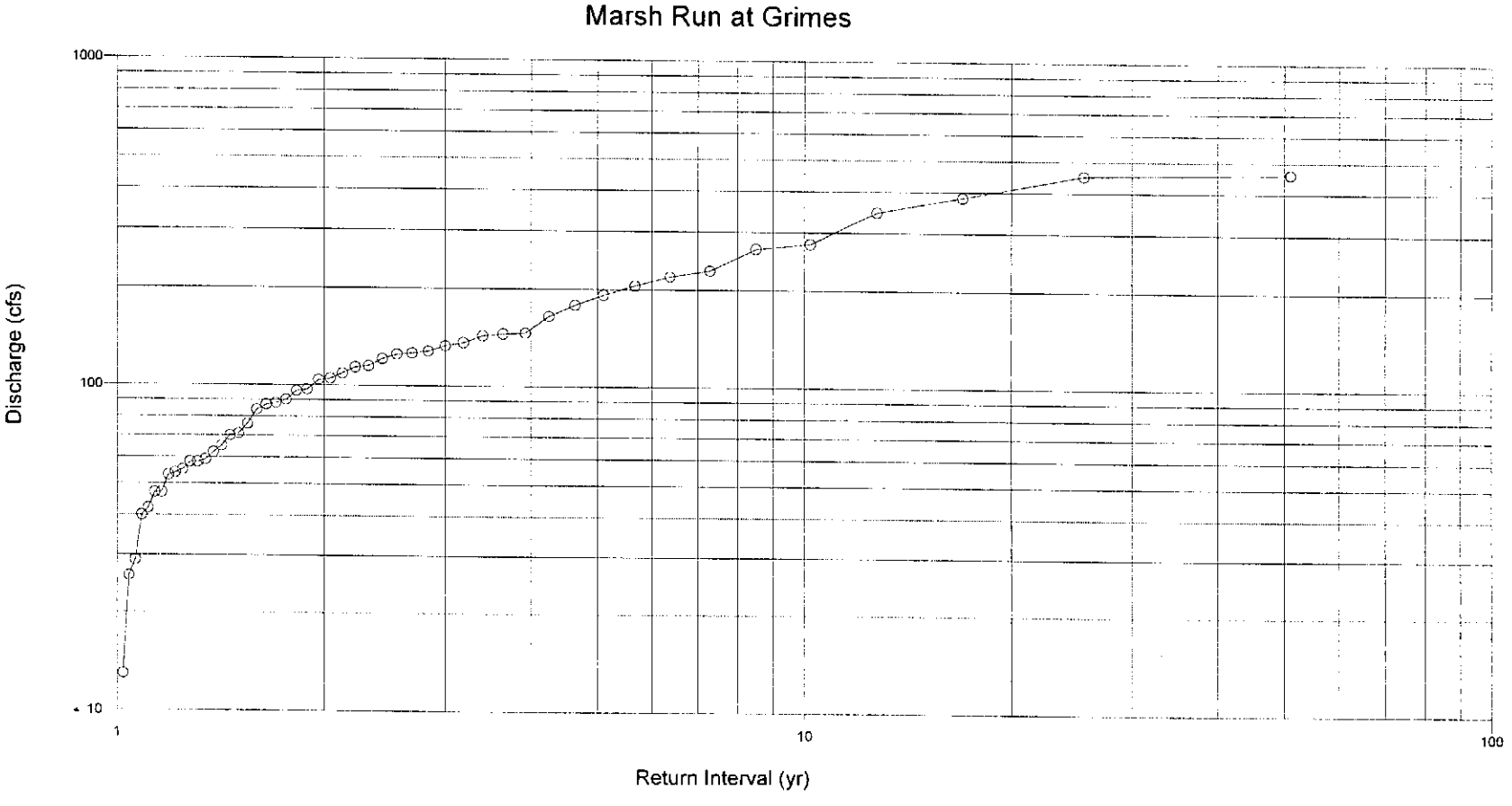


$y = 0.3711\,Q^{0.3436}$

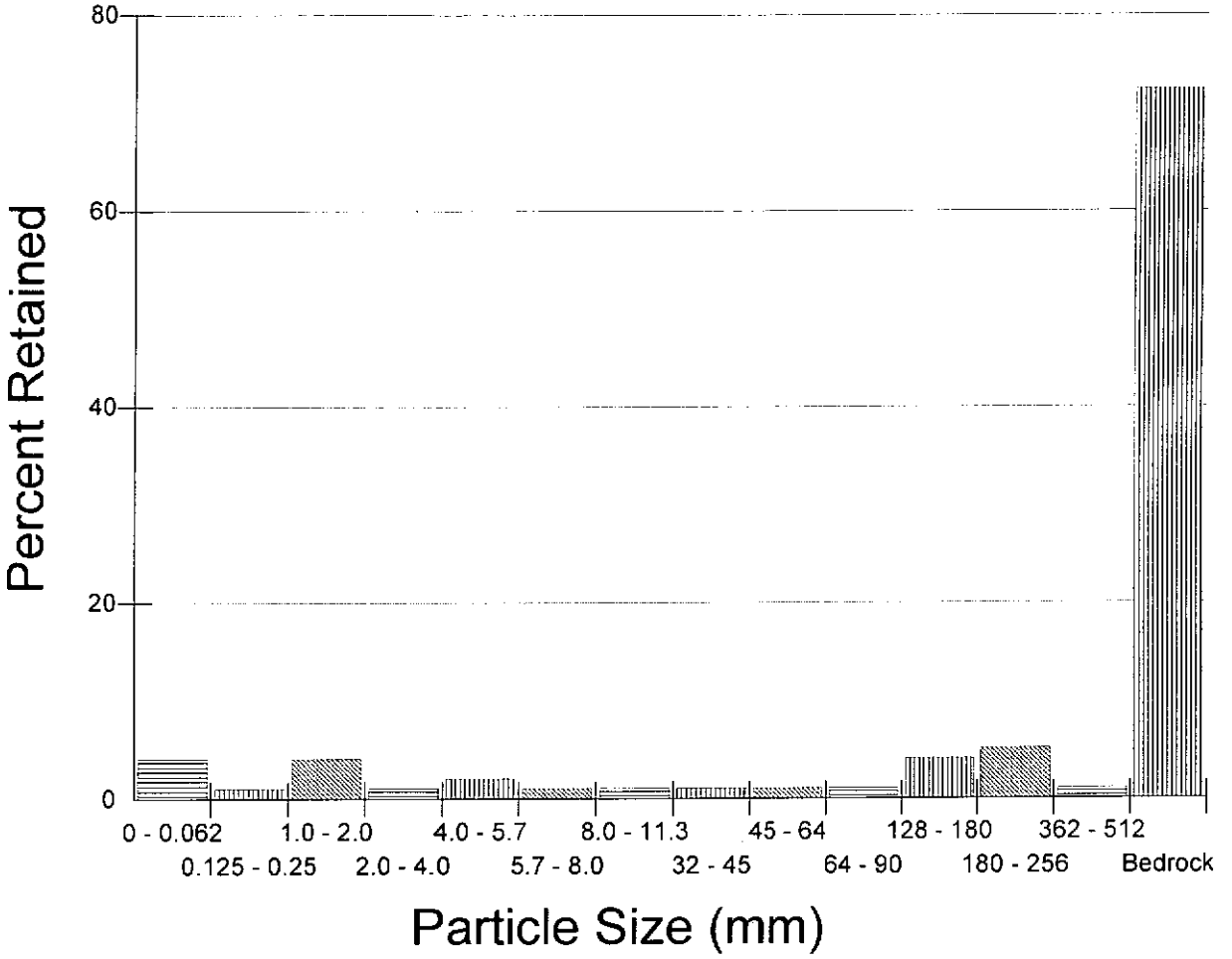
$y(78) = 1.65$



$Q_{BKF} = 78$


Marsh Run at Grimes
1000
100
10
Discharge (cfs)
1
10
100
Return Interval (yr)

Reach Average Pebble Count



Silt/Clay = 4.08%

Sand = 5.1%

Gravel = 7.15%

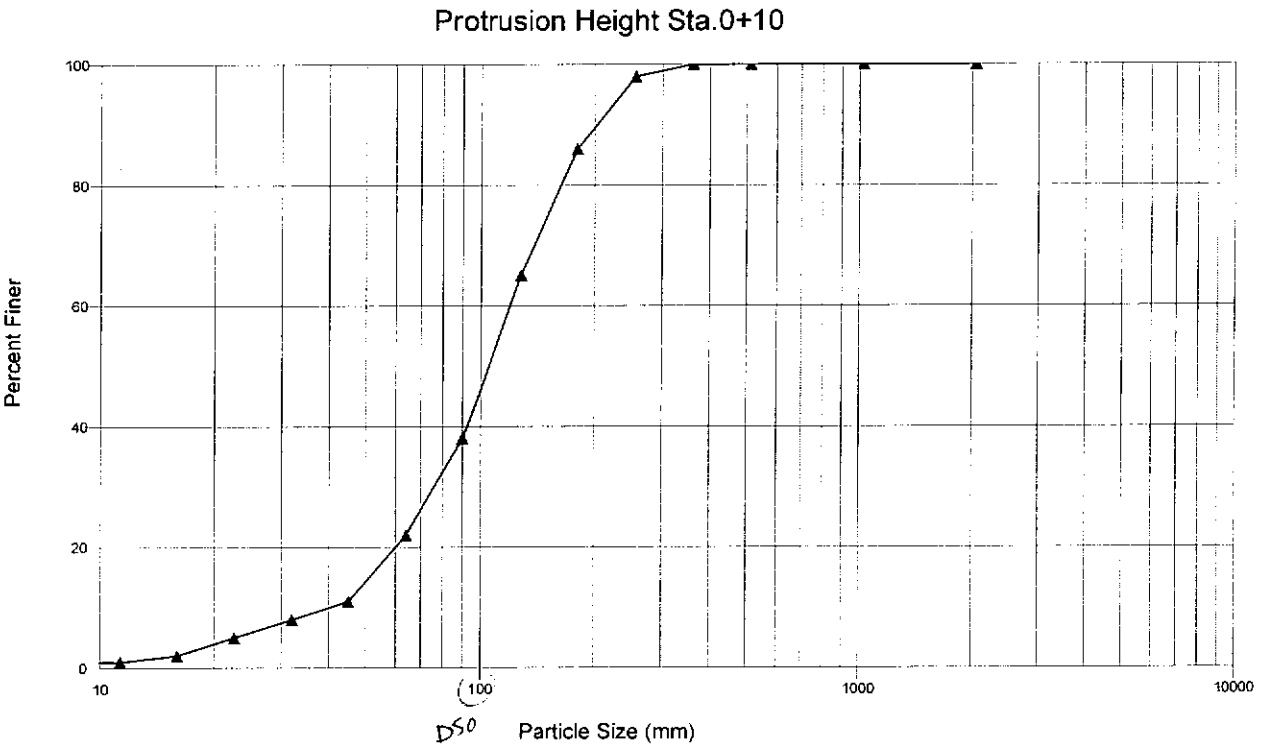
Cobble = 10.2%

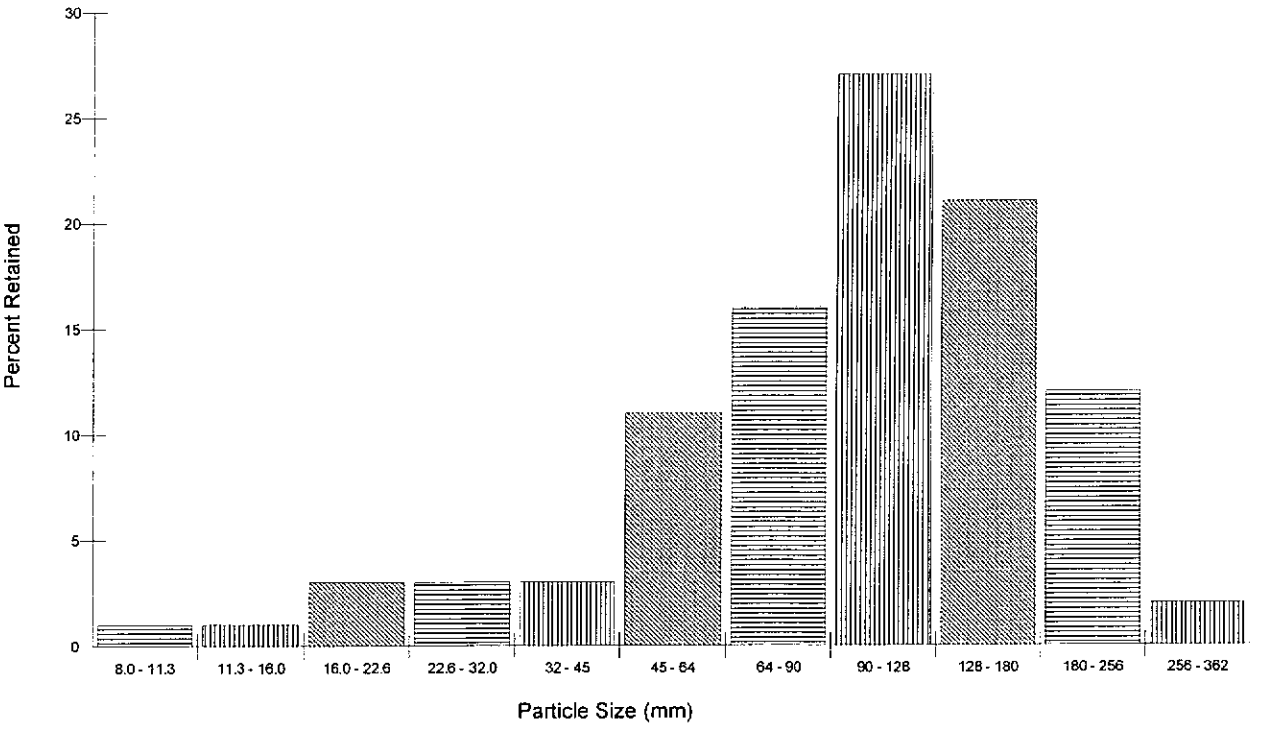
Boulder = 1.02%

Bedrock = 72.45%

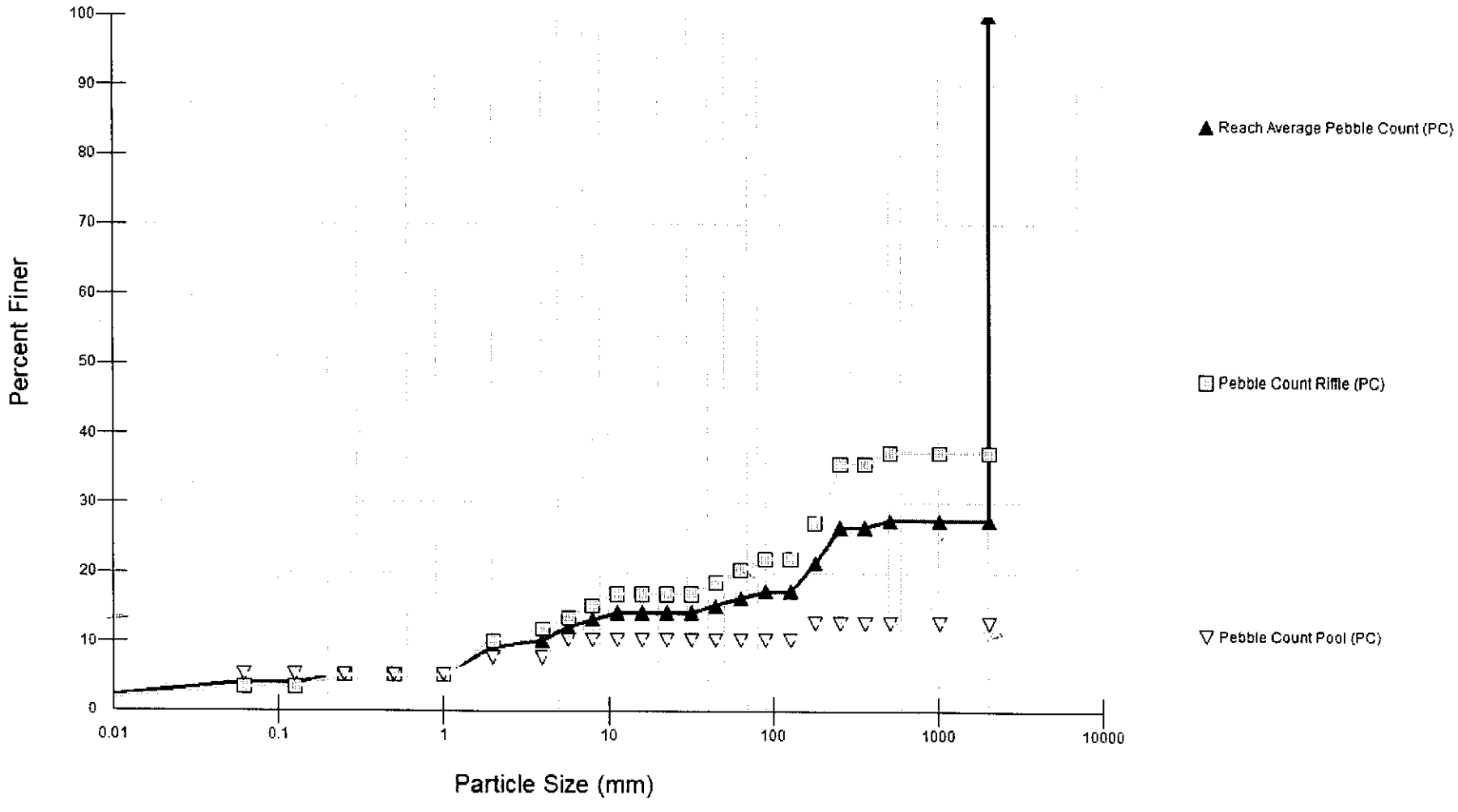
D_{50} = 106.89 mm
D_{84} = 175.05 mm

Both

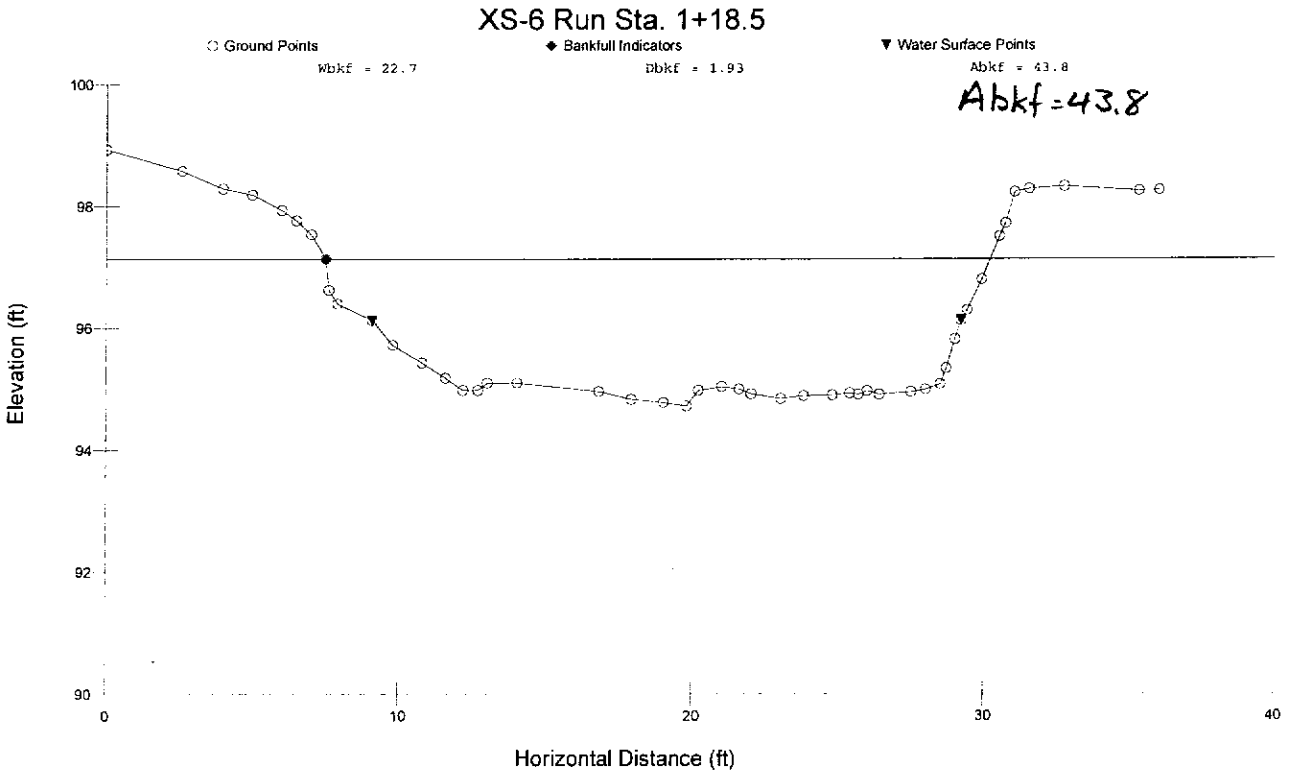


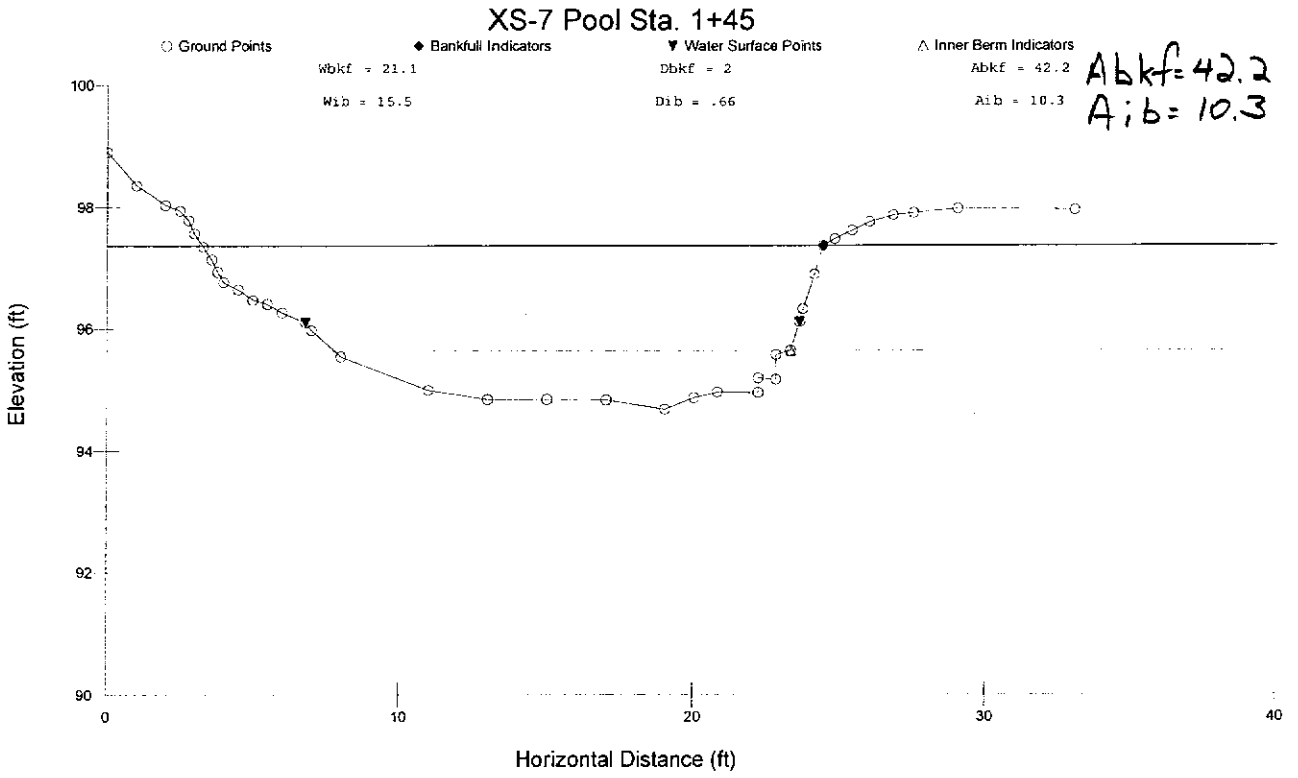

Percent Retained
30
25
20
15
10
5
0
8.0 - 11.3
11.3 - 16.0
16.0 - 22.6
22.6 - 32.0
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
Particle Size (mm)

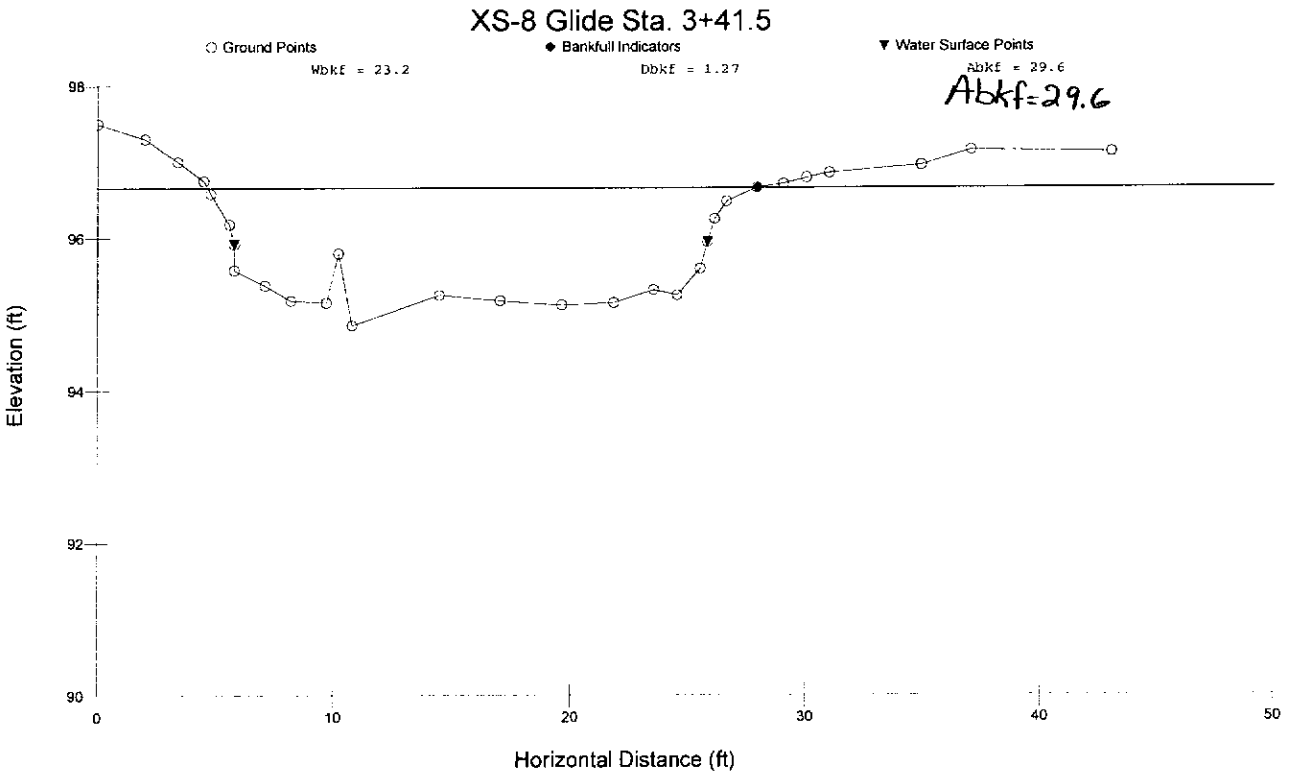
Reach Average Pebble Count



D_{50} : Bedrock


XS-6 Run Sta. 1+18.5
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 22.7
Dbkf = 1.93
Abkf = 43.8
Abkf = 43.8
100
98
96
94
92
90
0
10
20
30
40
Elevation (ft)
Horizontal Distance (ft)


XS-7 Pool Sta. 1+45
○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
△ Inner Berm Indicators
Wbkf = 21.1
Wib = 15.5
Dbkf = 2
Dib = .66
Abkf = 42.2
Aib = 10.3
Abkf = 42.2
Aib = 10.3
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
Horizontal Distance (ft)


XS-8 Glide Sta. 3+41.5
Ground Points
Bankfull Indicators
Water Surface Points
WbkE = 23.2
DbkE = 1.27
AbkE = 29.6
Abkf=29.6
98
96
94
92
90
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

Marsh Run @ Grimes Reach Form 1 7/17/14

Worksheet B-4. Procedure to validate hydraulic relations using gage station data.

1. Obtain the drainage area associated with the gaging station. 85 → from USGS rating
2. Obtain the field-determined bankfull discharge at the gaging station (**Figure B-43**). 78 ~> data Pt on Reg Curve
3. Obtain the bankfull channel dimensions from the gaging station hydraulic geometry relationships (discharge vs. width, depth, area and velocity).
4. Measure the average water surface slope. 0.00158 (Reach 4)
5. Perform an active bed pebble count on the riffle to obtain D_{84}. $D_{84} = 175 = 0.57$ ft, $D_{50} = 104 = 0.34$ ft } Reach 4
6. Determine the stream type.
7. Solve for Manning's 'n' at the bankfull stage: $n = (1.49R^{2/3}S^{1/2})/\bar{u}$ (use the bankfull mean velocity from Step 3). 0.033
8. Calculate relative roughness: R/D_{84}. Make sure that D_{84} is converted from millimeters to feet. Hydraulic radius (R) and mean depth (d_{bkf}) are often used interchangeably when width/depth ratios are greater than 12.
9. Calculate shear velocity: $u^* = (gRS)^{1/2}$.
10. Calculate friction factor: $\bar{u}/u^*$.
11. Plot bankfull discharge as a function of drainage area on the appropriate regional curve.
12. Plot bankfull channel dimensions as a function of drainage area on the appropriate regional curve (note stream type of plotted values using unique symbols).
13. Plot relative roughness by friction factor (**Figure B-34**) (Example in **Figure B-39**).
14. Plot Manning's 'n' by friction factor (**Figure B-35**) (Example in **Figure B-40**).
15. Plot Manning's 'n' by stream type (**Figure B-36**) (Example in **Figure B-41**).

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

Gaging Station Name: **Gaging Station Number:**

Drainage Area (mi^2)	Bankfull Discharge Q_{bkf} (cfs)	Bankfull Width W_{bkf}	Bankfull Mean Depth d_{bkf} (ft)	Bankfull Area A_{bkf} (ft^2)	Bankfull Velocity $\bar{u}_{bkf}$ (ft/s)	Ave. Water Surface Slope S (ft/ft)	D_{84} site (mm)	D_{84} site (ft)	Stream Type	Manning's 'n'	Relative Roughness R/D_{84} (ft/ft)	Shear Velocity u^* (ft/s)	Friction Factor $\bar{u}/u^*$
18.9	78	21.1	1.65	34.9	2.24	0.00158	175	0.57	C/E	.033	5.1	.43	5.15
		R = 1.43					103	0.34	E		6.3	.35	6.3

n → 0.035

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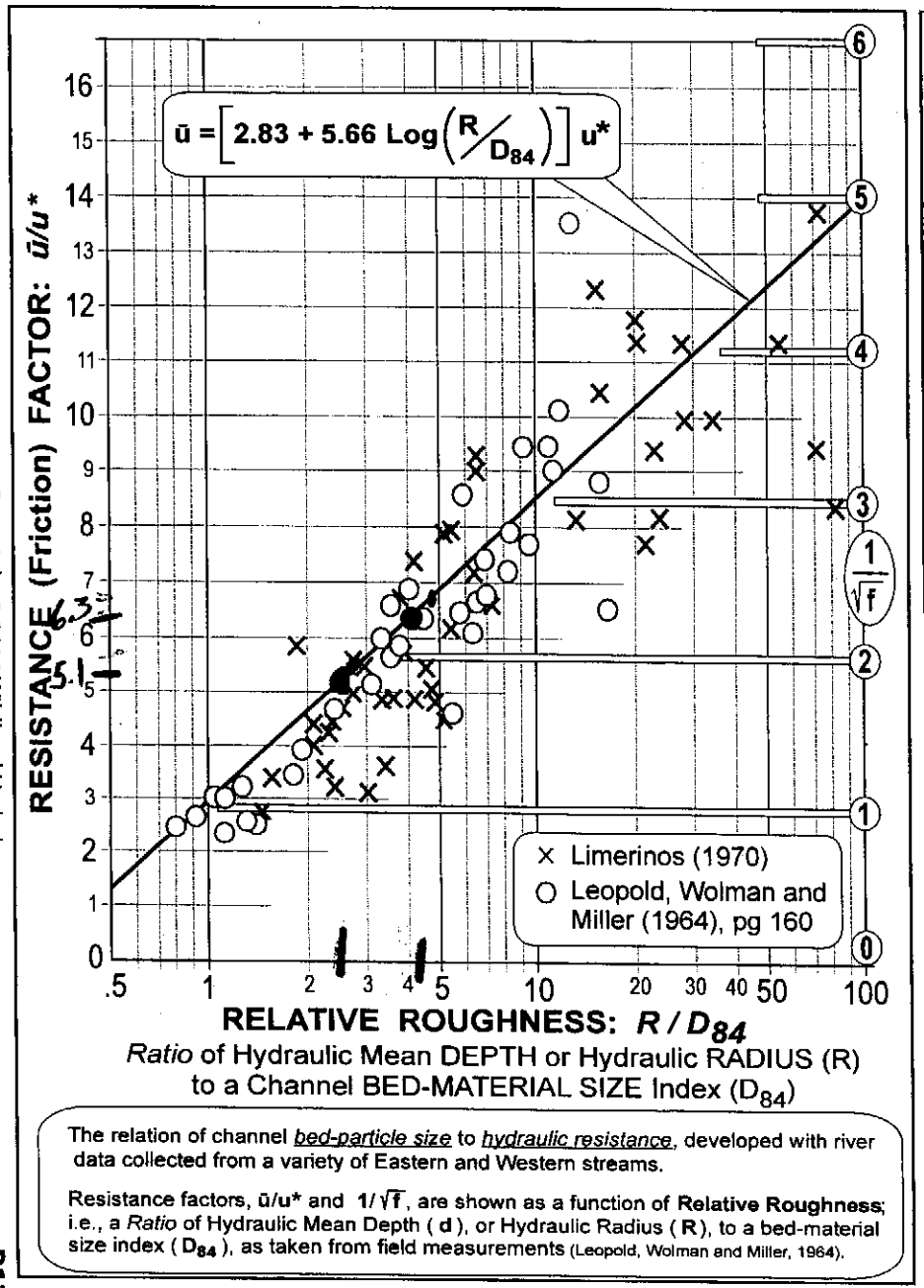

Figure B-34. Relative roughness (R/D_{84}) *vs.* friction factor ($\bar{u}/u^*$).

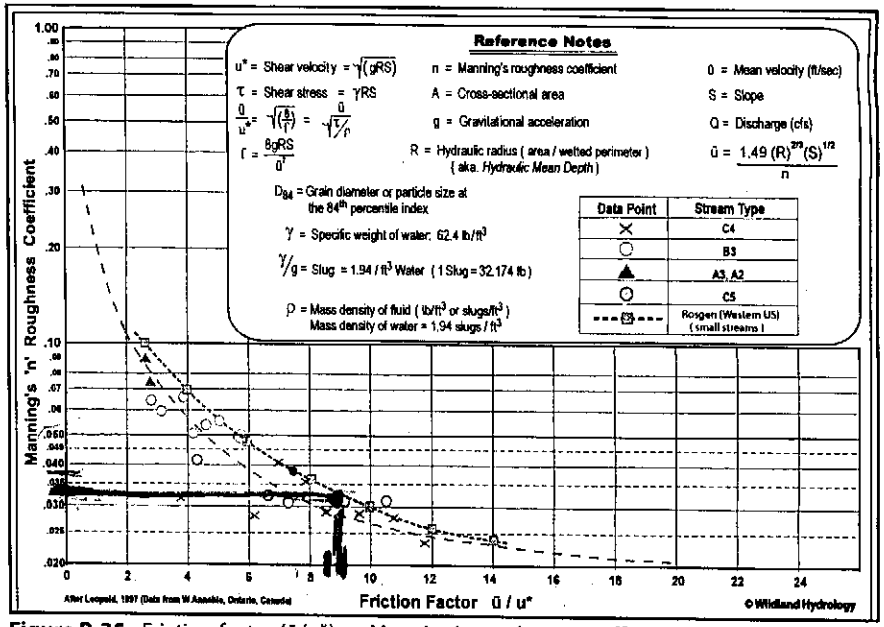

Figure B-35. Friction factor ($\bar{u}/u^*$) *vs.* Manning's roughness coefficient 'n'.

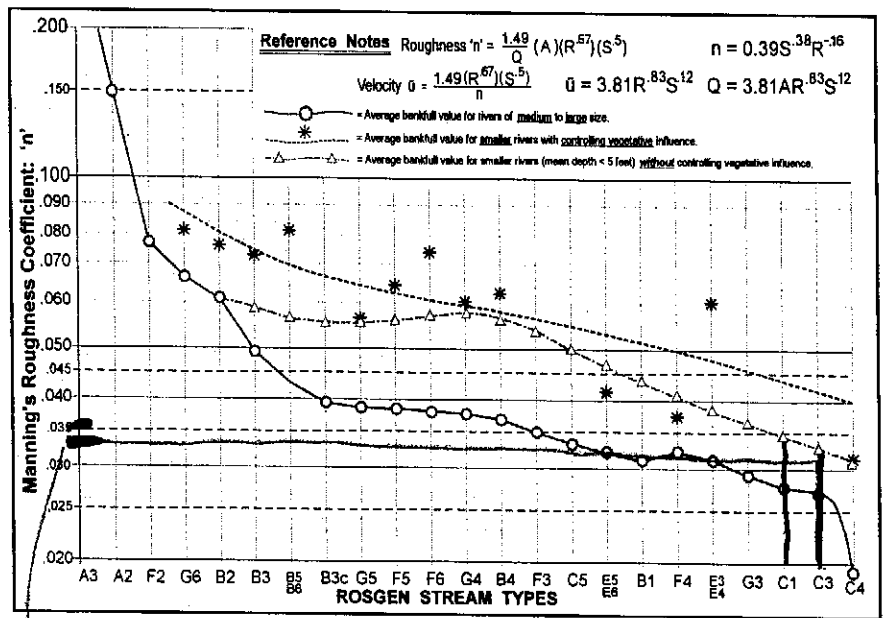

Figure B-36. Manning's 'n' roughness coefficient by stream type.

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Step 11

Summarize USGS gage data:

Summary of USGS Gage Station Data

Station Name:	Marsh Run @ Grimes			Station Number:	01617800
Station Location:	Lat 39°30'52.4" Long 77°46'38"			Period of Record:	50 yrs
Drainage Area (DA):	18.9 acres	18.9	mi²	D.A. Mean Elevation:	ft
Stream Type:	C1	Valley Type:	VIII b	Mean Annual Disch.:	cfs
Reference Reach Slope:	0.00154 ft/ft			HUC:	02070004

BANKFULL CHARACTERISTICS

Determined from FIELD MEASUREMENT			Determined from GAGE DATA ANALYSIS		
Bankfull Width (W_{bkf})		ft	Bankfull Width (W_{bkf})	21	ft
Bankfull Mean Depth (d_{bkf})		ft	Bankfull Mean Depth (d_{bkf})	1.65	ft
Bankfull XS Area (A_{bkf})		ft²	Bankfull XS Area (A_{bkf})	35	ft²
Wetted Perimeter (W_p)		ft	Wetted Perimeter (W_p)	24	ft
Bankfull Stage (Gage Ht.)		ft	Bankfull Stage (Gage Ht.)	2.17	ft
Est. Mean Velocity ($\bar{u}$)		ft/sec	Mean Velocity ($\bar{u}$)	2.3	ft/sec
Est. BKF. Discharge (Q_{bkf})		cfs	Bankfull Discharge (Q_{bkf})	78	cfs

Bankfull Discharge associated with "field-determined" Bankfull Stage	78	cfs
Recurrence Interval (R.I.) associated with "field-determined" Bankfull Stage	1.52	yrs

From the *Annual Peak Flow Frequency Analysis* for the Gage Station, determine:

1.5 Year **R.I.** Discharge =	74	cfs	**10** Year **R.I.** Discharge =	278	cfs
2.0 Year **R.I.** Discharge =	105	cfs	**25** Year **R.I.** Discharge =	450	cfs
5.0 Year **R.I.** Discharge =	192	cfs	**50** Year **R.I.** Discharge =	459	cfs

MEANDER GEOMETRY

Linear Wavelength (λ)	418	ft	Stream Meander Length (L_m)	344	ft
Radius of Curvature (R_c)	98.5	ft	Belt Width (W_{blt})	61	ft/ft

HYDRAULIC GEOMETRY

Based on *USGS Discharge Summary Notes* data (Form 9-207) and regression analyses of measured discharge (**Q**) with the hydraulic parameters of Width (**W**), Area (**A**), Mean Depth (**d**) & Mean Velocity ($\bar{u}$), determine the *intercept coefficient* (***a***) and the *slope exponent* (***b***) values for a power function of the form $Y = aX^b$, when **Y** is one of the selected hydraulic parameters and **X** is a given discharge value (**Q**).

		Width (W)	Depth (d)	Area (A)	Vel. ($\bar{u}$)
Intercept Coefficient	(a)	8.935	0.3711	3.3154	0.2997
Slope Exponent	(b)	0.1968	0.3856	0.5404	0.4622

Hydraulic Radius: $R = A / W_p$	1.38	ft	Manning's 'n' at Bankfull Stage	0.033 Coeff.

$n = 1.49\ [(\text{Area})\ (\text{Hydraulic Radius}^{2/3})\ (\text{Slope}^{1/2})] / Q_{bkf}$

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Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Marsh Run, Reach - Reach 4**		
Basin:	Drainage Area: **12486** acres	**19.51**	mi^2
Location:			
Twp.&Rge: ;	Sec.&Qtr.: ;		
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**	Date: **04/17/14**	
Observers:		Valley Type: VIIIb	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**19.26**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.75**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**33.8**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**11.01**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**2.48**	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.	**231.2**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**12**	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.	**2048**	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.	**0.00158**	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).	**1.186**	

Stream Type **C1** (See **Figure 2-14**)

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Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Marsh Run			Location:	Reach - Reach 4
Date:	4/17/2014	Stream Type:	C3	Valley Type:	VIIIb
Observers:				HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	33.80	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.75	d_{bkf} (ft)
Bankfull Riffle WIDTH	19.26	W_{bkf} (ft)	Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	20.73	W_p (ft)
D_{84} at Riffle	106.89	Dia. (mm)	D_{84} (mm) / 304.8	0.35	D_{84} (ft)
Bankfull SLOPE	0.0016	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.63	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	4.64	R / D_{84}
Drainage Area	19.5	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.288	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\ 2.83 + 5.66 * Log\ \{ R / D_{84} \}\ ]\ u^*$	1.90	ft / sec	64.32	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ 0.0398	2.06	ft / sec	69.53	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-20) $u = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ 0.0325	2.52	ft / sec	85.14	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $n = 0.39 * S^{0.38} * R^{-0.16}$ **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 $n =$ 0.031	2.63	ft / sec	88.96	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach (Leopold, Wolman and Miller)	2.04	ft / sec	68.96	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Chezy C	0.00	ft / sec	0.00	cfs
4. Continuity Equations: a) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge $Q =$ 1.5 year	0.00	ft / sec	0.00	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	2.31	ft / sec	78.00	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 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Stream: **Marsh Run** Location: **Reach - Reach 4**

Observers: Date: **04/17/14** Valley Type: **VIIIb** Stream Type: **C1**

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, *

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
Riffle Width (W_{bkf})	19.3	19.3	25.3	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	33.80	33.80	43.62
Mean Riffle Depth (d_{bkf})	1.75	1.73	1.75	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	12.80	11.01	14.60
Maximum Riffle Depth (d_{max})	2.62	2.48	2.76	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.506	1.417	1.595
Width of Flood-Prone Area (W_{fpa})	215	199	231	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	9.943	7.881	12.004
Riffle Inner Berm Width (W_{ib})	16.1	15	17.3	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	0.731	0.685	0.777
Riffle Inner Berm Depth (d_{ib})	0.63	0.49	0.77	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.362	0.279	0.444
Riffle Inner Berm Area (A_{ib})	10.3	7.32	13.3	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.261	0.217	0.304
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	26.6	22.6	30.6					

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
Pool Width (W_{bkfp})	20	18.8	21.1	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	1.037	0.977	1.097
Mean Pool Depth (d_{bkfp})	2.03	2	2.06	ft	Mean Pool Depth to Mean Riffle Depth (d_{bkfp} / d_{bkf})	1.160	1.143	1.177
Pool Cross-Sectional Area (A_{bkfp})	40.5	38.7	42.2	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	1.197	1.144	1.249
Maximum Pool Depth (d_{maxp})	2.82	2.68	2.95	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	1.611	1.531	1.686
Pool Inner Berm Width (W_{ibp})	15.2	14.9	15.5	ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})	0.765	0.735	0.794
Pool Inner Berm Depth (d_{ibp})	0.69	0.66	0.72	ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})	0.340	0.330	0.349
Pool Inner Berm Area (A_{ibp})	10.5	10.3	10.8	ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})	0.261	0.243	0.278
Point Bar Slope (S_{pb})	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})	22.129	20.752	23.506

Run Dimensions*

Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean	Min	Max
Run Width (W_{bkfr})	21.3	19.9	22.7	ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})	1.105	1.032	1.178
Mean Run Depth (d_{bkfr})	1.92	1.9	1.93	ft	Mean Run Depth to Mean Riffle Depth (d_{bkfr} / d_{bkf})	1.097	1.086	1.103
Run Cross-Sectional Area (A_{bkfr})	40.8	37.8	43.8	ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})	1.208	1.119	1.296
Maximum Run Depth (d_{maxr})	2.66	2.42	2.9	ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})	1.520	1.383	1.657
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})	11.1	10.5	11.8	ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean	Min	Max
Glide Width (W_{bkfg})	25.2	23.2	27.1	ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})	1.307	1.207	1.408
Mean Glide Depth (d_{bkfg})	1.18	1.09	1.27	ft	Mean Glide Depth to Mean Riffle Depth (d_{bkfg} / d_{bkf})	0.674	0.623	0.726
Glide Cross-Sectional Area (A_{bkfg})	29.7	29.6	29.7	ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})	0.877	0.876	0.878
Maximum Glide Depth (d_{maxg})	1.75	1.68	1.81	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.000	0.960	1.034
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})	21.6	18.3	24.9	ft/ft	Glide Inner Berm Width/Depth Ratio (W_{ibg} / d_{ibg})	0.000	0.000	0.000
Glide Inner Berm Width (W_{ibg})	0	0	0	ft	Glide Inner Berm Width to Glide Width (W_{ibg}/W_{bkfg})	0.000	0.000	0.000
Glide Inner Berm Depth (d_{ibg})	0	0	0	ft	Glide Inner Berm Depth to Glide Depth (d_{ibg} / d_{bkfg})	0.000	0.000	0.000
Glide Inner Berm Area (A_{ibg})	0	0	0	ft^2	Glide Inner Berm Area to Glide Area (A_{ibg} / A_{bkfg})	0.000	0.000	0.000

Step**

Step Dimensions**	Mean	Min	Max		Step Dimensionless Ratios****	Mean	Min	Max
Step Width (W_{bkfs})	0	0	0	ft	Step Width to Riffle Width (W_{bkfs} / W_{bkf})	0.000	0.000	0.000
Mean Step Depth (d_{bkfs})	0	0	0	ft	Mean Step Depth to Riffle Depth (d_{bkfs} / d_{bkf})	0.000	0.000	0.000
Step Cross-Sectional Area (A_{bkfs})	0	0	0	ft	Step Area to Riffle Area (A_{bkfs} / A_{bkf})	0.000	0.000	0.000
Maximum Step Depth (d_{maxs})	0	0	0	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	0.000	0.000	0.000
Step Width/Depth Ratio (W_{bkfs} / d_{bkfs})	0	0	0					

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

****Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses mean riffle width value.

Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Stream: **Marsh Run** Location: **Reach - Reach 4**

Observers: Date: **04/17/14** Valley Type: **VIIIb** Stream Type: **C1**

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	2.31	ft/sec	Estimation Method	continuity	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	78	cfs	Drainage Area	19.51	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Linear Wavelength (λ)	286	163	418	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	14.849	8.463	21.703
Stream Meander Length (L_m)	344	344	344	ft	Stream Meander Length Ratio (L_m / W_{bkf})	17.861	17.861	17.861
Radius of Curvature (R_c)	158	79	118	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	8.178	4.102	6.127
Belt Width (W_{blt})	130	96	163	ft	Meander Width Ratio (W_{blt} / W_{bkf})	6.724	4.984	8.463
Arc Length (L_a)	192	133	251	ft	Arc Length to Riffle Width (L_a / W_{bkf})	9.969	6.906	13.032
Riffle Length (L_r)	14.5	10.5	18.4	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	0.751	0.547	0.954
Individual Pool Length (L_p)	24.4	13.7	33.8	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	1.266	0.711	1.756
Pool to Pool Spacing (P_s)	73	38	105	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	3.791	1.972	5.471

Channel Profile

Valley Slope (S_{val})	0.0019	ft/ft	Average Water Surface Slope (S)	0.00158	ft/ft	Sinuosity (S_{val} / S)		1.186
Stream Length (SL)	344	ft	Valley Length (VL)	290	ft	Sinuosity (SL / VL)		1.1862069
Low Bank Height (LBH)	start 2.69 / end 1.94	ft	Max Depth (d_{max})	start 2.36 / end 1.94	ft	Bank-Height Ratio (BHR) (LBH / d_{max})	start 1.1398305 / end 1	

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.010	0.005	0.016	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	6.582	3.228	9.930
Run Slope (S_{run})	0.001	0.001	0.001	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	0.639	0.348	0.930
Pool Slope (S_p)	0.001	0.001	0.001	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.557	0.380	0.734
Glide Slope (S_g)	0.001	0.001	0.001	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	0.500	0.411	0.589
Step Slope (S_s)	0.000	0.000	0.000	ft/ft	Step Slope to Average Water Surface Slope (S_s / S)	0.000	0.000	0.000

Max Depths[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Max Riffle Depth (d_{maxrif})	2.02	1.67	2.36	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.1542857	0.954285714	1.3485714
Max Run Depth (d_{maxrun})	2.09	1.82	2.35	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	1.1942857	1.04	1.3428571
Max Pool Depth (d_{maxp})	2.76	2.13	3.42	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	1.5771429	1.217142857	1.9542857
Max Glide Depth (d_{maxg})	1.77	1.69	1.9	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.0114286	0.965714286	1.0857143
Max Step Depth (d_{maxs})	0	0	0	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	0	0	0

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	4.08	3.39		D_{16}	57.85	9.46		53.64	mm
% Sand	5.1	6.78		D_{35}	Bedrock	250.71		85.13	mm
% Gravel	7.15	10.17		D_{50}	Bedrock	Bedrock		106.89	mm
% Cobble	10.2	15.25		D_{84}	Bedrock	Bedrock		175.05	mm
% Boulder	1.02	1.7		D_{95}	Bedrock	Bedrock		237	mm
% Bedrock	72.45	62.71		D_{100}	Bedrock	Bedrock		361.99	mm

[a] Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.
[b] Composite sample of riffles and pools within the designated reach. [c] Active bed of a riffle. [d] Height of roughness feature above bed.

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