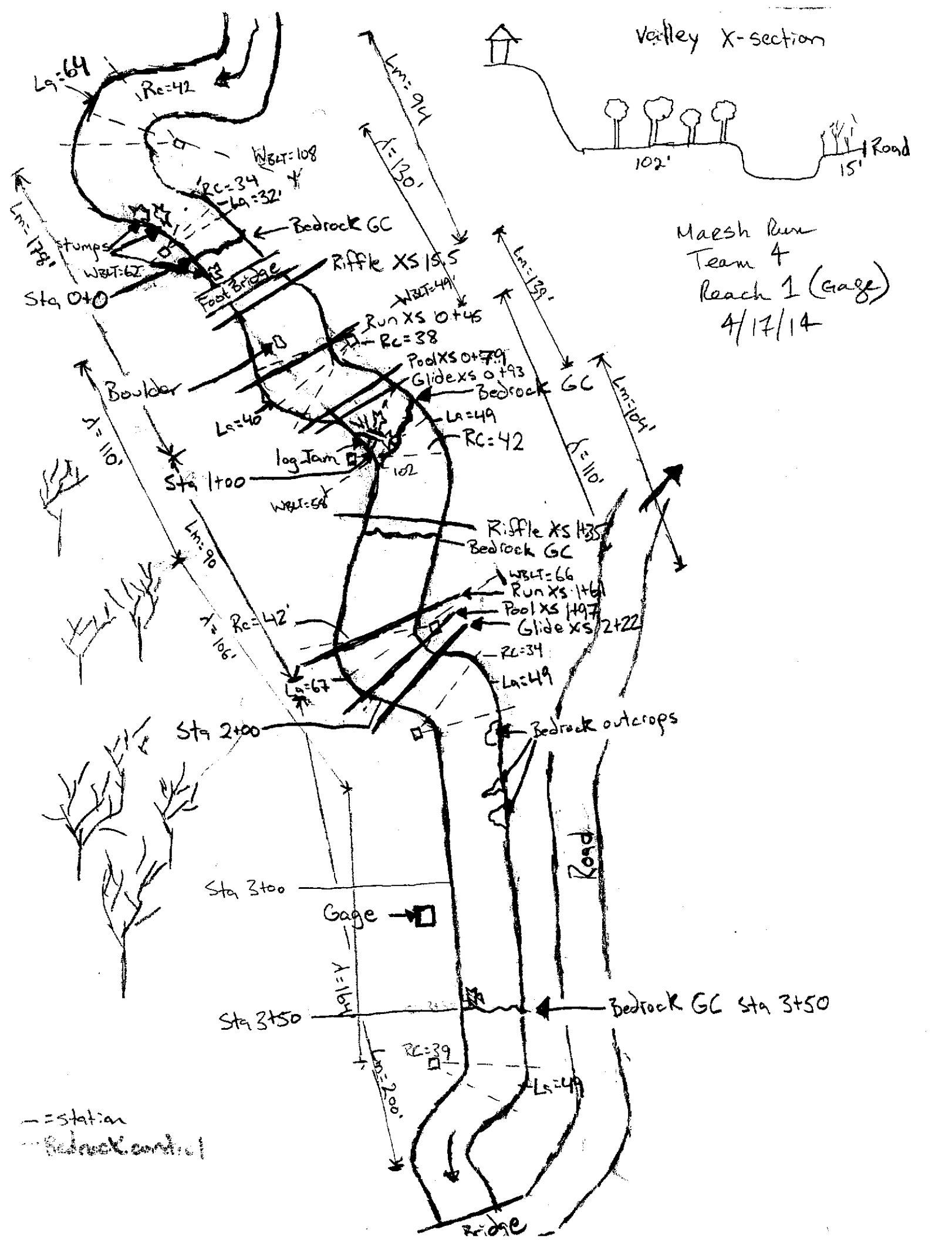
Valley X-section
102'
15'
Road
Marsh Run
Team 4
Reach 1 (Gage)
4/17/14
La=64
Rc=42
Lm=94
λ=130'
WBLT=108
Rc=34
La=32'
Bedrock GC
Lm=178'
stumps
WBLT=62
Sta 0+0
Foot Bridge
Riffle XS 1+5.5
WBLT=49
Run XS 0+46
Rc=38
Pool XS 0+79
Glide XS 0+93
Bedrock GC
Lm=139'
Lm=104'
Boulder
La=40
La=49
Rc=42
λ=110'
log Jam
102
Sta 1+00
WBLT=56
Riffle XS 1+35
Bedrock GC
Lm=90
WBLT=66
Run XS 1+61
Pool XS 1+97
Glide XS 2+22
Rc=42'
λ=106'
Rc=34
La=67
La=49
Sta 2+00
Bedrock outcrops
Road
Sta 3+00
Gage
λ=164'
Sta 3+50
Bedrock GC Sta 3+50
Rc=39
Lm=200'
La=49
Bridge
— = station
Bedrock control

SURVEY DATA ⟹ **CROSS - SECTION** 1 ✓

SITE: Marsh Run Reach 1 Date:

Location: Sta 0+15.5

Party / Notes: Team 4 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						RIFFLE XS
2	0			4.03		BOP
3	3			4.03		ground shot
4	8.8			~~4.20~~ 4.22		TOB
5	11.8			8.99		~~BOB Ledge of ws~~ WS
6	12.3			8.49		BOB
7	14			8.83		ground shot
8	18.8			8.89		ground shot
9	21.2			8.89		Thalweg
10	25.6			9.00		~~gs~~ slope break
11	33.9			8.59		Bottom bank of inner berm
12	34.9			7.91		Inner berm
13	37			7.58		bottom bank
14	38.3			5.4		slope break
15	40.0			4.52		TOB
16	48			4.53		End Sta.
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						

4.91 - 4.83 = 0.08

4.12 - 3.94 = 0.18

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SURVEY DATA ⟹ **CROSS - SECTION** 2

SITE: STA 0+45 Marsh Run Reach 1 Date: 4/17/14

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29						RUN XS
30						
31	0			3.96		Groundshot
32	6			3.95		TOB
33	10.7			6.01		slope break
34	12			8.16		L E of W
35	12.2			9.32		B of B
36	15.2			9.72		TW
37	17.2			9.28		slope break
38	23.8			9.21		" "
39	29.2			8.17		R E of W
40	30.2			7.18		Bankful
41	34			4.6		TOB
42	38			4.32		BOP
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						

4.81 - 4.86 = .05

3.65 3.30 = 0.35

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SURVEY DATA ⟹ **CROSS - SECTION** 3 ✓

SITE: Station 0+~~84.5~~ 79.5 - Pool Date: 4/17/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	0+00	4.15		4.15	4.15	GS
30	0+02			4.3		GS
31	04			4.41		GS
32	06			4.3		SB
33	08			4.79		Mid S
34	8.2			4.85		TB
35	10.5			6.02		Roof
36	11			7.12		BB
37	12.5			7.73		Start of Berm
38	15.6			8.02		Berm
39	16.2			8.25		LEW
40	18.2			8.8		SB - Sed Deposit.
41	20.9			10.08		~~B~~ Mid - Slope Sed
42	22.2			10.58		" " Sed
43	24.1			11.05		Bottom Slope BR
44	24.1			11.17		TH
45	26.6			10.85		SB
46	28.1			10.65		Mid S
47	31.5			9.9		Mid S / Log Debris
48	32.6			9.58		Mid S / Log D
49	34.9			8.97		" " "
50	35.4			8.19		REW / ~~BB~~
51	36.5			8.04		~~BB~~ IB
52	37.5			7.8		Edge - ~~Bed~~ Veg
53	39.3			6.71		Mid S
54	40.2			5.45		TB
55	44.4			5.41		GS
56						
57						
58						
59						

4.79
4.77 = 0.02

1.85
2.02 = -.17

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SURVEY DATA ⟹ **CROSS - SECTION** 4 ✓

SITE: Sta. 93+00 Date: 4/17/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS	
29	0+00			4.35		GS	
30	0+03			3.4		GS	
31	5			4.7		GS	
32	7.6			5.32		TB	
33	8.9			6.39		MS	
34	9.9			8.7-		BB	4.67
35	9.9			8.35		LEW	4.60 = .07
36	9.8			7.61		BF ?	
37	11.7			8.95		MS - Rock	
38	13			8.93		GS	
39	14			9.05		GS / TH	
40	16			8.94		GS	
41	20.5			8.95		GS	
42	22.6			8.2		ON LOG	3.71
43	24.0			8.94		GS	3.88 = .17
44	26.2			9.31		TH / GS	~~3.80~~
45	29.0			9.09		GS	
46	30.5			9.03		GS / START LOG	
47	31.1			7.65		ON LOG	
48	31.9			8.78		GS	
49	34.9			8.58		BB	
50	34.9			8.35		~~BB~~ REW	
51	36			7.67		BF	
52	38			4.54		TB	
53	42			4.30		GS	
54							
55							
56							
57							
58							
59							

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* HARD ROCK / BEDROCK THROUGH XS.

* 6.63 - TIE IN OFF BOARD BY GAUGE

SURVEY DATA ⟹ **CROSS - SECTION** 5

SITE: XSec 1+29 Riffle Date: 4/17/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29	0.0			3.2		Lazer
30	1.9			13.54		Top Bank
31	4			6.56		
32	5.1			8.08		water edge
33	6.6			8.46		
34	8.3			8.55		
35	10			8.58		
36	12			8.65		
37	14			8.57		
38	16			8.59		
39	18			8.56		
40	20			8.64		
41	23			8.7		
42	24.4			8.7		
43	25.3			8.56		
44			WS	8.31		
45	26			7.55		
46	26.5			7.33		DF
47	28			7.06		
48	29.5			6.71		
49	31			6.0		
50	34			4.56		
51	36			3.9		
52	38			3.42		end tape
53						
54						
55						
56						
57						
58						
59						

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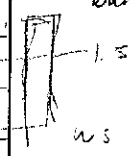
SURVEY DATA ⟹ **CROSS - SECTION** 6

SITE: sta. 161 Run XS Date: 4/17/14

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES COMMENTS REMARKS
29						
30	0			5.23		BOP / Groundshot
31	10			5.95		"
32	14.2			6.28		" / start of root mass
33	17.5			6.95		top of bank / end of root mass
34	17.9					overcut of bank (rod) 1.5' undercut 2.6'
35						1' (rod) undercut 2.3'
36						1.2' @ WS (water surface)
37	16.8			9.16		LEOW
38	19			9.70		slope break
39	20.8			9.78		" "
40	22.4			10.00		" "
41	22.6			9.89		" "
42	26			9.84		gs
43	30.5			9.84		gs
44	33.2			9.80		TW
45	34.4			9.75		GS
46	38			9.69		GS
47	39.3			9.20		~~(K) EOW~~ GS
48	41.2			8.57		BOB
49	41.6			7.95		BKF
50	45			5.13		TOB
51	47			4.89		GS
52						
53						
54						
55						
56						
57						
58						
59						

blw point on top of overhanging bank



3.86 / 3.86 = 0.00

3.22 / 2.97 = 0.25

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SURVEY DATA ⟹ **CROSS - SECTION 7** ✓

SITE: 1-97 P001 **Date:** 4/16/14

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES COMMENTS REMARKS
29	0		5.84	6.47		GS
30	1.6		6.46	7.16		TB
31	3.4		6.87	7.29		SB
32	4.7		7.84	8.39		BB } SILT REPOINT
33	10.2		8.57	9.25		LEWG
34	10.8		9.08	9.15		LEW / 9.49
35	14.1		9.56	10.12		Edge Berm
36	16.4		10.58	11.62		MS
37	19.4		11.05	12.1		BP
38	20.2		10.98	12.03		SB
39	21.6		10.25	11.35		Rock
40	23.1		9.91	11		MS
41	25.7		9.31	10.37		MS
42	30.1		8.56	9.37		~~B~~ LEW
43	30.4		8.27	9.33		Edge Bench
44	32.3		7.36	8.6		MS
45	33		5.94	6.92		TB
46	35.2		5.67	6.77		GS
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						

5.42 - TH
(A)
XS 1 / 0112

~~SUBTRACT 0.34~~

-7.85
LEW
(A)
XS 1
AFTER LUNCH

8.11
B4
LUNCH

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~~[illegible]~~ - Δ TIE
6.63 B4 - LUNCH
7.45 AFTER 7

SURVEY DATA ⟹ **CROSS - SECTION** 8 ✓

SITE: X Sec 2+22 Zn zer **Date:** 4/17/14

Item	STATION ft	B S ft	H I ft	F S ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	0			3.82		
30	2			4.66		
31	4			5.5		
32	6			6.07		
33	8			6.51		
34	10.5			6.97		BF
35	11.4			7.8		
36	14			8.5		water edge
37	16			9.22		
38	17			9.55		
39	19			9.53		
40	21			9.54		
41	23			9.54		
42	25			9.8		
43	26			9.87		
44	27			9.7		
45	28			9.43		
46	29			9.24		
47	29.6			8.59		
48	31			7.22		
49	33			4.59		
50	34.5			3.53		TOB
51	37			3.44		
52						
53						
54				6.31		BM
55						
56						
57						
58						
59						

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riffle

Station 1+30 Reach 1

Site: Team 4 Date: 4/15/14

Location: Marsh Run HUC:

Party:

Inches	PARTICLE	Millimeters	S/C	Dot Count for RIFFLE 1 Protrusion	Dot Count for Riffle Pebble Count	Dot Count for 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
	Silt / Clay	< .062													
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0			8										
.04 - .08	Very Coarse	1.0 - 2													
.08 - .16	Very Fine	2 - 4	GRAVEL		2										
.16 - .22	Fine	4 - 5.7			2										
.22 - .31	Fine	5.7 - 8		1	3										
.31 - .44	Medium	8 - 11.3		8	4										
.44 - .63	Medium	11.3 - 16		4	5										
.63 - .89	Coarse	16 - 22.6		6	2										
.89 - 1.3	Coarse	22.6 - 32		8	2										
1.3 - 1.8	Very Coarse	32 - 45		15	1										
1.8 - 2.5	Very Coarse	45 - 64		18	1										
2.5 - 3.5	Small	64 - 90	COBBLE	14											
3.5 - 5.0	Small	90 - 128		15	1										
5.0 - 7.1	Large	128 - 180		13	3										
7.1 - 10.1	Large	180 - 256			4										
10.1 - 14.3	Small	256 - 362	BOULDER		1										
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048			61										
	Bedrock		BDRK												
Stream Type:			Valley Type:			TOTAL→									

Wetted width: 21 ft

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Reach 1

Site: Team 4 Date: 4/15/14

Location: Marsh Run HUC:

Party:

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	Dot Count for POOL 2	Dot Count for 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:	Date:	Date:									
	Silt / Clay	< .062	S/C	2	13										
	Very Fine	.062 - .125	SAND	2											
	Fine	.125 - .25	SAND												
	Medium	.25 - .50	SAND		6										
	Coarse	.50 - 1.0	SAND	13											
.04 - .08	Very Coarse	1.0 - 2	SAND	3	2										
.08 - .16	Very Fine	2 - 4	GRAVEL												
.16 - .22	Fine	4 - 5.7	GRAVEL												
.22 - .31	Fine	5.7 - 8	GRAVEL	3											
.31 - .44	Medium	8 - 11.3	GRAVEL	1											
.44 - .63	Medium	11.3 - 16	GRAVEL	1											
.63 - .89	Coarse	16 - 22.6	GRAVEL	2											
.89 - 1.3	Coarse	22.6 - 32	GRAVEL	4											
1.3 - 1.8	Very Coarse	32 - 45	GRAVEL												
1.8 - 2.5	Very Coarse	45 - 64	GRAVEL	1											
2.5 - 3.5	Small	64 - 90	COBBLE	2											
3.5 - 5.0	Small	90 - 128	COBBLE	4	1										
5.0 - 7.1	Large	128 - 180	COBBLE	3	1										
7.1 - 10.1	Large	180 - 256	COBBLE	1											
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	29	6										
Stream Type:			Valley Type:			TOTAL→									

71 29

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Reach 1 4/17/14
Team 4 Marsh Run

RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

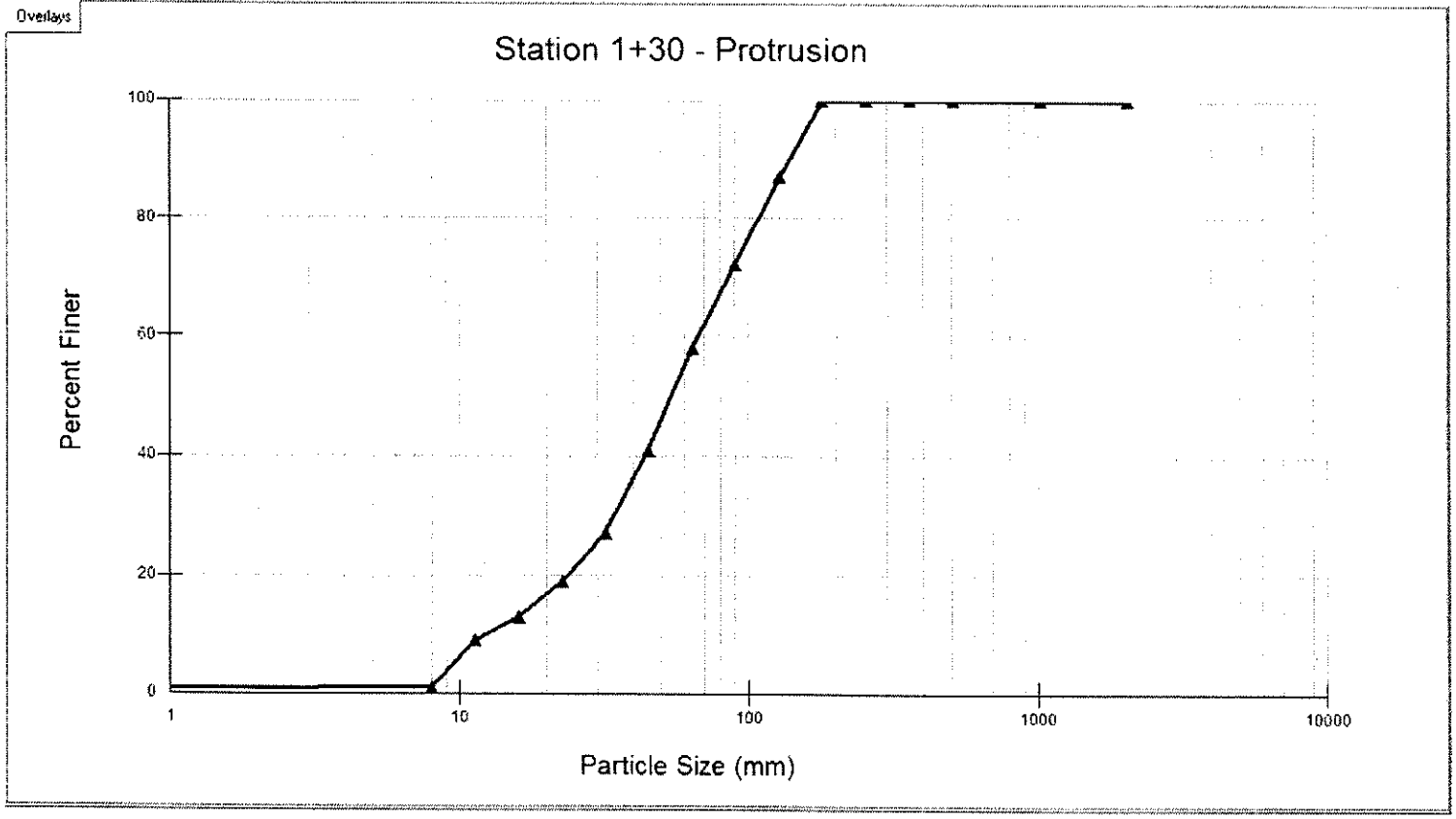
File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Protrusion

Data | Linear Graph | Bar Graph | Date: 04/17/2014

Overlays



Start

10:03 PM
4/17/2014

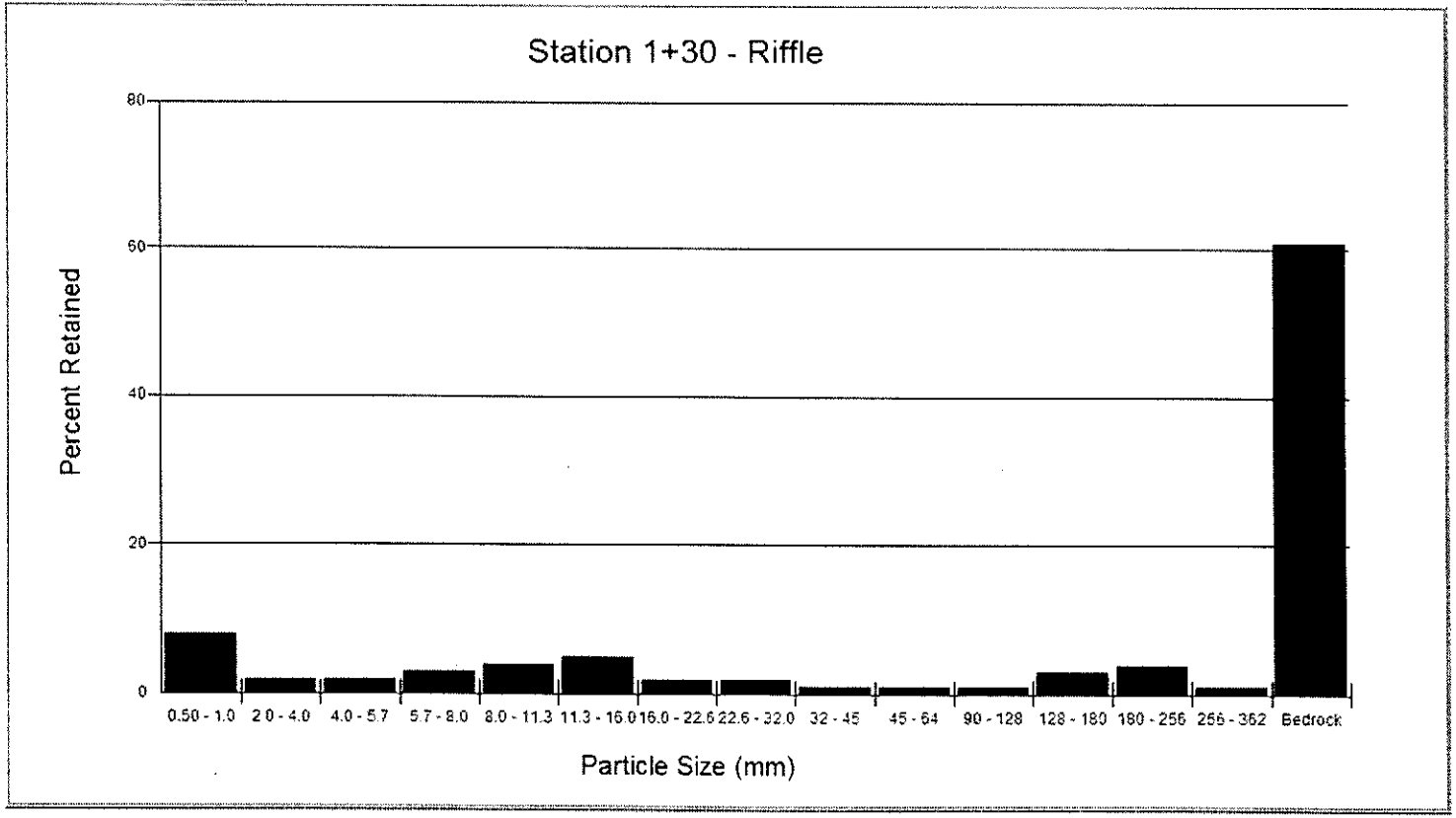
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Riffle

Data | Linear Graph | Bar Graph | Date: 04/17/2014



Start

10:02 PM
4/17/2014

RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

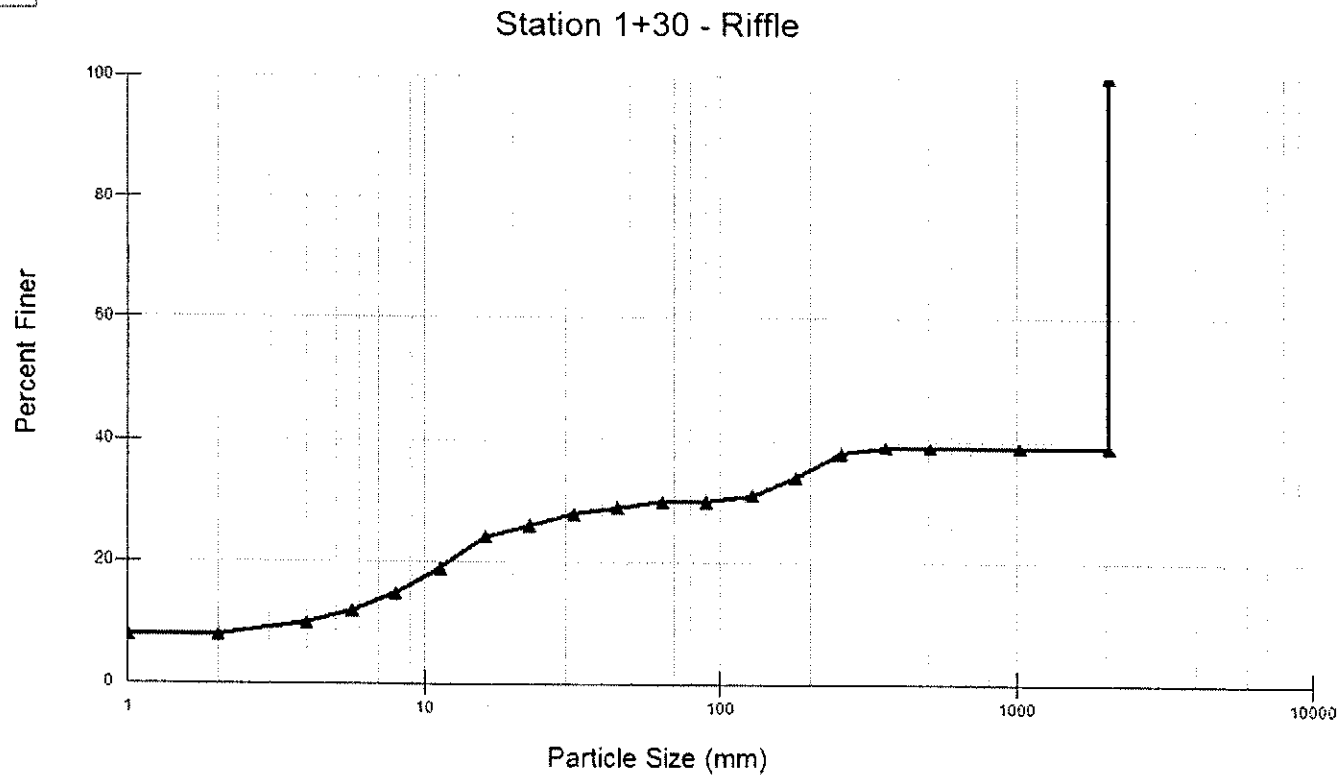
File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Riffle

Data | Linear Graph | Bar Graph | Date: 04/17/2014

Overlays



Start

10:02 PM
4/17/2014

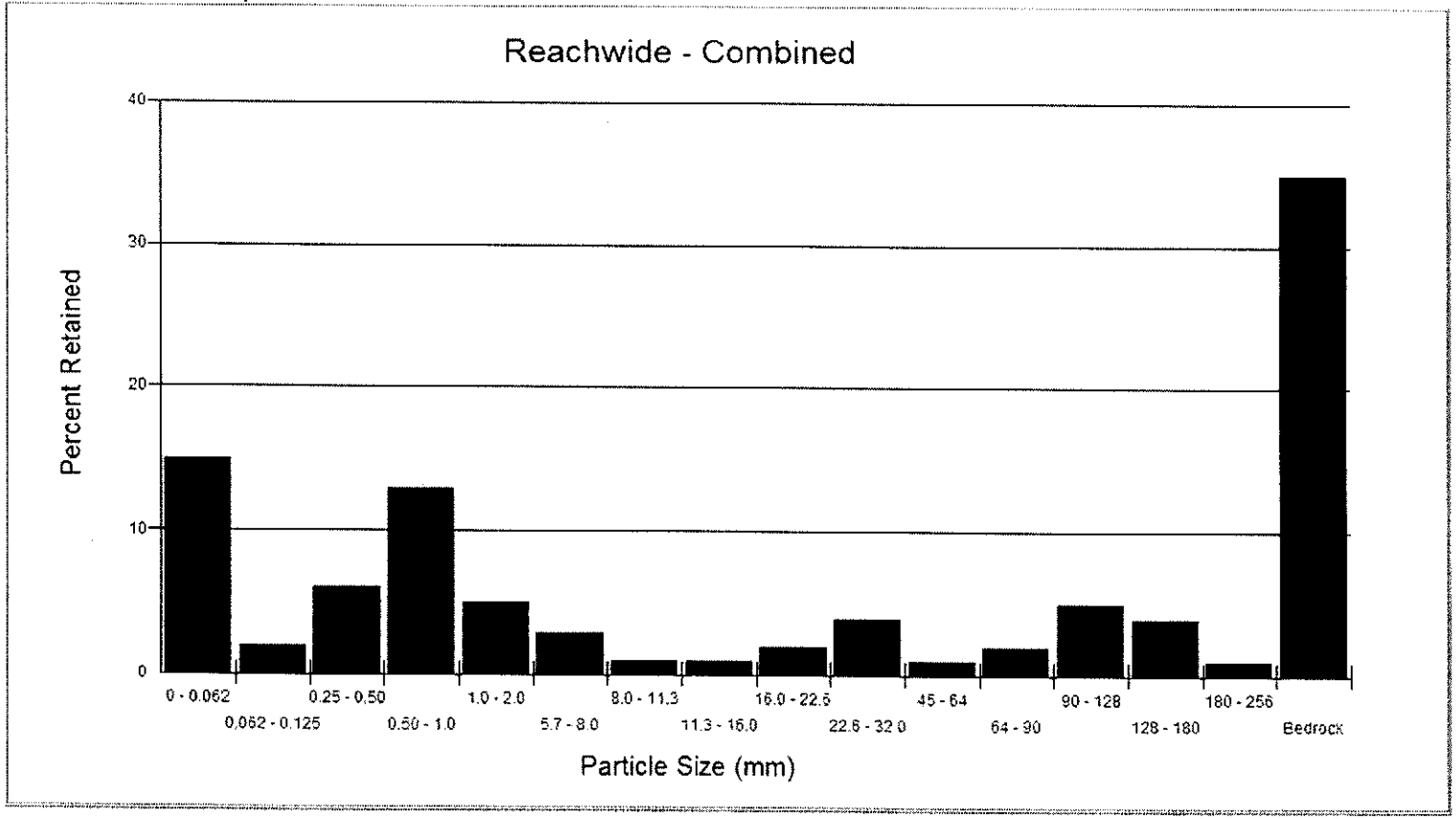
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Reach

Data | Linear Graph | Bar Graph | Date: 04/17/2014



Start

10:01 PM
4/17/2014

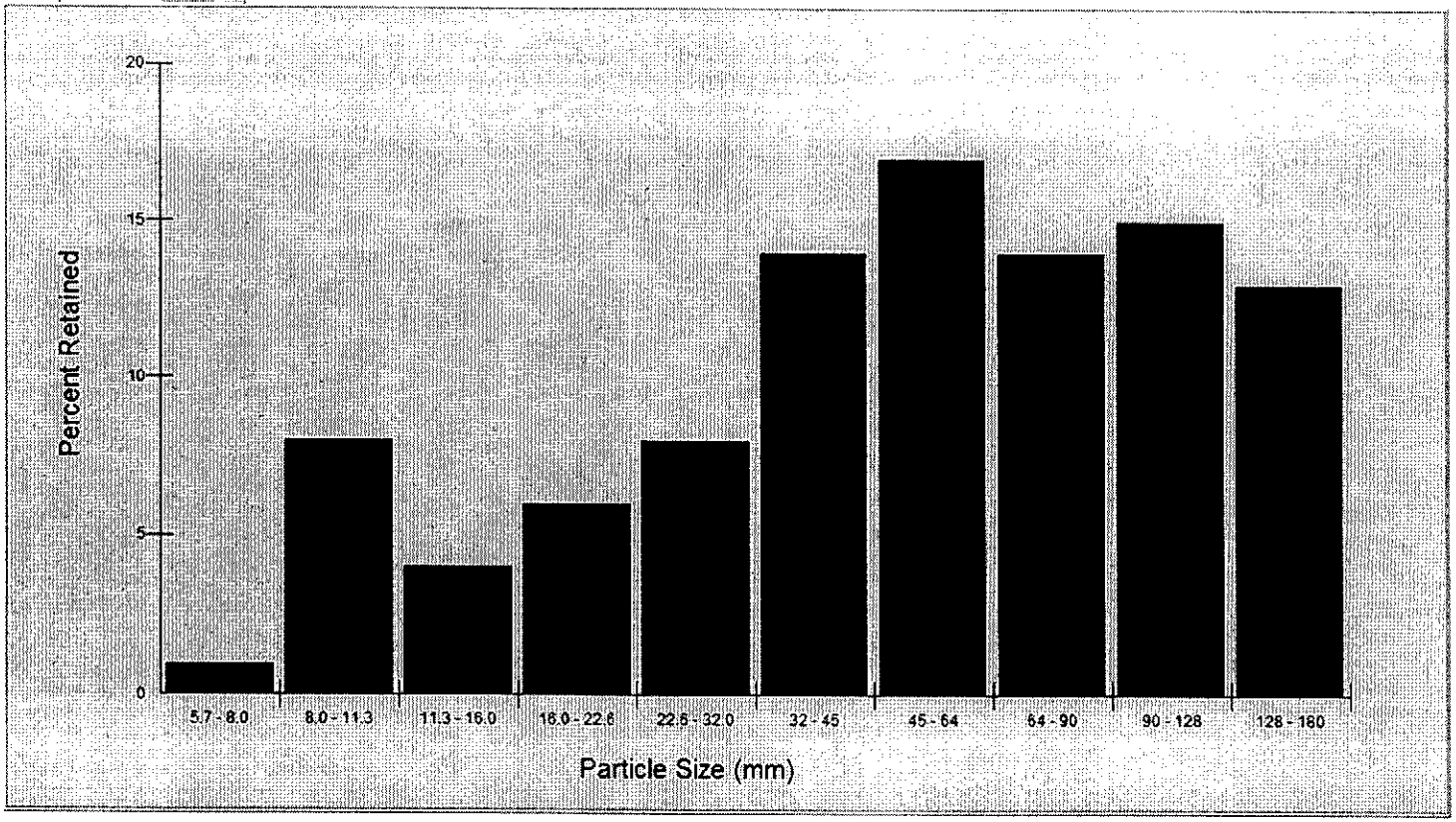
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Protrusion

Data | Linear Graph | Bar Graph | Date: 04/17/2014



Start

10:03 PM
4/17/2014

RIVERMorph 5.1.9.1 Professional - marsh run at 11.pm

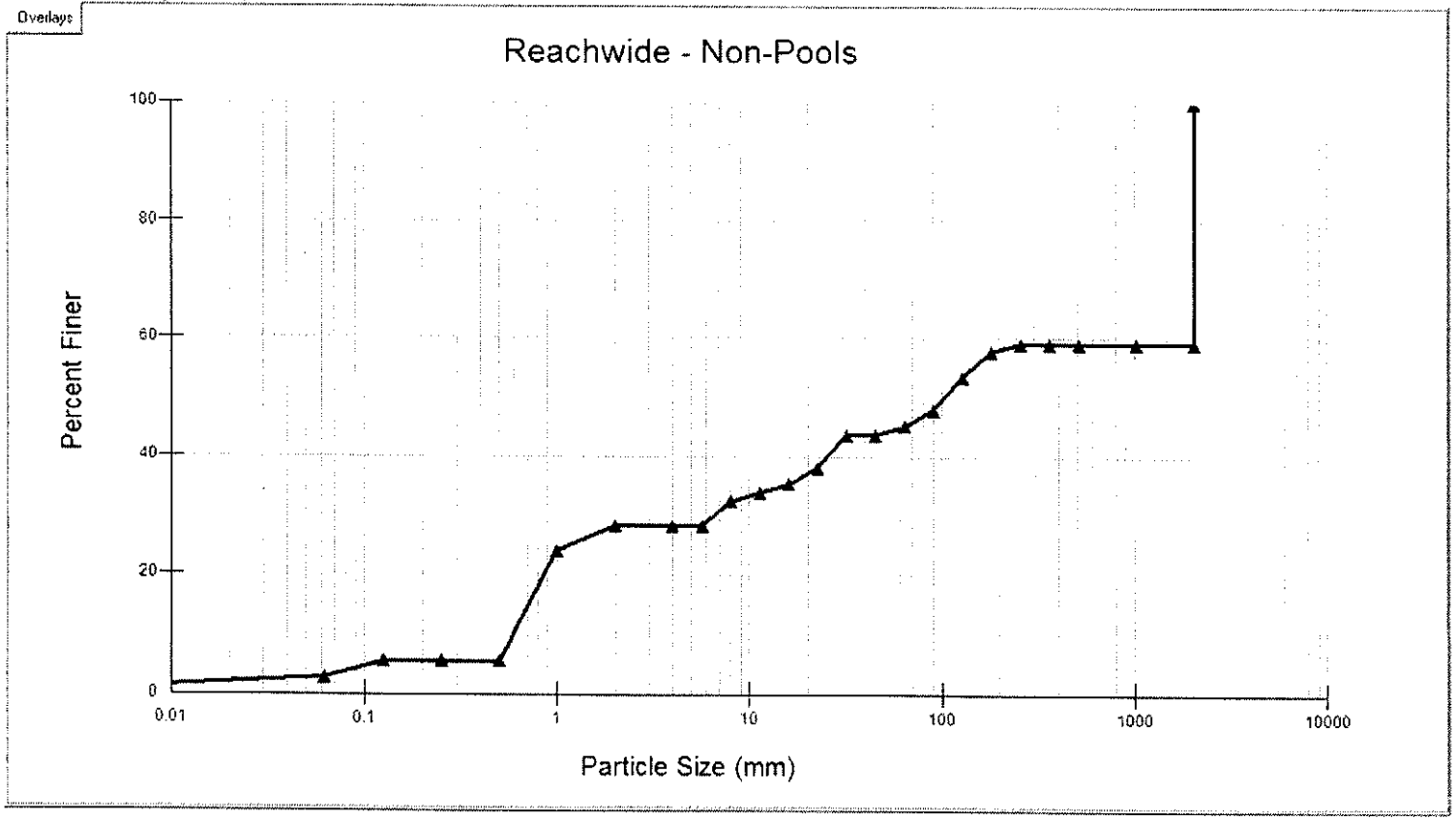
File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
      - Team 4 Hydraulic Calculations
    - Assesments
      - Pfankuch
      - SVAP
      - RBP
      - Vegetation
      - Evaluation
    - BEHI
    - Compelence
    - Designs
    - Notes

Sample Type: Run

Data | Linear Graph | Bar Graph | Date: 04/17/2014

Overlays



Start

11:38 PM
4/17/2014

RIVERMorph 5.1.9.1 Professional - marsh run at 11pm

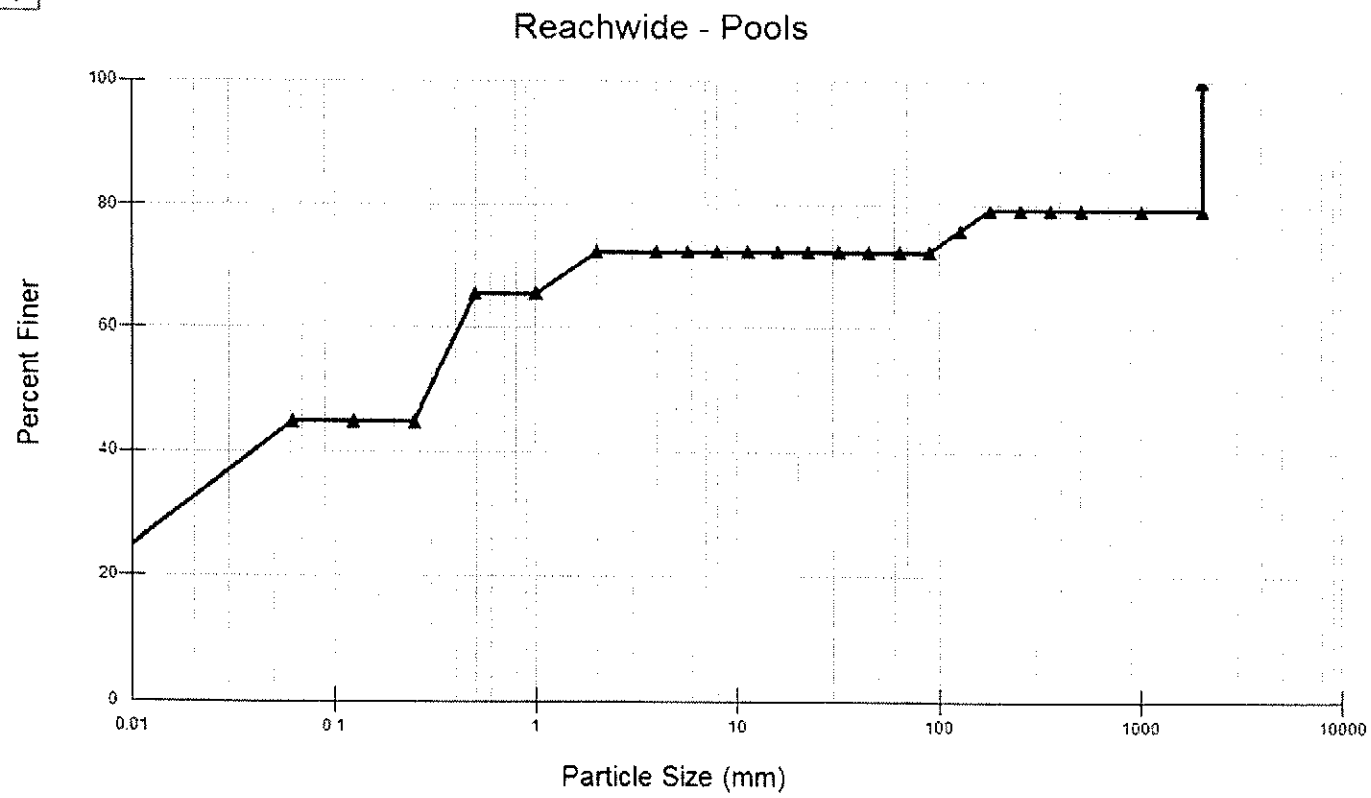
File Tools Help

- March Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
      - Team 4 Hydraulic Calculations
    - Assesments
      - Pfankuch
      - SVAP
      - RBP
      - Vegetation
      - Evaluation
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Pool

Data | Linear Graph | Bar Graph | Date: 04/17/2014

Overlays



Start

11:38 PM
4/17/2014

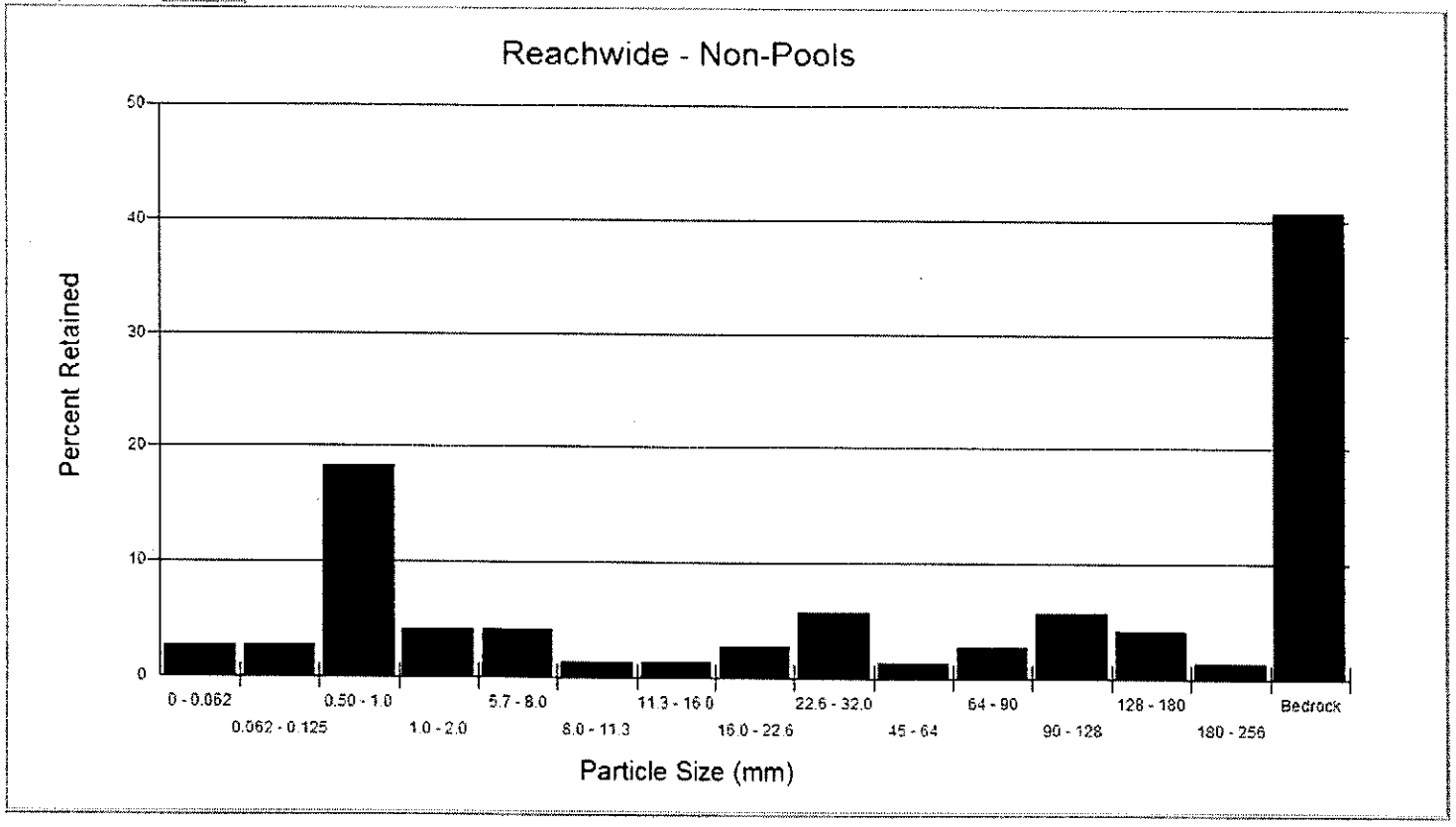
RIVERMorph 5.1.9.1 Professional - marsh run at 11 pm

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
      - Team 4 Hydraulic Calculations
    - Assesments
      - Pfankuch
      - SVAP
      - RBP
      - Vegetation
      - Evaluation
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Run

Data | Linear Graph | Bar Graph | Date: 04/17/2014



Start

11:38 PM
4/17/2014

RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

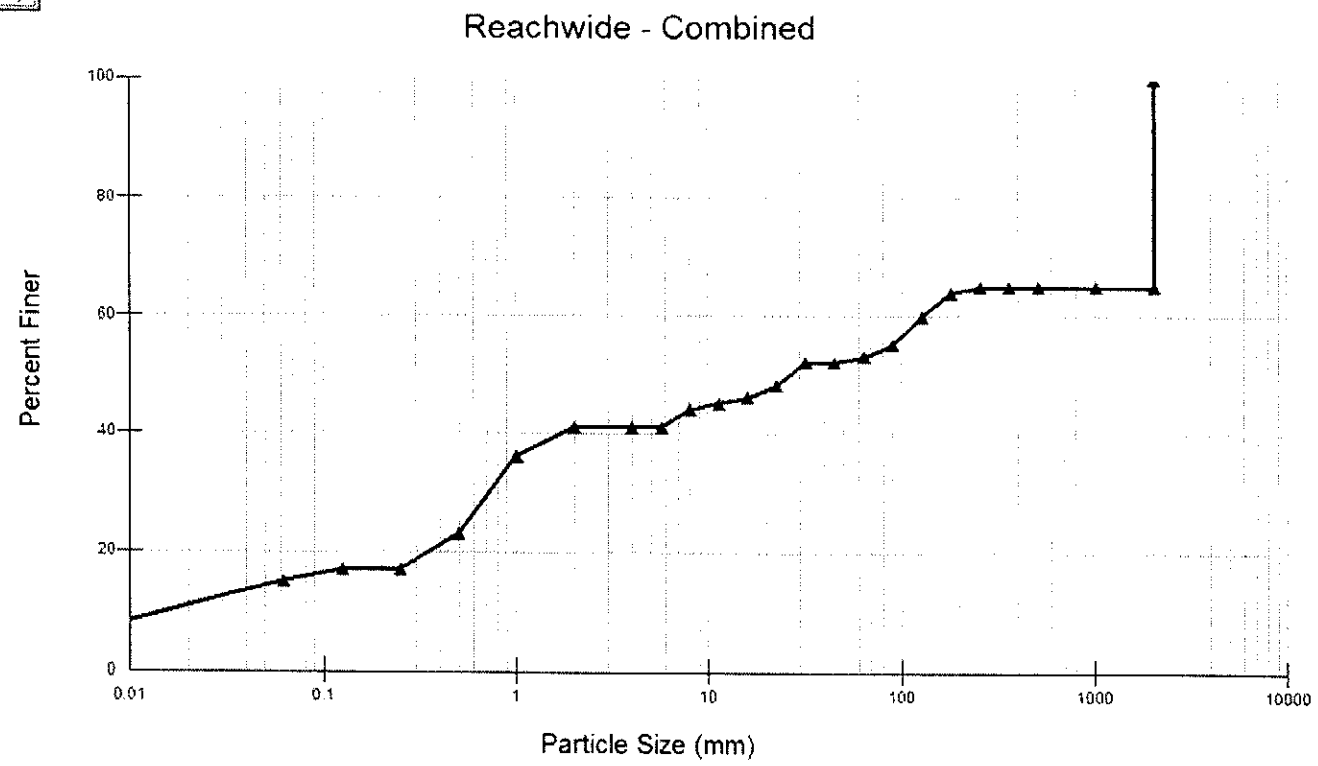
File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Reach

Data | Linear Graph | Bar Graph | Date: 04/17/2014

Overlays



Start

10:01 PM
4/17/2014

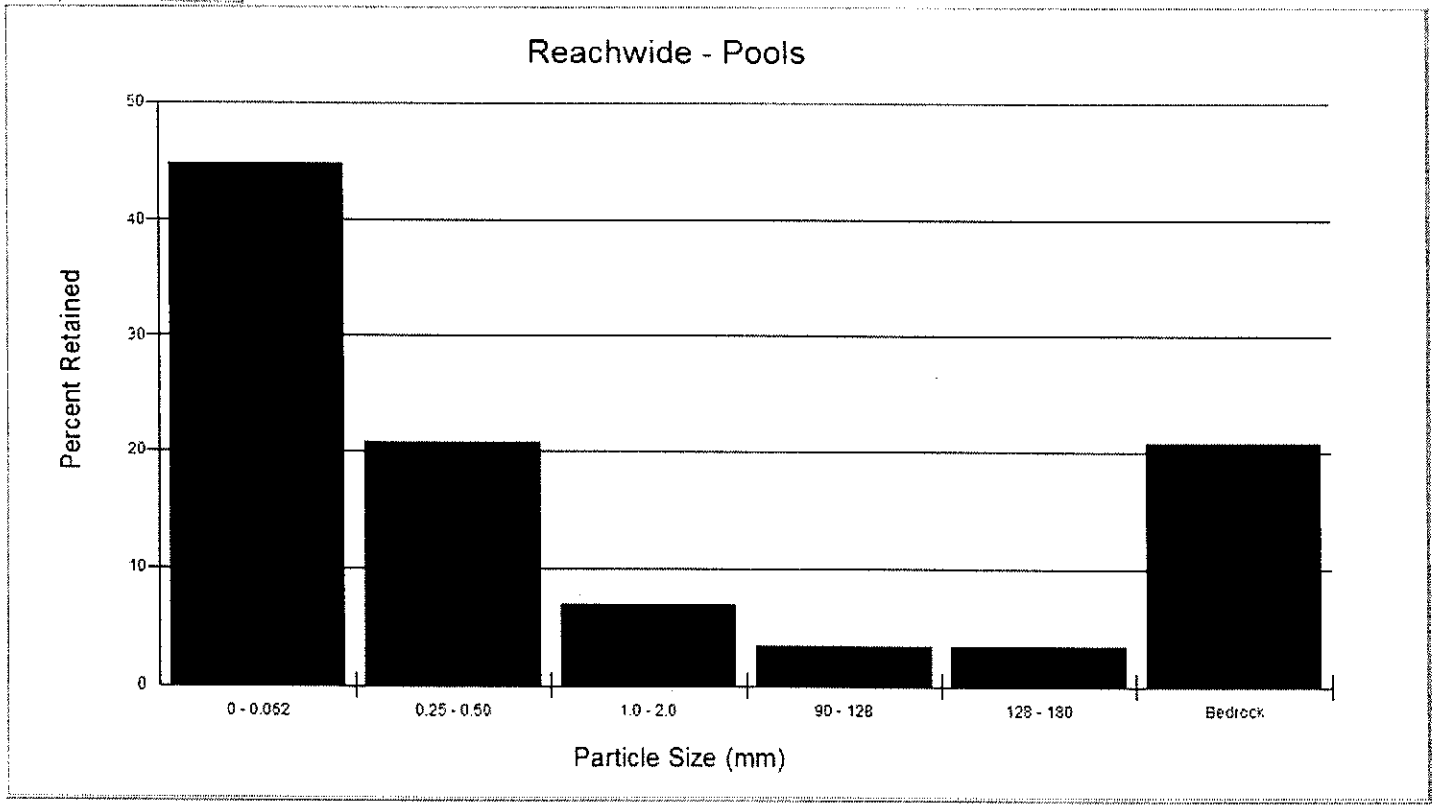
RIVERMorph 5.1.9.1 Professional - marsh run at 11pm

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
      - Team 4 Hydraulic Calculations
    - Assesments
      - Plankuch
      - SVAP
      - RBP
      - Vegetation
      - Evaluation
    - BEHI
    - Competence
    - Designs
    - Notes

Sample Type: Pool

Data | Linear Graph | Bar Graph | Date: 04/17/2014



Start

11:39 PM
4/17/2014

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

Stream:	**Marsh Run, Reach - Team 4**		
Basin:	Drainage Area: **12096** acres	**18.9**	mi^2
Location:	Reach 1		
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.	**23.64**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.36**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**32.12**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**17.38**	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.	**1.64**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**29**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.23**	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.	**27.3**	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.	**0.0034**	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).	**1.6**	

Stream Type ~~**F1**~~ F4/1 (See **Figure 2-14**)

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RIVERMORPH CROSS SECTION SUMMARY

River Name: Marsh Run
Reach Name: Team 4
Cross Section Name: Station 0+15.5 - Glide
Survey Date: 04/17/2014

Cross Section Data Entry

BM Elevation: 103.65 ft
Backsight Rod Reading: 6.93 ft

TAPE	FS	ELEV	NOTE
0	4.03	106.55	BOP
3	4.03	106.55	GROUND
8.8	4.22	106.36	LB
11.11	0	103.37	BKF
11.8	8.11	102.47	LEW
12.3	8.49	102.09	BOB
14	8.83	101.75	GROUND
18.8	8.89	101.69	GROUND
21.2	8.9	101.68	TW
25.6	9	101.58	SLOPE BREAK
33.9	8.59	101.99	BOT INNER BERM
34.9	7.91	102.67	
37	7.58	103	BOB
38.3	5.4	105.18	SLOPE BREAK
40	4.52	106.06	RB
48	4.53	106.05	END

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	105.16	105.16	105.16
Bankfull Elevation (ft)	103.37	103.37	103.37
Floodprone Width (ft)	28.56	-----	-----
Bankfull Width (ft)	26.11	0.35	25.76
Entrenchment Ratio	1.09	-----	-----
Mean Depth (ft)	1.47	0.23	1.48
Maximum Depth (ft)	1.79	0.46	1.79
Width/Depth Ratio	17.76	1.53	17.41
Bankfull Area (sq ft)	38.3	0.08	38.22
Wetted Perimeter (ft)	27.17	1.03	27.05
Hydraulic Radius (ft)	1.41	0.08	1.41
Begin BKF Station	11.11	11.11	11.46
End BKF Station	37.22	11.46	37.22

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			

Movable Particle (mm)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Marsh Run
Reach Name: Team 4
Cross Section Name: Station 0+45 - Run
Survey Date: 04/17/2014

Cross Section Data Entry

BM Elevation: 103.65 ft
Backsight Rod Reading: 6.96 ft

TAPE	FS	ELEV	NOTE
0	3.96	106.65	GROUND
6	3.95	106.66	LB
10.7	6.1	104.51	SLOPE BREAK
12	8.16	102.45	LEW
12.2	9.32	101.29	BOB
15.2	9.72	100.89	TW
17.2	9.28	101.33	SLOPE BREAK
23.8	9.21	101.4	SLOPE BREAK
29.2	8.16	102.45	REW
30.2	7.18	103.43	BKF
34	4.6	106.01	RB
38	4.32	106.29	BOP

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	105.97	105.97	105.97
Bankfull Elevation (ft)	103.43	103.43	103.43
Floodprone Width (ft)	26.43	-----	-----
Bankfull Width (ft)	18.82	9.41	9.41
Entrenchment Ratio	1.4	-----	-----
Mean Depth (ft)	1.83	2.1	1.57
Maximum Depth (ft)	2.54	2.54	2.06
Width/Depth Ratio	10.28	4.48	5.99
Bankfull Area (sq ft)	34.52	19.75	14.78
Wetted Perimeter (ft)	20.91	13.06	11.97
Hydraulic Radius (ft)	1.65	1.51	1.23
Begin BKF Station	11.38	11.38	20.79
End BKF Station	30.2	20.79	30.2

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: Marsh Run
Reach Name: Team 4
Cross Section Name: Station 0+79 - Pool
Survey Date: 04/17/2014

Cross Section Data Entry

BM Elevation: 103.65 ft
Backsight Rod Reading: 7.01 ft

TAPE	FS	ELEV	NOTE
0	4.15	106.51	GS
2	4.3	106.36	GS
4	4.1	106.56	GS
6	4.3	106.36	SB
8	4.79	105.87	MOS?
8.2	4.85	105.81	LB
10.5	6.02	104.64	ROOT
11	7.12	103.54	BB
11.6	0	103.36	BKF
12.5	7.73	102.93	START OF BERM
15.6	8.02	102.64	BERM
16.2	8.25	102.41	LEW
18.2	8.8	101.86	SB SEDIMENT DEPOSIT
20.9	10.08	100.58	MID SLOPE SED?
22.2	10.58	100.08	MID SLOPE SED?
24.1	11.05	99.61	BOTTOM SLOPE
26.1	11.17	99.49	TW
26.6	10.85	99.81	SB
28.1	10.65	100.01	MID SED?
31.5	9.9	100.76	MID S/LOG DEBRIS
32.6	9.58	101.08	MID S/LOFD
34.9	8.97	101.69	MID S/LOFD
35.4	8.25	102.41	REW
36.5	8.04	102.62	IB
37.5	7.8	102.86	EDGE VEG
39.3	6.71	103.95	MID S
40.2	5.45	105.21	RB
44.4	5.41	105.25	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	107.23	107.23	107.23
Bankfull Elevation (ft)	103.36	103.36	103.36
Floodprone Width (ft)	44.4	-----	-----
Bankfull Width (ft)	26.73	13.36	13.37
Entrenchment Ratio	1.66	-----	-----
Mean Depth (ft)	2.09	1.84	2.33
Maximum Depth (ft)	3.87	3.8	3.87
Width/Depth Ratio	12.79	7.26	5.74
Bankfull Area (sq ft)	55.72	24.57	31.16
Wetted Perimeter (ft)	28.27	17.83	18.05
Hydraulic Radius (ft)	1.97	1.38	1.73

Begin BKF Station	11.6	11.6	24.96
End BKF Station	38.33	24.96	38.33

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: Marsh Run
Reach Name: Team 4
Cross Section Name: Station 0+93 - Glide
Survey Date: 04/17/2014

Cross Section Data Entry

BM Elevation: 103.65 ft
Backsight Rod Reading: 7.01 ft

TAPE	FS	ELEV	NOTE
0	4.35	106.31	GS
3	3.4	107.26	GS
5	4.7	105.96	GS
7.6	5.32	105.34	LB
8.9	6.39	104.27	MS
9.8	7.61	103.05	BKF
9.9	8.35	102.31	LEW
9.9	8.7	101.96	BB
11.7	8.95	101.71	MS ROCK
13	8.93	101.73	GS
14	9.05	101.61	GS-TH
16	8.94	101.72	GS
20.5	8.95	101.71	GS
22.6	8.2	102.46	ON LOG
24	8.94	101.72	GS
26.2	9.31	101.35	TW
29	9.09	101.57	GS
30.5	9.03	101.63	GS-START LOG
31.9	8.78	101.88	GS
34.9	8.58	102.08	BB
34.9	8.35	102.31	REW
36	7.67	102.99	BF
38	4.54	106.12	RB
42	4.3	106.36	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	104.75	104.75	104.75
Bankfull Elevation (ft)	103.05	103.05	103.05
Floodprone Width (ft)	28.81	-----	-----
Bankfull Width (ft)	26.24	13.12	13.12
Entrenchment Ratio	1.1	-----	-----
Mean Depth (ft)	1.25	1.25	1.26
Maximum Depth (ft)	1.7	1.44	1.7
Width/Depth Ratio	20.99	10.53	10.41
Bankfull Area (sq ft)	32.91	16.35	16.55
Wetted Perimeter (ft)	28.1	15.08	14.54
Hydraulic Radius (ft)	1.17	1.08	1.14
Begin BKF Station	9.8	9.8	22.92
End BKF Station	36.04	22.92	36.04

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: Marsh Run
Reach Name: Team 4
Cross Section Name: Station 1+35 - Riffle
Survey Date: 04/17/2014

Cross Section Data Entry

BM Elevation: 103.65 ft
Backsight Rod Reading: 6.31 ft

TAPE	FS	ELEV	NOTE
0	3.2	106.76	
1.9	3.54	106.42	TOB
4	6.56	103.4	
5.1	8.08	101.88	LEW
6.6	8.46	101.5	
8.3	8.55	101.41	
10	8.58	101.38	
12	8.65	101.31	
14	8.57	101.39	
16	8.59	101.37	
18	8.56	101.4	
21	8.64	101.32	
23	8.7	101.26	
24.4	8.7	101.26	
25.3	8.56	101.4	
26	7.55	102.41	
26.5	7.33	102.63	
28	7.06	102.9	BKF
29.5	6.71	103.25	
31	6	103.96	
34	4.56	105.4	
36	3.9	106.06	
38	3.42	106.54	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	104.54	104.54	104.54
Bankfull Elevation (ft)	102.9	102.9	102.9
Floodprone Width (ft)	29	-----	-----
Bankfull Width (ft)	23.64	11.17	12.47
Entrenchment Ratio	1.23	-----	-----
Mean Depth (ft)	1.36	1.41	1.31
Maximum Depth (ft)	1.64	1.59	1.64
Width/Depth Ratio	17.38	7.93	9.52
Bankfull Area (sq ft)	32.12	15.74	16.39
Wetted Perimeter (ft)	24.82	13.27	14.61
Hydraulic Radius (ft)	1.29	1.19	1.12
Begin BKF Station	4.36	4.36	15.53
End BKF Station	28	15.53	28

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: Marsh Run
Reach Name: Team 4
Cross Section Name: Station 1+61 - Run
Survey Date: 04/17/2014

Cross Section Data Entry

BM Elevation: 103.65 ft
Backsight Rod Reading: 7.01 ft

TAPE	FS	ELEV	NOTE
0	5.23	105.43	BOP
10	5.95	104.71	G
14.2	6.28	104.38	START OF ROOT MASS
17.5	6.95	103.71	LB
15.3	7.66	103	UNDERCUT
15.6	8.16	102.5	UNDERCUT
15.7	0	102.4	BKF
16.7	9.16	101.5	UNDERCUT
16.8	9.16	101.5	LEW
19	9.7	100.96	SLOPE BREAK
20.8	9.78	100.88	SLOPE BREAK
22.4	10	100.66	SLOPE BREAK
22.6	9.89	100.77	SLOPE BREAK
26	9.84	100.82	G
30.5	9.84	100.82	G
33.2	9.8	100.86	TW
34.4	9.75	100.91	G
38	9.69	100.97	G
39.3	9.16	101.5	REW
41.2	8.57	102.09	BB
41.6	7.95	102.71	
45	5.13	105.53	RB
47	4.89	105.77	G

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	104.14	104.14	104.14
Bankfull Elevation (ft)	102.4	102.4	102.4
Floodprone Width (ft)	27.94	-----	-----
Bankfull Width (ft)	25.7	12.84	12.86
Entrenchment Ratio	1.09	-----	-----
Mean Depth (ft)	1.37	1.42	1.33
Maximum Depth (ft)	1.74	1.74	1.58
Width/Depth Ratio	18.76	9.06	9.67
Bankfull Area (sq ft)	35.27	18.19	17.08
Wetted Perimeter (ft)	26.52	14.88	14.8
Hydraulic Radius (ft)	1.33	1.22	1.15
Begin BKF Station	15.7	15.7	28.54
End BKF Station	41.4	28.54	41.4

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: Marsh Run
Reach Name: Team 4
Cross Section Name: Station 1+97 - Pool
Survey Date: 04/17/2014

Cross Section Data Entry

BM Elevation: 103.65 ft
Backsight Rod Reading: 6.31 ft

TAPE	FS	ELEV	NOTE
0	5.84	104.12	GS
1.6	6.46	103.5	TB
3.4	6.87	103.09	SB
4.7	7.84	102.12	BKF
10.2	8.57	101.39	LOG
10.8	9.08	100.88	LEW
14.1	9.56	100.4	INNER BERN
16.4	10.58	99.38	MS
19.4	11.05	98.91	BP
20.2	10.98	98.98	SB
21.6	10.25	99.71	ROCK
23.1	9.91	100.05	MS
25.7	9.31	100.65	MS
30.1	8.56	101.4	G
30.4	8.27	101.69	
32.3	7.36	102.6	BKF
33	5.94	104.02	TB
35.2	5.67	104.29	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	105.81	105.81	105.81
Bankfull Elevation (ft)	102.36	102.36	102.36
Floodprone Width (ft)	35.2	-----	-----
Bankfull Width (ft)	27.42	13.62	13.8
Entrenchment Ratio	1.28	-----	-----
Mean Depth (ft)	1.74	1.5	1.97
Maximum Depth (ft)	3.45	3.23	3.45
Width/Depth Ratio	15.76	9.08	7.01
Bankfull Area (sq ft)	47.59	20.43	27.16
Wetted Perimeter (ft)	28.64	17.44	17.67
Hydraulic Radius (ft)	1.66	1.17	1.54
Begin BKF Station	4.38	4.38	18
End BKF Station	31.8	18	31.8

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side

Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: Marsh Run
Reach Name: Team 4
Cross Section Name: Station 2+22 - Glide
Survey Date: 04/17/2014

Cross Section Data Entry

BM Elevation: 103.65 ft
Backsight Rod Reading: 6.31 ft

TAPE	FS	ELEV	NOTE
0	3.82	106.14	
2	4.66	105.3	
4	5.5	104.46	
6	6.07	103.89	
8	6.51	103.45	
10.5	6.97	102.99	Questionable BKfull
11.4	7.8	102.16	
14	8.5	101.46	LEW
16	9.22	100.74	
17	9.55	100.41	
19	9.53	100.43	
21	9.54	100.42	
23	9.54	100.42	
25	9.8	100.16	
26	9.87	100.09	
27	9.7	100.26	
28	9.43	100.53	
29	9.24	100.72	
29.6	8.59	101.37	
31	7.22	102.74	BKF
33	4.59	105.37	
34.5	3.53	106.43	RB
37	3.44	106.52	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	105.39	105.39	105.39
Bankfull Elevation (ft)	102.74	102.74	102.74
Floodprone Width (ft)	31.24	-----	-----
Bankfull Width (ft)	20.23	10.13	10.1
Entrenchment Ratio	1.54	-----	-----
Mean Depth (ft)	1.9	1.69	2.12
Maximum Depth (ft)	2.65	2.33	2.65
Width/Depth Ratio	10.65	6.01	4.76
Bankfull Area (sq ft)	38.47	17.08	21.39
Wetted Perimeter (ft)	21.66	12.95	13.35
Hydraulic Radius (ft)	1.78	1.32	1.6
Begin BKF Station	10.77	10.77	20.9
End BKF Station	31	20.9	31

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

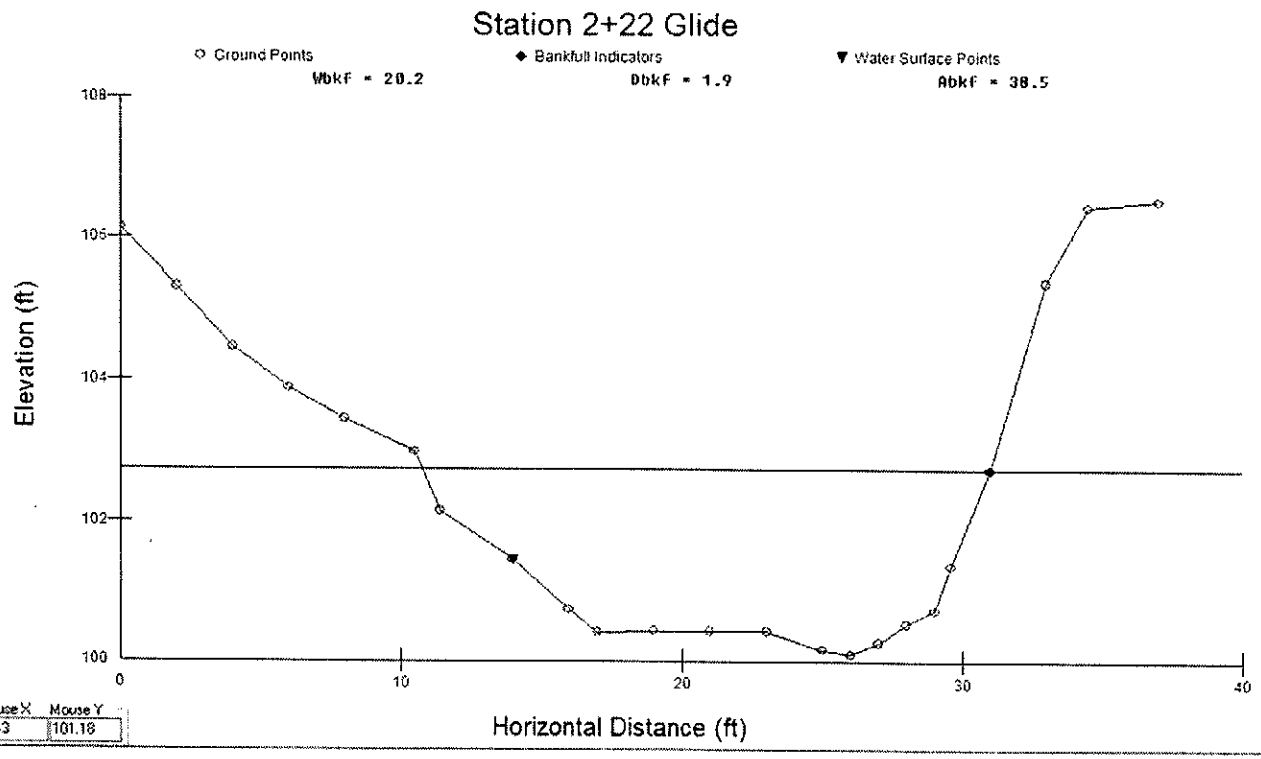
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle (Representative)
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Data | Graph | Summary | Stages | Photographs | Data Collection Date 04/17/2014

Graph Tools Drawing | Bankfull Elev 102.74



Mouse X 2.43 | Mouse Y 101.18

Start

9:58 PM
4/17/2014

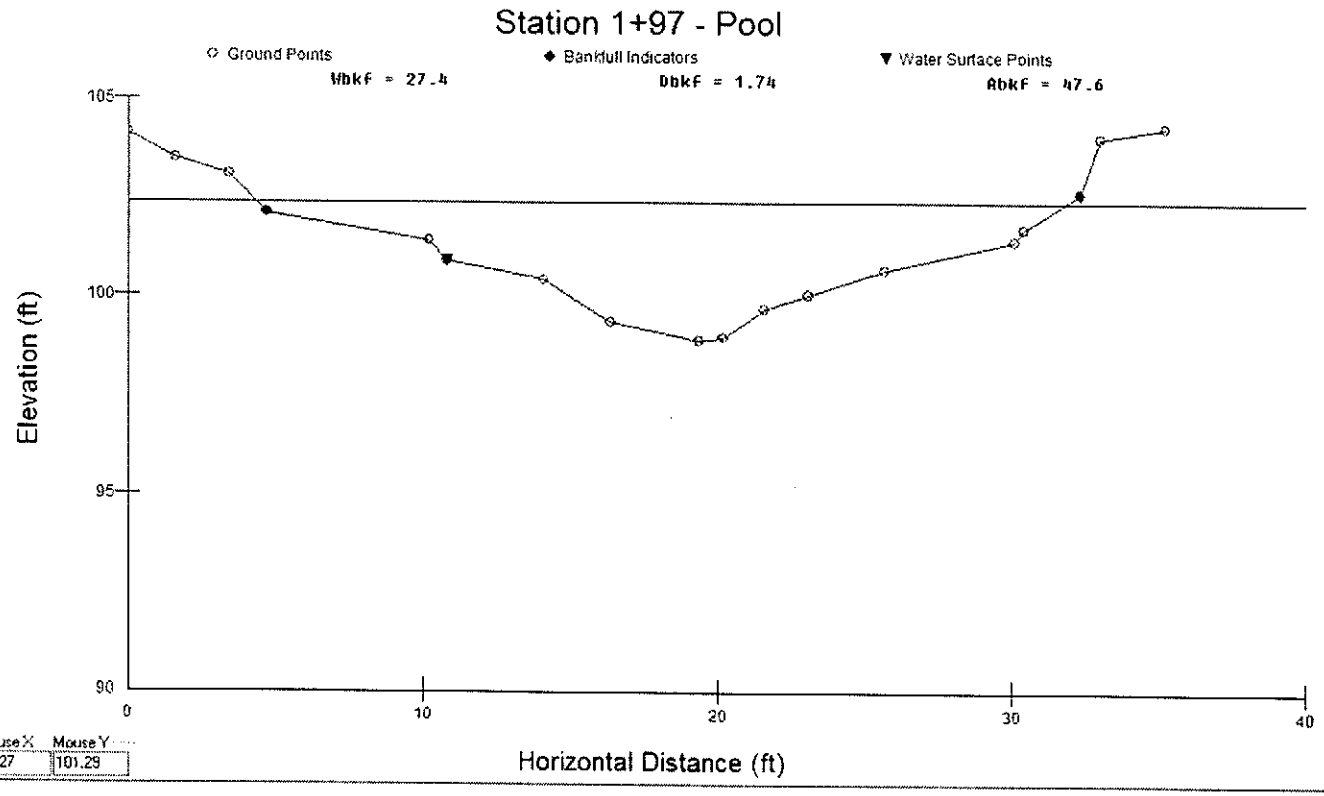
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle (Representative)
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Data | Graph | Summary | Stages | Photographs | Data Collection Date 04/17/2014

Graph Tools Drawing Bankfull Elev 102.36



Start

9:55 PM 4/17/2014

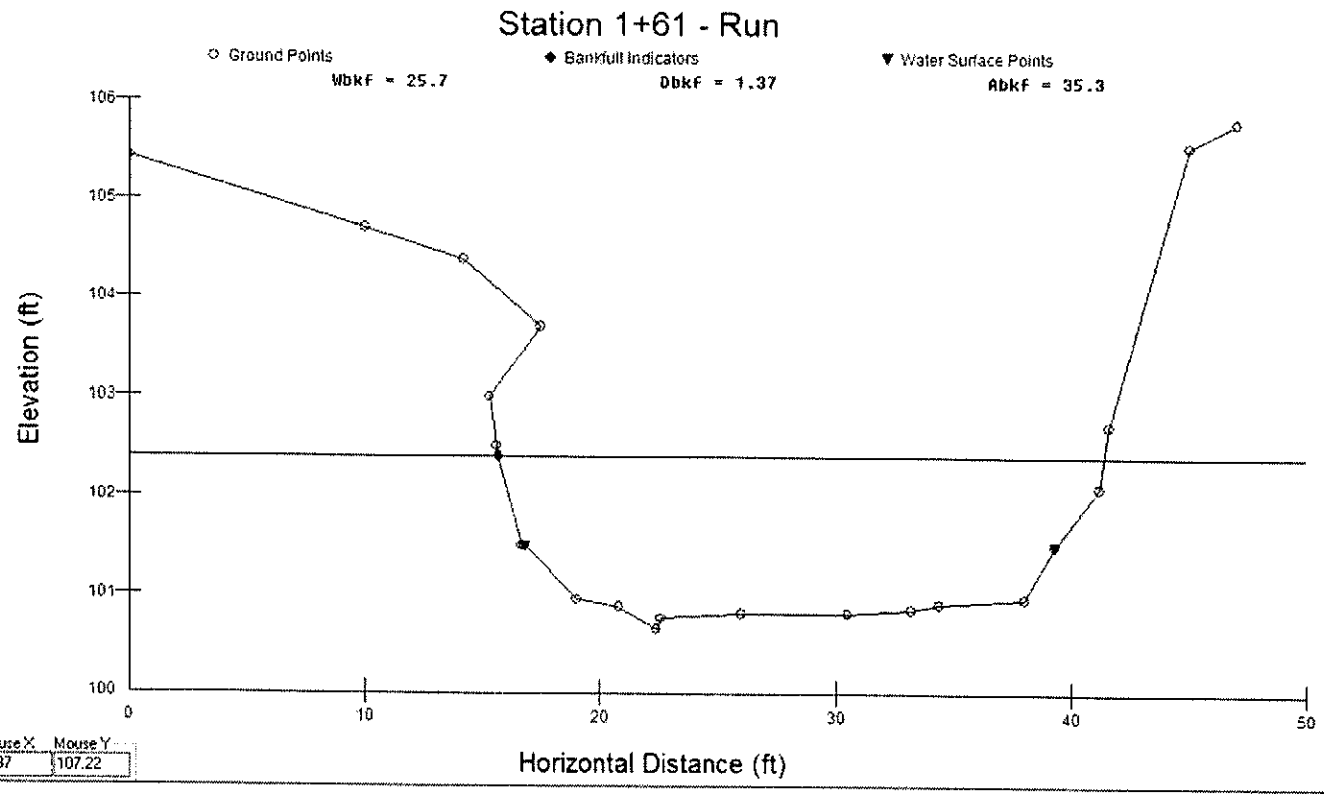
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle (Representative)
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Data | Graph | Summary | Stages | Photographs | Data Collection Date 04/17/2014

Graph Tools Drawing Bankfull Elev 102.4



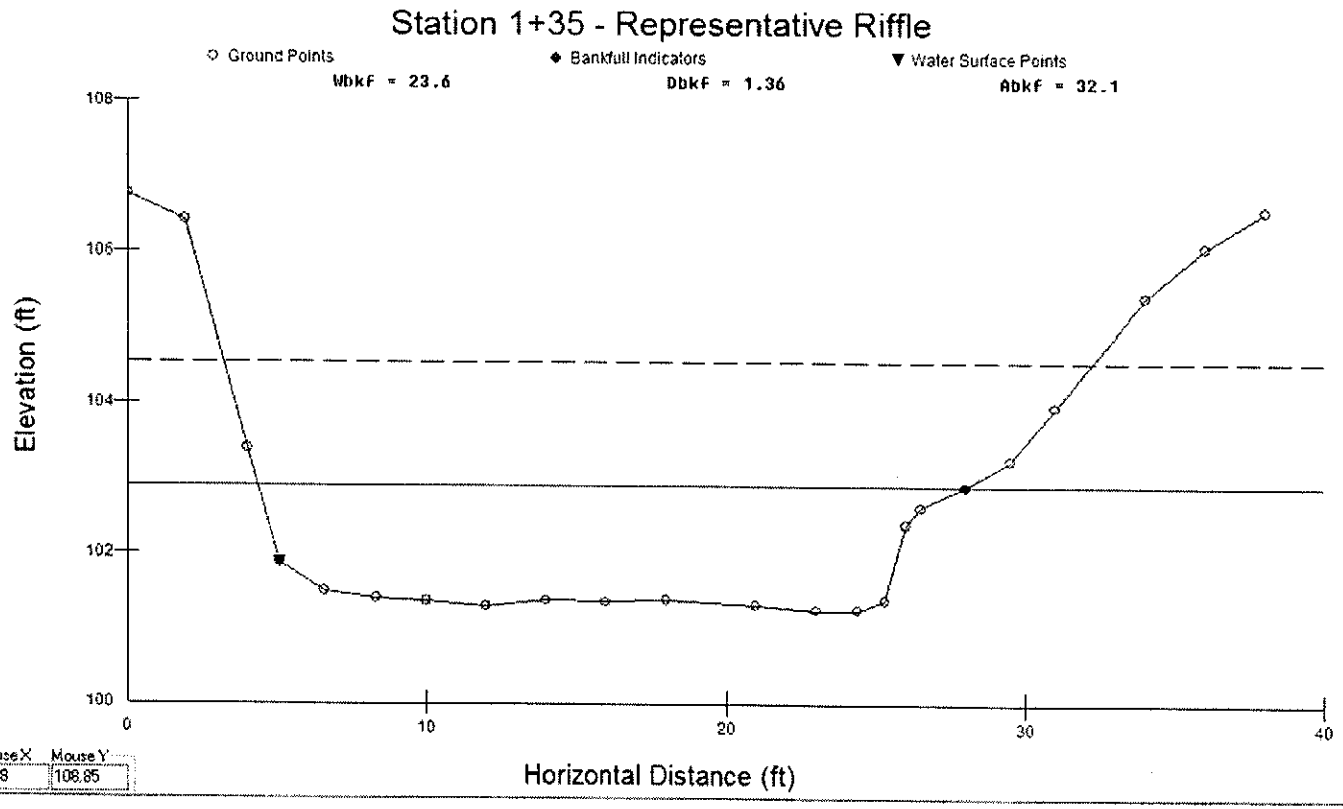
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle (Representative)
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Data | Graph | Summary | Stages | Photographs | Data Collection Date 04/17/2014

Graph Tools Drawing Bankfull Elev 102.9



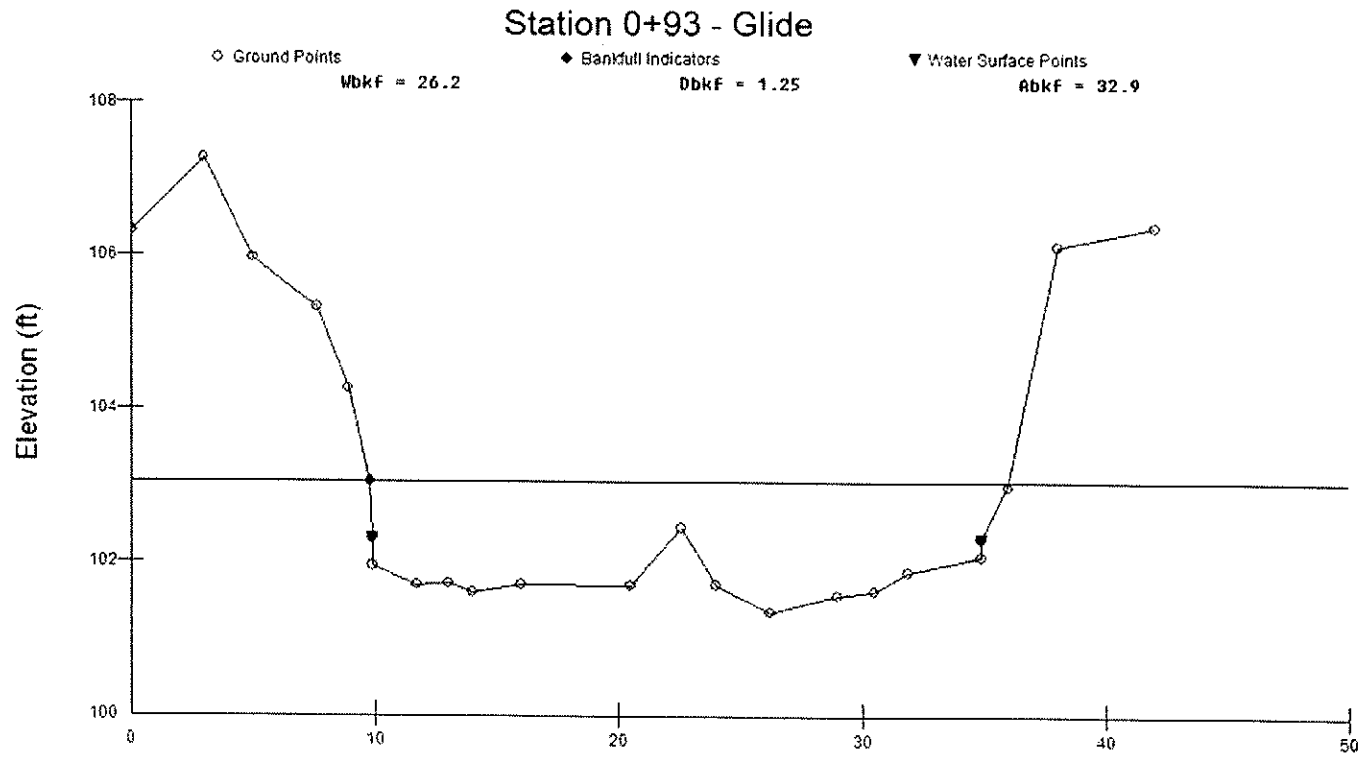
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle (Representative)
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Data | Graph | Summary | Stages | Photographs | Data Collection Date 04/17/2014

Graph Tools Drawing Bankfull Elev 103.05



Mouse X 17.66 Mouse Y 109.62

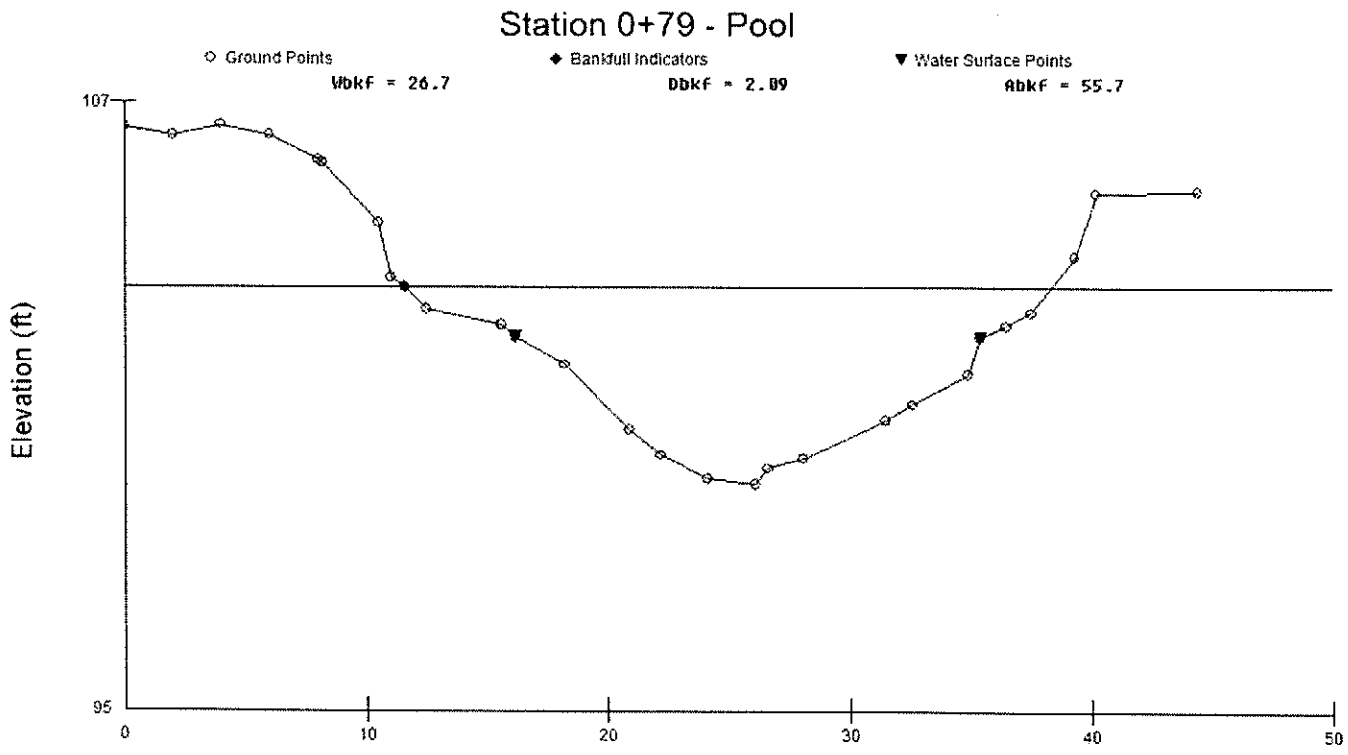
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle (Representative)
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Data | Graph | Summary | Stages | Photographs | Data Collection Date 04/17/2014

Graph Tools Drawing | Bankfull Elev 103.36



Mouse X -4.34 Mouse Y 109.46

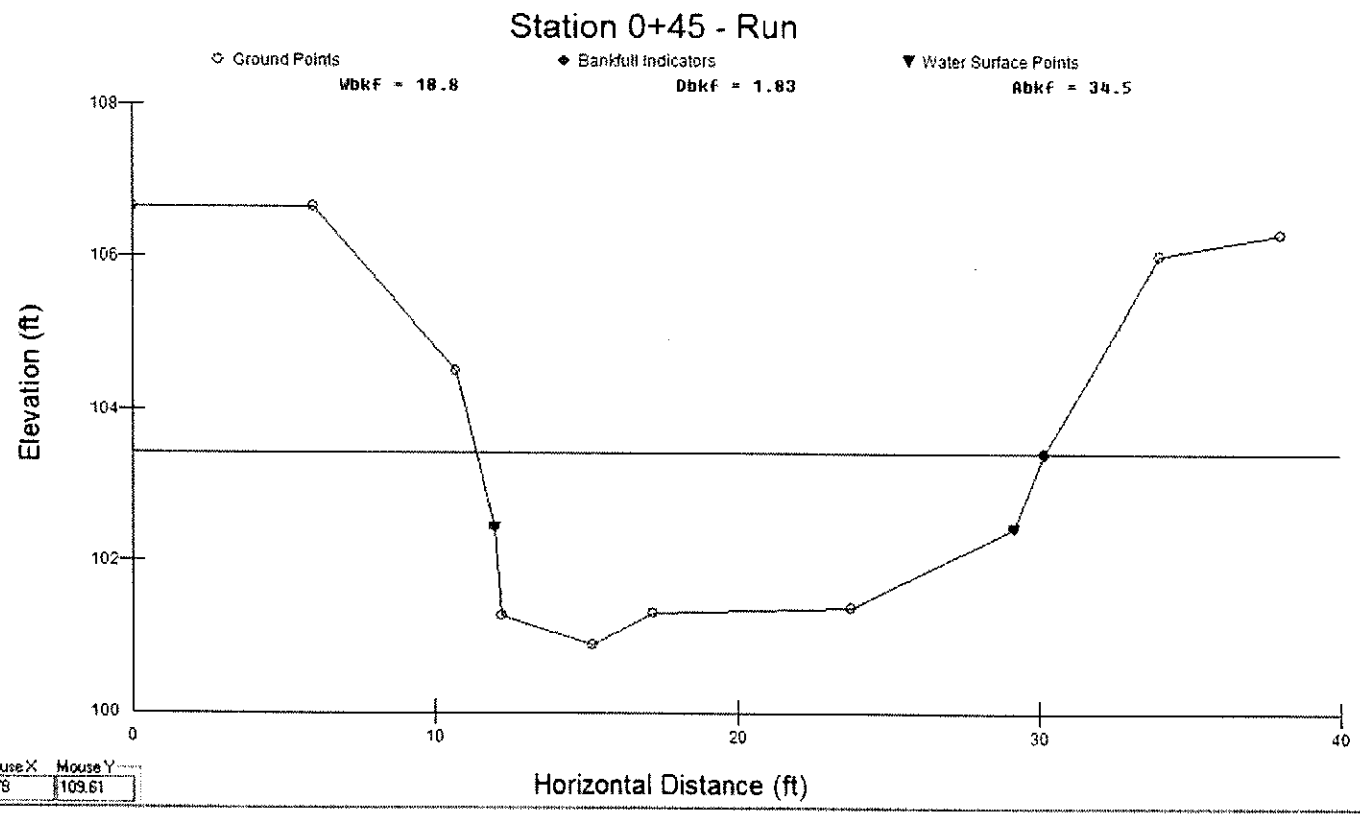
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle (Representative)
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assesments
    - BEHI
    - Competence
    - Designs
    - Notes

Data | Graph | Summary | Stages | Photographs | Data Collection Date 04/17/2014

Graph Tools Drawing Bankfull Elev 103.43



Mouse X 6.78 Mouse Y 109.61

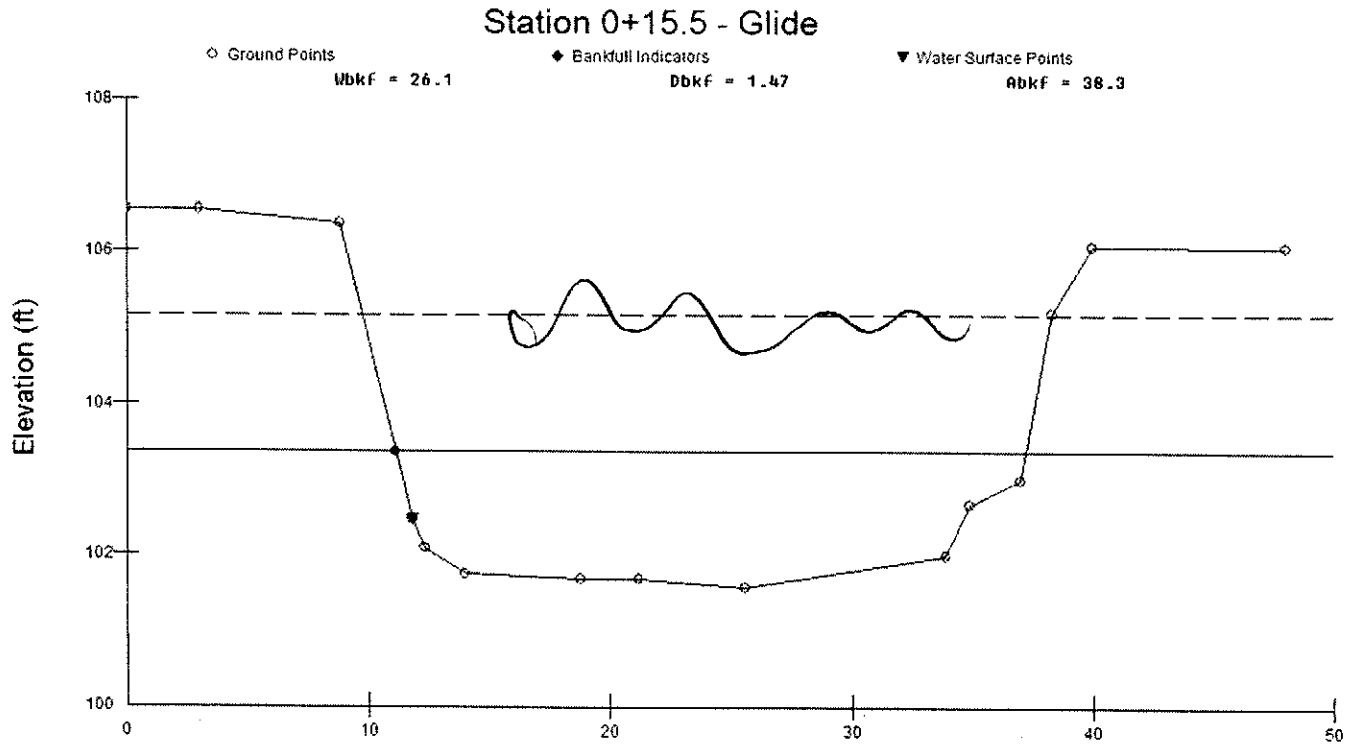
RIVERMorph 5.1.9.1 Professional - Marsh Run at Grimes - Team 4

File Tools Help

- Marsh Run
  - Team 4
    - Survey Data
    - Cross Sections
      - Station 0+15.5 - Glide
      - Station 0+45 - Run
      - Station 0+79 - Pool
      - Station 0+93 - Glide
      - Station 1+35 - Riffle (Representative)
      - Station 1+61 - Run
      - Station 1+97 - Pool
      - Station 2+22 - Glide
      - Station 3+18 - Gage
    - Banks
    - Profiles
      - Team 4 Reach
    - Particles
      - Station 1+35 - Riffle
      - Station 1+35 - Protrusion
      - Reachwide - Combined
      - Reachwide - Non-Pools
      - Reachwide - Pools
    - Classification
    - Ratios
    - Velocity & Discharge
    - Assessments
    - BEHI
    - Competence
    - Designs
    - Notes

Data | Graph | Summary | Stages | Photographs | Data Collection Date 04/17/2014

Graph Tools Drawing | Bankfull Elev 103.37



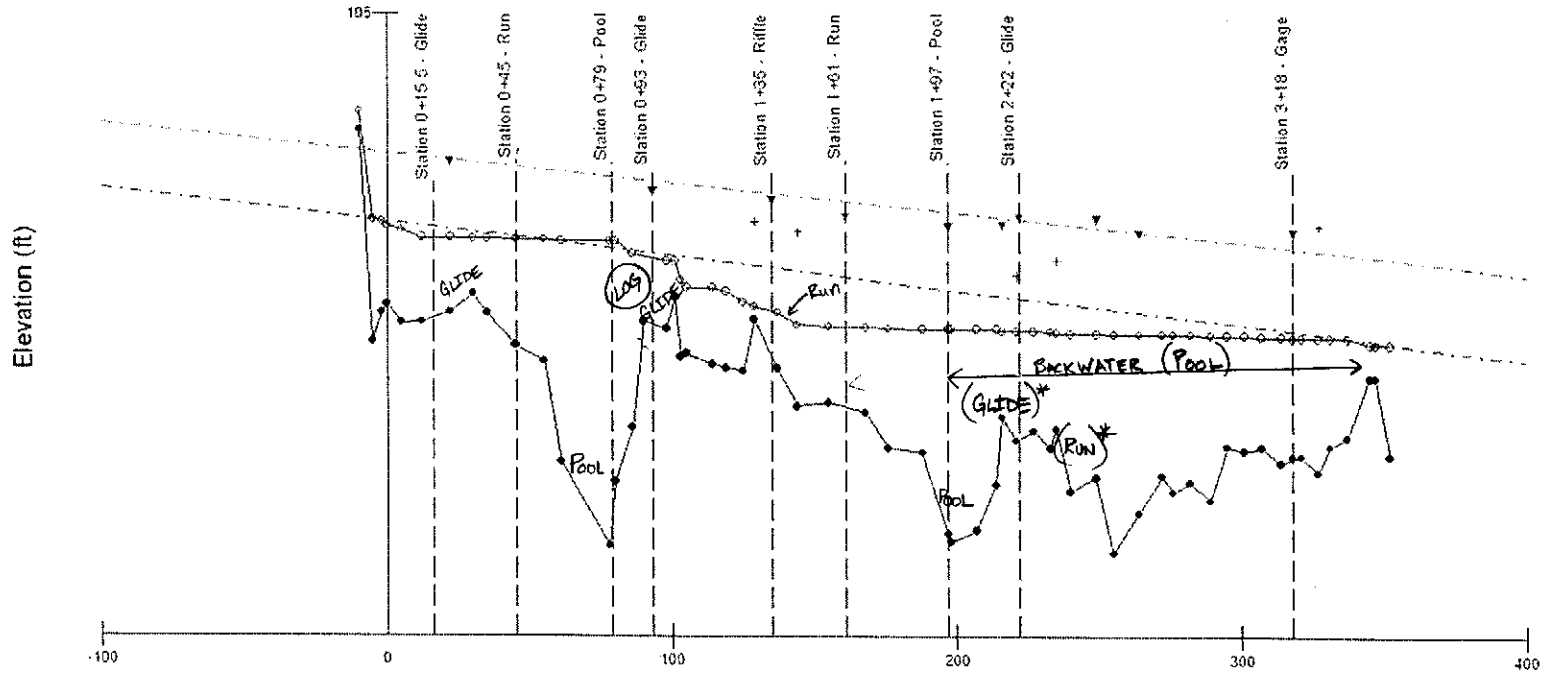
Mouse X -6.79 Mouse Y 107.05

Marsh Run 4/17/14

RIVERMorph Longitudinal Profiles

X 423.12 Y 100.24 Tags Slopes Measure Mode: Draw Select Measure Guide

Team 4 Reach 1



BKF Best Fit Slope = 0.00340
WS Slo Best Fit Slope = 0.00383

*THESE BED FACETS WERE INUNDATED DUE TO BEDROCK CONTROL FEATURE AT STATION 3+50.
THIS BEDROCK GRADE CONTROL CREATED A BACKWATER POOL FACET FROM ~STATION 1+97 – 3+50

Start

All
None

9:59 PM
4/17/2014

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 Reach 1	Location:	Reach - Team 4
Date: 4/17/2014	Stream Type: ??	Valley Type:	VIIIb
Observers:	Team 4	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	32.12	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.36	d_{bkf} (ft)
Bankfull Riffle WIDTH	23.64	W_{bkf} (ft)	Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	24.82	W_p (ft)
D_{84} at Riffle	120.40	Dia. (mm)	D_{84} (mm) / 304.8	0.40	D_{84} (ft)
Bankfull SLOPE	0.0034	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.29	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	3.27	R / D_{84}
Drainage Area	18.9	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	0.376	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\ 2.83 + 5.66 * Log\ \{ R / D_{84} \}\ ]\ u^*$	2.16	ft / sec	69.48	cfs
2. Roughness Coefficient: a) Manning's n from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49 * R^{2/3} * S^{1/2} / n$ $n =$ 0.038	2.71	ft / sec	87.01	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	0.00	ft / sec	0.00	cfs
2. Roughness Coefficient: c) Manning's n from Jarrett (USGS): $u = 1.49 * R^{2/3} * S^{1/2} / n$ $n = 0.39 * S^{0.38} * R^{-0.16}$ Note: This equation is applicable to steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$ 0.043	2.38	ft / sec	76.54	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach (Leopold, Wolman and Miller)	2.28	ft / sec	73.27	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 = 2.0 year	3.21	ft / sec	103.20	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	2.74	ft / sec	88.00	cfs

use n for F4

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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Step 11

Summarize USGS gage data:

Summary of USGS Gage Station Data

Station Name:	MARSH RUN (GRIMES) Reach 1	Station Number:	
Station Location:		Period of Record:	yrs
Drainage Area (DA):	18.9 ~~acres~~ mi²	D.A. Mean Elevation:	ft
Stream Type:	F4/1	Valley Type:	U-A-FD	Mean Annual Disch.:	cfs
Reference Reach Slope:	ft/ft	HUC:	

BANKFULL CHARACTERISTICS

Determined from FIELD MEASUREMENT			Determined from GAGE DATA ANALYSIS		
Bankfull Width (W_{bkf})	23.64	ft	Bankfull Width (W_{bkf})	22	ft
Bankfull Mean Depth (d_{bkf})	1.36	ft	Bankfull Mean Depth (d_{bkf})	1.75	ft
Bankfull XS Area (A_{bkf})	32.12	ft²	Bankfull XS Area (A_{bkf})	38	ft²
Wetted Perimeter (W_p)	26.36	ft	Wetted Perimeter (W_p)	25.5	ft
Bankfull Stage (Gage Ht.)	2.19	ft	Bankfull Stage (Gage Ht.)	2.20	ft
Est. Mean Velocity ($\bar{u}$)	2.74	ft/sec	Mean Velocity ($\bar{u}$)	2.2	ft/sec
Est. BKF. Discharge (Q_{bkf})	87.0	cfs	Bankfull Discharge (Q_{bkf})	88	cfs
Bankfull Discharge associated with "field-determined" Bankfull Stage				88	cfs
Recurrence Interval (R.I.) associated with "field-determined" Bankfull Stage				1.77	yrs

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

1.5 Year **R.I.** Discharge =	70	cfs	**10** Year **R.I.** Discharge =	285	cfs
2.0 Year **R.I.** Discharge =	102	cfs	**25** Year **R.I.** Discharge =	450	cfs
5.0 Year **R.I.** Discharge =	185	cfs	**50** Year **R.I.** Discharge =	475	cfs

MEANDER GEOMETRY

Linear Wavelength (λ)	136	ft	Stream Meander Length (L_m)	108.3	ft
Radius of Curvature (R_c)	38.2	ft	Belt Width (W_{blt})	88	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)	9.6307	0.4066	3.916	0.258
Slope Exponent	(b)	0.1934	0.3106	0.504	0.4928

Hydraulic Radius: $R = A / W_p$	1.22	ft	Manning's 'n' at Bankfull Stage	0.038	Coeff.

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

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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** Reach 1 Location: **Reach - Team 4**

Observers: Date: **04/17/14** Valley Type: **VIIIb** Stream Type: **F1**

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, ***

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
Riffle Width (W_{bkf})	23.6	23.6	23.6	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	32.12	32.12	32.12
Mean Riffle Depth (d_{bkf})	1.36	1.36	1.36	ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})	17.38	17.38	17.38
Maximum Riffle Depth (d_{max})	1.64	1.64	1.64	ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})	1.206	1.206	1.206
Width of Flood-Prone Area (W_{fpa})	29	29	29	ft	Entrenchment Ratio (W_{fpa} / W_{bkf})	1.227	1.227	1.227
Riffle Inner Berm Width (W_{ib})	0	0	0	ft	Riffle Inner Berm Width to Riffle Width (W_{ib} / W_{bkf})	0.000	0.000	0.000
Riffle Inner Berm Depth (d_{ib})	0	0	0	ft	Riffle Inner Berm Depth to Mean Depth (d_{ib} / d_{bkf})	0.000	0.000	0.000
Riffle Inner Berm Area (A_{ib})	0	0	0	ft^2	Riffle Inner Berm Area to Riffle Area (A_{ib} / A_{bkf})	0.000	0.000	0.000
Riffle Inner Berm W/D Ratio (W_{ib} / d_{ib})	0	0	0					

Pool Dimensions*, **, *

Pool Dimensions*, **, ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
Pool Width (W_{bkfp})	27.1	26.7	27.4	ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})	1.146	1.131	1.160
Mean Pool Depth (d_{bkfp})	1.92	1.74	2.09	ft	Mean Pool Depth to Mean Riffle Depth (d_{bkfp} / d_{bkf})	1.412	1.279	1.537
Pool Cross-Sectional Area (A_{bkfp})	51.7	47.6	55.7	ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})	1.608	1.482	1.735
Maximum Pool Depth (d_{maxp})	3.66	3.45	3.87	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.691	2.537	2.846
Pool Inner Berm Width (W_{ibp})	0	0	0	ft	Pool Inner Berm Width to Pool Width (W_{ibp} / W_{bkfp})	0.000	0.000	0.000
Pool Inner Berm Depth (d_{ibp})	0	0	0	ft	Pool Inner Berm Depth to Pool Depth (d_{ibp} / d_{bkfp})	0.000	0.000	0.000
Pool Inner Berm Area (A_{ibp})	0	0	0	ft^2	Pool Inner Berm Area to Pool Area (A_{ibp} / A_{bkfp})	0.000	0.000	0.000
Point Bar Slope (S_{pb})	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W_{ibp} / d_{ibp})	0.000	0.000	0.000

Run Dimensions*

Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean	Min	Max
Run Width (W_{bkfr})	22.3	18.8	25.7	ft	Run Width to Riffle Width (W_{bkfr} / W_{bkf})	0.942	0.796	1.087
Mean Run Depth (d_{bkfr})	1.6	1.37	1.83	ft	Mean Run Depth to Mean Riffle Depth (d_{bkfr} / d_{bkf})	1.176	1.007	1.346
Run Cross-Sectional Area (A_{bkfr})	34.9	34.5	35.3	ft	Run Area to Riffle Area (A_{bkfr} / A_{bkf})	1.087	1.075	1.098
Maximum Run Depth (d_{maxr})	2.14	1.74	2.54	ft	Max Run Depth to Mean Riffle Depth (d_{maxr} / d_{bkf})	1.574	1.279	1.868
Run Width/Depth Ratio (W_{bkfr} / d_{bkfr})	14.5	10.3	18.8	ft				

Glide Dimensions*

Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean	Min	Max
Glide Width (W_{bkfg})	24.2	20.2	26.2	ft	Glide Width to Riffle Width (W_{bkfg} / W_{bkf})	1.023	0.856	1.110
Mean Glide Depth (d_{bkfg})	1.54	1.25	1.9	ft	Mean Glide Depth to Mean Riffle Depth (d_{bkfg} / d_{bkf})	1.132	0.919	1.397
Glide Cross-Sectional Area (A_{bkfg})	36.6	32.9	38.5	ft	Glide Area to Riffle Area (A_{bkfg} / A_{bkf})	1.138	1.025	1.198
Maximum Glide Depth (d_{maxg})	2.05	1.7	2.65	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	1.507	1.250	1.949
Glide Width/Depth Ratio (W_{bkfg} / d_{bkfg})	16.5	10.7	21	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**	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 the *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** Reach 1		Location: **Reach - Team 4**	
Observers:	Date: **04/17/14**	Valley Type: **VIIIb**	Stream Type: **F1**

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	2.74	ft/sec	Estimation Method		
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	88	cfs	Drainage Area	18.9	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Linear Wavelength (λ)	136	94	200	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	5.753	3.976	8.460
Stream Meander Length (L_m)	108	76	128	ft	Stream Meander Length Ratio (L_m / W_{bkf})	4.581	3.215	5.415
Radius of Curvature (R_c)	38.2	34	42	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	1.616	1.438	1.777
Belt Width (W_{blt})	88	58	139	ft	Meander Width Ratio (W_{blt} / W_{bkf})	3.723	2.453	5.880
Arc Length (L_a)	49.1	32	69	ft	Arc Length to Riffle Width (L_a / W_{bkf})	2.077	1.354	2.919
Riffle Length (L_r)	9.75	7.28	12.2	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	0.412	0.308	0.517
Individual Pool Length (L_p)	36.5	25	48.9	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	1.545	1.059	2.068
Pool to Pool Spacing (P_s)	36.5	25	48.9	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	1.545	1.059	2.068

REVERSE

Channel Profile

Valley Slope (S_{val})	0.0061	ft/ft	Average Water Surface Slope (S)	0.0034	ft/ft	Sinuosity (S_{val} / S)	1.6
Stream Length (SL)	350	ft	Valley Length (VL)	290	ft	Sinuosity (SL / VL)	1.21

Low Bank Height (LBH)	start	4.67	ft	Max Depth (d_{max})	start	1.71	ft	Bank-Height Ratio (BHR) (LBH / d_{max}) start 2.73
	end	6.2	ft		end	2.6	ft	end 2.38

USING U/S D/S of Reach

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.016	0.012	0.019	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	4.603	3.574	5.629
Run Slope (S_{run})	0.004	0.000	0.011	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	1.171	0.000	3.126
Pool Slope (S_p)	0.001	0.000	0.001	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.179	0.109	0.324
Glide Slope (S_g)	0.005	0.000	0.011	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	1.565	0.000	3.126
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

THESE BED FACETS ARE CONFOUNDED BY BACKWATER FROM POOL ? GRADE CONTROL.

Max Depths[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Max Riffle Depth (d_{maxrif})	1.81	1.76	1.86	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.33	1.294	1.37
Max Run Depth (d_{maxrun})	2.15	2	2.29	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	1.58	1.471	1.68
Max Pool Depth (d_{maxp})	3.77	3.57	4.09	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.77	2.625	3.01
Max Glide Depth (d_{maxg})	1.26	1.22	1.3	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	0.93	0.897	0.96
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	15	0		D_{16}	0.09	8.83		19.3	mm
% Sand	26	8		D_{35}	0.96	199		39.43	mm
% Gravel	12	22		D_{50}	27.3	Bedrock		55.06	mm
% Cobble	12	8		D_{84}	Bedrock	Bedrock		120.4	mm
% Boulder	0	1		D_{95}	Bedrock	Bedrock		160	mm
% Bedrock	35	61		D_{100}	Bedrock	Bedrock		180	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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