TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE
PORTLAND, OREGON JANUARY 2005

PROCEDURES FOR USING OREGON STREAM HABITAT DATA SHEET

Introduction

Purpose: To assess stream corridor conditions for use in planning, baseline data, monitoring, and alternative evaluation. This procedure is not intended to replace intensive surveys conducted by professional biologists. This method was developed with cooperation from agency resource professionals, based on compilation of numerous inventory methods and field tested extensively with field level planners (non-biologists).

Intended users: Field biologists and non-biologist resource planners. This inventory method does require some basic skills in stream habitat evaluation.

This stream habitat assessment procedure can be used on a broad reach or site-specific scale. The values can be estimated or measured. The flexibility in intensity allows either a general overview of stream corridor condition or specific habitat unit conditions needed for baseline inventory data or project monitoring.

Some data categories may not apply to particular stream types or may not be information needed for study objectives. The data collected are necessary for biological evaluations and are the variables most often evaluated by other resource agencies.

The watershed overview sheet should be filled out before the data sheet. Use the back of the watershed overview sheet to diagram the inventory area.

It is important to know which fish species occur in the stream and at what time of the year. Stream surveys should *not* be conducted during migration periods or when fish eggs are still in the gravel. There is potential to disturb eggs and newly hatched fish when conducting a survey. This is particularly important in streams where fish are listed as threatened or endangered. If unsure about the timeliness of the survey, contact the local ODFW office. The best time of year to assess a stream is during low flow conditions.

When conducting the inventory it is best to start at the bottom of the watershed / stream and walk up to avoid disturbing the streambed to be evaluated and maximize opportunities to observe fish and amphibians. Take notes of wildlife observations, landuse problems, and any other information that may be useful to the planner.

Data Entry Form

Reach ID - The Reach ID is a number or letter identifying the reach on a quad map or other map of the stream.

Habitat Type - The Habitat Type is only used when conducting a detailed survey or to characterize a typical pool, riffle or flatwater area within a reach. The data in this column will be specifically related to this habitat unit. Enter "P" for pool, "R" for riffle or "F" for flatwater. *Note*: the habitat unit must be longer than the stream is wide. This habitat evaluation does not evaluate microhabitats. See Habitat Type reference sheet.

If evaluating a long reach (broad scale) for general habitat conditions do not identify the specific habitat type. The column will represent general conditions in the identified reach.

Length - Measure or estimate the channel length (in feet) of the reach or habitat unit being evaluated.

Channel Type - Enter the channel type using the Rosgen Classification System of Natural Rivers (see reference sheet).

This entry is optional and requires skill and knowledge in this classification system.

Temperature – Enter the current stream temperature in Fahrenheit. If the time of day for temperature measurement is different than time recorded at top of the form note the time as well. This entry is optional.

Substrate Composition – Stream substrate composition is visually estimated or measured using Wolman Pebble Count Transects (see Appendix A) in riffles and pool tails. A simple transect across the stream can be used to identify the substrate type at the "toe of your boot" at every step. Note percentage for each applicable substrate size on form.

Bank Vegetation – Estimate or measure by transect the percentage of trees, shrubs, forbs, grasses, sedges or bare bank viewed upstream along the left and right bank. This is the area directly adjacent to the stream and along its banks.

Width / Depth Ratio – Calculate this value by dividing the bankfull width by the average bankfull depth in feet.

Bankfull Width – Measure or estimate the bankfull width (active channel) using indicators such as point bars, small benches, rock staining, and level of established alders, ash or conifers.

Average Bankfull Depth – Cross section depths may be measured from a measuring tape stretched perpendicular to the stream flow across the stream located at bankfull level. Vertical measurements are taken by reading the depth at the intersection of the tape. Take 5 equally spaced measurements across the stream. *Option*: also measure and record maximum depth of pools.

The Nine Scored Variables – Use the rating system on the reverse side of the data form. Use the scores that best fit the description and the range to fine-tune the score. When two or more surveyors are present get a consensus on the scoring.

1. Channel Condition – Evaluate across the active channel floodplain the general connectivity of the stream channel to its floodplain and other variables listed in the chart.

2. Percent Pool Habitat – *Collect this information when evaluating a reach (broad scale)* and not individual habitat types. The pool length must be longer than the stream is wide.

3. Shelter Rating – This rating is intended to rate the shelter complexity that serves as instream cover for fish and creates areas of diverse velocities.

4. Off-channel Habitat – Rating evaluates adjacent stream habitat to the main channel. Some off-channel habitat may be dry during low flow conditions but should be included in this rating for their value during high flow events.

5. Embeddedness – Estimate or measure the percent to which cobbles or gravel are surrounded or covered by fines. *This value is only rated in riffles and at pool tails.*

6. Shade / Canopy – Estimate or measure (using a densiometer) the amount of canopy over the active stream channel.

7. Stable Bank – Estimate or measure the percent of stable bank.

8. Riparian Width and Condition – Evaluate the width, diversity and disturbance regime of the riparian area within the floodplain as described in the chart.
9. Macroinvertebrates - In a riffle (*only*) look under rocks for macroinvertebrates and record condition or use standard sampling procedures for invertebrate collection. See Stream Insects & Crustaceans reference sheet.

Scoring

Total all of the scores recorded, divide total by the number of conditions rated for the average score. General stream condition rating can be obtained from this score (excellent, good, fair, and poor).

Evaluation

Any single scored value lower than 0.5 identifies a limiting factor for fish habitat. Listed below are a few examples for improving the various habitat factors. It is important to have interdisciplinary input for solutions from experts in geomorphology, engineering, plant ecology and fish and wildlife biology. Structural methods should be used only as a last resort when natural processes may not adequately improve conditions in the desired time frame.
1. Channel Condition – Evaluate ways to reconnect or enhance the connectivity of the stream channel to its floodplain.
2. Percent Pool Habitat – Pool habitat can be improved with better riparian conditions, large woody debris, sediment reduction, better channel conditions, and structural methods.
3. Shelter Rating –Instream cover for fish can be improved with better riparian and channel conditions, large woody debris, and structural methods.
4. Off-channel Habitat – Evaluate ways to create or reconnect off-channel habitat.
5. Embeddedness – Reduce sediment input from the upper watershed and eroding streambanks.
6. Shade / Canopy – Tall trees and shrubs will improve shade along the stream.
7. Stable Bank – Improve bank stability with a wide riparian buffer, better channel conditions and bioengineering methods.
8. Riparian Width and Condition – Improve conditions with plantings and management for a wide riparian buffer.
9. Macroinvertebrates – Improve water quality conditions, riparian vegetation, channel conditions, and woody debris.

Recommended References:

Flosi, Gary, F. Reynolds. ***Salmonid Stream Habitat Restoration Manual***. 1996 California Department of Fish and Game available on the Internet at www.dfg.ca.gov/ifd/index.html

MacDonald, Lee H., A.W. Smart, R.C. Wissmar. ***Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska***. 1991 US EPA 910/91-001

Overton, Kerry C., S.P. Wollrab, B.C. Roberts, M.A. Radko. ***R1/R4 Fish and Fish Habitat Standard Inventory Procedures Handbook.*** May 1997 USDA – Forest Service General Technical Report INT-GTR-346

Rosgen, Dave. ***Applied River Morphology***. 1996 Wildland Hydrology, Pagosa Springs, Colorado

Spence, Brian C., A.L. Gregg, R.M. Hughes, R.P. Novitzki***. An Ecosystem Approach to Salmonid Conservation***. December 1996 MANTECH Report for EPA TR-4501-96-6057

WATERSHED OVERVIEW WORKSHEET

Date:__________________________ Investigator:________________________________
Stream Name __________________ Tributary to: ________________________________
Tributary to: ___________________ Tributary to: ________________________________
Tributary to: ___________________ Tributary to: ________________________________
County ________________________ USGS Quad ________________________________
Location T____ R_____S_____Latitude _______________ Longitude_________________
Landowner / Access ____

____

Hydrologic Unit Code:___________________ Valley Type:__________________________
Aerial Photos:____
Stream Order:___________________ Total length:___________________________ miles
Drainage Area:__________ sq. mi. Summer Base Flows:____________________ cfs
Elevation: a) Mouth ___________ feet b) Headwaters:___________________ feet
Fish Species:____

____

____

Endangered / Threatened / Proposed / Candidate / Sensitive Species:_______________

____

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____

____

Stream Flow Data:____

____

Water Quality Data:____

____

Ownership along Stream (miles): Federal _________ State ________Private __________
Additional information:____

____

____

Major Land uses in the Watershed:____

____

____

Wildlife and other Resource issues in the Watershed:_____________________________

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Comments:____

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Diagram of the Stream Habitat Inventory Area

Correlate Information to a USGS Quad Map and / or Aerial Photo

Oregon Stream Habitat Data Sheet

Date / / Time : a.m.☐ p.m.☐ Weather

Stream Name Surveyors

Reach ID / Habitat Type							
Length - Ft.							
Channel Type (Rosgen)							
Temperature - ºF							
Substrate Composition - %							
Silt/clay							
Sand							
Gravel 0.08 - 2.5"							
Cobble 2.5 - 10"							
Small Boulder 10 - 20"							
Large Boulder >20"							
Bedrock							

Bank Vegetation % - upstream left bank / right bank														
Tree														
Shrub														
Forbs														
Grass / Sedge														
None														

Width / Depth Ratio							
Bankfull Width							
Ave. Bankfull Depth							
Score each category - Use reference sheet for values.							
1. Channel Condition							
2. Percent Pool Habitat							
3. Shelter Rating							
4. Off-Channel Habitat							
5. Percent Embeddedness							
6. Percent Shade / Canopy							
7. Percent Stable Bank							
8. Riparian Width / Condition							
9. Macroinvertebrates							
Total score							
Total Score / # variables							
Ave. score							
1.0 - 0.9 Excellent							
0.8 - 0.7 Good							
0.6 - 0.5 Fair							
0.4 - 0.1 Poor							

Please add notes on Page 8

Notes, i.e., wildlife, sightings, max. pool depth. Valley type:

Rate each category by reach. Level of intensity can be adjusted by varying the length of the reach evaluated and whether the values are estimated or measured. Some data categories may not apply to study objectives or stream type, omit as needed.

1. **CHANNEL CONDITION** (evaluate across flood prone width)

Condition	Score
Off-channel areas are frequently hydrologically linked to main channel: overbank flows occur and maintain wetland riparian functions. Natural channel with meanders.	1.0 – 0.9
Reduced linkage of wetland, floodplains and riparian areas to main channel. Overbank flows are reduced relative to historic frequency as evidenced by moderate degradation of wetland and riparian function and vegetation.	0.8 – 0.6
Severe reduction in hydrologic connectivity, wetland and riparian extent drastically reduced and altered.	0.5 – 0.3
No connection to floodplain, severely degraded.	0.2 – 0.1

2. **PERCENT POOL HABITAT** (pool must be equal to or longer than the stream is wide)

Condition	Score
40 – 65 % deep pools	1.0
20 – 39 % pools or > 85% pools	0.9 – 0.8
10 – 19 % pools	0.7 – 0.6
5 – 9 % pools	0.5 – 0.4
0 – 4 % pools	0.3 – 0.1

3. **SHELTER RATING**
LWD: large woody debris > 12” diameter
SWD: small woody debris < 12” diameter

Condition	Score
Combinations of: LWD / boulders / rootwads **OR** 3 or more pieces of LWD or boulders with SWD **OR** bubble curtain with LWD or boulders **OR** stable undercut bank (>12”) with roots or LWD **OR** extensive submersed vegetative fish cover.	1.0 – 0.7
1-2 pieces of LWD with SWD **OR** 6+ boulders/50ft. **OR** stable undercut bank **OR** single rootwad **OR** branches in or near water **OR** bubble curtain **OR** limited submersed vegetative fish cover.	0.6 – 0.4
1-5 boulders **OR** bare undercut bank or bedrock ledge **OR** single LWD.	0.3 – 0.2
No shelter.	0.1

4. **OFF - CHANNEL HABITAT**

Condition	Score
Backwaters with cover and low energy off-channel areas (ponds, oxbows etc.).	1.0 – 0.7
Some backwaters and high energy side channels.	0.6 – 0.3
Minimal backwater or side channel with no cover.	0.2
No off-channel habitat	0.1

5. **PERCENT EMBEDDEDNESS** (gravel’s surrounded by fines in the pool tail out or riffle)

Condition	Score
0 – 4 %	1.0
5 – 10 %	0.9
11 – 20 %	0.8 – 0.7
21 – 30 %	0.6 – 0.4
32 – 40 %	0.3
42- 50 %	0.2
> 50 %	0.1

6. **PERCENT SHADE / CANOPY** (over active stream channel)

Condition	Score
0 – 4 %	0.1
5 – 10 %	0.2
11 - 20 %	0.3 – 0.4
21 - 30 %	0.5 – 0.6
31 - 40 %	0.7 - 0.8
41 – 59 %	0.9
> 60 %	1.0

7. **PERCENT STABLE BANK**

Condition	Score
85 – 100 %	1.0
80 – 84 %	0.9
76 – 79 %	0.8
71 – 75 %	0.7
66 – 70 %	0.6
61 – 65 %	0.5
56 – 60 %	0.4
50 – 55 %	0.3
< 49 %	0.1

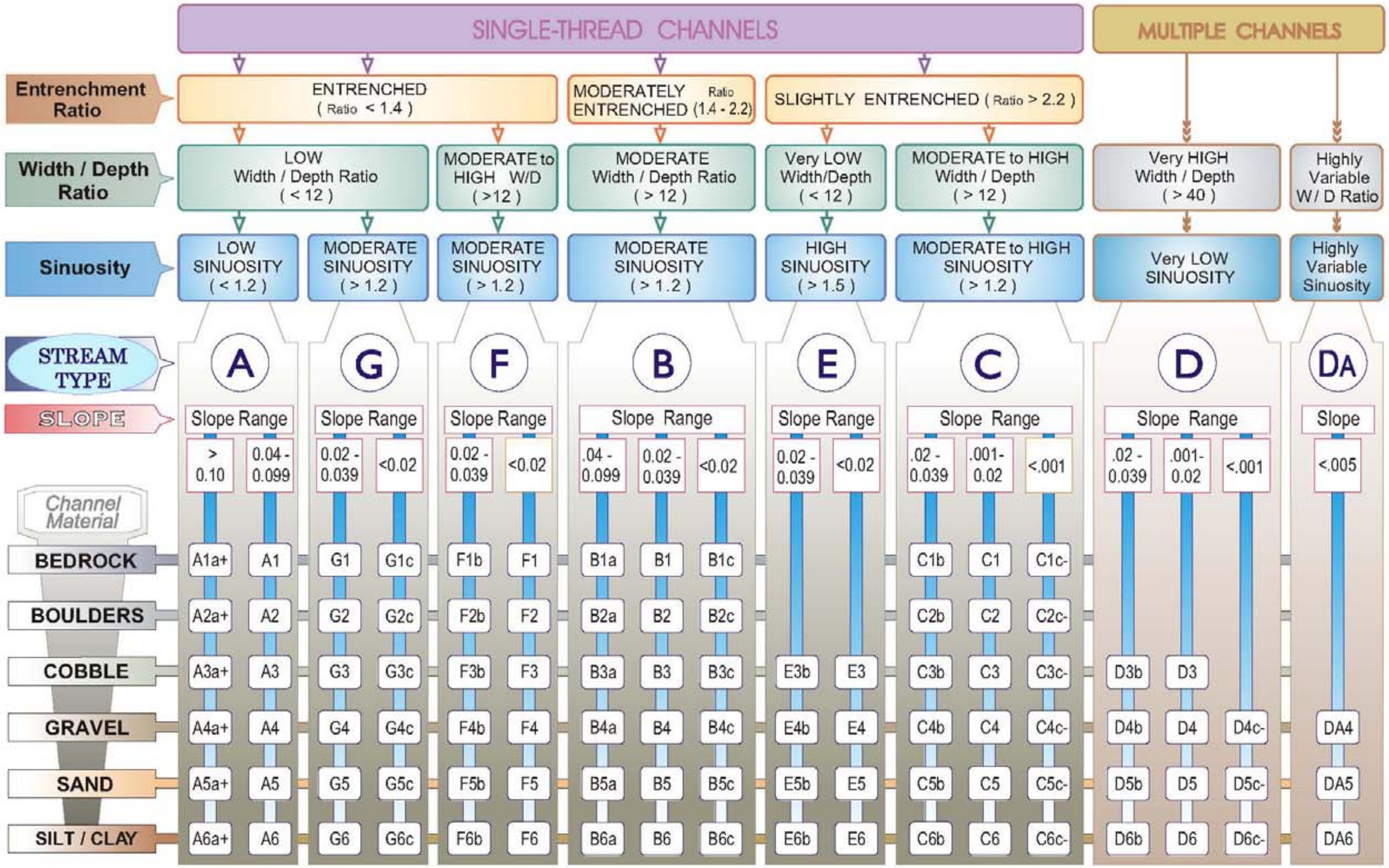
8. **RIPARIAN WIDTH / CONDITION**

Condition	Score
Riparian area width of floodplain, diverse, variety of age classes. Undisturbed.	1.0 - 0.8
Riparian area width at least two channel widths wide, diverse, variety of age classes. Minimal use.	0.7 - 0.6
Riparian area width at least one channel width wide, somewhat degraded, few age classes & diversity. Regularly grazed or other disturbance.	0.5 - 0.4
Severely degraded riparian area, less than one channel width wide.	0.3 - 0.2
Little to no riparian vegetation.	0.1

9. **MACROINVERTEBRATES**

Condition	Score
Several kinds of macroinvertebrates present intolerant to pollution: caddisfly, stonefly, mayfly, hellgrammites, riffle beetle, right hand snail.	1.0 - 0.8
Several but fewer kinds of macroinvertebrates that include, pollution tolerant damselfly, dragonfly, blackfly, cranefly, diving beetle, aquatic sow bugs.	0.7 - 0.5
Few or low diversity of macroinvertebrates present and include pollution tolerant: midges, blackfly, left-handed snails, Few leeches, aquatic earthworms, rat-tailed maggot.	0.4 - 0.2
Very reduced number of species or near absence of all macroinvertebrates.	0.1

The Key to the Rosgen Classification of Natural Rivers



KEY to the ROSGEN CLASSIFICATION of NATURAL RIVERS. As a function of the *"continuum of physical variables"* within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units; while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

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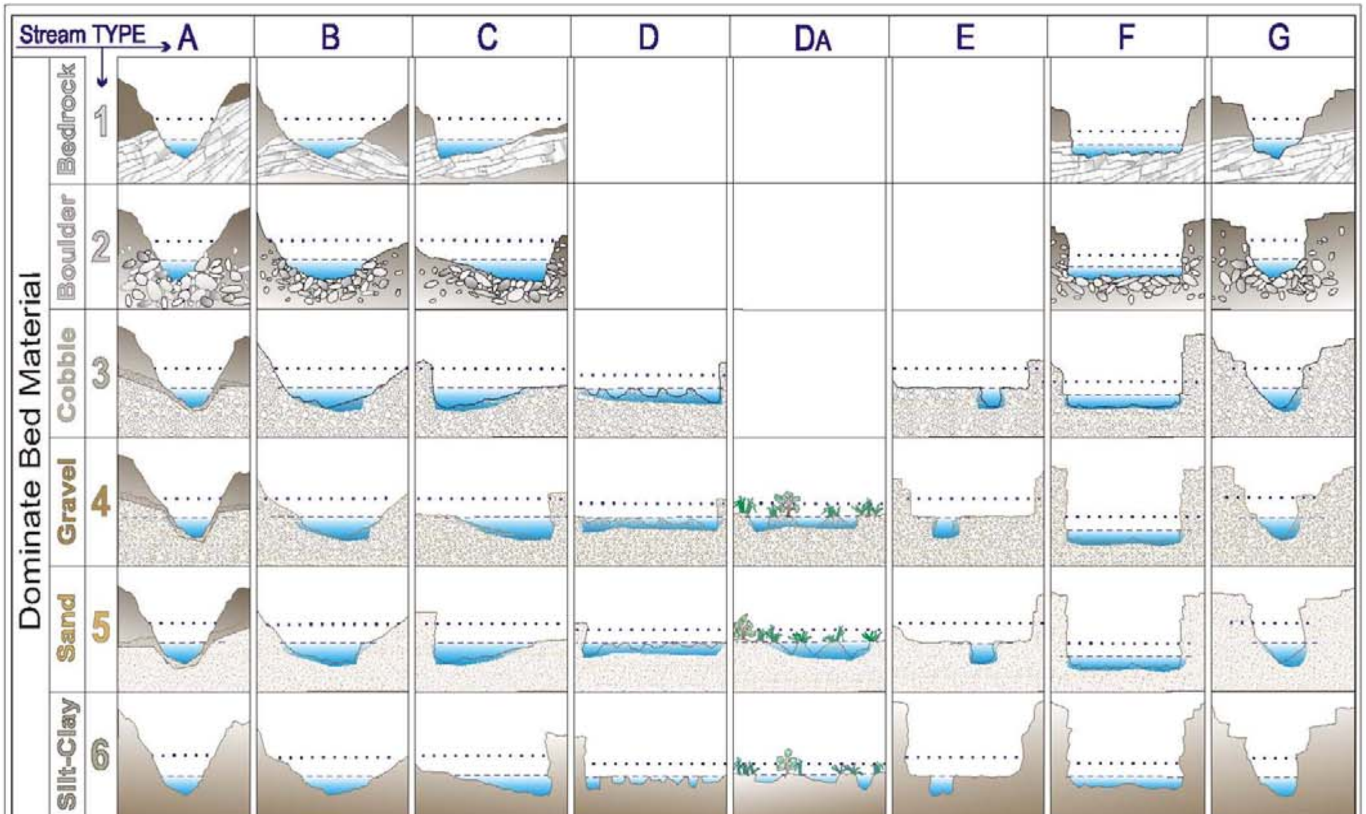

Entrchmnt.	< 1.4	1.4 - 2.2	> 2.2	n/a	> 4.0	> 2.2	< 1.4	< 1.4
W/D Ratio	< 12	> 12	> 12	> 40	< 40	< 12	> 12	< 12
Sinuosity	1 - 1.2	> 1.2	> 1.2	n/a	variable	> 1.5	> 1.2	> 1.2
H_2O Slope	.04-.099	.02-.039	< .02	< .04	<.005	< .02	< .02	.02-.039

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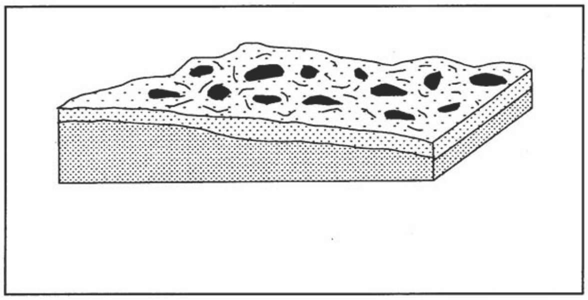
The habitat unit must be longer than the stream is wide to qualify as a:

HABITAT TYPES
Level II

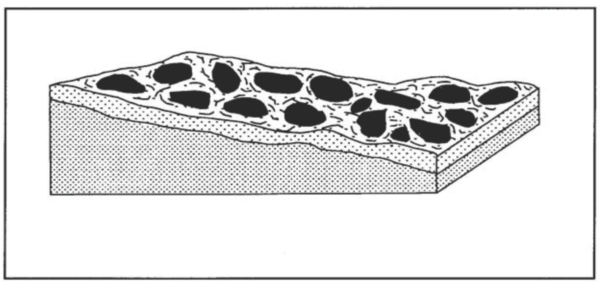
Riffle

LOW-GRADIENT RIFFLE (LGR) [1.1] {1}



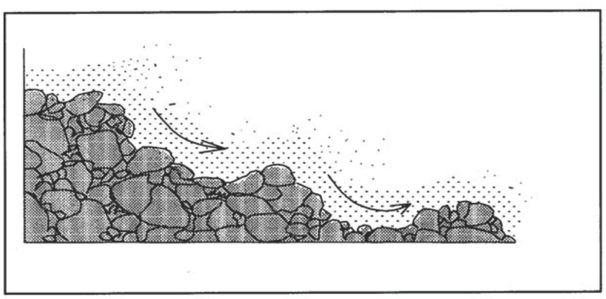
Shallow reaches with swiftly flowing, turbulent water with some partially exposed substrate. Gradient < 4%, substrate is usually cobble dominated.

HIGH-GRADIENT RIFFLE (HGR) [1.2] {2}



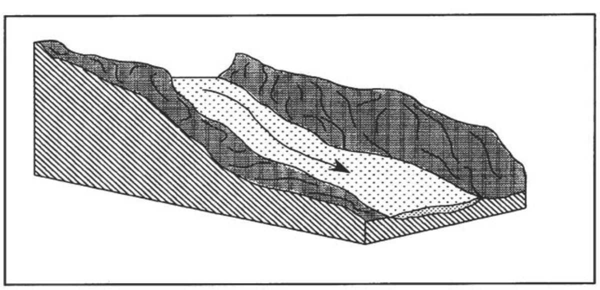
Steep reaches of moderately deep, swift, and very turbulent water. Amount of exposed substrate is relatively high. Gradient is > 4%, and substrate is boulder dominated.

CASCADE (CAS) [2.1] {3}



The steepest riffle habitat, consisting of alternating small waterfalls and shallow pools. Substrate is usually bedrock and boulders.

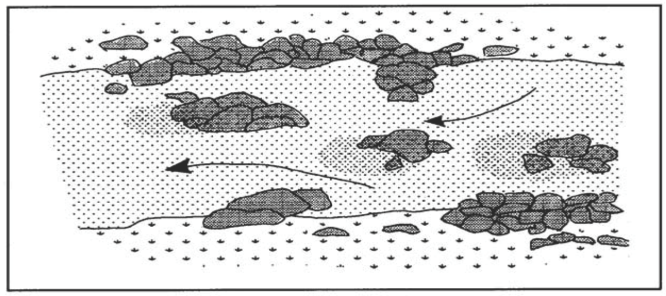
BEDROCK SHEET (BRS) [2.2] {24}



A thin sheet of water flowing over a smooth bedrock surface. Gradients are highly variable.

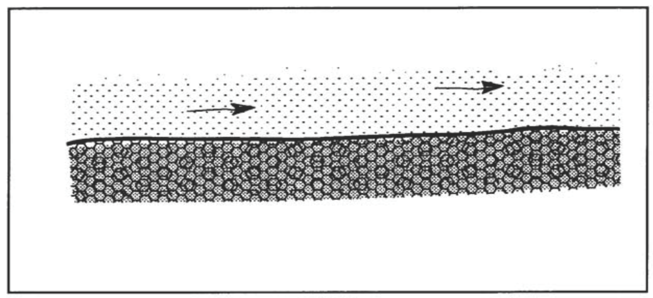
Flatwater

POCKET WATER (POW) [3.1] {21}



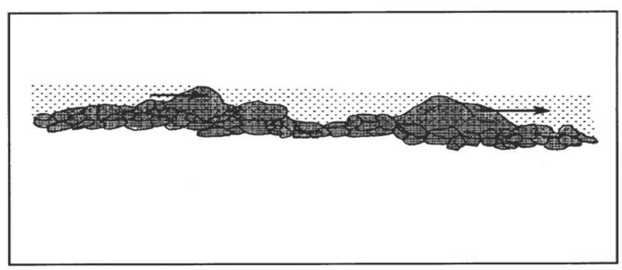
A section of swift-flowing stream containing numerous boulders or other large obstructions which create eddies or scour holes (pockets) behind the obstructions.

GLIDE (GLD) [3.2] {14}



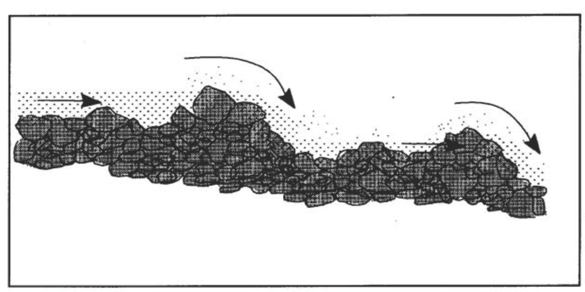
A wide, uniform channel bottom. Flow with low to moderate velocities, lacking pronounced turbulence. Substrate usually consists of cobble, gravel, and sand.

RUN (RUN) [3.3] {15}



Swiftly flowing reaches with little surface agitation and no major flow obstructions. Often appears as flooded riffles. Typical substrate consists of gravel, cobble, and boulders.

STEP RUN (SRN) [3.4] {16}



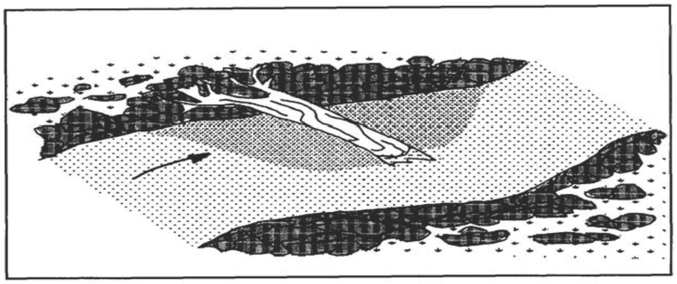
A sequence of runs separated by short riffle steps. Substrate is usually cobble and boulder dominated.

The habitat unit must be longer than the stream is wide to qualify as a:

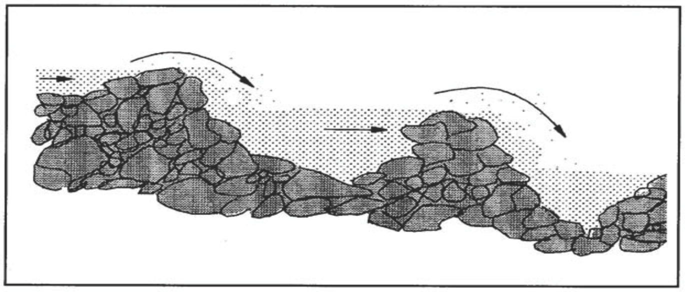
HABITAT TYPES
Level II

Pool

LATERAL SCOUR POOL - LOG ENHANCED (LSL) [5.2] {10}

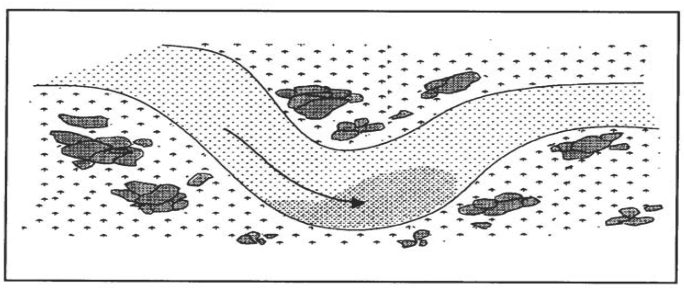


STEP POOL (STP) [4.4] {23}



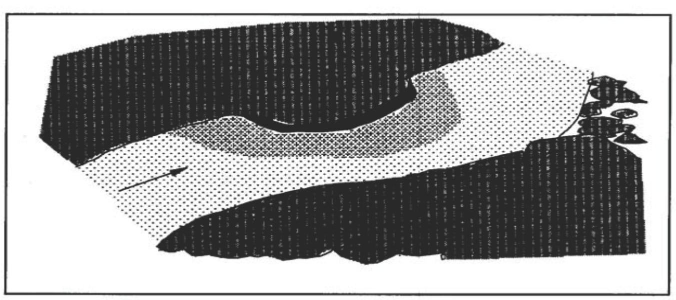
A series of pools separated by short riffles or cascades. Generally found in high-gradient, confined mountain streams dominated by boulder substrate.

CORNER POOL (CRP) [5.1] {22}

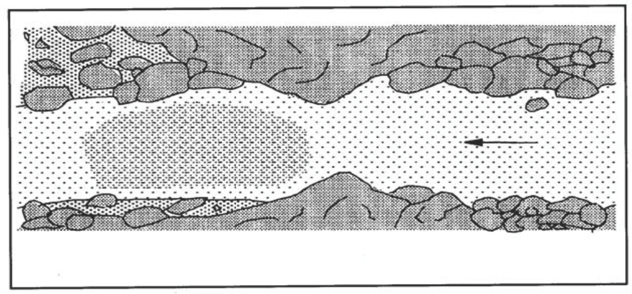


Lateral scour pools formed at a bend in the channel. These pools are common in lowland valley bottoms where stream banks consist of alluvium and lack hard obstructions.

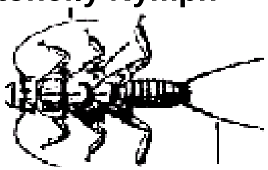
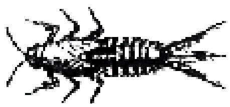
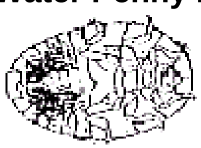
LATERAL SCOUR POOL - BEDROCK FORMED (LSBk) [5.4] {12}

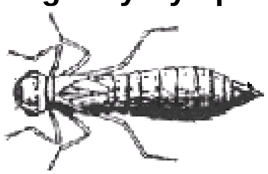
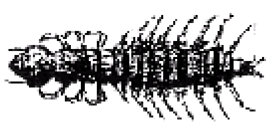


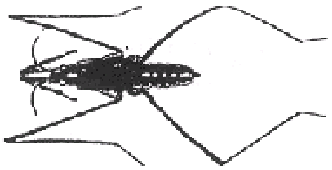
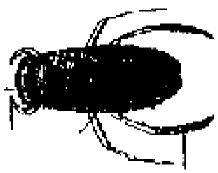
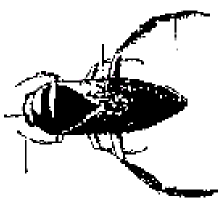
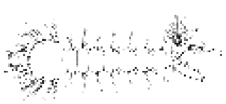
MID-CHANNEL POOL (MCP) [4.2] {17}

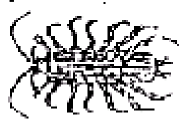
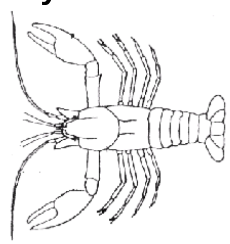
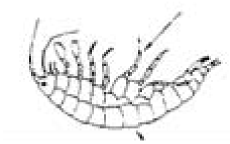
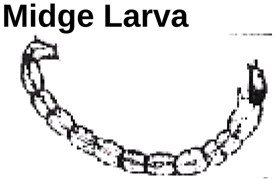
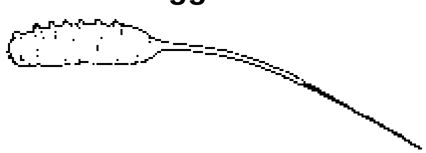


Large pools formed by mid-channel scour. The scour hole encompasses more than 60% of the wetted channel. Water velocity is slow, and the substrate is highly variable.

Name	Distinguishing Characteristics	Where Found	How Oxygen is Obtained	Food Gathering	Things To Look For
Stonefly Nymph 	2 tails, 2 sets wing pads, (wing pads not always noticeable)	Cold running water	Through body surface; some small gills; does “push ups to increase oxygen flow	Predator or herbivore	Streamlined body for crawling on rocks; requires high oxygen levels **Group 1: Pollution Intolerant**
Mayfly Nymph 	3 tails (sometimes 2); 1 set wing pads.	Cool or cold running water	Through gills along abdomen; may wave gills in water to increase oxygen flow	Herbivore or scavenger	Requires high to medium oxygen levels **Group 1: Pollution Intolerant**
Caddisfly Larva 	Most species build cases or nets soft body, some free living	Cool or cold running water; ponds	Through body surface; some finger-like gills	Filter feeder, herbivore, predator	Builds cases of heavy material (rocks) to avoid being swept away by fast-flowing streams; uses grass and plants to make cases as well **Group 1: Pollution Intolerant**
Water Penny Larva 	Round, flat, segmented, disk-like body	Cold running water	Usually through gills on underside	Herbivore—grazes on algae	Flattened body resists pull of current **Group 1: Pollution Intolerant**
Predaceous Diving Beetle Larva 	Up to 6 cm long; robust jaws	Most still and moving water habitats	Through body surface	Voracious predator	Special channels in jaws to suck body fluids of prey **Group 1: Pollution Intolerant**

Name	Distinguishing Characteristics	Where Found	How Oxygen is Obtained	Food Gathering	Things To Look For
Whirligig Beetle 	Black; congregates in schools	Surface of quiet water	From atmosphere	Predator or scavenger	Has two pairs of eyes to see above and below water's surface; has type of "radar" to locate object in water; secretes white odorous substance to deter predators **Group 3: Pollution Tolerant**
Black Fly Larva 	Small body; small hooks at end of abdomen attach to rocks	Cold running water	Through body surface; small gills	Filter feeder	Anchors to rocks with silk; only needs medium to high oxygen levels **Group 3: Pollution Tolerant**
Dragonfly Nymph 	Stout body; arm-like grabbing mouthpart	Cool still water	Dissolved oxygen, through gills in internal body chamber	Active predator	Clings to vegetation or hides in clumps of dead leaves or sediment **Group 2: Somewhat Pollution Tolerant**
Damselfly Nymph 	3 leaf-like gills at end; arm-like grabbing mouthpart	Cool still water	Through gills at end of abdomen	Active predator	Clings to vegetation or hides in clumps of dead leaves or sediment **Group 2: Somewhat Pollution Tolerant**
Hellgrammite (Dobsonfly, Alderfly or fishfly Larva 	Up to 9 cm. Long	Cool or cold, slow to fast moving water	Through gills along side of abdomen; some fish flies have breathing tubes	Active predator	Can swallow prey without chewing **Group 1: Pollution Intolerant**

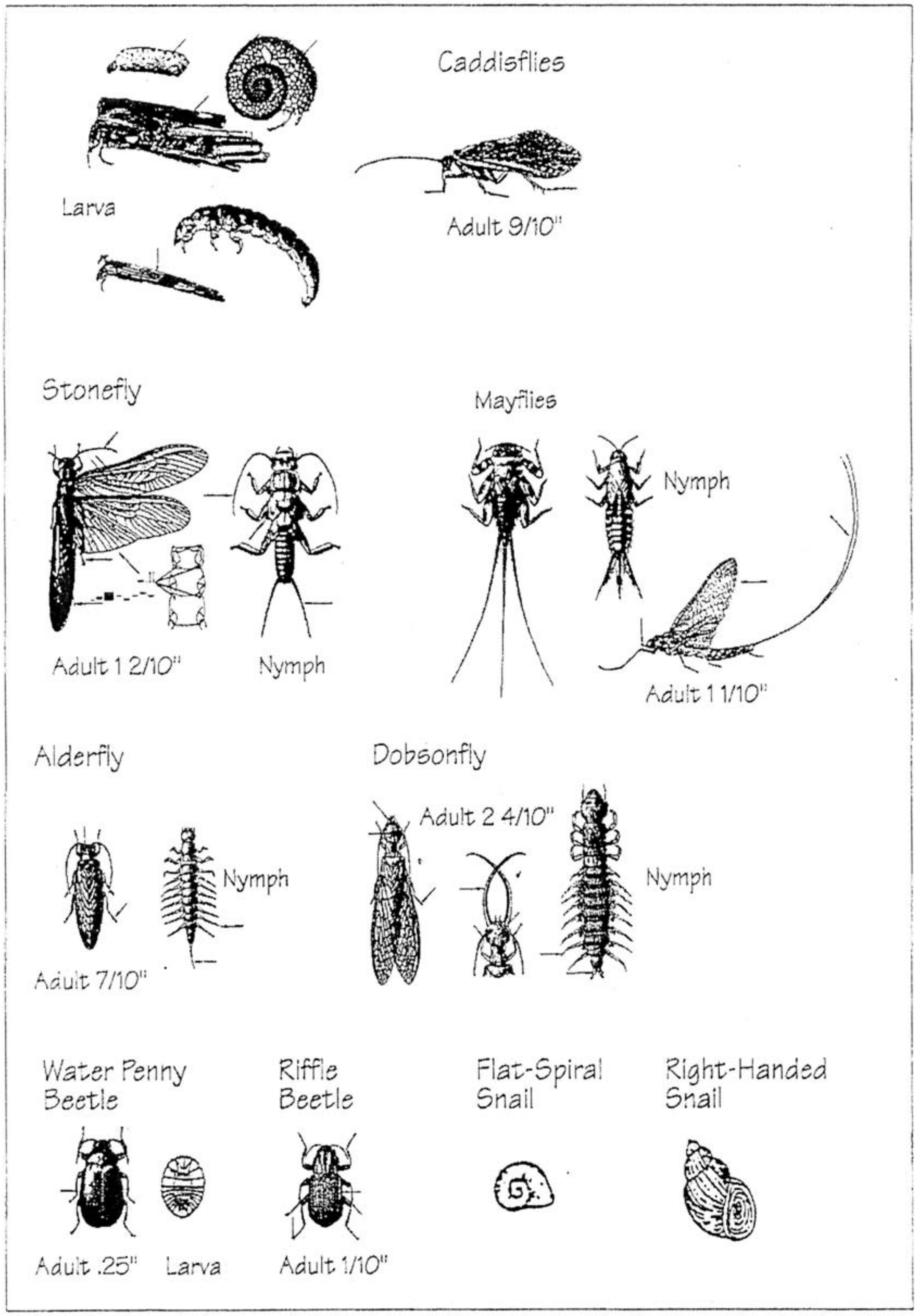
Name	Distinguishing Characteristics	Where Found	How Oxygen is Obtained	Food Gathering	Things to Look For
Water Strider Adult 	Skates on water's surface	Ponds or still pools of stream	From atmosphere	Active predator	Can stay on water's surface because feet have small surface area and are water repellant **Group 3: Pollution Tolerant**
Water Boatman Adult 	Long swimming hairs on legs	Ponds or still pools of stream	From atmosphere, by carrying air bubble from water's surface on body	Omnivore, herbivore, or scavenger	Has swimming hairs on legs that act as oars **Group 3: Pollution Tolerant**
Backswimmer Adult 	Light-colored underside; swims on back	Ponds or still pools of streams	From atmosphere, by carrying air bubble from water's surface on body	Predator	Swim on back, sleek body shape **Group 3: Pollution Tolerant**
Cranefly Larva 	Cylindrical body; often has lobes at hind end, may have small soft legs	Bottoms of streams and ponds in sediment and algae	From atmosphere through spiracles (openings) at hind end	Active predator, herbivore, or omnivore	Species that eat woody decaying matter have gut bacteria to digest cellulose **Group 2: Somewhat Pollution Tolerant**
Mosquito Larva 	Small body; floats at surface	Cool to warm still water	From atmosphere through breathing tube, on hind end as a larva and front end as pupa	Scavenger —feeds on micro-organisms	Swims or dives when disturbed **Group 3: Pollution Tolerant**

Name	Distinguishing Characteristics	Where Found	How Oxygen is Obtained	Food Gathering	Things to Look For
Aquatic Sowbug 	Flattened body, top to bottom; 7 pairs legs	Shallow freshwater, among rocks and dead leaves	Through body surface on legs	Scavenger —eats decaying matter---or omnivore	Male clasps female under it during mating; female then sheds half of exoskeleton, which becomes case into which fertilized eggs are placed **Group 2: Somewhat Pollution Tolerant**
Crayfish 	5 pairs of legs, first pair often robust; looks like small lobster	Under rocks or in burrows in shallow freshwater	Through gills underbody	Scavenger or omnivore	Crawls backwards when disturbed; males display some courtship behavior to reduce female aggressiveness **Group 2: Somewhat Pollution Tolerant**
Scud 	Flattened body, side to side swims on side	Bottom of lakes, streams or ponds, or streams	Through gills underbody	Scavenger or omnivore	Male carries female on its back during mating; female then sheds half of exoskeleton, which becomes case into which fertilized eggs are placed **Group 2: Somewhat Pollution Tolerant**
Midge Larva 	Small thin body with a hard head and small legs on the hind end	Most still and moving water habitats	Through body surface, small gills	Predator, herbivore, or omnivore	Extremely common; sometimes red because they have hemoglobin in their blood to help transport oxygen; wiggle actively **Group 3: Pollution Tolerant**
Rat-Tailed Maggot Larva 	Cylindrical body; tail-like breathing tube	Cool to warm water with low oxygen levels	From atmosphere through breathing tube	Scavenger —eats decaying matter and sewage	Can survive low oxygen levels fatal to most invertebrates **Group 3: Pollution Tolerant**

INSECT GROUPS ARRANGED BY TOLERANCE TO POLLUTION

Group 1: Intolerant

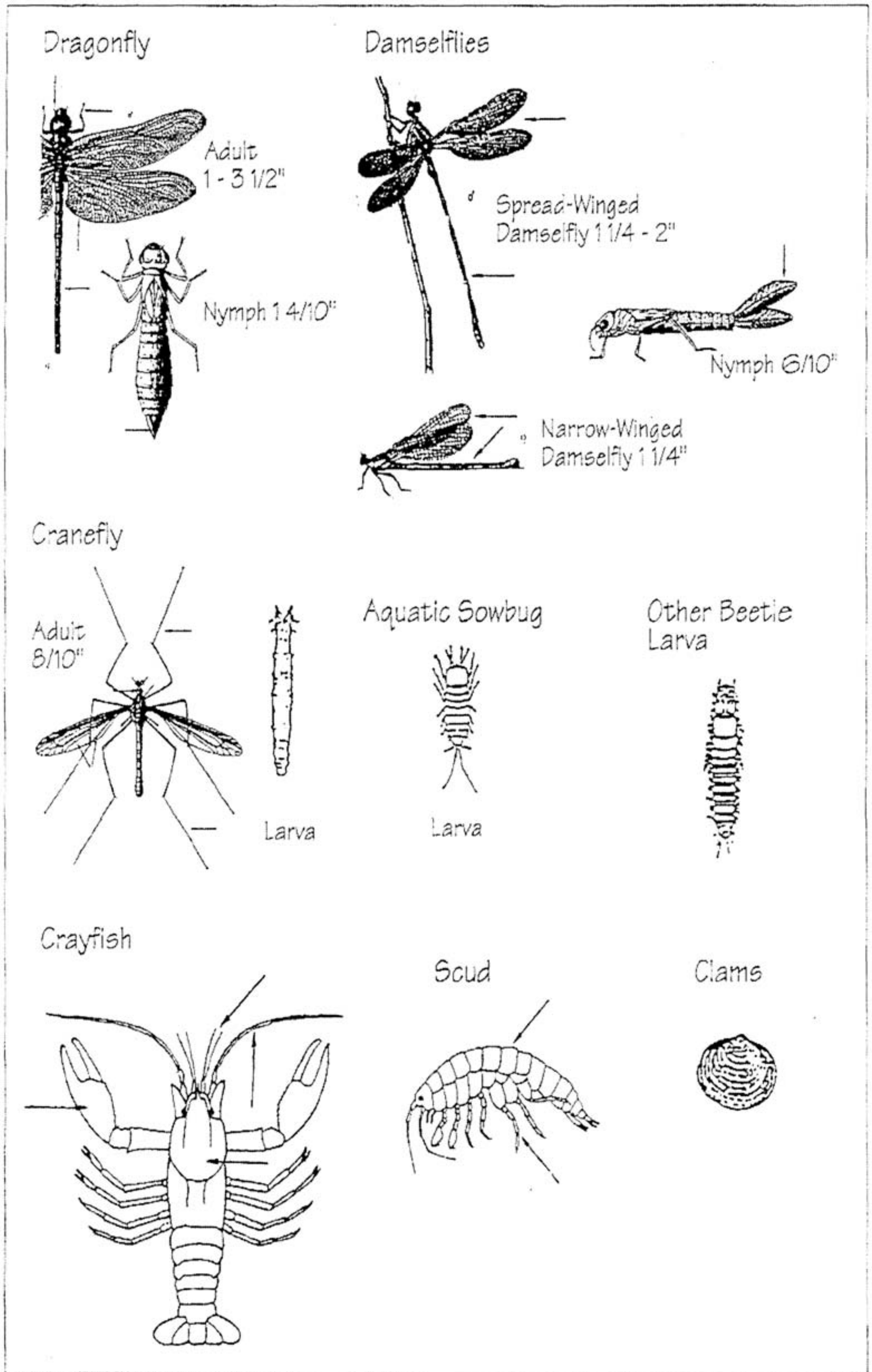
These organisms are sensitive to pollution.
Their dominance generally suggests good water quality.



INSECT GROUPS ARRANGED BY TOLERANCE TO POLLUTION

Group 2: Somewhat Tolerant

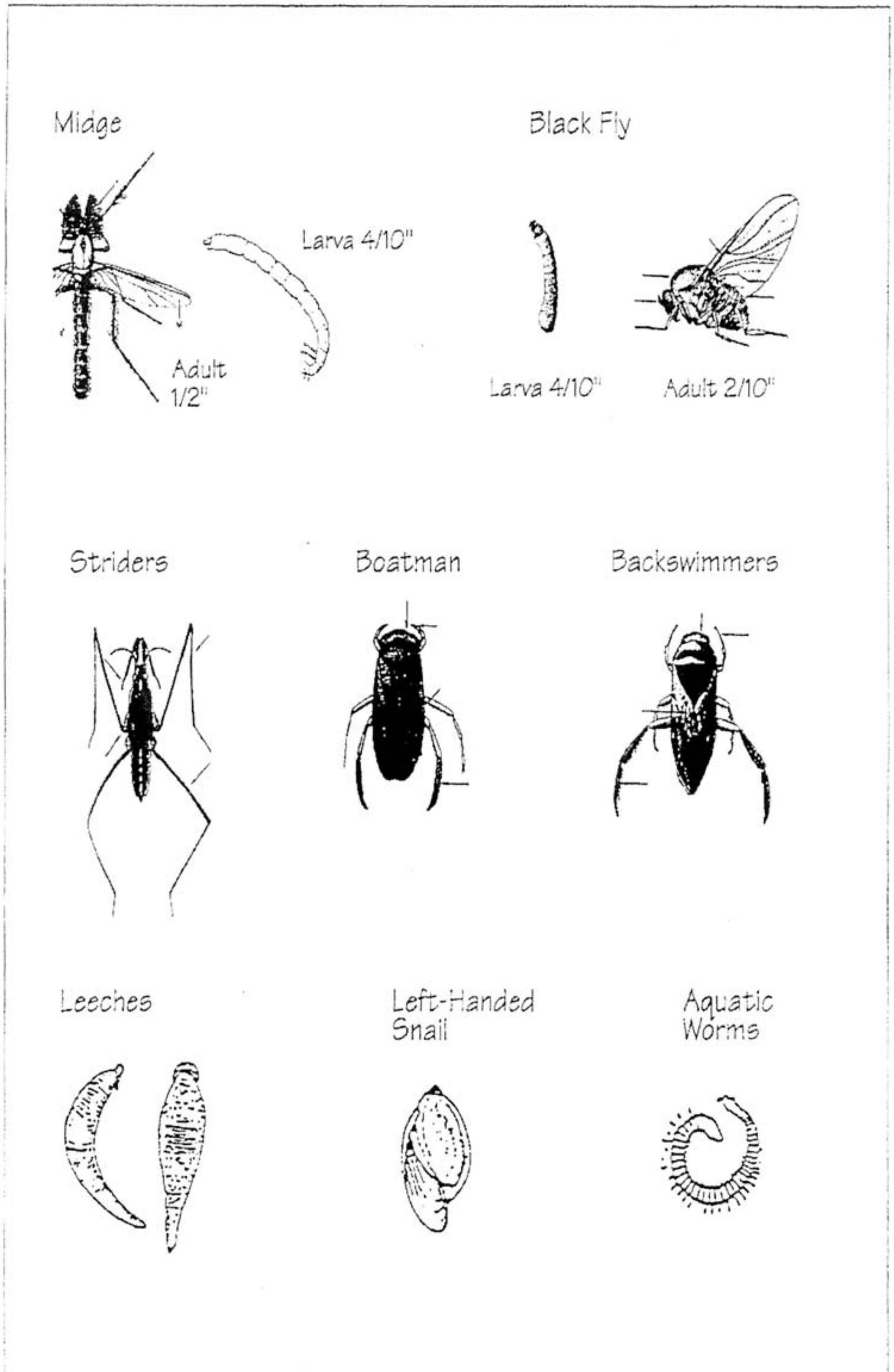
These organisms can tolerate a wider range of water quality conditions.



INSECT GROUPS ARRANGED BY TOLERANCE TO POLLUTION

Group 3: Tolerant

These organisms are generally tolerant of pollution. Their dominance suggests poor water quality.



Appendix A (Used with permission from the U.S. Forest Service Stream Inventory Handbook)

Wolman Form
R6-2500/2600-32: WOLMAN PEBBLE COUNTS

PROCEDURE
The Wolman pebble count will be performed two times in each stream reach identified during the level I (office phase) inventory as delineated on the field map. One pebble count will be completed at approximately one-third and a second pebble count will occur at two-thirds of the total reach length. The fast water unit chosen for each pebble count should possess what is perceived to be normal conditions for fast water units already inventoried in that reach. The fast water unit chosen for the Wolman pebble count need not be a measured fast water unit. It is the surveyor's task to determine the normal condition of fast water units in each reach. The survey team needs to continually evaluate the following questions.

- What water level gradient is normal in the fast water units; less than 4 percent, greater than 4 but less than 10 percent, or greater than 10 percent?
- What substrate types best represent the reach; bedrock is common, cobble and gravel dominate, sand/silt/clay is common, etc.?
- Is LWD a common component of fast water units?
- Are the banks actively eroding in most fast water units?
- Are side channels commonly associated with riffles in the reach?

While the answers to these questions may change as more of the reach is observed, these channel characteristics will provide guidance in selecting a riffle that is representative or average for the reach. The first Wolman pebble count is performed in a representative riffle located at one-third of the reach's length; the second Wolman pebble count is performed in a riffle that is representative of the reach at two-thirds of the reach's length.

The pebble count technique (Wolman 1954) has long been used by geomorphologists, hydrologists, and river engineers to characterize rivers which flow on coarse material and are wadable during low flows. The procedure has recently been recognized by fishery biologists as a better alternative to characterize substrate than the visual estimation techniques commonly used in fisheries and instream flow studies. In addition, pebble counts are used on many National Forests as monitoring tools to evaluate entry of fine sediment into streams.

For monitoring purposes, a selected site is often measured for several years. Generally, individuals are interested in measuring changes to surface fines (i.e., sand, silt, or clay) due to management activities such as timber harvest, fire, or road construction. It is widely accepted that an increase in fines in stream channels is detrimental to fisheries.

Several different schemes can be adopted to provide the minimum 100 tallies of substrate. One transect of 100 equally-spaced tallies can be selected, or two transects of 50 tallies each, or any combination that is linear and equates to at least 100 samples of the streambed. It is common to tally an excess of 100 samples, but avoid having less than 100. The transects must run from one edge of the bankfull channel to the opposite edge of the bankfull channel. These transects need not be perpendicular to the flow, but they must span the entire bankfull channel, with both the first and last substrate tally of each transect occurring at bankfull stage. <u>Do not</u> limit the sampling to the wetted channel! A zigzag set of transects is commonly employed through the chosen riffle.

As the channel dimensions decrease and habitats become smaller, it may be difficult to perform a complete Wolman pebble count in a single riffle. In such cases, it is quite acceptable to perform some of the tallies in slow water units, provided the transect chosen does not intentionally avoid the deeper portions of the slow water unit. Whenever slow water units are included in the Wolman pebble count, the percent of tallies in slow water units should approximate the percent that slow water unit habitat comprises of the total habitat of the reach.

THE PEBBLE COUNT TECHNIQUE

A pebble count consists of a random selection of at least 100 particles from the streambed. Individual pebbles can be selected from a grid system, but more commonly pebbles are selected from the toe of the boot along a toe-to-heel transect which traverses the stream from bankfull stage to bankfull stage. The intermediate axis of each pebble, defined as neither the longest nor the shortest of three mutually perpendicular axes of a particle, is measured. The intermediate axis can be visualized as that dimension of the pebble which controls whether or not it would pass through a soil sieve.

The greatest source of bias in pebble counting is associated with the manner in which observers pick up particles. The natural tendency is to select larger rocks. To avoid this, observers will need to consistently use a fixed reference point, such as a mark on the tip of a boot, and a fixed point on the tip of the finger that descends into the water to select the particle for measurement. To limit the visual bias towards larger substrate, the observer should extend their finger over the boot without looking until the streambed is touched. The first particle touched by the tip of the finger will be measured. Because the technique requires physically picking up particles, it is commonly limited to wadable streams. Particles too large or too well cemented into the streambed to be removed must be estimated. Whenever possible, measure the lesser of the two exposed axes and record in the appropriate size class. In certain situations, the depth of the channel may impede sampling. Surveyors are encouraged to determine the dimensions of their boots so that the boots' width and length may be used as a surrogate for a millimeter ruler.

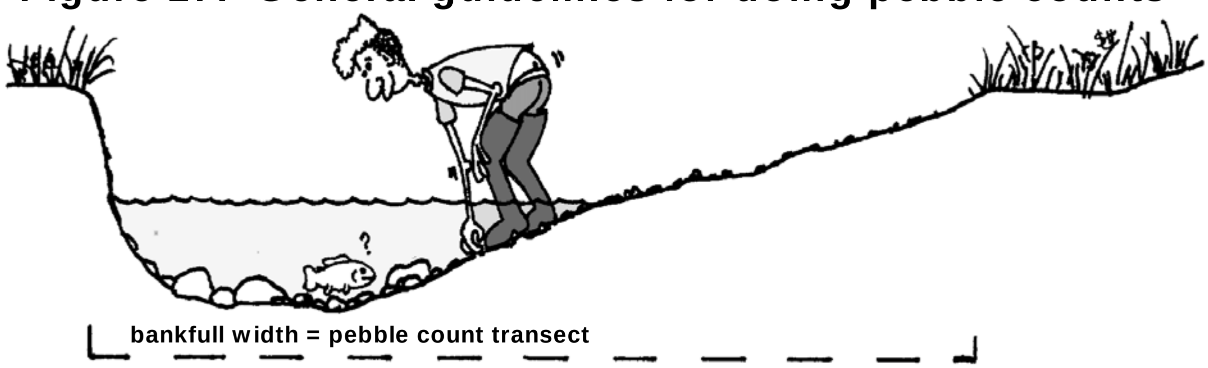
Pebbles down to 2 mm in size (very coarse sand) will be directly measured and tallied in the appropriate size class. Sand, silt, and clay particles will be tallied as "less than 2 mm". Wolman pebble counts also have a built-in bias against fine sediment due to the precision of selecting individual pieces of substrate. Numbing due to cool stream temperatures, low visibility in turbulent water, and our visual bias for larger substrate reduce the ability to accurately record fines (sand, silt, and clay) as streambed substrate tallies. By carefully lifting the finger from the streambed, the observer can reduce the bias against fine sediment. If a plume or cloud of fine sediment is released as the finger lifts, the tally should be in the "less than 2 mm" size class. Caution should be taken to recognize the difference between the organic material coating many streambed particles (= algal scum) and fine inorganic sediment resting atop larger particles of the streambed.

The number of pebbles in each size class will be tabulated and converted into percentages. Data will be plotted as a cumulative size distribution curve. "Cumulative percent finer" will be plotted on the y-axis, and "particle size" expressed as the upper limit of each size range will be plotted on the x-axis. "Particle size" classes and cumulative percent finer versus size are shown on The Wolman Form. While any bedrock encountered as tallies during the Wolman procedure should be recorded, the tallies are not graphed. This is due to the absurdity of graphing an “upper limit” to the size of bedrock. In such cases, the graph will form an asymptote at the cumulative percent finer than 4096 mm.

The resulting frequency distribution represents the percent of the streambed covered by particles of a certain size since each pebble represents a portion of the bed surface. Results are theoretically equivalent to size distributions obtained from bulk samples.

The entire width of the bankfull channel is investigated, and the rocky particles of the streambed are grouped by their size. A frequency distribution by size class is graphed, and the resultant curve is used to make inferences about channel dynamics. During bankfull flows, it is expected that all particles smaller than the median value (D_{50}) displayed on the curve will be mobile, and this same value further refines the Rosgen channel type for that reach. In a similar sense, particles larger than the 84th percentile (D_{84}) will comprise the immobile portion of the streambed during bankfull discharge.

Figure 17: General guidelines for doing pebble counts



Pebble Count "Hints":

1) Always begin a transect at the edge of the bankfull channel and end each transect at the opposite edge of the bankfull channel.
2) Measure at least 100 "pebbles" (but, don't stop measuring until you reach the end\ of the transect atop the bankfull indicator).
3) Measure the first "substrate element" you touch at each designated sample location.
4) Substrate is measured across the intermediate axis, (neither the longest nor shortest of the three mutually perpendicular axes).
5) Pebble counts are usually done in riffles (twice per reach).
6) If you don't get 100 measurements on a transect, continue to do transects within the riffle until you meet or exceed 100 measurements.
7) Two pebble counts should be done for each reach, in riffle habitats. The riffles should be located about 1/3 and 2/3 of the total length of each reach. Use your map (developed during the completion of the Preliminary Reach Form) to locate the section of stream in which the sample riffles will be located.

*** for additional information, see Harrelson, et al. 1994.**

References:

King, R, Potyandj, J. 1993. *Statistically Testing Wolman Pebble Counts: Changes in Percent Fines!* Stream Notes, USDA Forest Service.

Rosgen, D.L. 1996. *Applied River Morphology.* Wildland Hydrology,

Wolman, M.G. 1954. *A method of sampling coarse river-bed material.* Transactions of the American Geophysical Union. 35(6): 951-956.

WOLMAN FORM
R6-2500/2600-32
(Revised for use by Oregon NRCS)

Page: ____ of ____

A. County ________B. Basin __________ C. Service Center ___________________

E. Stream Name____.

F. 4th HUC Code ____, ____, ____, ____ 5th _____6th _____

G. USGS Quad ____

H. Survey Date ____/______/______
MM / DD / YYYY

PEBBLE COUNT							
Stream Order #:		Habitat Unit #		# of Transects:			
Surveyor:				Reach:			
Inches	PARTICLE	Millimeters		Particle Count	**Total #**	**Item %**	**% Cum**
<.08	. Sand	< 2	S/C/S				
.08 -.16	Very Fine	2 -4					
.16 - .22	Fine	4 -5.7	G				
.22 - .31	Fine	5.7 - 8	R				
.31 - .44	Medium	8 -11.3	A				
.44 - .63	Medium	11.3 - 16	V				
.63 - .89	Coarse	16 -22.6	E				
.89 - 1.26	Coarse	22.6 - 32	L				
1.26 - 1.77	Vry Coarse	32 - 45	S				
1.77 -2.5	Vry Coarse	45 - 64					
2.5 - 3.5	Small	64 - 90	C				
3.5 - 5.0	Small	90 - 128	O				
5.0 - 7.1	Large	128 - 180	B				
7.1 - 10.1	Large	180 - 256	B				
10.1 - 14.3	Small	256 - 362	B				
14.3 - 20	Small	362 - 512	L				
20 - 40	Medium	512 - 1024	D				
40 - 80	Large	1024 -2048	R				
80 - 160	Vry Large	2048 -4096	S				
	Bedrock		BDRK				
				Totals:			
	Total Tally:						

Cumulative Percent Finer vs. Particle Size- Logarithmic Graph: