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

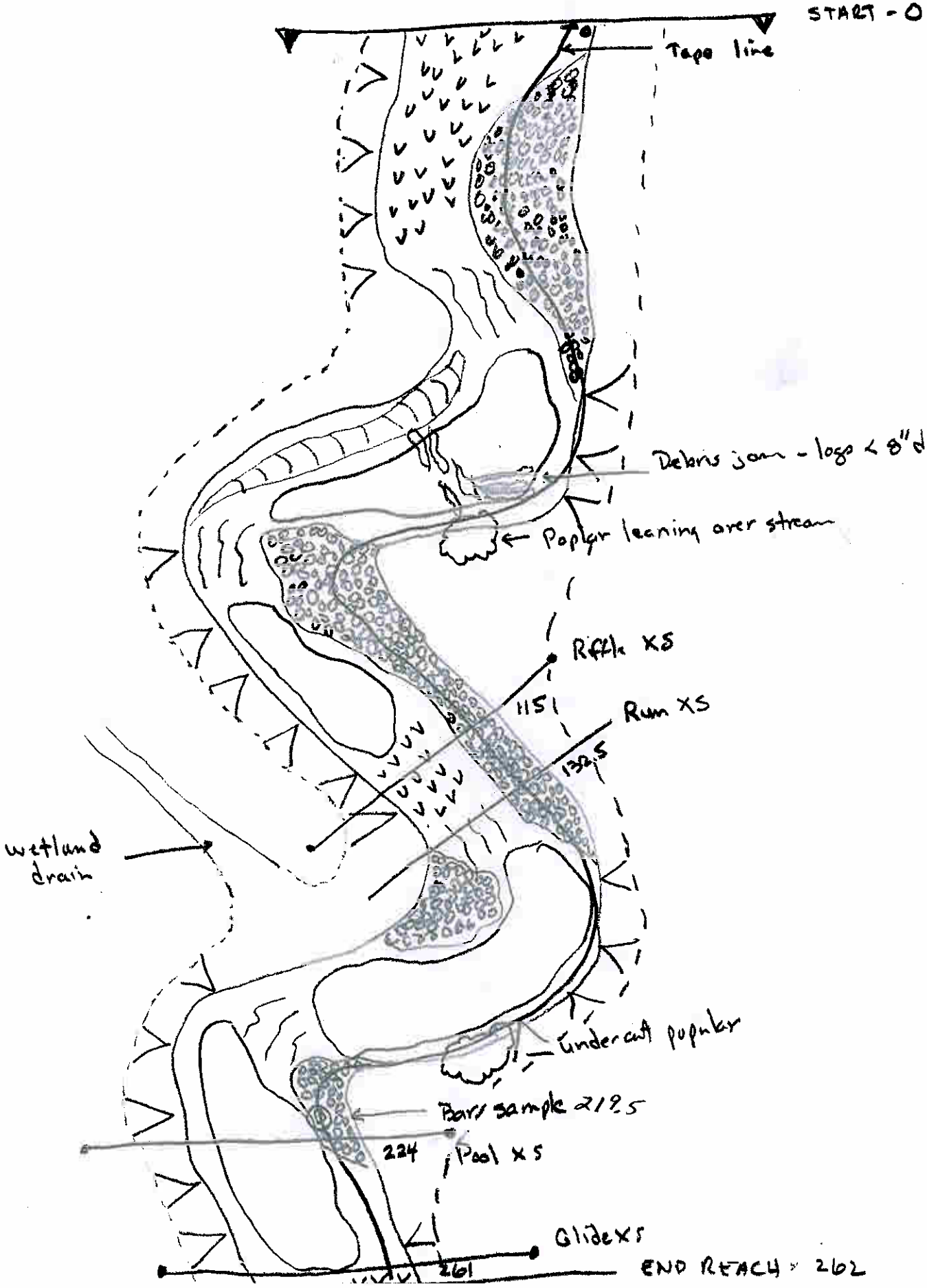
Team 2
Day 3
Magruder Branch
Degraded Reach

SITE SKETCH

STREAM: McGruder

DATE: 9/25/07

CREW: 2

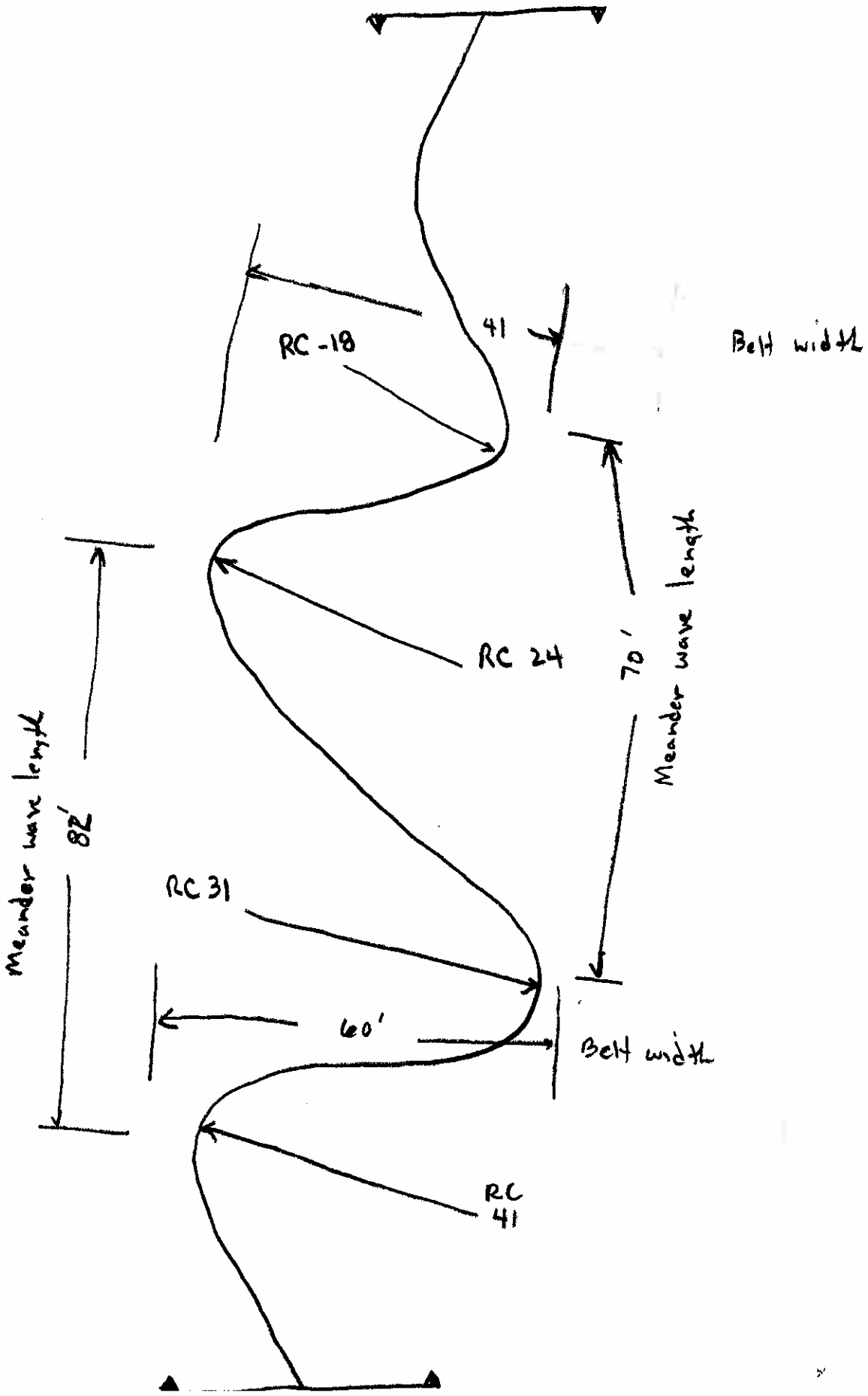


SITE GEOMETRY

STREAM Mc Gruder

DATE 9/25/07

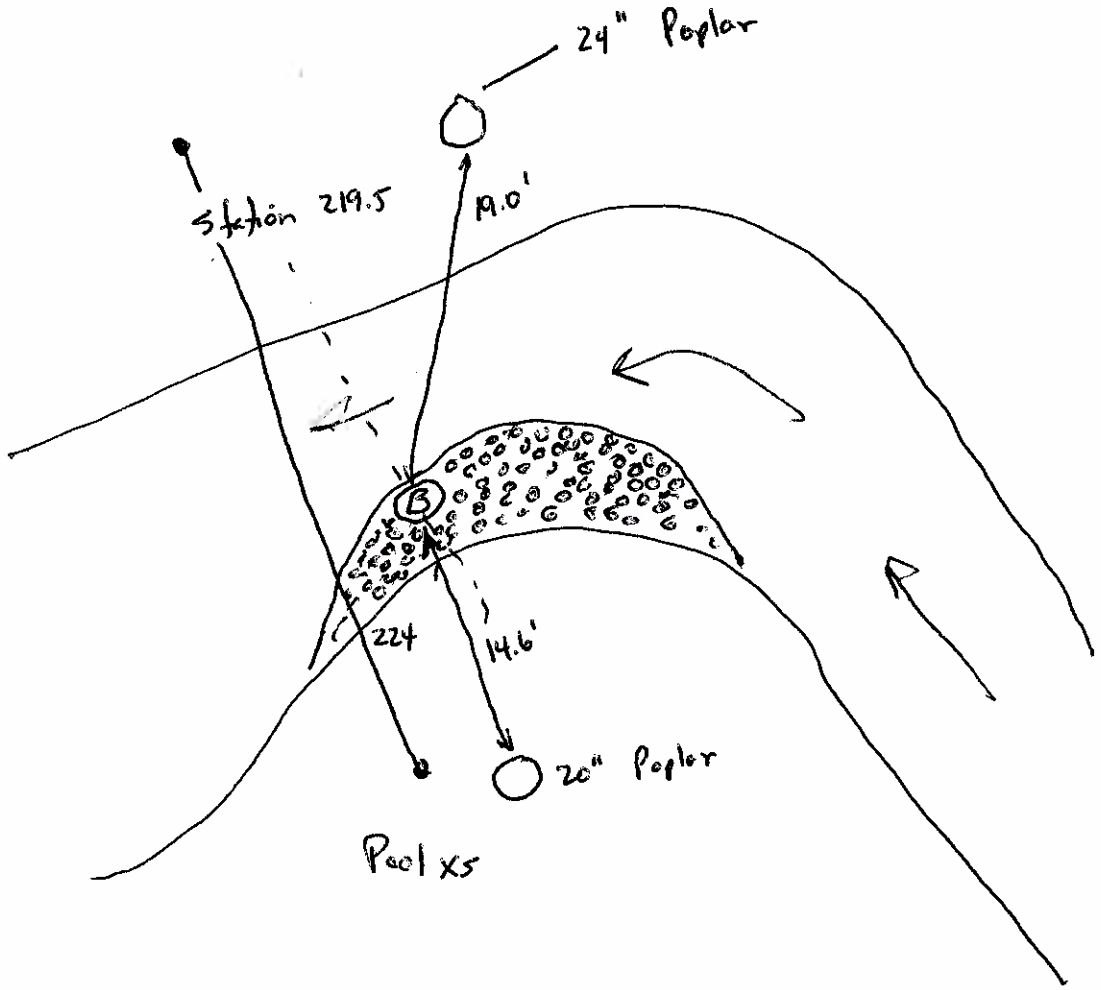
CREW: 2

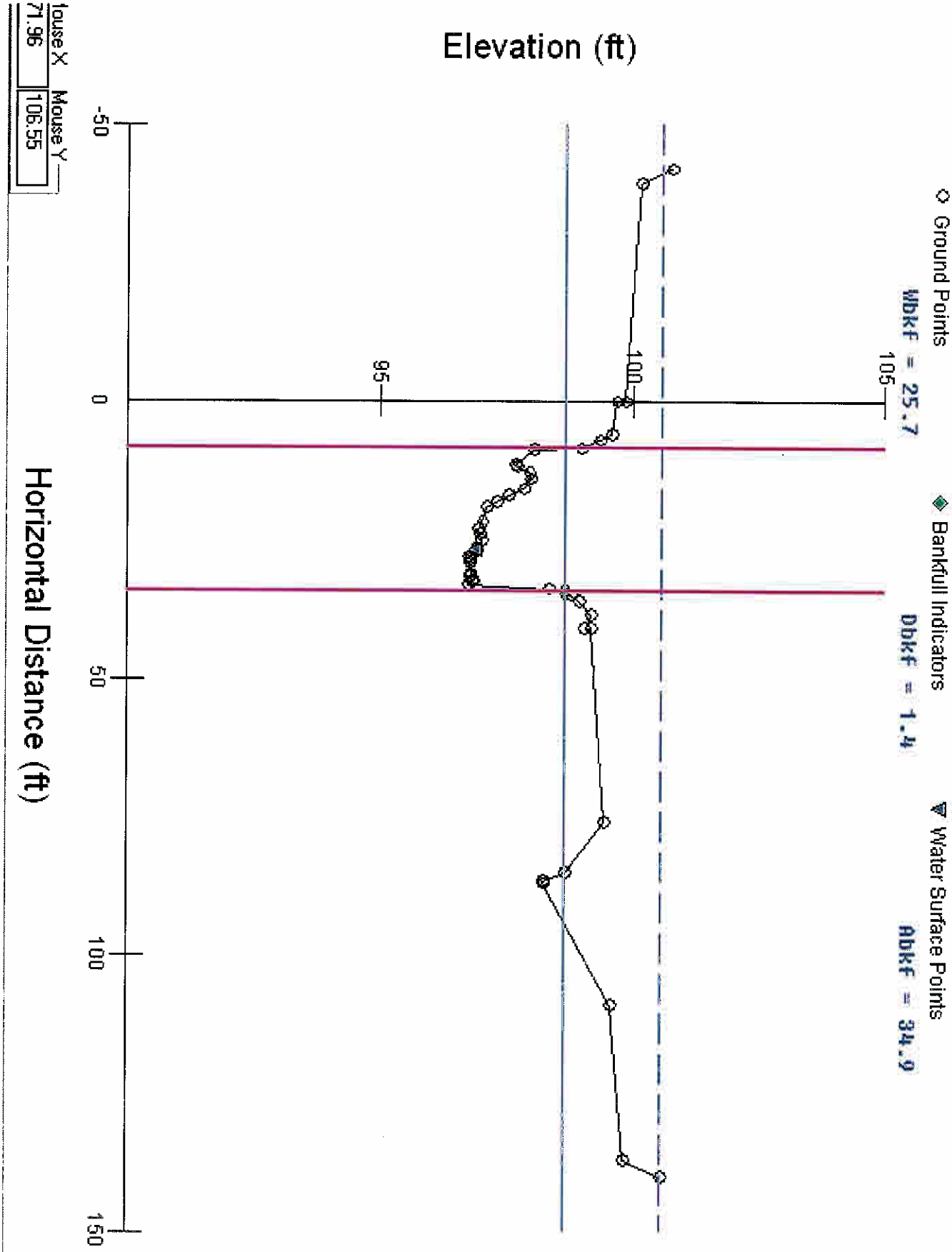


BAR SAMPLE LOCATION

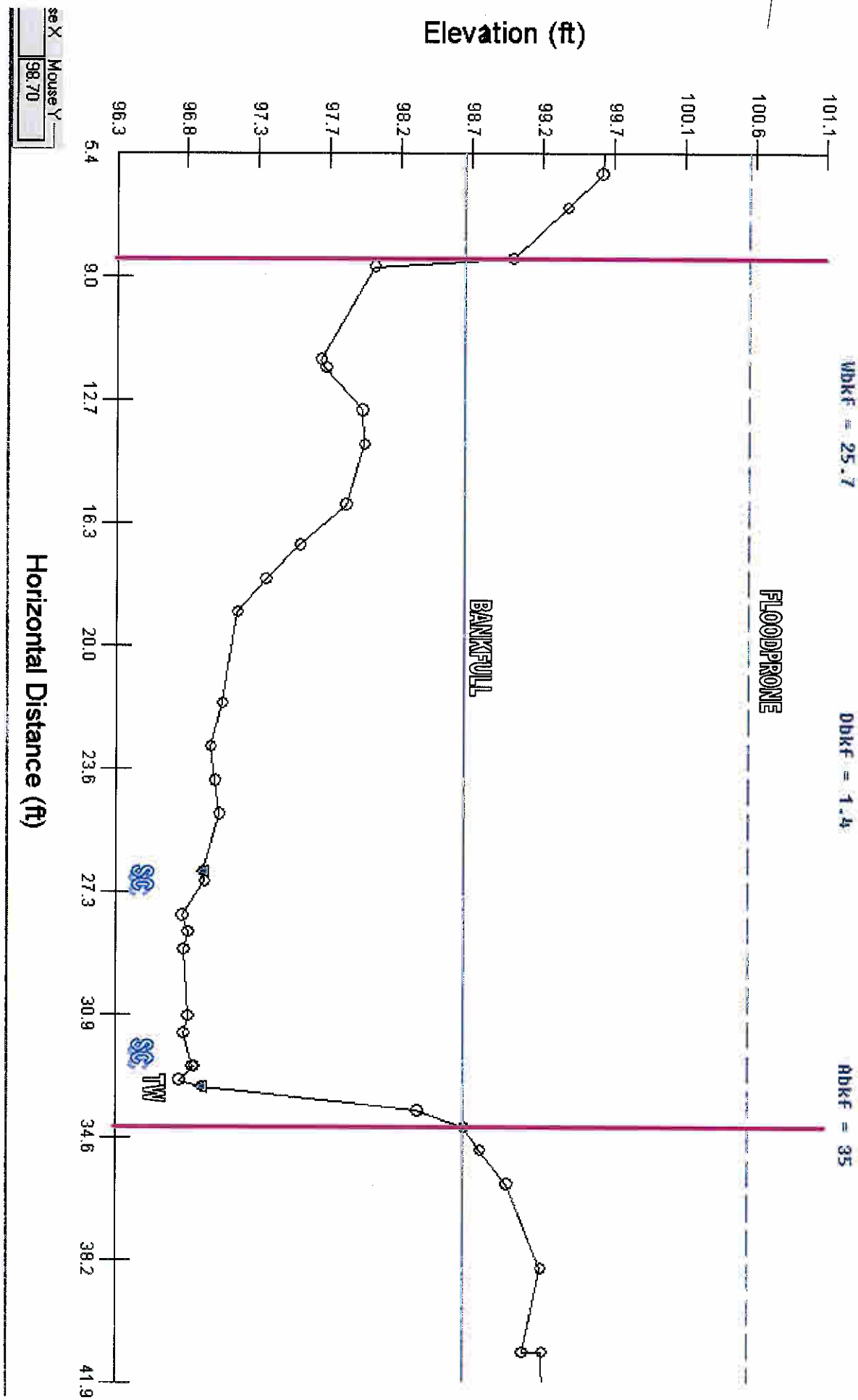
STREAM McGruder DATE 9/25/07

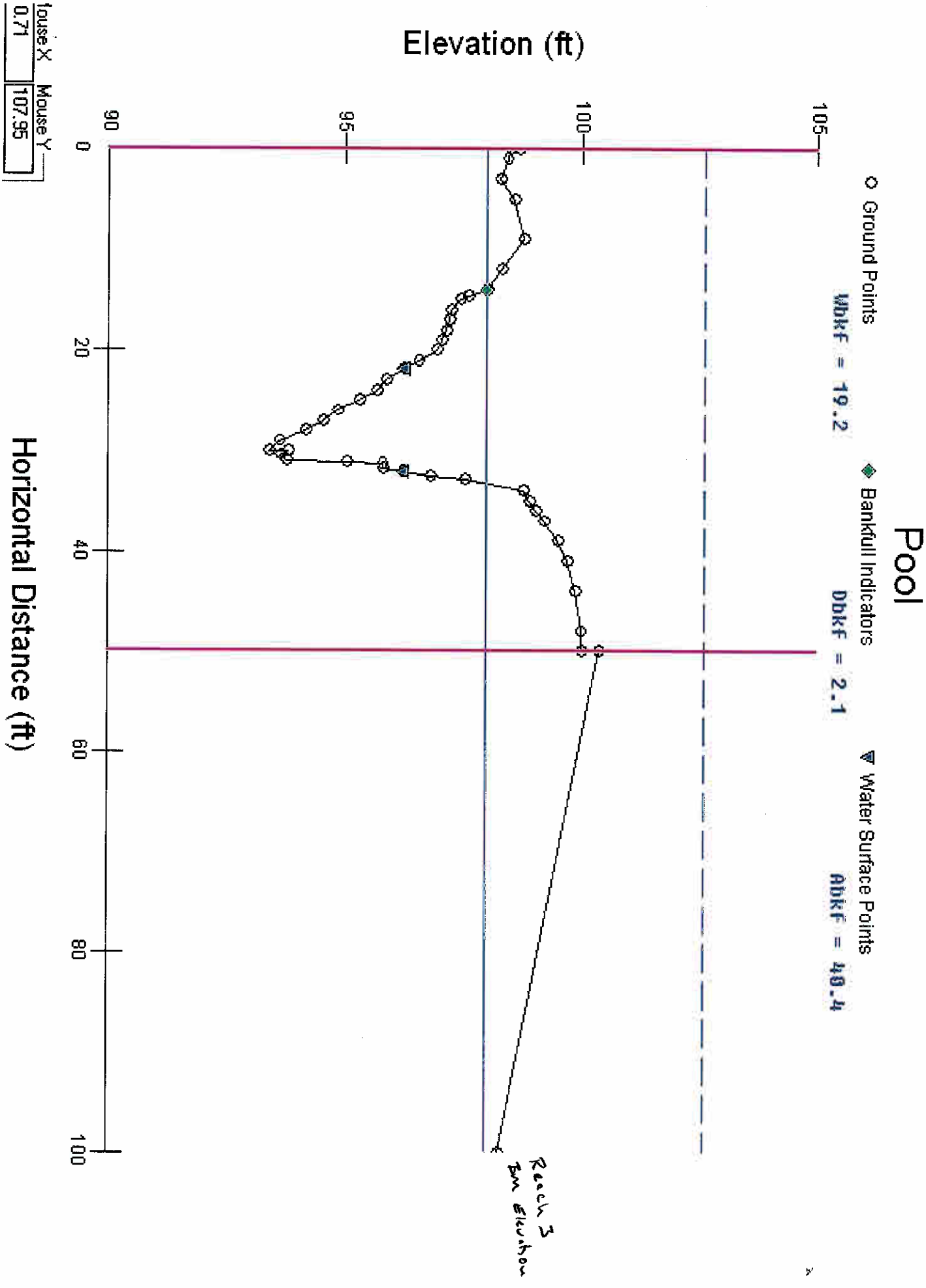
CREW 2

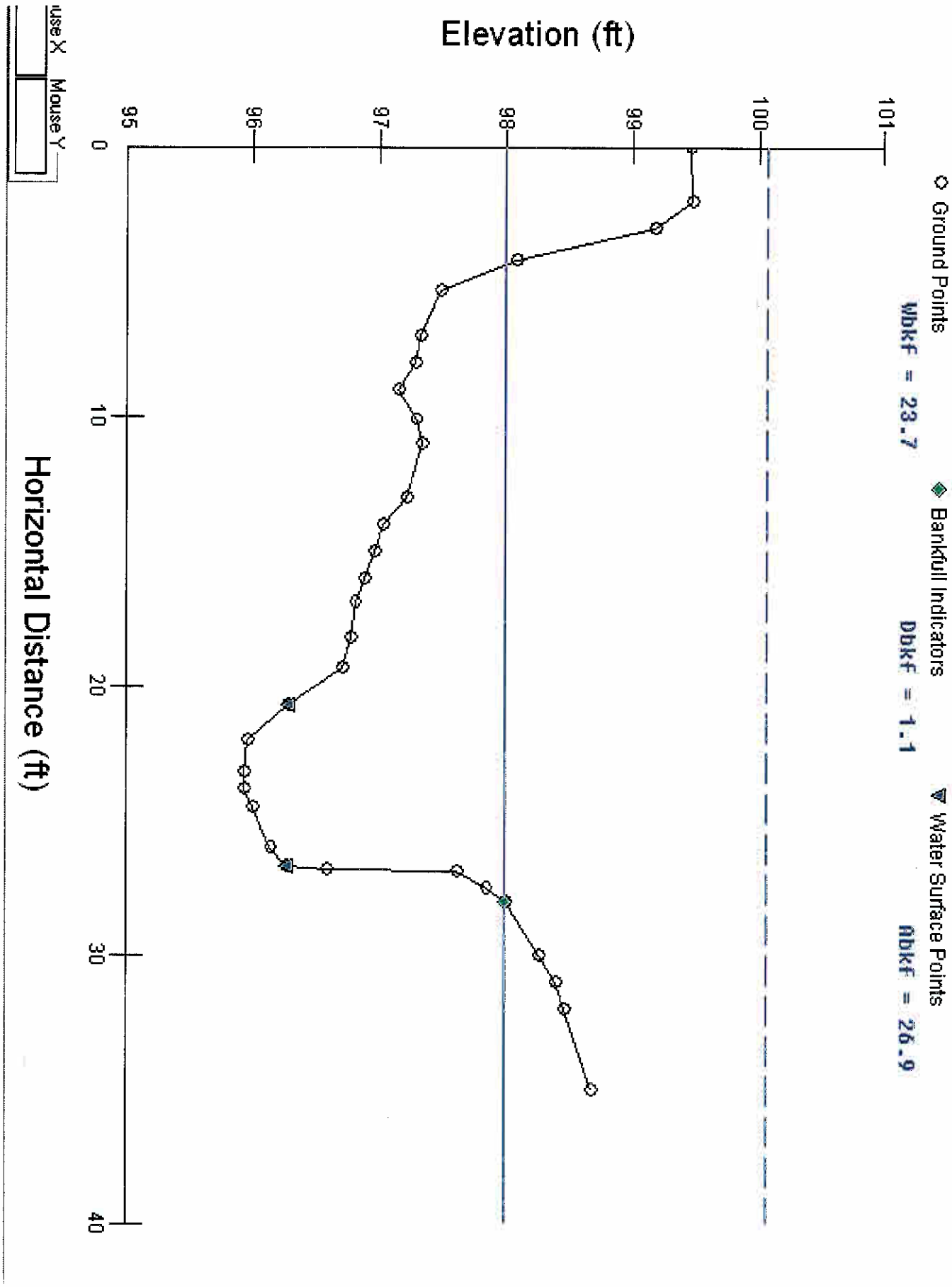


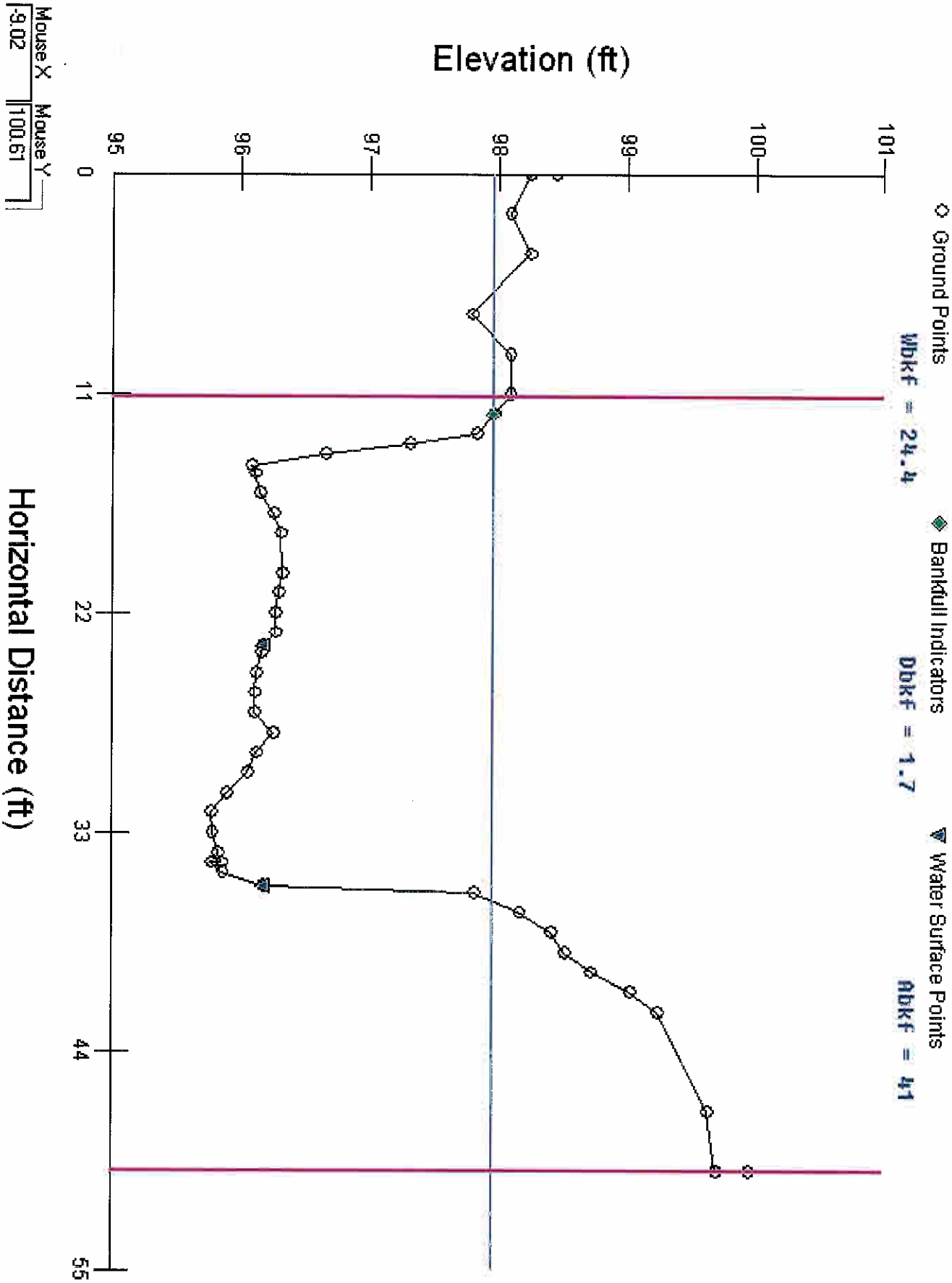

riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 25.7
Dbkf = 1.4
Abkf = 34.9
Elevation (ft)
105
100
95
-50
0
50
100
150
Horizontal Distance (ft)
Mouse X
71.96
Mouse Y
106.55

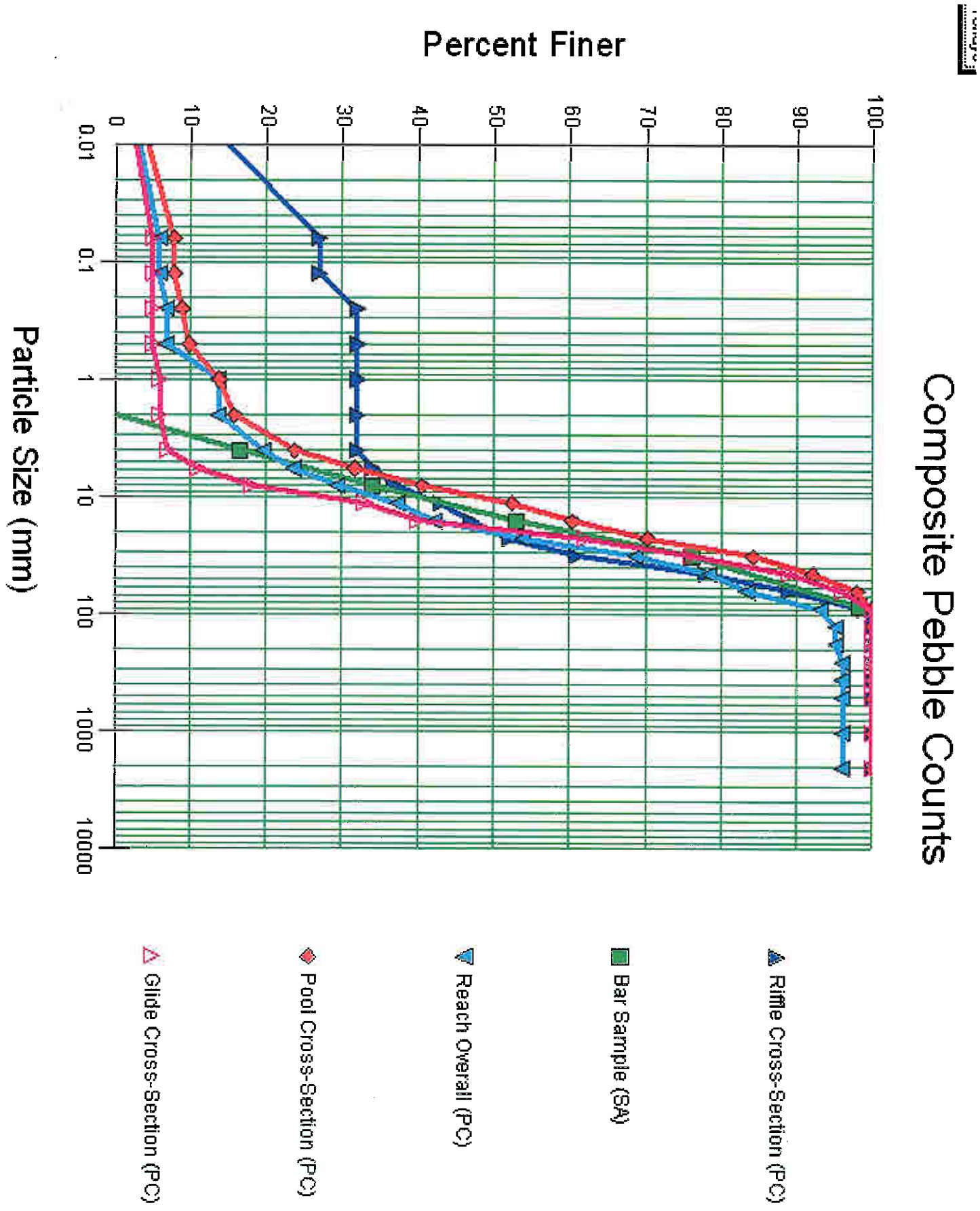
Magruder Branch Degraded Reach Team 2 9/25/2007

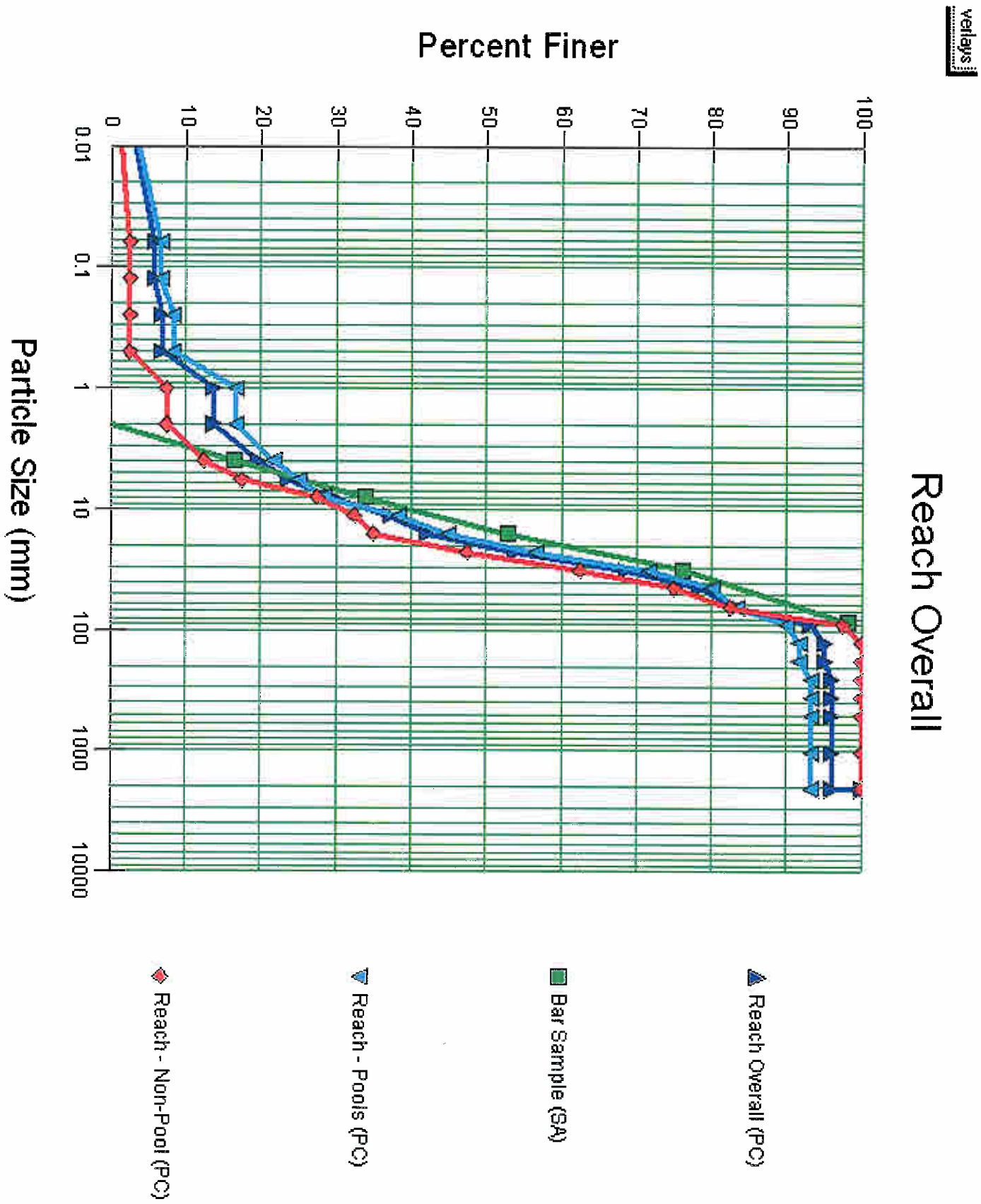


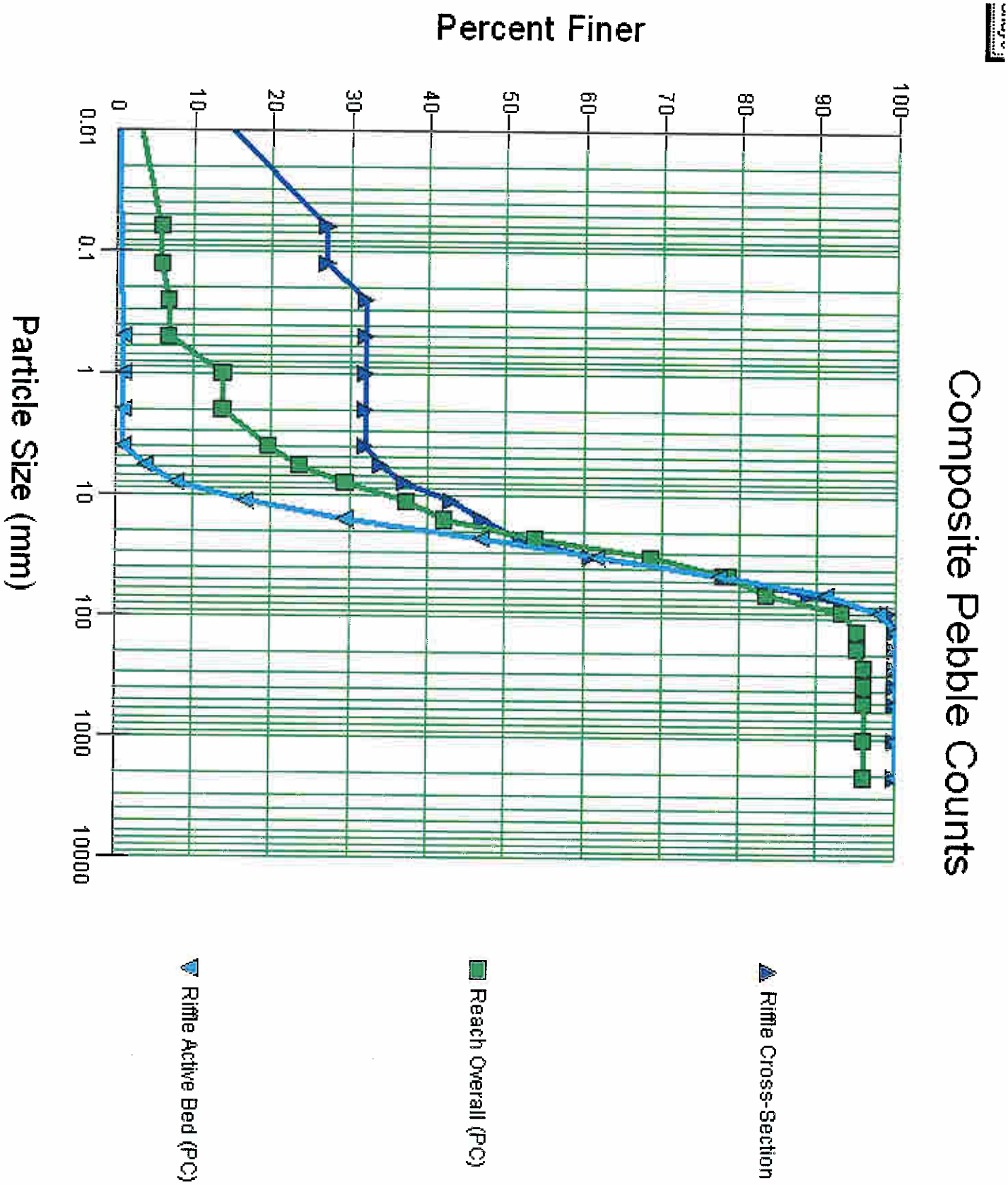

Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 19.2
Dbkf = 2.1
Abkf = 40.4
Elevation (ft)
105
100
95
90
0
20
40
60
80
100
Horizontal Distance (ft)
Mouse X
0.71
Mouse Y
107.95
Reach 3
Bm Elevation


Run
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 23.7
Dbkf = 1.1
Abkf = 26.9
Elevation (ft)
101
100
99
98
97
96
95
0
10
20
30
40
Horizontal Distance (ft)
Mouse X
Mouse Y


Glide
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 24.4
Dbkf = 1.7
Abkf = 41
Elevation (ft)
101
100
99
98
97
96
95
0
11
22
33
44
55
Horizontal Distance (ft)
Mouse X
-9.02
Mouse Y
100.61


Composite Pebble Counts
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)
Riffle Cross-Section (PC)
Bar Sample (SA)
Reach Overall (PC)
Pool Cross-Section (PC)
Glide Cross-Section (PC)


Reach Overall
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 Overall (PC)
Bar Sample (SA)
Reach - Pools (PC)
Reach - Non-Pool (PC)


Composite Pebble Counts
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)
Riffle Cross-Section (PC)
Reach Overall (PC)
Riffle Active Bed (PC)

River Assessment and Monitoring: Impaired Reach 3rd Field Day

Worksheet C-1. Level II stream classification form.

Stream: Magruder			
Basin:	Drainage Area:	acres	mi^2
Location: Reach 2			
Twp.&Rge:	Sec.&Qtr.:		
Cross-Section Monuments (Lat./Long.):		Date: 9-25-07	
Observers: Team 2		Valley Type:	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	25.71	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	1.36	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	34.86	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	18.9	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.	1.93	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.	180	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	7	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.	20.4	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.0078	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).	1.5	

Stream Type C4

Reference: *WARSSS*, **Figure 2-14**, page 2-23

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

Stream: **Macgruder, Reach - Day3 Reach** Location:

Observers: Team 2 Date: **9/25/2007** Valley Type: ~~VIII~~ Stream Type: C4

River Reach Summary Data

Channel Dimension								
Mean Riffle Depth (d_{bkf})	1.36	ft	Riffle Width (W_{bkf})	25.71	ft	Riffle Area (A_{bkf})	34.960	ft^2
Mean Pool Depth (d_{bkfp})	2.1	ft	Pool Width (W_{bkfp})	19.25	ft	Pool Area (A_{bkfp})	40.42	ft^2
Mean Pool Depth/Mean Riffle Depth	1.54	d_{bkfp}/d_{bkf}	Pool Width/Riffle Width	0.75	W_{bkfp}/W_{bkf}	Pool Area / Riffle Area	1.16	A_{bkfp}/A_{bkf}
Max Riffle Depth (d_{mbkf})	~~1.47~~	ft 1.9	Max Pool Depth (d_{mbkfp})	~~3.43~~	ft	Max Riffle Depth/Mean Riffle Depth	~~1.08~~	1.35
Max Pool Depth/Mean Riffle Depth	~~2.522~~	3.4		4.62		Point Bar Slope	0.23	
Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})				3.7	ft/s	Estimation Method		
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})				131.07	cfs	Drainage Area	1.1	mi^2

Channel Pattern: Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Meander Length (Lm)	76	70	82	ft	Meander Length Ratio (Lm/W_{bkf})	2.96	2.72	3.19
Radius of Curvature (Rc)	28.3	18	41	ft	Radius of Curvature/Riffle Width (Rc/W_{bkf})	1.10	0.70	1.59
Belt Width (W_{blt})	50.5	41	60	ft	Meander Width Ratio (W_{blt}/W_{bkf})	1.96	1.59	2.33
Individual Pool Length	92.4	79.3	106	ft	Pool Length/Riffle Width (4.85)	3.59	3.08	4.10
Pool to Pool Spacing	130	130	130	ft	Pool to Pool Spacing/Riffle Width	~~5.07~~	~~5.07~~	~~5.07~~
Riffle Length	22	12	31.9	ft	Riffle Length/Riffle Width	0.85	0.47	1.24

Channel Profile								
Valley Slope (VS)	.0150	ft/ft	Average Water Surface Slope (S)	0.0078	ft/ft	Sinuosity (VS/S)	1.5	
Stream Length (SL)	2670	ft	Valley Length (VL)	1750	ft	Sinuosity (SL/VL)	1.5	
Low Bank Height (LBH)	start 0.63	ft	Max Riffle Depth	start 1.30	ft	Bank-Height Ratio (BHR) (LBH/Max Riffle Depth)	start 1.0	
	end 1.57	ft		end 1.50	ft		end 1.0	

Facet Slopes	Mean	Min	Max		Dimensionless Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.044	0.043	0.045	ft/ft	Riffle Slope/Average Water Surface Slope (S_{rif} / S)	5.646	5.482	5.809
Run Slope (S_{run})	0.000	0.000	0.001	ft/ft	Run Slope/Average Water Surface Slope (S_{run} / S)	0.035	0.000	0.104
Pool Slope (S_p) 0.000	~~0.011~~	0.000	~~0.045~~ 0.001	ft/ft	Pool Slope/Average Water Surface Slope (S_p / S) 0.038	~~1.365~~	0.000	~~5.809~~ 0.077
Glide Slope (S_g) 0.0	~~0.002~~	0.000	~~0.013~~ 0.008	ft/ft	Glide Slope/Average Water Surface Slope (S_g / S) 0.974	~~0.256~~	0.000	~~1.695~~ 0.987

Feature Midpoint [a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Riffle Depth (d_{rif})	1.47	1.38	1.56	ft	Riffle Depth/Mean Riffle Depth (d_{rif} / d_{bkf}) 1.29, 1.38, 1.22	~~1.08~~	~~1.01~~	~~1.15~~
Run Depth (d_{run})	2.34	1.97	2.84	ft	Run Depth/Mean Riffle Depth (d_{run} / d_{bkf})	1.72	1.45	2.09
Pool Depth (d_p)	3.43	2.55	4.32	ft	Pool Depth/Mean Riffle Depth (d_p / d_{bkf})	2.52	1.88	3.18
Glide Depth (d_g)	2.19	1.73	2.81	ft	Glide Depth/Mean Riffle Depth (d_g / d_{bkf})	1.61	1.27	2.07

Channel Materials	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay	5.88	27	0	D_{16}	2.77	0.04	4.3	0	mm
% Sand	7.85	5	0	D_{35}	10.35	6.47	10.21	0	mm
% Gravel	69.6	57	83.31	D_{50}	20.4	19.96	18.02	0	mm
% Cobble	12.75	11	16.69	D_{84}	65.78	55.36	65.01	0	mm
% Boulder	0	0	0	D_{95}	126.06	79.6	78.75	0	mm
% Bedrock	3.92	0	0	D_{100}	2048	128	85	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.

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Worksheet C-3. Bankfull velocity and discharge estimates.

Bankfull VELOCITY / DISCHARGE Estimates

Site	Magruder Branch	Location	Reach 2
Date	9/25/07	Stream Type	C4
Valley Type	8		
Observers	TEAM 2	HUC	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Cross-section AREA	34.86	A_{bkf} (SqFt)	Bankfull Mean DEPTH	1.36	D_{bkf} (Ft)
Bankfull WIDTH	25.7	W_{bkf} (Ft)	Wetted PERIMETER ~ $2 * d_{bkf} + W_{bkf}$	28.42	W_{Pbkf} (Ft)
D84 @ Riffle	54.06	Dia. (mm)	D84 mm / 304.8 =	0.177	D84 (Ft)
Bankfull SLOPE	0.0078	S (Ft / Ft)	Hydraulic RADIUS A_{bkf} / W_{Pbkf}	1.23	R (Ft)
Gravitational Acceleration	32.2	g (Ft /Sec^2)	Relative Roughness R (ft) / D84 (ft)	6.95	
Drainage AREA	1.1	DA (SqMi)	Shear Velocity $u^* = \sqrt{gRS}$	0.56	u^* (Ft / Sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\,2.83 + 5.66\mathrm{Log}\{R / D84\}\,]u^*$	4.25	Ft / Sec	148.2	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness. $u = 1.4895 * R^{2/3} * S^{1/2}/n$ n = 0.035	4.31	Ft / Sec	150.25	CFS
2. Roughness Coefficient: $u = 1.4895 * R^{2/3} * S^{1/2}/n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39 S^{.38} R^{-.16}$ n = 0.064 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.	2.36	Ft / Sec	82.3	CFS
2. Roughness Coefficient: $u = 1.4895 * R^{2/3} * S^{1/2}/n$ c) Manning's 'n' from Stream Type n = 0.032	4.72	Ft / Sec	164.5	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.)	4.62	Ft / Sec	161	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) By Stream Type with reg.	3.7	Ft / Sec	131.07	CFS
4. Continuity Equations: a) Regional Curves u = Q / A Return Period for Bankfull Discharge Q = [ ] MD PIRD mt. Reg. 2.9	2.9	Ft / Sec	100	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/joints/ uplifted surfaces above channel bed elevations. Substitute an average bedrock protrusion height (h_{br} in feet) for the D84 term in estimation method 1.

DAY #1 D.A. 1.3 SEAME Q=115 (LOW, DEVELOPED)

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a. Riparian Vegetation

Worksheet B-4. Riparian vegetation composition/density used for channel stability assessment.

Riparian Vegetation

Stream: McGruder

Location: Reach 2

Observers: Team 2

Reference reach [ ]

Disturbed (impacted reach) [X]

Date: 09/25/2007

Existing species composition: Mid successional

Potential species composition: Ironwood, Arrowwood, sm. Red Maple, Blueberry, Sycamore (in openings) ~~Same~~

	Riparian cover categories	Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	70	4	Tulip Poplar	80
				Red Maple	10
				Green Ash	5
				American sycamore	5
					100%
2. Understory	Shrub layer		6	Spice Bush	65
				Northern Red Oak	5
				Multiflora Rose	20
				Barberry	5
				Greenbrier	5
					100%
3. Ground level	Herbaceous		10	Fern	45
				Canary grass	5
				Smartweed	45
				Nettle	5
					100%
	Leaf or needle litter		62		
	Bare ground		18		
			Column total = 100%		

Remarks:

Condition, vigor and/or usage of existing reach:

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

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b. Flow Regime

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

FLOW REGIME

Stream: Macgruder		Location: Reach 2						
Observers: Team 2						Date: 9-25-07		
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 C-6. Stream size/order categories for stratification by stream type.

Stream Size and Order			
Stream: Macguder			
Location: Reach 2			
Observers: Team 2			
Date: 9-25-07			
Stream Size Category and Order ☞			S4
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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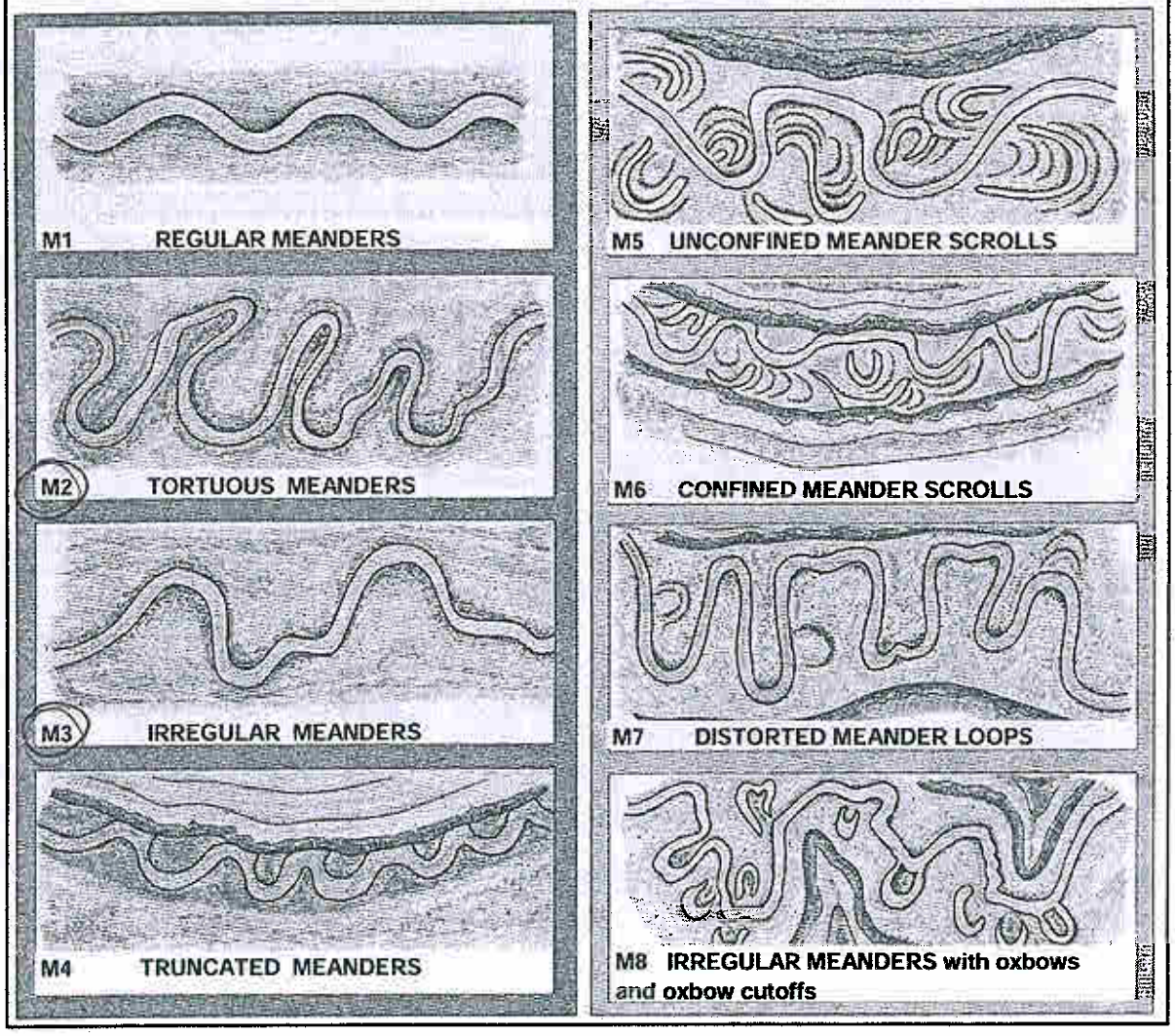
d. Meander Patterns

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

Meander Patterns					
Stream: Magruder	Reach: Reach 2				
Observers: Team 2	Date: 9-25-07				
List ALL CATEGORIES that APPLY ☞	M2	M3			

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



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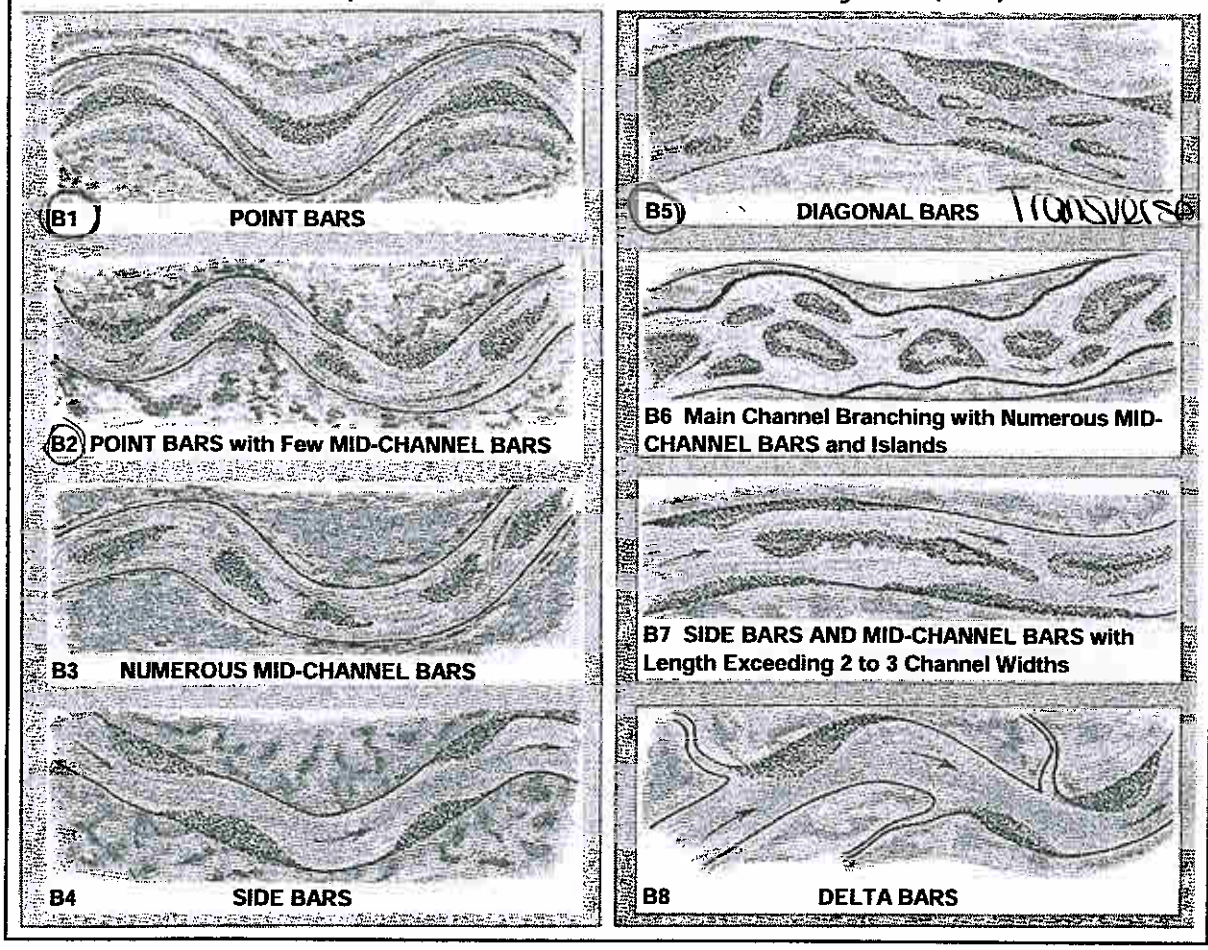
e. Depositional Patterns

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

Depositional Patterns					
Stream: Magruder			Reach: Reach 2		
Observers: Team 2			Date: 9-25-07		
List ALL CATEGORIES that APPLY ☞	B1	B5	B2		

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



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f. Channel Blockages

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

Channel Blockages			
Stream: Magruder		Location: Reach 2	
Observers: Team 2		Date: 9-25-07	
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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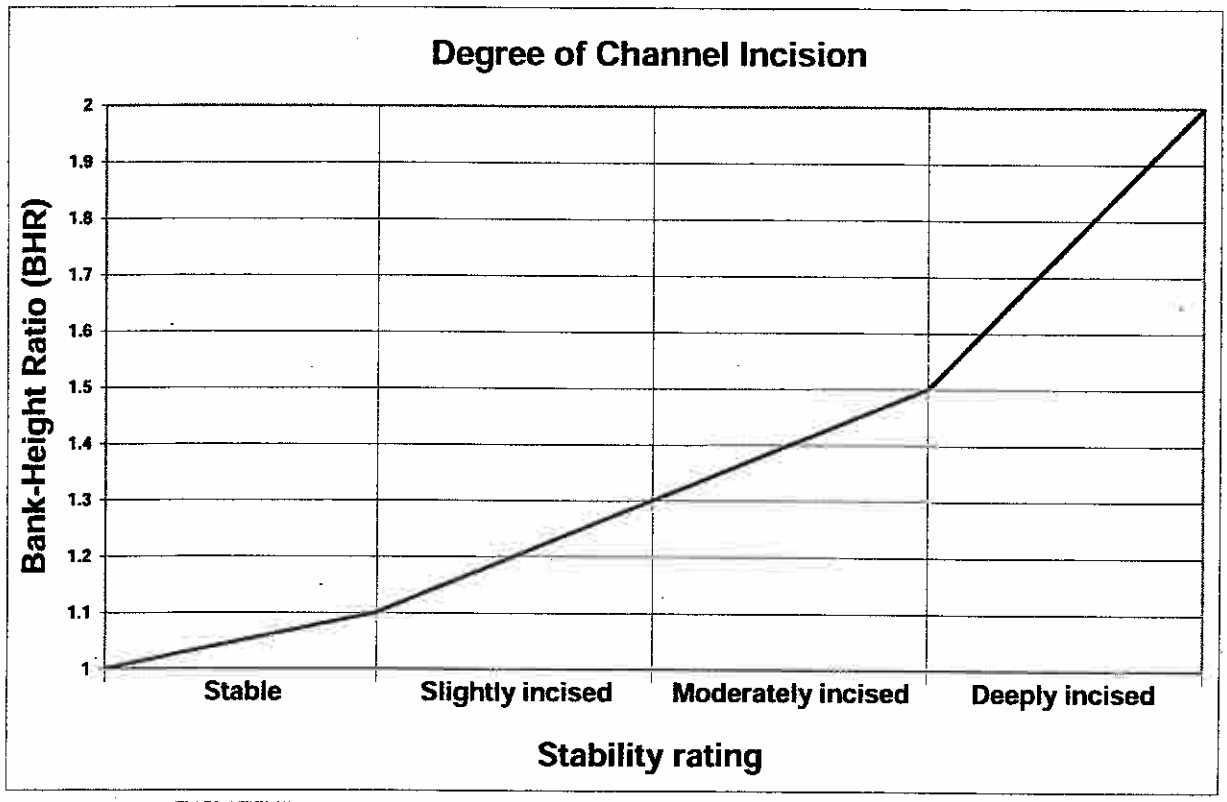
g. Degree of Channel Incision (Bank-Height Ratio)

Worksheet C-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:	1.9	Bank-Height Ratio:	1
Max Bankfull Depth:	1.9		
Degree of Channel Incision Stability Rating ☞	Stable		



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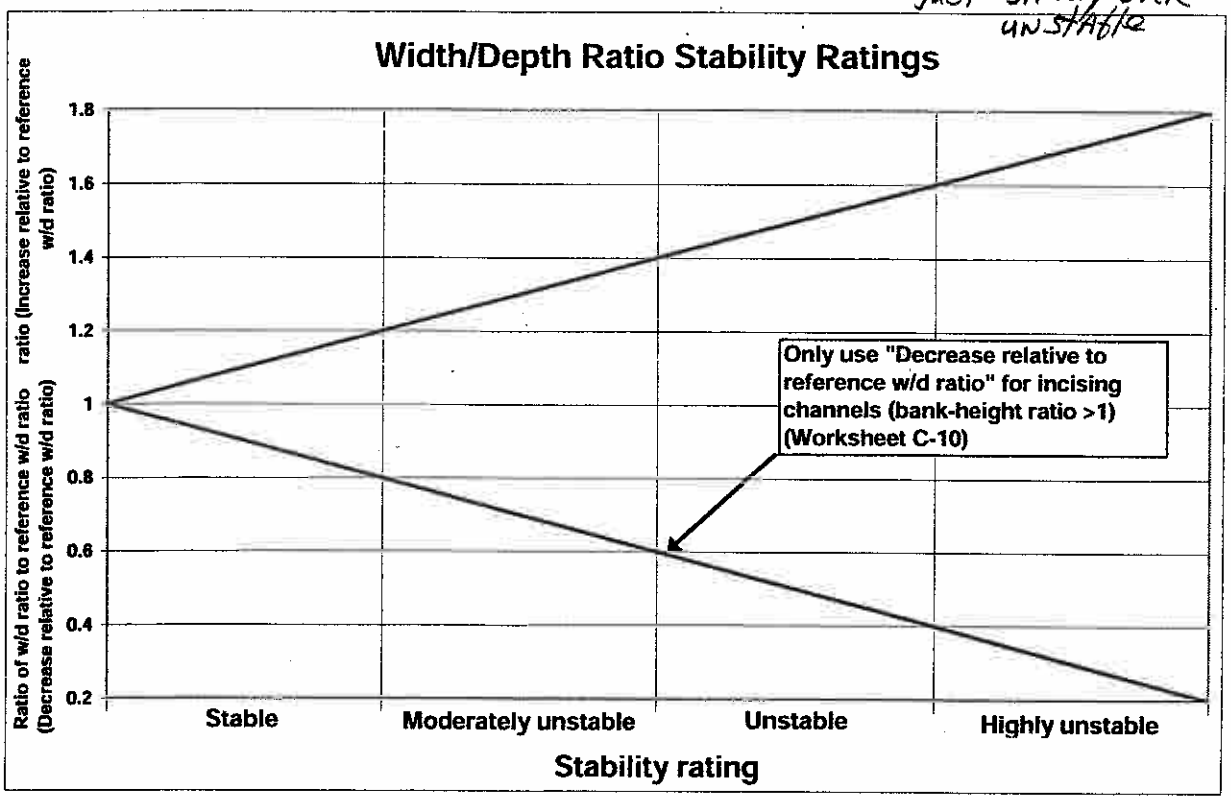
i. Width/Depth Ratio State

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

Width/Depth Ratio State			
Existing Width/Depth Ratio:	18.9	Ratio of existing w/d to reference w/d:	1.62
Reference Width/Depth Ratio:	11.7		
Width/Depth Ratio State Stability Rating ☞	Highly Unstable just barely over unstable		



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

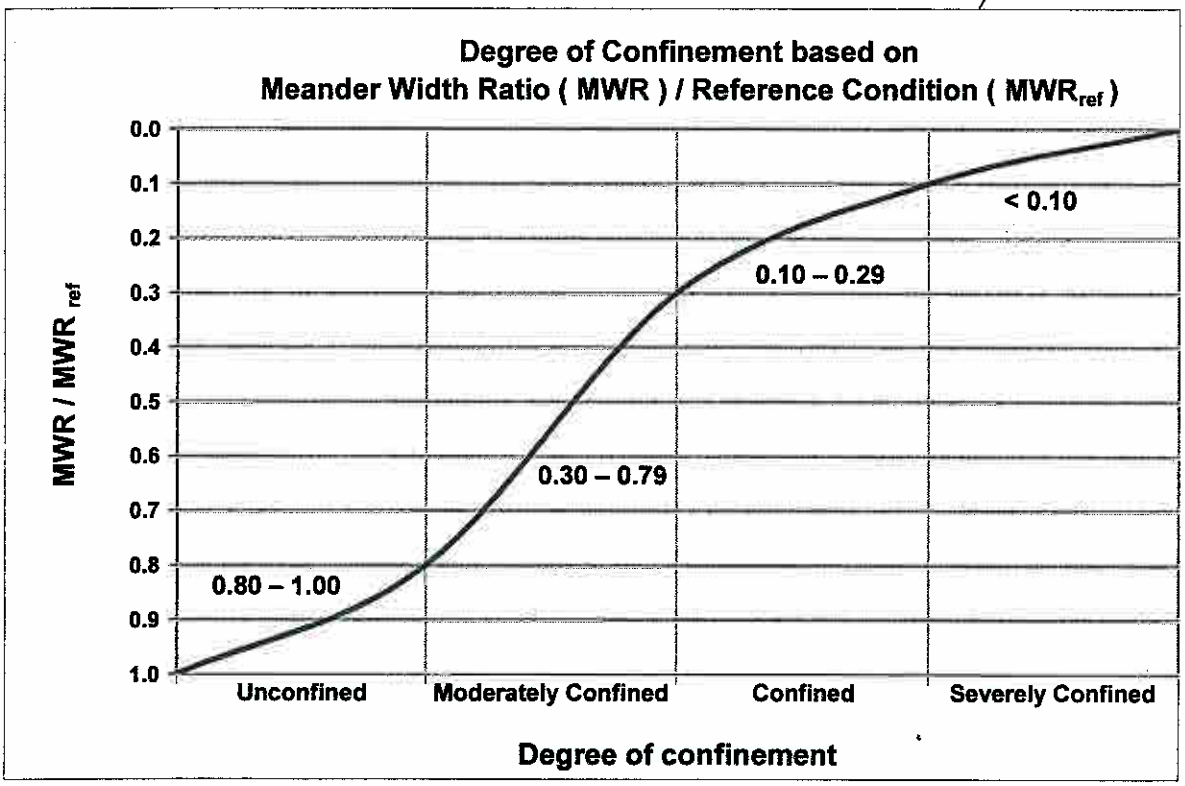
1.6
2.3

Bankfull width
25.7

41
or
60

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

Degree of Confinement			
Existing Meander Width Ratio (MWR):	2.3	Ratio of MWR to MWRref:	.57
Reference Meander Width Ratio (MWR_{ref}):	4*	* Reference Data (Lower End)	
Degree of Confinement Stability Rating ☞	Moderately Confined		



4-20
range

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

h. Modified Pfankuch Channel Stability Rating

Worksheet C-11. Modified Pfankuch channel stability rating procedure as modified by Rosgen.

Stream: Magruder Location: Reach 2 Valley Type: R Observers: Team 2 Date: 9-25-07

Location	Key	Category	Excellent Description	Excellent Rating	Good Description	Good Rating	Fair Description	Fair Rating	Poor Description	Poor Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species & less vigor indicating poor, discontinuous and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water, too.	1	Common. Algae forms in low velocity and pool areas. Moss here, too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent total =	7	Good total =	20	Fair total =	14	Poor total =	64

Stream type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

*Rating should be adjusted to potential stream type, not existing.

Grand total =	105
Existing stream type =	C4
*Potential stream type =	Fair
Modified channel stability rating =	unstable

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SITE SKETCH

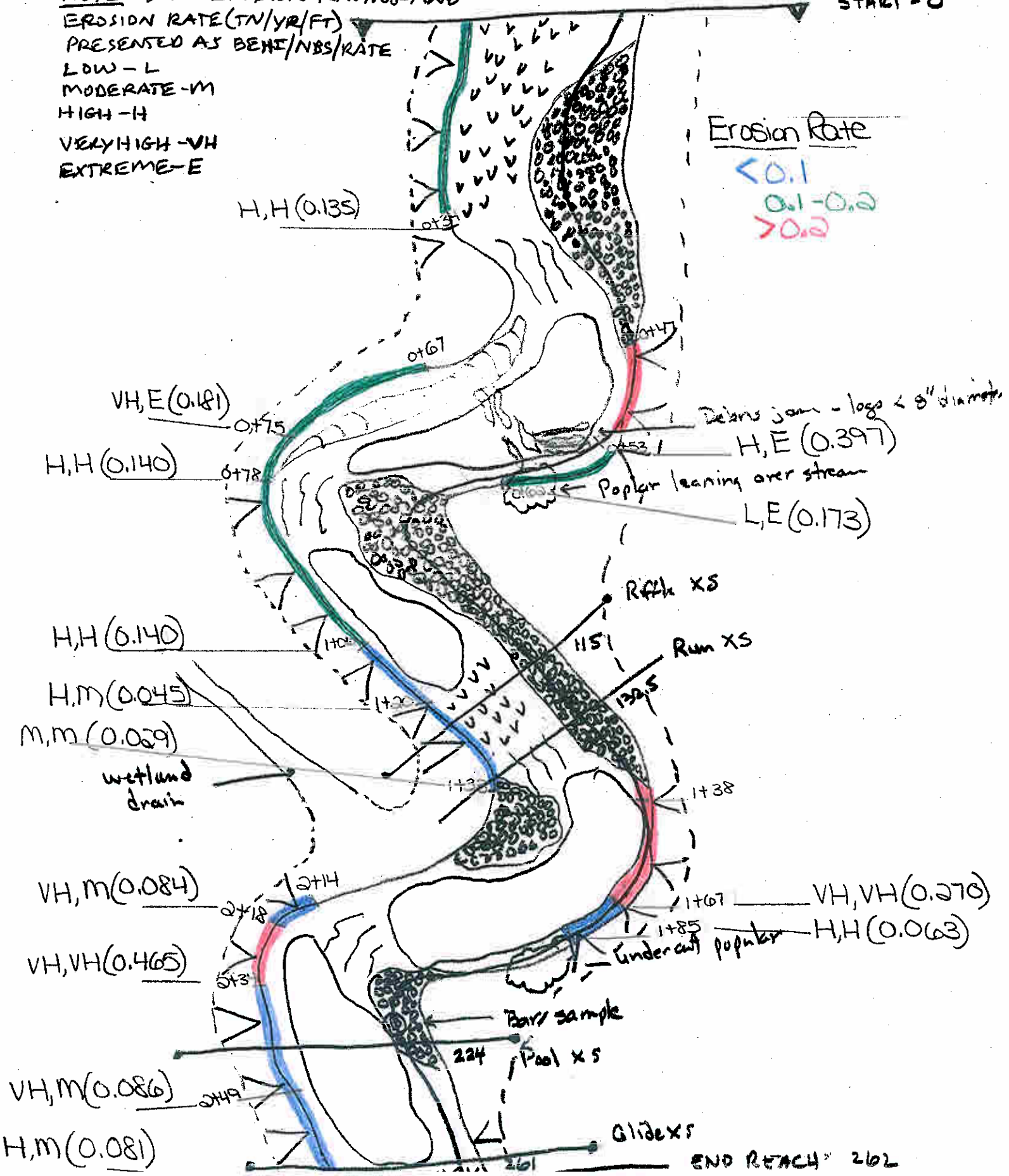
STREAM: McGruder Br, Montg. Co., MD DATE: 9/25/07

STREAM TYPE: C4, VALLEY TYPE: B

CREW: 2

NOTE: BANK EROSION RATING AND EROSION RATE (TN/YR/FT) PRESENTED AS BEHI/NBS/RATE

LOW - L
MODERATE - M
HIGH - H
VERY HIGH - VH
EXTREME - E



River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-16. Summary form to estimate annuals streambank erosion for various study reaches.

Stream: MacGruder Location: Montg. Co. MD

Graph Used: D.C. 9/07 Total Bank Length (ft): 210 Date: 9/25/07

Observers: Team 2 Valley Type: 8 Stream Type: C4

(1) Station (ft)	(2) BEHI rating (Worksheet A-14) (adjective)	(3) NBS rating (Worksheet A-15) (adjective)	(4) Bank erosion rate ~~(Figure A-24 or A-25)~~ (ft/yr)	(5) Length of bank (ft)	(6) Study bank height (ft)	(7) Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)	(8) Erosion Rate (tons/yr/ft) {[(7)/27] × 1.3 / (5)}
1. 0+02 TO 0+34 RT	HIGH	HIGH	1.0	32	2.8	89.6	0.135
2. 0+53 TO 0+62 LT	LOW	EXTREME	1.2	9	3.0	32.4	0.173
3. 0+47 TO 0+53 LT.	HIGH	EXTREME	2.5	6	3.3	49.5	0.397
4. 0+67 TO 0+75 RT	VERY HIGH	EXTREME	2.5	8	1.5	30.0	0.181
5. 0+75 0+78 RT	HIGH	HIGH	1.0	3	2.9	8.7	0.140
6. 0+78 TO 0+90 RT	HIGH	HIGH	1.0	12	3.0	36.0	0.144
7. 0+90 TO 0+98 RT	HIGH	HIGH	1.0	8	2.9	23.2	0.140
8. 0+98 TO 1+06 RT	HIGH	HIGH	1.0	8	3.0	24.0	0.140
1+06-1+28 RT	HIGH	MODERATE	0.45	15	2.1	14.2	0.045
RIFFLE RUN 9. 1+21-1+33 RT	MODERATE	MODERATE	0.30	12	2.0	7.2	0.029
10. 1+38 TO 1+67 LT	VERY HIGH	VERY HIGH	1.7	29	3.3	162.7	0.270
11. 1+67 TO 1+85 LT	HIGH	HIGH	1.0	18	1.3	23.4	0.063
12. 2+14 TO 2+18 RT	VERY HIGH	MODERATE	0.65	4	2.7	7.0	0.084
POOL 13. 2+18 TO 2+34 RT	VERY HIGH	VERY HIGH	2.1	16	4.6	154.5	0.465
14. 2+34 TO 2+49 LT	VERY HIGH	MODERATE	0.62	15	2.9	27.0	0.086
GLIDE 15. 2+49 TO 2+64 RT	HIGH	MODERATE	0.62	15	2.7	25.1	0.081
Sum erosion subtotals in Column (7) for each BEHI/NBS combination				Σ210	Total erosion (ft^3/yr)	714.5	
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}					Total erosion (yds^3/yr)	26.5	
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}					Total erosion (tons/yr)	34.4	
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed} 210					Total erosion (tons/yr/ft)	.164	

(0.0.5)

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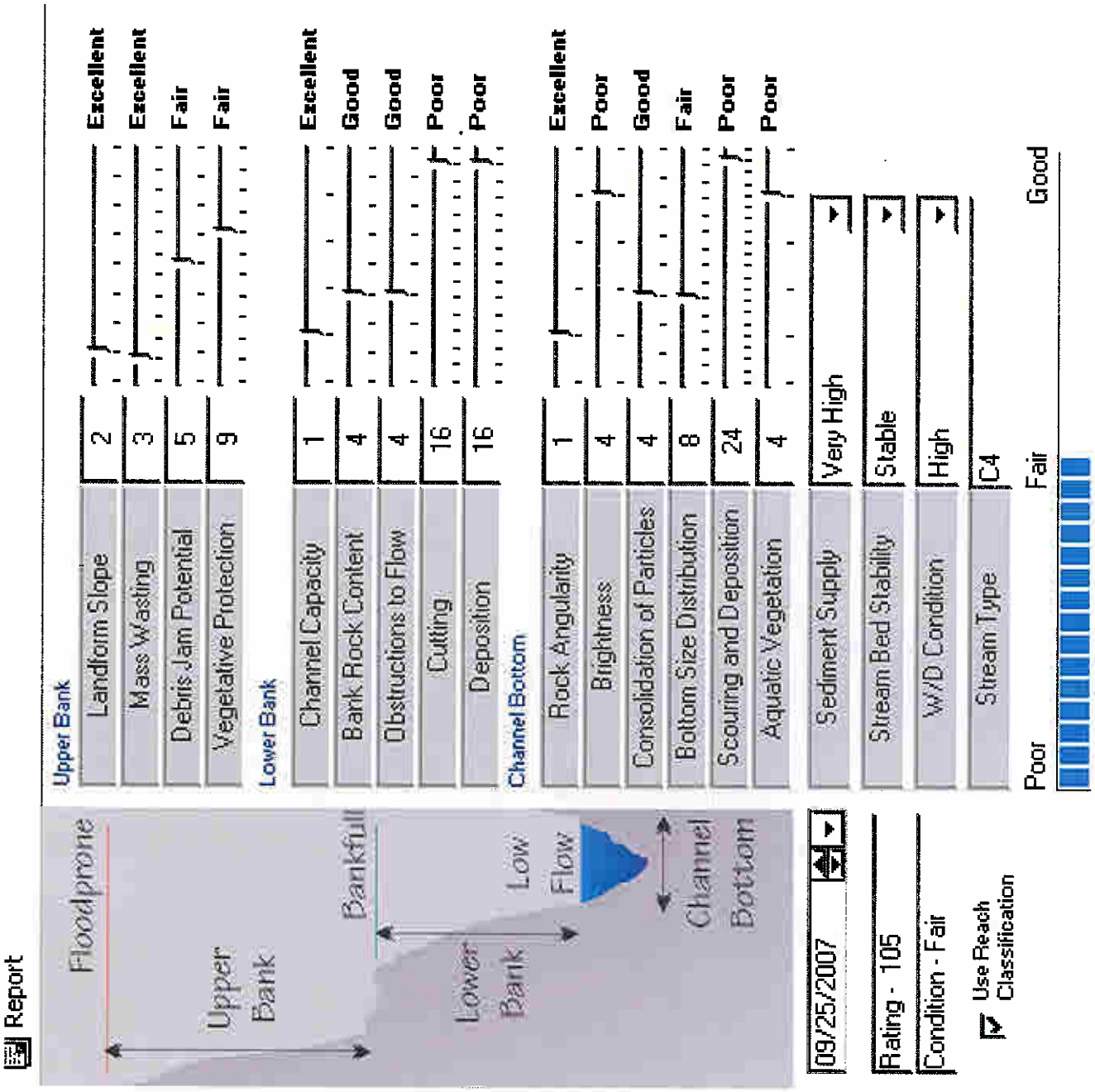
RIFFLE X.S. BANK PROFILE STA. 1+15 BEHI = ~~HIGH~~, NBS = LOW .4 1.2 .72 .034

POOL X.S. BANK PROFILE STA. 2+24 BEHI = V.HIGH, NBS = HIGH 1.0 4.8 4.8 .23

GLIDE X.S BANK PROFILE STA. 2+62 BEHI = HIGH, NBS = LOW .4 2.3 .92 .04


Report
Floodprone
Upper Bank
Bankfull
Lower Bank
Low Flow
Channel Bottom
09/25/2007
Rating - 105
Condition - Fair
Use Reach Classification
Upper Bank
Landform Slope 2 Excellent
Mass Wasting 3 Excellent
Debris Jam Potential 5 Fair
Vegetative Protection 9 Fair
Lower Bank
Channel Capacity 1 Excellent
Bank Rock Content 4 Good
Obstructions to Flow 4 Good
Cutting 16 Poor
Deposition 16 Poor
Channel Bottom
Rock Angularity 1 Excellent
Brightness 4 Poor
Consolidation of Particles 4 Good
Bottom Size Distribution 8 Fair
Scouring and Deposition 24 Poor
Aquatic Vegetation 4 Poor
Sediment Supply Very High
Stream Bed Stability Stable
W/D Condition High
Stream Type C4
Poor
Fair
Good

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

Stream: extra BEHIS, Reach - Reach 1 Location:

Graph Used: Total Bank Length (ft): 210 Date: 12/30/1999

Observers: Valley Type: Stream Type:

(1) Station (ft)	(2) BEHI rating (Worksheet 5-8) (adjective)	(3) NBS rating (Worksheet 5-9) (adjective)	(4) Bank erosion rate (Figure 5-38 or 5-39) (ft/yr)	(5) Length of bank (ft)	(6) Study bank height (ft)	(7) Erosion subtotal [(4)×(5)×(6)] (ft³/yr)	(8) Erosion Rate (tons/yr/ft) [[(7)/27] × 1.3 /(5)]
1. 115 Riffle	High	Low	0.45	1	1.8	0.81	0.04
2. 224 Pool	Very High	High	1.6875	1	4.8	8.1	0.39
3. 262 Glide	High	Low	0.3521739	1	2.3	0.81	0.04
4. 38-106 RB	High	High	1.00125	8	3	24.03	0.14
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					Total erosion (ft³/yr)	33.75	
Convert erosion in ft³/yr to yds³/yr (divide Total erosion (ft³/yr) by 27)					Total erosion (yds³/yr)	1.25	
Convert erosion in yds³/yr to tons/yr (multiply Total erosion (yds³/yr) by 1.3)					Total erosion (tons/yr)	1.63	
Calculate erosion per unit length of channel (divide Total erosion (tons/yr) by total length of stream (ft) surveyed)					Total erosion (tons/yr/ft)	0.0077	

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

Stream: Macgruder Creek, Reach - Reach 1 Location:

Graph Used: Total Bank Length (ft): 210 Date: 12/30/1995

Observers: Valley Type: Stream Type:

(1) Station (ft)	(2) BEHI rating (Worksheet 5-8) (adjective)	(3) NBS rating (Worksheet 5-9) (adjective)	(4) Bank erosion rate (Figure 5-58 or 5-59) (ft/yr)	(5) Length of bank (ft)	(6) Study bank height (ft)	(7) Erosion subtotal [(4)×(5)×(6)] (ft³/yr)	(8) Erosion Rate (tons/yr/ft) [((7)/27)×1.3/(5)]
1. 106-121 RB	High	Moderate	0.4542857	15	2.1	14.31	0.05
2. 121-133 RB	Moderate	Very High	0.30375	12	2	7.29	0.03
3. 138-167 LB	High	Very High	1.7012539	29	3.3	162.81	0.27
4. 167-185 LB	High	Very High	1.0038462	18	1.3	23.49	0.06
5. 214-218 RB	High	Low	0.65	4	2.7	7.02	0.03
6. 218-234 RB	Very High	Very High	2.0583696	16	4.6	154.44	0.46
7. 2-34 RB	High	High	1.0004464	32	2.8	89.64	0.13
8. 234-249 RB	Very High	Moderate	0.6206857	15	2.9	27	0.09
9. 249-264 RB	High	Moderate	0.62	15	2.7	25.11	0.08
10. 47-53 LB	High	Extreme	2.4954545	6	3.3	49.41	0.40
11. 53-62 LB	Moderate	Extreme	1.2	9	3	32.4	0.17
12. 67-75 RB	High	Extreme	2.4975	8	1.5	29.97	0.18
13. 75-78 RB	High	High	0.553 1034	3	2.9	8.64	0.14
14. 78-90 RB	High	High	0.9975	12	3	35.91	0.14
15. 90-98 RB	High	High	1.0008621	8	2.9	23.22	0.14
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					Total erosion (ft³/yr)	690.66	
Convert erosion in ft³/yr to yds³/yr (divide Total erosion (ft³/yr) by 27)					Total erosion (yds³/yr)	25.58	
Convert erosion in yds³/yr to tons/yr (multiply Total erosion (yds³/yr) by 1.3)					Total erosion (tons/yr)	33.25	
Calculate erosion per unit length of channel (divide Total erosion (tons/yr) by total length of stream (ft) surveyed)					Total erosion (tons/yr/ft)	0.1584	

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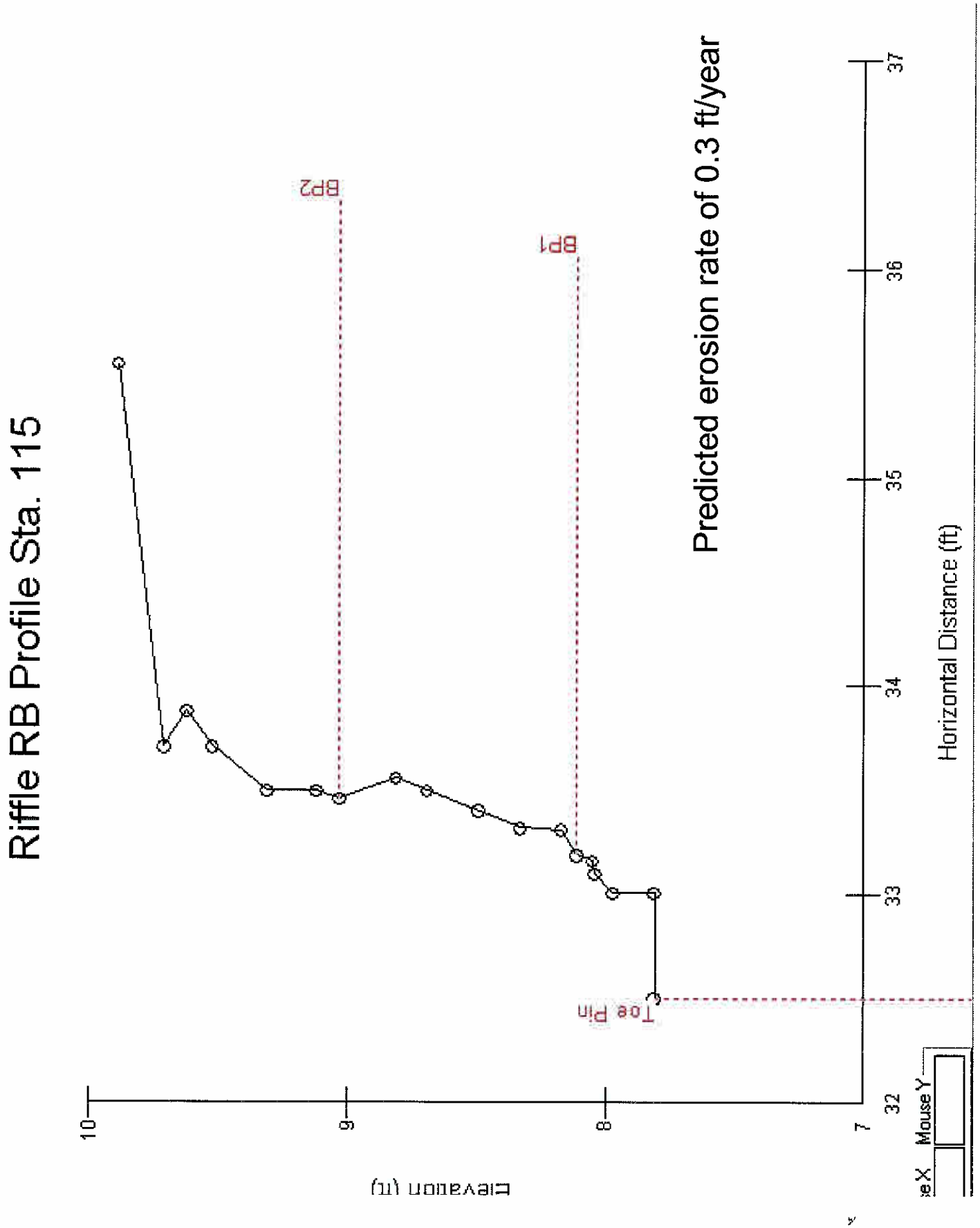
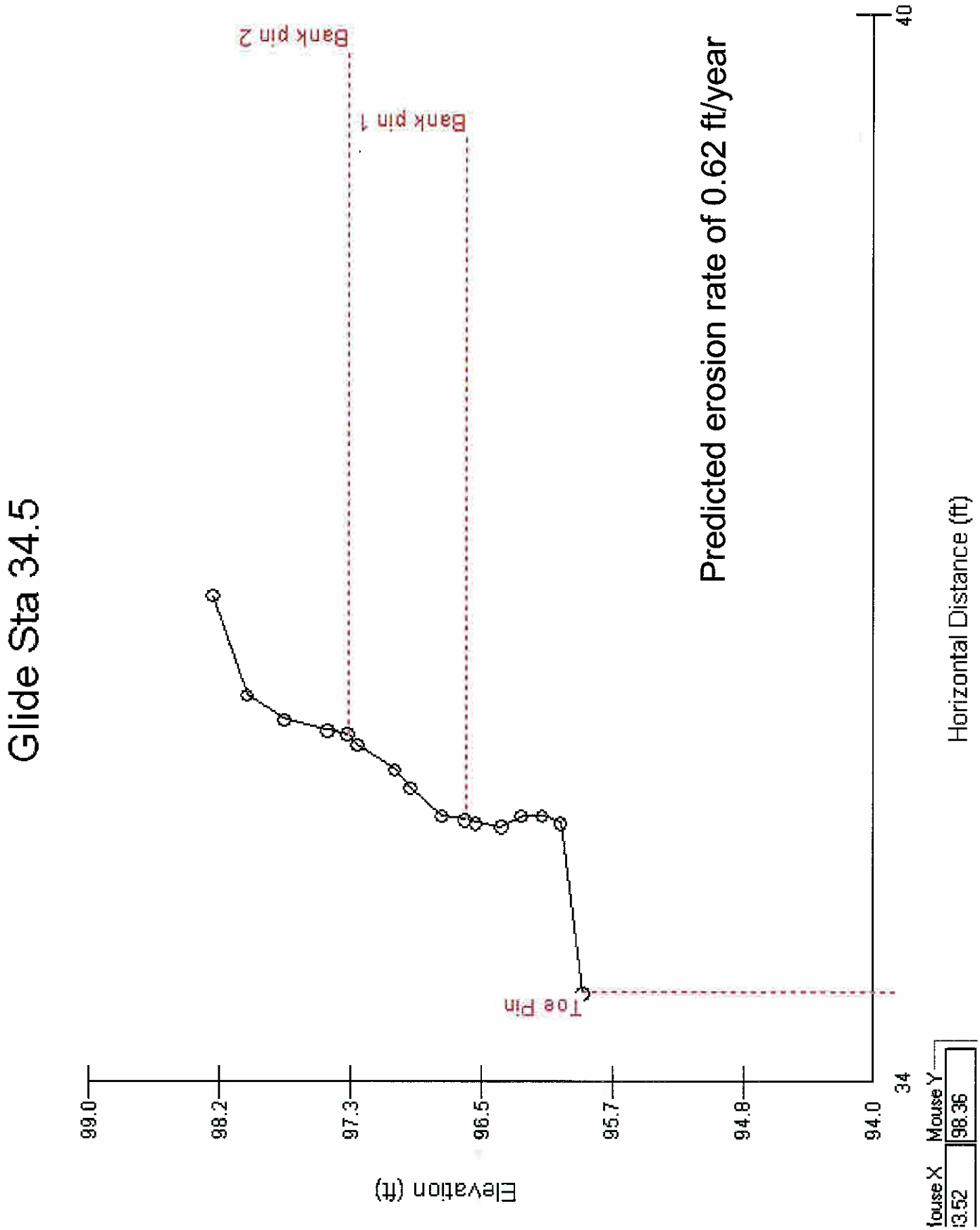
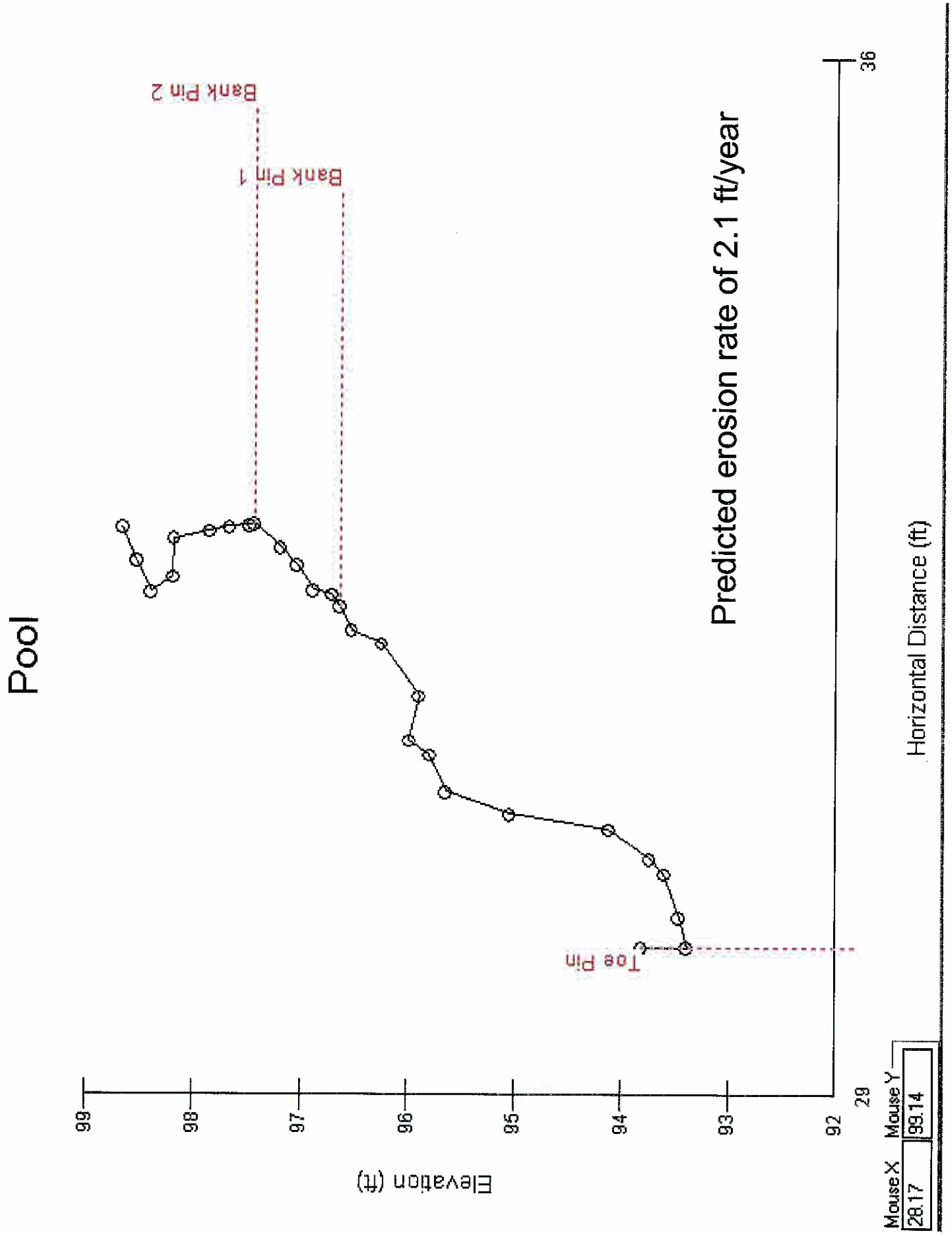

Riffle RB Profile Sta. 115
Predicted erosion rate of 0.3 ft/year
BP2
BP1
Toe Pin
Elevation (ft)
10
9
8
7
32
33
34
35
36
37
Horizontal Distance (ft)
Mouse Y
Mouse X


Glide Sta 34.5
Predicted erosion rate of 0.62 ft/year
Bank pin 2
Bank pin 1
Toe Pin
Elevation (ft)
99.0
98.2
97.3
96.5
95.7
94.8
94.0
34
40
Horizontal Distance (ft)
Mouse X
Mouse Y
98.36


Pool
Predicted erosion rate of 2.1 ft/year
Bank Pin 2
Bank Pin 1
Toe Pin
Elevation (ft)
99
98
97
96
95
94
93
92
29
36
Horizontal Distance (ft)
Mouse X
28.17
Mouse Y
99.14

Worksheet 5-12b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream: Magruder Branch, Reach 3, Riffle cross section Location: Reach 3 Date: 09/18/07

Observers: Team 3 Stream Type: C4 Valley Type: VIII Gage Station #: 01591000

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)*(14)]	Time adjusted suspended sand transport [(13)*(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.13										0%						
90.0%	5.18	2.66	0.76	6.63	0.11	3.52	0.007	0.05	1.29	0.13	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	7.51	6.35	1.81	11.48	0.16	3.52	0.008	0.08	3.09	0.27	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	9.19	8.35	2.37	12.69	0.19	3.52	0.008	0.09	4.06	0.32	10%	36.50	0.00	0.10	0.00	0.01	0.01
60.0%	11.52	10.36	2.95	13.80	0.21	3.52	0.008	0.10	5.04	0.37	10%	36.50	0.00	0.10	0.00	0.01	0.01
50.0%	15.02	13.27	3.77	14.43	0.26	3.52	0.007	0.12	6.46	0.45	10%	36.50	0.00	0.10	0.00	0.01	0.01
40.0%	18.39	16.70	4.75	14.82	0.32	3.52	0.008	0.15	8.13	0.55	10%	36.50	0.00	0.10	0.00	0.01	0.01
30.0%	23.05	20.72	5.89	15.25	0.39	3.52	0.007	0.18	10.08	0.66	10%	36.50	0.00	0.20	0.00	0.02	0.02
20.0%	29.91	26.48	7.53	15.73	0.48	3.52	0.008	0.23	12.83	0.82	10%	36.50	0.00	0.20	0.00	0.02	0.02
10.0%	41.43	35.67	10.14	16.54	0.61	3.52	0.008	0.29	17.36	1.05	10%	36.50	0.40	0.30	0.04	0.03	0.07
5.0%	58.13	49.78	14.15	18.32	0.73	3.52	0.007	0.34	24.23	1.25	5%	18.25	0.40	0.50	0.02	0.03	0.05
4.0%	64.39	61.56	17.50	23.22	0.75	3.52	0.007	0.35	29.96	1.29	1%	3.65	0.40	0.7	0.00	0.01	0.01
3.0%	75.35	70.17	19.95	24.86	0.80	3.52	0.008	0.38	34.15	1.37	1%	3.65	0.90	0.90	0.01	0.01	0.02
2.0%	97.23	86.29	24.53	25.55	0.96	3.52	0.01	0.45	42.00	1.64	1%	3.65	1.30	1.30	0.01	0.01	0.02
1.5%	116.78	107.01	30.42	30.24	1.01	3.52	0.007	0.47	52.08	1.72	1%	1.83	1.30	1.80	0.01	0.01	0.02
1.0%	147.34	132.06	37.55	35.29	1.06	3.52	0.01	0.49	64.28	1.82	1%	1.83	1.70	2.40	0.01	0.01	0.02

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	36.5	69.4	105.9
Upstream total annual sediment supply (tons/yr) (Worksheet 5-12a):	124.0	124.0	248.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-87.5	-54.7	-142.2
Stability evaluation: Aggradation, Degradation or Stable:			

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River Assessment and Monitoring: Reference Reach 1st Field Day

Additional BEHI and NBS worksheets

Stream: MacGruder Br Location: Monts. Co MD

Station: (78-90) (98-106) RB Observers: Team 2

Date: 9/25/07 Stream Type: C4 Valley Type: B

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.0 (A)	Bankfull Height (ft) =	1.6 (B)	(A)/(B) =	1.8 (C)	7.5
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	2.0 (D)	Study Bank Height (ft) =	~~7~~ 3.0 (A)	(D)/(A) =	~~1~~ .6 (E)	5
Weighted Root Density (G)						
Root Density as % =	25 (F)			(F) x (E) =	20 (G)	7
Bank Angle (H)						
Bank Angle as *Degrees* =	50 (H)					3
Surface Protection (I)						
Surface Protection as % =	35 (I)					5

Bank Material Adjustment:

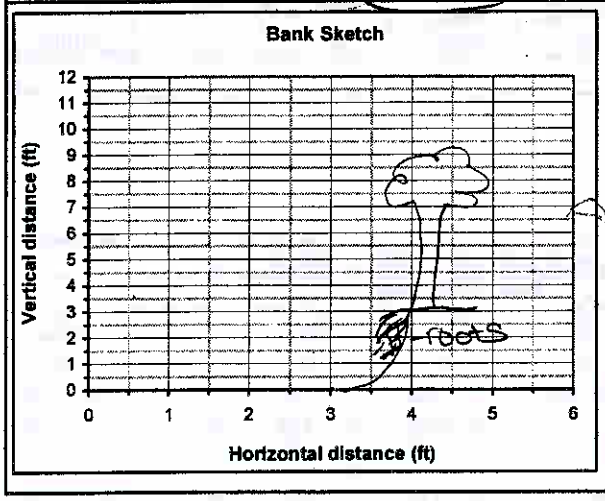
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

Bank Material Adjustment 0

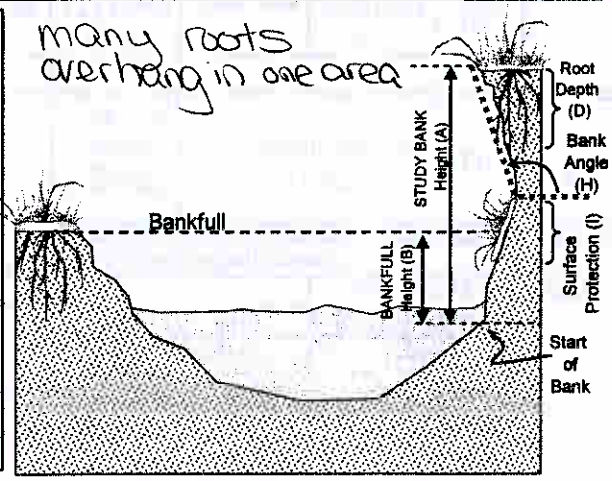
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 2

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	30

High



many roots overhang in one area



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River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream:	Location:	
Station:	Stream Type:	Valley Type:
Observers:		Date:

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

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress: High

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	2.3	1.18	1.9	High

1.8

(6)	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)

Level IV

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

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

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River Assessment and Monitoring: Reference Reach 1st Field Day

Additional BEHI and NBS worksheets

Stream: MAGRUDER BR Location: MONTEGO, MO

Station: Sta 9098 RB (75-78) Observers: TEAM 2

Date: 9/25/07 Stream Type: C4 Valley Type: 8

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.9 (A)	Bankfull Height (ft) =	1.7 (B)	(A)/(B) =	1.7 (C)	7.5
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.9 (D)	Study Bank Height (ft) =	2.9 (A)	(D)/(A) =	.31 (E)	5.8
Weighted Root Density (G)						
Root Density as % =	40 (F)			(F)x(E) =	12.4 (G)	8.5
Bank Angle (H)						
Bank Angle as *Degrees* =	55 (H)					3.8
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

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)

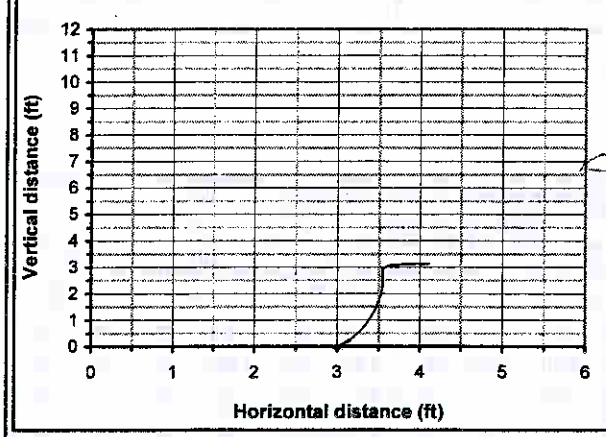
Bank Material Adjustment 0

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 2

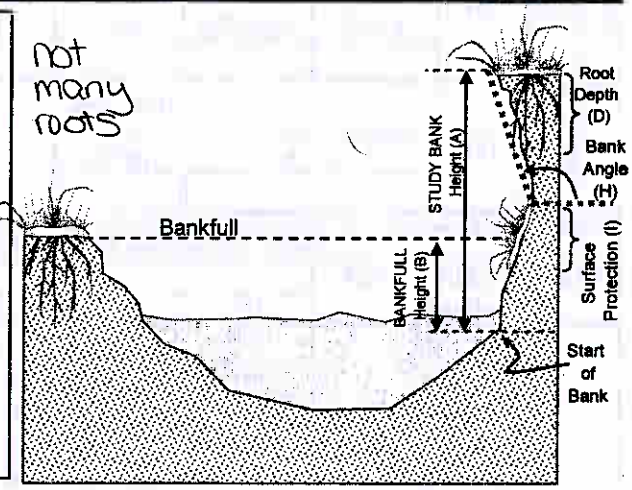
Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score 37.6 High

Bank Sketch



not many roots



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River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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

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

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

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

Dominant Near-Bank Stress

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2.25	1.18	1.9	High

(6) 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)

Level IV

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

.75
+1.5
2.25

.3 2.1
.5 1.8
.85 2.1
1.5 .65
1.75 = 9.45

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

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Additional BEHI and NBS worksheets

Stream: MAGRUDER BR. Location: MONTG. CO., MD

Station: Sta 262 RB Observers: TEAM 2

Date: 7/25/07 Stream Type: C4 Valley Type: B

Glide XS Bank profile

						BEHI Score (Fig. B-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.3 (A)	Bankfull Height (ft) =	2.2 (B)	(A) / (B) =	1.0 (C)	0
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.6 (D)	Study Bank Height (ft) =	2.3 (A)	(D) / (A) =	.26 (E)	6.5
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F) x (E) =	2.6 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	85 (H)					8
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

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)

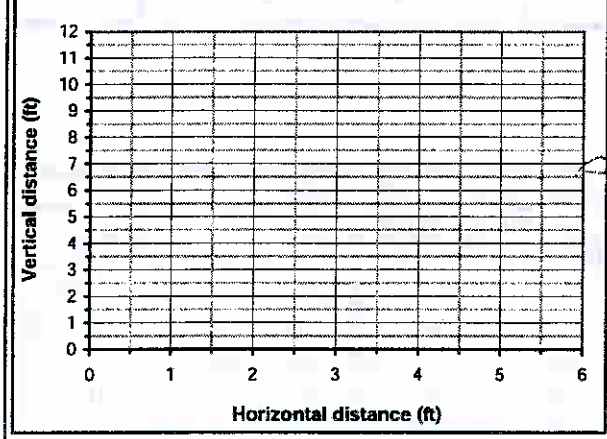
Bank Material Adjustment 0

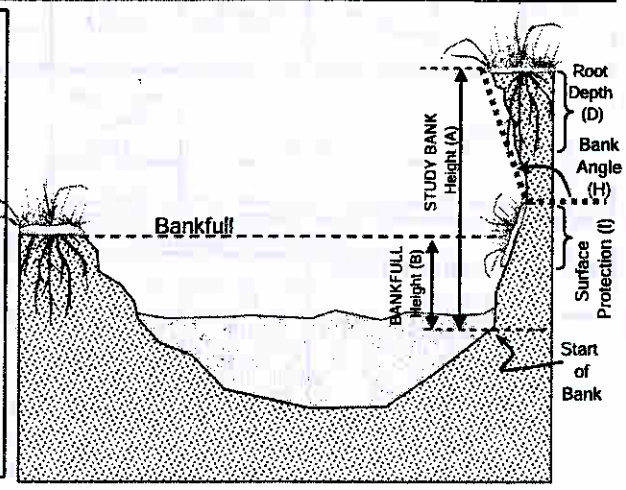
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 3

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 37.5

Bank Sketch





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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Estimating Near-Bank Stress (NBS)

Stream: MAGRUDER BR. Location: MONTG. CO, MD

Station: 262 Sta RB Stream Type: C4 Valley Type: B

Observers: TEAM 2 Date: 9/25/07

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

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress: LOW

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	2.19	1.7	1.2	

(6)	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)

Level IV

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

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

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Additional BEHI and NBS worksheets

At Riffle xs Bank profile

Stream: Macanuder		Location: Reach 2	
Station: Sta 115 RB		Observers: Team 2	
Date: 9-25-07	Stream Type: C4	Valley Type: 8	

						BEHI Score (Fig. B-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	1.8 (A)	Bankfull Height (ft) =	2.0 (B)	(A) / (B) =	.9 (C)	1
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.8 (D)	Study Bank Height (ft) =	1.8 (A)	(D) / (A) =	.4 (E)	5
Weighted Root Density (G)						
		Root Density as % =	10 (F)	(F) x (E) =	4 (G)	9.5
Bank Angle (H)						
				Bank Angle as *Degrees* =	85 (H)	8
Surface Protection (I)						
				Surface Protection as % =	15 (I)	10

Bank Material Adjustment:

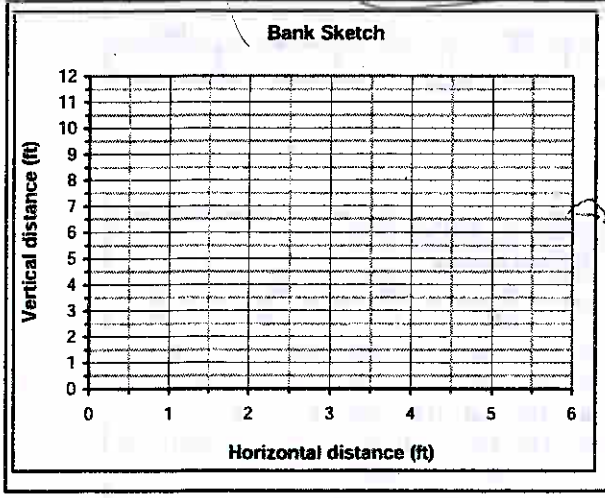
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

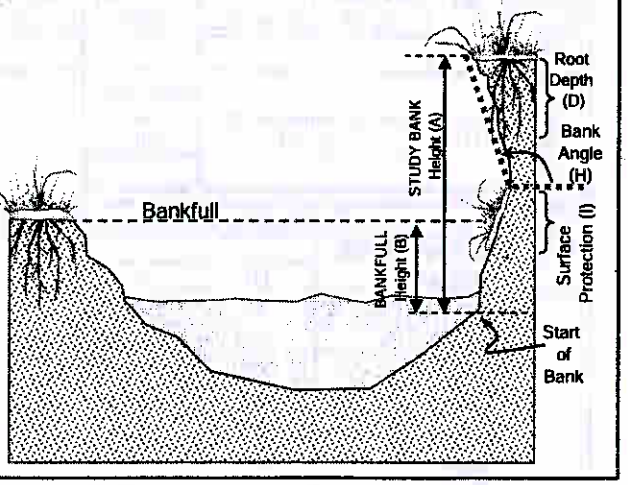
Bank Material Adjustment 0

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 33.5





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River Assessment and Monitoring: Impaired Reach 2nd Field Day

ii. Near-Bank Stress

Worksheet B-15. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: MCGRUDER BR Location: Riffle XS Bank profile

Station: Sta 115 RB Stream Type: Valley Type:

Observers: JE Date:

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

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

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

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

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
1.960	1.39	1.4	

(6) 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)

Level IV

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

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

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River Assessment and Monitoring: Impaired Reach 2nd Field Day

Additional BEHI and NBS worksheets

Stream: MAGRUDER BR. Location: MONTG CO., MD

Station: Sta 224 RB Observers: TEAM 2

Date: 9/25/07 Stream Type: C4 Valley Type: 8

Pool XS Bank profile

						BEHI Score (Fig. B-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.8 (A)	Bankfull Height (ft) =	3.7 (B)	(A) / (B) =	1.2 (C)	4
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.7 (D)	Study Bank Height (ft) =	4.8 (A)	(D) / (A) =	.14 (E)	8
Weighted Root Density (G)						
Root Density as % =	15 (F)			(F) x (E) =	2.1 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	75 (H)					5
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

Get NBS from XS

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

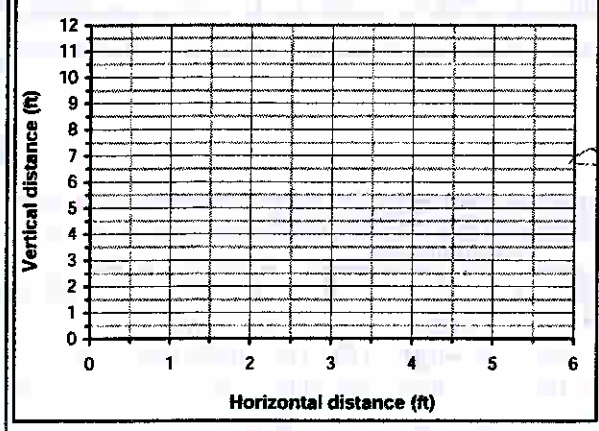
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 4

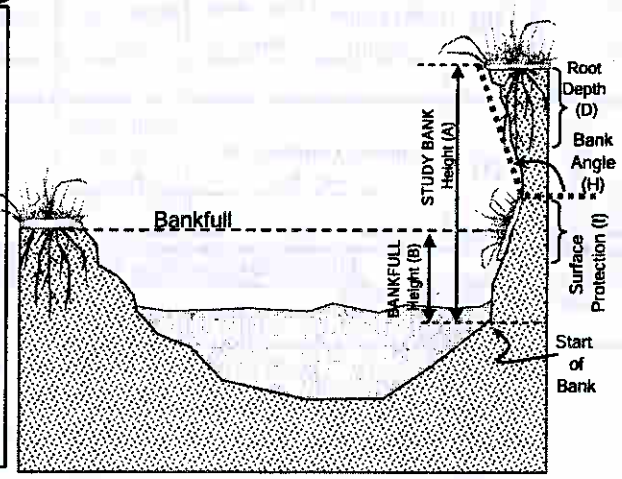
Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score 41

Very High

Bank Sketch





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Pool XS Bank

River Assessment and Monitoring: Impaired Reach 2nd Field Day

Estimating Near-Bank Stress (NBS)

Stream: MACGRUDER Location: MONTG. CO, MD

Station: Sta 224 RB Stream Type: C4 Valley Type: 8

Observers: TEAM 2 Date: 9/25/07

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

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

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

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

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
4.6	2.1	2.1	

(6) 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)

Level IV

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

Dominant Near-Bank Stress: High

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

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream: MACGRUDER BR. Location: MONTG. CO. MO

Station: 2-34 RB Observers: TEAM 2

Date: 9/25/07 Stream Type: C4 Valley Type: 8

WS to Bkfl: 1.5

							BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)							
3.1 2.7 2.8	Study Bank Height (ft) =	2.8 (A)	Bankfull Height (ft) =	1.6 (B)	(A) / (B) =	1.8 (C)	7.5
Root Depth / Study Bank Height (E)							
2.5 2.6 2.8	Root Depth (ft) =	1.6 (D)	Study Bank Height (ft) =	2.8 (A)	(D) / (A) =	.57 (E)	35
Weighted Root Density (G)							
	Root Density as % =	30 (F)			(F) x (E) =	17 (G)	7.5
Bank Angle (H)							
130 133 135	Bank Angle as *Degrees* =	133 (H)					10
Surface Protection (I)							
	Surface Protection as % =	2 (I)					10

off chart

Bank Material Adjustment:

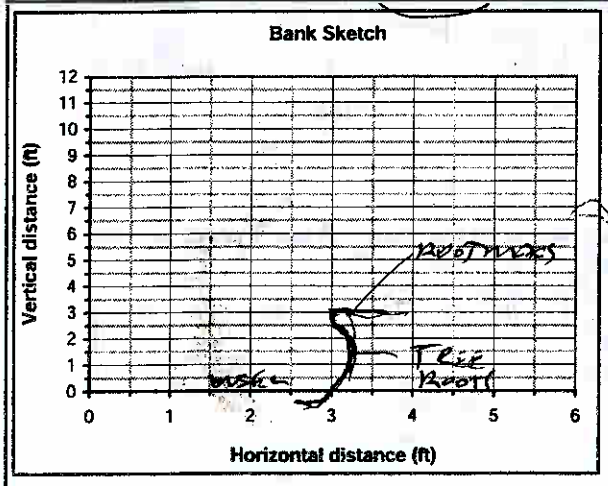
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

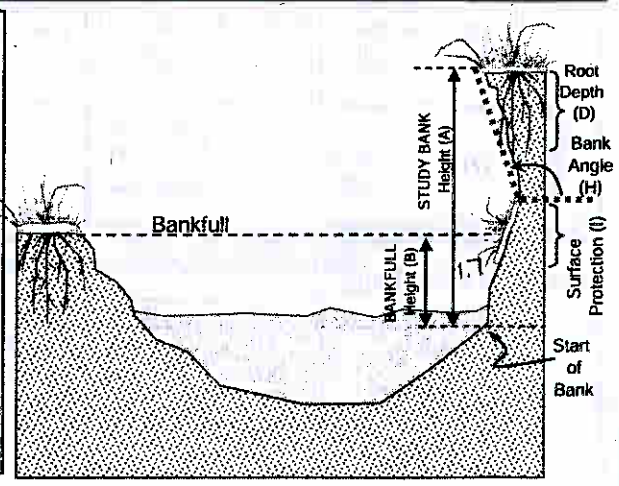
Bank Material Adjustment 0

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	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	38.5

High





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River Assessment and Monitoring: Impaired Reach 3rd Field Day

ii. Near-Bank Stress

Worksheet C-15. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location:	
Station:	Stream Type:	Valley Type:
Observers:		Date:

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)				

Dominant Near-Bank Stress

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	2.1	1.07	2.0	High

	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)		

2.1 = max
1.9
1.9
1.65
1.5
1.3
1.3
1.3
1.0
.8
.7
.6
.5
.5
.5
16.05
15
1/1.07
2.0 = 1.07
no max width 16' width

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

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream: MacGruder Br. Location: Montgoa, MO

Station: Sta 47-53 LB Observers: Team 2

Date: 9/25/07 Stream Type: C4 Valley Type: B

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.3 (A)	Bankfull Height (ft) =	1.9 (B)	(A) / (B) =	1.7 (C)	7
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.8 (D)	Study Bank Height (ft) =	3.3 (A)	(D) / (A) =	.24 (E)	6.5
Weighted Root Density (G)						
Root Density as % =	5 (F)			(F) x (E) =	1.2 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	55 (H)					3.8
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

Bank Material Adjustment:

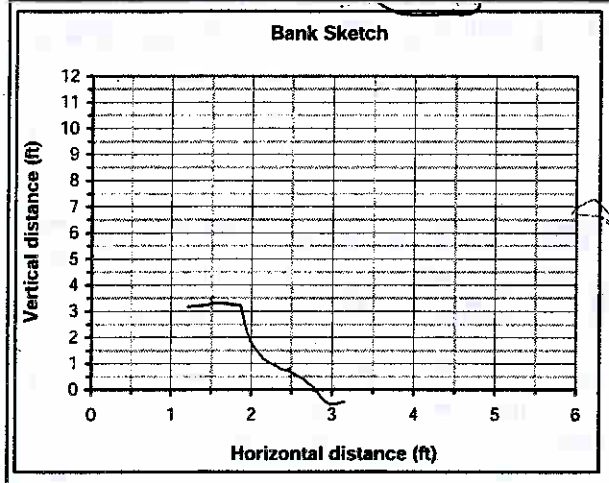
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

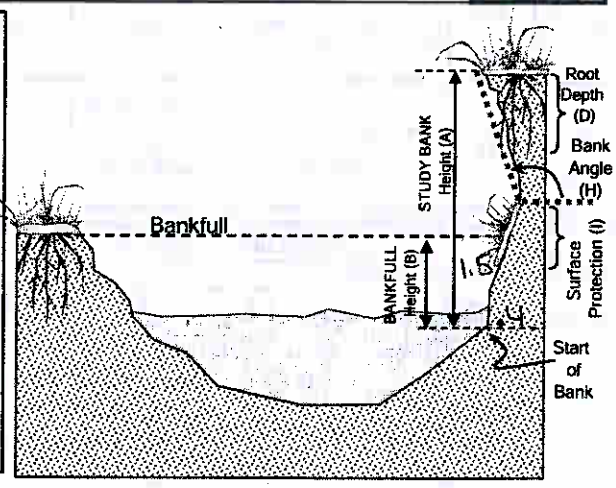
Bank Material Adjustment 0

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 37.3 High





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Estimating Near-Bank Stress (NBS)

Stream:	Location:	
Station:	Stream Type:	Valley Type:
Observers:		Date:

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)	17	17	1.0	Extreme

	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)				

Dominant Near-Bank Stress

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)		

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

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream: MacGruder Location: MONTG. CO. MD

Station: Sta 53-62 LB Observers: TEAM 2

Date: 9/25/07 Stream Type: C4 Valley Type: 8

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.0 (A)	Bankfull Height (ft) =	1.9 (B)	(A) / (B) =	1.5 (C)	6
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	12 (D)	Study Bank Height (ft) =	3.0 (A)	(D) / (A) =	4 (E)	5
Weighted Root Density (G)						
Root Density as % =	60 (F)			(F) x (E) =	39.6 (G)	3.5
Bank Angle (H)						
Bank Angle as *Degrees* =	55 (H)					3.5
Surface Protection (I)						
Surface Protection as % =	85 (I)					1.2

Bank Material Adjustment:

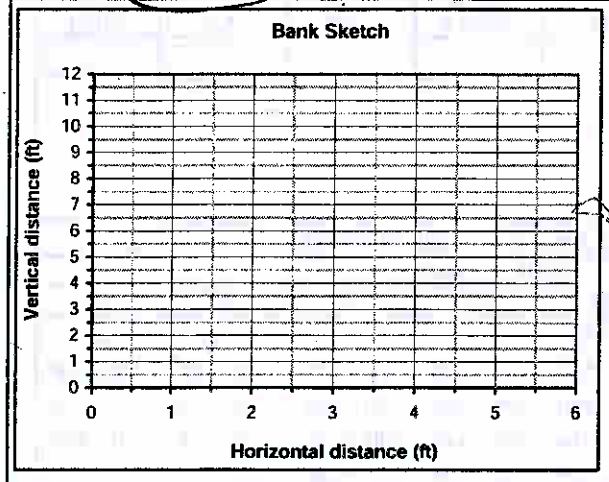
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment 0

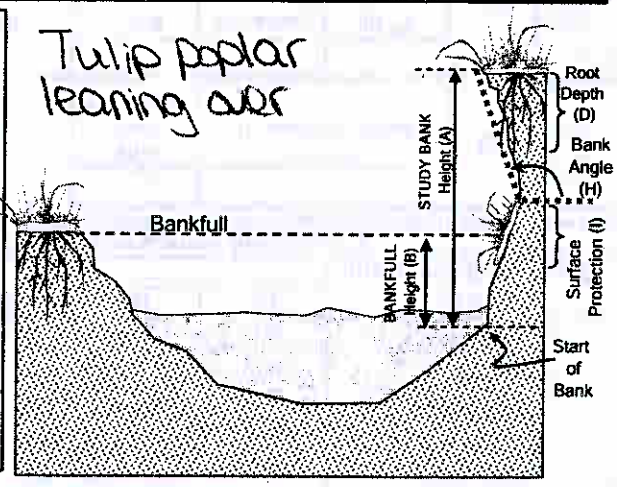
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 0

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 19.2



Tulip poplar leaning over



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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
	17	17	1.0	Extreme

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

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

Dominant Near-Bank Stress: Extreme

Level III

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

(6)	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)

Level IV

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

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

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River Assessment and Monitoring: Impaired Reach

3rd Field Day

Additional BEHI and NBS worksheets

Ask Dave about top

Stream: MacGruder Br. Location: Montgo Co MD & lower bank

Station: Sta 67-75 RB Observers: Team 2

Date: 9/25/07 Stream Type: C4 Valley Type: B

measuring lower bank

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	1.5 (A)	Bankfull Height (ft) =	1.8 .3 (B)	(A) / (B) =	.83 (C)	4.5
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	.3 (D)	Study Bank Height (ft) =	1.5 (A)	(D) / (A) =	.2 (E)	7
Weighted Root Density (G)						
Root Density as % =	5 (F)			(F) x (E) =	1 (G)	10
Bank Angle (H)						
90 45 50		Bank Angle as *Degrees* =			90 (H)	7.8
Surface Protection (I)						
Surface Protection as % =					15 (I)	9

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)

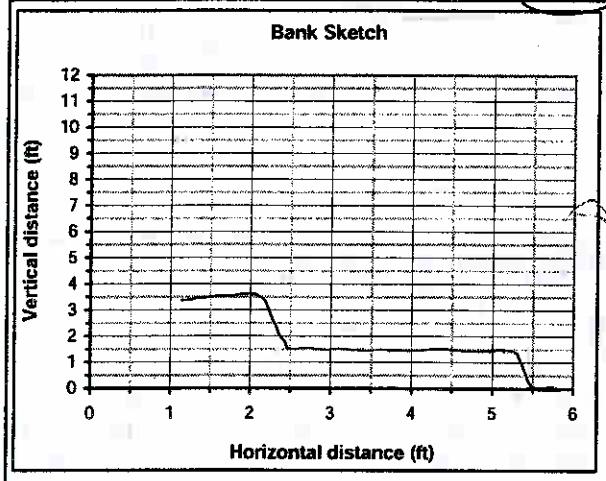
Bank Material Adjustment 0

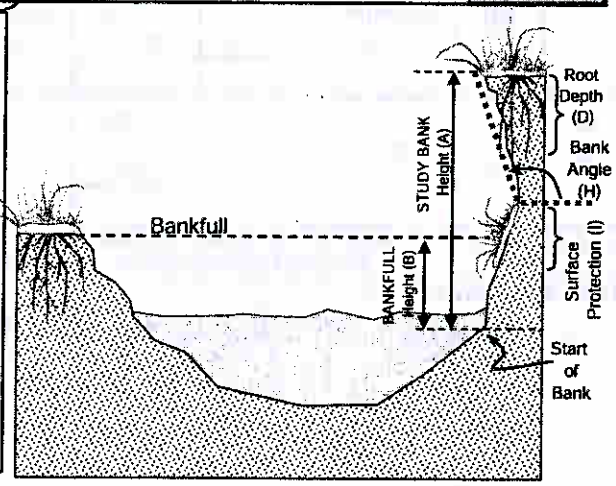
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 0 +5

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 43.3

very high





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River Assessment and Monitoring: Impaired Reach

3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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

(2) Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
20	20	1.0	Extreme

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

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

Dominant Near-Bank Stress: Extreme

Level III

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

(6) 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)

Level IV

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

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

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River Assessment and Monitoring: Reference Reach 1st Field Day

Additional BEHI and NBS worksheets

Stream: Magruder Location: Reach 2

Station: ~~98~~ ~~100~~ 106-121 RB Observers: Team 2

Date: 9-25-07 Stream Type: C4 Valley Type: 8

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.1 (A)	Bankfull Height (ft) =	.5 2.0 1.5 (B)	(A)/(B) =	1.05 (C)	1.8
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.1 (D)	Study Bank Height (ft) =	2.1 (A)	(D)/(A) =	.52 (E)	35
Weighted Root Density (G)						
Root Density as % =	20 (F)			(F)×(E) =	10.4 (G)	9
Bank Angle (H)						
Bank Angle as *Degrees* =	150 (H)					10
Surface Protection (I)						
Surface Protection as % =	20 (I)					7

off chart

Bank Material Adjustment:

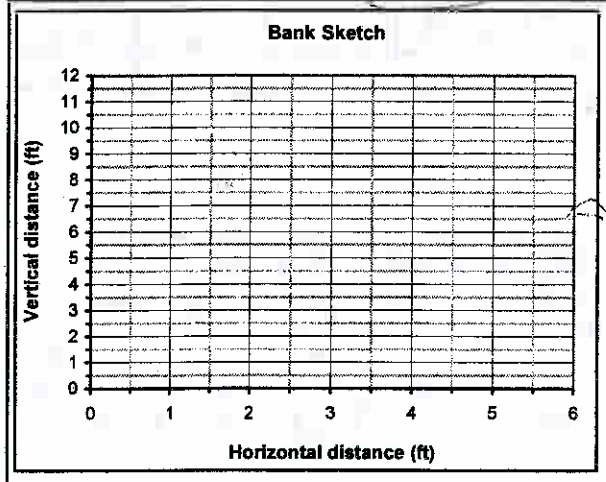
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

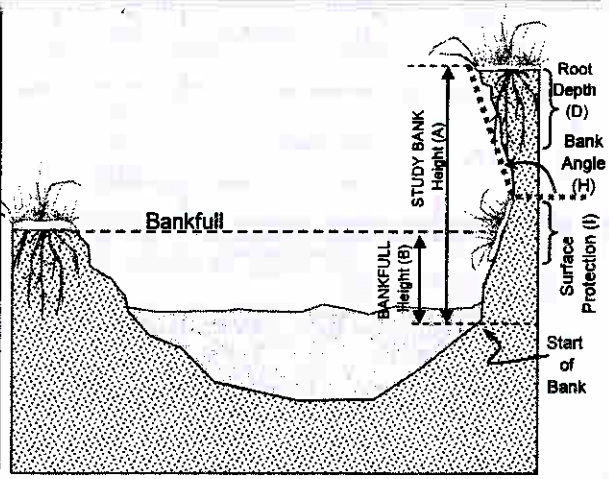
Bank Material Adjustment 0

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	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	31.3

High.





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River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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

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

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

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

Dominant Near-Bank Stress: Moderate

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	2.1	1.2	1.7	

(6)	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)

Level IV

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

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

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River Assessment and Monitoring: Reference Reach 1st Field Day

Additional BEHI and NBS worksheets

Stream: MAGRUDER BR. Location: MONTG. CO. MD

Station: 121-133 RB Observers: TEAM 2

Date: 9/25/07 Stream Type: C4 Valley Type: B

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.0 (A)	Bankfull Height (ft) =	~~1.6~~ 1.5 (B)	(A)/(B) =	1.25 (C)	5.5
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.7 (D)	Study Bank Height (ft) =	2.0 (A)	(D)/(A) =	.85 (E)	25
Weighted Root Density (G)						
Root Density as % =	35 (F)			(F)x(E) =	29 (G)	6
Bank Angle (H)						
Bank Angle as *Degrees* =	85 (H)					7
Surface Protection (I)						
Surface Protection as % =	50 (I)					4

Bank Material Adjustment:

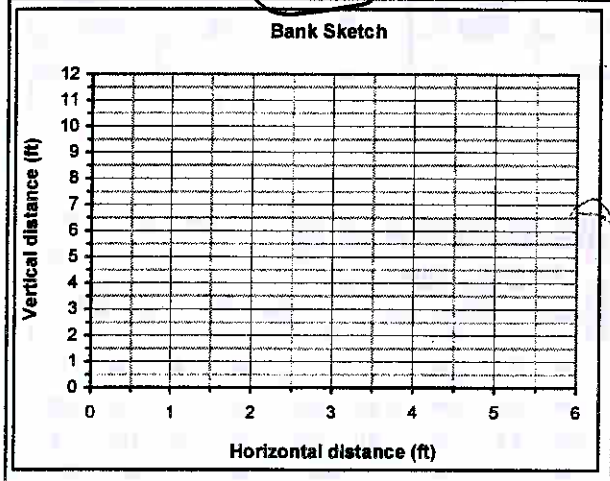
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

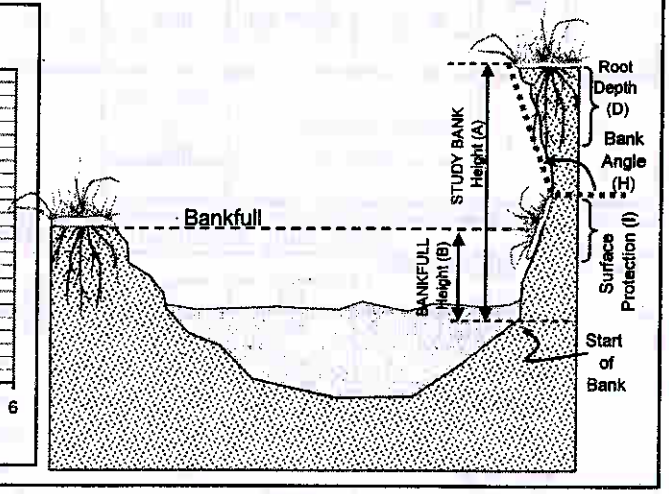
Bank Material Adjustment 0

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 25 Moderate





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River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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)				

Dominant Near-Bank Stress: Moderate

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	2.07	1.14	1.8	

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb} (XS run)	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)		

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

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Additional BEHI and NBS worksheets

Stream: Macgruder		Location: Reach 2	
Station: 138-T61 LB		Observers: Team 2	
Date: 9-25-07	Stream Type: C4	Valley Type: 8	

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.3 (A)	Bankfull Height (ft) =	3.8 (B)	(A) / (B) =	.9 (C)	1
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.0 (D)	Study Bank Height (ft) =	3.3 (A)	(D) / (A) =	.3 (E)	6
Weighted Root Density (G)						
Root Density as % =	15 (F)			(F) x (E) =	4.5 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	90 (H)					8
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

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)

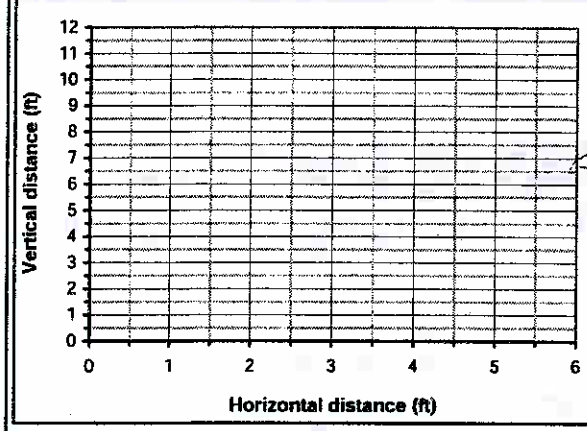
Bank Material Adjustment 0

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

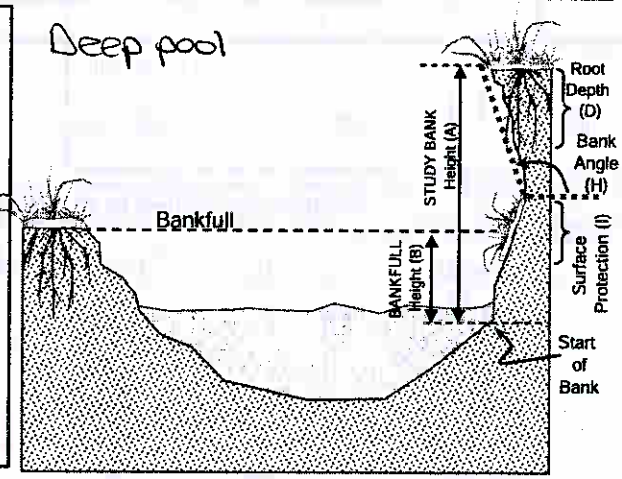
Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	40

very high

Bank Sketch



Deep pool



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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream:	Location:	
Station:	Stream Type:	Valley Type:
Observers:		Date:

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)	30	19	1.6	VH

	Pool Slope S_p	Bkfl 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)	3.7	1.45	2.5	VH

	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)		

1.4 1.45 .1
3.4 1.0 13.05
2.6 .7 = 1.45
2.0 .4

* very high transverse bar

Dominant Near-Bank Stress: Very High

Compound pool use overall radius of both pools

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

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River Assessment and Monitoring: Reference Reach 1st Field Day

Additional BEHI and NBS worksheets

Stream: Macgruder Location: Reach 2

Station: 167-185 LB Observers: Team 2

Date: 9-25-07 Stream Type: C4 Valley Type: 8

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	1.3 (A)	Bankfull Height (ft) =	1.7-2.2 .5 (B)	(A) / (B) =	.59 (C)	1
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.3 (D)	Study Bank Height (ft) =	1.3 (A)	(D) / (A) =	1 (E)	0
Weighted Root Density (G)						
Root Density as % =	15 (F)			(F) x (E) =	15 (G)	9
Bank Angle (H)						
Bank Angle as *Degrees* =	120 (H)					9
Surface Protection (I)						
Surface Protection as % =	15 (I)					9

Bank Material Adjustment:

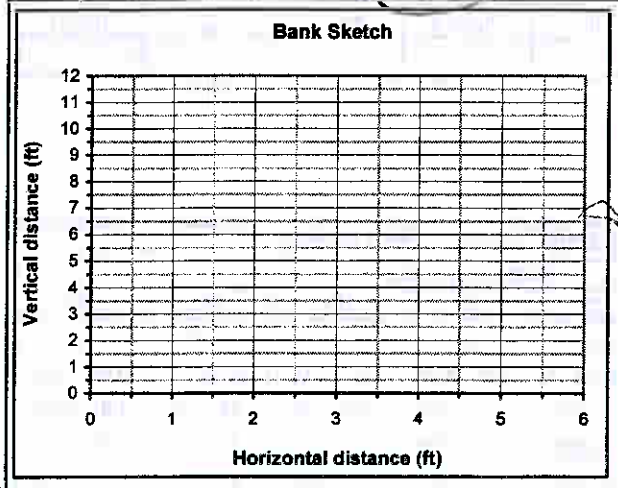
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no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

Bank Material Adjustment 0

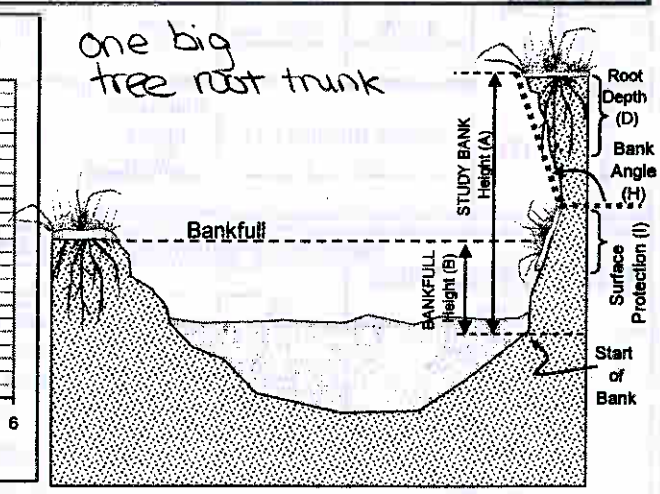
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 5

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 33 High



one big tree root trunk



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River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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)	30	19	1.6	High

	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)				

Dominant Near-Bank Stress: High

compound pool

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)		

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

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River Assessment and Monitoring: Reference Reach

1st Field Day

Additional BEHI and NBS worksheets

4

Stream: Magruder		Location: Reach 2	
Station: 214-218 RB		Observers: Team 2	
Date: 9-25-07	Stream Type: C4	Valley Type: 8	

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.7 (A)	Bankfull Height (ft) =	1.7 2.2 1.5 (B)	(A)/(B) =	1.2 (C)	3
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.1 (D)	Study Bank Height (ft) =	2.7 (A)	(D)/(A) =	.4 (E)	5
Weighted Root Density (G)						
		Root Density as % =	15 (F)	(F) x (E) =	6 (G)	9
Bank Angle (H)						
				Bank Angle as *Degrees* =	85 (H)	8
Surface Protection (I)						
				Surface Protection as % =	5 (I)	10

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)

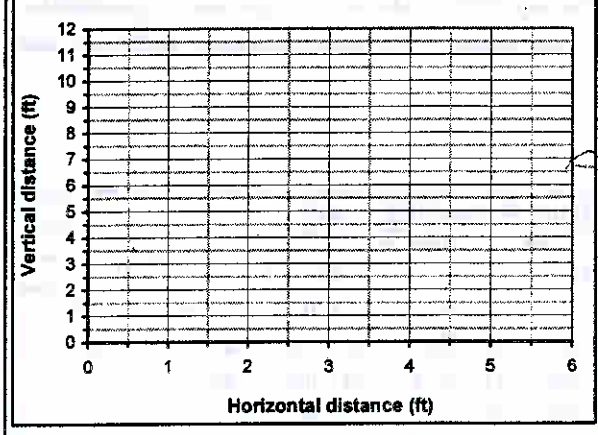
Bank Material Adjustment 0

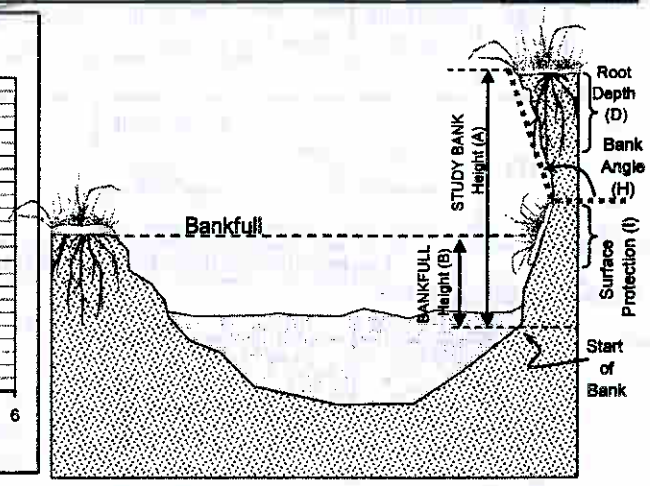
Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	40

Very High

Bank Sketch





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River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream:	Location:	
Station:	Stream Type:	Valley Type:
Observers:		Date:

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

(2)

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

(3)

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

(4)

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

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2.4	1.6	1.5	MOD

0.15 1.99
0.80 2.01
1.10 2.30
1.50 2.44
1.27 2.14
1.59 19/12 = 1.6
1.80

(6)

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)

Level IV

(7)

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

Dominant Near-Bank Stress: Moderate

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

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River Assessment and Monitoring: Reference Reach 1st Field Day

Additional BEHI and NBS worksheets

Stream: Macgruder Location: Reach 2

Station: 218-234 RB Observers: Team 2

Date: 9-25-07 Stream Type: C4 Valley Type: 8

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.6 (A)	Bankfull Height (ft) =	2.0-3.7 1.7 (B)	(A) / (B) =	1.2 (C)	4
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.0 (D)	Study Bank Height (ft) =	4.6 (A)	(D) / (A) =	.2 (E)	8
Weighted Root Density (G)						
		Root Density as % =	10 (F)	(F) x (E) =	2 (G)	9
Bank Angle (H)						
				Bank Angle as *Degrees* =	85 (H)	8
Surface Protection (I)						
				Surface Protection as % =	5 (I)	10

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

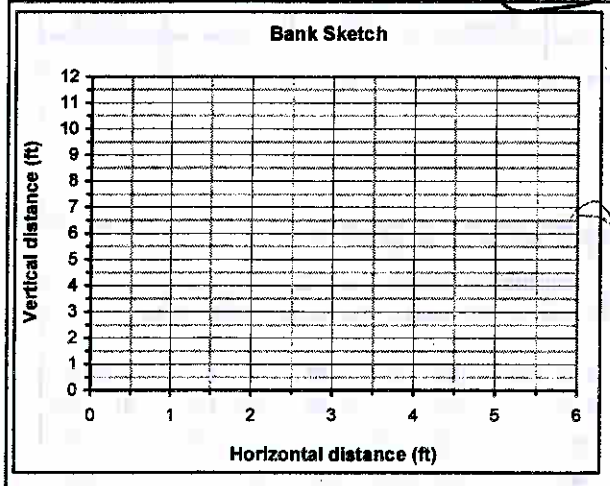
Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 5

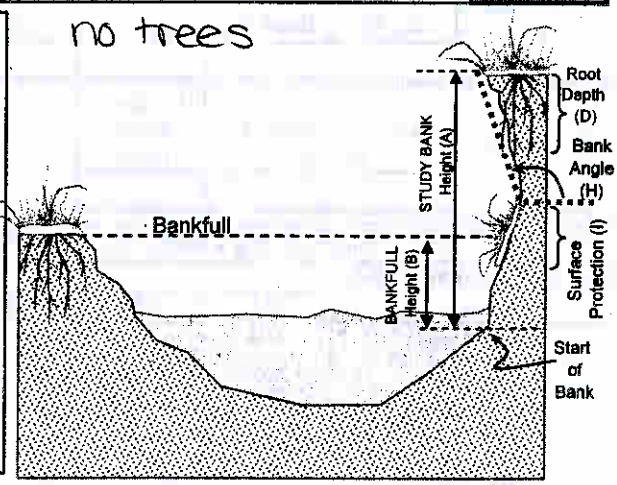
Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score 44

very high

no trees





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River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream:	Location:	
Station:	Stream Type:	Valley Type:
Observers:		Date:

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

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

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

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

Dominant Near-Bank Stress
VH

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
3.9	1.46	2.6	VH

(6) 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)

Level IV

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

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	

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River Assessment and Monitoring: Reference Reach 1st Field Day

Additional BEHI and NBS worksheets

Stream:	Magruder	Location:	Reach 2
Station:	234-249 RB	Observers:	Team 2
Date: 9-25-07	Stream Type: C4	Valley Type:	8

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.9 (A)	Bankfull Height (ft) =	1.5 = 1.7 (B)	(A) / (B) =	1.7 (C)	7.8
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.3 (D)	Study Bank Height (ft) =	2.9 (A)	(D) / (A) =	.4 (E)	5
Weighted Root Density (G)						
Root Density as % =	5 (F)			(F) x (E) =	2 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	80 (H)					6
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

no trees roots

Bank Material Adjustment:

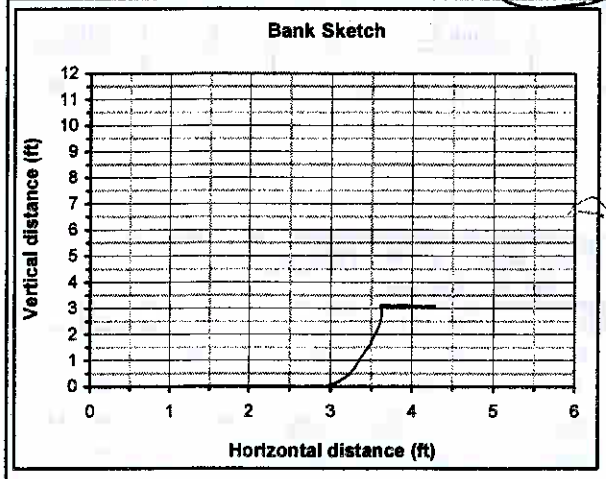
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

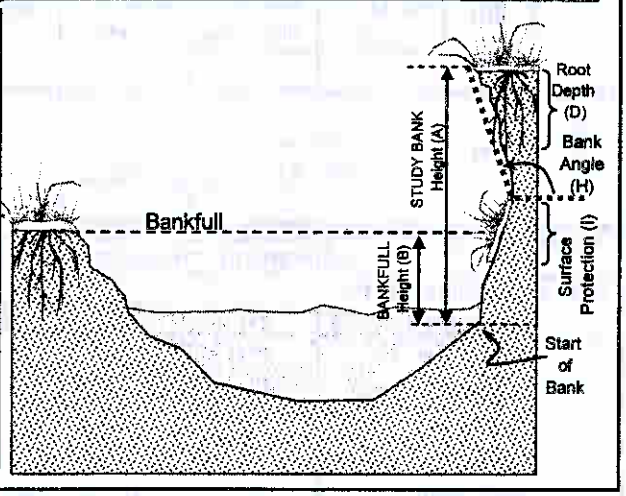
Bank Material Adjustment 0

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

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	43.8

very high





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River Assessment and Monitoring: Reference Reach 1st Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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

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

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

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

0.2 2.60
1.21 2.45
1.11 2.10
1.30 1.64
1.61
2.03
2.70

Dominant Near-Bank Stress: Moderate

Level III

(5) Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2.7	1.7	1.6	

(6) 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)

Level IV

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

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

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Additional BEHI and NBS worksheets

Stream: MAGRUDER BR. Location: MONTG. CO.

Station: 249-2604 RB Observers: TEAM 2

Date: 9/25/07 Stream Type: C4 Valley Type: B

						BEHI Score (Fig. C-1)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	2.7 (A)	Bankfull Height (ft) =	2.7 (B)	(A) / (B) =	1.0 (C)	0
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.5 (D)	Study Bank Height (ft) =	2.7 (A)	(D) / (A) =	.5 (E)	4
Weighted Root Density (G)						
		Root Density as % =	20 (F)	(F) x (E) =	10 (G)	9
Bank Angle (H)						
				Bank Angle as *Degrees* =	90 (H)	8
Surface Protection (I)						
				Surface Protection as % =	15 (I)	10

Bank Material Adjustment:

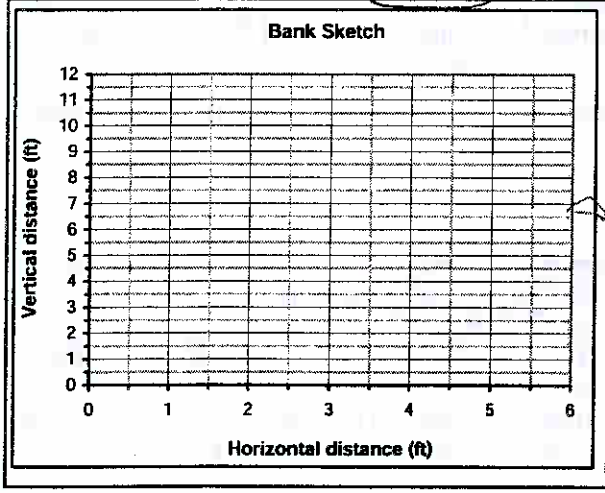
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

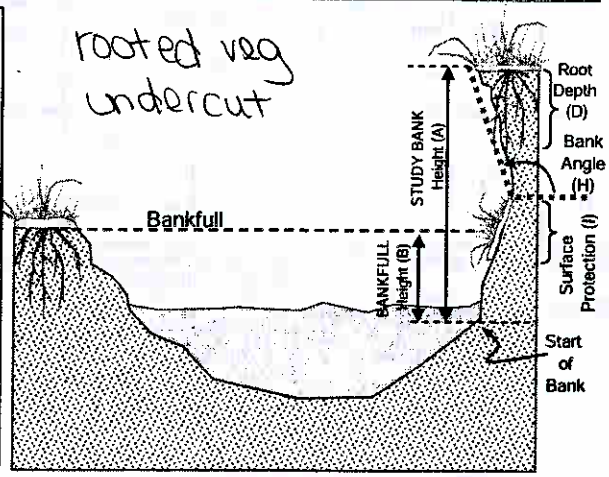
Bank Material Adjustment 0

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

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 36





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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Estimating Near-Bank Stress (NBS)

Stream: Location:

Station: Stream Type: Valley Type:

Observers: Date:

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)				

Dominant Near-Bank Stress: Moderate

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	2.6	1.7	1.53	Mod

	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)		

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

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

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

Stream: Macgruder Branch			Stream Type: C4		
Location: Reach 2			Valley Type: 8		
Observers: Team 2			Date: 9/25/07		
Enter required information					
24.48	D_{50}	Riffle bed material D_{50} (mm)			
18.02	$\hat{D}_{50}$	Bar sample D_{50} (mm)			
0.28	D_{max}	Largest particle from bar sample (ft)	85	(mm)	304.8 mm/ft
0.0078	S	Existing bankfull water surface slope (ft/ft)			
1.36	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					
1.36	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$		
4.26	D_{max}/D_{50}	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$		
N/A	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:		
Calculate bankfull mean depth required for entrainment of largest particle in bar sample					
N/A	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					
N/A	S	Required bankfull water surface slope (ft/ft)	$S = \frac{\tau^* \gamma_s D_{max}}{d}$		
Check: ☐ Stable ☐ Aggrading ☐ Degrading					
Sediment competence using dimensional shear stress					
0.66	Bankfull shear stress $\tau = \gamma dS$ (lbs/ft^2) (substitute hydraulic radius, R, with mean depth, d)				
128	Moveable particle size (mm) at bankfull shear stress **(Figure C-4)**				
0.43	Predicted shear stress required to initiate movement of D_{max} (mm) **(Figure C-4)**				
0.88	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$				
0.0078	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d}$				

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

Stream: Magruder Br.	Stream Type: C4
Location: Reach 2	Valley Type: 8
Observers: Team 2	Date: 9/25/07

Stream type changes due to successional stage shifts (Figure C-5)	Stability rating (check appropriate rating)
Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	☐ Stable
(E→C) High W/D 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 C-20. Lateral stability prediction summary.

Stream: Magruder Branch			Stream Type: C4		
Location: Reach 2			Valley Type: 8		
Observers: Team 2			Date: 9/25/07		
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 C-12)**	< 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	> 1.6 (8)	8
2 **Depositional pattern (Worksheet C-8)**	B1, B2 (1)	B4, B8 (2)	B3 (3)	B5, B6, B7 (4)	4
3 **Meander pattern (Worksheet C-7)**	M1, M3, M4 (1)		M2, M5, M6, M7, M8 (3)		3
4 **Dominant BEHI / NBS (Worksheet C-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)	8
5 **Degree of confinement (MWR / MWR_{ref}) (Worksheet C-13)**	0.8 – 1.0 (1)	0.3 – 0.79 (2)	0.1 – 0.29 (3)	< 0.1 (4)	2
				Total points	25
	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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River Assessment and Monitoring: Impaired Reach 3rd Field Day

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

Stream: Macgruder Branch	Stream Type: C4
Location: Reach 2	Valley Type: 8
Observers: Team 2	Date: 9/25/07

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 C-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)	8
3 W/d ratio state (Worksheet C-12)	1.0 – 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	>1.6 (8)	8
4 Stream succession states (Worksheet C-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 C-8)	B1 (1)	B2, B4 (2)	B3, B5 (3)	B6, B7, B8 (4)	3
6 Debris / blockages (Worksheet C-9)	D1, D2, D3 (1)	D4, D7 (2)	D5, D8 (3)	D6, D9, D10 (4)	1
				Total points	28

Vertical stability for excess deposition / aggradation (use total points and check stability rating)	Vertical stability category point range for excess deposition / aggradation			
	No deposition 10 – 14 ☐	Moderate deposition 15 – 20 ☐	Excess deposition 21 – 30 ☑	Aggradation > 30 ☐

Assumption: Removal Tons 248 Reach can move 105 tons

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

Stream: Magruder Branch			Stream Type: C4		
Location: Reach 2			Valley Type: 8		
Observers: Team 2			Date: 9/25/07		
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 C-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)	2
3 **Degree of channel incision (BHR) (Workshet C-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 C-19 and C-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 C-13)**	0.80 – 1.00 (1)	0.30 – 0.79 0.57 (2)	0.10 – 0.29 (3)	< 0.10 (4)	2
				Total points	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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Worksheet C-23. Channel enlargement prediction summary.

Stream: Magruder Branch			Stream Type: C4		
Location: Reach 2			Valley Type: 8		
Observers: Team 2			Date: 9/25/07		
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 C-19)**	Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C) (2)	High W/D C (E→C) (4)	(G→F), (F→D) (6)	(C→D), (B→G), (D→G), (C→G), (E→G), (C→F) (8)	4
2 **Lateral stability (Worksheet C-20)**	Stable (2)	Moderately unstable (4)	Unstable (6)	Highly unstable (8)	8
3 **Vertical stability excess deposition/ aggradation (Worksheet C-21)**	No deposition (2)	Moderate deposition (4)	Excess deposition (6)	Aggradation (8)	6
4 **Vertical stability incision/ degradation (Worksheet C-22)**	Not incised (2)	Slightly incised (4)	Moderately incised (6)	Degradation (8)	4
				Total points	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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Worksheet C-24. Overall sediment supply rating determined from individual stability rating categories.

Stream: Magruder Branch	Stream Type: C4
Location: Reach 2	Valley Type: 8
Observers: Team 2	Date: 9/25/07

Overall sediment supply prediction criteria (choose corresponding points for each criterion 1–5)	Stability rating	Points	Selected points
1 Lateral stability (Worksheet C-20)	Stable	1	4
	Mod. unstable	2	
	Unstable	3	
	Highly unstable	4	
2 Vertical stability excess deposition/ aggradation (Worksheet C-21)	No deposition	1	3
	Mod. deposition	2	
	Excess deposition	3	
	Aggradation	4	
3 Vertical stability channel incision/ degradation (Worksheet C-22)	Not incised	1	2
	Slightly incised	2	
	Mod. incised	3	
	Degradation	4	
4 Channel enlargement prediction (Worksheet C-23)	No increase	1	3
	Slight increase	2	
	Mod. increase	3	
	Extensive	4	
5 Pfankuch channel stability (Worksheet C-11)	Good: stable	1	2
	Fair: mod unstable	2	
	Poor: unstable	4	
		Total Points	14

	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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River Assessment and Monitoring: Impaired Reach — 3rd Field Day

Worksheet C-25. Summary of stability condition categories.

Stream: McGruder			Location: U/S of road Xing		
Observers: Team 2		Date: 9/25/07	Stream Type: C4	Valley Type: VIII	
Channel Dimension	Mean bankfull depth (ft): 1.36	Mean bankfull width (ft): 25.7	Cross-section area (ft²): 34.86	Width of flood-prone area (ft): 180	Entrenchment ratio: 7.0
Channel Pattern	Mean (range) MWR: 1.59 – 2.33 (1.96)	Lm/W$_{bkf}$: 2.72 – 3.19 (2.96)	Rc/W$_{bkf}$: 0.70 – 1.59 (1.10)	Sinuosity: 1.5	
River Profile and Bed Features	Circle: Riffle/pool Step/pool Plane bed Convergence/divergence Dunes/antidunes/smooth bed				
	Max bankfull depth (ft): Riffle 1.93, Pool 4.62	Depth ratio (max/mean): Riffle 1.42, Pool 2.2	Pool to pool spacing: Ratio 1.24	Slope: Valley: .012	Average bankfull: .0046
Level III Stream Stability Indices	Riparian vegetation	Current composition/density: mid-successional riparian	Potential composition/density: same, more shrubs	Remarks: Condition, vigor and/or usage of exiting reach: fair-good health, detaching (roots) from ch	
	Flow regime: P2	Stream size and order: S-5( )	Meander pattern(s): M2 – 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): 105		
	Width/depth ratio (W/D): 18.9	Reference W/D ratio (W/D$_{ref}$): ~~1.62~~ 11.7	Width/depth ratio state (W/D) / (W/D$_{ref}$): ~~HIGHLY UNSTABLE~~ 1.62	W/D ratio state stability rating: ~~HIGHLY~~ UNSTABLE	
	Meander Width Ratio (MWR): 2.33	Reference MWR$_{ref}$: 4	Degree of confinement (MWR / MWR$_{ref}$): 0.59	MWR / MWR$_{ref}$ stability rating: MODERATELY CONFINED	
Bank Erosion Summary	Length of reach studied (ft): 262	Annual streambank erosion rate: 34.4 (tons/yr)	0.164 (tons/yr/ft)	Curve used: Columbia	Remarks:
Sediment Capacity (POWERSED)	Sufficent capacity	Insufficient capacity	Remarks:		
Entrainment/ Competence	Largest particle from bar sample (mm): 85	$\tau = 0.66$	$\tau^* =$ NA	Existing depth$_{bkf}$: 1.36	Required depth$_{bkf}$: 0.88
	Existing slope$_{bkf}$: 0.0078	Required slope$_{bkf}$: 0.0078			
Successional Stage Shift	C4 → C4 (H W/D) → → → →	Existing stream state (type): C4	Potential stream state (type): C4 H w/o		
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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~~*NOT INCISED/SLIGHT MARGIN~~

River Assessment and Monitoring: Impaired Reach 3rd Field Day

3. Channel Change

Worksheet C-28. Summary of annual data comparisons.

Data Comparison Form

Stream: McGruder Reach: 2

Observers: Team 2 Date - Year 1: Date - Year 2:

		Riffle XS:		Pool XS:		Glide XS:	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Cross-section dimensions	$Width_{BKF}$	25.7		19.25		24.4	
	Mean $depth_{bkf}$	1.36		2.1		1.7	
	Width/depth ratio	18.9		9.17		14.5	
	Cross-sectional $Area_{bkf}$	34.86		40.42		41.01	
	Max $depth_{bkf}$	1.93		4.6		2.19	
Pebble count	D_{35} (mm)	6.47		6.56		~~35.0~~ 12.64	
	D_{50} (mm)	19.96		10.61		~~12.64~~ 19.0	
	D_{84} (mm)	55.36		31.89		40.0	
Bank Erosion	BEHI rating	High		VH		~~37.5~~ High	
	NBS rating	Low		High		Low	
	Predicted erosion (ft/yr)	.4		1.0		.4	
	Measured erosion (ft/yr)	—		—		—	

		Year 1	Year 2			Year 1	Year 2
Revised Pfankuch Channel Stability Rating		105		Bar Sample	D_{35} (mm)	10.21	
Bank-Height Ratio	start:	1.0			D_{50} (mm)	18.02	
	end:	1.0			D_{84} (mm)	65.01	
Point Bar slope		.23			D_{100} (mm)	85.0	
Riffle Length/Riffle Width		21.95/25.7 .85					
Pool Length/Riffle Width		92.4/19.25 4.8					
Dimensionless Slope Ratios	S_{rif}/S	5.646		Dimensionless Depth Ratios	d_{rif}/d_{bkf}	1.47	
	S_{run}/S	0.035			d_{run}/d_{bkf}	2.34	
	S_p/S	1.365			d_p/d_{bkf}	3.43	
	S_g/S	0.256			d_g/d_{bkf}	2.19	

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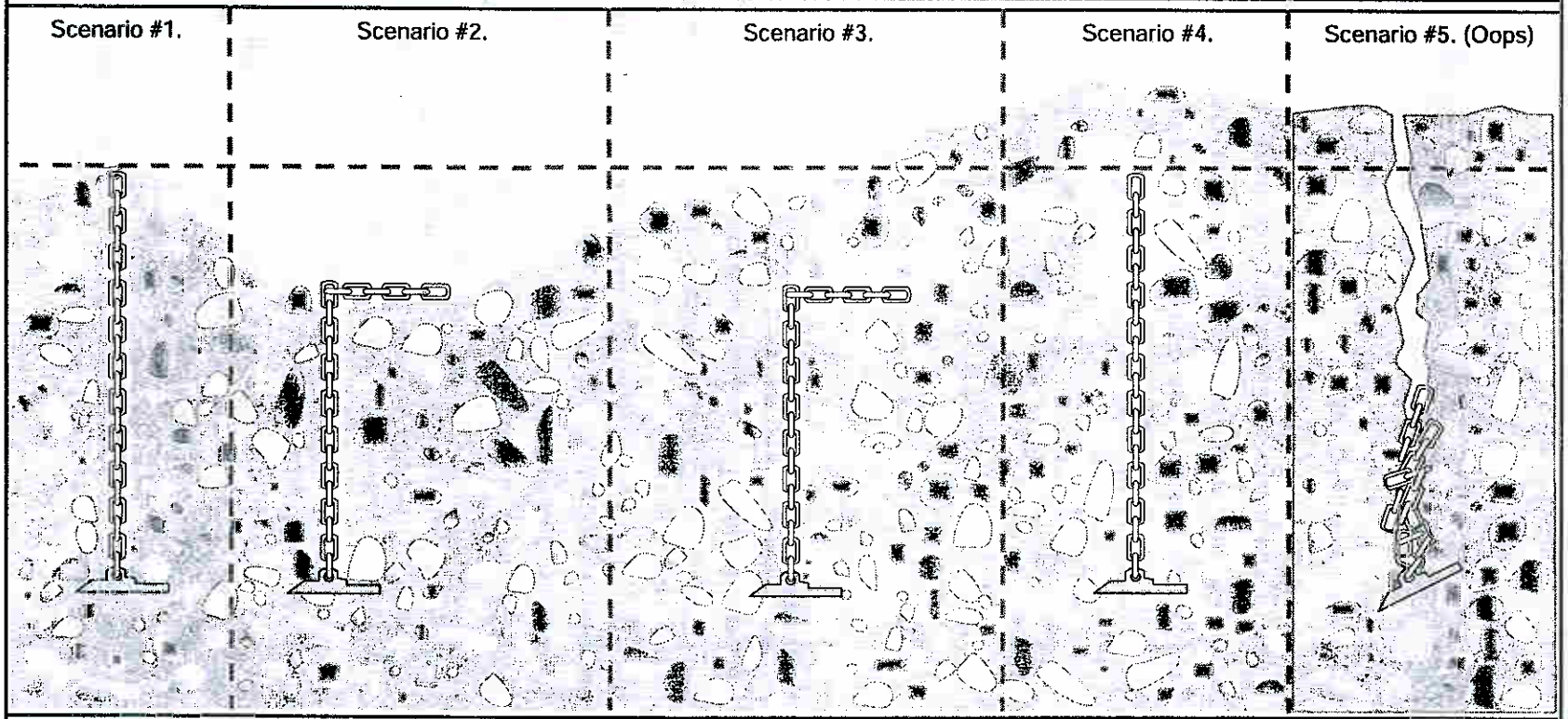
Worksheet C-26. Field form for documenting scour chain results and corresponding bed-elevation changes.

Stream name: Macaruder Creek Location: Reach (Team) 2

Observers: Riffle - Bill Rice / Steve Schoenberg Stream Type: C4 Valley Type: 8 Date: 9/25/07

Glide - Greg Manresta / Paul Powers

		Installation Data (1st Year)				Recovery Data (2nd Year)					
		From cross-section		Particles near chain		Chain recovery				Particles near chain	
		Station (ft)	Elevation (ft)	Largest (mm)	2nd Largest (mm)	Scenario # (1–5)	Scour depth[a] (ft)	Elevation[b] (ft)	Net change[c] (ft)	Largest (mm)	2nd Largest (mm)
Riffle	Chain #1	31.5	96.76	80	73						
Riffle	Chain #2	27	96.90	72	63						
Glide	Chain #3	34	95.83	110	69						
Glide	Chain #4	30	96.05	49	38						



[a] Scenario 2 or 3. Scenario 2: Enter length of chain exposed. Scenario 3: Enter length of chain exposed then subsequently buried.

[b] Scenario 3 or 4. Scenario 3: Enter elevation of bed at same station @ 2nd year. Scenario 4: Enter depth of material over chain.

[c] Scenario 3: Subtract 1st and 2nd year elevations to calculate net change in bed.

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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Worksheet C-27. Bank profile and bank erosion summary data form. STA 115

BANK PROFILE WORKSHEET

Stream: MaGruder Creek	Observers: Schoenholtz Steve, Bill Rice
Location: RiFFle X-C Team 2	Date: 9/25/07
Cross-section: RiFFle	BEHI adjective:
Bank: RB	NBS adjective:
Toe pin station (ft): 32.5 (tied in)	Predicted erosion (ft):
Toe pin elevation (ft): 7.81 (96.83)	Measured erosion (ft):

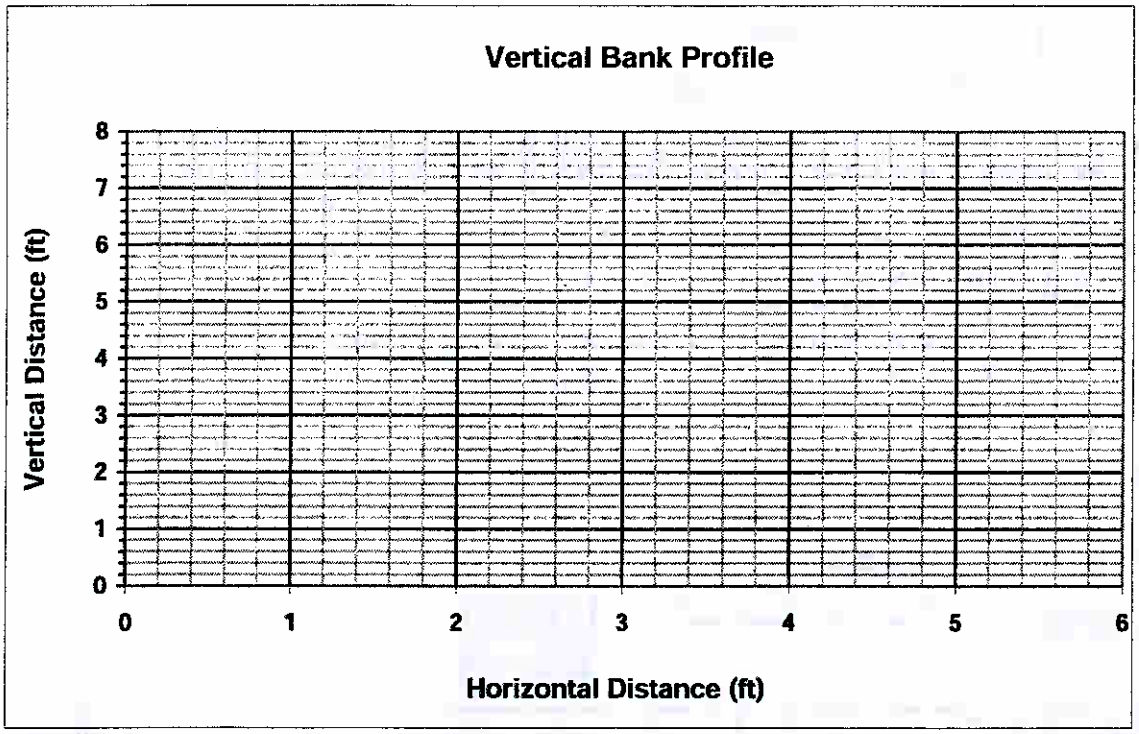
Toe Pin Intended to be Flush

Date: 9/24/07

Horizontal	Vertical	Notes
0.51	0	Toe pin top across
0.54	0.16	
0.50	0.23	
0.66	0.24	
0.69	0.30	Bank Pin
0.81	0.36	
0.82	0.52	
0.95	.68	
1.0	.88	
1.06	1.0	
0.96	1.22	Bank Pin
1.0	1.31	
1.0	1.50	
1.21	1.71	

Date:

Horizontal	Vertical	Notes
1.38	1.81	@ BKF Est. (mors)
1.21	1.90	
3.05	2.08	Top Bank



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River Assessment and Monitoring: Impaired Reach 3rd Field Day

Worksheet C-27. Bank profile and bank erosion summary data form.

BANK PROFILE WORKSHEET

Stream: Magruder Creek	Observers: PAU, GREG
Location: TEAM 2 / 224. 4"	Date: 9/25
Cross-section: Pool	BEHI adjective:
Bank: right	NBS adjective:
Toe pin station (ft): 224.4 field	Predicted erosion (ft):
Toe pin elevation (ft): 9.3 (93.81)	Measured erosion (ft):

measures from water surface

-.4

2.43 Top pin

150 ft of cross section

water surface

Bank pin

Date:

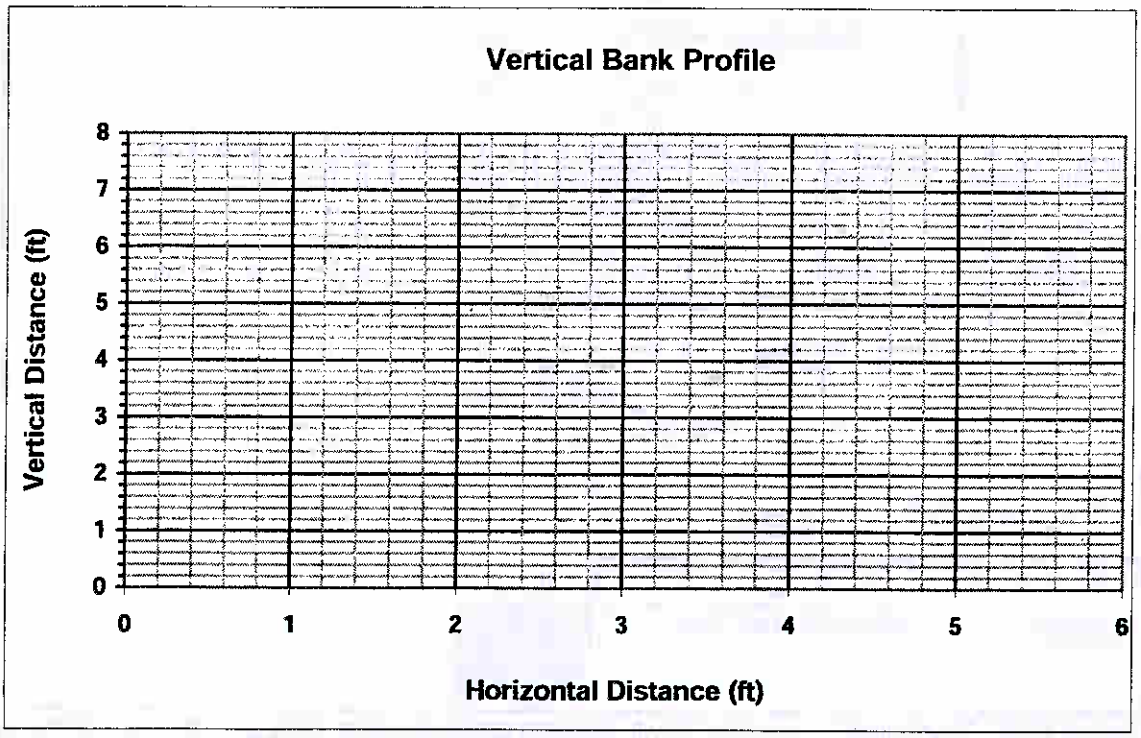
Horizontal	Vertical	Notes
.56	.42	Horz Vert
.66	0.0	0.0 -.42
0.0	0.0	
.2	2.78	
.5	2.64	measurements
.6	2.50	
.8	2.12	from
.9	1.2	WS
1.05	.6	
1.3	.45	
1.4	.26	
1.7	.35	
2.05	2.43	2.43
2.14	2.71	
2.30	2.82	#1 PIN

Date:

Horizontal	Vertical	Notes
2.38	2.90	
2.41	3.07	
2.58	3.22	
2.70	3.32	
2.86	3.62	#2 PIN
2.85	3.67	
2.84	3.85	
2.81	4.04	
2.76	4.38	
2.50	4.38	
2.40	4.58	
2.61	4.72	
2.84	4.85	

top of pin eye level to glide pin measurement 3.16

3.42 bottom



5.15

XS pool BM L 100.38 R

XS glide BM 101.47 R

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Glide 100.99

Pool 99.7

Pool 93.81

Glide toe pin 95.85

Riff 99.19

River Assessment and Monitoring: Impaired Reach 2nd Field Day

Worksheet B-27. Bank profile and bank erosion summary data form.

BANK PROFILE WORKSHEET

Stream: Macgruder Creek	Observers: Paul Hawg, Greg Meanesto
Location: Team 2 261.6	Date: 9/25/07
Cross-section: Glide	BEHI adjective:
Bank: right Tied in	NBS adjective:
Toe pin station (ft): 261.6	Predicted erosion (ft):
Toe pin elevation (ft): 7.26 (95.85)	Measured erosion (ft):

Date:

Horizontal	Vertical	Notes
.96	.14	
1.00	.26	
1.00	.39	
.94	.52	
.96	.68	
.98	.75	
1.00	.90	
1.16	1.1	
1.26	1.20	
1.40	1.44	
1.46	1.50	
1.48	1.63	
1.54	1.90	
1.68	2.14	
2.24	2.36	

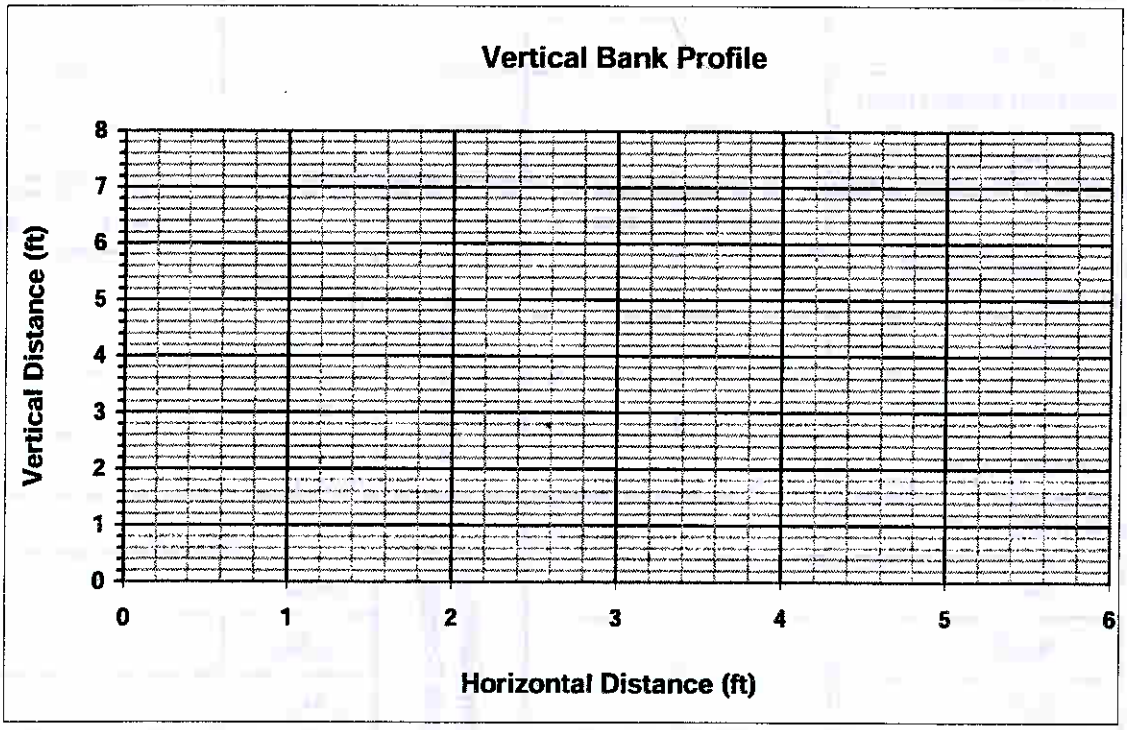
Date:

Horizontal	Vertical	Notes

Water surface

one pin

2nd pin



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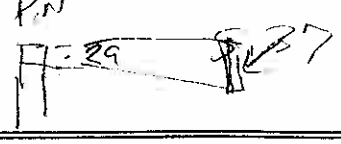
Magruder Branch Degraded Reach Team 2 9/25/2007

PIN



STREAM SURVEY

CROSS SECTION

Scour chain location (31.5) and (27)

STREAM Magruder Creek 508 – 29 – 5.32	DATE 9/25/07
REACH Team 2	CREW Bill Rice, Steve Schoenberg
XS Riffle STATION STA 115	

Begin on left, facing downstream (all measurements are in feet unless otherwise noted)

NOTE	DIST.	ELEV./ DEPTH	NOTE (Top of monument)	DIST.	ELEV./ DEPTH
MON Left Bank Monument	0	4.79	STA 115 on bank		
MON LB monument	0	4.95	PRO 0		
EP	6	5.06			
TOB	7	5.29	Right Bank	76	5.2
[illegible]	8.5	5.66	Floodplain	-42	3.9
IP	8.75	6.60		-39.5	4.48
	11.5	6.96			
	11.75	6.93			
	13.0	6.68			
	14.0	6.67			
	15.8	6.79			
above	17.0	7.1			
BAR inweg	18.0	7.33			
"	19.0	7.52			
"	21.7	7.62			
	23	7.705			
	24	7.67			
	25	7.64			
WS/EW (LB)	26.7	7.75			
	28	7.89			
TW?	28.5	7.85			
	29	7.88			
	31	7.85			
	32.5	7.82			
(WS) EW	33.9	7.76			
	33.1	(under a root)	No measurement		
	32.9	7.91			
	33.8	6.3			
BF (RB)	34.3	5.98			
	35	5.87			
COMMON (B)	27	7.74			
SCOUR (C)	31.5	7.88			
TOE RIN	32.5	7.81			
	36	5.69			
	38.5	5.46			
	41	5.58	Top of Monument		
(EP) XSander	41	5.45			
	137	4.8			
(FP)	140	4.05			
	104	5.06			
	87	6.4			
	86.5	6.4			
	85	5.95			

NOTATIONS

NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Vegetation Line	VL

ENTRENCHMENT

FLOODPRONE ELEVATION	
FLOODPRONE WIDTH	
BANKFULL WIDTH	
ENTRENCHMENT	

scour chain Location @ 31.5 @ 27

4.79 Pocket
+.16 Ring Mech
4.95

35.35 X sect
1.37 mean
1.93 max

25.71 Drain. Area
18.71 W/D

STREAM SURVEY

CROSS SECTION

STREAM Magruder Br	DATE 9/27/07
REACH Team 2	CREW Steve, Bill
XS ~~Gate~~ Run / STATION 132.5	

Begin on left, facing downstream (all measurements are in feet unless otherwise noted)

NOTE	DIST.	ELEV. / DEPTH	NOTE	DIST.	ELEV. / DEPTH
0	5.18				
2	5.17		FP		
3	5.46		FP		
4.2	6.56				
5.3	7.16				
7	7.32				
8	7.36				
9	7.49				
10.1	7.35				
11.0	7.31				
13.0	7.43				
14.0	7.61				
15	7.68				
16	7.76				
18.9	7.83				
18.2	7.86				
19.3	7.93				
20.7	8.36		EW		
22	8.58		CS		
23.2	8.71		TH		
23.8	8.71		TN		
24.5	8.64		CS		
26	8.495		CS		
26.7	8.37		EW		
26.4	8.05				
28.9	7.02				
27.5	6.79				
30	6.37				
31	6.24				
32	6.17				
35	5.96				
28	6.64		BF?		

NOTATIONS

NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Vegetation Line	VL

ENTRENCHMENT
FLOODPRONE ELEVATION
FLOODPRONE WIDTH
BANKFULL WIDTH
ENTRENCHMENT

Used same laser location & setup as Riffle cross-section

Magruder Branch Degraded Reach Team 2 9/25/2007

bank toe pin @ 30'

STREAM SURVEY

CROSS SECTION

STREAM Magruder Creek	DATE 9/25/07
REACH 2	CREW Paul (Powers), Greg (Manness to)
XS Pool / STATION 224	

Begin on left, facing downstream (all measurements are in feet unless otherwise noted)

NOTE	DIST.	ELEV. / DEPTH	NOTE	DIST.	ELEV. / DEPTH
	0	4.64	GPIN		
	0	4.42	TPIN		
	1	4.68			
	3	4.83			
	5	4.53	Base of Tulip Poplar		
	9	4.32			
	12	4.79			
	14	5.10	LBKF *	GOOD	
	14.6	5.50			
	15	5.68			
	16	5.86			
	17	5.91			
	18	5.98			
	19	6.07			
	20	6.16			
	21	6.55			
	21.8	6.88	LEW		
	23	7.23			
	24	7.44			
	25	7.80			
	26	8.26			
	27	8.56			
	28	8.95			
	29	9.49			
	30	9.72	TW		
	30	9.30	Top of Toe PIN		
	30.4	9.47			
	30.9	9.35			
	31.1	8.08	Embeded lens		
	31.3	7.32			
	31.7	7.31			
	32	6.89	REW		
	32.5	6.30			
	32.8	4.56	TOB		
	34	4.32			
	35	4.20			
	36	4.06			
	37	3.90			
	39	3.60			
	41	3.40			
	44	3.22			
	48	3.11			
	50	3.09	RPIN		
	50	2.73	Top of RB PIN		

NOTATIONS

NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Vegetation Line	VL

ENTRENCHMENT
FLOODPRONE ELEVATION
FLOODPRONE WIDTH
BANKFULL WIDTH
ENTRENCHMENT

~~23~~
~~22~~

Magruder Branch Degraded Reach Team 2 9/25/2007

Team 3 Bench Mark = 4.82

= 98.38

STREAM SURVEY

CROSS SECTION

STREAM	Macgruder Creek	DATE	9/25/07
REACH	2	CREW	Paul Powers, Greg Mannestro
XS	Glide	STATION	261.6

Begin on left, facing downstream (all measurements are in feet unless otherwise noted)

NOTE	DIST.	ELEV. / DEPTH	NOTE	DIST.	ELEV. / DEPTH
GPIN	0	4.[illegible]			
TPIN	0	4.67			
	2	5.02			
	4	4.82			
	7	5.32	Disturbed area		
	9	5.02			
	11	5.02			
	12	5.15	BKF		
	13	5.28			
	13.5	5.80			
	14	6.45			
	14.6	7.03			
	15	7.00			
	16	6.96			
	17	6.86			
	18	6.80			
	20	6.79			
	21	6.82			
	22	6.84			
	23	6.84			
23.6	23.6	6.94	LEW		
	24	6.95	Riffle		
	25	6.99			
	26	7.00			
	27	7.00			
	28	6.86			
	29	6.99			
scour chain	30	7.06	Glide		
	31	7.22			
	32	7.34			
	33	7.33			
Scour chain	34	7.28			
Top Toe pin	34.5	7.26			
Bed at pin	34.5	7.34			
	35	7.25			
	35.7	6.94	REW / toe of bank		
	36	5.29			
	37	4.94			
	38	4.69			
	39	4.59			
	40	4.38			
	41	4.08			
	42	3.86			

NOTATIONS

NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Vegetation Line	VL

ENTRENCHMENT
FLOODPRONE ELEVATION
FLOODPRONE WIDTH
BANKFULL WIDTH
ENTRENCHMENT

OVER

0.47
~~0.58~~
.63

STREAM SURVEY

LONGITUDINAL PROFILE

STREAM Magruder	DATE 9-25-07
REACH 2	CREW VLN & RC

(all measurements are in feet unless otherwise noted)

STATION	TW	WS	BKF	WS/BF	TOB	Other	Other	COMMENT
0		6.37	1.61 L		3.95	(6.41)		To Riffle
4.7	6.93	6.72						
12.5	7.22							
21.0	7.44							
26.4	7.58							
.5 27.2	7.76	7.59	5.71 L		4.48			Pinched pt at bar
37.0	8.16							
~~27.8~~						7.21	TP7	Other inst. (bp)
~~27.8~~						6.72	TP1	or instrument
31.9		8.20					8.33	To Run (other)
34.7		8.20	6.36 L				8.67	To Pool (other)
39.8	8.67							
40.6								7.28 Terrace
.5- 56.5	9.53							Start just upstream of log jam
0.2 62.3	9.48							
0.4 .6 69.1	8.74	(1.03)						To Riffle
72.2	7.92	(.20)						Top Bar
77.6		7.72						To Pool
82.3	8.25	7.72	6.21 R					
88.0	8.26							Dmax
95.2	8.5							"
101	8.5							
111.4	8.14	7.71	6.10 R		5.78			TOB
115	7.88	7.75						Riffle x-sec
115							5.44	rt mon. riffle
118.1	7.91							
122.7	8.61							
127.0	8.42	8.31	6.71					To Run
131.0	8.78							
147.2	8.65							
152.0	10.43	(2.08)						To Pool
163.0	10.83							DMAX
167.7	9.68	8.40	7.02	(6.45) →				GLIDE/↑XS
182.5	8.995							
187.7		(2.3)						RUN
192.6	10.37							POOL (DMAX)
199.1	9.39	8.405						GLIDE
210	8.71							
217.5	9.58							RUN
218.5	~~[illegible]~~	(1.92)						POOL
224.1	10.68	(2.38)	~~8.66~~				4.25	to XS
224.1							4.25	Tout Mon XS

NOTATIONS

NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Veg Line	VL

RB @ 21.3 xs to

- STA 7B (WL DRAINAGE)
- TOB (LOW BANK) ~~[illegible]~~ @ TORT MEANDERS

STREAM SURVEY

LONGITUDINAL PROFILE

STREAM MAGRUDER	DATE 092507
REACH 2	CREW TLN/RMC

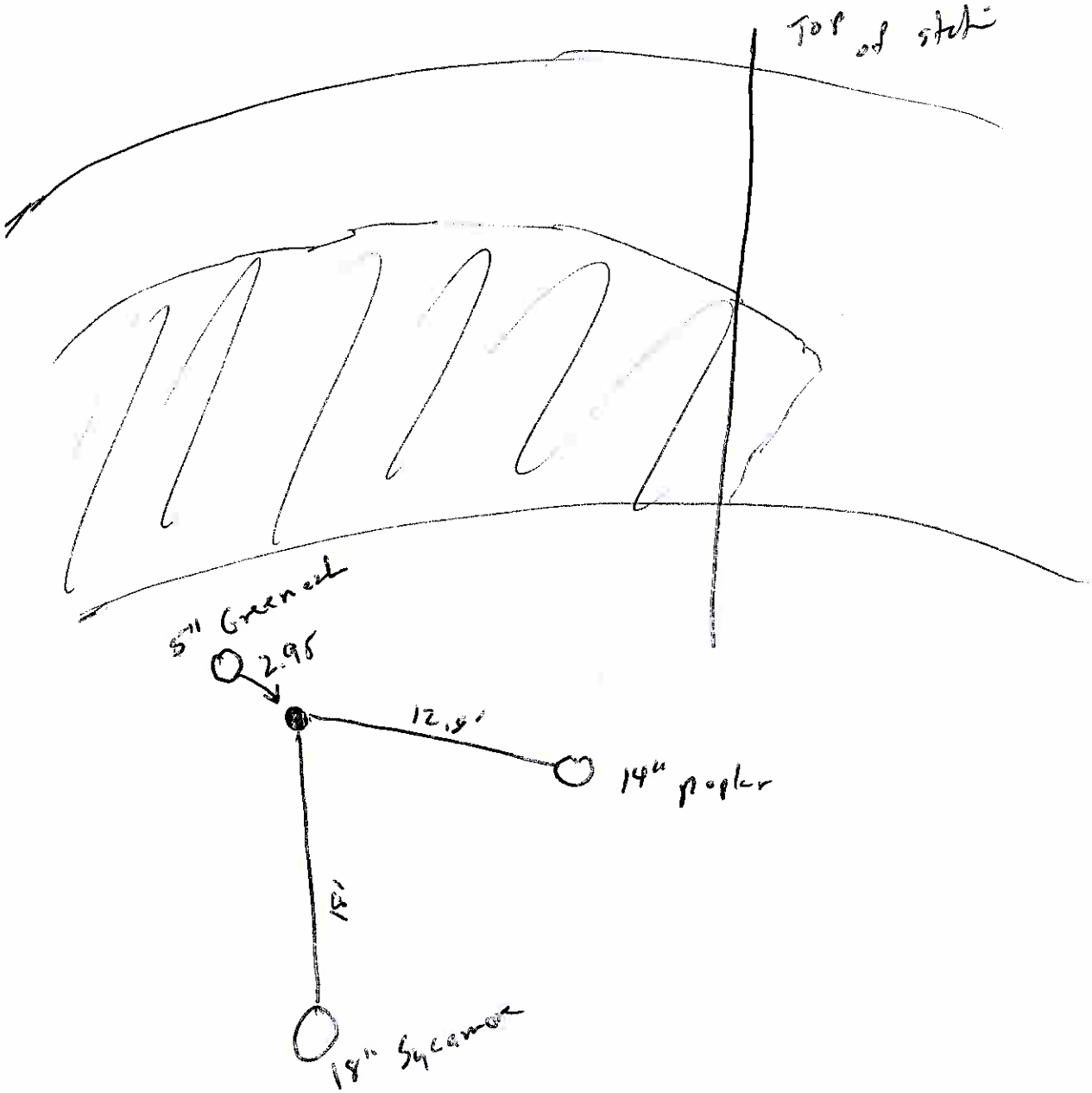
(all measurements are in feet unless otherwise noted)

STATION	TW	WS	BKF	WS/BF	TOB	Other	Other	COMMENT
224.1	10.81							TOP OF 100 PIN POOL
	11.205							GROUND
228.5	9.71							
236.3	10.14							
245.2	9.56	8.41	7.14					
257.5	8.93							GLDE X-S
262.0	8.58	8.42	6.80		6.35	6.25		(261)
"	3.16							X-S St A27.7
	3.42		PALLS LEVEL @ RB MON					
D/S			GRND @ RB MON			6.25		
GLP								
MON E								
TOP OF REACH MON (STA 10)						4.63		
U/S GROUND		LB GLIDE MON				3.93		

NOTATIONS	
NOTE	ABBREV
Left	L
Right	R
Pin	P
Edge of Water	EW
Water Surface	WS
Channel Shot	CS
Ground Shot	GS
Thalweg	TW
Monument T/B	MON
Floodprone	FP
Bankfull	BF
Top of Bank	TOB
Slope Break	SL BRK
Scour Line	SL
Inflection Point	IP
Veg Line	VL

Team 2 Bench mark Date 9/25/07

(used as reference to tie multiple Reaches together, also used by Team 1)

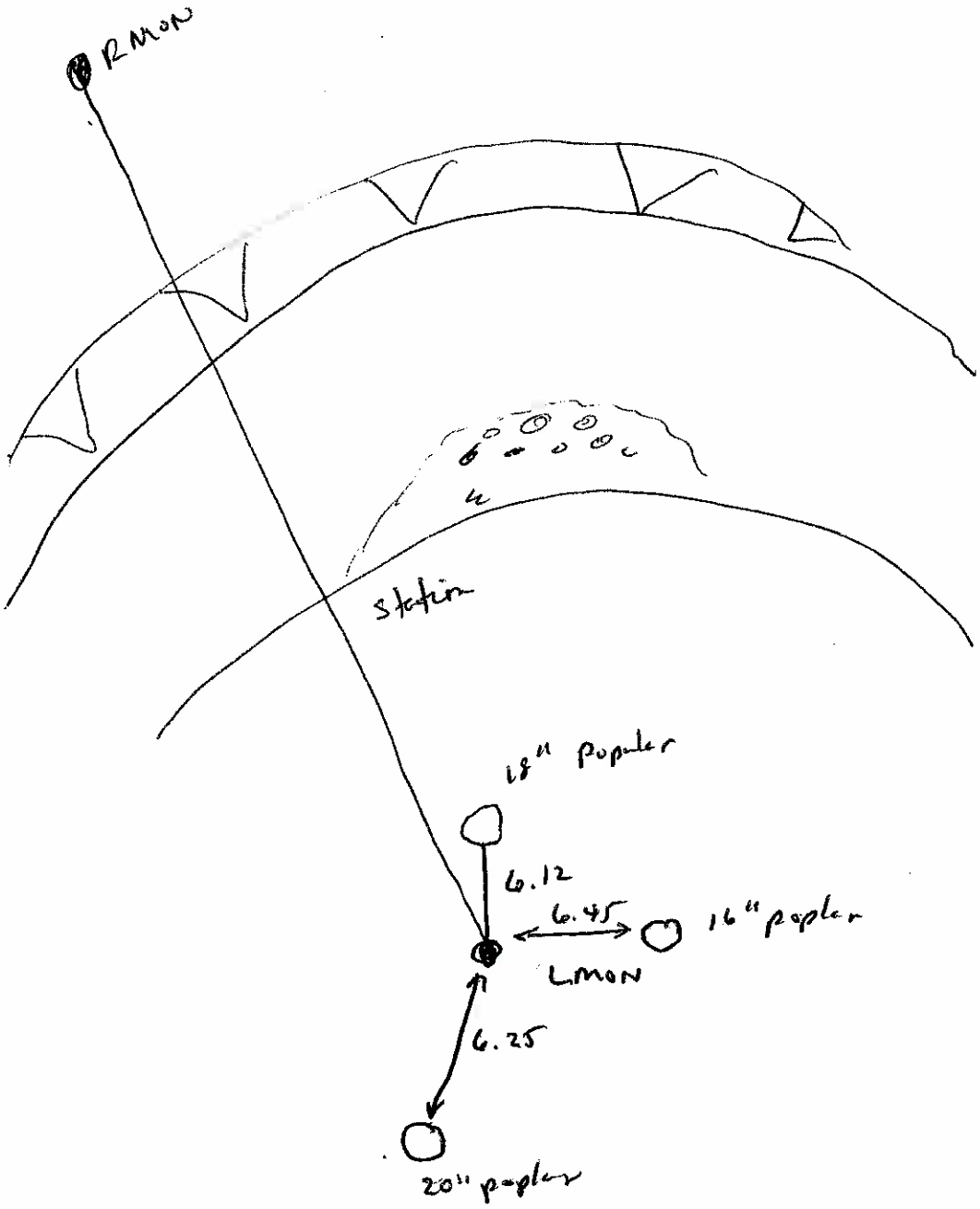


Page 2 x 5 m 9/25/2007 map

SITE SKETCH

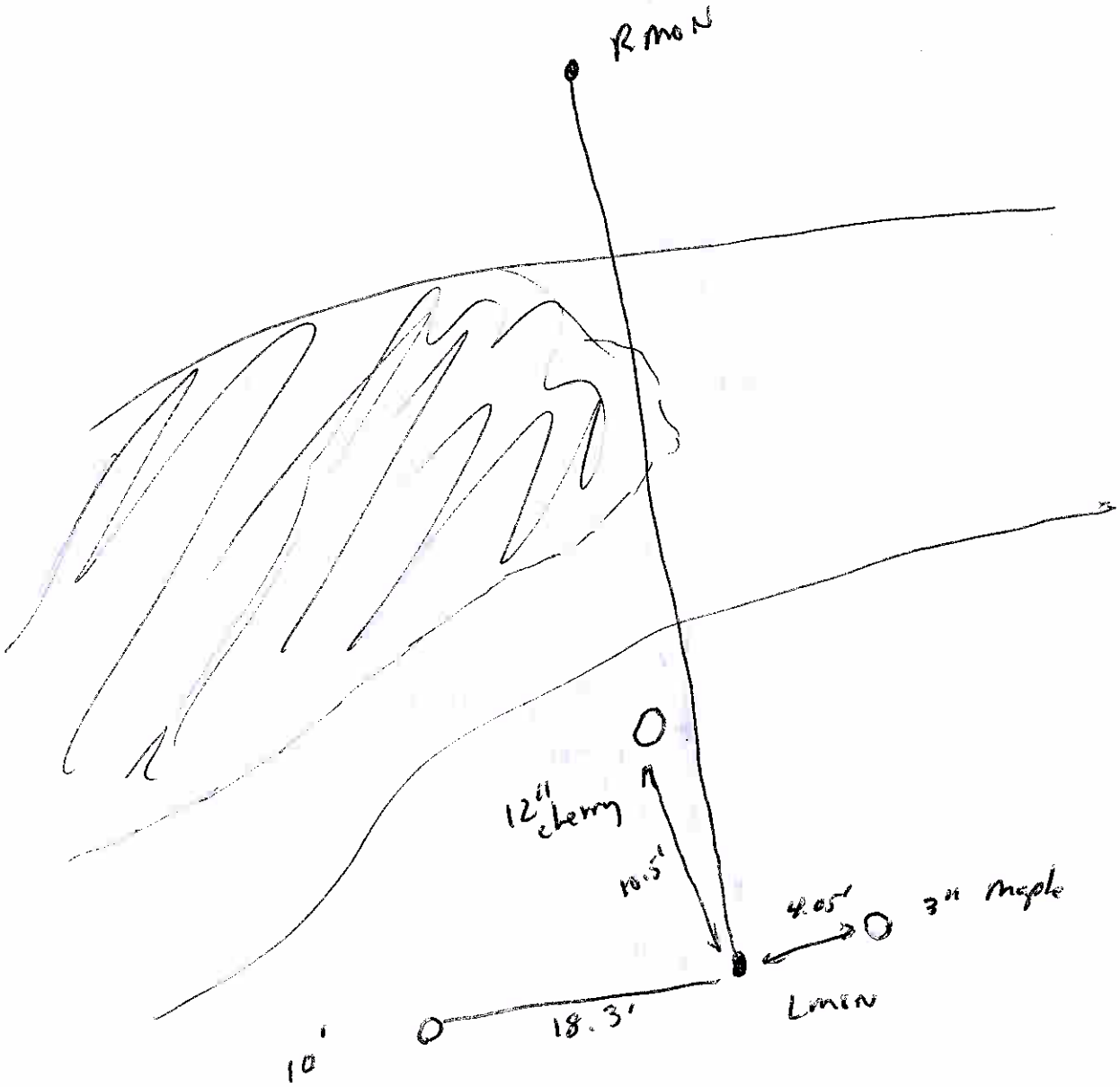
STREAM Macgruder Creek DATE 09/25/07

DA CREW Team 2



Team 2

Glade x-section
Monument Map

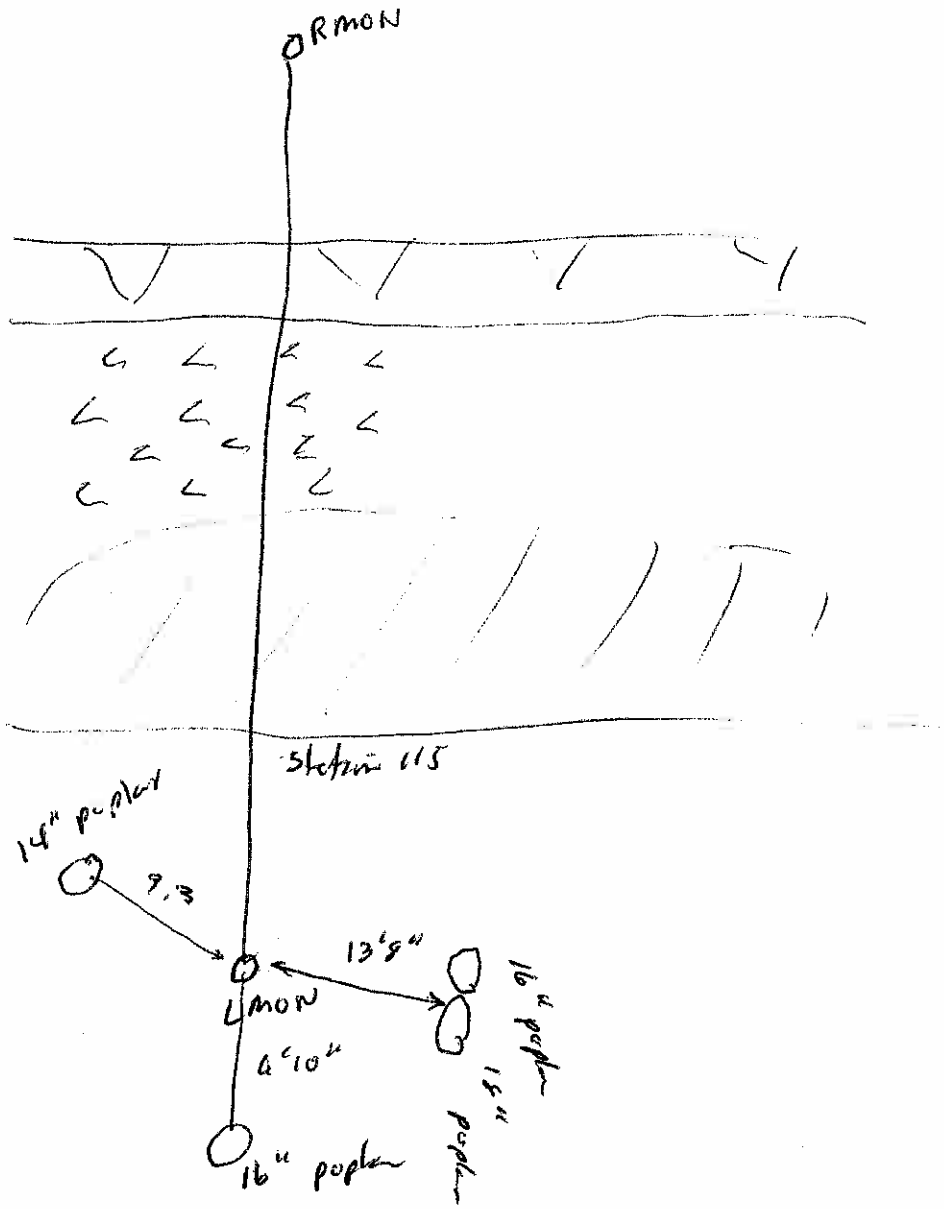


Magruder Branch Degraded Reach Team 2 9/25/2007

SITE SKETCH

STREAM Magruder Creek DATE 9/25/07

DA CREW Team 2



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: Team 2

Stream: MacGruder (MacGruder Creek)

Location: STA. 219+50

Date: 09/25/07

Subsamples	Catch Pan or BUCKET (0)		Sieve SIZE 2 mm (2)		Sieve SIZE 4 mm (4)		Sieve SIZE 8 mm (8)		Sieve SIZE 16 mm (16)		Sieve SIZE 32 mm (32)		Sieve SIZE 64 mm (64)		Sieve SIZE 128 mm (128)		Sieve SIZE 256 mm (256)		Sieve SIZE 512 mm (512)	
Tare weight	2-4						2-2		2-6		2-6		2-9		2-10		2-6			
Sample weights	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net
1	9-12	7-8					4-0	1-14	4-8	2-2	4-15	2-9	6-5	3-12	5-4	2-10	5-8	3-2		
2							5-4	3-2	4-14	2-8	5-12	3-6	4-8	1-15	6-0	3-16	—	2-8		
3							3-15	1-13	4-13	2-7	4-3	1-13	6-7	3-14						
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
Net wt. total	7.5						6.8		7.1		7.8		9.5		6.6		5.6			
% Grand total																				
Accum. % =<																				

SURFACE MATERIALS DATA (Two largest particles)

No.	Dia.	WT.
1	85	1/6 oz
2	80	1/2 oz

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

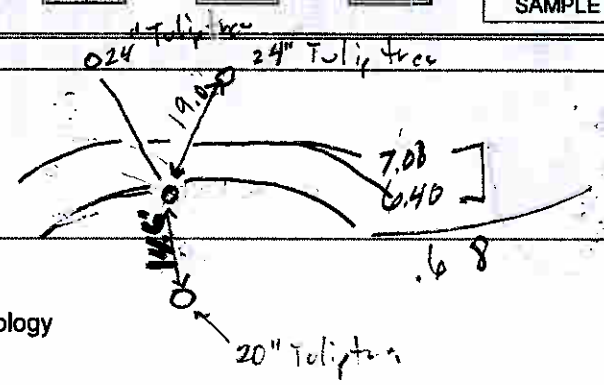
Be sure to add separate material weights to grand total

GRAND TOTAL SAMPLE WEIGHT

Sample location notes

Did not sample pool just downstream from riffle due to less coarse material. This is caused by backwater effect from tree downstream

Sample location sketch



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Magruder Branch Degraded Reach Team 2 9/25/2007

POOL PEBBLE COUNT

STREAM: Macgruder	**DATE:** 9/25/07
REACH: Team 2	**CREW:**
XS No.:	**Riffle Location (also mark on reach sketch):**

Station. 224+00±

ft	PARTICLE	mm		1	2	3	4	5	6	7	8	9	10	TOTALS Tot #	TOTALS % Cum
	Silt/Clay	< .062	S/C	~~IIII~~ III		8	8								
	Very Fine	.062 - .125	S												
	Fine	.125 - .25	A	I		1	1								
	Medium	.25 - .50	N	I		1	1								
	Coarse	.50 - 1.0	D	IIII		4	4								
	Vry Coarse	1.0 - 2	S	II		2	2								
	Very Fine	2 - 4		~~IIII~~ III		8	8								
	Fine	4 - 6	G	~~IIII~~ III		8	8								
	Fine	6 - 8	R	~~IIII~~ IIII		8	8								
	Medium	8 - 12	A	~~IIII~~ ~~IIII~~	II	12	12								
	Medium	12 - 16	V	~~IIII~~ III		8	8								
	Coarse	16 - 24	E	~~IIII~~ ~~IIII~~		10	10								
	Coarse	24 - 32	L	~~IIII~~ ~~IIII~~	IIII	14	14								
	Vry Coarse	32 - 48	S	~~IIII~~ III		8	8								
	Vry Coarse	48 - 64		~~IIII~~ I		6	6								
0.21-0.31	Small	64 - 96	C	II		2	2								
0.31-0.42	Small	96 - 128	O												
0.42-0.63	Large	128 - 192	B												
0.63-0.84	Large	192 - 256	L												
0.84-1.26	Small	256 - 384	B												
1.26-1.68	Small	384 - 512	L												
1.68-3.36	Medium	512 - 1024	D												
3.36-6.72	Lrg	1024 - 2048	R												
6.72-13.43	Vry Lrg	2048-4096													
	Bedrock	>4096	BDRK												

LARGEST PARTICLES ON BAR

Bar Location (also mark on reach sketch):

Bar Length:
Bar Width (Thalweg - BF):
Sketch bar profile (Thalweg - BF)

Part. #	mm	Part. #	mm	Part. #	mm
1		6		11	
2		7		12	
3		8		13	
4		9		14	
5		10		15	

(Glide Pebble Count (X-Section))

ROSGEN REPRESENTATIVE REACH PEBBLE COUNT

9/25/2007 Team 2 Magruder Branch Degraded Reach

STREAM: Mac Gruder Creek	DATE: 9/25/07
REACH:	CREW:

PARTICLE TALLY COUNTS BY TRANSECT

ft	PARTICLE	mm		1	2	3	4	5	6	7	8	9	10	Tot Pool	Tot Riff	Comb Tot	%CUM
	Silt/Clay	< .062	S/C	5		5	4										
	Very Fine	.062 - .125	S														
	Fine	.125 - .25	A														
	Medium	.25 - .50	N														
	Coarse	.50 - 1.0	D	1		1	1										
	Vry Coarse	1.0 - 2	S														
	Very Fine	2 - 4		1		1	1										
	Fine	4 - 6	G	5		4	1										
	Fine	6 - 8	R	7		7	6										
	Medium	8 - 12	A	8	5	15	10										
	Medium	12 - 16	V	7		7	6										
	Coarse	16 - 24	E	10	10	11 22	15										
	Coarse	24 - 32	L	10	4	14	8										
	Vry Coarse	32 - 48	S	10	3	13	9										
	Vry Coarse	48 - 64		7		7	7										
0.21-0.31	Small	64 - 96	C	5		4	4										
0.31-0.42	Small	96 - 128	O														
0.42-0.63	Large	128 - 192	B														
0.63-0.84	Large	192 - 256	L														
0.84-1.26	Small	256 - 384	B														
1.26-1.68	Small	384 - 512	L														
1.68-3.36	Medium	512 - 1024	D														
3.36-6.72	Lrg	1024 - 2048	R														
6.72-13.43	Vry Lrg	2048-4096															
	Bedrock	>4096	BDRK														

FEATURE SAMPLED

	Length	Proportion	No. Units	Sampled
REACH				
POOL				
RIFFLE				
RUN				

Transect	Feature	Length	Width
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

9/25/2007 Magruder Branch Degraded Reach Team 2

RIFFLE PEBBLE COUNT

100 Bankfull TO Bankfull

STREAM: Macgruder C/c **DATE:** 9/25/07

REACH: Tecm 2 **CREW:**

XS No.: **Riffle Location (also mark on reach sketch):** ~~STA.~~ 115+00

ft	PARTICLE	mm		1 (STA 115+00)	2	3 (Active Bed)	4	5	6	7	8	9	10	Tot #	% Cum
	Silt/Clay	< .062	S/C		27									27	
	Very Fine	.062 - .125	S											0	
	Fine	.125 - .25	A		5										
	Medium	.25 - .50	N				1								
	Coarse	.50 - 1.0	D												
	Vry Coarse	1.0 - 2	S												
	Very Fine	2 - 4													
	Fine	4 - 6	G		2		3								
	Fine	6 - 8	R		3		4								
	Medium	8 - 12	A		6		9								
	Medium	12 - 16	V		4	1	13								
	Coarse	16 - 24	E		5		18								
	Coarse	24 - 32	L		9	7	15								
	Vry Coarse	32 - 48	S		17		16								
	Vry Coarse	48 - 64			11	1	14								
0.21-0.31	Small	64 - 96	C		10		7								
0.31-0.42	Small	96 - 128	O		1		2								
0.42-0.63	Large	128 - 192	B												
0.63-0.84	Large	192 - 256	L												
0.84-1.26	Small	256 - 384	B												
1.26-1.68	Small	384 - 512	L												
1.68-3.36	Medium	512 - 1024	D												
3.36-6.72	Lrg	1024 - 2048	R												
6.72-13.43	Vry Lrg	2048-4096													
	Bedrock	>4096	BDRK												

LARGEST PARTICLES ON BAR

Bar Location (also mark on reach sketch):

Bar Length:
Bar Width (Thalweg - BF):
Sketch bar profile (Thalweg - BF)

Part. #	mm	Part. #	mm	Part. #	mm
1		6		11	
2		7		12	
3		8		13	
4		9		14	
5		10		15	

USFWS-Stream Habitat Assessment and Restoration Program
Modified 04/22/04, TLM

Riffle_PC_Form2

Magruder Branch Degraded Reach Team 2 9/25/2007

REACH AVERAGE

~~POOL PEBBLE COUNT~~

STREAM: Magruder Branch	**DATE:** 9/25/07
REACH: REACH 2	**CREW:** TEAM 2
XS No.:	**Riffle Location (also mark on reach sketch):**

ft	PARTICLE	mm		POOLS 1	2	RIFFLES 3	RUN 4	5	6	7	GLIDE 8	9	10	TOTALS Tot #	% Cum
	Silt/Clay	< .062	S/C	4		1 1					1			6	
	Very Fine	.062 - .125	S	0										0	
	Fine	.125 - .25	A	1										1	
	Medium	.25 - .50	N	0										0	
	Coarse	.50 - 1.0	D	5						11	2			7	
	Vry Coarse	1.0 - 2	S	0										0	
	Very Fine	2 - 4		3		1 1	1				1			6	
	Fine	4 - 6	G	2			11							4	
	Fine	6 - 8	R	2			11			11	2			6	
	Medium	8 - 12	A	6						11	2			8	
	Medium	12 - 16	V	4						1	1			5	
	Coarse	16 - 24	E	7		111 3	11				3			12	
	Coarse	24 - 32	L	9		111 3	11			1	4			15	
	Vry Coarse	32 - 48	S	5		1111 4	1				4			10	
	Vry Coarse	48 - 64		2		11 2				1	3			5	
0.21-0.31	Small	64 - 96	C	4		1111 5				1	6			10	
0.31-0.42	Small	96 - 128	O	1		1 1					1			2	
0.42-0.63	Large	128 - 192	B	0										0	
0.63-0.84	Large	192 - 256	L	1										1	
0.84-1.26	Small	256 - 384	B												
1.26-1.68	Small	384 - 512	L												
1.68-3.36	Medium	512 - 1024	D												
3.36-6.72	Lrg	1024 - 2048	R												
6.72-13.43	Vry Lrg	2048-4096													
	Bedrock	>4096	BDRK	4										4	

LARGEST PARTICLES ON BAR

Bar Location (also mark on reach sketch):

Bar Length:
Bar Width (Thalweg - BF):
Sketch bar profile (Thalweg - BF)

Part. #	mm	Part. #	mm	Part. #	mm
1		6		11	
2		7		12	
3		8		13	
4		9		14	
5		10		15	

REACH AVERAGE

ROSGEN REPRESENTATIVE REACH PEBBLE COUNT

(10)

STREAM: MacGruder Branch **DATE:** 9/25/07

REACH: Reach 2 **CREW:** Team 2

9/25/2007 Team 2 Magruder Branch Degraded Reach

PARTICLE TALLY COUNTS BY TRANSECT

ft	PARTICLE	mm		Riffles 1	2	Run 3	Pool 4	Pool 5	Pool 6	Pool 7	Pool 8	Pool 9	Glide 10	Tot Pool	Tot Riff	Comb Tot	%CUM
	Silt/Clay	< .062	S/C	I			I		I	I	I	4					
	Very Fine	.062 - .125	S									0					
	Fine	.125 - .25	A								I	1					
	Medium	.25 - .50	N									0					
	Coarse	.50 - 1.0	D				I			II		II 5	II				
	Vry Coarse	1.0 - 2	S									0					
	Very Fine	2 - 4		I		I	II		I			3					
	Fine	4 - 6	G			II		I				I 2					
	Fine	6 - 8	R			II				I		I 2	II				
	Medium	8 - 12	A				I			II	I	II 6	II				
	Medium	12 - 16	V				I	II			I	4	I				
	Coarse	16 - 24	E	II	I	II	I	I	II		III	7					
	Coarse	24 - 32	L		III	II	I	II	IIII	I	I	9	I				
	Vry Coarse	32 - 48	S	II	II	I	I	I	II	I		5					
	Vry Coarse	48 - 64		I	I			I				I 2	I				
0.21-0.31	Small	64 - 96	C	II	III		I			I	I	I 4	I				
0.31-0.42	Small	96 - 128	O	I							I						
0.42-0.63	Large	128 - 192	B														
0.63-0.84	Large	192 - 256	L							I		1					
0.84-1.26	Small	256 - 384	B														
1.26-1.68	Small	384 - 512	L														
1.68-3.36	Medium	512 - 1024	D														
3.36-6.72	Lrg	1024 - 2048	R														
6.72-13.43	Vry Lrg	2048-4096															
	Bedrock	>4096	BDRK					II									
			FEATURE SAMPLED									II 4					

	Length	Proportion	No. Units	Sampled
REACH				
POOL				
RIFFLE				
RUN				

Transect	Feature	Length	Width
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			