River Assessment and Monitoring
NCTC - Shepherdstown, WV
9/17 – 9/27/2007

Team 2
Day 1
Magruders Branch
Reference Reach

Magruder Branch Reference Reach Team 2 DAY 1 9/18/2007

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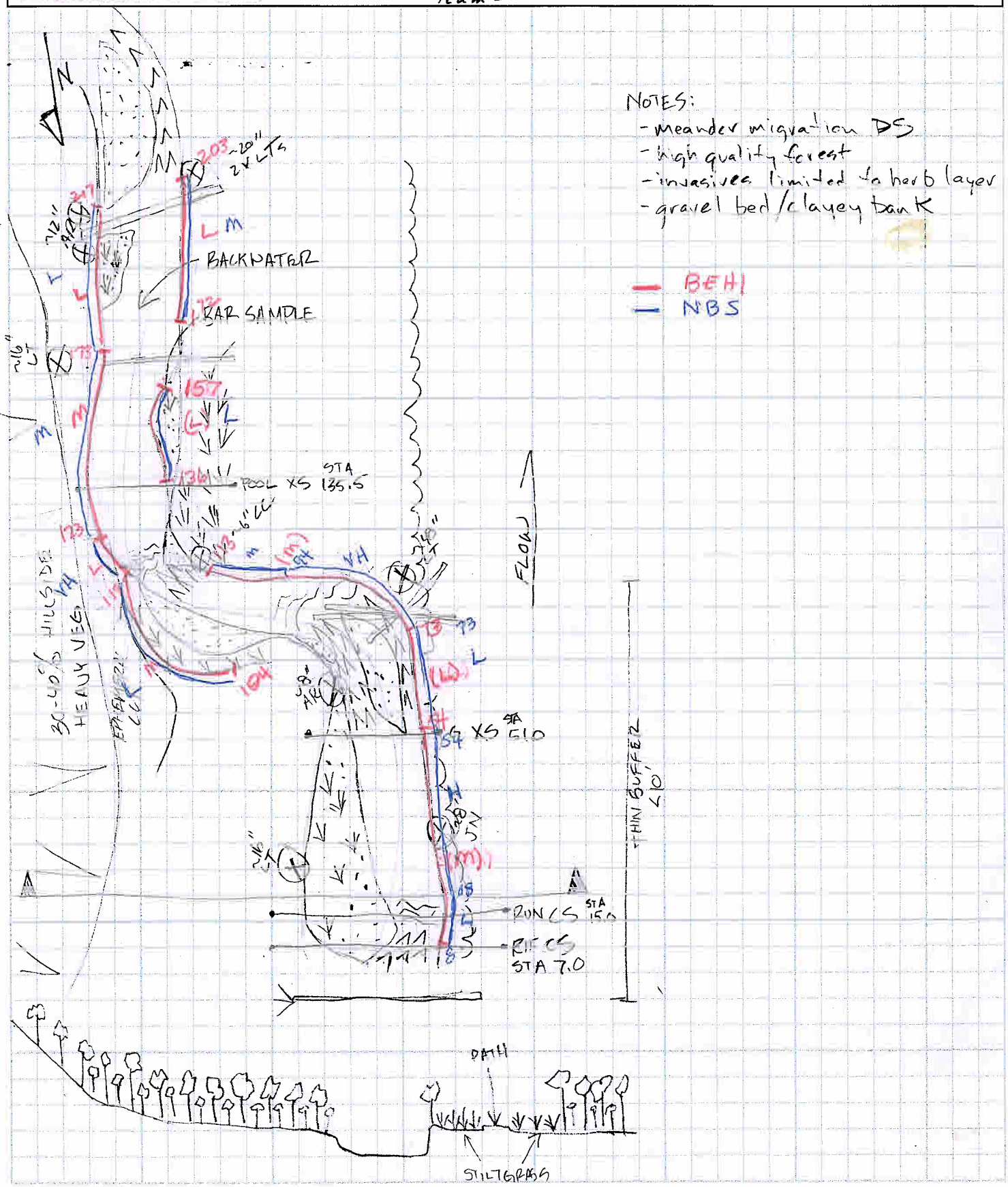
Subject MAGRUDER BRANCH Page ____ of ____
PLAN VIEW Cm. No. ____
Prepared By RMC Date 091807 Checked By ____ Date ____
Team 2



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Subject GEOMETRY Page ____ of ____

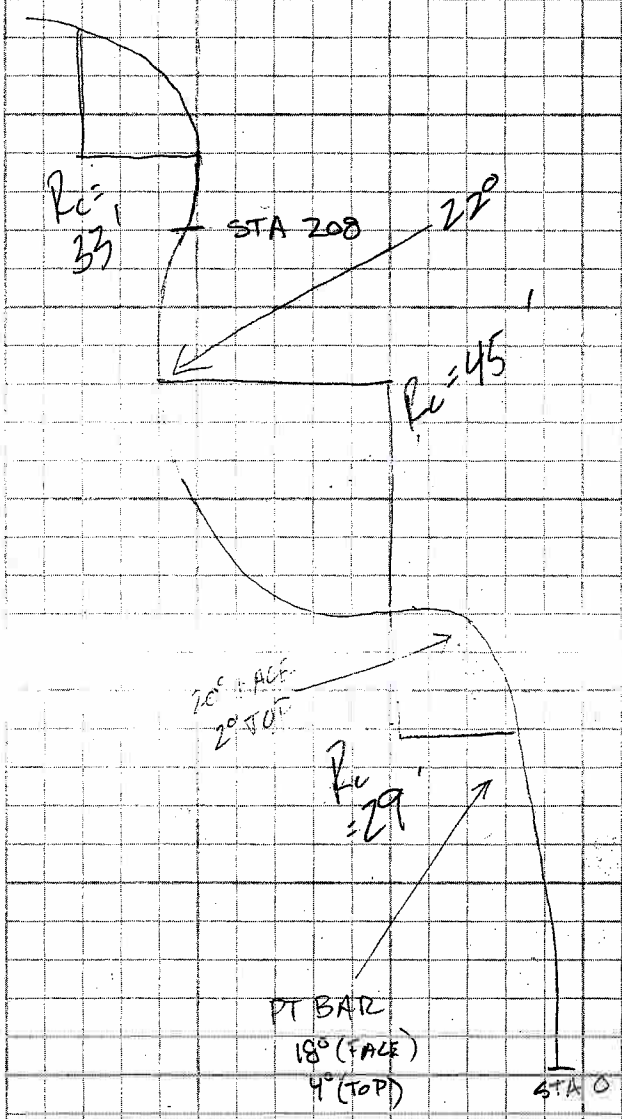
MAGRUDER BRANCH Cm. No. ____

Prepared By BML Date 091807 Checked By ____ Date ____

Team 2

BKFW = 68'
VL = 148'
SL = 209
SINUOSITY = 1.4

R_c = 29, 36, 45



9/18/07

River Assessment and Monitoring: Reference Reach 1st Field Day

Worksheet A-1. Level II stream classification form.

Stream: Magruder Branch	
Basin:	Drainage Area: acres 13 mi²
Location:	
Twp.&Rge:	Sec.&Qtr.:
Cross-Section Monuments (Lat./Long.):	Date:
Observers:	Valley Type: 8

Terraced Alluvial Valley

C4

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	24.5	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	1.27	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	31	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	6.13	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.	1.78	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.	165	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	6.13	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.	17.9	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.	.0086	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).	1.4	

Stream Type C4 — **Reference:** *WARSSS*, **Figure 2-14**, page 2-23

Slope 0.899

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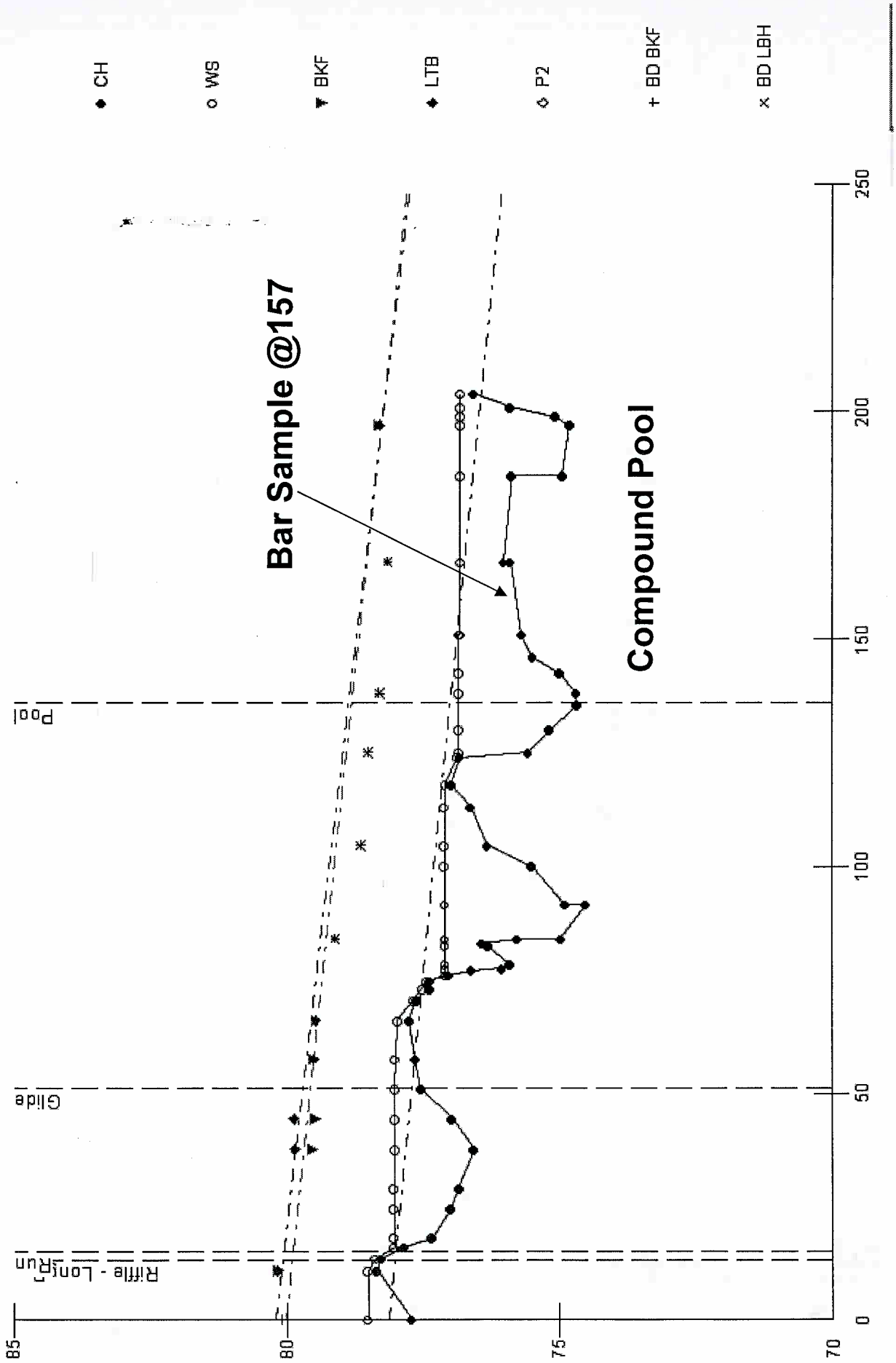

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BM2 LongPro Ref
RIVERMORPH PROFILE SUMMARY

River Name: Little Bennett
Reach Name: Reach 1
Profile Name: Team 2 Long Pro
Survey Date: 09/21/2007

Survey Data

DIST	CH	WS	BKF	P1	P2	P3	P4
-10.4		6.29					
0	6.9	6.74	4.67	3.1			6.74
8.5	7.05	6.84					
11	7.19	7.06					
13	7.44	7.24					
19	7.53	7.2					
25	7.45	7.15					
31	7.83	7.28					
35	7.81	7.34	4.96	3.76	2.28	2.58	
41	8.13	7.38					
44	7.94	7.35					
51	7.75	7.35	5.03	4.15			
57	7.65	7.35					
60.5	7.69	7.36	5.16				
61	7.63	7.35					
63	8.07	7.37					
65.5	8.38	7.39					
69	8.7	7.4	5.35	3.32		3.82	
72.5	9.08	7.41					
78	8.98	7.39					
80	8.94						
88	8.54	7.4					
98	8.26	7.4	5.07	4.7			
99.9	8.05	7.45					
101.5	7.97	7.43					
107	7.65	7.44					
122	7.82	7.65					
127	8.09	7.73					
128.5	8.14	7.73					
132	8.3	7.71	5.71	4.41			
141.5	8.68	8.21					
149.5	9.33	8.21	6.08	4.96			
158	9.69	8.21					
163	9.7	8.23					
171.5	9.11	8.2					
174	9.41						
174.5	8.46	8.19					
177.5	8.42	8.2					
180	8.61						
191	8.56	8.42					
197	9.35	8.63					
202	9.45						
204	9.53						
206	10.21						
212.5	9.86	8.73					
217	9.67	8.72					
222	9.72	8.71	6.48	5.95			

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BM2 LongPro Ref

227	9.63			
234	9.45	8.6	6.8	
238.5	9.24	8.65		
243	9.07	8.67		
247	8.88	8.66	6.5	8.66

Cross Section / Bank Profile Locations

Name	Type	Profile Station
Pool	Pool XS	0
Riffle	Riffle XS	0
Glide	Glide XS	0
Run	Run XS	0

Measurements from Graph

Bankfull Slope: 0.0056

Variable	Min	Avg	Max
S riffle	0.01197	0.01656	0.02341
S pool	0	0.00039	0.00061
S run	0.03619	0.06365	0.09111
S glide	0.00082	0.00449	0.0089
P - P	58.91	69.53	80.15
Pool length	29.99	33.02	36.77
Riffle length	8.24	12.25	14.99
Dmax riffle	2.24	2.31	2.38
Dmax pool	3.52	3.71	3.87
Dmax run	2.64	2.78	2.95
Dmax glide	2.88	2.98	3.13
Low bank ht	2.7	3.25	4.07

Length and depth measurements in feet, slopes in ft/ft.

RIVERMORPH PROFILE SUMMARY

Notes

River Name: Little Bennett
Reach Name: Reach 1
Profile Name: Team 2 Long Pro
Survey Date: 09/21/2007

DIST	Note
0	Riffle
35	riffle cross section
57	glide
63	begin pool
69	Pool cross section
88	end pool
98	glide
107	riffle
127	end riffle
132	run cross section
141.5	pool
163	end pool
171.5	glide
177.5	riffle

Macgruder Branch Reference Reach Team 2 9/18/2007

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1) 5-4
2) Incision
3)

Pool mixed up
want to
W/D to 8
Area to 31

Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2005).

Stream: **Macgruder, Reach - Final Reach** Location:

Observers: Date: **9/18/2007** Valley Type: **VIII** Stream Type: **C 4**

River Reach Summary Data

Channel Dimension

Mean Riffle Depth (d_{bkf})	1.27	ft	Riffle Width (W_{bkf})	24.46	ft	Riffle Area (A_{bkf})	31	ft^2
Mean Pool Depth (d_{bkfp})	2.38	ft	Pool Width (W_{bkfp})	11.57	ft	Pool Area (A_{bkfp})	27.59	ft^2
Mean Pool Depth/Mean Riffle Depth	1.87	d_{bkfp}/d_{bkf}	Pool Width/Riffle Width	0.47	W_{bkfp}/W_{bkf}	Pool Area / Riffle Area	0.89	A_{bkfp}/A_{bkf}
Max Riffle Depth (d_{mbkf}) 1.98	~~4.78~~	ft	Max Pool Depth (d_{mbkfp}) 4.02	~~3.8~~	ft	Max Riffle Depth/Mean Riffle Depth	~~1.40~~ → 1.56	
Max Pool Depth/Mean Riffle Depth	~~2.992~~ 3.165					Point Bar Slope	~~0.035~~ → 0.36	
Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})				3.71	ft/s	Estimation Method	Friction Factor	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})				115	cfs	Drainage Area	1.3	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Meander Length (Lm)	0	0	0	ft	Meander Length Ratio (Lm/W_{bkf})	0.00	0.00	0.00
Radius of Curvature (Rc)	36	29	45	ft	Radius of Curvature/Riffle Width (Rc/W_{bkf})	1.47	1.19	1.84
Belt Width (W_{blt})	68	0	0	ft	Meander Width Ratio (W_{blt}/W_{bkf})	2.78	0.00	0.00
Individual Pool Length	47.8	33	76	ft	Pool Length/Riffle Width	1.96	1.35	3.11
Pool to Pool Spacing	64.9	54.3	75.5	ft	Pool to Pool Spacing/Riffle Width	2.65	2.22	3.09
Riffle Length	5.83	2.71	8.72	ft	Riffle Length/Riffle Width	0.24	0.11	0.36

Channel Profile

Valley Slope (VS)	0.0122	ft/ft	Average Water Surface Slope (S)	0.00874	ft/ft	Sinuosity (VS/S)	1.4	
Stream Length (SL)	209	ft	Valley Length (VL)	148	ft	Sinuosity (SL/VL)	1.41	

Low Bank Height (LBH)	start ~~1.49~~ ft 1.72		Max Riffle Depth	start ~~1.72~~ ft 1.61		Bank-Height Ratio (BHR) (LBH/Max Riffle Depth)	start ~~0.69~~ → 1.07	
	end ~~1.72~~ ft 1.79			end ~~1.25~~ ft ~~1.6~~			end ~~1.38~~ 1.1	

Facet Slopes	Mean	Min	Max		Dimensionless Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.051	0.036	0.064	ft/ft	Riffle Slope/Average Water Surface Slope (S_{rif} / S)	5.793	4.149	7.273
Run Slope (S_{run})	0.~~143~~ 12	0.036 ~~0.036~~	0.260	ft/ft	Run Slope/Average Water Surface Slope (S_{run} / S) 17.9 →	#####	3.965	~~#####~~ 22.5
Pool Slope (S_p)	0.000	0.000	0.001	ft/ft	Pool Slope/Average Water Surface Slope (S_p / S)	0.051	0.038	0.059
Glide Slope (S_g)	0.003	0.002	0.004	ft/ft	Glide Slope/Average Water Surface Slope (S_g / S)	0.326	0.212	0.400

Feature Midpoint[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Riffle Depth (d_{rif})	1.78	1.63	1.86	ft	Riffle Depth/Mean Riffle Depth (d_{rif} / d_{bkf})	1.4	1.28	1.46
Run Depth (d_{run})	2.44	2	3.11	ft	Run Depth/Mean Riffle Depth (d_{run} / d_{bkf})	1.92	1.57	2.45
Pool Depth (d_p)	3.8	3.04	4.53	ft	Pool Depth/Mean Riffle Depth (d_p / d_{bkf})	2.99	2.39	3.57
Glide Depth (d_g)	1.8	1.24	2.2	ft	Glide Depth/Mean Riffle Depth (d_g / d_{bkf})	1.42	0.98	1.73

check

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	11	0	0	D_{16}	1	17.65	0	0	mm
% Sand	5	0	28.77	D_{35}	12.48	28.48	3.04	0	mm
% Gravel	75	73	69.46	D_{50}	17.89	37.32	6.36	0	mm
% Cobble	9	27	1.77	D_{84}	47.38	78.3	24.31	0	mm
% Boulder	0	0	0	D_{95}	97.6	105.2	49.3	0	mm
% Bedrock	0	0	0	D_{100}	179.99	255.99	78	0	mm

a Min, max, mean depths are the average mid-point values except pools, which are taken at deepest part of pool.
b Composite sample of riffles and pools within the designated reach.
c Active bed of a riffle.
d Height of roughness feature above bed.

✓ ① ▲ BF line
② check depth to BF
③

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River Assessment and Monitoring: Reference Reach — 1st Field Day

Worksheet A-25. Summary of stability condition categories.

Stream: Macgruger Branch								Location: Reach 1		
Observers: Group 2					Date: September 18, 2007		Stream Type: C4		Valley Type: VIII	
Channel Dimension	Mean bankfull depth (ft): 1.27	Mean bankfull width (ft): 24.5	Cross-section area (ft^2): 31.00	Width of flood-prone area (ft): 150	Entrenchment ratio: 6.13					
Channel Pattern	Mean (range)	MWR: 2.77	Lm/W_{bkf}: 8.33	Rc/W_{bkf}: 1.25	Sinuosity: 1.4					
River Profile and Bed Features	Circle: Riffle/pool	Step/pool	Plane bed	Convergence/divergence	Dunes/antidunes/smooth bed					
	Max bankfull depth (ft):	Riffle: 1.98 ~~1.99~~	Pool: 4.02 ~~4.63~~	Depth ratio (max/mean):	Riffle: 1.56 ~~1.49~~	Pool: 3.165 ~~3.56~~	Pool to pool spacing:	Ratio: 2.65	Slope: Valley: 0.0122	Average bankfull: 0.008
Level III Stream Stability Indices	Riparian vegetation	Current composition/density: Forest / Moderate	Potential composition/density: Forest / Moderate	Remarks: Condition, vigor and/or usage of exiting reach: Good condition and vigor						
	Flow regime: P2	Stream size and order: S-4 (2)	Meander pattern(s): M3	Depositional pattern(s): B5	Debris/channel blockage(s): D3					
	Degree of incision (Bank-Height Ratio): 1.0	Degree of incision stability rating: Stable	Modified Pfankuch stability rating (numeric and adjective rating): 74 - Good							
	Width/depth ratio (W/D): 19.26	Reference W/D ratio (W/D_{ref}): 15	Width/depth ratio state $(W/D)/(W/D_{ref})$: 1.28	W/D ratio state stability rating: Mod. Unstable						
	Meander Width Ratio (MWR): 3.56	Reference MWR_{ref}: 12.5	Degree of confinement (MWR/MWR_{ref}): 0.72	MWR/MWR_{ref} stability rating: mod unstable						
Bank Erosion Summary	Length of reach studied (ft): 209	Annual streambank erosion rate: 10.1 (tons/yr)	0.05 (tons/yr/ft)	Curve used: DC	Remarks:					
Sediment Capacity (POWERSED)	Sufficent capacity	Insufficient capacity	Remarks:							
Entrainment/ Competence	Largest particle from bar sample (mm): 78	$\tau = 0.37$	$\tau^* = 0.02$	Existing $depth_{bkf}$: 1.27	Required $depth_{bkf}$: 1.05	Existing $slope_{bkf}$: 0.008	Required $slope_{bkf}$: 0.007			
Successional Stage Shift	C → F → → → →	Existing stream state (type): C4	Potential stream state (type): C4							
Lateral Stability	Circle: Stable	Moderately unstable	Unstable	Highly unstable	Remarks/causes:					
Vertical Stability (Aggradation)	Circle: No deposition	Moderate deposition	Excess deposition	Aggradation	Remarks/causes:					
Vertical Stability (Degradation)	Circle: Not incised	Slightly incised	Moderately incised	Degradation	Remarks/causes:					
Channel Enlargement	Circle: No increase	Slight increase	Moderate increase	Extensive	Remarks/causes:					
Sediment Supply (Channel Source)	Circle: Low	Moderate	High	Very high	Remarks/causes:					

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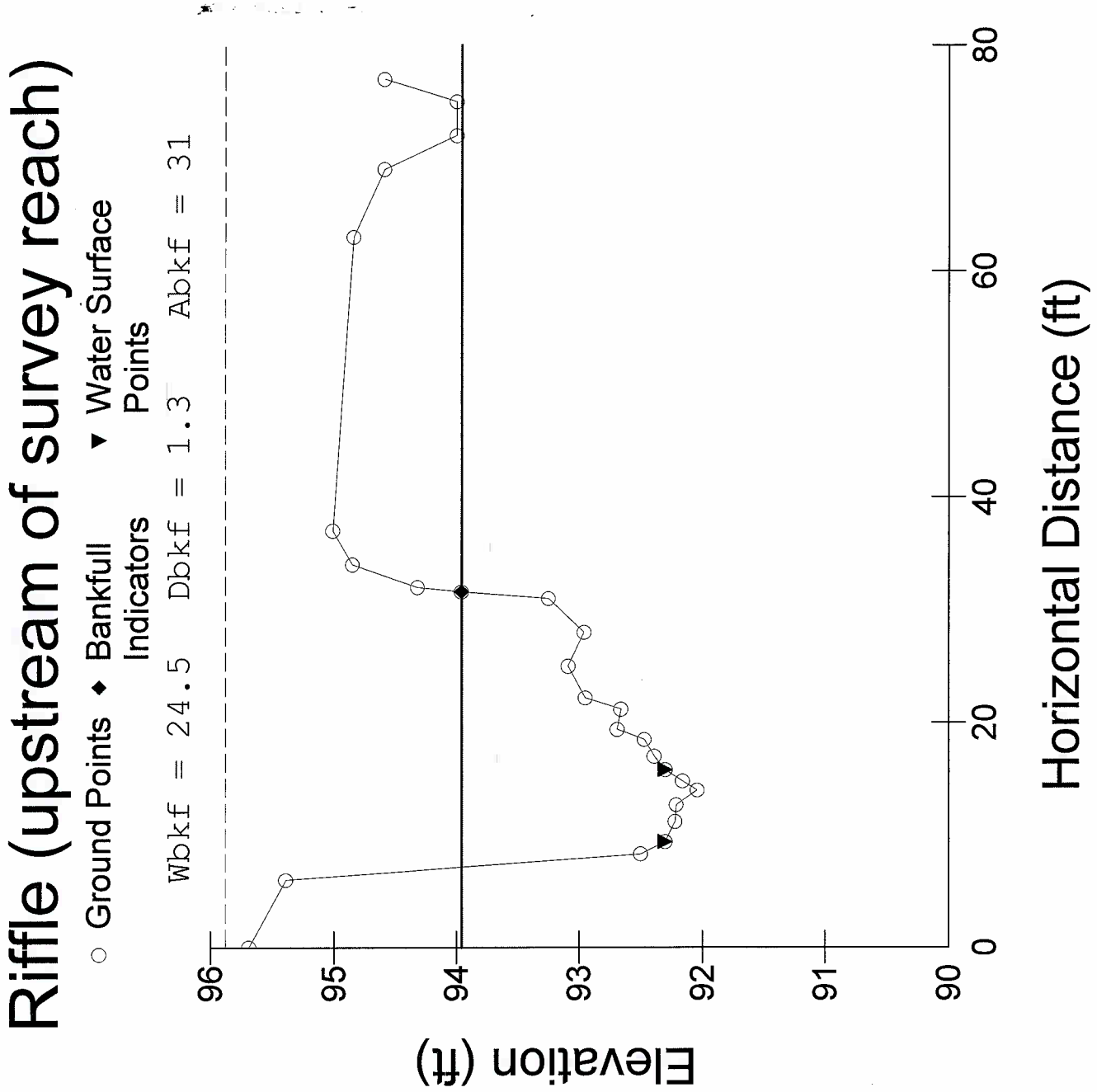
Riffle (upstream of survey reach)
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 24.5 Dbkf = 1.3 Abkf = 31
Elevation (ft)
96
95
94
93
92
91
90
0
20
40
60
80
Horizontal Distance (ft)

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9/18/07

RIVERMORPH CROSS SECTION SUMMARY

Macgruder Branch Reference Reach Team 2 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Cross Section Name: Riffle US
Survey Date: 09/18/2007

Cross Section Data Entry

BM Elevation: 100 ft
Backsight Rod Reading: 1.46 ft

TAPE	FS	ELEV	NOTE
0	5.77	95.69	
6	6.07	95.39	
8.3	8.96	92.5	
9.4	9.16	92.3	lew
11.2	9.24	92.22	
12.7	9.25	92.21	
14	9.42	92.04	tw
14.8	9.3	92.16	
15.8	9.16	92.3	rew
17	9.07	92.39	
18.5	8.99	92.47	
19.4	8.77	92.69	
21.2	8.8	92.66	
22.2	8.51	92.95	
25	8.37	93.09	
28	8.5	92.96	
31	8.21	93.25	
31.6	7.5	93.96	bkf
32	7.14	94.32	
34	6.61	94.85	
37	6.45	95.01	
63	6.62	94.84	
69	6.87	94.59	
72	7.61	94	
75	7.64	94	
77	6.87	94.59	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	95.88	95.88	95.88
Bankfull Elevation (ft)	93.96	93.96	93.96
Floodprone Width (ft)	150	-----	-----
Bankfull Width (ft)	24.46	22.55	1.91
Entrenchment Ratio	6.13	-----	-----
Mean Depth (ft)	1.27	1.32	0.64
Maximum Depth (ft)	1.92	1.92	0.84
Width/Depth Ratio	19.26	17.08	2.98
Bankfull Area (sq ft)	31	29.78	1.23
Wetted Perimeter (ft)	25.64	24.23	3.08
Hydraulic Radius (ft)	1.21	1.23	0.4
Begin BKF Station	7.14	7.14	29.69
End BKF Station	31.6	29.69	31.6

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)			

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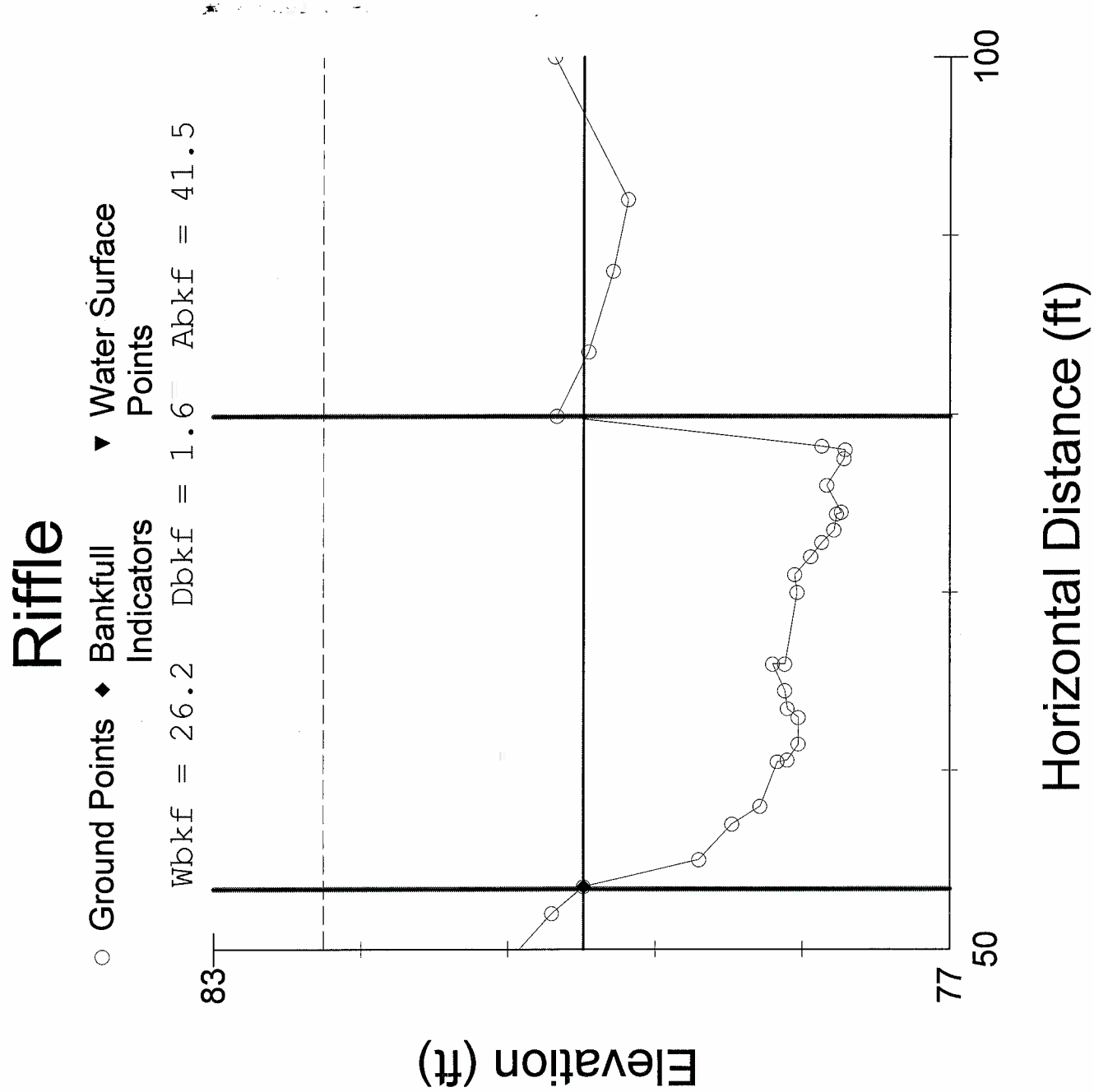
Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 26.2 Dbkf = 1.6 Abkf = 41.5
83
77
50
100
Elevation (ft)
Horizontal Distance (ft)

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RIVERMORPH CROSS SECTION SUMMARY

Magruder Branch Reference Reach Team 2 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Cross Section Name: Riffle - LongPro
Survey Date: 09/18/2007

Cross Section Data Entry

BM Elevation: 80.12 ft
Backsight Rod Reading: 4.92 ft

TAPE	FS	ELEV	NOTE
0	2.3	82.74	FP
12	3	82.04	
27	3.7	81.34	
39	3.8	81.24	
49	4.4	80.64	
52	4.8	80.24	
53.5	5.06	79.98	BKF
55	6	79.04	
57	6.27	78.77	
58	6.5	78.54	
60.5	6.64	78.4	
60.6	6.72	78.32	WS
61.5	6.81	78.23	
63	6.81	78.23	
63.5	6.72	78.32	WS
64.5	6.7	78.34	
66	6.6	78.44	
66	6.7	78.34	
70	6.8	78.24	
71	6.78	78.26	
72	6.91	78.13	
72.8	7	78.04	
73.5	7.1	77.94	
74.4	7.12	77.92	
74.5	7.16	77.88	
76	7.04	78	
77.5	7.18	77.86	
78	7.19	77.85	
78.2	7	78.04	
79.9	4.84	80.2	RB
83.5	5.1	79.94	FP
88	5.3	79.74	
92	5.42	79.62	
100	4.82	80.22	
110	4.4	80.64	
120	4.9	80.14	
176	4.2	80.84	FP

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	82.11	82.11	82.11
Bankfull Elevation (ft)	79.98	79.98	79.98
Floodprone Width (ft)	165.2	-----	-----

Magruder Branch Reference Reach Team 2 9/18/2007

Bankfull Width (ft)	26.23	13	13.23
Entrenchment Ratio	6.3		
Mean Depth (ft)	1.58	1.38	1.78
Maximum Depth (ft)	2.13	1.75	2.13
Width/Depth Ratio	16.6	9.42	7.43
Bankfull Area (sq ft)	41.49	17.99	23.5
Wetted Perimeter (ft)	27.75	15.12	15.94
Hydraulic Radius (ft)	1.5	1.19	1.47
Begin BKF Station	53.5	53.5	66.5
End BKF Station	79.73	66.5	79.73

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)			

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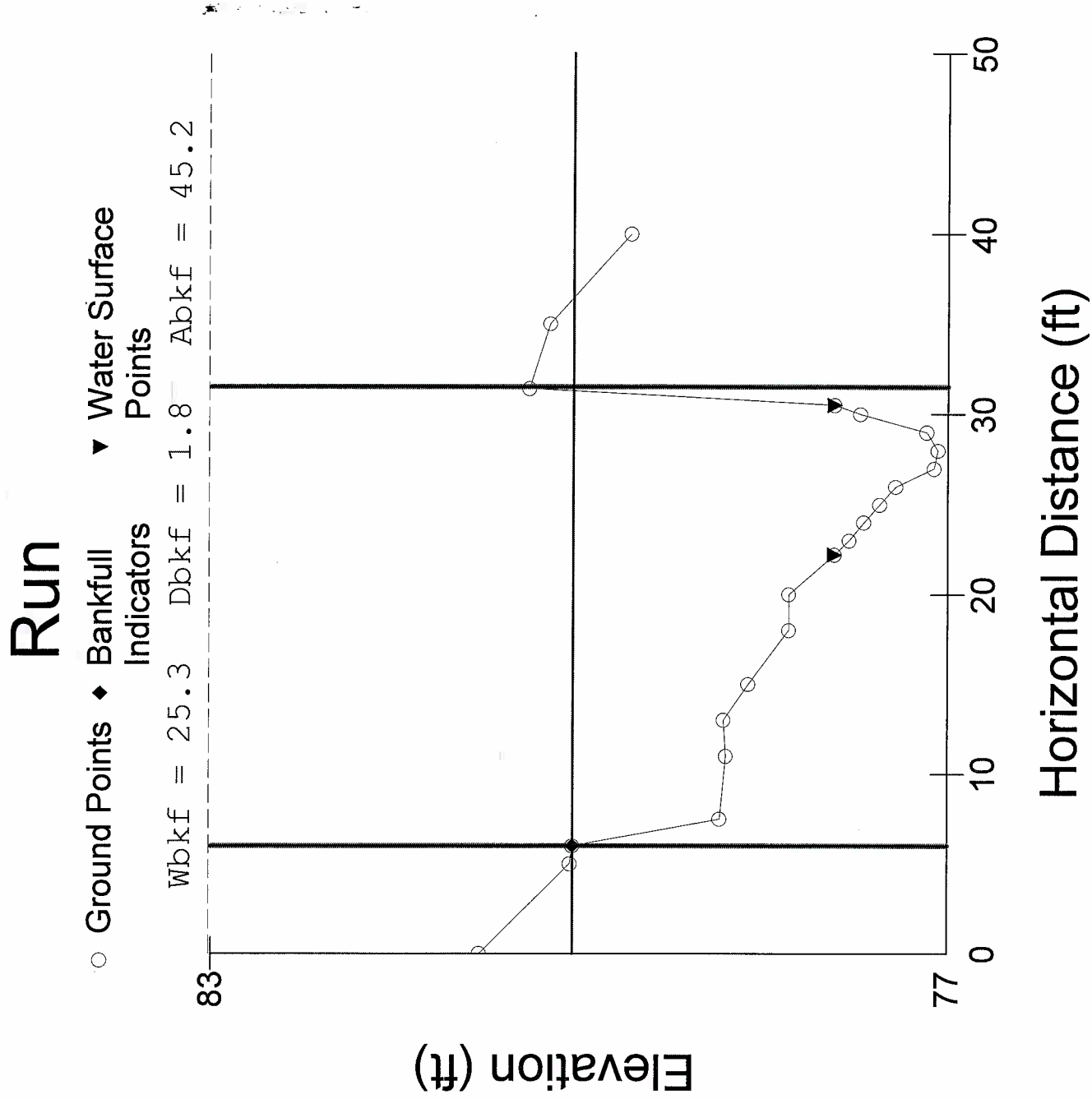
Run
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 25.3 Dbkf = 1.8 Abkf = 45.2
83
77
0
10
20
30
40
50
Elevation (ft)
Horizontal Distance (ft)

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TEAM 2
9/18/07

RIVERMORPH CROSS SECTION SUMMARY

Magruder Branch Reference Reach Team 2 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Cross Section Name: Run
Survey Date: 09/18/2007

Cross Section Data Entry

BM Elevation: 80.25 ft
Backsight Rod Reading: 4.92 ft

TAPE	FS	ELEV	NOTE
0	4.36	80.81	
5	5.1	80.07	LB
6	5.12	80.05	BKF
7.5	6.32	78.85	
11	6.37	78.8	
13	6.35	78.82	
15	6.55	78.62	
18	6.88	78.29	
20	6.88	78.29	
22.2	7.25	77.92	LEW
23	7.37	77.8	
24	7.49	77.68	
25	7.62	77.55	
26	7.75	77.42	
27	8.06	77.11	
28	8.09	77.08	TW
29	8	77.17	
30	7.46	77.71	
30.5	7.25	77.92	REW
31.4	4.76	80.41	RB
35	4.93	80.24	
40	5.59	79.58	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	83.02	83.02	83.02
Bankfull Elevation (ft)	80.05	80.05	80.05
Floodprone Width (ft)	165	-----	-----
Bankfull Width (ft)	25.27	14.39	10.88
Entrenchment Ratio	6.53	-----	-----
Mean Depth (ft)	1.79	1.34	2.38
Maximum Depth (ft)	2.97	1.83	2.97
Width/Depth Ratio	14.12	10.74	4.57
Bankfull Area (sq ft)	45.19	19.33	25.85
Wetted Perimeter (ft)	27.51	16.67	14.49
Hydraulic Radius (ft)	1.64	1.16	1.78
Begin BKF Station	6	6	20.39
End BKF Station	31.27	20.39	31.27

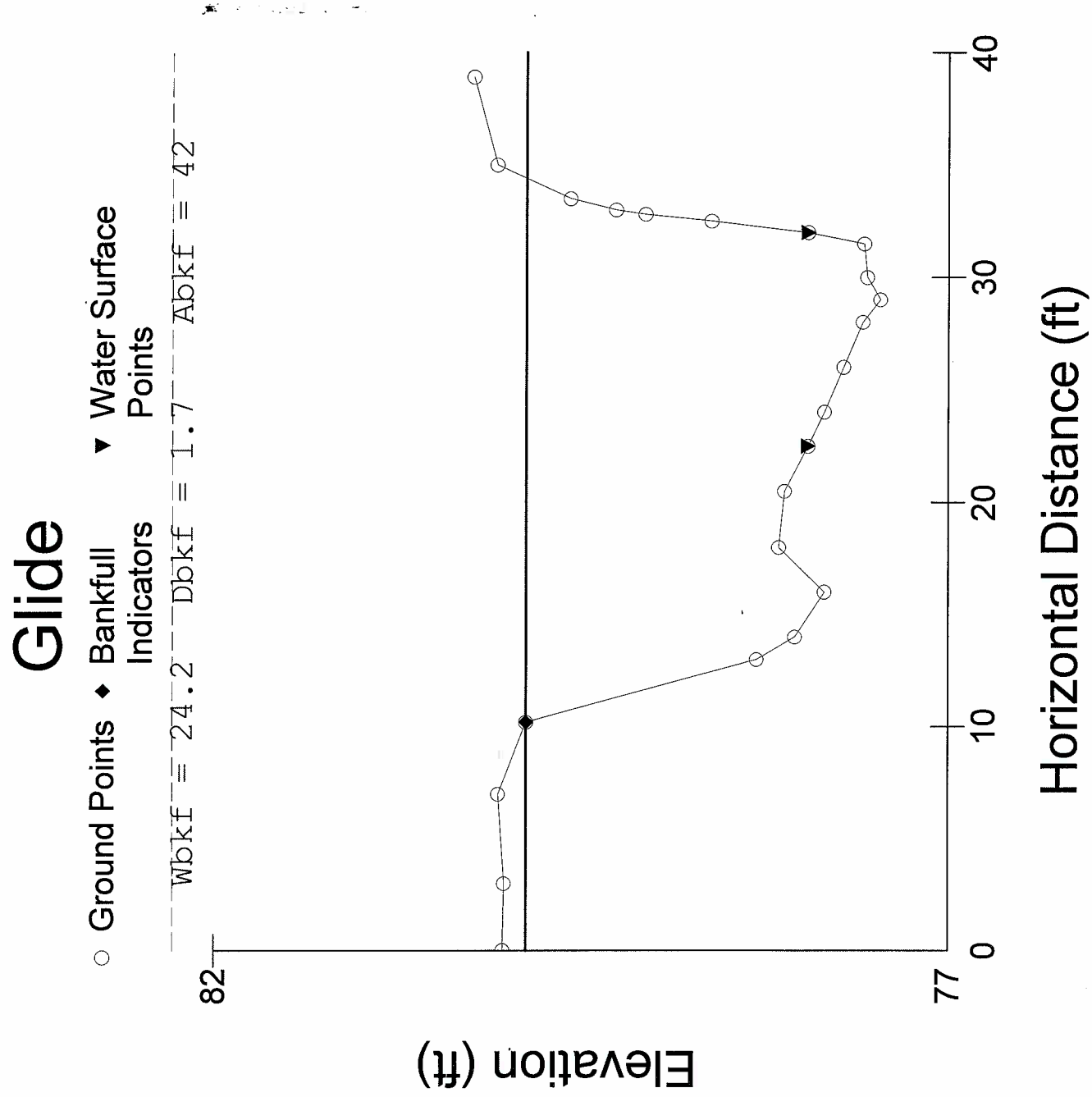
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

Magruder Branch Reference Reach - Team 2 9/18/2007

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

TEAM 2
9/18/07


Glide
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 24.2 Dbkf = 1.7 Abkf = 42
82
77
0
10
20
30
40
Elevation (ft)
Horizontal Distance (ft)

TEAM 2
9/18/07

TEAM 2
9/18/07

Magruder Branch Reference Reach Team 2 — RIVERMORPH CROSS SECTION SUMMARY — 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Cross Section Name: Glide
Survey Date: 09/18/2007

Cross Section Data Entry

BM Elevation: 80.25 ft
Backsight Rod Reading: 4.86 ft

TAPE	FS	ELEV	NOTE
0	5.08	80.03	
3	5.09	80.02	
7	5.05	80.06	
10.2	5.24	79.87	BKF
13	6.81	78.3	
14	7.07	78.04	
16	7.27	77.84	edge of bar
18	6.96	78.15	
20.5	7	78.11	
22.5	7.16	77.95	LEW
24	7.27	77.84	
26	7.4	77.71	
28	7.53	77.58	
29	7.65	77.46	TW
30	7.56	77.55	
31.5	7.54	77.57	
32	7.16	77.95	REW
32.5	6.5	78.61	
32.8	6.05	79.06	
33	5.85	79.26	field BKF
33.5	5.54	79.57	
35	5.04	80.07	
38.9	4.88	80.23	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	82.28	82.28	82.28
Bankfull Elevation (ft)	79.87	79.87	79.87
Floodprone Width (ft)	165	-----	-----
Bankfull Width (ft)	24.2	12.1	12.1
Entrenchment Ratio	6.82	-----	-----
Mean Depth (ft)	1.73	1.58	1.89
Maximum Depth (ft)	2.41	2.03	2.41
Width/Depth Ratio	13.99	7.66	6.4
Bankfull Area (sq ft)	41.99	19.16	22.83
Wetted Perimeter (ft)	25.62	14.49	14.95
Hydraulic Radius (ft)	1.64	1.32	1.53
Begin BKF Station	10.2	10.2	22.3
End BKF Station	34.4	22.3	34.4

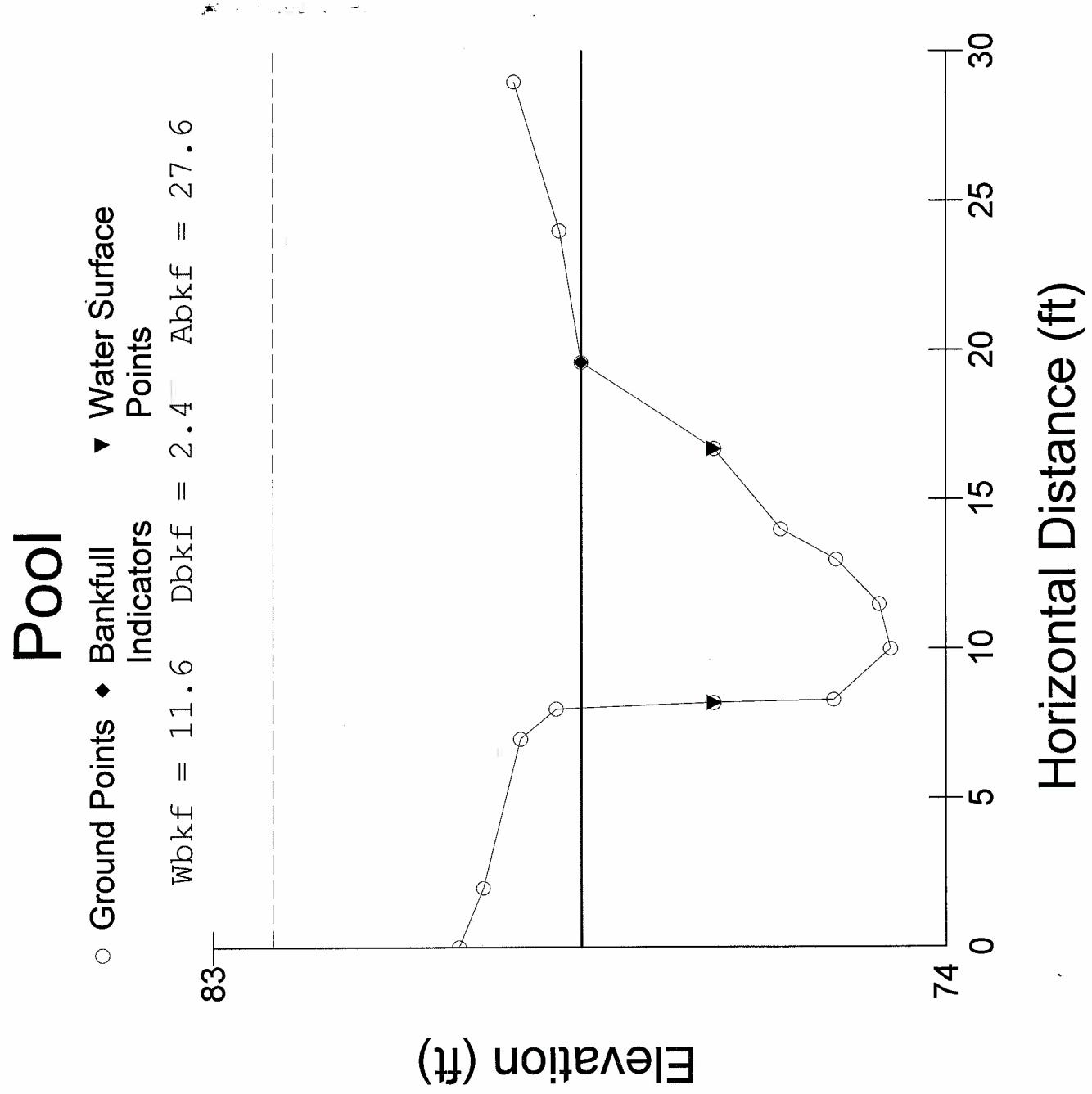
Entrainment Calculations

Magruder Branch Reference Reach Team 2 9/18/2007

Entrainment Formula: Rosgen Modified Shields Curve

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

TEAM 2
9/18/07


Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 11.6 Dbkf = 2.4 Abkf = 27.6
83
74
0
5
10
15
20
25
30
Elevation (ft)
Horizontal Distance (ft)

TEAM 2
9/18/07

TEAM 2 9/18/07

Magruder Branch Reference Reach Team 2 — RIVERMORPH CROSS SECTION SUMMARY — 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Cross Section Name: Pool
Survey Date: 09/18/2007

Cross Section Data Entry

BM Elevation: 80.25 ft
Backsight Rod Reading: 4.92 ft

TAPE	FS	ELEV	NOTE
0	5.19	79.98	
2	5.49	79.68	
7	5.95	79.22	LB
8	6.39	78.78	
8.2	8.33	76.84	LEW
8.3	9.8	75.37	
10	10.5	74.67	TW
11.5	10.36	74.81	
13	9.83	75.34	
14	9.15	76.02	
16.7	8.33	76.84	REW
19.6	6.7	78.47	BKF
24	6.43	78.74	RB
29	5.87	79.3	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	82.27	82.27	82.27
Bankfull Elevation (ft)	78.47	78.47	78.47
Floodprone Width (ft)	165	-----	-----
Bankfull Width (ft)	11.57	5.78	5.79
Entrenchment Ratio	14.26	-----	-----
Mean Depth (ft)	2.38	3.33	1.44
Maximum Depth (ft)	3.8	3.8	2.58
Width/Depth Ratio	4.86	1.74	4.02
Bankfull Area (sq ft)	27.59	19.24	8.35
Wetted Perimeter (ft)	15.41	11.61	8.96
Hydraulic Radius (ft)	1.79	1.66	0.93
Begin BKF Station	8.03	8.03	13.81
End BKF Station	19.6	13.81	19.6

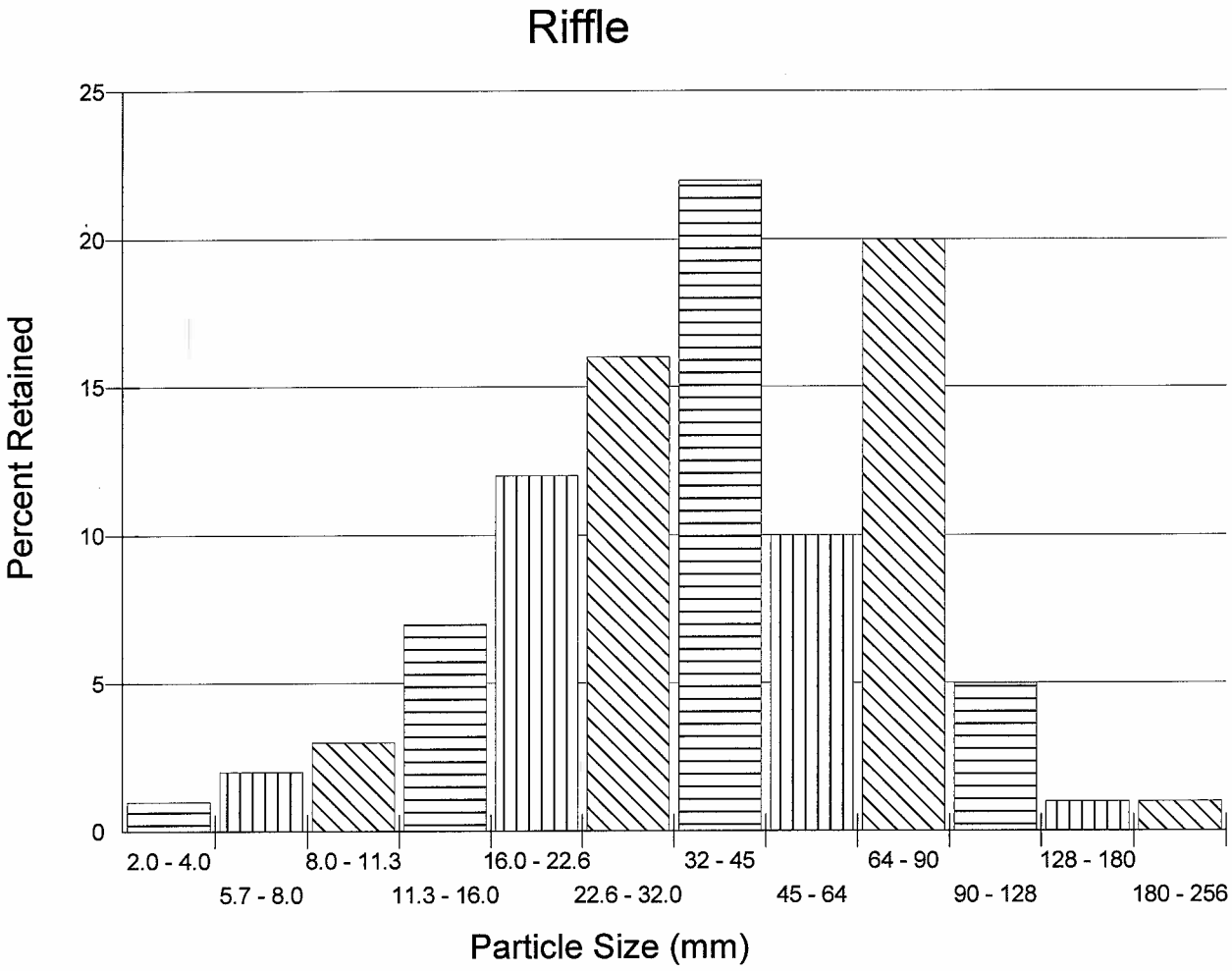
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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

Magruder Branch Reference Reach Team 2 9/18/2007

TEAM 2
9/18/07



TEAM 2
9/18/07

Magruder Branch Reference Reach Team 2 — RIVERMORPH PARTICLE SUMMARY — 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Sample Name: Riffle
Survey Date: 09/18/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	0	0.00	0.00
0.50 - 1.0	0	0.00	0.00
1.0 - 2.0	0	0.00	0.00
2.0 - 4.0	1	1.00	1.00
4.0 - 5.7	0	0.00	1.00
5.7 - 8.0	2	2.00	3.00
8.0 - 11.3	3	3.00	6.00
11.3 - 16.0	7	7.00	13.00
16.0 - 22.6	12	12.00	25.00
22.6 - 32.0	16	16.00	41.00
32 - 45	22	22.00	63.00
45 - 64	10	10.00	73.00
64 - 90	20	20.00	93.00
90 - 128	5	5.00	98.00
128 - 180	1	1.00	99.00
180 - 256	1	1.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	17.65
D35 (mm)	28.48
D50 (mm)	37.32
D84 (mm)	78.3
D95 (mm)	105.2
D100 (mm)	255.99
Silt/Clay (%)	0
Sand (%)	0
Gravel (%)	73
Cobble (%)	27
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

9/18/07 Team 2

Magruder Branch Reference Reach Team 2

RIVERMORPH PARTICLE SUMMARY 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Sample Name: Reach
Survey Date: 09/18/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	11	11.00	11.00
0.062 - 0.125	0	0.00	11.00
0.125 - 0.25	4	4.00	15.00
0.25 - 0.50	0	0.00	15.00
0.50 - 1.0	1	1.00	16.00
1.0 - 2.0	0	0.00	16.00
2.0 - 4.0	1	1.00	17.00
4.0 - 5.7	5	5.00	22.00
5.7 - 8.0	4	4.00	26.00
8.0 - 11.3	6	6.00	32.00
11.3 - 16.0	12	12.00	44.00
16.0 - 22.6	21	21.00	65.00
22.6 - 32.0	9	9.00	74.00
32 - 45	9	9.00	83.00
45 - 64	8	8.00	91.00
64 - 90	3	3.00	94.00
90 - 128	5	5.00	99.00
128 - 180	1	1.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

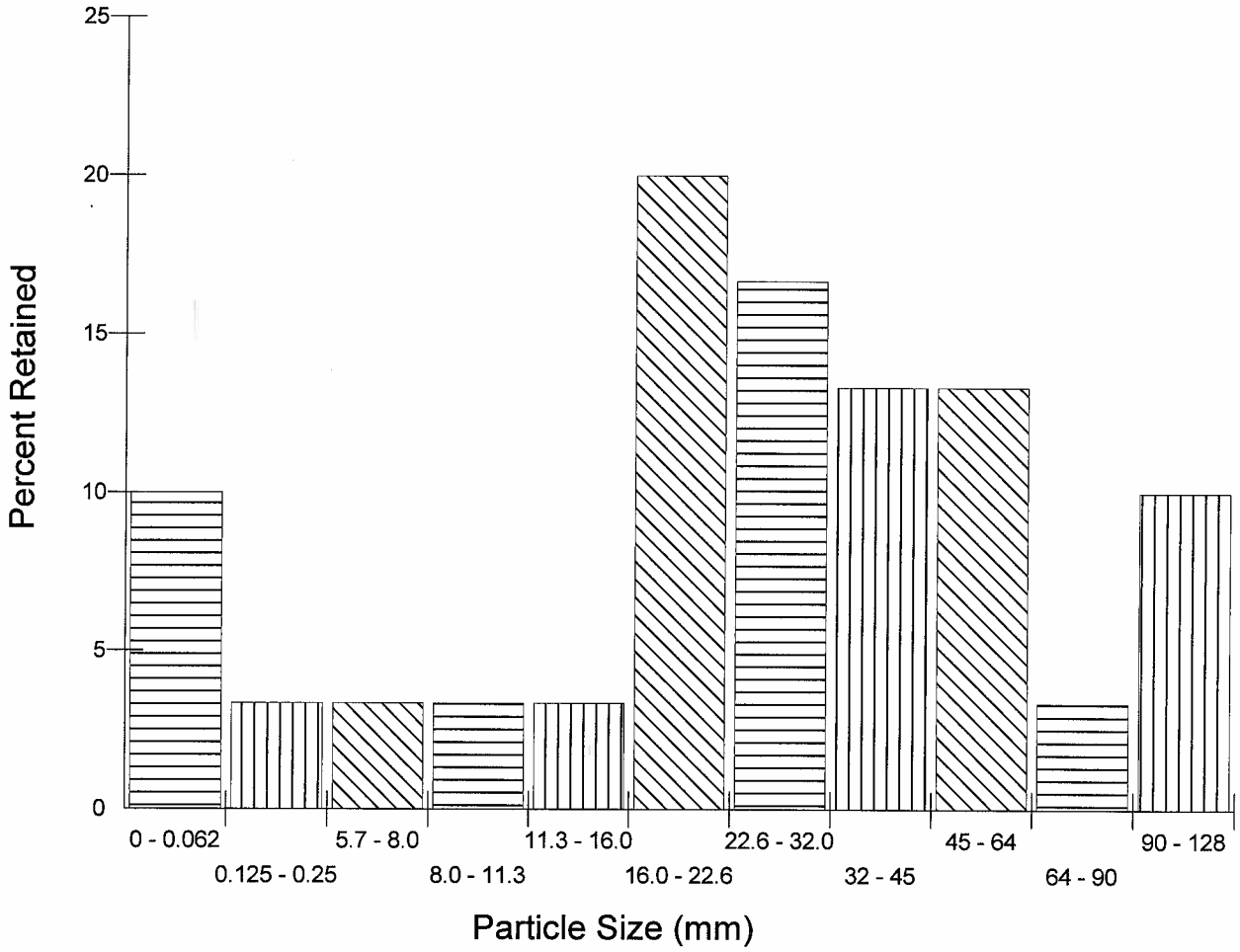
D16 (mm)	1
D35 (mm)	12.48
D50 (mm)	17.89
D84 (mm)	47.38
D95 (mm)	97.6
D100 (mm)	179.99
Silt/Clay (%)	11
Sand (%)	5
Gravel (%)	75
Cobble (%)	9
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

Magruder Branch Reference Reach Team 2 9/18/2007

TEAM 2
9/18/07

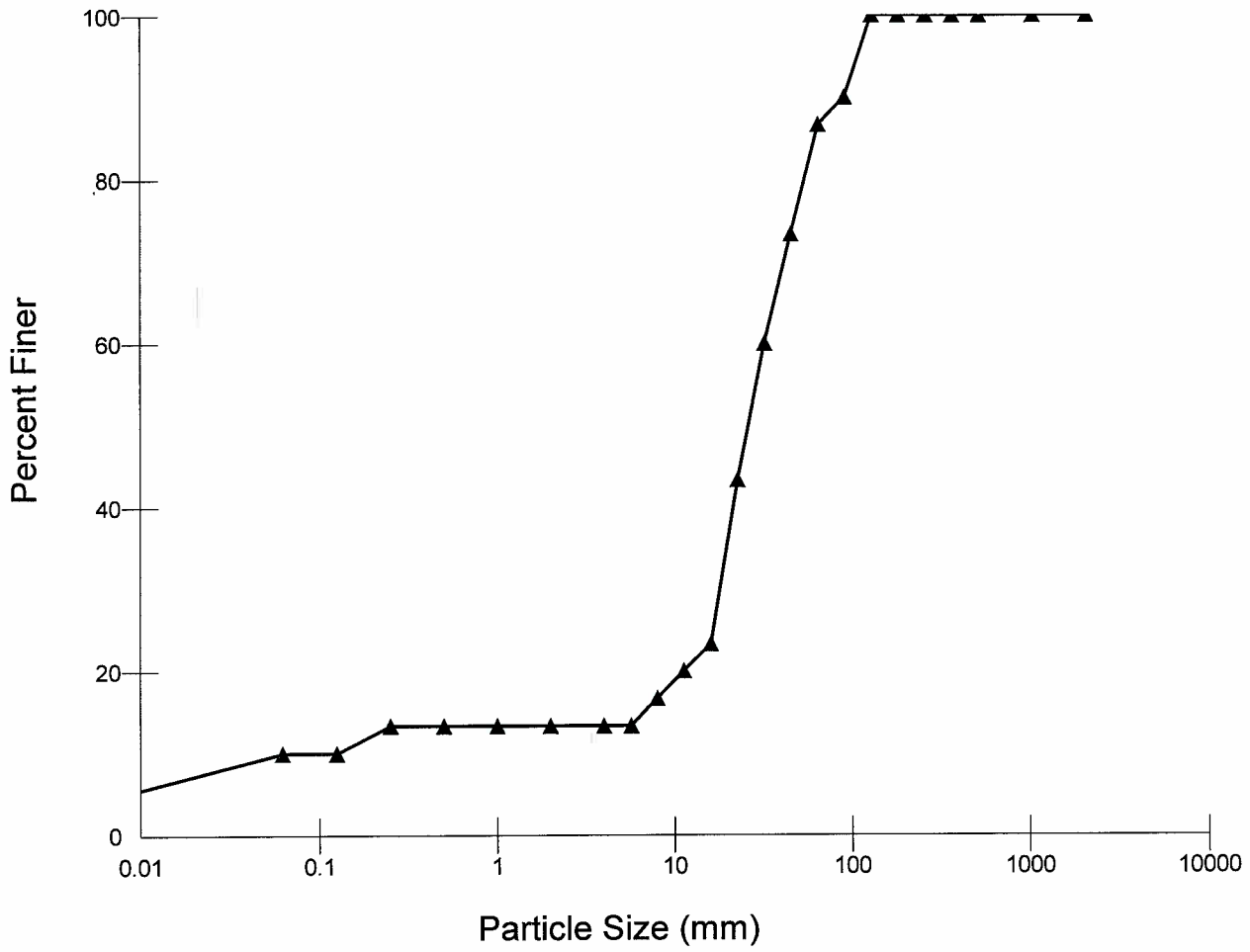
REACH/RIFFLE



Magruder Branch Reference Reach Team 2 9/18/2007

TEAM 2
9/18/07

REACH/RIFFLE



Team 2
9/18/07

RIVERMORPH PARTICLE SUMMARY

Magruder Branch Reference Reach Team 2 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Sample Name: Reach/Riffle
Survey Date: 09/18/2007

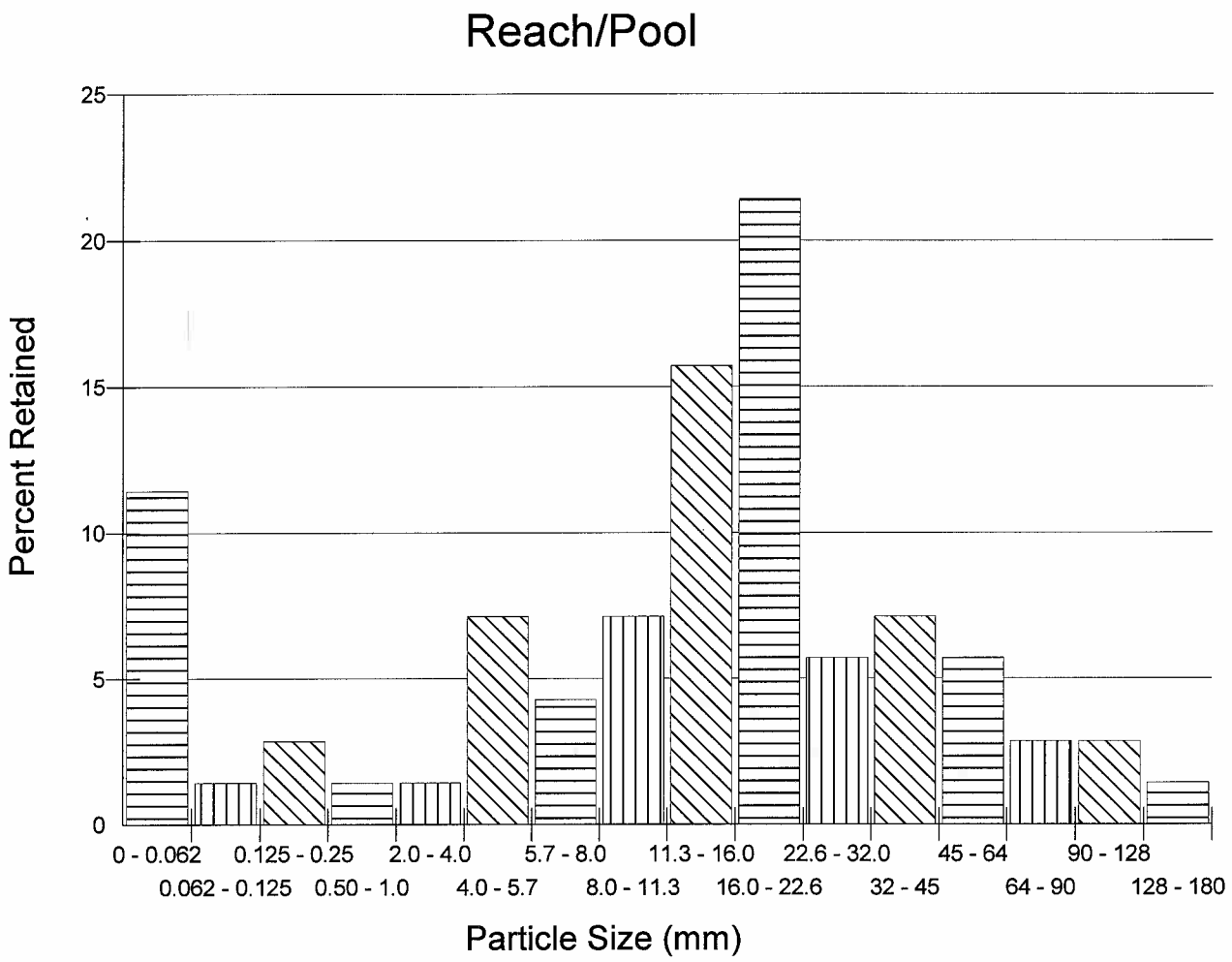
Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	10.00	10.00
0.062 - 0.125	0	0.00	10.00
0.125 - 0.25	1	3.33	13.33
0.25 - 0.50	0	0.00	13.33
0.50 - 1.0	0	0.00	13.33
1.0 - 2.0	0	0.00	13.33
2.0 - 4.0	0	0.00	13.33
4.0 - 5.7	0	0.00	13.33
5.7 - 8.0	1	3.33	16.67
8.0 - 11.3	1	3.33	20.00
11.3 - 16.0	1	3.33	23.33
16.0 - 22.6	6	20.00	43.33
22.6 - 32.0	5	16.67	60.00
32 - 45	4	13.33	73.33
45 - 64	4	13.33	86.67
64 - 90	1	3.33	90.00
90 - 128	3	10.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	7.54
D35 (mm)	19.85
D50 (mm)	26.36
D84 (mm)	60.2
D95 (mm)	109
D100 (mm)	128
Silt/Clay (%)	10
Sand (%)	3.33
Gravel (%)	73.34
Cobble (%)	13.33
Boulder (%)	0
Bedrock (%)	0

Total Particles = 30 (need at least 60).

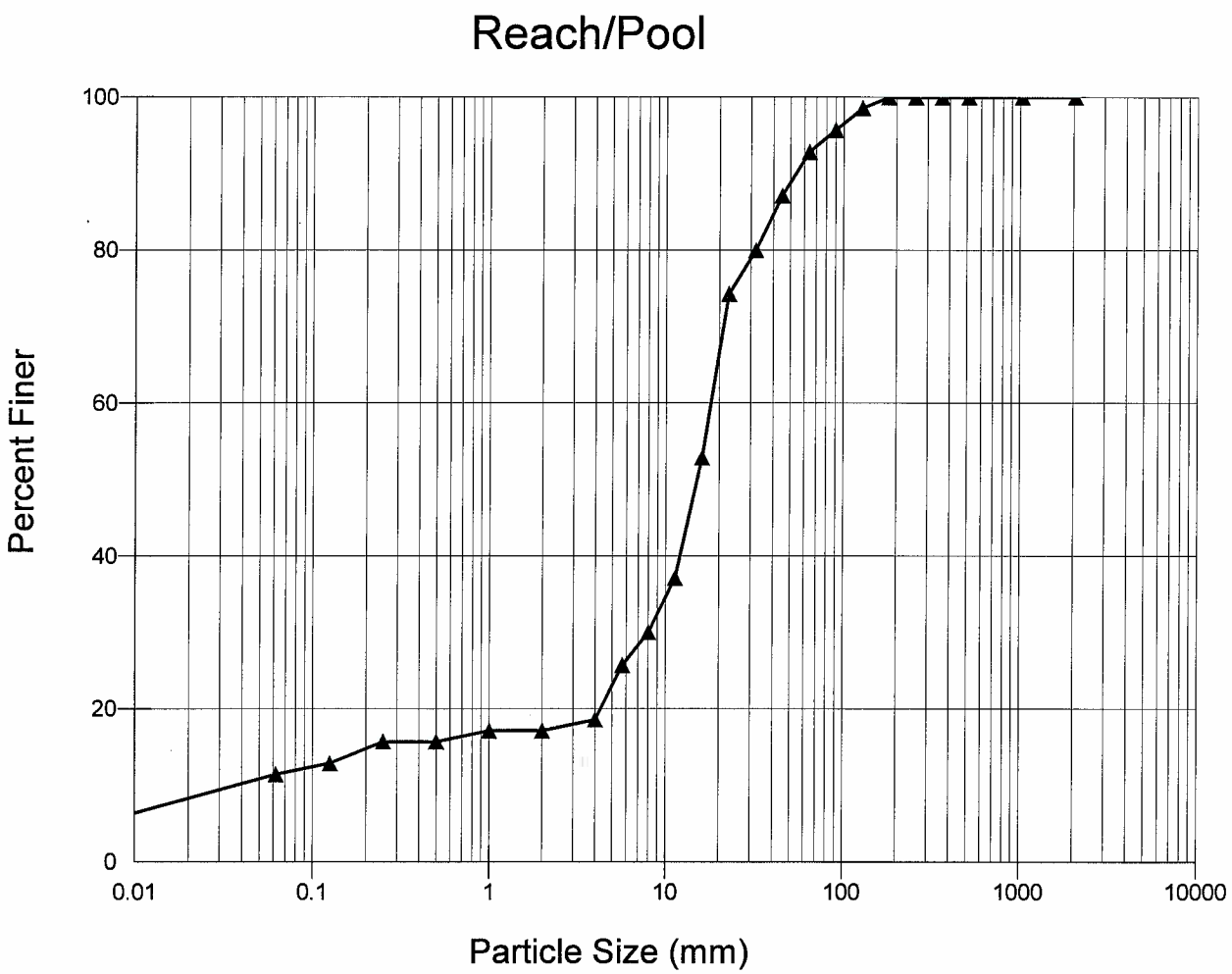
TEAM 2
9/18/07

Magruder Branch Reference Reach Team 2 9/18/2007



Magruder Branch Reference Reach Team 2 9/18/2007

TEAM 2
9/18/07



TEAM 2
9/18/07

RIVERMORPH PARTICLE SUMMARY

Magruder Branch Reference Reach Team 2 9/18/2007

River Name: Macgruder
Reach Name: Final Reach
Sample Name: Reach/Pool
Survey Date: 09/19/2007

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	8	11.43	11.43
0.062 - 0.125	1	1.43	12.86
0.125 - 0.25	2	2.86	15.71
0.25 - 0.50	0	0.00	15.71
0.50 - 1.0	1	1.43	17.14
1.0 - 2.0	0	0.00	17.14
2.0 - 4.0	1	1.43	18.57
4.0 - 5.7	5	7.14	25.71
5.7 - 8.0	3	4.29	30.00
8.0 - 11.3	5	7.14	37.14
11.3 - 16.0	11	15.71	52.86
16.0 - 22.6	15	21.43	74.29
22.6 - 32.0	4	5.71	80.00
32 - 45	5	7.14	87.14
45 - 64	4	5.71	92.86
64 - 90	2	2.86	95.71
90 - 128	2	2.86	98.57
128 - 180	1	1.43	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)
D35 (mm)
D50 (mm)
D84 (mm)
D95 (mm)
D100 (mm)
Silt/Clay (%)
Sand (%)
Gravel (%)
Cobble (%)
Boulder (%)
Bedrock (%)

Total.

TEAM 2
9/18/07

Magruder Branch Reference Reach Team 2 9/18/2007

RIVERMORPH PARTICLE SUMMARY

River Name: Macgruder
Reach Name: Final Reach
Sample Name: Bar
Survey Date: 09/19/2007

SIEVE (mm)	NET WT
31.5	1.2
16	6.1
8	6.6
4	5.6
2	4.3
PAN	10.3

D16 (mm)	0
D35 (mm)	3.04
D50 (mm)	6.36
D84 (mm)	24.31
D95 (mm)	49.3
D100 (mm)	78
Silt/Clay (%)	0
Sand (%)	28.77
Gravel (%)	69.46
Cobble (%)	1.77
Boulder (%)	0
Bedrock (%)	0

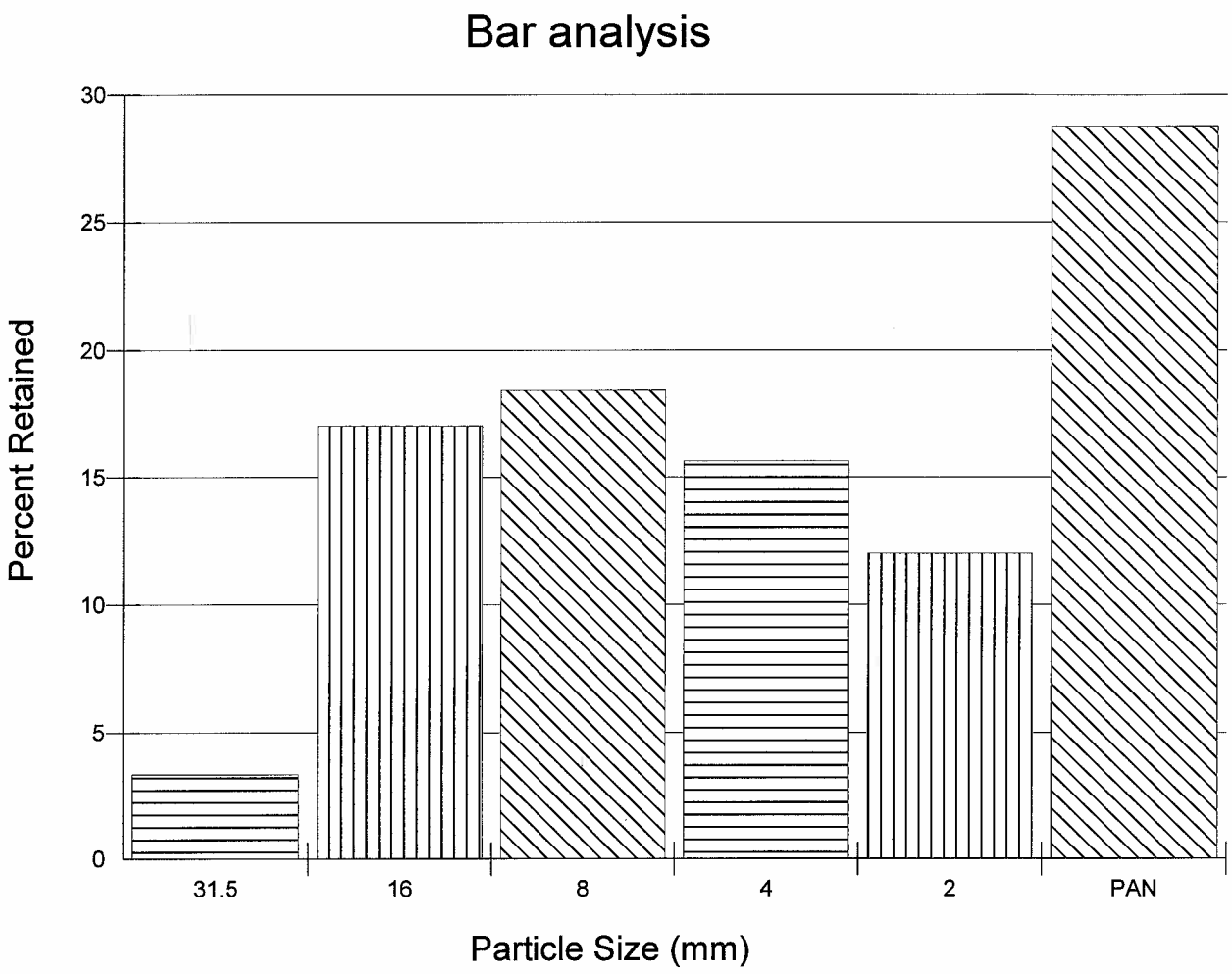
Total Weight = 35.8000.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	78	1.4
Particle 2:	54	0.3

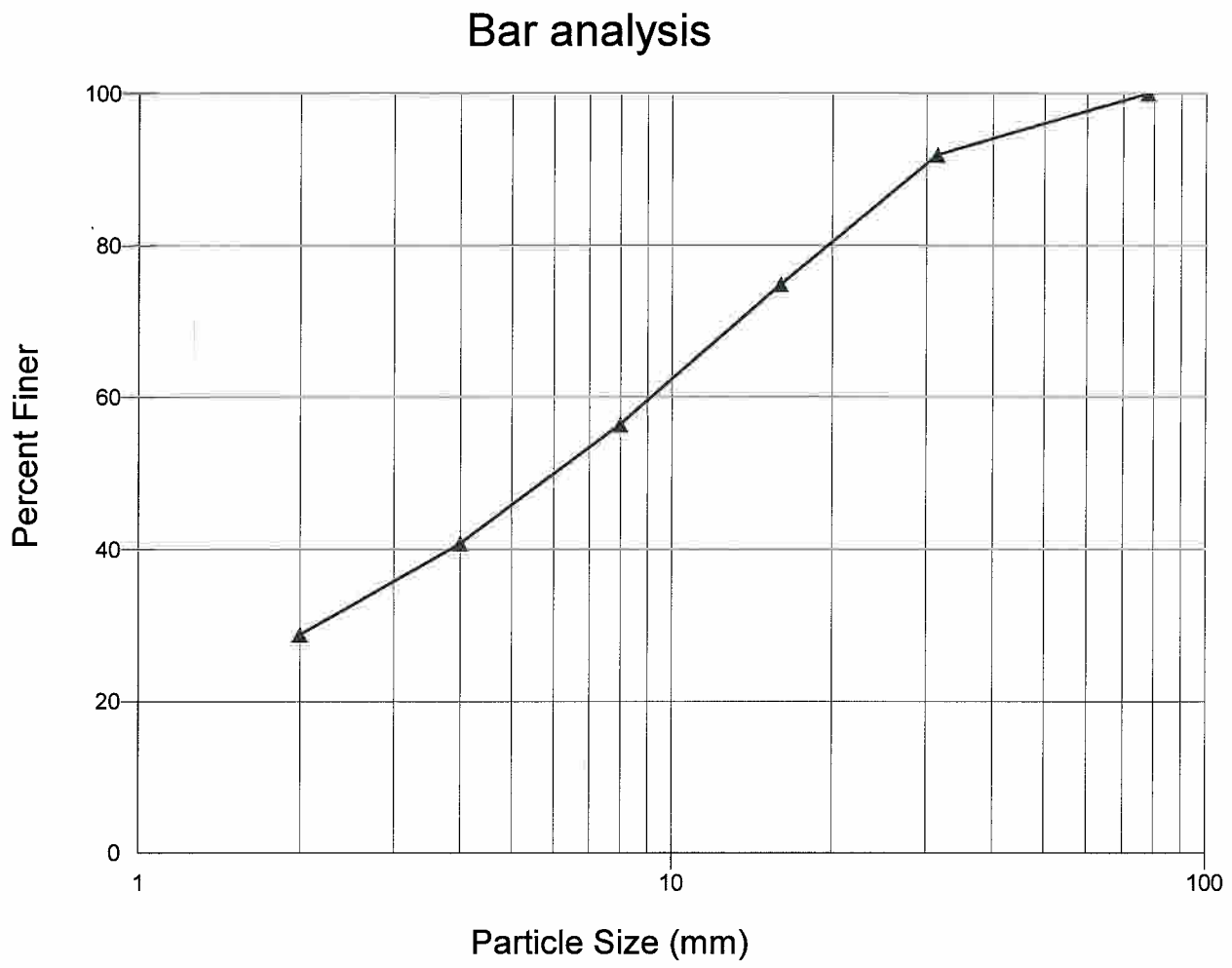
Magruder Branch Reference Reach Team 2 9/18/2007

TEAM 2
9/18/07



Magruder Branch Reference Reach Team 2 9/18/2007

TEAM 2
9/18/07



TEAM 2
9/18/07

River Assessment and Monitoring: Reference Reach

1st Field Day

Worksheet A-17. Bar sample data collection and sieve analysis form.

Point / Side BAR-BULK MATERIALS SAMPLE DATA: Size Distribution Analysis

Observers:

Stream: Macgruder

Location: Reach 2

Date:

Subsamples	0		2		4		8		16		32		64		128		256		512
	Catch Pan or BUCKET		Sieve SIZE 2 mm		Sieve SIZE 4 mm		Sieve SIZE 8 mm		Sieve SIZE 16 mm		Sieve SIZE 32 mm		Sieve SIZE 64 mm		Sieve SIZE 128 mm		Sieve SIZE 256 mm		
	Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		Tare weight		
	2.1		1.9		1.9		1.9		1.9		1.9								
	Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		Sample weights		
	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	
1		12.4		6.2		7.5		8.5		8		3.1							
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Net wt. total		10.3		4.3		5.6		6.6		6.1		1.2							35.8
% Grand total																			
Accum. % =<																			

SURFACE MATERIALS DATA
(Two largest particles)

No.	Dia.	WT.
1	78	1.4
2	54	.3

Bucket + materials weight	
Bucket tare weight	
Materials weight	
Materials less than:	mm

Be sure to add separate material weights to grand total

GRAND TOTAL SAMPLE WEIGHT

Sample location notes

Sample location sketch

Magruder Branch Reference Reach Team 2 9/18/2007

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TEAM 2
9/18/07

Worksheet 5-6. Riparian vegetation composition/density used for channel stability assessment.

Stream: Macgruder Branch		Location: Reach 2	
Observers: Group 2	Pseudo Reference reach X	Disturbed (impacted reach)	Date: 9/18/2007
Existing species composition: mid to late successional Tulip-poplar forest		Potential species composition: Late successional hardwood forest	

	Riparian cover categories	Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	85	40	Tulip-poplar	40
				Red Maple	20
				Black Walnut	40
					100%
2. Understory	Shrub layer		40	Ironwood	45
				Spice bush	45
				Northern Red Oak	5
				Multiflora rose	5
					100%
3. Ground level	Herbaceous		10	Japanese Stiltgrass (RB)	30
				Nettle spp. (RB)	30
				Garlic Mustard (RB)	30
				smartweed (bars)	10
					100%
	Leaf or needle litter		5		
	Bare ground		5		
			Column total = 100%		

*Based on crown closure.
**Based on basal area to surface area.

Remarks:
Condition, vigor and/or usage of existing reach:

Mid to late successional tulip-poplar dominated forest with dense understory/shrub layer. Forest health is good. Riparian buffer is thin (5-40) on the right bank because of mowing. Herbaceous layer is generally limited to the right bank where disturbed, and on top of bars.

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9/18/07

b. Flow Regime

Worksheet A-5. Flow Regime variables that influence channel characteristics, sediment regime and biological interpretations.

FLOW REGIME

Stream: Macgruder Branch Location: Reach 1

Observers: Group 2 Date: September 18, 2007

List ALL COMBINATIONS that APPLY.....	P2							

General Category

E	Ephemeral stream channels: flows only in response to precipitation. Often used in conjunction with intermittent.
S	Subterranean stream channel: flows parallel to and near the surface for various seasons - a sub-surface flow that follows the stream bed.
I	Intermittent stream channel: one that flows only seasonally or sporadically. Surface sources involve springs, snowmelt, artificial controls, etc. Often this term is associated with flows that reappear along various locations of a reach then run subterranean.
P	Perennial stream channels: surface water persists yearlong.

Specific Category

1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.
4	Streamflow regulated by glacial melt.
5	Ice flows/ice torrents from ice dam breaches.
6	Alternating flow/backwater due to tidal influence.
7	Regulated streamflow due to diversions, dam release, dewatering, etc.
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.
9	Rain-on-snow generated runoff.

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c. Stream Size and Order

Worksheet A-6. Stream size/order categories for stratification by stream type.

Stream Size and Order			
Stream: Macgruder Branch			
Location: 2			
Observers: Group 2			
Date: September 18, 2007			
Stream Size Category and Order ☞			S-4
Category	STREAM SIZE: Bankfull width		Check (✓) appropriate category
	meters	feet	
S-1	0.305	<1	☐
S-2	0.3 – 1.5	1 – 5	☐
S-3	1.5 – 4.6	5 – 15	☐
S-4	4.6 – 9	15 – 30	☑
S-5	9 – 15	30 – 50	☐
S-6	15 – 22.8	50 – 75	☐
S-7	22.8 – 30.5	75 – 100	☐
S-8	30.5 – 46	100 – 150	☐
S-9	46 – 76	150 – 250	☐
S-10	76 – 107	250 – 350	☐
S-11	107 – 150	350 – 500	☐
S-12	150 – 305	500 – 1000	☐
S-13	>305	>1000	☐
Stream Order			
Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).			

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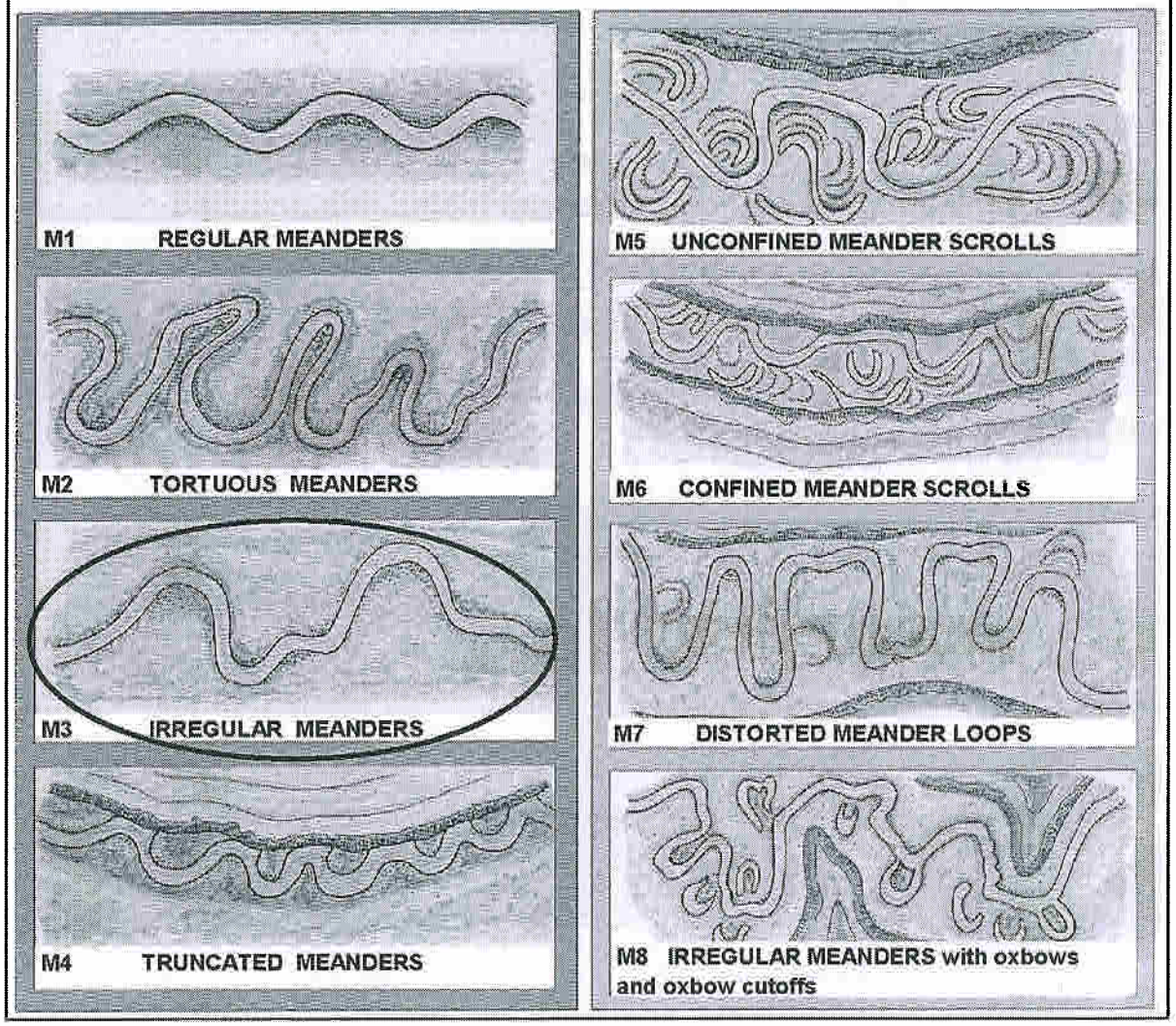
d. Meander Patterns

Worksheet A-7. Meander pattern relations used for interpretations for river stability.

Meander Patterns					
Stream: Macgruder Branch	Reach: 2				
Observers: GROUP 2	Date: September 19, 2007				
List ALL CATEGORIES that APPLY ☞	M3				

Various Meander Pattern variables modified from Galay et al. (1973)



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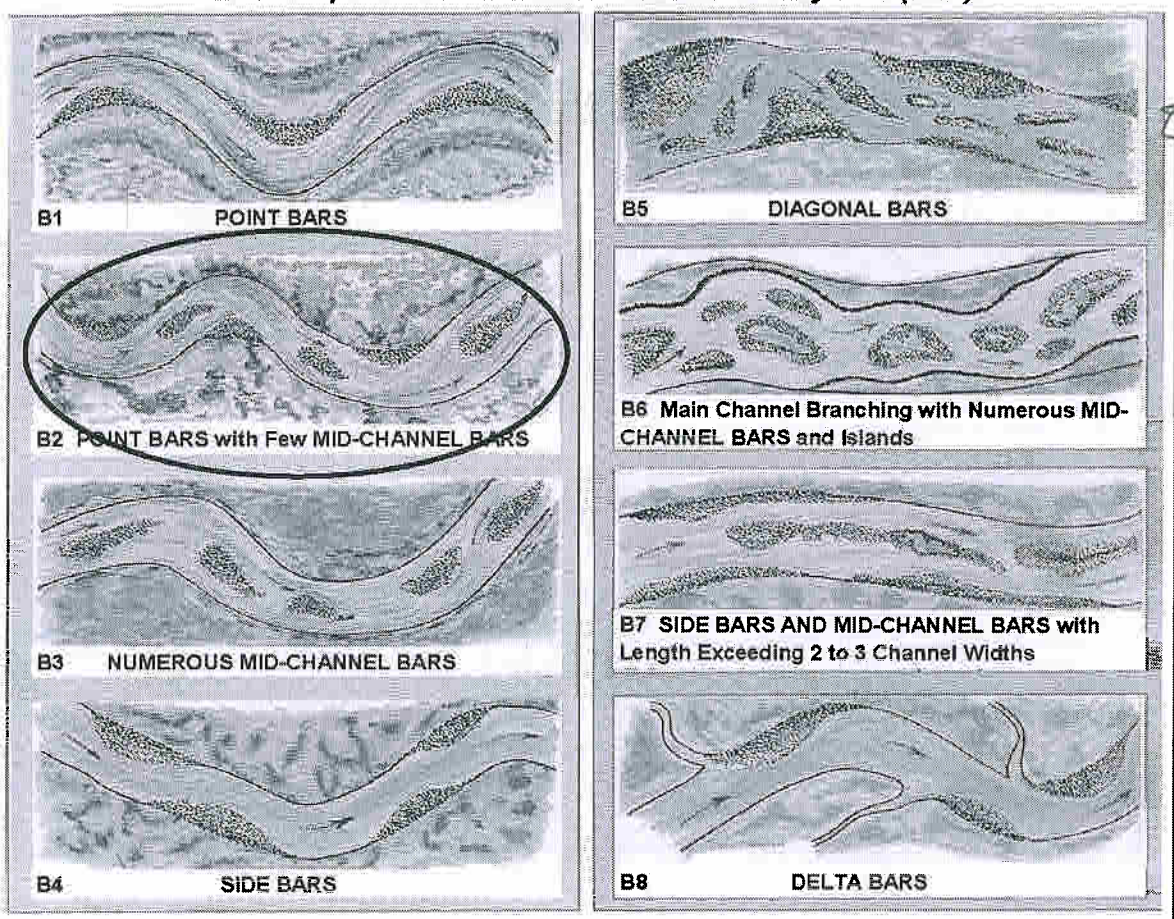
e. Depositional Patterns

Worksheet A-8. Depositional patterns used for stability assessment interpretations.

Depositional Patterns					
Stream: Macgruder Branch	Reach: 2				
Observers: Group 2	Date: September 19, 2007				
List ALL CATEGORIES that APPLY ☞	B2				

Various Depositional Features modified from Galay et al. (1973)



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f. Channel Blockages

Worksheet A-9. Various categories of in-channel debris, dams and/or channel blockages used to evaluate channel stability.

Channel Blockages		
Stream: Macgruder Branch	Location: Reach 1	
Observers: Group 2	Date: September 18, 2007	
Description/extent	**Materials, which upon placement into the active channel or flood-prone area, may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.**	**Check (✓) all that apply**
D1 None	Minor amounts of small, floatable material.	☐
D2 Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.	☐
D3 Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	✓
D4 Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.	✓
D5 Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.	☐
D6 Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7 Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8 Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9 Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.	☐
D10 Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

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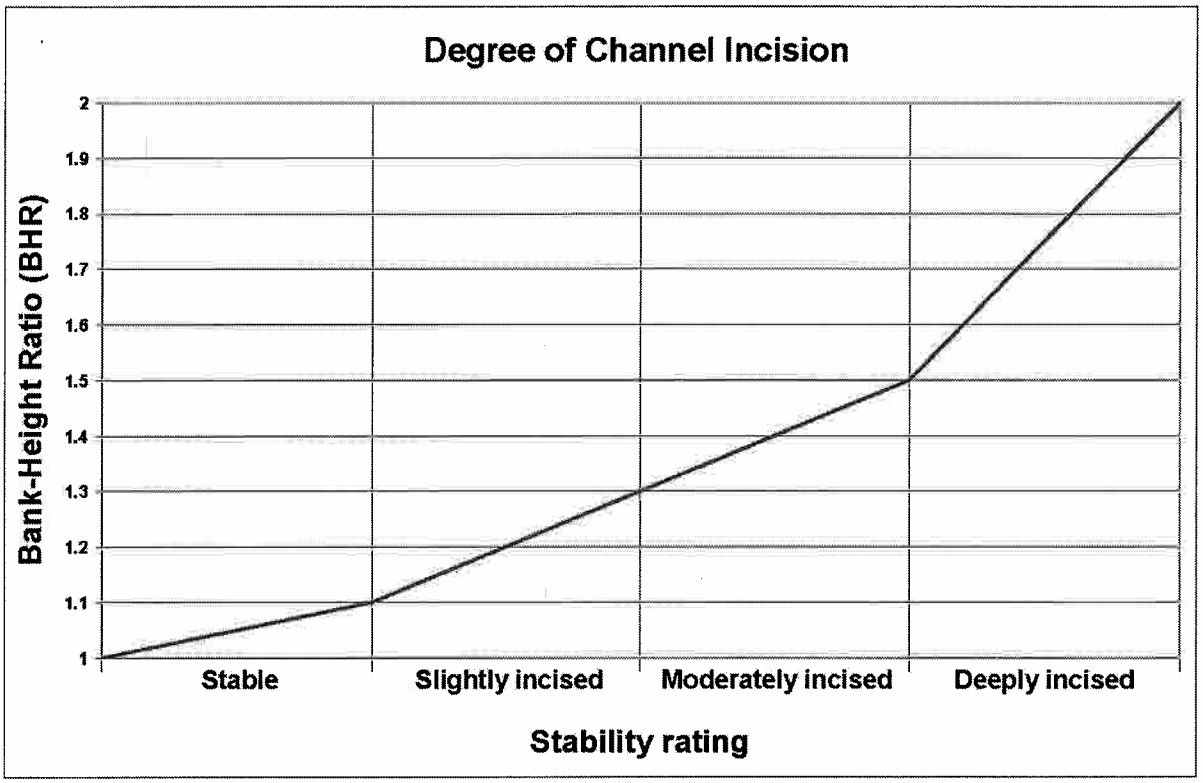
g. Degree of Channel Incision (Bank-Height Ratio) (*continued*)

Worksheet A-10. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings to determine degree of channel incision.

Degree of Channel Incision			
Low Bank Height:	1.72	Bank-Height Ratio:	1.00
Max Bankfull Depth:	1.72		
Degree of Channel Incision Stability Rating	Stable		



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A-11 Magruder Branch Reference Reach Team 2 9/18/2007

RIVERMORPH PEANKUCH SUMMARY

TEAM 2 9/18/07

River Name: Macgruder
Reach Name: Final Reach
Survey Date: 09/19/2007

Upper Bank

Landform Slope:	3
Mass Wasting:	3
Debris Jam Potential:	6
Vegetative Protection:	6

Lower Bank

Channel Capacity:	2
Bank Rock Content:	6
Obstructions to Flow:	5
Cutting:	6
Deposition:	4

Channel Bottom

Rock Angularity:	1
Brightness:	2
Consolidation of Particles:	6
Bottom Size Distribution:	8
Scouring and Deposition:	12
Aquatic Vegetation:	4

Channel Stability Evaluation

Sediment Supply:	
Stream Bed Stability:	
W/D Condition:	
Stream Type:	C4

Rating - 74
Condition - Good

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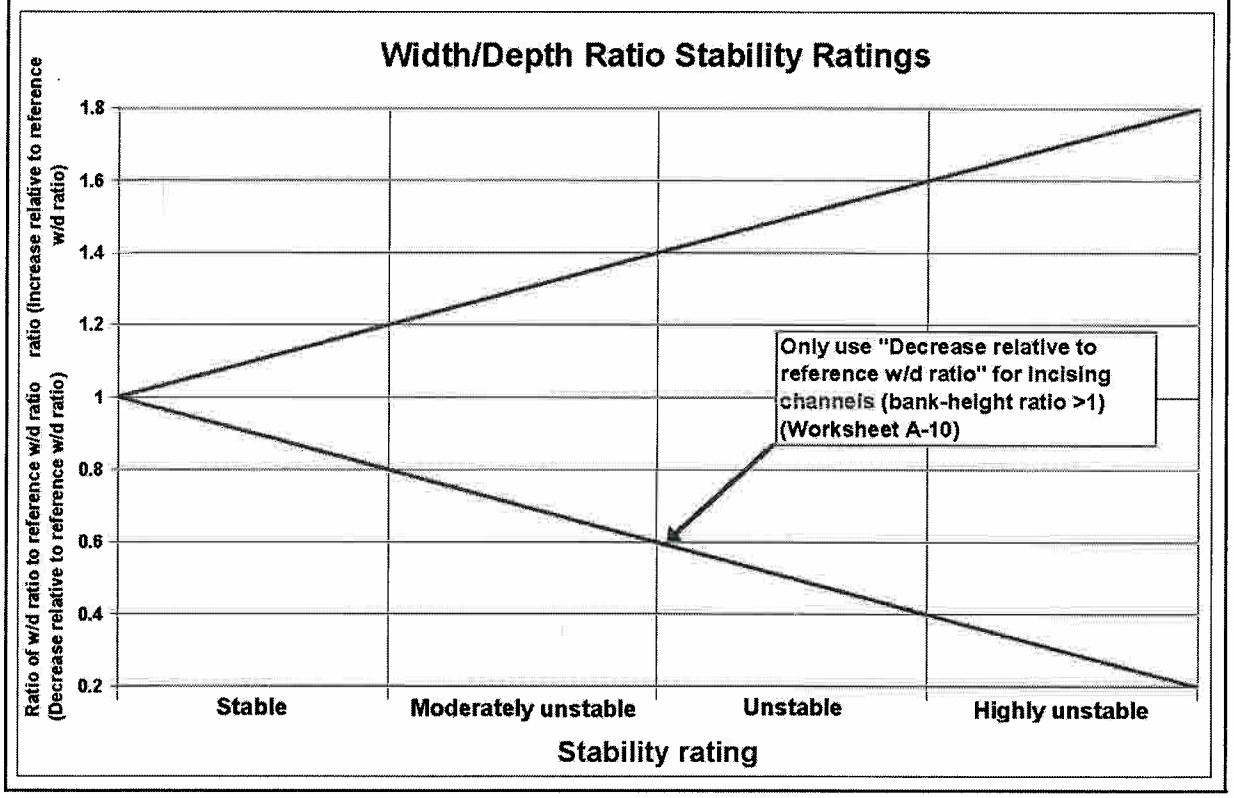
i. Width/Depth Ratio State (*Continued*)

Worksheet A-12. Width/depth ratio state stability rating.

Width/Depth Ratio State			
Existing Width/Depth Ratio:	19.26	Ratio of existing w/d to reference w/d:	1.28
Reference Width/Depth Ratio:	15.0		
Width/Depth Ratio State Stability Rating ☞	Moderately Unstable		



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j. Degree of Channel Confinement (Meander Width Ratio (MWR)) (*Continued*)

Forgot to collect
Did not have

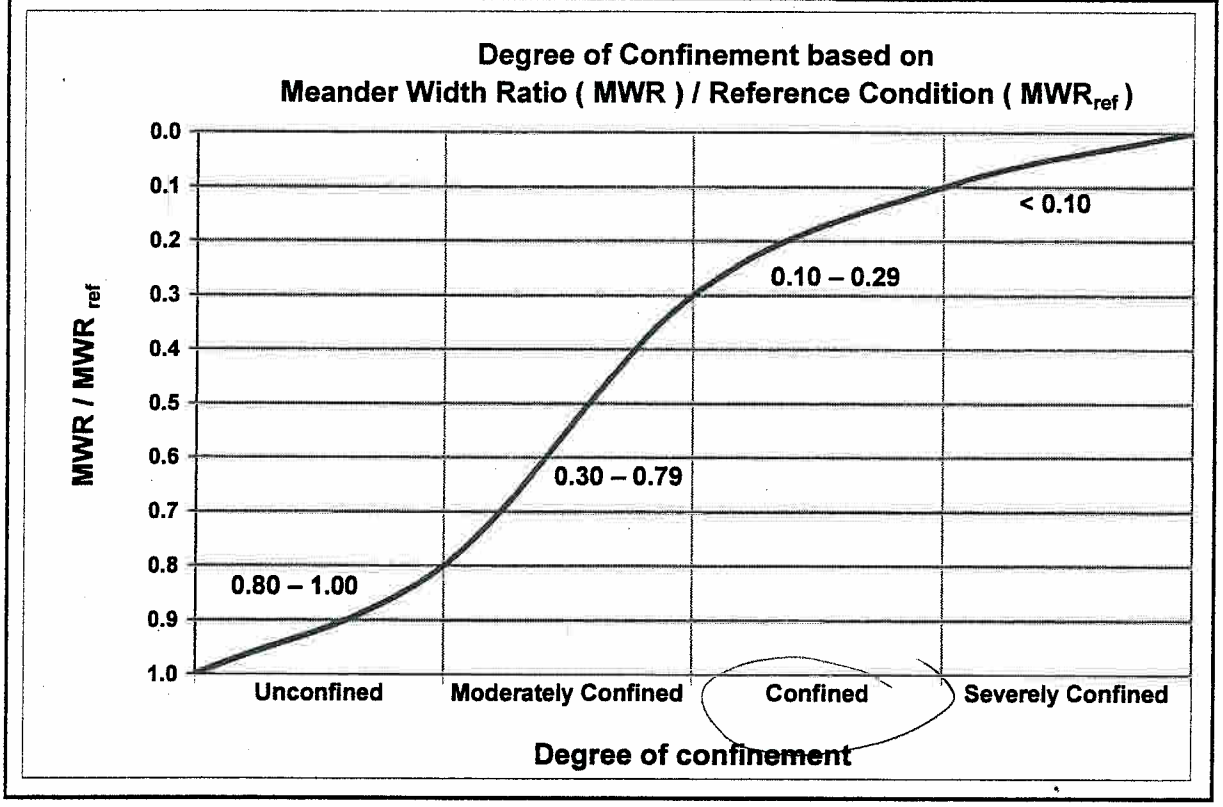
Worksheet A-13. Degree of confinement stability ratings based on meander width ratio divided by reference meander width ratio.

check in packet forms

update w/ all forms

Degree of Confinement			
Existing Meander Width Ratio (MWR):	2.77	Ratio of MWR to MWRref:	.22
Reference Meander Width Ratio (MWR_{ref}):	125	— from figure A7 (A25)	
Degree of Confinement Stability Rating			

date



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TEAM 2
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RIVERMORPH BEHI SUMMARY REPORT

Magruder Branch Reference Reach Team 2 9/18/2007

River Name: Macgruder
Reach Name: Final Reach

Table 1. Bank Identification Summary

Bank	Name
1	Bank1
2	Bank2r
3	Bank3r
4	Bank4r
5	Bznk5r
6	Bank6r
7	Bank7r
8	Bank8l
9	Bank9l
10	Bank10l
11	Bank11l

Table 2. Predicted Annual Bank Erosion Rates

Bank	BEHI Numeric Rating	BEHI Adjective Rating	NBS Adjective Rating	Length ft	Loss cu yds/yr	Loss tons/yr
1	0	Moderate	Low	10	0.1	0.13
2	0	Moderate	High	36	3.52	4.58
3	0	Low	Low	19	0.03	0.04
4	0	Moderate	Very High	21	1.28	1.66
5	0	Moderate	Moderate	19	0.51	0.66
6	0	Low	Low	21	0.02	0.03
7	0	Low	Moderate	31	0.31	0.4
8	0	Moderate	Low	14	0.04	0.05
9	0	Low	Very High	5	0.22	0.29
10	0	Moderate	Moderate	50	1.67	2.17
11	0	Low	Low	34	0.07	0.09
Totals				260	7.77	10.1

Total Reach Ln: 199 Total Loss (tons/yr) per ft of Reach: 0.0508

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Worksheet A-19. Stability ratings for corresponding successional stage shifts of stream types. Check (✓) the appropriate stability rating.

Stream: Macgruder	Stream Type: C4
Location: Group 2	Valley Type: VIII
Observers: SHARP	Date: August 30, 2006
Stream type changes due to successional stage shifts (Figure A-29)	**Stability rating (check appropriate rating)**
Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	☒ Stable "C to C"
(E→C)	☐ Moderately unstable
(G→F), (F→D), (C→F)	☑ Unstable
(C→D), (B→G), (D→G), (C→G), (E→G)	☐ Highly unstable

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Worksheet A-3. Bankfull velocity and discharge estimates. Crew #2

Bankfull VELOCITY / DISCHARGE Estimates

Site	MacGruder Branch	Location	
Date	9/18/2007	Stream Type	C4
Valley Type	VIII		
Observers		HUC	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-section AREA	31	A_{bkf} (SqFt)	Bankfull Mean DEPTH	1.27	D_{bkf} (Ft)
Bankfull WIDTH	24.5	W_{bkf} (Ft)	Wetted PERIMETER ~ $2 * d_{bkf} + W_{bkf}$	27.04	W_{Pbkf} (Ft)
D84 @ Riffle	78.3	Dia. (mm)	D84 mm / 304.8 =	.2569	D84 (Ft)
Bankfull SLOPE	.00874	S (Ft / Ft)	Hydraulic RADIUS A_{bkf} / W_{Pbkf}	1.15	R (Ft)
Gravitational Acceleration	32.2	g (Ft /Sec^2)	Relative Roughness R (ft) / D84 (ft)	4.476	
Drainage AREA	1.3	DA (SqMi)	Shear Velocity $u^* = \sqrt{gRS}$	.6382	u* (Ft / Sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\,2.83 + 5.66\mathrm{Log}\{R / D84\}\,]u^*$	3.7	Ft / Sec	114.5	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness. $u = 1.4895*R^{2/3}*S^{1/2}/n$ n = .0385	3.96	Ft / Sec	122.8	CFS
2. Roughness Coefficient: $u = 1.4895*R^{2/3}*S^{1/2}/n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39S^{.38}R^{-.16}$ n = .063 Note: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder-dominated stream systems; i.e., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.	2.42	Ft / Sec	75.02	CFS
2. Roughness Coefficient: $u = 1.4895*R^{2/3}*S^{1/2}/n$ c) Manning's 'n' from Stream Type n = .040	3.80	Ft / Sec	117.8	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach	3.73	Ft / Sec	115.9	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) Red Reach Book	2.90	Ft / Sec	90	CFS
4. Continuity Equations: a) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge Q =		Ft / Sec		CFS
4. Continuity Equations: b) USGS Gage Data $u = Q / A$		Ft / Sec		CFS

Options for using the D84 term in the **relative roughness relation** (R/D84), 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 feet) for the D84 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 average boulder protrusion height (h_{bo} in feet) for the D84 term in estimation method 1.

Option 3: For **bedrock-dominated** channels: measure several **"protrusion heights"** (h_{br}) of rock separations/steps/[illegible] above channel bed elevations. Substitute an average bedrock protrusion height (h_{br} in feet) for the D84 term in estimation method 1.

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Worksheet A-18. Sediment competence calculation form to assess bed stability.

Stream: Magruder Branch			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
Enter required information					
37.32	D_{50}	Riffle bed material D_{50} (mm)			
6.39	$\hat{D}_{50}$	Bar sample D_{50} (mm)			
.256	D_{max}	Largest particle from bar sample (ft)	78	(mm)	304.8 mm/ft
.008	S	Existing bankfull water surface slope (ft/ft)			
1.27	d	Existing bankfull mean depth (ft)			
1.65	γ_s	Submerged specific weight of sediment			

Select the appropriate equation and calculate critical dimensionless shear stress				
5.8	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$	
2.1	D_{max}/D_{50} (78)	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$	
.018 .019	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:	1.

Calculate bankfull mean depth required for entrainment of largest particle in bar sample			
.95 1.0	d	Required bankfull mean depth (ft)	$d = \frac{\tau^* \gamma_s D_{max}}{S}$
Check: ☐ Stable ☐ Aggrading ☒ Degrading			

Calculate bankfull water surface slope required for entrainment of largest particle in bar sample			
.005	S	Required bankfull water surface slope (ft/ft)	$S = \frac{\tau^* \gamma_s D_{max}}{d_{existing}}$
Check: ☐ Stable ☐ Aggrading ☒ Degrading			

Sediment competence using dimensional shear stress 62.4	
.57	Bankfull shear stress $\tau = \gamma dS$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d) 1.15
100	Moveable particle size (mm) at bankfull shear stress **(Figure A-28)**
.39	Predicted shear stress required to initiate movement of D_{max} (mm) **(Figure A-28)**
1.14	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$
.007	Predicted slope required to initiate movement of D_{max} (mm). $S = \frac{\tau}{\gamma d}$

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Worksheet A-20. Lateral stability prediction summary.

Stream: Macgruder Branch			Stream Type: C4		
Location: 2			Valley Type: VIII		
Observers: Group 2			Date: September 18, 2007		
Lateral stability criteria (choose one stability category for each criterion 1–5)	**Lateral stability categories**				**Selected points (from each row)**
	Stable	**Moderately unstable**	**Unstable**	**Highly unstable**	
1 **W/d ratio state (Worksheet A-12)**	< 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	> 1.6 (8)	4
2 **Depositional pattern (Worksheet A-8)**	~~B1, B2~~ (1)	B4, B8 (2)	B3 (3)	B5, B6, B7 (4)	~~1~~ 4
3 **Meander pattern (Worksheet A-7)**	M1, M3, M4 (1)		M2, M5, M6, M7, M8 (3)		1
4 **Dominant BEHI / NBS (Worksheet A-16)**	L/VL, L/L, L/M, L/H, L/VH, M/VL (2)	M/L, M/M, M/H, L/Ex, H/L (4)	M/VH, M/Ex, H/L, H/M, H/H, VH/VL, Ex/VL (6)	H/H, H/Ex, Ex/M, Ex/H, Ex/VH, VH/VH, Ex/Ex (8)	4
5 **Degree of confinement (MWR / MWR_{ref}) (Worksheet A-13)**	0.8 – 1.0 (1)	0.3 – 0.79 (2)	0.1 – 0.29 (3)	< 0.1 (4)	3
				Total points	~~13~~ 16
	Lateral stability category point range				
Overall lateral stability category (use total points and check stability rating)	**Stable 7 – 9** ☐	**Moderately unstable 10 – 12** ☐	**Unstable 13 – 21** ✓	**Highly unstable > 21** ☐	

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Team 2
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River Assessment and Monitoring: Reference Reach 1st Field Day

Worksheet A-21. Vertical stability prediction for excess deposition/aggradation.

Stream: Macgruder Branch			Stream Type: C4		
Location: 2			Valley Type: VIII		
Observers: Group 2			Date: September 18, 2007		
Vertical stability criteria (choose one stability category for each criterion 1–6)	**Vertical stability categories for excess deposition / aggradation**				**Selected points** (from each row)
	No deposition	**Moderate deposition**	**Excess deposition**	**Aggradation**	
1 **Sediment competence (Worksheet A-18)**	Sufficient depth and/or slope to transport largest size available (2)	Trend toward insufficient depth and/or slope-slightly incompetent (4)	Cannot move D_{35} of bed material and/or D_{100} of bar material (6)	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size (8)	2
2 **Sediment capacity (POWERSED)**	Sufficient capacity to transport annual load (2)	Trend toward insufficient sediment capacity (4)	Reduction up to 25% of annual sediment yield of bedload and/or suspended (6)	Reduction over 25% of annual sediment yield for bedload and/or suspended (8)	2
3 **W/d ratio state (Worksheet A-12)**	1.0 – 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	>1.6 (8)	4
4 **Stream succession states (Worksheet A-19)**	Current stream type at potential or does not indicate deposition/ aggradation (2)	(E→C) (4)	(C→High w/d C), (B→High w/d B), (C→F) (6)	(C→D), (F→D) (8)	6
5 **Depositional patterns (Worksheet A-8)**	B1 (1)	~~B2, B4~~ (2)	B3, B5 (3)	B6, B7, B8 (4)	~~2~~ 3
6 **Debris / blockages (Worksheet A-9)**	D1, D2, D3 (1)	D4, D7 (2)	D5, D8 (3)	D6, D9, D10 (4)	1
				Total points	~~17~~ 18
	Vertical stability category point range for excess deposition / aggradation				
Vertical stability for excess deposition / aggradation (use total points and check stability rating)	**No deposition** 10 – 14 ☐	**Moderate deposition** 15 – 20 ☑	**Excess deposition** 21 – 30 ☐	**Aggradation** > 30 ☐	

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River Assessment and Monitoring: Reference Reach 1st Field Day

Worksheet A-22. Vertical stability prediction for channel incision/degradation.

Stream: Macgruger Branch			Stream Type: C4		
Location: 2			Valley Type: VIII		
Observers: Group 2			Date: September 18, 2007		
Vertical stability criteria (choose one stability category for each criterion 1–5)	**Vertical stability categories for channel incision / degradation**				**Selected points** (from each row)
	Not incised	**Slightly incised**	**Moderately incised**	**Degradation**	
1 **Sediment competence (Worksheet A-18)**	Does not indicate excess competence (2)	Trend to move larger sizes than D_{100} of bar or > D_{84} of bed (4)	D_{100} of bed moved (6)	Particles much larger than D_{100} of bed moved (8)	4
2 **Sediment capacity (POWERSED)**	Does not indicate excess capacity (2)	~~Slight excess energy, up to 10% increase above reference (4)~~	Excess energy sufficient to increase load up to 50% of annual load (6)	Excess energy transporting more than 50% of annual load (8)	~~4~~ 2
3 **Degree of channel incision (BHR) (Worksheet A-10)**	1.00 – 1.10 (2)	1.11 – 1.30 (4)	1.31 – 1.50 (6)	> 1.50 (8)	2
4 **Stream succession states (Worksheets A-19 and A-10)**	Does not indicate incision or degradation (2)	If BHR > 1.1 and stream type has w/d between 5–10 (4)	If BHR > 1.1 and stream type has w/d less than 5 (6)	(B→G), (C→G), (E→G), (D→G) (8)	2
5 **Confinement (MWR / MWR_{ref}) (Worksheet A-13)**	0.80 – 1.00 (1)	0.30 – 0.79 (2)	0.10 – 0.29 (3)	< 0.10 (4)	2
				Total points	~~14~~ 12
	Vertical stability category point range for channel incision / degradation				
Vertical stability for channel incision/ degradation (use total points and check stability rating)	**Not incised** 9 – 11 ☐	**Slightly incised** 12 – 18 ☑	**Moderately incised** 19 – 27 ☐	**Degradation** > 27 ☐	

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River Assessment and Monitoring: Reference Reach 1st Field Day

Worksheet A-23. Channel enlargement prediction summary.

Stream: Macgruger Branch	Stream Type: C4
Location: 2	Valley Type: VIII
Observers: Group 2	Date: September 18, 2007

Channel enlargement prediction criteria (choose one stability category for each criterion 1–4)	Channel enlargement prediction categories				Selected points (from each row)
	No increase	Slight increase	Moderate increase	Extensive	
1 **Successional stage shift (Worksheet A-19)**	Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C) (2)	(E→C) (4)	(G→F), (F→D) (6)	(C→D), (B→G), (D→G), (C→G), (E→G), (C→F) (8)	8
2 **Lateral stability (Worksheet A-20)**	Stable (2)	Moderately unstable (4)	Unstable (6)	Highly unstable (8)	~~4~~ 6
3 **Vertical stability excess deposition/ aggradation (Worksheet A-21)**	No deposition (2)	Moderate deposition (4)	Excess deposition (6)	Aggradation (8)	4
4 **Vertical stability incision/ degradation (Worksheet A-22)**	Not incised (2)	Slightly incised (4)	Moderately incised (6)	Degradation (8)	4
				Total points	~~20~~ 22

	Category point range			
Channel enlargement prediction (use total points and check stability rating)	**No increase** 8 – 10 ☐	**Slight increase** 11 – 16 ☐	**Moderate increase** 17 – 24 ✔	**Extensive** > 24 ☐

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River Assessment and Monitoring: Reference Reach 1st Field Day

Worksheet A-24. Overall sediment supply rating determined from individual stability rating categories.

Stream: Macgruger Branch	Stream Type: C4
Location: Reach 1	Valley Type: VIII
Observers: Group 2	Date: September 18, 2007

Overall sediment supply prediction criteria (choose corresponding points for each criterion 1–5)	Stability rating	Points	Selected points
1 **Lateral stability (Worksheet A-20)**	Stable	1	2
	Mod. unstable	2	
	Unstable	3	
	Highly unstable	4	
2 Vertical stability excess deposition/ aggradation (Worksheet A-21)	No deposition	1	2
	Mod. deposition	2	
	Excess deposition	3	
	Aggradation	4	
3 **Vertical stability channel incision/ degradation (Worksheet A-22)**	Not incised	1	2
	Slightly incised	2	
	Mod. Incised	3	
	Degradation	4	
4 Channel enlargement prediction (Worksheet A-23)	No increase	1	3
	Slight increase	2	
	Mod. increase	3	
	Extensive	4	
5 **Pfankuch channel stability (Worksheet A-11)**	Good: stable	1	1
	Fair: mod unstable	2	
	Poor: unstable	4	
		Total Points	10

	Category point range			
Overall sediment supply rating (use total points and check stability rating)	Low 5 ☐	Moderate 6 – 10 ✓	High 11 – 15 ☐	Very High 16 – 20 ☐

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Worksheet 5-8. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-19** with BEHI variables to determine BEHI score.

Stream:	**Macgruder, Reach - Final Reach**	Location:	
Station:	**Bank3r**	Observers:	
Date:	**09/18/07**	Stream Type: **C 4**	Valley Type: **VIII**

							BEHI Score (Fig. 5-19)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	2.4 (A)	Bankfull Height (ft) =	1.9 (B)	(A) / (B) =	1.26316 (C)		4.38
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	2.4 (A)	(D) / (A) =	0.41667 (E)		4.7
Weighted Root Density (G)							
		Root Density as % =	10 (F)	(F) x (E) =	4.16667 (G)		10
Bank Angle (H)							
				Bank Angle as *Degrees* =	50 (H)		3.41
Surface Protection (I)							
				Surface Protection as % =	25 (I)		6.54

Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

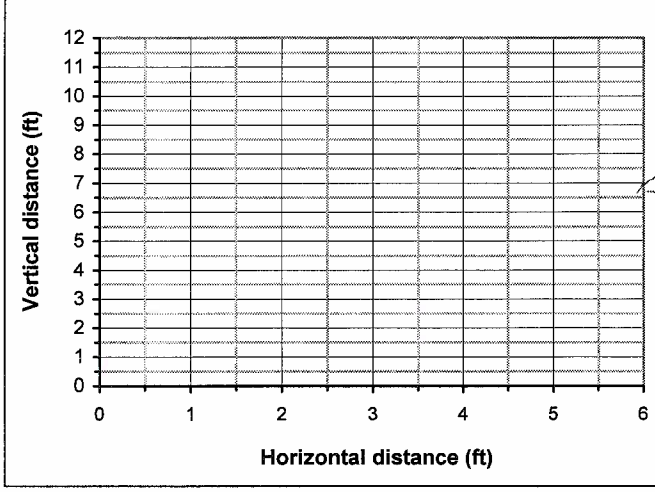
Bank Material Adjustment 0

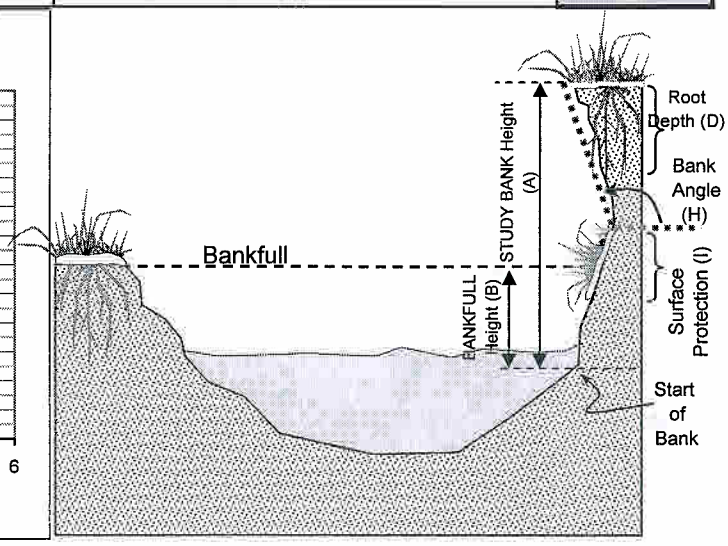
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 0

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score 29

Bank Sketch





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TEAM 2
9/18/07

Worksheet 5-9. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Macgruder, Reach - Final Reach** Location:

Station: **Bank3r** Stream Type: **C 4** Valley Type: **VIII**

Observers: Date: **09/18/07**

Methods for estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS.....	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf}).....	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S).....	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif}).....	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf}).....	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf}).....	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient.....	Level IV	Validation

Level I

(1)	Transverse and/or central bars-short and/or discontinuous..... .....NBS = High / Very High
	Extensive deposition (continuous, cross-channel).....NBS = Extreme
	Chute cutoffs, down-valley meander migration, converging flow.....NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Dominant Near-Bank Stress
Low

Converting values to a Near-Bank Stress (NBS) rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating Low

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Worksheet 5-10. Summary form of annual streambank erosion estimates for various study reaches.

Stream: **Macgruder, Reach - Final Reach**				Location:			
Graph Used:		Total Bank Length (ft): **199**				Date: **9/18/2007**	
Observers:			Valley Type: **VIII**			Stream Type: **C 4**	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Station (ft)	**BEHI rating (Worksheet 5-8) (adjective)**	**NBS rating (Worksheet 5-9) (adjective)**	**Bank erosion rate (Figure 5-38 or 5-39) (ft/yr)**	**Length of bank (ft)**	**Study bank height (ft)**	**Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)**	**Erosion Rate (tons/yr/ft) {[(7)/27] × 1.3 / (5)}**
1. Bank1	Moderate	Low	0.1	10	2.7	2.7	0.01
2. Bank10l	Moderate	Moderate	0.3006	50	3	45.09	0.04
3. Bank11l	Low	Low	0.0205882	34	2.7	1.89	0.00
4. Bank2r	Moderate	High	0.8	36	3.3	95.04	0.13
5. Bank3r	Low	Low	0.0177632	19	2.4	0.81	0.00
6. Bank4r	Moderate	Very High	0.4987013	21	3.3	34.56	0.08
7. Bank6r	Low	Low	0.0257143	21	1	0.54	0.00
8. Bank7r	Low	Moderate	0.1	31	2.7	8.37	0.01
9. Bank8l	Moderate	Low	0.0771429	14	1	1.08	0.00
10. Bank9l	Low	Very High	0.396	5	3	5.94	0.06
11. Bznk5r	Moderate	Moderate	0.3019737	19	2.4	13.77	0.03
12.							
13.							
14.							
15.							
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					**Total erosion (ft^3/yr)**	209.79	
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}					**Total erosion (yds^3/yr)**	7.77	
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}					**Total erosion (tons/yr)**	10.1	
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}					**Total erosion (tons/yr/ft)**	0.0508	

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Wicsht Magruder Branch Reference Reach Team 2 9/18/2007

RIVERMORPH BANK EROSION HAZARD INDEX (BEHI)

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River Name: Macgruder
Reach Name: Final Reach
BEHI Name: Bank1
Survey Date: 09/19/2007

Bankfull Height: 1.6 ft
Bank Height: 2.7 ft
Root Depth: 1.5 ft
Root Density: 0.25 %
Bank Angle: 90 Degrees
Surface Protection: 0.2 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #1: Channel Pattern and/or Depositional Features for Adjustments in Near-Bank Stress
Rating: Low

BEHI Numerical Rating: 37.9
BEHI Adjective Rating:
NBS Numerical Rating:
NBS Adjective Rating: Low
Total Bank Length: 10 ft
Estimated Sediment Loss: 0.1 Cu Yds per Year
Estimated Sediment Loss: 0.13 Tons per Year

RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

River Name: Macgruder
Reach Name: Final Reach
BEHI Name: Bank2r
Survey Date: 09/19/2007

TEAM 2
9/18/07

Bankfull Height: 1.6 ft
Bank Height: 3.3 ft
Root Depth: 1.5 ft
Root Density: 0.25 %
Bank Angle: 90 Degrees
Surface Protection: 0.2 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #1: Channel Pattern and/or Depositional Features for Adjustments in Near-Bank Stress
Rating: High

BEHI Numerical Rating: 40.2
BEHI Adjective Rating:
NBS Numerical Rating:
NBS Adjective Rating: High
Total Bank Length: 36 ft
Estimated Sediment Loss: 3.52 Cu Yds per Year
Estimated Sediment Loss: 4.58 Tons per Year

RIVERMORPH BANK EROSION HARZARD INDEX (BEHI)

Team 2
9/18/07

River Name: Macgruder
Reach Name: Final Reach
BEHI Name: Bank3r
Survey Date: 09/19/2007

Bankfull Height: 1.9 ft
Bank Height: 2.4 ft
Root Depth: 1 ft
Root Density: 10 %
Bank Angle: 50 Degrees
Surface Protection: 25 %

Bank Material Adjustment: 0

Bank Stratification Adjustment: None 0

Erosion Loss Curve: Yellowstone

NBS Method #1: Channel Pattern and/or Depositional Features for Adjustments in Near-Bank Stress
Rating: Low

BEHI Numerical Rating: 29
BEHI Adjective Rating:
NBS Numerical Rating:
NBS Adjective Rating: Low
Total Bank Length: 19 ft
Estimated Sediment Loss: 0.03 Cu Yds per Year
Estimated Sediment Loss: 0.04 Tons per Year

Magruder Branch Reference Reach Team 2 9/18/2007

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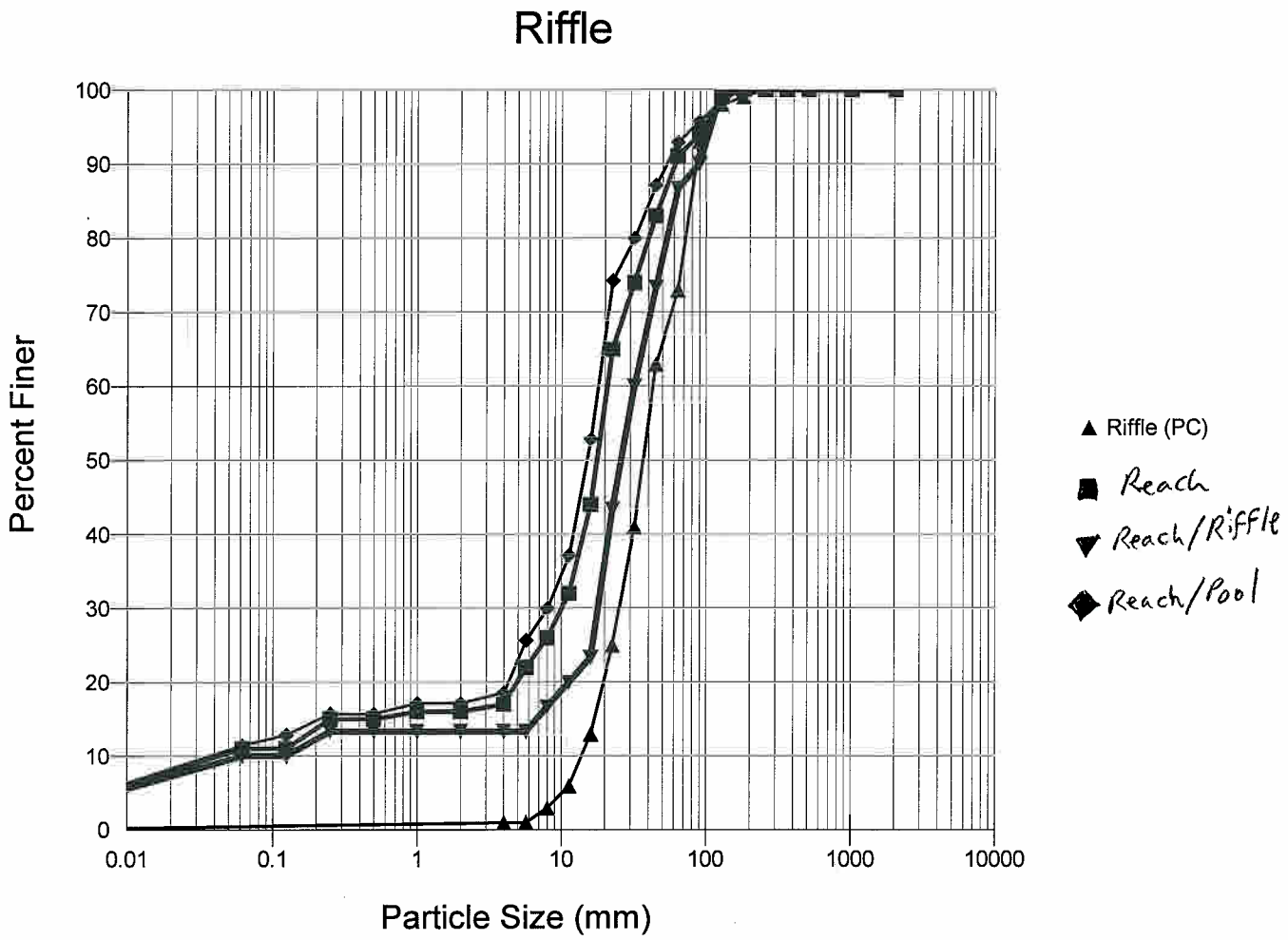

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RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Macgruder
Reach Name: Final Reach <-- This is a Reference Reach
Drainage Area: 1.3 sq mi
State: Maryland
County: Montgomery
Latitude: 0
Longitude: 0
Survey Date: 09/18/2007

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.0122	ft/ft
Number of Channels:	Single	
Width:	24.46	ft
Mean Depth:	1.27	ft
Flood-Prone Width:	150	ft
Channel Materials D50:	17.89	mm
Water Surface Slope:	0.00874	ft/ft
Sinuosity:	1.4	
Discharge:	115	cfs
Velocity:	3.71	fps
Cross Sectional Area:	31	sq ft
Entrenchment Ratio:	6.13	
Width to Depth Ratio:	19.26	
Rosgen Stream Classification:	C 4	

TEAM 2
9/18/07

36 20 1500

20

8 THE REFERENCE REACH FIELD BOOK

SURVEY DATA ⟶ CROSS - SECTION 135.7 Part I

SITE: POOL X-SECTION Date: 9/18/07

Location: Beach 80.25

Party / Notes:

Item	Distance; Point; or STATION Ft.	Back-Sight BS Ft.	Height of Instrument HI Ft.	Fore-Sight FS Ft.	Height; Depth; or Elevation Ft.	NOTES / COMMENT / REMARKS
1	0+00				5.19	
2	2+00				5.49	
3	7+00				5.95	Top Left Bank
4	8+00				6.39	Vertical Bank
5	8+30				9.80	Edge of Water
6	10+00				10.50	Thalweg
7	11+50				10.36	
8	13+00				9.83	
9	14+00				9.15	
10	16+70				5.33	Edge of water
11	19+60				6.70	
12	24+00				6.43	Top of Right Bank
13	29+00				5.87	
14						
15						
16						
17						
18						
19						
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: 9/18/09

230 Riffle X-section
Team 2 on Long Pro X-section 2 Riffle

Ref Paul Bill Reach Tom

1		BM2	4.92	9/18/09		NCTC
2	0	2.3	Floodplain	76	7.04	~~Floodplain~~
3	12	3.0		77.5	7.18	
4	27	3.7		78	7.19	
5	39	3.8		78.2	7.0	
6	49	4.4		79.9	4.84	
7	52	4.8		83.5	5.10	
8	53.4	5.06	BKF	88	5.30	
9	55	6.0		92	5.42	Floodplain 176'
10	57	6.27		100	4.82	
11	58	6.50		110	4.4	
12	60.5	6.64		120	4.9	
13	60.6	6.72	use flow WS Edge	176	4.2	
14	61.5	6.81		Edge		
15	63	6.81				
16	63.5	6.72	use Flow Edge WS			
17	64.5	6.70				
18	66.0	6.60				
19	68	6.70				
20	70	6.8				
21	71	6.78				
22	72	6.91				
23	72.8	~~6.99~~ 7.0	Edge WS			
24	73.5	7.10				
	74.5	7.16				
	74.4	7.12				

Transverse Riffle

TEAM 2
9/18/07

SURVEY DATA → CROSS - SECTION Part II

SITE: Riffle upstream of Group Reach Date: 9/18/07

Item	STATION Ft.	BS Ft.	HI Ft.	FS Ft.	Elevation Ft.	NOTES / COMMENT / REMARKS
36	BM	1.46				top of footbridge Assumed elev. 100.00
37	0	5.77				
38	6	6.07				
39	8.3	8.96				
40	9.4	9.16				Left Edge of H_2O
41	11.2	9.24				
42	12.7	9.25				
43	14.0	9.42				Thalweg
44	14.8	9.30				
45	15.8	9.16				Right Edge of H_2O
46	17.0	9.07				
47	18.5	8.99				
48	19.4	8.77				
49	21.2	8.30				
50	22.2	8.51				
51	25.0	8.37				
52	28.0	8.50				
53	31.0	8.21				
54	32.0	7.14				
55	34.0	6.61				
56	37.0	6.45				
57	63.0	6.62				
58	69.0	6.87				
59	72.0	7.61				Side channel against valley wall
60	75.0	7.64				
61	77.0	6.87				
62						
63	31.6	7.50				
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						

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THE REFERENCE REACH FIELD BOOK 9

SURVEY DATA ⟹ CROSS - SECTION Run Part II

SITE: 21+00' BM - 80.25 Date: 9/18/07

Item	STATION Ft.	BS Ft.	HI Ft.	FS Ft.	Elevation Ft.	NOTES COMMENT REMARKS
36	BM	4.92				
37	0+00			4.36		
38	5+00			5.10		Bankfull / Top of Bank
39	7+50			6.32		Bottom of slope
40	11+00			6.37		
41	13+00			6.35		
42	15+00			6.55		
43	18+00			6.98		
44	20+00			6.88		
45	22+20			7.25		Left Edge of H_2O
46	23+00			7.37		
47	24+00			7.49		
48	25+00			7.62		
49	26+00			7.75		
50	27+00			8.06		
51	28+00			8.09		
52	29+00			8.00		
53	30+00			7.46		Right Edge of H_2O / Toe of Slope
54	31+40			4.76		Top of Bank
55	35+00			4.93		
56	40+00			5.59		
57						
58	6+00			5.12		
59						
60						
61						
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74						

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 Crew #2

SURVEY DATA ⟹ CROSS - SECTION Glide Part I

SITE: Date: 9/18/07

Location: STA 51+00

Party / Notes: BM El = 80.25

Item	Distance; Point; or STATION Ft.	Back-Sight BS Ft.	Height of Instrument HI Ft.	Fore-Sight FS Ft.	Height; Depth; or Elevation Ft.	NOTES COMMENT REMARKS
1	BM	4.86				
2	0.0			5.08		
3	3.0			5.09		
4	7.0			5.05		
5	10.2			5.24		Top of Bank
6	13.0			6.81		
7	14.0			7.07		
8	16.0			7.27		Edge of Bar
9	18.0			6.96		Top of Bar
10	20.5			7.05		
11	22.5			7.16		LT Edge of water
12	24.0			7.27		channel
13	26.0			7.40		"
14	28.0			7.53		"
15	29.0			7.65		Thalweg
16	30.0			7.56		"
17	31.5			7.54		RT Edge of water
18	32.5			6.50		
19	32.8			6.05		
20	33.0			5.85		Back Fill
21	33.5			5.54		
22	35.0			5.04		
23	38.9			4.88		
24						
25						
26						
27						
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TEAM 2
9/18/07

Team 2 Day 1
Crew #2

8 THE REFERENCE REACH FIELD BOOK

SURVEY DATA → CROSS - SECTION Glide Part I

SITE: Date: 9/18/07

Location: STA 51+00

Party / Notes: BM El = 80.25

Item	Distance; Point; or STATION Ft.	Back-Sight BS Ft.	Height of Instrument HI Ft.	Fore-Sight FS Ft.	Height; Depth; or Elevation Ft.	NOTES COMMENT REMARKS
1	BM	4.86				
2	0.0			5.08		
3	3.0			5.09		
4	7.0			5.05		
5	10.2			5.24		Top of Bank
6	13.0			6.81		
7	14.0			7.07		
8	16.0			7.27		Edge of Bar
9	18.0			6.96		Top of Bar
10	20.5			7.00		
11	22.5			7.16		LT Edge of water
12	24.0			7.27		channel
13	26.0			7.40		"
14	28.0			7.53		"
15	29.0			7.65		Thalweg
16	30.0			7.56		"
17	31.5			7.54		RT Edge of water
18	32.5			6.50		
19	32.8			6.05		
20	33.0			5.85		Back fill
21	33.5			5.54		
22	35.0			5.04		
23	38.9			4.88		
24						
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Team 2 Day 1

SURVEY DATA ⟹ CROSS - SECTION RUN Part II

SITE: 21+00 BM - 80.25 Date: 9/18/07

Item	STATION Ft.	BS Ft.	HI Ft.	FS Ft.	Elevation Ft.	NOTES / COMMENT / REMARKS
36	BM	4.92				
37	0+00			4.36		
38	5+00			5.10		Bankfull / Top of Bank
39	7+50			6.32		Bottom of slope
40	11+00			6.37		
41	13+00			6.35		
42	15+00			6.55		
43	18+00			6.58		
44	20+00			6.88		
45	22+20			7.25		Left Edge of H_2O
46	23+00			7.37		
47	24+00			7.49		
48	25+00			7.62		
49	26+00			7.75		
50	27+00			8.06		
51	28+00			8.09		
52	29+00			8.00		
53	30+00			7.46		Right Edge of H_2O / Top of Slope
54	31+40			4.76		Top of Bank
55	35+00			4.93		
56	40+00			5.59		
57						
58	6+00			5.12		
59						
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Team 2 Day 1

SURVEY DATA ⟶ CROSS - SECTION Part II

SITE: Riffle upstream of Group Reach Date: 9/18/07

Item	STATION Ft.	BS Ft.	HI Ft.	FS Ft.	Elevation Ft.	NOTES COMMENT REMARKS
36	BM	1.46				top of footbridge Assumed elev. 100.00
37	0	5.77				
38	6	6.07				
39	8.3	8.96				
40	9.4	9.16				Left Edge of H_2O
41	11.2	9.24				
42	12.7	9.25				
43	14.0	9.42				Thalweg
44	14.8	9.30				
45	15.8	9.16				Right Edge of H_2O
46	17.0	9.07				
47	18.5	8.99				
48	19.4	8.77				
49	21.2	8.80				
50	22.2	8.51				
51	25.0	8.37				
52	28.0	8.50				
53	31.0	8.21				
54	32.0	7.14				
55	34.0	6.61				
56	37.0	6.45				
57	63.0	6.62				
58	69.0	6.87				
59	72.0	7.61				Side channel against valley wall
60	75.0	7.64				
61	77.0	6.87				
62						
63	31.6	7.50				
64						
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Team 2 Day 1

THE REFERENCE REACH FIELD BOOK

SURVEY DATA → CROSS - SECTION 135.7 Part I

SITE: POOL X-SECTION Date: 9/18/07

Location: Bench 80.25

Party / Notes:

Item	Distance; Point; or STATION Ft.	Back-Sight BS Ft.	Height of Instrument HI Ft.	Fore-Sight FS Ft.	Height; Depth; or Elevation Ft.	NOTES COMMENT REMARKS
1	0+00				5.19	
2	2+00				5.49	
3	7+00				5.95	Top Left Bank
4	8+00				6.39	Vertical Bank
5	8+30				9.80	Edge of Water
6	10+00				10.50	Thalweg
7	11+50				10.36	
8	13+00				9.83	
9	14+00				9.15	
10	16+70				8.33	Edge of Water
11	19+60				6.70	
12	24+00				6.43	Top of Right Bank
13	29+00				5.87	
14						
15						
16						
17						
18						
19						
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35						

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9-21-07 largest particle on bar = 95 mm

several 60-80 mm

bar with great deal of vegetation cover

TEAM 2
9/18/07

2.3 tare bucket

White Marsh Run
Montgomery County Maryland
River Assessment and Monitoring: Impaired Reach

2nd Field Day

Worksheet B-17. Bar sample data collection and sieve analysis form. Station ~ 172

Point / Side BAR-BULK MATERIALS SAMPLE DATA: Size Distribution Analysis

Observers: Rice / Powers

Stream: White Marsh Run

Location: White Marsh [illegible] in Montgomery County MD

Date: 9-21-07

Subsamples	0	2	4	8	16	32	64	128	256	512
	Catch Pan or BUCKET	Sieve SIZE 2 mm	Sieve SIZE 4 mm	Sieve SIZE 8 mm	Sieve SIZE 16 mm	Sieve SIZE 32 mm	Sieve SIZE 64 mm	Sieve SIZE 128 mm	Sieve SIZE 256 mm	
Tare weight	2.3	2.3	2.3	2.3	2.3	2.3				

Subsamples	0 Total	0 Net	2 Total	2 Net	4 Total	4 Net	8 Total	8 Net	16 Total	16 Net	32 Total	32 Net	64 Total	64 Net	128 Total	128 Net	256 Total	256 Net	512 Total	512 Net
1	39.5	37.2	7.4	5.1	6.9	4.6	8.4	6.1	9.1	6.8	7.4	5.1								
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
Net wt. total																				
% Grand total																				
Accum. % =<																				

39.5
- 2.3
37.2

8.1
- 2.3
6.8

64.2
34.8
33.8
3.4

SURFACE MATERIALS DATA
(Two largest particles)

No.	Dia.	WT.
1	80	3.1
2	75	3.0

0.8 wt.
0.7 wt.

Bucket + materials weight	11.2
Bucket tare weight	2.3
Materials weight	8.9
Materials less than:	2 mm

Be sure to add separate material weights to grand total

GRAND TOTAL SAMPLE WEIGHT

Sample location notes

Sample location sketch

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