

# The New VT ANR Rapid Habitat Assessment: Linking Physical Processes to Aquatic Habitat in Different Stream Types

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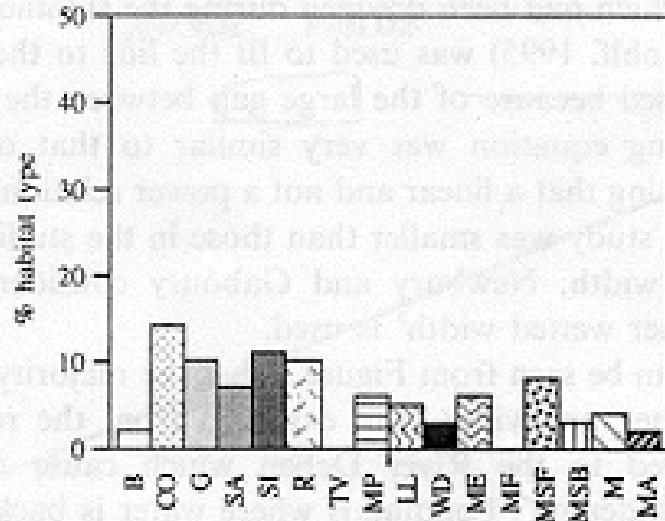


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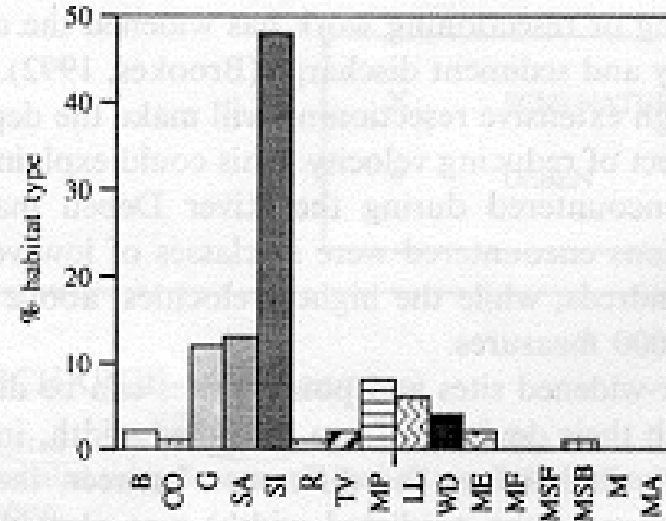
*“Ecological restoration is a holistic approach not achieved through isolated manipulations of individual elements but through approaches ensuring that natural ecological processes occur.” (Kauffman et al., 1997)*



Great Ouse at Radcliffe - semi-natural



Deben at Wickham Market - overwidened



□ B - boulders/rocks

▣ CO - cobbles

▤ G - gravel

▥ SA - sand

▦ SI - silt

▧ R - roots

▨ TV - trailing vegetation

▩ MP - marginal plants

▪ LL - leaf litter

▬ WD - woody debris

▭ ME - emergent macrophytes

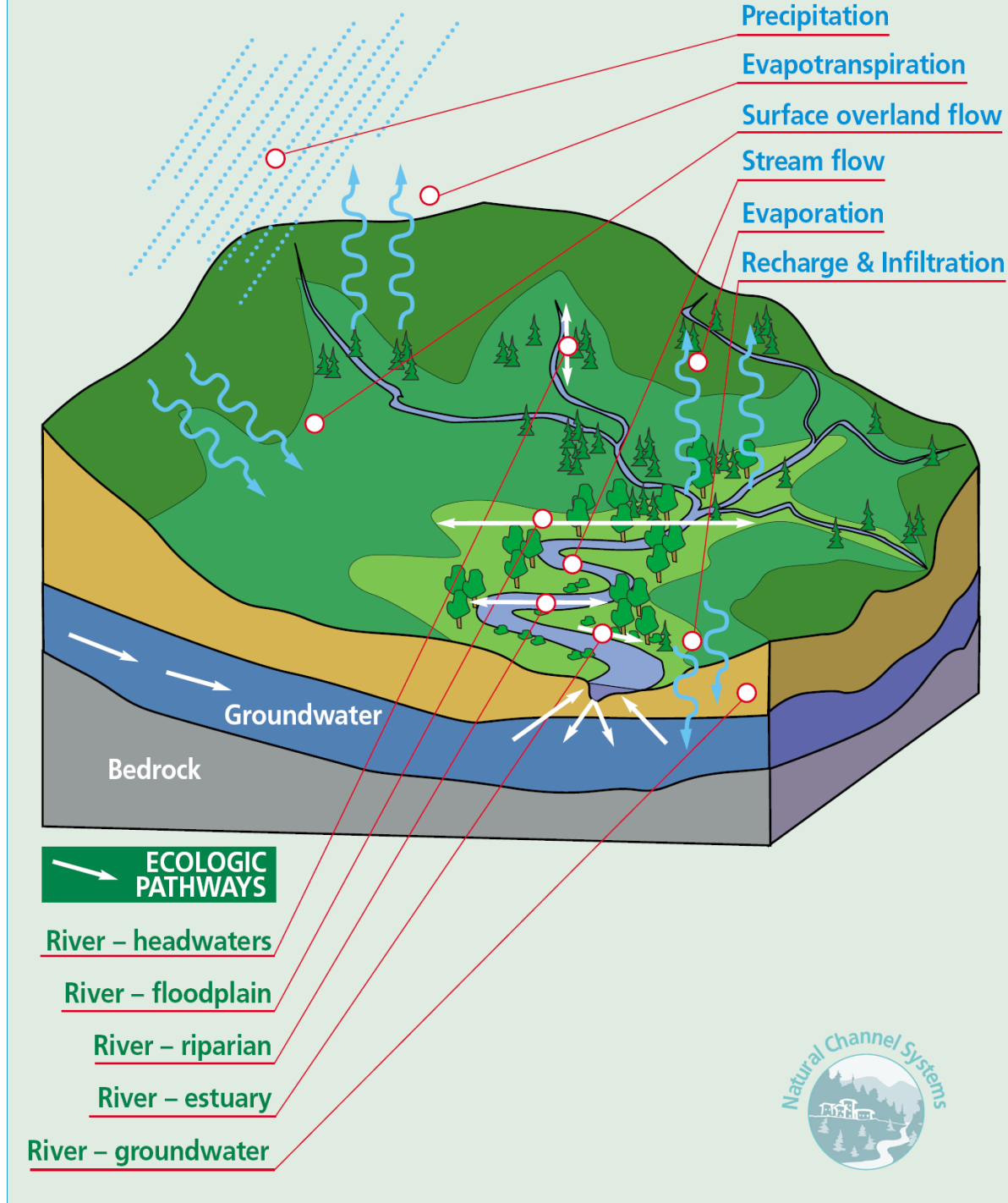
▮ MF - floating-leaved macrophytes

▯ MSF - submerged, fine-leaved mac.

▰ MSB - submerged, broad-leaved mac.

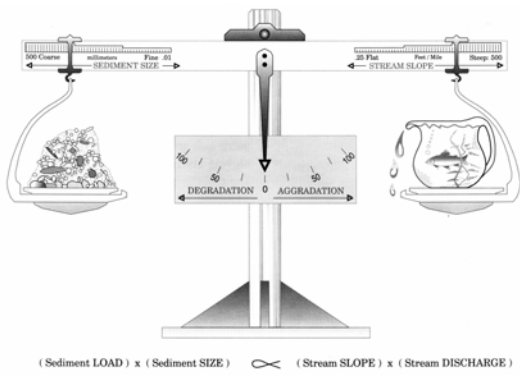
▱ M - moss

▲ MA - macroalgae

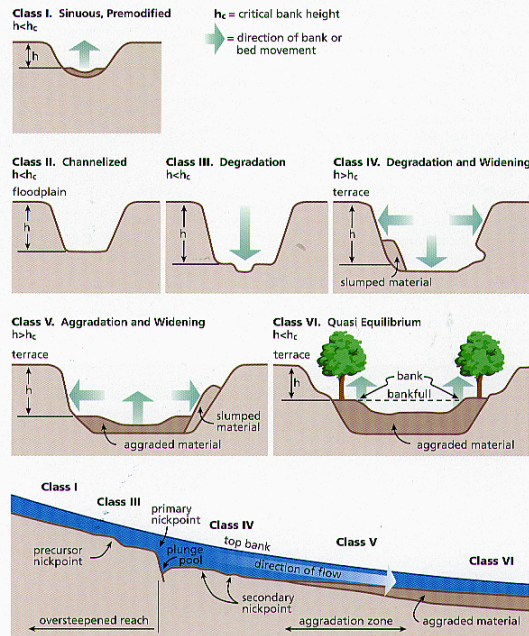


(MODIFIED FROM WARD & STANFORD 1989 AND IMHOF ET AL. 1991)

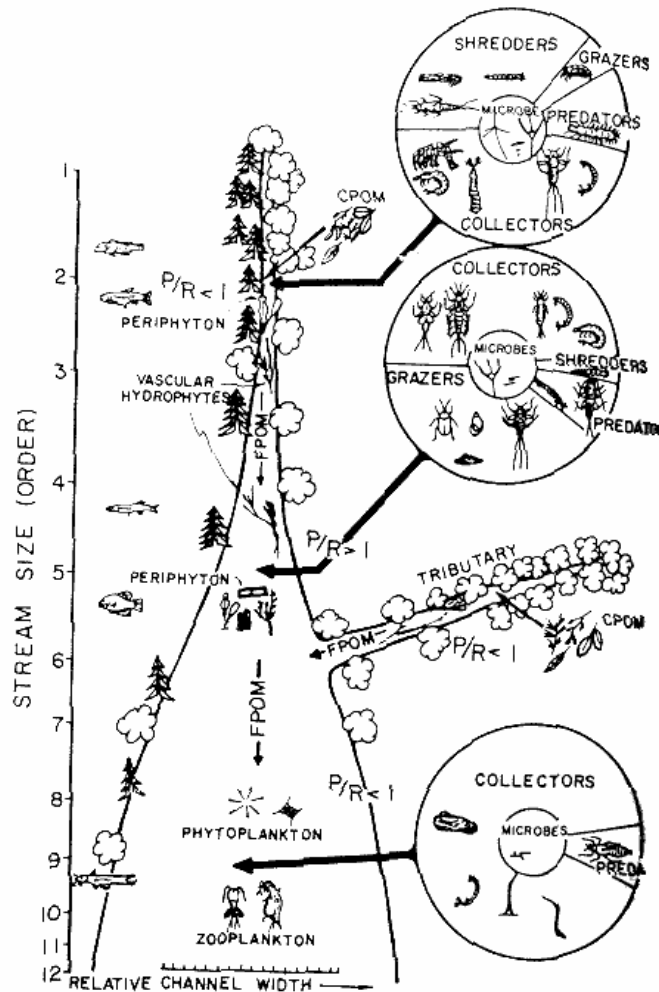
Source: OMNR, 2001



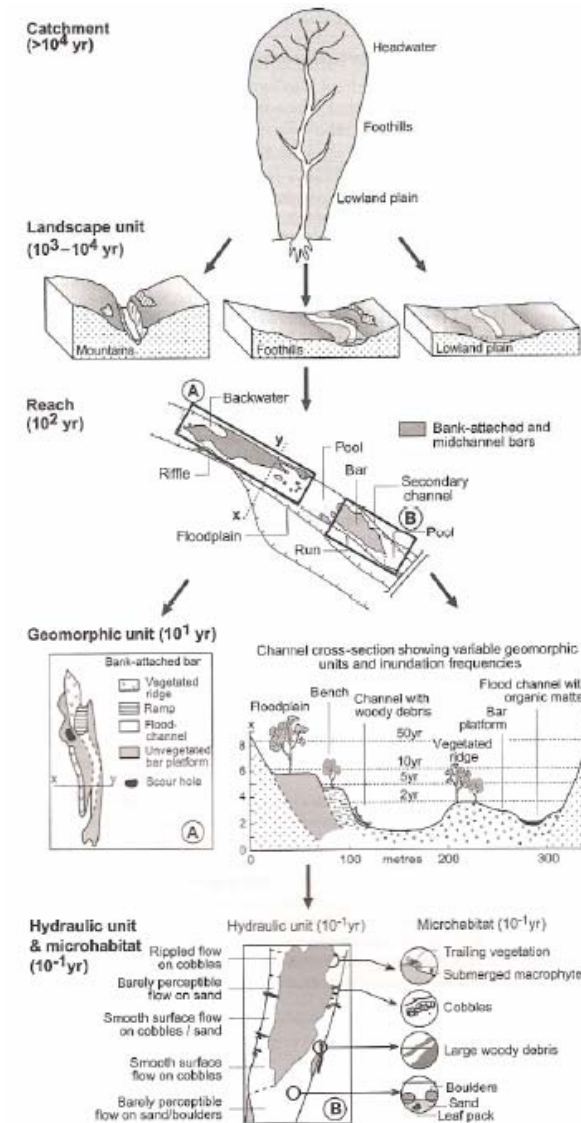
Source: Lane, 1955; Rosgen and Silvey, 1996



Source: Simon 1989; FISRWG, 1998



Source: Vannote, 1980



Source: Brierley and Fryirs, 2005

*"We may conclude then that in every respect the valley rules the stream. Its rock determines the availability of ions, its soil, its clay, even its slope. The soil and climate determine the vegetation, and the vegetation rules the supply of organic matter. The organic matter reacts with the soil to control the release of ions, and the ions, particularly nitrate and phosphate, control the decay of the litter, and hence lie right at the root of the food cycle."* Source: Hynes, 1975

# “Habitat Equilibrium”

The optimal relationship between habitat abundance and its formation and maintenance by physical processes

### **8.1 Woody Debris Cover**

LWD pieces / mile  
Abundance of larger LWD  
Debris jams / mile  
Wood recruitment potential  
CPOM coverage

### **8.2 Bed Substrate Cover**

Riffle embeddedness  
Margin embeddedness  
Fining  
Riffle stability index  
Sediment mobility and sorting

### **8.3 Scour and Deposition Features**

Pools / mile  
Abundance of larger pools  
Pool cover  
Riffle (ripple) coverage and form  
Riffle (ripple) spacing  
Hydraulic pattern, distribution  
Deposition

### **8.4 Channel Morphology**

Width / depth ratio  
Entrenchment ratio  
Incision ratio  
Channel alteration

### **8.5 Hydrologic Characteristics**

Wetted width / bankfull width  
Exposed substrate  
Adjacent wetland features  
Flow alteration

### **8.6 Connectivity**

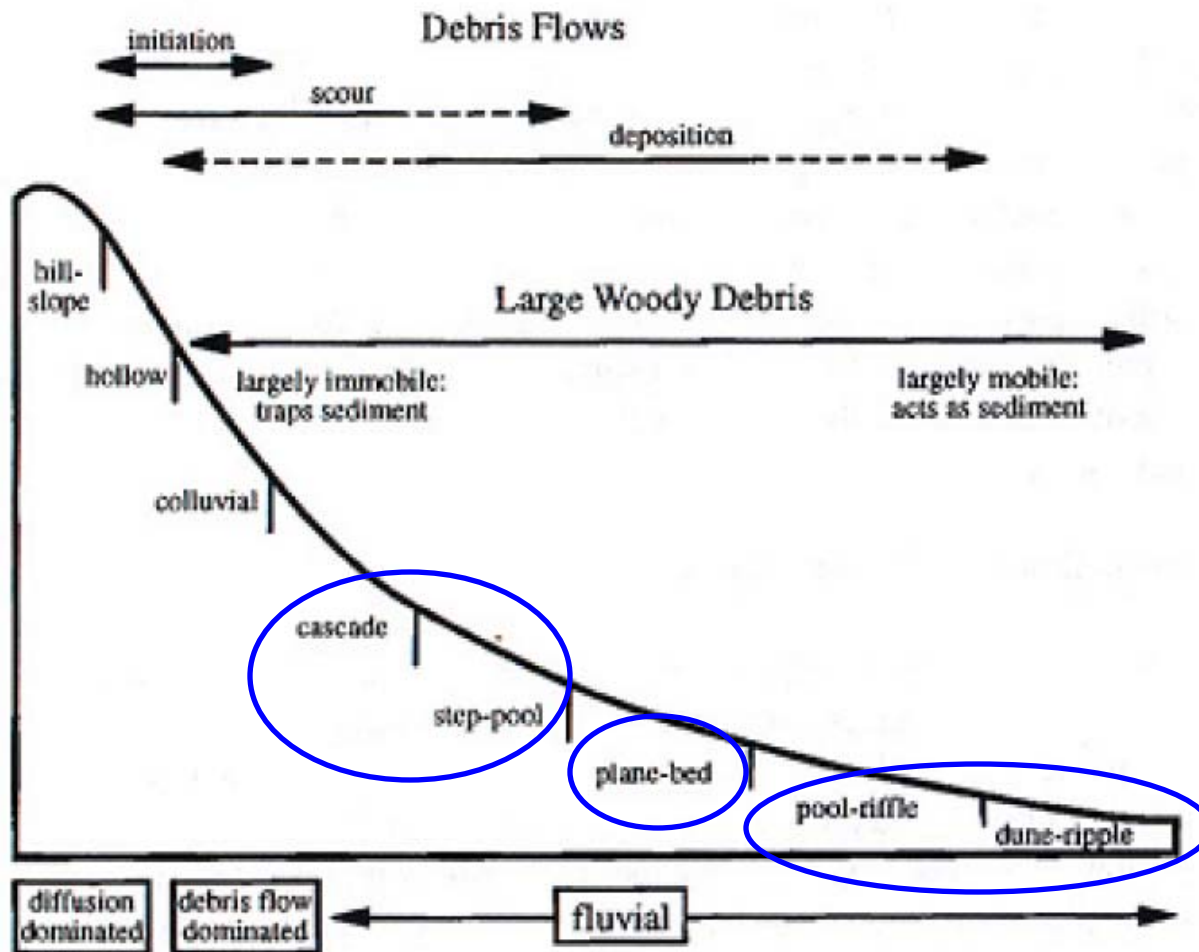
Reach obstructions  
System obstructions  
Refuge

### **8.7 River Banks**

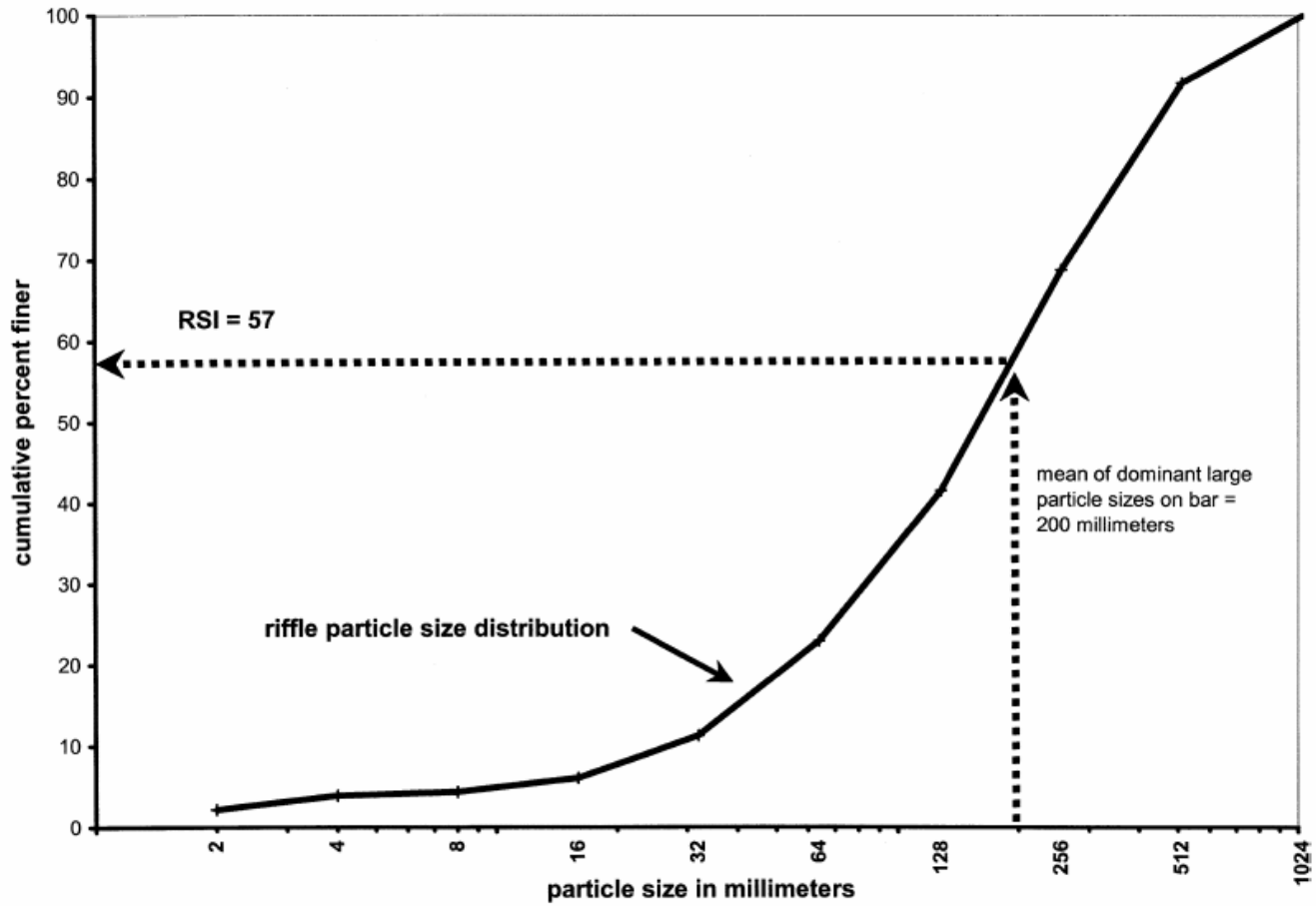
Amount of bank erosion  
Bank vegetation  
Bank canopy  
Undercut banks / mile  
Abundance of larger undercut banks, stability,  
and overhanging vegetation  
Water adjacency thalweg side  
Mass failures

### **8.8 Riparian Area**

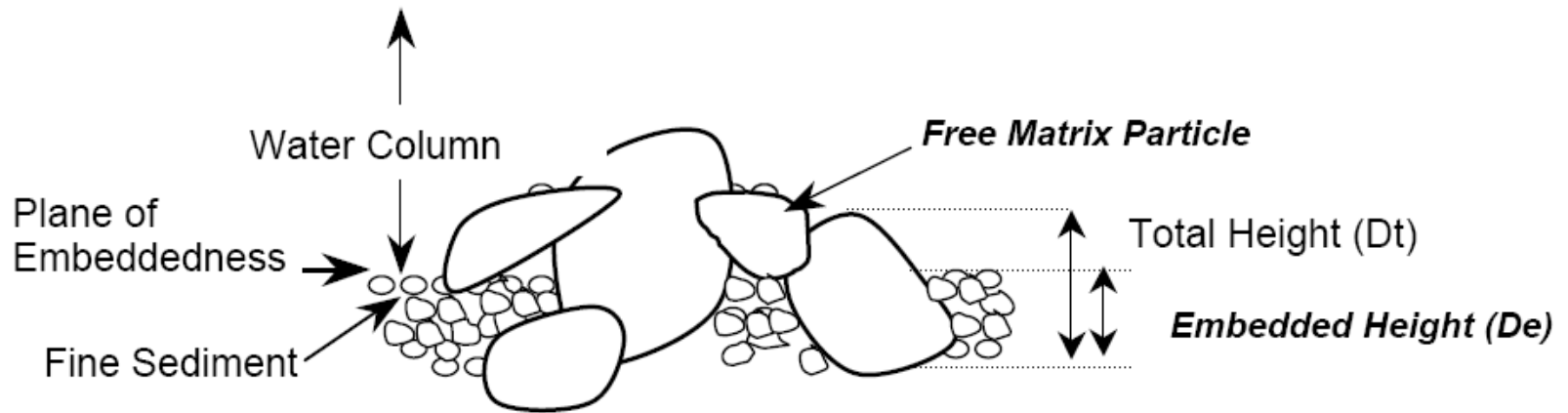
Buffer width  
Riparian vegetation  
River corridor development



Source: Montgomery and Buffington, 1997



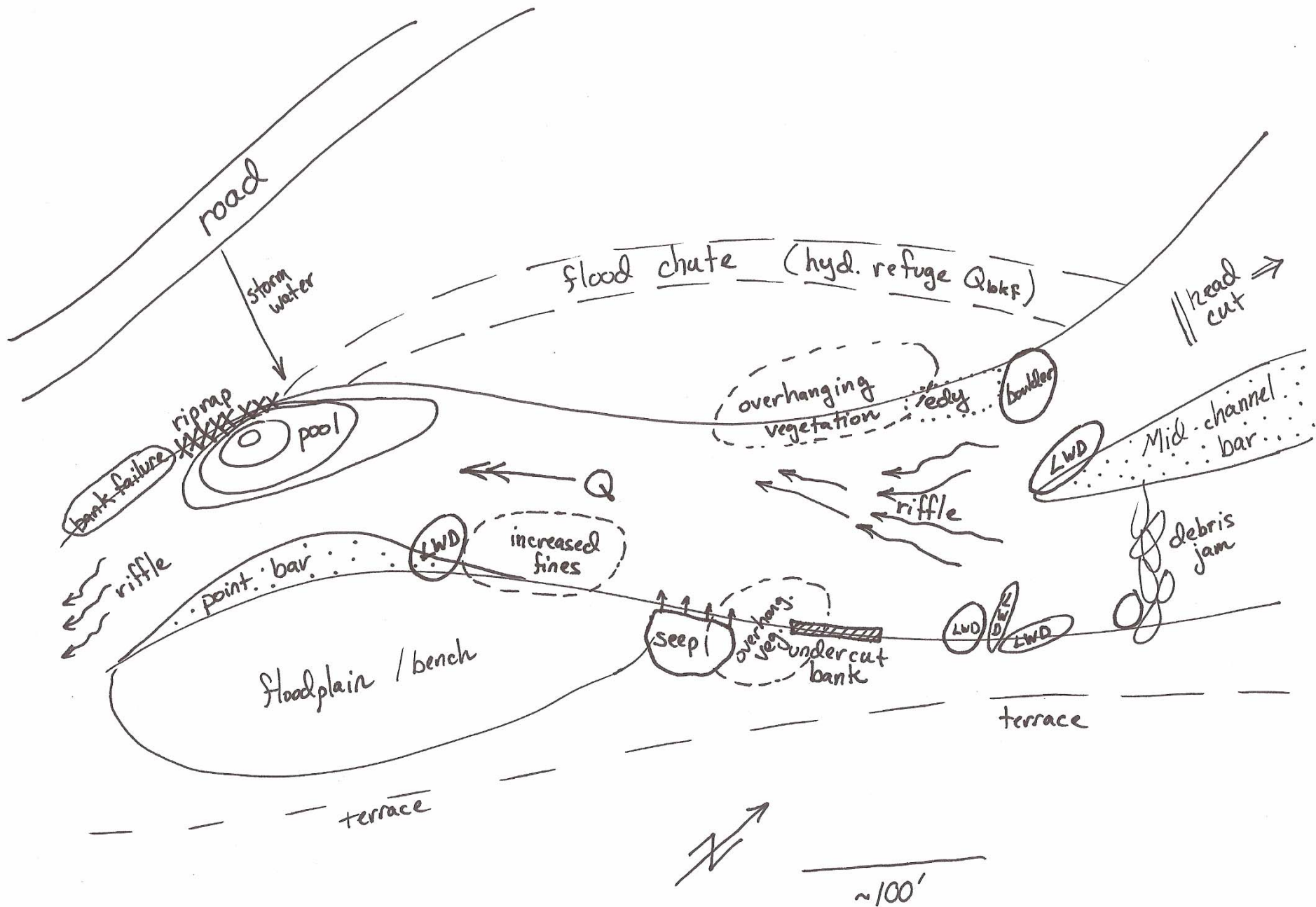
Source: Kappesser, 2002



Source: Sylte and Fischenich, 2002

*Differences between sediment deposition and common biologic metrics could possibly be due to typical embeddedness measures not accurately describing the true level of embeddedness in the substrate that could better be represented by other indicators such as the percent fines.*

Source: McHugh and Budy, 2005



### 6.1 Large Woody Debris

Rank	D <sub>large</sub> (ft)	L (/width)	Count	%
1	0.5 - 1.0	< 0.5		
2	0.5 - 1.0	> 0.5		
3	1.0 - 2.0	< 0.5		
4	1.0 - 2.0	> 0.5		
5	> 2.0	< 0.5		
6	> 2.0	> 0.5		
7	Debris jam			
<b>Total</b>				
<b># LWD / mile</b>				
<b># jams / mile</b>				
<b>% coverage of CPOM</b>				

### 6.2 Pools (assess cover, fine sediment, & turbulence in pool)

Rank	D (ft)	W (/width)	Count	%
1	1.0 - 2.0	< 0.5		
2	1.0 - 2.0	> 0.5		
3	2.0 - 3.0	< 0.5		
4	2.0 - 3.0	> 0.5		
5	> 3.0	< 0.5		
6	> 3.0	> 0.5		
<b>Total</b>				
<b># Pools / mile</b>				

### 6.3 Refuge Areas / Connections

ID	Location	Q <sub>access</sub>	Adds quality habitat?
	in / out	low / blkf	yes / no
	in / out	low / blkf	yes / no
	in / out	low / blkf	yes / no
	in / out	low / blkf	yes / no
	in / out	low / blkf	yes / no

### 6.4 Undercut Banks (assess over-hanging vegetation)

Rank	D <sub>max</sub> (ft)	L (ft)	Count	%
1	0.5 - 1.0	< 2.0		
2	0.5 - 1.0	> 2.0		
3	1.0 - 2.0	< 2.0		
4	1.0 - 2.0	> 2.0		
5	>2.0	< 2.0		
6	>2.0	> 2.0		
<b>Totals</b>				
<b># undercut banks / mile</b>				
<b>% overhanging vegetation</b>				
<b>% water adjacency</b>				

## 2. Stream Channel

- 2.1 Bankfull Width: \_\_\_\_\_ ft.    **2.1a Wetted Width:** \_\_\_\_\_ ft.    **2.1b Ratio ( $W_{\text{wetted}} / W_{\text{bkf}}$ ):** \_\_\_\_\_
- 2.2 Max. Bankfull Depth: \_\_\_\_\_ ft.    2.3 Mean Bankfull Depth: \_\_\_\_\_ ft.
- 2.4 Floodprone Width: \_\_\_\_\_ ft.    2.5 Recently Abandoned FP : \_\_\_\_\_ ft.    2.6 Ratio  $W/d_{\text{mean}}$ : \_\_\_\_\_
- 2.7 Entrenchment: \_\_\_\_\_    2.8 Incision Ratio: \_\_\_\_\_    2.9 Sinuosity: \_\_\_\_\_
- 2.10 Riffles/Steps: complete / eroded / sedimented / NA / NE    2.11 Riffle/Step Spacing: \_\_\_\_\_ ft.  
(partial or none) (diagonal or continuous)

### 2.12 Bed Substrate Composition (percent):

1 Bedrock	2 Boulder >10 in >256 mm	3 Cobble 2.5 - 10 in 64-256 mm	4 Gravel		5 Sand <0.1 in <2 mm	6 Silt or Clay (present)  Y / N	Embeddedness		2.13 Avg. Size of Largest Particles on:  Bed:            Bar:  circle: inches or millimeters  <b>2.13a % Exp. Substrate:</b>
			Course 0.6-2.5in 16-64mm	Fine 0.08-0.63in 2-16 mm			Mean Channel	Mean Margin	

- 2.14 Stream Type: A   G   F   B   E   C   D   1   2   3   4   5   a   b   c  
 Cascade   Step-Pool   Plane Bed   Riffle-Pool   Ripple-Dune   Braided

Stream Type
-------------

Reference Type

**VTANR RAPID HABITAT ASSESSMENT ----- RIFFLE-POOL STREAM TYPE**

(Also use this form for dune-ripple stream type.)

Stream Name: \_\_\_\_\_

Segment I.D.: \_\_\_\_\_

Location: \_\_\_\_\_

Date: \_\_\_\_\_

\_\_\_\_\_

Town: \_\_\_\_\_

Observers: \_\_\_\_\_

Elevation: \_\_\_\_\_ ft.

Organization /Agency: \_\_\_\_\_

Latitude (N/S): \_\_\_\_\_

USGS Map Name(s): \_\_\_\_\_

Longitude (E/W): \_\_\_\_\_

Weather: \_\_\_\_\_

Drainage Area: \_\_\_\_\_ sq. mi.

Rain Storm within past 7 days: Y / N

Segment Length: \_\_\_\_\_ ft.

Habitat Parameter	Condition (Departure) Category																			
	Reference (None)					Good (Minor)					Fair (Major)					Poor (Severe)				
<b>8.1 Woody Debris Cover</b>	<input type="checkbox"/> LWD pieces / mile > 100					<input type="checkbox"/> 100 ≥ LWD / mile > 50					<input type="checkbox"/> 50 ≥ LWD / mile > 25					<input type="checkbox"/> LWD / mile ≤ 25				
	<input type="checkbox"/> LWD size rank 3-6 >50%					<input type="checkbox"/> 50 ≥ LWD rank 3-6 > 25%					<input type="checkbox"/> 25 ≥ LWD rank 3-6 > 10%					<input type="checkbox"/> LWD size rank 3-6 ≤ 10%				
<b>SCORE</b>	<input type="checkbox"/> debris jams / mile > 25					<input type="checkbox"/> 25 ≥ jams / mile > 10					<input type="checkbox"/> 10 ≥ jams / mile > 5					<input type="checkbox"/> jams / mile ≤ 5				
	<input type="checkbox"/> high woody debris recruitment potential					<input type="checkbox"/> moderate woody debris recruitment potential					<input type="checkbox"/> low woody debris recruitment potential					<input type="checkbox"/> no woody debris recruitment potential				
<b>SCORE</b>	<input type="checkbox"/> CPOM coverage >50%					<input type="checkbox"/> 50 ≥ CPOM > 25%					<input type="checkbox"/> 25 ≥ CPOM > 10%					<input type="checkbox"/> CPOM ≤ 10%				
	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
<b>8.2 Bed Substrate Cover</b>	<input type="checkbox"/> riffle embeddedness < 20%					<input type="checkbox"/> 20 ≤ emb <sub>riffle</sub> < 40%					<input type="checkbox"/> 40 ≤ emb <sub>riffle</sub> < 75%					<input type="checkbox"/> riffle embeddedness ≥ 75%				
	<input type="checkbox"/> margin embeddedness < 40%					<input type="checkbox"/> 40 ≤ emb <sub>margin</sub> < 60%					<input type="checkbox"/> 60 ≤ emb <sub>margin</sub> < 80%					<input type="checkbox"/> margin embeddedness ≥ 80%				
<b>SCORE</b>	<input type="checkbox"/> fining* < 10%					<input type="checkbox"/> 10 ≤ fining* < 20%					<input type="checkbox"/> 20 ≤ fining* < 40%					<input type="checkbox"/> fining* ≥ 40%				
	<input type="checkbox"/> Riffle stability index < 25%					<input type="checkbox"/> 25 ≤ RSI < 50%					<input type="checkbox"/> 50 ≤ RSI < 75%					<input type="checkbox"/> RSI ≥ 75%				
<b>SCORE</b>	<input type="checkbox"/> sediment apparently stable & sorted					<input type="checkbox"/> some evidence of sediment mobility & lack of sorting					<input type="checkbox"/> major evidence of sediment mobility & lack of sorting					<input type="checkbox"/> sediments unstable, unsorted, soft underfoot				
	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

\*fines: sand if d<sub>50</sub> ≥ gravel, otherwise silt.

(Dune-ripple stream type: Fining only.)

<p><b>8.3 Scour and Deposition Features</b></p> <p>(Dune-ripple stream type: Only evaluate pools and ripples.)</p> <p><i>Depth-velocity combinations</i>  <i>fast-shallow</i>  <i>fast-deep</i>  <i>slow-shallow</i>  <i>slow-deep</i>  <i>(cutoffs: 1.0 fps, 1.5 ft)</i></p>	<input type="checkbox"/> pools / mile > 40 <input type="checkbox"/> pool size rank 3-6 >50% <input type="checkbox"/> good pool cover over > 75% of surface area typical <input type="checkbox"/> riffle (ripple) coverage > 25% reach area, distinctly formed and complete <input type="checkbox"/> riffle (ripple) spacing < 10 bankfull channel widths <input type="checkbox"/> well-defined riffle-run-pool-glide pattern with all four depth-velocity combinations present <input type="checkbox"/> finer deposition located entirely in slack water below larger substrates/debris, and along margins	<input type="checkbox"/> 40 ≥ pools / mile > 20 <input type="checkbox"/> 50 ≥ pool rank 3-6 > 25% <input type="checkbox"/> 75 ≥ good pool cover > 50% of surface area typical <input type="checkbox"/> 25 ≥ riffle coverage > 10% reach area, moderately well formed and complete <input type="checkbox"/> 10 ≤ riffle spacing < 15 bankfull channel widths <input type="checkbox"/> well-defined riffle-run-pool-glide pattern with three depth-velocity combinations dominant <input type="checkbox"/> finer deposition located in slack water below larger substrates/debris, signs of mid-channel accumulation	<input type="checkbox"/> 20 ≥ pools / mile > 10 <input type="checkbox"/> 25 ≥ pool rank 3-6 > 10% <input type="checkbox"/> 50 ≥ good pool cover > 25% of surface area typical <input type="checkbox"/> 25 ≥ riffle coverage > 10% reach area, poorly formed and incomplete <input type="checkbox"/> 15 ≤ riffle spacing < 25 bankfull channel widths <input type="checkbox"/> moderately defined riffle-run-pool-glide pattern with two depth-velocity combinations dominant <input type="checkbox"/> very large depositional features below larger substrates/debris, abundant mid-channel accumulation	<input type="checkbox"/> pools / mile ≤ 10 <input type="checkbox"/> pool size rank 3-6 ≤ 10% <input type="checkbox"/> good pool cover over ≤ 25% of surface area typical <input type="checkbox"/> riffle (ripple) coverage ≤ 10% reach area, or mostly indistinct <input type="checkbox"/> riffle (ripple) spacing ≥ 25 bankfull channel widths <input type="checkbox"/> poorly defined riffle-run-pool-glide pattern with one depth-velocity combination dominant <input type="checkbox"/> finer deposition throughout channel, even filling pools, larger substrates almost buried OR bed largely incised
	SCORE	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6
<p><b>8.4 Channel Morphology</b></p>	<input type="checkbox"/> width/depth < 15 <input type="checkbox"/> entrenchment ratio ≥ 1.4, incision ratio < 1.2 <input type="checkbox"/> no evidence of channel alteration	<input type="checkbox"/> 15 ≤ width/depth < 25 <input type="checkbox"/> entrenchment ratio ≥ 1.4, 1.2 ≤ incision ratio < 1.4 <input type="checkbox"/> evidence of minor historic channel alteration	<input type="checkbox"/> 25 ≤ width/depth < 40 <input type="checkbox"/> entrenchment ratio ≥ 1.4, 1.4 ≤ incision ratio < 2.0 <input type="checkbox"/> major historic channel alteration or minor recent alteration	<input type="checkbox"/> width/depth ≥ 40 <input type="checkbox"/> entrenchment ratio < 1.4, incision ratio ≥ 2.0 <input type="checkbox"/> extensive historic channel alteration or major recent alteration
	SCORE	20   19   18   17   16	15   14   13   12   11	10   9   8   7   6

Habitat Parameter	Condition (Departure) Category																			
	Reference (None)					Good (Minor)					Fair (Major)					Poor (Severe)				
<b>8.5 Hydrologic Characteristics</b>  <input type="checkbox"/> wetted width / $W_{bkf} > 0.75$ <input type="checkbox"/> exposed substrate < 20% <input type="checkbox"/> adjacent springs, seeps, and wetlands extensive <input type="checkbox"/> no known flow alteration	<input type="checkbox"/> $0.75 \geq W_{wet} / W_{bkf} > 0.50$ <input type="checkbox"/> $20 \leq \text{exp. substrate} < 40\%$ <input type="checkbox"/> adjacent springs, seeps, and wetlands present <input type="checkbox"/> minor flow alteration likely due to flow regulation and/or land use changes					<input type="checkbox"/> $0.50 \geq W_{wet} / W_{bkf} > 0.25$ <input type="checkbox"/> $40 \leq \text{exp. substrate} < 60\%$ <input type="checkbox"/> adjacent springs, seeps, and wetlands altered <input type="checkbox"/> major flow alteration likely due to flow regulation and/or land use changes					<input type="checkbox"/> $W_{wet} / W_{bkf} \leq 0.25$ <input type="checkbox"/> exposed substrate $\geq 60\%$ <input type="checkbox"/> adjacent springs, seeps, and wetlands altered / absent <input type="checkbox"/> runoff characteristics completely altered due to flow regulation and storm water influence									
																<b>SCORE</b>	20	19	18	17
<b>8.6 Connectivity</b>  - tend towards a higher score for natural obstructions  - tend towards a lower score for man-made obstructions	<input type="checkbox"/> no obstructions in reach that block longitudinal movement of aquatic species over all but the lowest flows <input type="checkbox"/> system obstructions absent <input type="checkbox"/> refuge with abundant high quality habitat accessible during low and bankfull flows					<input type="checkbox"/> one or two small low flow obstructions present in reach that block movement of aquatic species <input type="checkbox"/> limited system obstructions <input type="checkbox"/> refuge with abundant high quality habitat only accessible during $\geq$ bankfull flows					<input type="checkbox"/> one or two small to medium bankfull obstructions present in reach that block movement of aquatic species <input type="checkbox"/> system obstructions present <input type="checkbox"/> refuge with limited high quality habitat accessible during low and bankfull flows					<input type="checkbox"/> more than two bankfull obstructions present in reach that block movement of aquatic species <input type="checkbox"/> many system obstructions <input type="checkbox"/> no refuge or limited high quality habitat only accessible during $\geq$ bankfull flows				

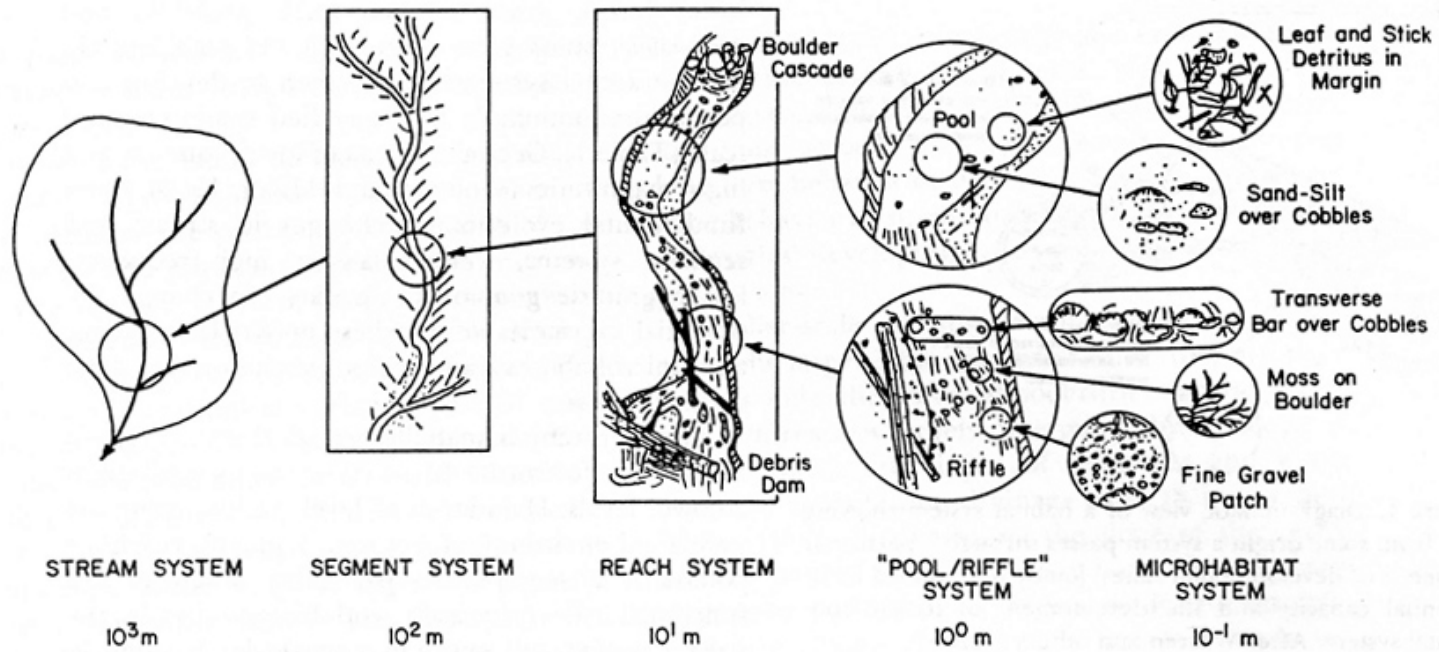
<b>8.7 River Banks</b> (score each bank)  -Water adjacency indicates percentage of reach length that water's edge is mostly adjacent to bank nearest thalweg.	<input type="checkbox"/> bank erosion <10%, typical of natural conditions, little or no bank revetments  <input type="checkbox"/> bank vegetation > 90% in tree, shrub and herb layers, diverse assemblages, plants create good cover and roots help stabilize bank  <input type="checkbox"/> bank canopy > 90%  <input type="checkbox"/> undercut banks / mile > 30  <input type="checkbox"/> ≥ 50% undercut banks size rank 3-6, mostly stable boundaries with abundant overhanging vegetation  <input type="checkbox"/> water adjacency > 75%  <input type="checkbox"/> no mass failures in valley	<input type="checkbox"/> 10 ≤ bank erosion < 30%, infrequent small areas, some bank revetments  <input type="checkbox"/> 90 ≥ bank vegetation > 75% in each layer, diverse assemblages, plants create good cover and roots help stabilize bank  <input type="checkbox"/> 90 ≥ bank canopy > 75%  <input type="checkbox"/> 30 ≥ undercuts / mile > 15  <input type="checkbox"/> ≥ 50% undercut banks size rank 3-6, some stable boundaries with reduced overhanging vegetation  <input type="checkbox"/> 75 ≥ water adjacency > 50%  <input type="checkbox"/> 1 mass failure in valley	<input type="checkbox"/> 30 ≤ bank erosion < 60%, mod. unstable banks, and/or extensive bank revetments  <input type="checkbox"/> 75 ≥ bank vegetation > 50%, in two of three layers, reduced diversity, plants create limited cover and roots do not stabilize bank  <input type="checkbox"/> 75 ≥ bank canopy > 50%  <input type="checkbox"/> 15 ≥ undercuts / mile > 5  <input type="checkbox"/> < 50% undercut banks size rank 3-6, mostly stable boundaries with abundant overhanging vegetation  <input type="checkbox"/> 50 ≥ water adjacency > 25%  <input type="checkbox"/> 1 - 2 mass failures in valley	<input type="checkbox"/> bank erosion ≥ 60%, banks unstable, extensive erosion, and failing bank revetments  <input type="checkbox"/> bank vegetation ≤ 50% in two of three layers, limited diversity, plants create no cover and roots do not stabilize bank  <input type="checkbox"/> bank canopy ≤ 50%  <input type="checkbox"/> undercuts / mile ≤ 5  <input type="checkbox"/> < 50% undercut banks size rank 3-6, some stable boundaries with reduced overhanging vegetation  <input type="checkbox"/> water adjacency ≤ 25%  <input type="checkbox"/> > 3 mass failures in valley																				
	<b>SCORE _____ (LB)</b> <b>SCORE _____ (RB)</b>	<table border="1"> <tr> <td>Left Bank</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> </tr> <tr> <td>Right Bank</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> </tr> </table>	Left Bank	10	9	8	7	6	5	4	3	2	1	Right Bank	10	9	8	7	6	5	4	3	2	1
	Left Bank	10	9	8	7	6	5	4	3	2	1													
Right Bank	10	9	8	7	6	5	4	3	2	1														
<b>8.8 Riparian Area</b> (score each side of the channel)	<input type="checkbox"/> buffer width > 150 ft  <input type="checkbox"/> riparian vegetation > 75% in tree, shrub and herb layers, diverse assemblages, no invasives, closed channel canopy  <input type="checkbox"/> river corridor development and infrastructure absent	<input type="checkbox"/> 150 ≥ buffer width > 100 ft  <input type="checkbox"/> 75 ≥ riparian veg. > 50% in each layer, one plant type absent, minimal invasives, closed canopy  <input type="checkbox"/> river corridor development and infrastructure minimal	<input type="checkbox"/> 100 ≥ buffer width > 50 ft  <input type="checkbox"/> 75 ≥ riparian veg. > 50% in each layer, several types absent, altered patches, invasives present, open canopy  <input type="checkbox"/> river corridor development and infrastructure common	<input type="checkbox"/> buffer width ≤ 50 ft  <input type="checkbox"/> riparian veg. ≤ 50% in each layer, several types absent, large altered areas, invasive monocultures, open canopy  <input type="checkbox"/> river corridor development and infrastructure abundant																				
<b>SCORE _____ (LB)</b> <b>SCORE _____ (RB)</b>	<table border="1"> <tr> <td>Left Bank</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> </tr> <tr> <td>Right Bank</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> </tr> </table>	Left Bank	10	9	8	7	6	5	4	3	2	1	Right Bank	10	9	8	7	6	5	4	3	2	1	
Left Bank	10	9	8	7	6	5	4	3	2	1														
Right Bank	10	9	8	7	6	5	4	3	2	1														

8.9 Total Score: \_\_\_\_\_ / 160 = \_\_\_\_\_

Overall Physical Habitat Condition: \_\_\_\_\_

SHTD  Existing Stream Habitat Type: \_\_\_\_\_

Score	Condition (Departure)
0.85 – 1.0	Reference (None)
0.65 – 0.84	Good (Minor)
0.35 – 0.64	Fair (Major)
0.00 – 0.34	Poor (Severe)



Source: Frissell et al., 1986

**RHA Protocol Development (Part 2) coming up  
You can be a part of it...**



*8781. 6, 7, 23 Helch Helchy Reservoir*