WV Save Our Streams Water Quality Field Kit

The kit is only available while working with the WV Save Our Streams Program Coordinator or with one of WVDEP's Nonpoint Source Program's Basin Coordinators.

Since there are a limited number of kits, they cannot be loaned or donated to the group unless there is a specific need such as a special study or project. In those cases the volunteer group must show reason for using the kit by providing a written description of the project proposal.

Upon review of the proposal, a kit may be provided for a limited amount of time at the discretion of the program coordinator. The volunteer group must maintain the kit and is responsible for all damage that may occur through field use. The volunteer group may also be responsible for the cost of refills. The kit contains the following parameters:

Test Factor	Test system	Range and units	# of tests/kit
Wide range pH	Wide range 2-Octet comparators	3.0 – 10.5	100
Alkalinity	Total alkalinity Direct read titrator	0-200 ppm/4 ppm as $CaCO_3$	50 at 200 ppm
Iron	Total Iron Octa-slide comparator	0.5 – 10.0 ppm Fe	90
Nitrate-Nitrogen	Zinc-reduction Octa-slide comparator	0-10 ppm NO_3-N	50
Dissolved Oxygen	All liquid reagents Direct read titrator	0-10 ppm/0.2 ppm O_2	50
Thermometer	Armored, non-mercury	-5°C - 45°C in 0.5° increments	Unlimited
Turbidity	Turbidmetric comparator	0, 20, 40, 60, 80, 100 JTU	Unlimited

This kit is for sale from the LaMotte Company

To purchase the kit, contact Customer service at 1-800-344-3100. The kits name is "WV Save Our Streams Kit" and its order code is **XX01245-03**. The cost is $348.70. It includes one water sample bottle and one-pair of safety goggles; additional bottles (0688) are available for $3.20 each. This kit does not include any meters; these must be purchased separately. You would spend more than **$450.00** if you were to purchase each of the test kits separately, not including the cost of the case.

Before using a kit, be sure to read its instruction manual and all related safety precautions. Also, review the material safety data sheets (MSDS) for the chemicals included with the kits. MSDS for all LaMotte test kits are available from LaMotte listed by the product code of the kit.

Disposal of low volume chemical waste

All the waste generated by the LaMotte test procedures (not including bacteria test) may be poured down the drain with the water running to dilute it. The only time the waste may not be disposed of in this manner is if the waste generated is from 30 or more tests for a single parameter. For example, if 30 students all use the LaMotte test kit to test the dissolved oxygen levels of a sample, the waste cannot be poured down the drain. A waste management facility should be contacted to determine the correct method of disposal. But if 10 students test for pH, 10 students test for nitrates and 10 students test for dissolved oxygen, the waste generated by this group can be disposed of down the drain with the water running to dilute it. If the tests are done in the field, carry a waste container with a lid along with the kits. Pour all the waste into the container and save it for appropriate disposal at a later time. Before using a kit, be sure to read its instruction manual and all related safety precautions. Also, review the material safety data sheets (MSDS) for the chemicals included with the kits.

The remainder of this document describes each analysis and provides background information that will improve your understanding of the tests.

Contents

Important note: All of the picture are slightly different than what is actually in the kit. The kits have been updated to be more field sturdy and easier to read, but the instructions remain the same.

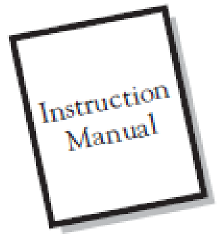
Notes:

General safety procedures

1.

Store the test kit in a cool, dry area.

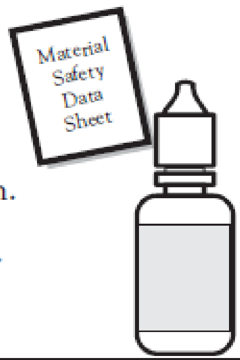
2.



Read all instructions and note precautions before performing the test procedure.

3.

Read the labels on all reagent bottles. Note warnings and first aid information. Read all Material Safety Data Sheets.



4.

Keep all equipment and reagent chemicals out of the reach of young children.

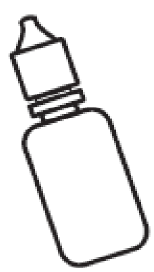
5.

Avoid contact between reagent chemicals and skin, eyes, nose, and mouth.

6.

Wear safety glasses when performing test procedures.

7.



In the event of an accident or suspected poisoning, immediately call the Poison Center phone number in the front of your local telephone directory or call a physician. Additional information for all LaMotte reagents is available in the United States, Canada, Puerto Rico, and the US Virgin Islands from Chem-Tel by calling 1-800-255-3924. For other areas, call 813-248-0585 collect to contact Chem-Tel's International access number. Each reagent can be identified by the four digit number listed on the upper left corner of the reagent label, in the contents list and in the test procedures.

What is pH?

A water molecule is made up of hydrogen ions (H^+) and hydroxide ions (OH^-): $H^+ + OH^- = H_2O$. The hydrogen ion concentration determines the pH of a solution. The term comes from the French "pouvoir hydrogen" literally hydrogen power or hydrogen potential. An acid solution has more hydrogen than hydroxide ions so the net effect when dissolved in water is a lower pH. A base has more hydroxide ions, so the result when dissolved in water is an increase in pH. The pH test allows us to infer how acidic or basic a substance is. The hydroxide and hydrogen ion concentrations are very small absolute numbers, so scientist developed a scale to make reporting and interpretation easier. Since this is a logarithmic scale, for every one change in pH there is a 10-fold change in hydrogen or hydroxide ion concentration. For example, rainwater is slightly acidic with a pH of around 6, while acid rain is ten times more acidic with a pH of about 5.

The carbonate system is one of the most prominent equilibrium systems in natural waters. Aquatic plants also influence pH through photosynthesis and respiration. The landscape of the surrounding watershed can influence pH. Watersheds that contain wetlands or pine forest tend to support waters with a slightly lower pH. Decaying vegetation and other organic matter also produces acids, which leach into nearby waters. Burning fossil fuels and other human activities have a dramatic impact on pH. Coal fired power plants and automobiles emit nitrogen oxides and sulfur dioxides, which react with water vapor in the air to produce nitric and sulfuric acids. Mining, chemical spills, thermal pollution, sewage effluent and agricultural runoff also affect the pH.

pH (5858)

1. Collect your water sample using a clean plastic sample bottle then transfer the sample to the test tube.
2. Always make sure your test tub is clean prior to adding the sample. The test tube is cleaned by rinsing with sample water or distilled water at least three-times. Fill the test tube with sample water to the 10-ml line (this is the only line on the tube).
3. Add 10-drops of Wide Range Indicator Solution cap and mix thoroughly.
4. Insert the Color Comparator and test tube; match the sample color to one of the standards. Always match the closest color, do not estimate or average numbers between colors.

What is alkalinity?

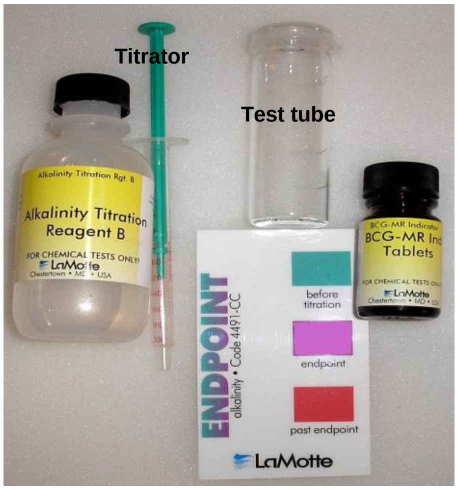
Alkalinity is a measure of water's capacity to resist a decrease in pH. In natural waters alkalinity is primarily a function of the carbonate system, which comes from rocks containing calcium carbonate. These rocks dissolve on contact with water and release calcium ions (Ca^{+2}), carbonate ions (CO_3^{-2}), bicarbonate ions (HCO_3^-, or carbonic acid (H_2CO_3), depending on the water's pH. The negative carbonate and bicarbonate ions combine with positive hydrogen ions (H^+) reducing acidity and increasing pH. Different types of carbonate dominate at different pH levels.

pH > 10: Carbonate (CO_3^{-2}) pH 6–10: Bicarbonate (HCO_3^-) pH < 6: Carbonic acid (H_2CO_3)

The sources of the carbonate minerals are found in some types of sedimentary rocks. Limestone yields calcium carbonate and dolostone yields calcium or magnesium carbonate. In areas where granite or other igneous rocks dominate the geology, waters have little natural alkalinity. Green plants also influence the carbonate system.

During photosynthesis, plants consume CO_2, which would otherwise form carbonic acid when dissolved in water. Thus, plants are the primary buffering system in areas with little geologic potential.

Alkalinity (4491-DR)

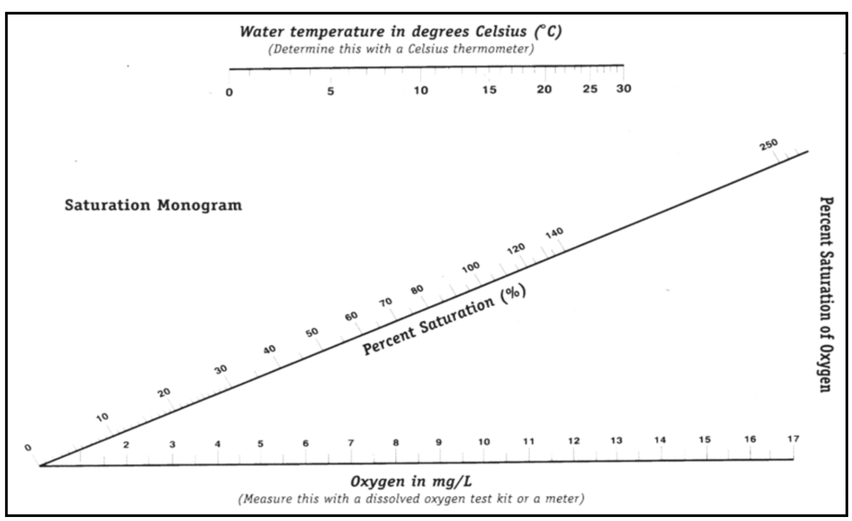


1. Collect your water sample using a clean plastic sample bottle then transfer the sample to the test tube.
2. Clean the test tube by rinsing with sample water or distilled water (3-times), then fill with sample water to the 5-ml line.
3. Add one BCG-MR Tablet, cap and mix until the tablet disintegrates. A blue-green color will develop.
4. Fill the Direct Reading Titrator with Titration Reagent B by pushing the titrator into the hole in the top of the reagent, and then turning the titrator and reagent upside down and pulling the liquid to the zero-line.
5. Add the titration solution to the sample very slowly drop-by-drop, swirling between each drop until the solution turns purple (consult the chart for exact colors).
6. Read the scale and record your result as ppm ($CaCO_3$); each minor division on the scale is equivalent to 4-units.

What is dissolved oxygen?

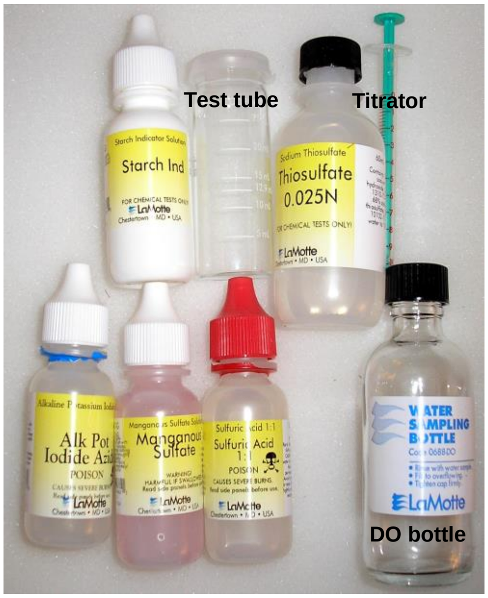
Dissolve oxygen (DO) is simply the oxygen that is dissolved in water. Stream and river systems both produce and consume oxygen. Waters gains oxygen from the atmosphere and from plants as a result of photosynthesis. Running water, because of its churning, dissolves more oxygen than still water, such as that in a reservoir behind a dam. Respiration by aquatic animals, decomposition, and various chemical reactions consume oxygen. If more oxygen is consumed than is produced, dissolved oxygen levels decline and some sensitive animals may move away, weaken, or die. Wastewater from sewage treatment plants often contains organic materials that are decomposed by microorganisms, which use oxygen in the process. The amount of oxygen consumed by these organisms in breaking down the waste is known as the biochemical oxygen demand (BOD).

DO levels fluctuate seasonally and over a 24-hour period. They vary with water temperature and altitude. Cold water holds more oxygen than warm water and water holds less oxygen at higher altitudes. Thermal discharges, such as water used to cool machinery in a manufacturing plant or a power plant, raise the temperature of water and lower its oxygen content. Aquatic animals are most vulnerable to lower DO levels in the early morning on hot summer days when stream flows are low, water temperatures are high, and aquatic plants have not been producing oxygen since sunset.



Instead of using (mg/L) or (ppm) to report your DO results, it is sometimes more useful to determine percent saturation. Percent saturation varies with temperature, altitude, motion of the water and barometric pressure. The actual calculation of these relationships can be complex, so we use a saturation monogram to estimate percent saturation.

Dissolved Oxygen (5860)



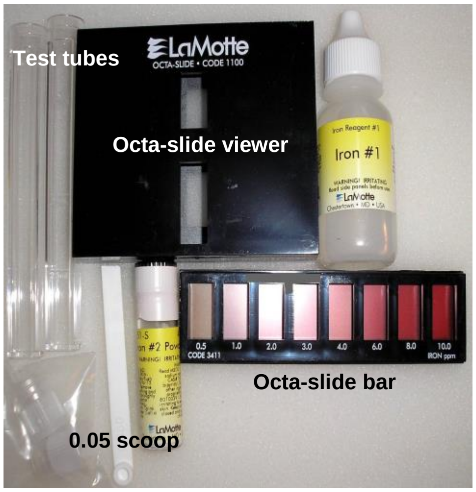
Note: The test can be completed if starch is not added. Simply titrate until the solution is clear.

1. Clean the DO-bottle by rinsing with sample water or distilled water (3-times) then fill the bottle completely, no spaces, with your sample water. There should be no air bubbles in the bottle.
2. Add 8-drops of Manganese Sulfate (4167).
3. Add 8-drops of Alkaline Potassium Azide (7166).
4. Cap the bottle and mix thoroughly, a precipitate will form. Allow the precipitate to partially settle.
5. Add 8-drops of 1:1 Sulfuric Acid (6141WT). Cap and mix until the precipitate dissolves.
6. Fill the test tube to the 20-mL line with the sample from the DO-bottle. Add 8-drops of Starch Indicator, a dark blue color will develop (See the note below the image).
7. Fill the titrator with Sodium Thiosulfate (4169) by pushing the titrator into the bottle, and then turn the bottle upside down and pull the plunger on the titrator until the liquid reaches the zero-line.
8. Remove the titrator and push it into the cap at the top of the sample bottle; slowly titrate by adding the solution drop-by-drop into the test tube, swirling after each drop.
9. Continue the titration until the blue color just disappears.
10. Read the scale and record your result as ppm DO; determine the % saturation using the monogram scale provided

What is iron?

Iron is usually present as a mineral in soils in small amounts but it is most obvious when exposed through sub-surface mining. If exposed to air and water, iron is released through oxidation of metal sulfides (usually pyrite, which is iron-sulfide) and generates acidity. Colonies of bacteria greatly accelerate the decomposition of metal ions, although the reactions also occur in an abiotic environment. These microbes, called extremophiles for their ability to survive in harsh conditions, occur naturally in the rock, but limited water and oxygen supplies usually keep their numbers low. Special extremophiles known as acidophiles especially favor the low pH levels of abandoned mines and are a key contributor to pyrite oxidation.

Iron (3318)



1. Collect your sample water using a clean plastic sample bottle then transfer the sample to the test tube.
2. Clean the test tube by rinsing with sample water or distilled water (3-times), then fill with sample water to the 5-ml line.
3. Add 5-drops of Iron Reagent#1 (4450); cap and mix thoroughly.
4. Use the 0.05-gram scoop and add one level-scoop of Iron Reagent #2 (4451), cap and mix until the powder dissolves.
5. Wait for three-minutes.
6. Insert the Iron Octa-Slide Bar (3411) into the Octa-Slide Viewer (1100). Insert the test tube into the Octa-Slide Viewer; match the sample color to a standard color.
7. Record your result as ppm Iron (Fe).

What are nitrates?

Nitrates are a form of nitrogen, which is found in several different forms in terrestrial and aquatic ecosystems. These forms of nitrogen include ammonia (NH_3), nitrates (NO_3), and nitrites (NO_2), all of which are part of the nitrogen cycle. Nitrogen is plentiful in the atmosphere making up 79% of the air we breathe but it is not readily available in a useable form to plants and animals because of the very strong covalent bond between nitrogen atoms. Fortunately there are many ways to "fix" or bound it to hydrogen or oxygen making it useable. Once fixed, plants quickly consume nitrogen, which in turn feeds the animal community.

Nitrates are essential plant nutrients, but in excess amounts they can cause significant water quality problems. Together with phosphorus, nitrates in excess amounts can accelerate eutrophication, causing dramatic increases in aquatic plant growth and changes in the types of plants and animals that live in the stream. This, in turn, affects dissolved oxygen, temperature, and other indicators. Excess nitrates can cause hypoxia (low levels of dissolved oxygen) and can become toxic to warm-blooded animals at higher concentrations (10 mg/L) or higher under certain conditions. The natural level of ammonia or nitrate in surface water is typically low (less than 1 mg/L); in the effluent of wastewater treatment plants, it can range up to 30 mg/L.

Sources of nitrates include wastewater treatment plants, runoff from fertilized lawns and cropland, failing on-site septic systems, runoff from animal manure storage areas, and industrial discharges that contain corrosion inhibitors.

Nitrate – Nitrogen (3354)

1. Collect your sample water using a clean plastic sample bottle then transfer the sample to the test tube.
2. Clean the test tube by rinsing with sample water or distilled water (3-times), then fill with sample water to the 5-ml line.
3. Add one Nitrite #1 Tablet (2799A). Cap and mix until tablet disintegrates.
4. Add one Nitrate #2 Tablet (NN-3703A). Cap and mix until tablet disintegrates.
5. Wait 5-minutes.
6. Insert the Octa-Slide Bar (3494) into the Octa-Slide Viewer (1100). Insert the test tube into the Octa-Slide Viewer and match the sample color to a standard color.
7. Record your result as ppm Nitrate-Nitrogen.

What is turbidity?

Turbidity is a measure of the relative clarity of water. Turbid water is caused by a variety of factors including suspended particles such as clay, silt, organic and inorganic matter, and even organisms. Turbid water may be caused by erosion, run-off from urban areas, algal blooms and disturbances to the bottom sediments.

Turbidity (5887)

1. Collect your sample water using a clean plastic sample bottle then transfer the sample to the test tube.
2. Make sure the test tub is clean. Clean the test tube by rinsing with sample water or distilled water at least three-times, then fill with sample water to the 25-ml line.
3. Place the base of the tube on the outline on the Turbidity Chart.
4. Look down through the sample water at the Secchi disk icon under the tube.
5. Compare the appearance of the icon under the tube to the Secchi disks on either side of the tube to estimate the turbidity in JTU.

Overall chemical integrity

Analysis	Optimal	Suboptimal	Marginal	Poor
Alkalinity (ppm)	> 40	21 - 40	5 - 20	< 5
pH	7.6 - 9.0	6.6 - 7.5	6.0 - 6.5	< 6.0 > 9.0
Dissolved oxygen (ppm)	8.1 - 12.0	5.0 - 8.0	> 12.0	< 5.0
Conductivity (μ/cm)	50 - 250	251 - 500	< 50	> 500
Nitrates/Phosphates (ppm)	< 1.0	1.0 - 2.0	2.0 - 4.0	> 4.0
Total Metals (ppm)	< 0.5	0.5 – 1.0	1.0 - 1.5	> 1.5
Bacteria (cfu)	< 100	100 - 200	201 - 400	> 400

The values provided here are those necessary to maintain the best ecological integrity in a stream environment; they are not based on water quality standards and in some cases the standard may not exist. Click-here to learn more about standards.

Water samples should be collected from the most represented portion of a stream, which is usually the **run** (a fast moving area without surface breaks) and as close to the downstream end of the reach as possible. Analysis can be performed either in the field or lab. Your results should fall within the excellent or good ranges; exceptions are pH (marginal – excellent) and dissolved oxygen (marginal – excellent). Note: Total metals category is a combination of all metals that may be present.

An example of a chemical survey data sheet is provided on the next page. Use this data sheet or another similar type as a complement your bioassessment efforts. In some cases chemical monitoring may need to occur more frequently (e.g. monthly, varying flow regimes etc.). Note: It is important to observe physical conditions while conducting water chemistry surveys.

WV Save Our Streams Water Chemistry Survey

(**1**) Determine your stream-reach boundary. (**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**) Evaluate other physical conditions and record information about known land use activities. (**5**) Sketch and photograph your reach. (**6**) Finally, include other comments that you feel are important for evaluating the conditions of your site.

Stream name ______________________________ Survey date __________
Watershed ______________________________ Station code __________
Latitude __________ Longitude __________ Directions to site __________

Survey completed by ______________________________
Affiliation ____________________ Email ____________________
Mailing address ____________________ Phone number __________

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		Water color		Water odor		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: ______________________________

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

WATER CHEMISTRY: Use the table on the next page to record the results of your water quality analysis; attach additional sheets if necessary.

Analysis	Result 1	Result 2	Result 3	Average	Units
Acidity					
Alkalinity					
pH				NA	
Temperature (°C)					
Conductivity					
Hardness					
Total solids					
Dissolved oxygen					
Biochemical oxygen demand					
Iron					
Aluminum					
Manganese					
Nitrates					
Nitrites					
Phosphates					
Sulfates					
Fecal coliform or E-coli					
Turbidity					

DISCHARGE: Use the velocity head rod method to determine your stream's discharge. Choose the best area, which is usually a run, a relatively straight section of the channel having fast moving water with little or no breaks (protruding rocks) in the surface. Stretch a tape across the stream to measure the width, and choose at least **five-positions** to measure the depth and rise of the water. Use the spaces below to record your data. If you do not measure discharge always measure your channels dimensions in a run, and estimate the water level.

Stream width (feet) ______________

Left Depth/Rise		**Deepest** Depth/Rise		**Right** Depth/Rise	

Average velocity ______________ ft/sec

Water level

Dry	Low	Normal	High

Discharge calculations (Convert depth to feet)

Width ______________ x Average depth ______________ x Average velocity ______________ = Stream discharge ____________ cfs

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

Photograph and **SKETCH YOUR STUDY REACH** on a separate piece of paper. Indicate the direction of flow, north, sample locations and important features of the reach. Choose a minimum of two permanent locations from which to take your photos.

Submit a legible copy or the original data sheet, photographs and sketches to the address below. Always keep a copy for your own records. If you have questions or comments contact the coordinator or call (304) 926-0499 x 1710.

WV Dept. of Environmental Protection
Watershed Improvement Branch
Save Our Streams Program
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