Level-1 Low Gradient Survey

(**1**) Determine your stream-reach boundary; this is a stream length up to 100-meters, which may be under certain circumstances. (**2**) Near the lower end of the reach (in the deepest portion of the run), collect water samples and analyze using the chemical tests you have available. You may use your collection container to observe watercolor and clarity and to determine water odors. (**3**) Measure the width-depth and velocity and estimate the water level. (**4**) For low-gradient streams you must collect macroinvertebrates from a combination of habitats to be representative; multiple samples (at least 10) should be collected throughout the reach. Make sure to use the appropriate net(s). (**5**) Evaluate the physical and habitat conditions; record information about known land use activities. (**6**) Sketch your reach or submit photographs with the survey and add any other comments that you feel are important for evaluating the conditions of your stream study site.

Stream name _____ Survey date _____

Watershed _____ County _____

Latitude _____ Longitude _____ Directions to site _____

_____ Start time _____

Survey completed by _____ Site code _____

Affiliation _____ Email _____

Mailing address _____ Phone number _____

Water chemistry: Use the boxes below to record the results of your water chemistry analysis; attach additional sheets if necessary.

	Result	units		Result	units		Result	units
Temperature (C/F)			Conductivity			Alkalinity		
Dissolved oxygen			Nitrates			Iron		
pH			Turbidity			Fecal/E-coli		

Additional tests (describe and record results) _____

Physical conditions: Use the check boxes below to describe the conditions that closely resemble those of your stream. The extra lines are provided to write in any additional comments. You may see more than one type of condition; if so, be sure to indicate these on your survey (check all that apply). If multiple conditions are observed, always indicate the most dominant condition. Note: If the condition you observe is not listed, describe it in the comment section.

Water clarity		Watercolor		Water/sediment odor	Sediment	Water	Surface foam	
Clear		None		None			None	
Murky		Brown		Fishy			Slight	
Milky		Black		Musky			Moderate	
Muddy		Orange/red		Rotten egg			High	
Other (describe)		Gray/White		Sewage				
		Green		Chemical				

Algae color		Algae abundance		Algae growth habit		Streambed color	
Light green		None		Even coating		Brown	
Dark green		Scattered		Hairy		Black	
Brown		Moderate		Matted		Green	
Other (describe)		Heavy		Floating		White/gray	
						Orange/red	

Physical condition comments: _____

Weather (today and past 48-hours): _____

Estimate the % of your reach that is shaded	> 80	80 - 60	60 - 40	< 40
	Excellent	Good	Fair	Poor

Width and depth measurements: Record the wetted width and depth from the channel's habitats. Record the average depth from a minimum of five measurements (one of these should be from the deepest part of the habitat). The width should be measured from the widest section of the feature. It is sometimes best to this task when you are measuring the discharge (see page 6).

Riffle Width (feet)	_____	Depth (feet)	_____
Run Width (feet)	_____	Depth (feet)	_____
Pool Width (feet)	_____	Depth (feet)	_____

Habitat conditions: Rate the habitat conditions by choosing the best description, and then choose a score from the range within the description.

Integrity	Optimal	Suboptimal	Marginal	Poor
Channel sinuosity	The bends in the stream increase the stream length 3-4 times longer than if it was in a straight line.	The bends in the stream increase the stream length 2-3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1-2 times longer than if it was in a straight line.	Channel is straight; waterway has been channelized for a long distance.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Channel substrate composition	Mixture of substrate materials with gravel and firm sand prevalent. Root mats, vegetation, or other cover also very common.	Mixture of soft sand, mud, or clay; mud may be dominant. Some root mats, vegetation, or other cover present.	All mud, clay, or sand bottom. Little or no root mats, vegetation, or other cover.	Hardpan clay or bedrock; no cover of any kind for aquatic life.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

The next two conditions are evaluated on both the left (L) and the right (R) sides of the stream. The **LEFT** and **RIGHT** sides are determined by looking downstream.

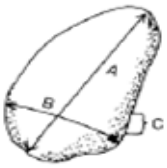
Integrity	Optimal	Suboptimal	Marginal	Poor
Bank stability	Banks are stable; no evidence of erosion or bank failure; little or no potential for future problems; < 10% of the reach affected.	Banks are moderately stable; infrequent areas of erosion occur, mostly shown by banks healed over or a few bare spots; 10-30 % of the reach affected.	Banks are moderately unstable; 30-50% of the reach has some areas of erosion; high potential for erosion during flooding events.	Banks are unstable; many have eroded areas (bare soils) along straight sections or bends; obvious bank collapse or failure; > 50% affected.
L R	10 9 8	7 6	5 4 3	2 1
Riparian buffer width	Mainly undisturbed vegetation > 60 ft; no evidence of human impacts such as parking lots, roadbeds, clear-cuts, mowed areas, crops, lawns etc.	Zone of undisturbed vegetation 40-60 ft; some areas of disturbance evident.	Zone of undisturbed vegetation 20-40 ft; disturbed areas common throughout the reach.	Zone of undisturbed vegetation < 20 ft; disturbed areas common throughout the entire reach.
L R	10 9 8	7 6	5 4 3	2 1
Total	> 70 (Optimal)	70 – 55 (Suboptimal)	54 – 40 (Marginal)	< 40 (Poor)

Habitat condition comments: _____

Streambed composition: You should always collect information about the composition of your reach. You can either estimate the proportions or you use a **pebble count** for a more accurate measure of composition. At a minimum you should estimate the composition of the riffles within your reach. The size categories are the intermediate axis (**B**) in millimeters.

Did you estimate ☐ or count ☐ ? Use the table below to record the data.

Silt/clay	Sand	Gravel	Cobble	Boulder	Bedrock	Woody debris
< 0.06	0.06 – 2	2 – 64	65 – 255	256 – 1096	> 1096	No size range
Very small; having a smooth slick feel	Very small; having a grainy feel	Pea to tennis ball	Tennis ball to basketball	Basketball to car size	Usually larger than a car; solid rock surface	Includes leaves, sticks, bark etc.



(A) Long axis (**Length**)
(B) Intermediate axis (**Width**)
(C) Short axis (**Height**)

Pebble counts require two people, one in the stream and one on shore. The person in the stream walks upstream from bank to bank using a zigzag pattern. After each step, the person reaches down without looking, picks up the first particle touched, and measures the intermediate axis with a ruler. The on-shore partner records the measurement. The process continues until 100 pebbles have been measured or the reach has been walked. Note: In many cases a pebble count is not necessary in muddy-bottom environments.

Land use: Indicate the land uses that you believe may be having an impact on your stream station. Use the letters (**S**) streamside, (**M**) within ¼ mile and (**W**) somewhere in the watershed, to indicate the approximate location of the disturbance and the numbers (**1**) slight, (**2**) moderate or (**3**) high, to represent the level of disturbance.

Active construction			Pastureland			Single-family residences		
Mountaintop mining			Cropland			Sub-urban developments		
Deep mining			Intensive feedlots			Parking lots, strip-malls etc.		
Abandoned mining			Unpaved Roads			Paved Roads		
Logging			Trash dumps			Bridges		
Oil and gas wells			Landfills			Other (describe)		
Recreation (parks, trails etc.)			Industrial areas					

Land use comments _____

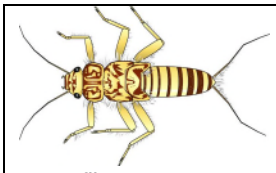
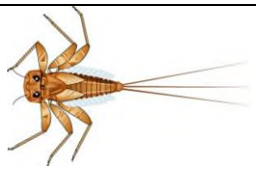
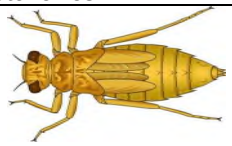
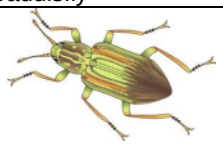
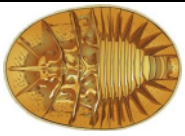
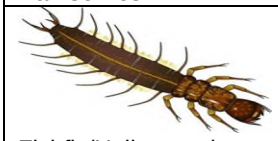
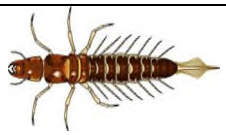
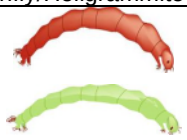
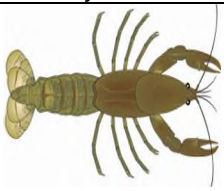
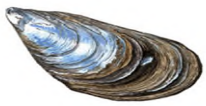
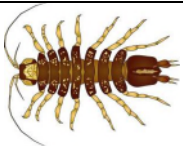
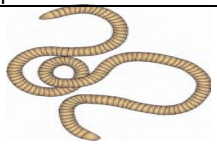
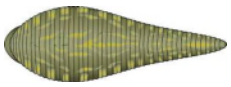
Pipes? Yes No

Describe the types of pipes observed and indicate if there is any discharge from the pipes. Also describe the color and odor of the discharge. _____

Photograph and **sketch your study reach**: Use the space below or a separate piece of paper to draw your study reach. Indicate the direction of flow, north, sample locations and important features of the reach. Photographs are an excellent method for tracking changes, especially changes related to the condition of the habitat. Choose a minimum of two permanent locations from which to take your photos. Submit your photos with your survey data sheet.

Benthic macroinvertebrates: Use the table below to record information about your macroinvertebrate collections. Record the abundance using this code: (**A**) > 50, (**C**) **5** – **50** and (**R**) < **5**. Also record the number of different kinds. The **# of kind's** box indicates groups in which multiple kinds (**families**) are possible. Note: If collected, include the **free-living caddisfly** with the other net-spinners.

Illustration's courtesy of the Cacapon Institute; Jennifer Gillies, artist

 Stoneflies	# of kinds	 Mayflies	# of kinds	 Caddisflies	**Case-builders** # of kinds
 Dragonflies	# of kinds	 Caddisfly	**Common netspinner**	 Caddisflies	**Other net-spinners** # of kinds
 Damselflies	# of kinds	 Riffle beetle		 Water penny	
 Fishfly/Hellgrammite		 Alderfly		 Other beetles	# of kinds
 Midges		 Black fly		 Crane fly	
 Watersnipe fly		 Other flies	# of kinds	 Crayfish	
 Clams	# of kinds	 Mussel		 Scud/Sideswimmer	
 Operculate snails	# of kinds	 Non-operculate snails	# of kinds	 Aquatic sowbug	
 Aquatic worm		 Leech		 Flatworm	

Other aquatic life observed or collected: _____

Note: Include **True bugs** in the "Other beetles" category

Stream score: Convert the abundance rating into numbers using this code: (A = **6**; C = **3**; R = **1**). Follow the instructions and use the table below to complete all the necessary calculations.

1. Multiply the abundance number by the tolerance to calculate the tolerance score. Add the entire tolerance score column and the relative abundance column. Divide the total tolerance by the relative abundance total. This calculation is called the **Biotic Index**.
2. Calculate the total number of kinds. This calculation is called the **Total Taxa**.
3. Calculate the total number of kinds from the beetles, mayflies, dragonflies and damselflies and caddisflies by adding the kinds together. This calculation is called **CEOT Taxa**.
4. You will determine a point value for three (metric) calculations by comparing your calculated value to the values in the table. The point values from each calculation are added together to determine your overall stream score and rating. Shaded boxes indicate that multiple kinds are possible within the group.

Benthic macroinvertebrates **Insect Groups**	Abundance	Tolerance	Tolerance Score	Number of Kinds (**Taxa**)
Stoneflies (Order *Plecoptera*)		2		
Mayflies (Order *Ephemeroptera*)		3		
Case-building caddisflies (Order *Trichoptera*)		3		
Net-spinning caddisflies (Order *Trichoptera*)		4		
Common netspinner (Family *Hydropsychidae*)		5		
Dragonflies (Order *Odonata*; sub-order *Anisoptera*)		4		
Damselflies (Order *Odonata*; sub-order *Zygoptera*)		7		
Riffle beetle (Family *Elmidae*)		5		
Water penny (Family *Psephenidae*)		3		
Other beetles (Order *Coleoptera*)		6		
True bugs (Order *Hemiptera*)		8		
Fishfly/Hellgrammite (Family *Corydalidae*)		3		
Alderfly (Family *Sialidae*)		6		
Non-biting midge (Family *Chironomidae*)		8		
Black fly (Family *Simuliidae*)		6		
Crane fly (Family *Tipulidae*)		4		
Watersnipe fly (Family *Athericidae*)		3		
Other true flies (Order *Diptera*)		6		
Non-Insect Groups				
Water mite (Order *Hydrachnida*)		6		
Crayfish (Order *Decapoda*)		5		
Scud/Sideswimmer (Order *Amphipoda*)		5		
Aquatic sowbug (Order *Isopoda*)		7		
Operculate snails (Sub-class *Prosobranchia*)		4		
Non-operculate snails (Sub-class *Pulmonata*)		7		
Clams (Order *Veneroida*)		6		
Mussel (Family *Unionidae*)		4		
Aquatic worm (Class *Oligochaeta*)		10		
Leech (Class *Hirudinea*)		10		
Flatworm (Class *Turbellaria*)		7		
Other invertebrates: _____	Total Abundance		Total Tolerance	Total Taxa

Metrics	Calculated Values	Point Values	**10**	**8**	**6**	**4**	**2**
Total Taxa			> 18	18 - 15	14 - 11	10 - 7	< 7
CEOT Taxa			> 10	10 - 8	7 - 5	4 - 2	< 2
Biotic Index			< 3.5	3.5 – 4.5	4.6 – 5.4	5.5 – 6.5	> 6.5
	Total points						

Rating Scale	> 24 Optimal	24 - 19 Suboptimal	18 - 13 Marginal	< 13 Poor

Determine the discharge by using a flow meter (if available) or other methods such as the **float method** or the **velocity head rod method** (VHR). Discharge should always be measured from a run (area of the channel with fast moving water with no breaks in the surface such as protruding rocks). The more measurements collected the more accurate your discharge results will be. To convert inches into feet, divide by 12. For example, if your depth measurement was 6-inches the result in feet would be 0.5. Indicate the method and use the tables to record your results.

Discharge method used

Float	Velocity Head Rod	Flow meter

Water Level

Low	Normal	High	Dry

Channel width _____ feet

Tape distance (ft)	Depth (ft)	Velocity (ft/sec)	VHR (Rise-inches)	Float (sec)	Discharge (cfs)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
Totals/Averages					

Average Depth _____ feet

Cross Sectional Area (CSA) _____ ft^2
(CSA = Average Depth x Width)

Discharge = CSA x Velocity

= _____ x _____
= _____ cfs (ft^3/sec)

If you use a float, record your distance below and the number of seconds it took to travel the distance in the column indicated.

Float distance (feet) _____

Use the table below to determine **VHR velocity** from the rises recorded above. The rises below are in inches.

Rise (R)	Velocity	Rise (R)	Velocity
¼	1.2	3 ¼	4.2
½	1.6	3 ½	4.3
¾	2.0	3 ¾	4.5
1	2.3	4	4.6
1 ¼	2.6	4 ¼	4.8
1 ½	2.8	4 ½	4.9
1 ¾	3.1	4 ¾	5.0
2	3.3	5	5.2
2 ¼	3.5	5 ¼	5.3
2 ½	3.7	5 ½	5.4
2 ¾	3.8	5 ¾	5.5
3	4.0	6	5.7

Submit a clear copy or the original data sheet to the Coordinator at address below. If you submit the original, always keep a copy of your records.

West Virginia Dept. of Environmental Protection
Save Our Streams Program
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