TEAM 1

Field Day 2 Presentation Order: Gage Station

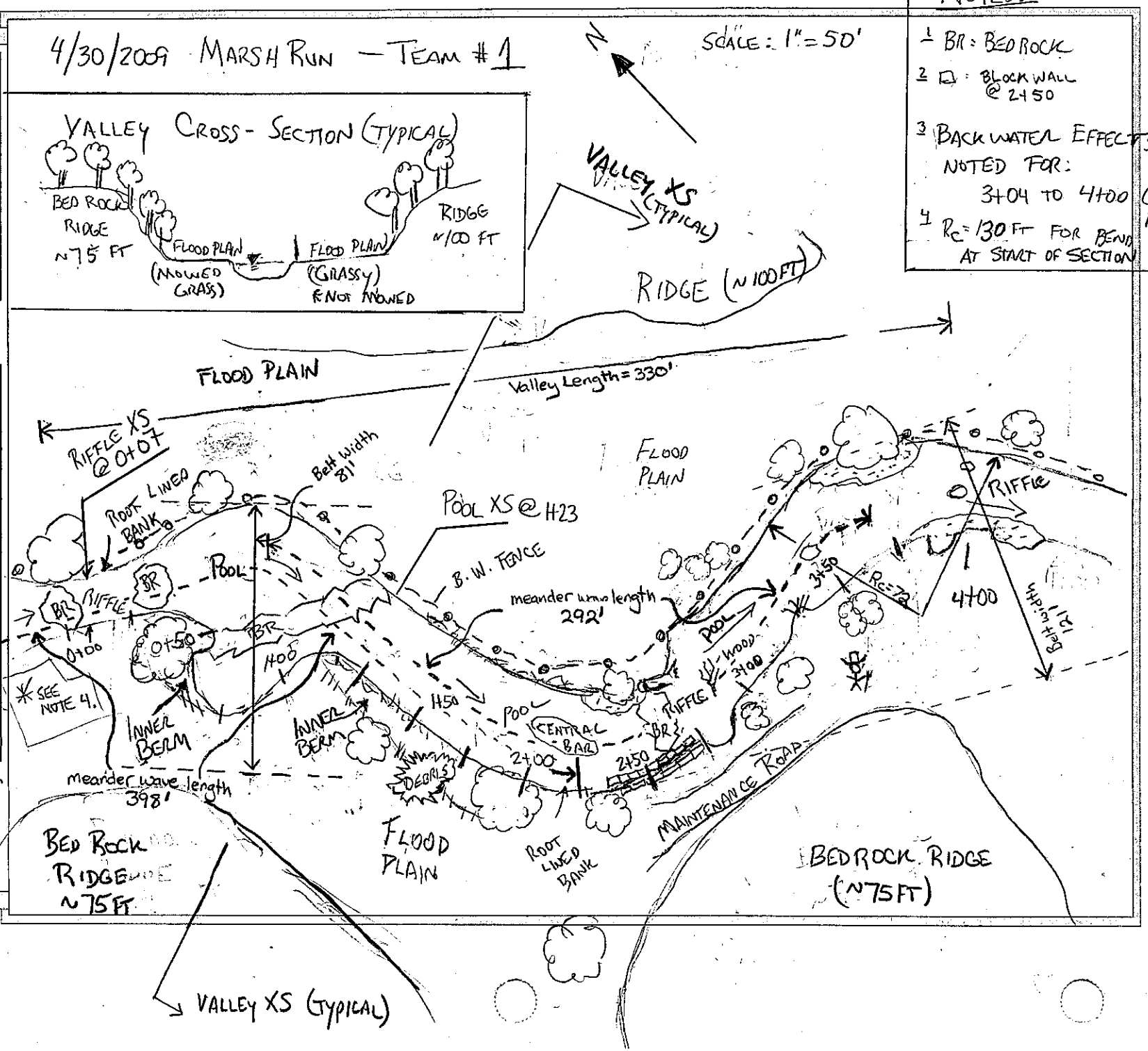
River Morphology and Applications

- Sketch Map
- Cross-sections
  - Riffle cross-section
  - Pool cross-section
- Longitudinal Profile
- Pebble Counts
  - Representative pebble count
  - Riffle pebble count
- Velocity (Worksheet B-2)
- Stream Classification (Worksheet B-1)
- Dimensionless Ratios (Worksheet B-3)

AREA-SITE LOCATION....REACH MAP

Stream: _____ Reach: _____

Drawn By: _____ Date: _____



NOTES:

1. BR: BEDROCK
2. ☐: BLOCK WALL @ 2+50
3. BACKWATER EFFECTS NOTED FOR: 3+04 TO 4+00 (START OF RIFFLE)
4. R_c = 130 FT FOR BEND AT START OF SECTION

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GAGE DATA

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

Bankfull VELOCITY / DISCHARGE Estimates

Site:	Marsh Run Gage		Location:		
Date:	4/30/09	Stream Type: C4/1	Valley Type:	VIII	
Observers:			HUC:		

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-sectional AREA	35	A_{bkf} (ft^2)	Bankfull Mean DEPTH	1.7	d_{bkf} (ft)
Bankfull WIDTH	21	W_{bkf} (ft)	Wetted PERIMETER ~ 2 * d_{bkf} + W_{bkf}	24.4	W_p (ft)
D_{84} @ Riffle	—	Dia. (mm)	D_{84} mm / 304.8 =	—	D_{84} (ft)
Bankfull SLOPE	0.005	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.4	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)		
Drainage AREA	18.9	DA (mi^2)	Shear Velocity $u^* = \sqrt{gRS}$	0.5	u^* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 \text{ Log}\{R/D_{84}\}]u^*$ u/u* = 2.3/0.5 = 4.6		ft / sec		cfs
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness $u = 1.4865 * R^{2/3} * S^{1/2}/n$ n =		ft / sec		cfs
2. Roughness Coefficient: $u = 1.4865 * R^{2/3} * S^{1/2}/n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39 S^{.38} R^{-.16}$ n = Note: This equation is for applications involving steep, step-pool, high boundary roughness, cobble- and boulder-dominated stream systems; i.e., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.		ft / sec		cfs
2. Roughness Coefficient: $u = 1.4865 * R^{2/3} * S^{1/2}/n$ c) Manning's 'n' from Stream Type n =		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
4. Continuity Equations: a) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge Q = Year		ft / sec		cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	2.3	ft / sec	82.8	cfs

Options for using the D_{84} term in the relative roughness relation (R/D_{84}), when using estimation method 1.

Option 1.	For **sand-bed** channels: Measure the **"protrusion height"** (h_{sd}) of sand dunes above channel bed elevations. Substitute an average sand dune protrusion height (h_{sd} in ft) for the D_{84} term in estimation method 1.
Option 2.	For **boulder-dominated** channels: Measure several **"protrusion heights"** (h_{bo}) of boulders above channel bed elevations. Substitute an ave. boulder protrusion height (h_{bo} in ft) for the D_{84} term in estimation method 1.
Option 3.	For **bedrock-dominated** channels: Measure several **"protrusion heights"** (h_{br}) of rock separations/steps/joints/ uplifted surfaces above channel bed elevations. Substitute an average bedrock protrusion height (h_{br} in feet) for the D_{84} term in estimation method 1.

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n from Manning's = 0.057
n from friction factor = 0.052

Table A-7. Procedure to validate hydraulic relations using gage station data from the West Fork San Juan River, Colorado.

Validation of Hydraulic Relationships Using Gaging Station Data

1. Obtain the drainage area associated with the gaging station.
2. Obtain the field-determined bankfull discharge at the gaging station(s) (**Figure A-22**).
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.
5. Perform an active bed pebble count on the riffle to obtain D_{84}.
6. Determine the stream type.
7. Solve for Manning's "n" at the bankfull stage: $n = (1.49R^{2/3}S^{1/2})/u$ (use the bankfull mean velocity from Step 3).
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: 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 A-16**) (Example in **FigureA-19**).
14. Plot Manning's "n" by friction factor (**Figure A-17**) (Example in **Figure A-20**).
15. Plot Manning's "n" by stream type (**Figure A-18**) (Example in **Figure A-21**).

Gaging Station Name: West Fork San Juan River near Pagosa Springs, Colorado **Gaging Station Number: 09341500**

1	2	3a	3b	3c	3d	4	5	6	7	8	9	10	11
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 u_{bkf} (ft/s)	Ave. Water Surface Slope S (ft/ft)	D_{84} (mm)	D_{84} (ft)	Stream Type	Manning's "n"	Relative Roughness R/D_{84} (ft/ft)	Shear Velocity u* (ft/s)	Friction Factor u/u*
Reach 1 18.9 mi^2	77	22.62	1.19	26.6	2.9	.007	159		C4/1	.048	2.3	.52	5.6

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

Stream: Marsh Run	
Basin:	Drainage Area: acres 18.9 mi^2
Location: Marsh Run Team 1 farthest D.S.	
Twp. & Rge:	Sec. & Qtr.:
Cross-Section Monuments (Lat./Long.):	Date: 4/30/04
Observers: Team 1	Valley Type: ~~VIII~~

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	21.4 ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	1.24 ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	26.6 ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) 21.4/1.24 Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	17.25 ft/ft
Maximum DEPTH (d_{max}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	1.97 ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{max}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	300+ ft
Entrenchment Ratio (ER) 300/(BF)21.4 The ratio of flood-prone area WIDTH divided by bankfull-channel WIDTH (W_{fpa} / W_{bkf})(riffle section).	14 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.	21.28 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.	.007 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).	1.2

Stream Type C4/1 **See Classification Key**

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

Bankfull VELOCITY / DISCHARGE Estimates

Site:	Team 1	Location:	Marsh Run
Date:	4-30-09	Stream Type:	C4/1
Valley Type:	VIII		
Observers:	Team 1	HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-sectional AREA	26.6	A_{bkf} (ft^2)	Bankfull Mean DEPTH	1.24	d_{bkf} (ft)
Bankfull WIDTH	21.4	W_{bkf} (ft)	Wetted PERIMETER ~ $2 * d_{bkf} + W_{bkf}$	22.5	W_p (ft)
D_{84} @ ~~Riffle~~ Reach	159	Dia. (mm)	D_{84} mm / 304.8 =	0.522	D_{84} (ft)
Bankfull SLOPE	.007	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.18	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R (ft) / D_{84} (ft)	2.26	
Drainage AREA	18.9	DA (mi^2)	Shear Velocity $u^* = \sqrt{gRS}$	0.52	u^* (ft / sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 \text{ Log}\{R / D_{84}\}]u^*$	2.5	ft / sec	66.5	cfs
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness $u = 1.4865 * R^{2/3} * S^{1/2} / n$ n = 0.048	2.9	ft / sec	77	cfs
2. Roughness Coefficient: $u = 1.4865 * R^{2/3} * S^{1/2} / n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39 S^{.38} R^{-.16}$ n = 0.058 Note: This equation is for applications involving steep, step-pool, high boundary roughness, cobble- and boulder-dominated stream systems; i.e., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.	2.4	ft / sec	63.7	cfs
2. Roughness Coefficient: $u = 1.4865 * R^{2/3} * S^{1/2} / n$ c) Manning's 'n' from Stream Type n = 0.04	3.5	ft / sec	92.3	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)		ft / sec		cfs
4. Continuity Equations: a) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge Q = ____ Year		ft / sec		cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	3.1	ft / sec	82.87	cfs

Options for using the D_{84} term in the relative roughness relation (R/D_{84}), when using estimation method 1.

Option 1. For **sand-bed** channels: Measure the **"protrusion height"** (h_{sd}) of sand dunes above channel bed elevations. Substitute an average sand dune protrusion height (h_{sd} in ft) for the D_{84} term in estimation method 1.

Option 2. For **boulder-dominated** channels: Measure several **"protrusion heights"** (h_{bo}) of boulders above channel bed elevations. Substitute an ave. boulder protrusion height (h_{bo} in ft) for the D_{84} term in estimation method 1.

Option 3. For **bedrock-dominated** channels: Measure several **"protrusion heights"** (h_{br}) of rock separations/steps/joints/ uplifted surfaces above channel bed elevations. Substitute an average bedrock protrusion height (h_{br} in feet) for the D_{84} term in estimation method 1.

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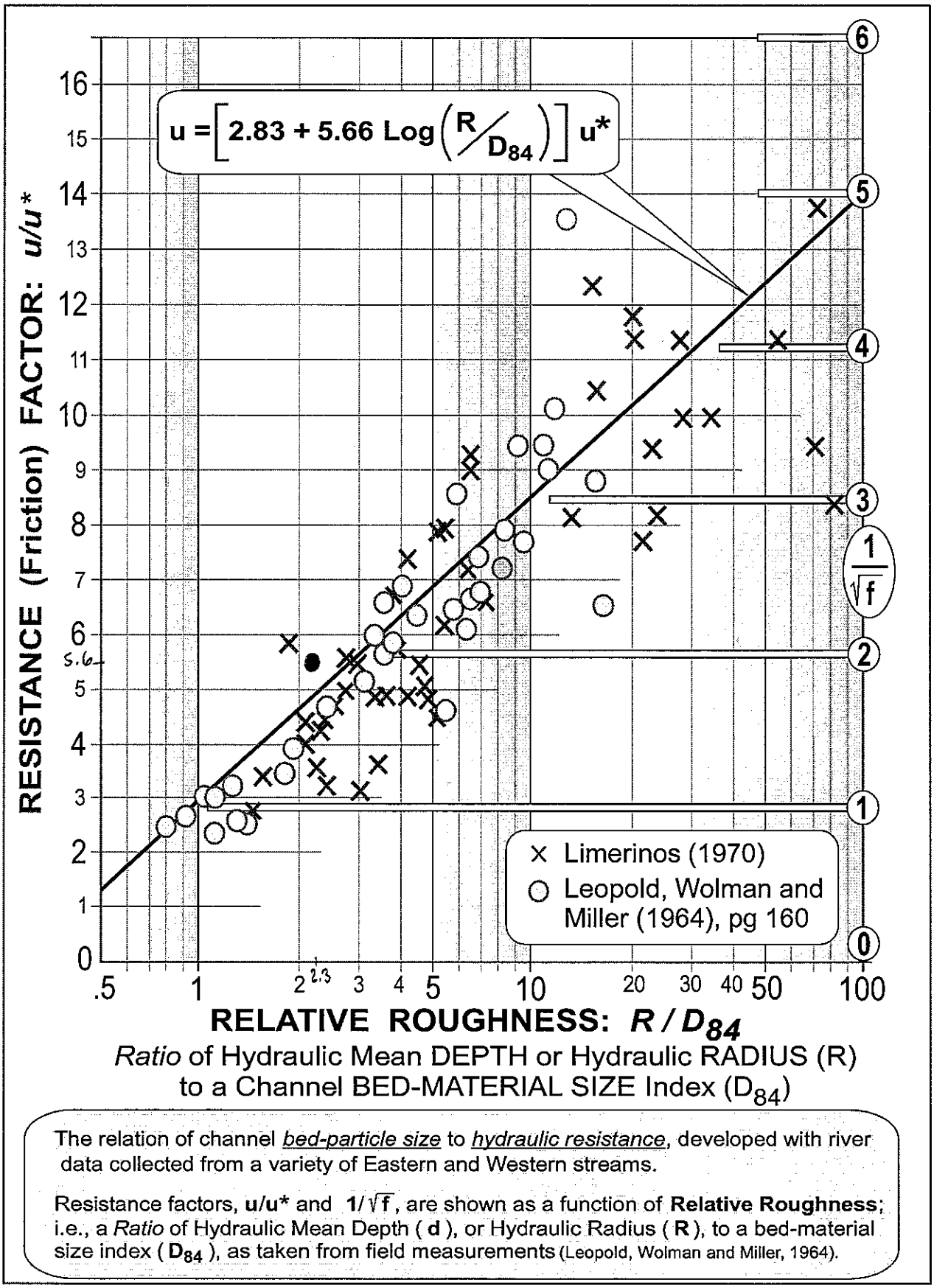

● Marsh Run Team 1

The relation of channel *bed-particle size* to *hydraulic resistance*, developed with river data collected from a variety of Eastern and Western streams.

Resistance factors, **u/u*** and $1/\sqrt{f}$, are shown as a function of **Relative Roughness**; i.e., a *Ratio* of Hydraulic Mean Depth (**d**), or Hydraulic Radius (**R**), to a bed-material size index ($\mathbf{D_{84}}$), as taken from field measurements (Leopold, Wolman and Miller, 1964).

Figure B-2. Relative roughness (R/D_{84}) vs. friction factor (u/u*) (Rosgen, 2006b; Rosgen and Silvey, 2007).

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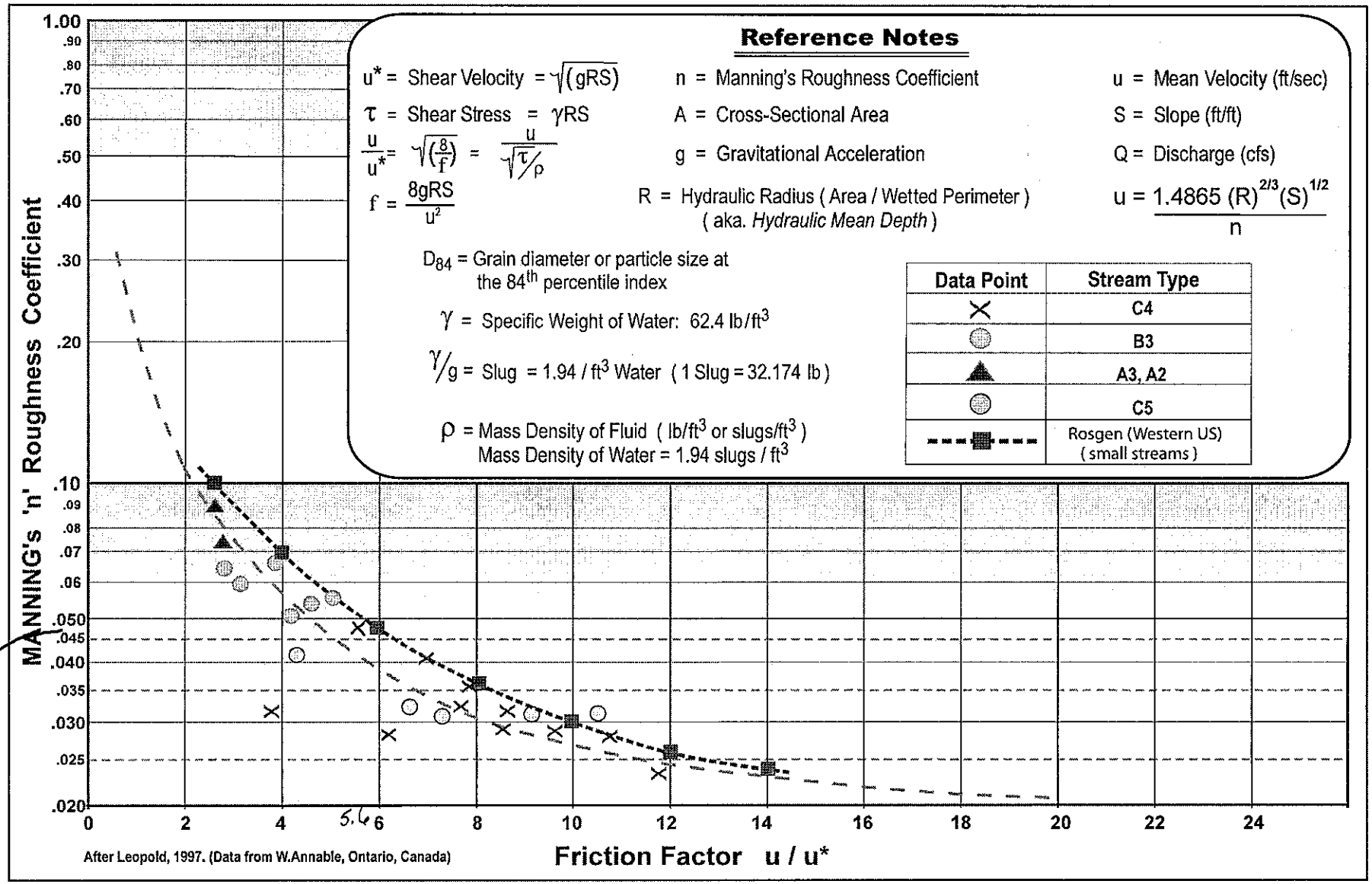

Figure B-3. Friction factor (u/u*) vs. Manning's roughness coefficient "n" (Rosgen, 2006b; Rosgen and Silvey, 2007).

X Marsh Run Team 1

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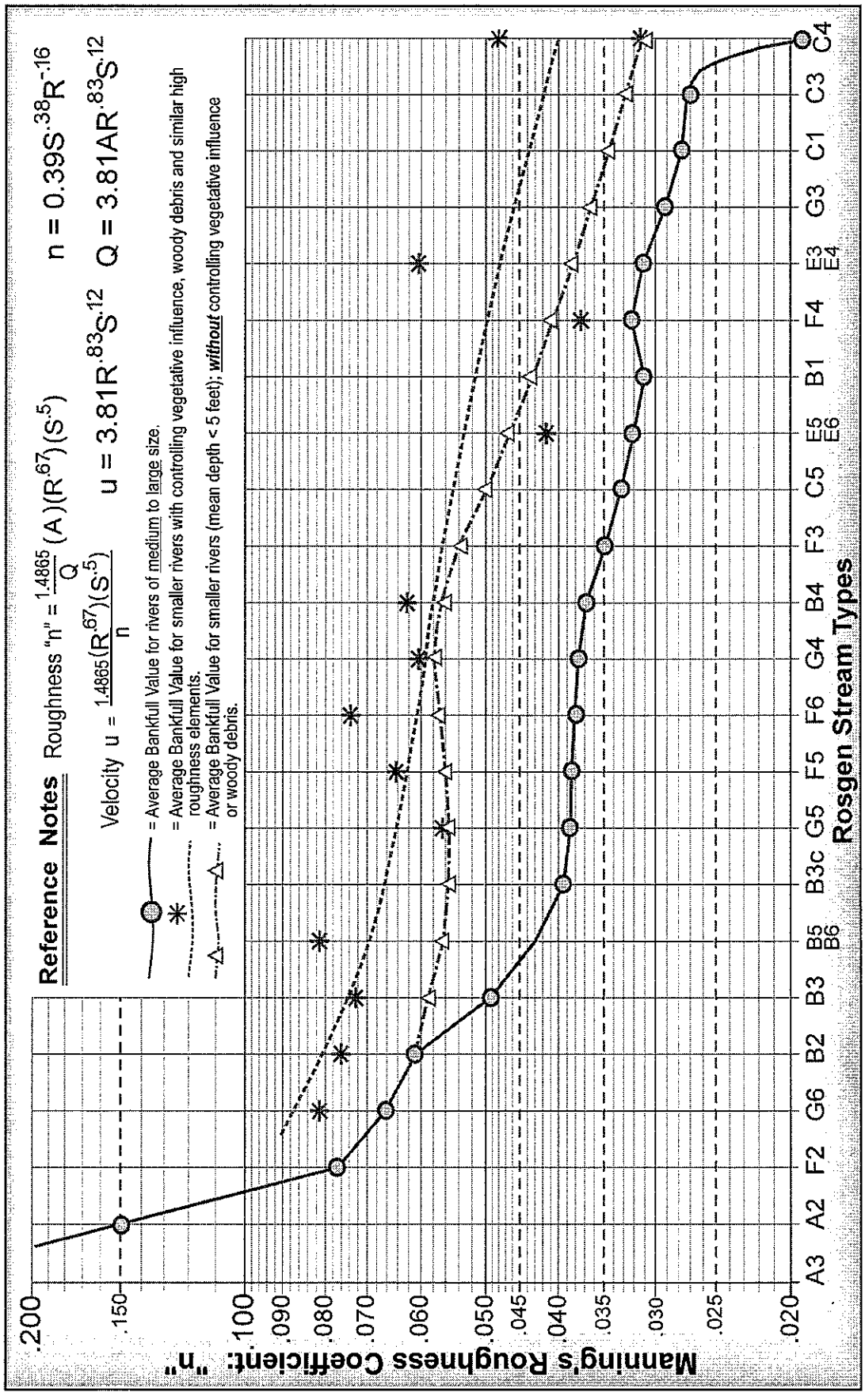

Figure B-4. Manning's "n" by stream type (Rosgen and Silvey, 2007).

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SURVEY DATA ⟹ **CROSS - SECTION 1**

SITE: MARSH RUN Date: 30 APR 09

Location: RIFFLE X-SECTION

Party / Notes: TEAM 1 - FARTHEST DOWNSTREAM 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		4.65			352.25	BM2
2			356.90			
3				6.60	350.30	Turn 1
4		3.66	353.96			Ht of Instr.
5	0.0			2.57	351.39	Right Pin R Side (looking downstream)
6	5.0			2.70	351.26	
7	8.0			2.89	351.07	
8	10.0			3.11	350.85	
9	15.0			3.56	350.4	
10	20.0			3.79	350.17	
11	30.0			4.00	349.96	
12	34.0			4.28	349.68	
13	36.3			4.32	349.64	Bankfull
14	37.0			4.54	349.42	Slope
15	36.5			5.25	348.71	Slope
16	39.8			5.50	348.46	Right Edge water
17	40.2			5.47	348.49	Water surface
18	41.0			5.190	348.77	Top of Rock Begin Bedrock
19	43.5			5.87	348.09	100 pct of rock
20	45.5			5.61	348.35	Top Rock
21	47.0			6.29	347.67	Bottom Bed Rock
22	49.0			5.71	348.25	Top of Bed Rock
23	51.0			5.78	348.18	
24	53.0			5.81	348.15	
25	55.0			5.73	348.23	
26	56.2			5.61	348.35	Left Water's Edge/Tree Root ← Couldn't Get signal
27	58.0			4.11	349.85	Above Tree Root - Base of Tree
28	58.5			3.85	350.11	

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SURVEY DATA ⟹ **CROSS - SECTION 2**

SITE: Riffle - X-sec. Page 2 Date:

Item	STATION ft	BS ft	HI ft	FS ft	Elevation ft	NOTES / COMMENTS / REMARKS
29	60.0			3.48	350.48	
30	62.0			3.41	350.55	at Fence
31	64.0			3.57	350.39	
32	66.0			3.73	350.23	At Pin Left Side
33						220-250 ft Toe break in Slope
34						
35						
36						
37						
38						
39						←220-250
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
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57						
58						
59						

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POOL X-SECTION

SURVEY DATA ⟹ **CROSS - SECTION 1**

SITE: MARSH RUN Date: 30 APR 09

Location: POOL X-SECTION

Party / Notes: TEAM 1 - EVELYN, LOREN HUC:

Item	Distance, Point, or STATION ft	Back-Sight BS ft	Height of Instrument HI ft	Fore-Sight FS ft	Elevation ft	REMARKS / COMMENTS / NOTES
1	0		353.96			LEFT PIN
2	0			4.63	349.33	LEFT PIN - FLOOD PLAIN
3	3.0			4.74	349.22	SLOPE
4	6.5			5.35	348.61	
5	9.0			5.71	348.25	BANKFULL
6	11.0			6.91	347.05	SLOPE
7	11.8			7.62	346.34	EDGE OF WATER
8	12.4			7.49	346.47	TOP OF ROCK
9	13.4			8.19	345.77	IN WATER
10	16.4			8.88	345.08	
11	19.5			9.13	344.83	
12	23.0			9.20	344.76	
13	24.5			9.35	344.61	THALWEG - DEEPEST PART OF POOL
14	27.0			9.04	344.92	
15	29.0			8.71	345.25	
16	31.0			7.66	346.3	WATER EDGE
17	32.5			6.28	347.68	TOP OF BANK
18	34.0			5.88	348.08	
19	42.0			5.26	348.70	
20	50.0			4.62	349.34	
21	57.0			4.61	349.35	RIGHT PIN
22						
23						
24						
25						
26						
27						
28						

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SURVEY DATA → LONGITUDINAL PROFILE 1

SITE: Marsh Run — Date: 4/30/09

Location: Group 1

Party / Notes: 1 — HUC: _____

	Distance, Point, or	Back-Sight	Height of Instru-ment	Thalweg		Water Surface		Bankfull		Low Bank Hl		NOTES
				Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	Fore-Sight	Elevation	e.g. Riffle Run Pool Glide
	STATION	BS	HI	FS	Elev.	FS	Elev.	FS	Elev.	FS	Elev.	
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
1	0+00		353.96	5.92	348.04	5.26	348.7	4.06	349.9			Riffle-Top
2	0+07			6.32	347.64	5.63	348.33					Riffle - X-Sect
3	0+14.5			6.85	347.11	5.94	348.02					Riffle End
4	0+20.3			7.47	346.49							Run
5	0+25			7.02	346.94	5.93	348.03					Riffle-Top
6	0+42			8.06	345.90	6.70	347.26			4.68	349.28	Riffle-End 6.15/342
7	0+49			8.82	345.14	6.79	347.17	5.15	348.81			Pool
8	0+56			7.86	346.10	6.75	347.21			4.58	349.38	Riffle-Top
9	0+96			8.46	345.50	7.60	346.36	6.18	347.78*			Riffle-End
10	1+11			9.25	344.71	7.72	346.24					Run-End
11	1+23			9.32	344.64	7.70	346.26					Pool
12	1+48			9.01	344.95	7.66	346.30					Pool
13	1+59			4.				6.41	347.55			Run
14	1+72			9.05	344.91					6.0	347.96	Glide
15	1+87			8.40	345.56	7.82	346.14					Riffle
16	2+14			9.01	344.95	7.79	346.17					Riffle ***
17	2+26			8.80	345.16	7.77	346.19					Pool
18	2+41			9.57	344.39							Pool
19	2+63			9.16	344.80	7.77	346.19					Glide
20	2+75			8.56	345.4	7.82	346.14	6.73	346.87			Riffle-Top
21	2+93			8.71	345.25	8.03	345.93					Riffle-End
22	3+08			9.97	343.99	8.02	345.94					Pool
23	3+35			9.35	344.61							"
24	3+46			9.26	344.7							
25	3+84			8.51	345.45	8.08	345.88	6.97	346.99			Riffle-Top
26	4+11			9.23	344.73	8.17	345.79					Riffle-End
27												

Inner Berm

Removed. Profile should go from riffle top to riffle top

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* - Not at a flag

** - Don't use in Riffle calcs (BR)

Marsh Run Active Riffle Pebble

Site: Tegue 1 entered in km in field Date:

Location: HUC:

Party:

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: Date: TOT #	ITEM %	% CUM	POOL (2) Reach: Date: TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: Date: TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 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													
.44 - .63	Medium	11.3 - 16													
.63 - .89	Coarse	16 - 22.6													
.89 - 1.3	Coarse	22.6 - 32													
1.3 - 1.8	Very Coarse	32 - 45													
1.8 - 2.5	Very Coarse	45 - 64													
2.5 - 3.5	Small	64 - 90	COBBLE												
3.5 - 5.0	Small	90 - 128													
5.0 - 7.1	Large	128 - 180													
7.1 - 10.1	Large	180 - 256													
10.1 - 14.3	Small	256 - 362	BOULDER												
14.3 - 20	Small	362 - 512													
20 - 40	Medium	512 - 1024													
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type:			Valley Type:			TOTAL→									

1st 10 riffle bedrock protrusions

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Team 1 entered in RM in Field Active Riffle Pebble Count

Site: Marsh Run Date: 4/30/09

Location: Maryland HUC:

Party: Team 1

Inches	PARTICLE	Millimeters		Dot Count for RIFFLE 1	POOL 2	COMP. 3	RIFFLE (1) Reach: Date: 4/30/08 TOT #	ITEM %	% CUM	POOL (2) Reach: Date: TOT #	ITEM %	% CUM	COMPOSITE (3) Reach: Date: TOT #	ITEM %	% CUM
	Silt / Clay	< .062	S/C												
	Very Fine	.062 - .125	SAND												
	Fine	.125 - .25													
	Medium	.25 - .50													
	Coarse	.50 - 1.0													
.04 - .08	Very Coarse	1.0 - 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													
.44 - .63	Medium	11.3 - 16													
.63 - .89	Coarse	16 - 22.6													
.89 - 1.3	Coarse	22.6 - 32		:			2								
1.3 - 1.8	Very Coarse	32 - 45													
1.8 - 2.5	Very Coarse	45 - 64		⊏			6								
2.5 - 3.5	Small	64 - 90	COBBLE	⊠ '			11								
3.5 - 5.0	Small	90 - 128		⊠⊠ •			20								
5.0 - 7.1	Large	128 - 180		⊠⊠ !			20								
7.1 - 10.1	Large	180 - 256		⊠⊠ ⊏			25								
10.1 - 14.3	Small	256 - 362	BOULDER	⊠ :			9								
14.3 - 20	Small	362 - 512		⊏ ,			6								
20 - 40	Medium	512 - 1024		'			1								
40 - 80	Large-Vry Large	1024 - 2048													
	Bedrock		BDRK												
Stream Type:			**Valley Type:**			TOTAL→»									

4th Bed Rock Protrusions

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Step 14

Summarize USGS gage data:

Summary....*USGS GAGE STATION* Data / Records for STREAM CHANNEL CLASSIFICATION

Station NAME:	Marsh Run @ Gaines, VA			Station Number:	01617580
LOCATION:					
Period of Record:		yrs		Mean Annual DISCHARGE:	cfs
Drainage AREA:	acres	18.9	mi^2	Drainage Area Mn Elev:	ft
Reference REACH SLOPE:	ft/ft			Valley Type:	VIII
Stream Type:	C			HUC:	

"BANKFULL" CHARACTERISTICS

Determined from FIELD MEASUREMENT			Determined from GAGE DATA Analysis		
Bankfull WIDTH (W_{bkf})	22.62	ft	Bankfull WIDTH (W_{bkf})	21	ft
Bankfull Mean DEPTH (d_{bkf})	1.19	ft	Bankfull MEAN DEPTH (d_{bkf})	1.7	ft
Bankfull Xsec AREA (A_{bkf})	26.6	ft^2	Bankfull Xsec AREA (A_{bkf})	35	ft^2
Wetted PERIMETER (W_P)	22	ft	Wetted PERIMETER (W_P)	24.4	ft
Bankfull STAGE (Gage Ht)	1.99	ft	Bankfull STAGE (Gage Ht)	2.15	ft
Est. Mean VELOCITY (u)	2.9	ft/sec	Mean VELOCITY (u)	2.5	ft/sec
Est. Bkf. DISCHARGE (Q_{bkf})	77	cfs	Bankfull DISCHARGE (Q_{bkf})	82.87	cfs
Bankfull DISCHARGE associated with **"field-determined"** Bankfull STAGE (From Gage Height reading at Staff Plate and tabular Stage-Discharge curve data)				82.87	cfs
Recurrence Interval (Log-Pearson) associated with **"field-determined"** Bankfull Discharge				1.7	yrs

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

1.5 Year R.I. Discharge =	70	cfs	**10** Year R.I. Discharge =	301	cfs
2.0 Year R.I. Discharge =	97	cfs	**25** Year R.I. Discharge =	451	cfs
5.0 Year R.I. Discharge =	202	cfs	**50** Year R.I. Discharge =	459	cfs

MEANDER GEOMETRY

Meander Wavelength (L_m)	345	ft	Radius of Curvature (R_C)	101	ft
Belt Width (W_{blt})	101	ft	Meander Width Ratio (W_{blt}/W_{bkf})	4.5	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 (**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)	Velocity(u)
Intercept Coefficient **a**)	9.4161	0.4077	3.8388	0.2638
Slope Exponent **b**)	0.1968	0.3111	0.508	0.487

Hydraulic Radius $R = A / W_P$	1.4	ft	Manning's "n" at Bankfull Stage	0.057	Coeff.

"n" = 1.4895 [(Area) (Hydraulic Radius$^{2/3}$) (Slope)$^{1/2}$] / Q_{bkf} — Gage

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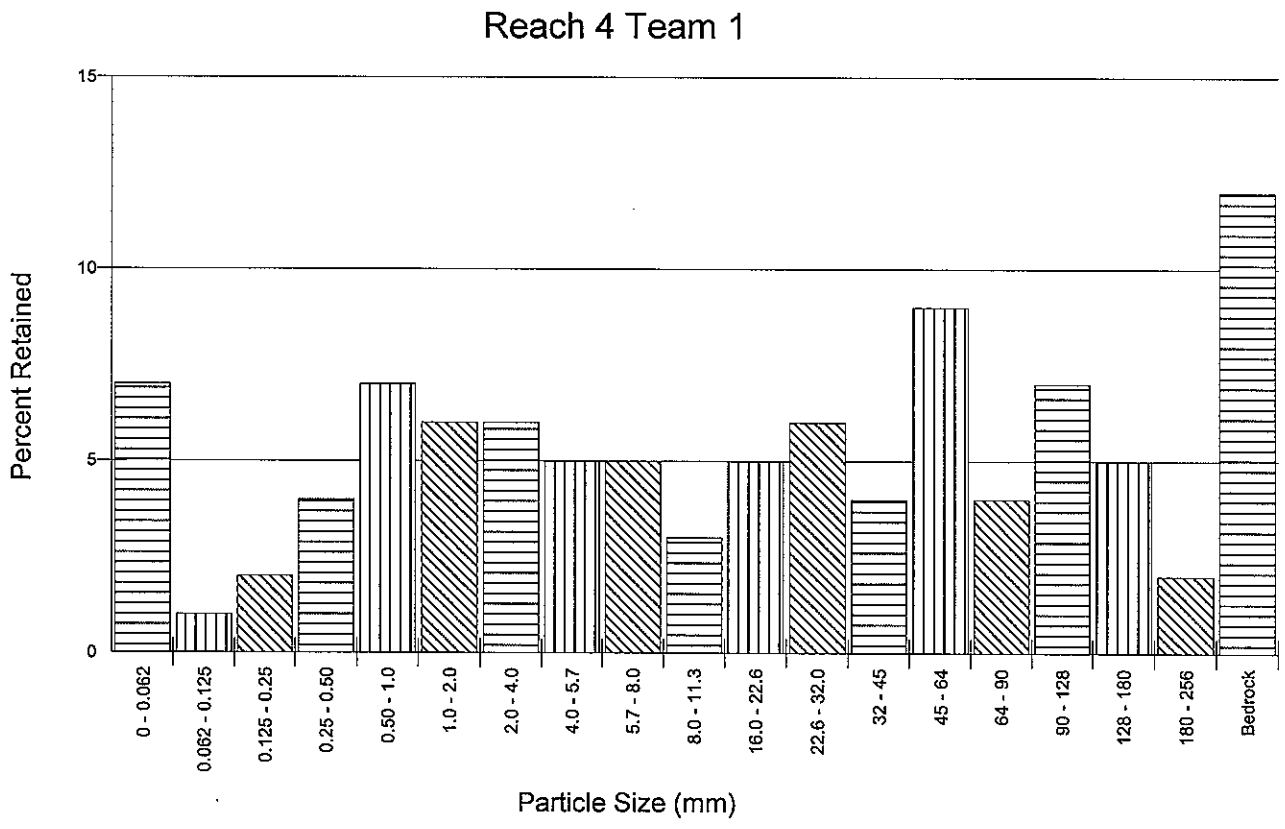
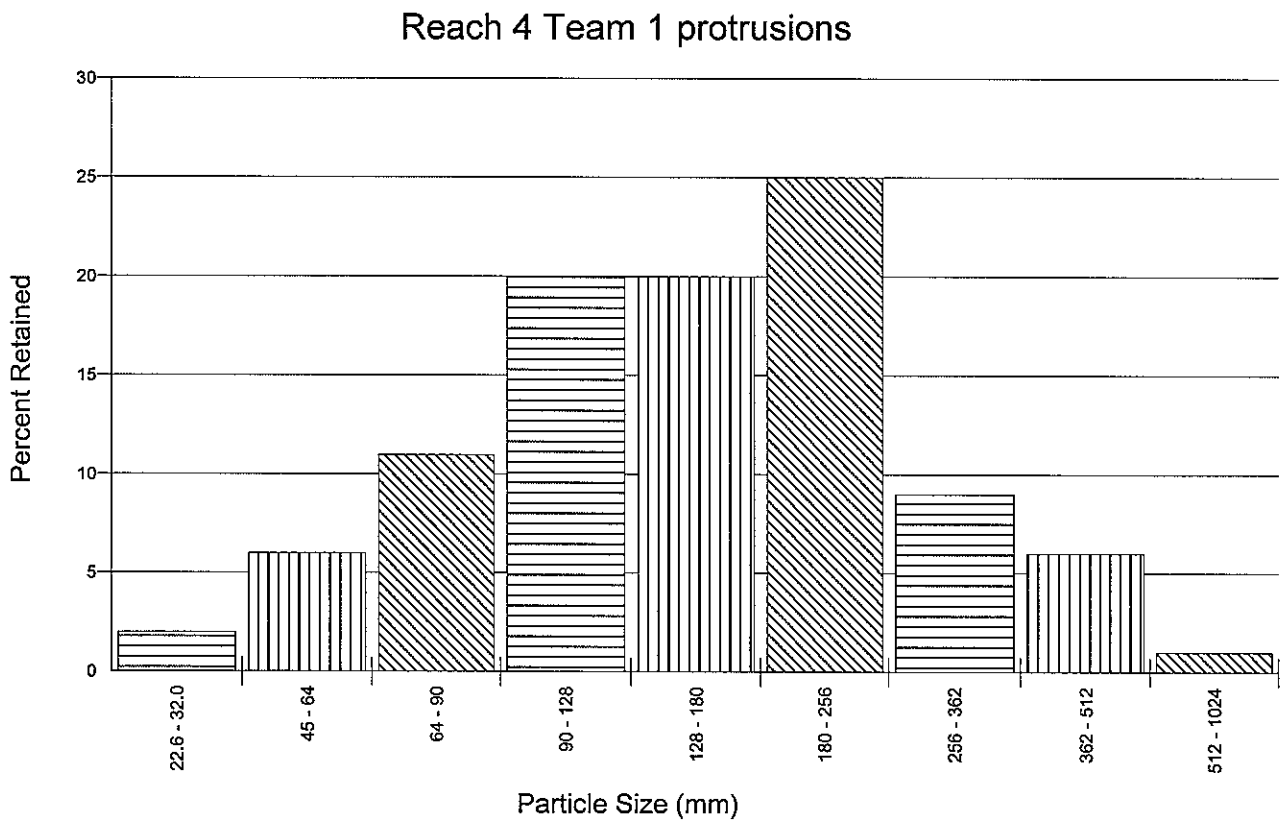
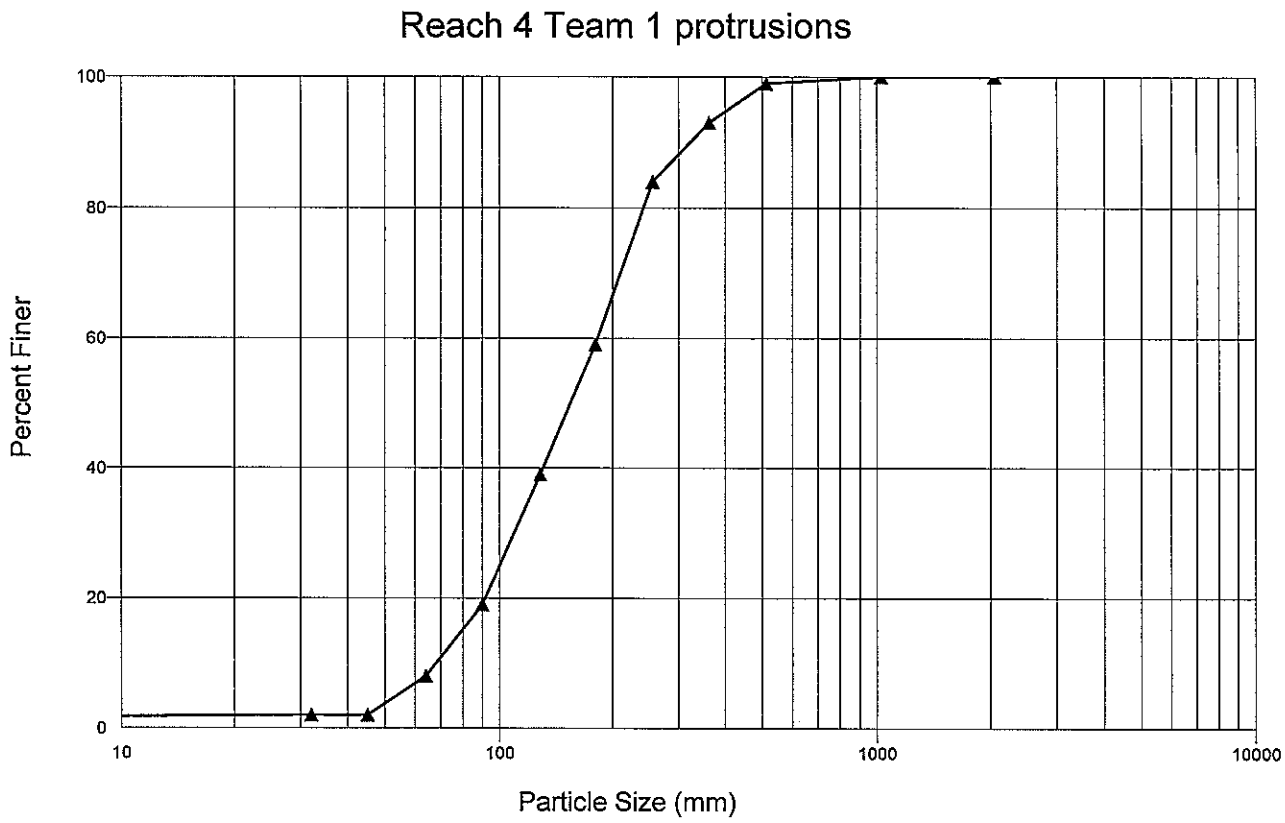
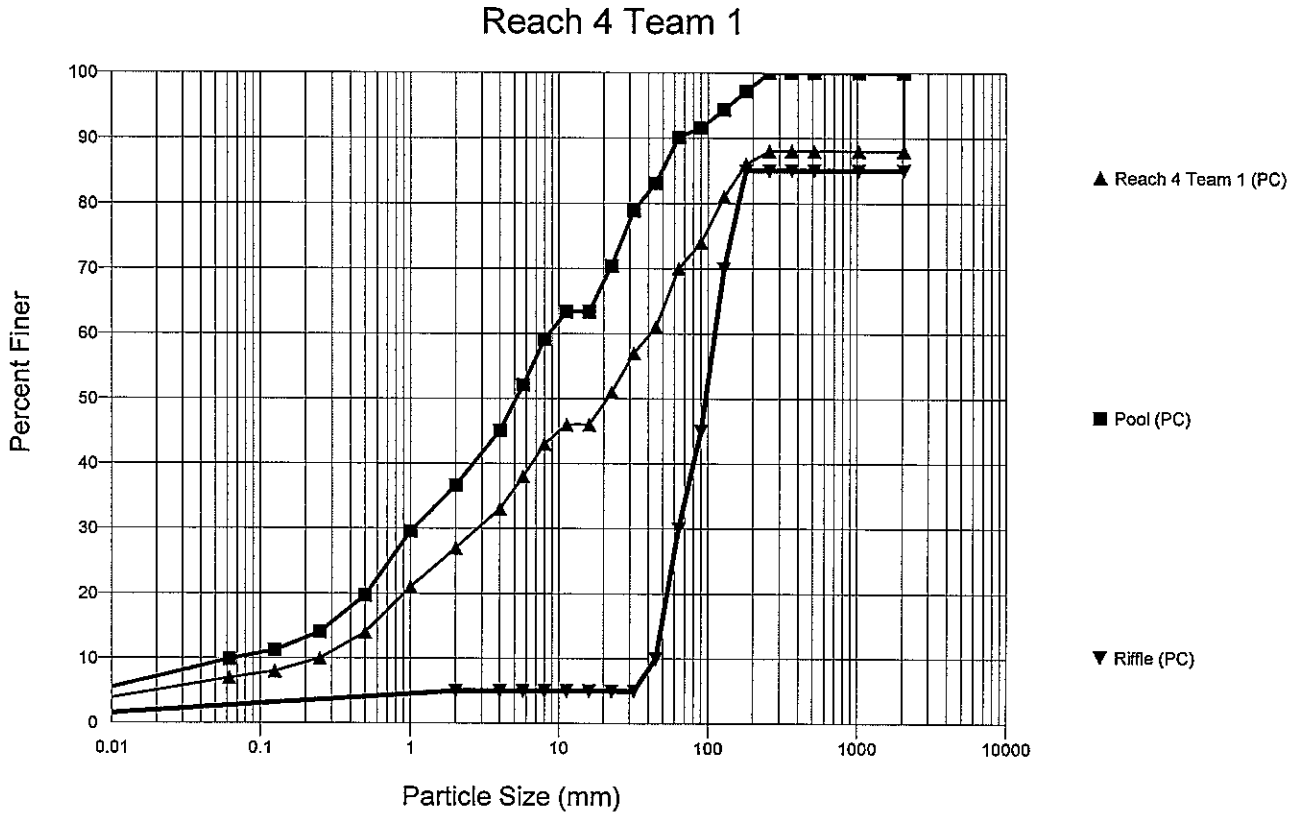
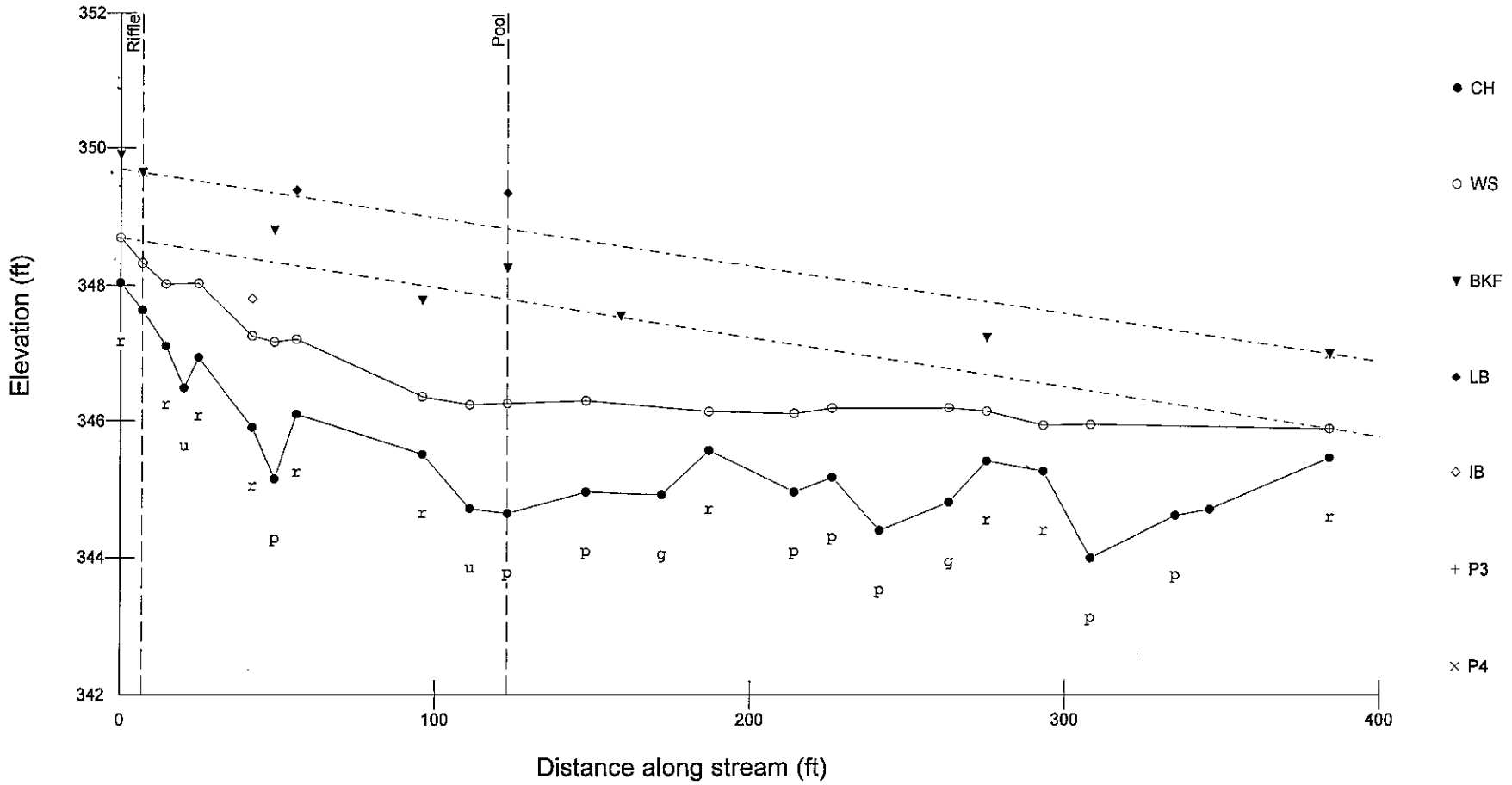

Reach 4 Team 1
Percent Retained
15
10
5
0
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.50
0.50 - 1.0
1.0 - 2.0
2.0 - 4.0
4.0 - 5.7
5.7 - 8.0
8.0 - 11.3
16.0 - 22.6
22.6 - 32.0
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
Bedrock
Particle Size (mm)


Reach 4 Team 1 protrusions
Percent Retained
30
25
20
15
10
5
0
22.6 - 32.0
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
Particle Size (mm)


Reach 4 Team 1 protrusions
Percent Finer
100
80
60
40
20
0
10
100
1000
10000
Particle Size (mm)

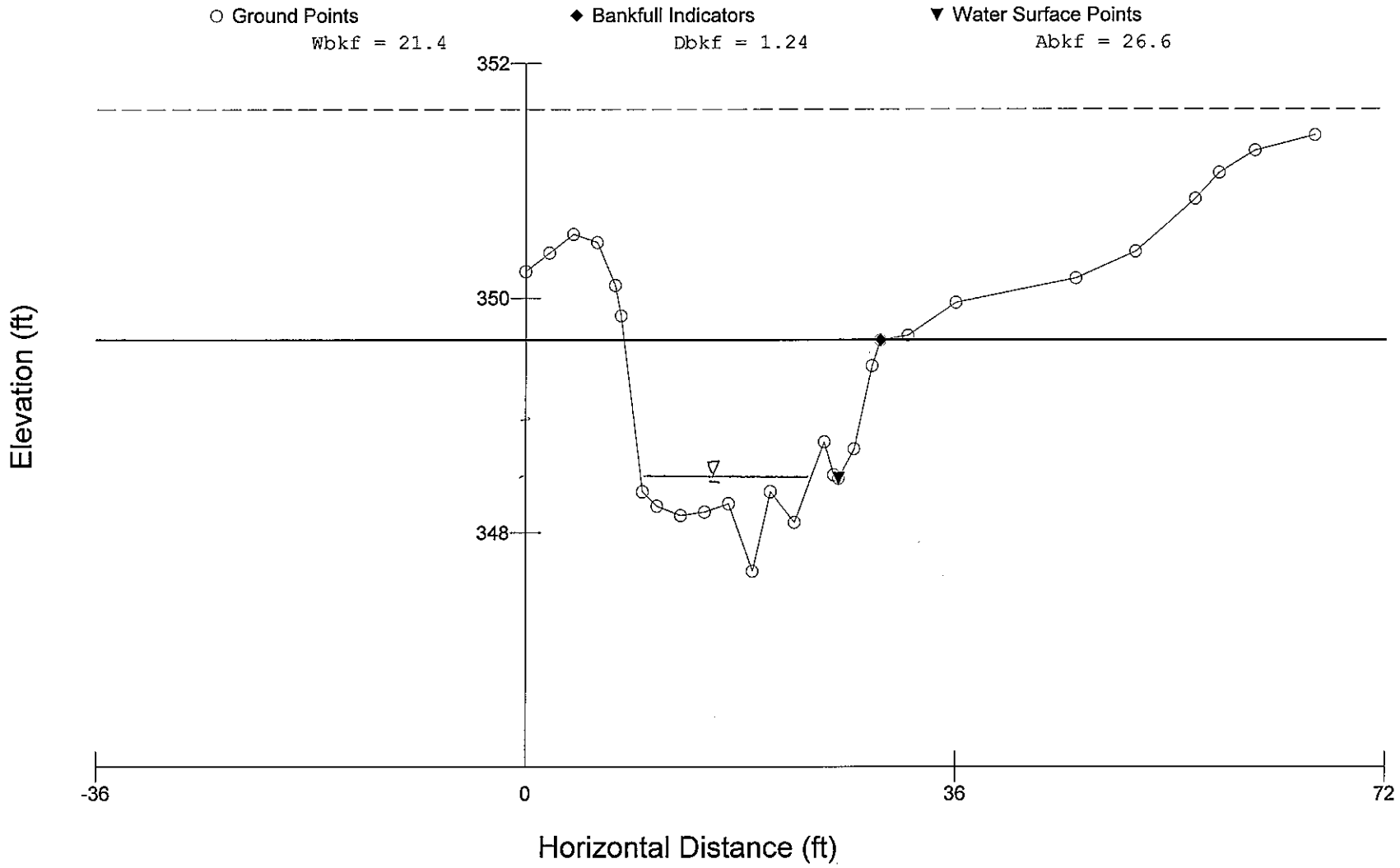
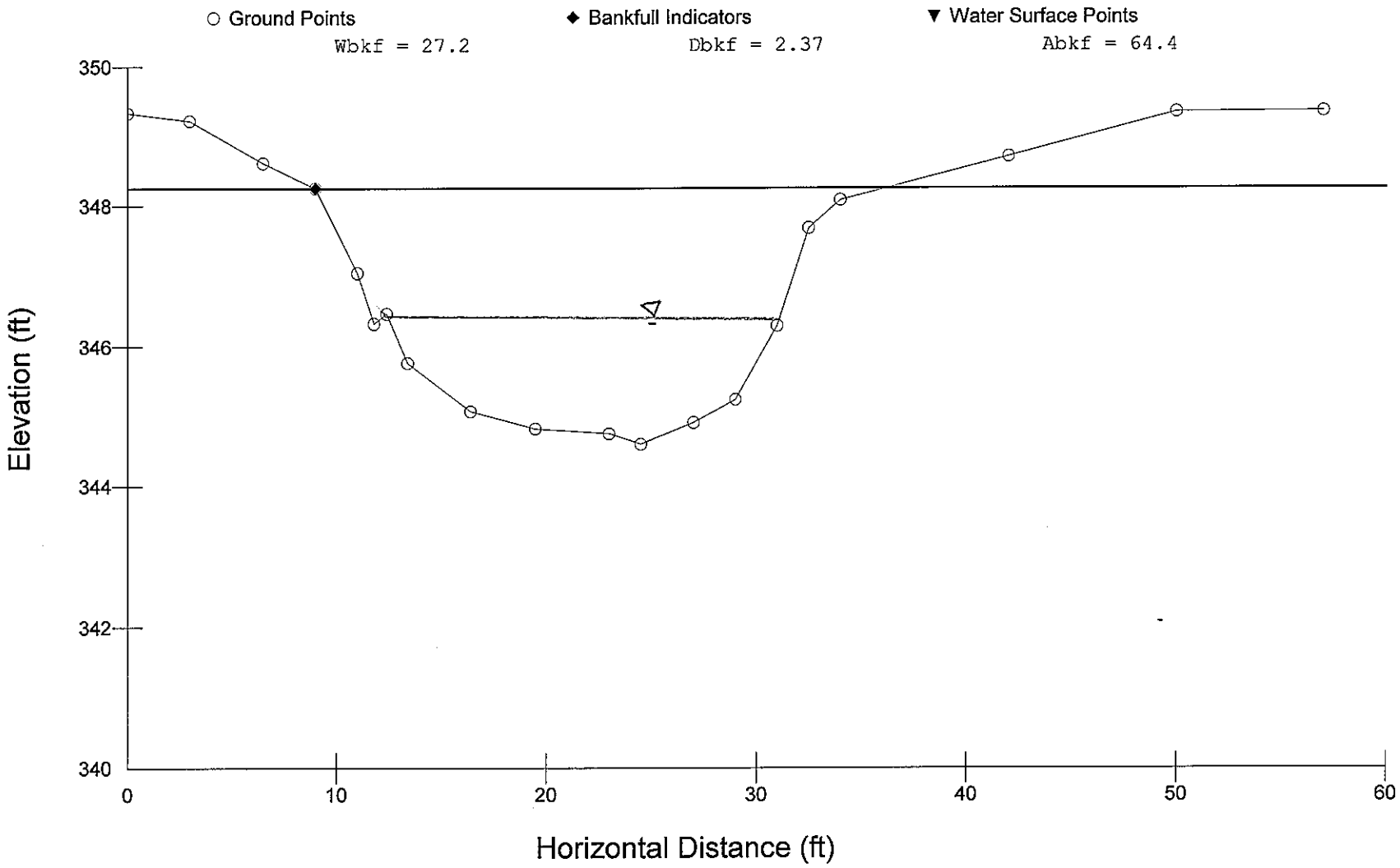

Reach 4 Team 1
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
▲ Reach 4 Team 1 (PC)
■ Pool (PC)
▼ Riffle (PC)

Group 1


Riffle
Pool
352
350
348
346
344
342
0
100
200
300
400
Elevation (ft)
Distance along stream (ft)
CH
WS
BKF
LB
IB
P3
P4

X-Sec

Riffle Count



Pool Cross section