# TROUT UNLIMITED

## WATER QUALITY MONITORING PROGRAM

# West Virginia FIELD MANUAL

## VERSION 3

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# ACKNOWLEDGEMENTS

Trout Unlimited's (TU) West Virginia and Virginia Water Quality Monitoring Program is a partnership between Trout Unlimited, the West Virginia Council of Trout Unlimited, the Virginia Council of Trout Unlimited, the West Virginia Rivers Coalition, and the program is made possible by funding from the Appalachian Stewardship Foundation and West Virginia Department of Environmental Protection.

TU's WV-VA Water Quality Monitoring program is based largely on the Pennsylvania TU Coldwater Conservation Corps, launched in 2010. The PATU Coldwater Conservation Corps program can be traced back to Pine Creek Waterdog program of the Pine Creek Headwaters Protection Group.

A large number of individuals and organizations contributed to the development of this manual. Individuals who provided input to the manual, authored text, and/or reviewed the draft document and provided helpful comments are listed below:

- Ted Bear, Dr. Peter Ryan, Bob Volkmar – God's Country Chapter of TU
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- Kevin Coyne, John Wirts – West Virginia Department of Environmental Protection

The authors drew on a several pre-existing documents during the development of this manual. They provided much useful information and many helpful ideas and are listed below.

- *Marcellus Shale Gas Extraction: A study design and protocol for volunteer monitoring.* Alliance for Aquatic Resource Monitoring (ALLARM), Dickinson College. Carlisle, PA. June 2010.
- *Pine Creek Waterdog Log Book*. Pine Creek Headwaters Protection Group. Wellsboro, PA. 2009.
- *Designing Your Monitoring Program*: *A Technical Handbook for Community-Based Monitoring in Pennsylvania*. Prepared by River Network and Pennsylvania Department of Environmental Protection, Bureau of Watershed Management. Harrisburg, PA. 2007.
- *Volunteer Stream Monitoring: A Methods Manual*. U.S. Environmental Protection Agency, Office of Water. Washington, DC. 1997.
- *Marcellus Well Site Inspection Protocol*. Pennsylvania Fish and Boat Commission. Harrisburg, PA. 2009.
- *Stream Testing Protocols*. Delaware Riverkeeper Network, Alliance for Aquatic Resource Monitoring, and U.S. Geologic Survey. 2010.

# TABLE OF CONTENTS

# INTRODUCTION

There is significant potential for damage to West Virginia's coldwater resources as a result of land disturbances, spills, water withdrawals and wastewater discharges associated with development of the unconventional shale gas resources. Anglers and other citizens who value coldwater streams and fisheries can assist state agencies in protecting these resources through stream monitoring and field surveillance.

Protection of coldwater fisheries is an integral part of Trout Unlimited's mission, and volunteers can contribute significantly through participation in TU's Water Quality Monitoring program. The program is designed to train a network of stream stewards who conduct stream monitoring and routine inspections of stream conditions and report problems to the appropriate agencies. In this fashion, we can promote early detection and reporting of problems that develop during oil and gas drilling and production activities. More than any other segment of society, it is we who spend considerable time on these streams, and thus we are well positioned to watch over them.

This manual provides guidance and instruction for TU volunteers in West Virginia. It addresses topics such as: what to look for; what types of information to record; how to monitor stream water quality; how to take samples of water and soils; and whom to contact when something is thought to be amiss. It also provides information on personal conduct and safety.

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## ISSUES AND CONCERNS

Oil and gas activities can affect streams and riparian areas in a number of ways. Some of these effects are discussed below.

### Land Disturbances

Land disturbance for drilling pads, access roadways, pipelines, and compressor stations can cause accelerated runoff and soil erosion. This adds to the sediment loading of nearby streams and can increase stream bank erosion. Deposition of sediments into the stream adversely affects stream biota. An erosion and sedimentation control plan incorporating best management practices must be prepared and followed for all land disturbances associated with oil and gas development in West Virginia. In general, these measures do a good job of holding soil erosion in check. However, sometimes improperly installed or maintained erosion and sediment control measures can lead to accelerated erosion. Often access roadways are the problem, as they frequently are built on steep slopes, and routine maintenance is not a priority once a well is installed and producing. Recent events have shown that pipeline construction too can result in significant environmental insults.

### Spills and Discharges

Discharges of polluted water to streams, whether intentional or not, can have a significant impact on water quality and stream biota. In extreme cases, fish kills can occur. Every producing gas well also produces some water, which is stored in a tank at the well site or in a nearby pit or impoundment, and periodically trucked to a treatment facility or injection well for disposal, or to another site for use in other hydraulic fracturing jobs. Unfortunately, spills do occur; and regrettably, "midnight dumping" occasionally does take place. These events can occur and important evidence can disappear before anyone takes notice, especially on more remote streams. Early detection and prompt reporting are crucial.

### Water Withdrawals

Withdrawal of water from streams for use in hydraulic fracturing at gas wells can also have an adverse impact on stream biota. Between two and eight million gallons of water is needed to fracture each well. There are laws and regulations that are intended to protect aquatic life and drinking water sources from excess withdrawals. In West Virginia, natural gas operators developing horizontal wells which will use more than two hundred ten thousand (210,000) gallons of water in any month (calendar month) must submit a Water Management Plan with their Well Work Permit Application to the WV Department of Environmental Protection. However, real time monitoring is not required to make sure that there is sufficient water in stream for aquatic life. By monitoring stream flow conditions, TU volunteers can help identify illegal water withdrawals or situations where stream flows are so low that aquatic life is stressed, and thus the water withdrawal should be suspended.

### Gas Migration or Leakage

Leakage of natural gas into soil, springs, and waterways results from a pipeline break, a breech in the gas well casing, or other avenue. Since it is colorless and odorless, when gas is routed to a pipeline, mercaptan compounds are sometimes added to provide an odor for detection. When natural gas mixes with atmospheric oxygen in the right proportions, any spark or flame can ignite the mixture. This situation  is particularly dangerous when someone's potable water supply is contaminated.

## DECIDING WHERE TO CONDUCT MONITORING OR RECONNAISSANCE

Each group and volunteer must decide where to deploy their volunteer resources to maximize benefit. This is a tiered process, beginning with the entire area of interest and funneling down to specific stream monitoring locations or areas earmarked for visual reconnaissance.

### TU Conservation Success Index & Watershed Selection

The first step is to prioritize subwatersheds (HUC 12's) falling within the nearby geographic area. This is accomplished using Trout Unlimited's Conservation Success Index (CSI). The CSI is a compilation and assessment of data and information related to a species' distribution, populations, habitat features, and threats. TU's science team has assembled spatial data from national, state, and non- profit resource management agencies into a database, analyzed the data by sub-watersheds, and assigned a categorical score of 5(High) to 1(Low), allowing for the investigation and comparison of conditions and threats across subwatersheds. The categories of spatial data are organized into three groups: trout populations (e.g., high quality streams), habitats (e.g.% of subwatershed impaired by acid mine drainage), and future security (e.g. 20 year forecasts for unconventional shale gas development).

Using local, West Virginia specific data, Trout Unlimited has identified a Shale Gas Monitoring Strategy for monitoring the impacts of shale gas drilling on water quality and aquatic communities within subwatersheds in the shale formation area. See *Appendix A for TU's West Virginia-Virginia Shale Gas Monitoring Strategy.*

The first step in deciding where to monitor is to access TU's CSI Shale Gas Monitoring Strategy, prioritize the subwatersheds that are assigned a strategy within your area, and decide which subwatershed(s) you want to monitor. Once subwatershed(s) are chosen, the next step is to identify specific streams (main stem, tributaries) of concern, taking into account water quality and use classifications of the streams, where unconventional shale gas well pads currently exist, where unconventional shale well pads are earmarked, your interests, etc. It may be that a volunteer is interested in monitoring a particular stream because he or she lives on it or fishes it frequently. Ultimately, we are interested in protecting all coldwater streams, and volunteer interest is sufficient reason to conduct baseline monitoring of a stream within the unconventional shale gas area.

### Monitoring Locations

The final step in the process is the selection of specific water quality monitoring locations and areas or stream reaches at which routine visual reconnaissance will be conducted. In basins where no unconventional shale gas development has yet occurred, you will be conducting true baseline monitoring. In other cases, you will be monitoring where shale gas development is occurring or already has occurred. When choosing monitoring sites, key considerations are manpower constraints, accessibility, locations of major tributary streams, current or future locations of unconventional shale gas wells, and locations of other development within the basin.

One important consideration is the location of major tributary streams. Tributary streams that appreciably increase flow in the main-stem waterway can alter water quality as well. Thus, it is beneficial to obtain baseline water quality data in the main stem both upstream and downstream of the tributary stream. When selecting a monitoring location downstream of a tributary, be sure to go sufficiently downstream from the mouth of the tributary so that the waters of the two streams are completely mixed. If you note a significant difference between a water quality parameter up- and downstream of a tributary, you may want to monitor the tributary itself as well.

Small headwater streams (< 10 sq. miles drainage area) can be adequately monitored via a single monitoring site located near the mouth. Any change to water quality originating in the basin can be detected there. Larger streams may require multiple monitoring locations, as any change to water quality upstream may be diluted out by the time it reaches the mouth of the stream.

### Locating Unconventional Shale Gas Wells

Another consideration is the presence of drilling activity or producing wells in the watershed. Ideally, you will be aware of where a well or group of wells will be drilled. If this is the case, it is beneficial to obtain baseline data in the vicinity of the intended drilling activity prior to the initiation of access road and well pad construction. Where a well pad already exists, monitoring should be conducted both upstream and downstream of the well(s) or access roadway. Visual reconnaissance should focus on the downstream areas.

Several tools are available to help you determine where wells have been permitted and/or drilled. Both West Virginia have online mapping systems that visually display where gas wells are located, as well as other important information about each well.

To access Fractracker maps, go to www.fractracker.org and click on “Regions” tab on the top navigation bar then click "State By State". Click on your state within the map of the United States. As you zoom into the map, additional data layers will appear including oil and gas permits and violations.

The West Virginia DEP Office of Oil & Gas online mapping system can be found at the following link: http://tagis.dep.wv.gov/oog/. To find out specific information about each well, click the icon on the map. Well information includes: American Petroleum Institute (API) number, type of well, when the permit was issued, well operator, well status, well type, well number and location latitude and longitude. You can also change the basemap using the Map Layers option in the top right hand corner. This is currently the most user friendly options for identifying the locations of unconventional oil and gas wells.

### Other Considerations

The number of monitoring locations within a particular basin often comes down to manpower availability. Often it is not possible to monitor all the locations or conduct reconnaissance in all the areas chosen using the criteria discussed above. It then becomes a matter of choosing the best locations, generally those that will provide the most useful information.

Accessibility is an important consideration. Stream reaches within posted private property or a one-mile walk from the nearest road are generally not good choices. Many of our monitoring locations on both public and private property are located at bridges. Also, you should consider winter conditions when assessing accessibility.

Also important is the presence of facilities or features that could affect the conductivity or pH of the stream in question. We want to monitor in a fashion that either rules out or takes into account those features when we record changes in water quality. For example, a highway department deicing salt storage pile could affect conductivity. Thus, it would be wise to do some reconnaissance testing up- and downstream of the pile during a rainfall event prior to establishing permanent baseline monitoring locations.

If you plan to monitor a stream within a state or national forest, please inform TU's Mid-Atlantic Angler Science Coordinator, prior to monitoring. Special procedures may need to be followed on national and state forest lands. If you must access private property to get to your monitoring location, please be sure to obtain landowner permission and submit a landowner permission form to TU's Mid-Atlantic Angler Science Coordinator. See *Appendix B* for the private landowner permission form.

As a final note, bear in mind that the TU Water Quality Monitoring program is directed at small streams. Larger streams require a great deal more effort, equipment, and other resources. Even during normal flows, larger streams present physical challenges that we are not equipped to deal with and that the program does not address. When selecting monitoring sites, try to select locations that are manageable even at higher flows.

As a TU volunteer, you will take periodic measurements of certain water quality parameters using a pocket meter and other equipment. To provide some context for, and understanding of, what you are measuring, we provide a brief discussion of key water quality parameters below. To assure that the data you obtain are accurate, please be certain to carefully follow the instructions provided with the meter for its proper calibration and use.

### Temperature

The rates of biological and chemical processes depend on temperature. Aquatic organisms—from microbes to fish—are dependent on certain temperature ranges for their optimal health. Optimal temperatures for fish depend upon the species: some survive best in colder water, whereas others prefer warmer water. Benthic macroinvertebrates are also sensitive to temperature and will move in the stream to find their optimal temperature. If temperatures are outside this optimal range for a prolonged period of time, organisms become stressed and can die. Temperature will be measured in degrees Fahrenheit (F).

To take water temperature, immerse the pocket meter (or a good stream thermometer) where there is moderate flow, allow at least one minute for it to equilibrate, then read the temperature and record it on the field data sheet or in your field notebook.

### Conductivity

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Pure water has very low conductivity; the higher the levels of dissolved solids, the higher the conductivity. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity.

Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams that run through areas with granite bedrock tend to have lower conductivity because granite is composed of more inert materials that do not ionize (dissolve into ionic components) when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize rapidly when washed into the water. Ground water inflows can have the same effects depending on the bedrock they flow through.

Mining, industrial and other discharges can dramatically increase the conductivity of streams through the addition of dissolved solids. In fact, conductivity is one of the key “fingerprint” parameters for discharges associated with unconventional shale gas development. Water that contacts the shale contains high levels of dissolved salts and has a very high salinity, even higher than that of seawater. Discharges of these waters to freshwater streams can have a severe impact on aquatic organisms which are not adapted to high salinity levels.

The basic unit of measurement of conductivity is the mho or siemens. Conductivity is measured in micromhos per centimeter (µmhos/cm) or microSiemens per centimeter (µS/cm). Distilled water has a conductivity range of 0.5 to 3 µmhos/cm. The conductivity of rivers in the United States generally ranges from 50 to 1500 µmhos/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 µmhos/cm.

**Turbidity**

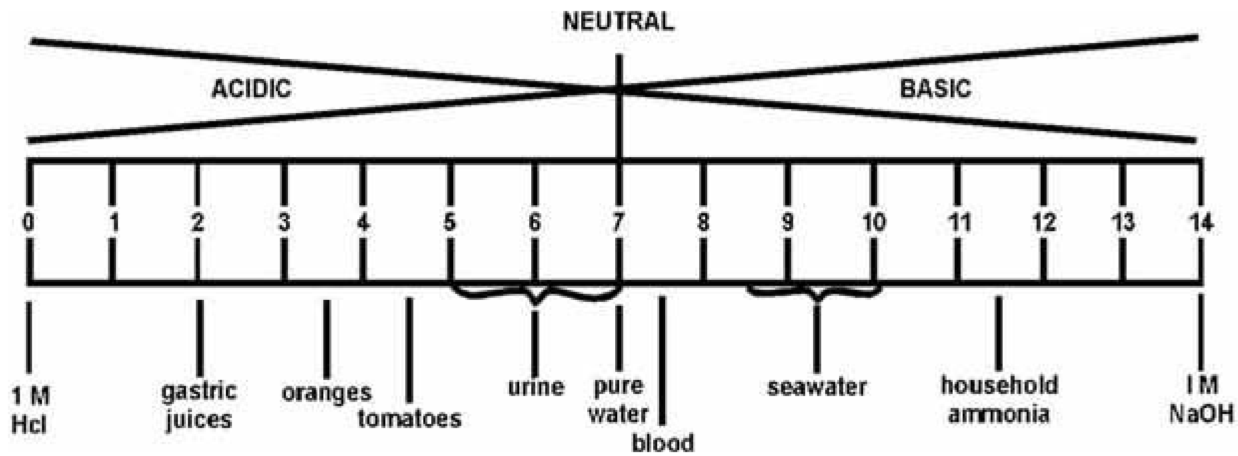
Turbidity is a measure of water clarity – how much the material suspended or dissolved in water decreases the passage of light through it. Suspended materials include soil particles (clay, silt, and sand), algae, plankton, microbes, and other substances. These materials are typically in the size range of 0.004 mm (clay) to 1.0 mm (sand).

Turbidity can affect the color of the water. Higher turbidity increases water temperatures because suspended particles absorb more heat. This in turn reduces the concentration of dissolved oxygen (DO) because warm water holds less DO than cold. Higher turbidity also reduces the amount of light penetrating the water, which reduces photosynthesis and the production of dissolved oxygen. Low DO levels can affect trout at every life phase. Suspended materials can clog fish gills, reducing resistance to disease, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Sources of turbidity include:

- Soil erosion
- Waste discharge
- Urban runoff
- Eroding stream banks
- Large numbers of bottom feeders (such as carp), which stir up bottom sediments
- Excessive algal growth.

**pH**

pH is a term used to indicate the alkalinity or acidity of a substance as ranked on a scale from zero to 14.0, with 7.0 being neutral (neither acidic nor alkaline). pH decreases as acidity increases. For reference, the figure below presents the pH of some common liquids.




Source: U.S. EPA.

pH affects many chemical and biological processes. For example, different organisms flourish within different ranges of pH. The largest variety of aquatic animals prefers a range of 6.5-8.0. A pH outside this range reduces biological diversity in a stream because it stresses the physiological systems of most organisms and can reduce reproduction. Low pH can also allow toxic elements and compounds (such as aluminum in acid mine drainage) to become mobile and "available" for uptake by aquatic plants and animals. This can produce conditions toxic to aquatic life, particularly to sensitive species like trout. Changes in acidity can be caused by atmospheric deposition (acid rain), erosion and solution of surrounding rock, and certain wastewater discharges, including acid mine drainage.

**Bromide**

Bromides are non-toxic salt compounds derived from the element Bromine. Found naturally in a variety of sources such as seawater and underground rock formations, bromides are known to be a component of Marcellus and Utica Shale produced waste-water. Bromide itself is not harmful and is not a human-health concern, but when combined with other elements such as chlorine during the disinfectant process at a water treatment plant, bromides readily form trihalomethanes (THMs) which are a serious human-health risk. Studies have linked the ingestion and exposure to THMs with several forms of cancer and birth defects. With brine, sewage, and powerplant wastewater treatment plants discharging treated water into water-ways, elevated bromide levels are a growing concern in West Virginia waterways, particularly when the discharge is upstream of drinking water supplies.

**Barium and Strontium**

These two metals are signature elements of brines originating in the Marcellus Shale. They are alkaline earth metals, putting them in the same group as calcium and magnesium on the periodic table of elements. In fact, strontium readily substitutes calcium in bone formation. Both are extremely reactive and are rarely found in nature as free elements. Rather, they readily form sulfates, chlorides, carbonates and other salts and minerals. The table below provides data on barium and strontium concentrations in samples of flowback water from Marcellus Shale wells in Pennsylvania and West Virginia. For comparison, the Pennsylvania water quality criteria for barium and strontium are 10 mg/L and 0.05 mg/L, respectively.

| Parameter | Minimum Concentration (mg/L) | Median Concentration (mg/L) | Maximum Concentration (mg/L) |
| --- | --- | --- | --- |
| **Barium** | 0.553 | 661 | 15,700 |
| **Strontium** | 0.501 | 821 | 5.841 |

Source: New York Department of Environmental Conservation. 2009. Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program, Table 5-9, p. 5-105.

## STREAM WATER QUALITY MONITORING

### Some General Rules

Before we get into details, let's establish some general rules of conduct when conducting monitoring and/or surveillance. Stream stewards should adhere to four general rules.

1. *Always respect private property*; *do not trespass on posted property.* Please note that due to safety and liability reasons, you are prohibited from entering active sites without permission. TU is not responsible for any issues that arise from anyone entering and/or trespassing on private property.

2. *Always be courteous to landowners and others* you meet on the stream; avoid confrontation.

3. If you suspect something unusual or concerning, your first call should be to TU's Mid-Atlantic Angler Science Coordinator, Jake Lemon at 814-779-3965 or jlemon@tu.org. To maintain the credibility and assure agencies that we have sound reporting protocols, we must avoid inaccurate reporting to state or federal regulatory agencies. If you see something that might create public health or safety hazard, please contact 911. Otherwise, take pictures and document the water quality conditions/measurements and contact TU to review the situation with you.

4. *Be mindful of your personal safety at all times*.

### Water Quality Monitoring

A core element of the TU program is routine monitoring of stream water quality. We discussed selection of monitoring locations in an earlier section of the manual. Here we'll discuss the monitoring activities.

The TU protocol calls for recording of the following parameters when conducting stream monitoring.

- Air temperature
- Weather conditions
- Water temperature
- Conductivity
- pH
- Water clarity
- Stream flow and water conditions
- Stream width and depths (used to approximate flow)

Typically these data and information are recorded on a field data sheet, provided in *Appendix C*.

In addition, you will take water samples twice per year – once during low flow conditions and once during high flow conditions – for shipment to the Alliance for Aquatic Resource Monitoring (ALLARM), based at Dickenson College conduct quality assurance/quality control (QA/QC) testing to verify your field measurements. Samples will sometimes be analyzed for other paramters including bromide, barium and strontium.

### Monitoring Kit

A limited number of monitoring kits will be provided at each training. Additional kits can be purchased from Trout Unlimited. The monitoring kit contains the following materials:

- A small pocket meter for measuring water conductivity, water and air temperature;
- A salt solution and a small beaker for calibrating the meter;
- pH measurement strips;
- 120cm Secchi tube;
- Squirt bottle for distilled water;
- Sample collection bottles;
- Gage staff for measuring water depth;
- Tape measure for measuring stream width;
- Field notebook; and
- Clipboard.

You will need to purchase distilled water, available in the grocery store for about $1.00 per gallon. You may also want to purchase a pair or two of disposable latex or nitrile gloves, in case you need to take a sample of contaminated material.

### Conducting Field Monitoring

We recommend that you monitor each selected site every two weeks or monthly. This varies somewhat, based on weather, personal constraints and other factors. In many areas, monitoring is suspended during the heart of winter due to accessibility problems and icy stream conditions. We also recommend that you team up with someone in the field. Experience has shown that having someone along to record data greatly enhances efficiency and reduces the time required to complete monitoring at a site. An experienced two-person monitoring team can complete a site in 15 minutes. Finally, once you have established your monitoring site, mark it with a small rock cairn, so you can return to the exact location during each monitoring visit.

The checklist below explains the activities that you will conduct at each monitoring location. They are listed in the order that experience has shown to be most efficient; however, you are free to conduct them in any sequence you wish.

1. Take location coordinates (first time only).
2. Note weather conditions.
3. Note stream flow and water conditions.
4. Take sample for pH and place pH strip in sample.
5. Record air temperature.
6. Take conductivity measurement.
7. Record water temperature.
8. Repeat conductivity measurement.
9. Take stream width and depth readings.
10. Take turbdity measurement.
11. Secure water samples for QA/QC (if collecting, see page 18).
12. Record pH.
13. Make visual observations.
14. Take photographs (if appropriate).

<u>pH Measurement</u>

It can require up to 10 minutes for the colors on the pH test strip to fully react, so we recommend that you take the pH sample after making observations about weather and stream conditions, and before completing the other stream monitoring tasks. Rinse the jar or beaker three times with stream water and fill with enough water that the color region of the strip is submersed. Set the sample aside in a safe place. When the other tasks (i.e., conductivity, temperature, stream cross-section) are completed, remove the pH test strip and hold it up to the color chart on the plastic box of test strips. Record the pH corresponding to the colors that most closely match those on the wet test strip. Most volunteers interpolate between two values when necessary. If the color falls between two of the pH values on the color chart, record your measurement as the median of those two values. For example, if the color falls between 6.5 and 7.0 record your measurement as 6.75. The pH of our freestone streams generally falls between 5.0 and 6.5. The pH of limestone streams is higher, above 7.0. The pH of streams in the southern coalfields of West Virginia is usually between 7.5 and 8.5 because of coal mine related water treatments.

Measuring Conductivity

The pocket meter provided in your monitoring kit will measure temperature, conductivity, total dissolved solids, and salinity. We do not use the salinity or total dissolved solids function. You will receive detailed training on how to use the meter during the TU Water Quality Monitoring Program training. Here we will discuss general procedure and tips for field use.

We recommend that you calibrate the meter at home, before heading to the stream, using the calibration beaker and solution provided in the monitoring kit. We have found that the meter reading will drift as the calibration sample cools or warms. Conducting the calibration indoors at home eliminates this problem. It is a simple process and takes less than five minutes. After completing the calibration, make a notation of such in your field notebook; include the date, time, and conductivity of the standard solution.

After arriving at a monitoring location, turn the meter on and set it aside; this allows it to equilibrate to the ambient temperature. Before placing the meter in the water to measure conductivity, record the temperature shown on the meter screen on the field data sheet in the space provided for air temperature.

You should measure conductivity near the center of the stream, at a location where there is some water movement but not a fast current. We have found that in a fast current the conductivity reading on the screen fluctuates erratically. In a riffle area, the slack water behind a rock provides a good location. You will take two conductivity readings and average them. If needed, use the mode button to set the meter to measure conductivity (µS). Place the meter tip in the water so that the electrodes are submersed. Often the conductivity reading will drift as the meter equilibrates to the water temperature. When the meter stabilizes, record the conductivity value on the field data sheet (see *Appendix C*). This is a good time to record the water temperature as well.

Measuring Turbidity

Turbidity in streams, particularly headwater streams, is very good indicator of stream health. Turbidity varies naturally across streams and both physical and biological factors can cause turbidity to fluctuate. Recent precipitation events can also significantly influence turbidity readings. You will measure turbidity using a 120cm Secchi tube. To begin, remove the secchi disk from the tube and rinse the tube to ensure removal of any residual materials. Facing up-stream, fill the tube with water from the center of the stream or as close to the center as possible, making sure not to disturb or collect any sediment from the stream bed. You will want to collect the sample from the middle of the water column and fill the tube to the zero centimeter mark. It is also a good idea to put your hand over the opening of the tube and shake the sample to re-suspend any sediment that may have settled at the bottom of the tube. Your reading should be taken in the open, but out of the direct sunlight. You may have to turn your back to the sun to shade the sample. Looking down the tube, slowly lower the secchi disk. As soon as you can no longer see the secchi disk, stop lowering the disk. While continuing to look down the tube, slowly raise the disk until it reappears.

Lower and raise the disk as many times as needed until you feel confident that you have found the midpoint between where the disk disappears and reappears. At this midpoint, pinch the string to the side of the tube to hold the secchi disk at this depth. Looking through the side of the tube, find where the top of the disk lines up with the measuring tape on the tube and identify the nearest centimeter. Record your measurement to the nearest centimeter.

Once the secchi disk depth is established, find the corresponding NTU (nephelometric turbidity units) that is closest to your measurement using the chart below and record the unit on your field data sheet. You will enter both values on the online database.

| Depth to Turbidity Conversion | | | |
|---|---|---|---|
| Centimeters | NTU | Centimeters | NTU |
| 6 | 240 | 39 | 16 |
| 7 | 200 | 41 | 15 |
| 9 | 150 | 43 | 14 |
| 12 | 100 | 46 | 13 |
| 18 | 50 | 48 | 12 |
| 19 | 45 | 51 | 11 |
| 20 | 40 | 53 | 10 |
| 23 | 35 | 57 | 9 |
| 26 | 30 | 62 | 8 |
| 29 | 25 | 67 | 7 |
| 33 | 21 | 76 | 6 |
| 35 | 19 | 85 | 5 |
| 36 | 18 | 97 | 4 |
| 38 | 17 | 118 | 3 |

## Stream Cross-Section or Stage

Conductivity will fluctuate with stream flow. As flow decreases, conductivity generally will increase. It is important to understand the relationship between flow and those water quality parameters in a given stream so that fluctuations in water quality can be placed in context. There are a couple possible methods for stream flow measurements discussed below.

It is important to determine the stream cross-sectional area at the exact same location each time the stream is monitored, so we must choose the location carefully. Deep pools and runs and fast flowing riffles are difficult to measure when water levels are high. On the other hand, very shallow riffles are difficult to measure when water levels are very low. So we typically choose moderate riffles and runs where flow is more or less uniform across the width of the stream as locations for measuring stream cross-sectional area. You should avoid areas where the streambed contains mud or silt, as walking in these areas stirs up a great deal of sediment. Be sure that you are measuring cross-sectional area in the stream in the same area marked by your small rock cairn, so you can be sure that you are measuring width and average depth in the same location during each monitoring visit.

The cross-sectional area is the product of the stream width and the average depth, according to the equation: Width (ft) x Depth (ft) = Area ($ft^2$). Your monitoring kit contains a tape measure for measuring stream width and a staff gage stick for measuring stream depth. Both should be measured in feet and tenths of a foot. Using the tape measure, measure the stream width perpendicular to the stream and record the value in the space provided on the field data sheet. You will take multiple depth readings using the gage stick. A minimum of eight depth readings is desirable. For streams more than 10 feet wide, take a depth reading every foot. For narrower streams, take depth readings on a closer spacing, so that you get eight or 10 values. Record the depth values on the field data sheet (see *Appendix C*). Later you will compute the average depth and compute the cross-sectional area.

Stage is an alternative to measuring discharge or cross-sectional area. Measuring the rise and fall of the water table in the stream using stage is an important metric that can help us understand the fluctuations between stream flow and conductivity. One advantage of using stage over cross-sectional area is that you do not have to enter the stream each time you monitor. It is also much easier to accomplish for volunteers who monitor alone.

There are several ways to set-up and measure stage at your monitoring location. First, an actual gage can be set-up on a permanent, non-movable structure such as a bridge, pier or a large rock, or a gage can be pounded into the streambed. This type of stage takes some additional work and expense to set- up and you must make sure it is sturdy enough to withstand high-water events and not wash away.

A second type of stage can be measured from a bridge. Many volunteers monitor by bridges since it allows easy access to the stream and is often a convenient place to park. Since the bridge is a permanent structure and is not varying in size or moving, you can measure from a point on the bridge to the top of the water and record the distance. First, choose a location on the bridge that is as close to the center of the stream as possible and is easy to come back to each time you monitor. A great example would be to choose a guard rail post that is close to the center of the stream and either mark the post or write it down in your field notebook (e.g., 7th post from left, facing upstream) so you don't forget.

Next, attach a small weight to the end of your measuring tape (if needed) and lower the tape down until the end touches the water. Choose a spot on the guard rail or post as your reference point and record the distance. A good example would be to measure to the top of the guard rail. Measurements should still be taken in tenths of a foot. It is important to remember when measuring from a bridge that your measurement will increase as stream flow decreases and the surface water table drops. As your stage measurement increases, so should your conductivity readings.

It is up to you which method of flow collection you complete. Cross-sectional area measurments can be more useful for some data analysis. That said, stage is much easier and quicker to complete, and still provides useful information. It is **very** important that you stick with one method for measuring your flow. If you began monitoring cross-sectional area with a gage stick and tape measure in the stream, you should stick with this protocol. Switching to a stage will not allow you to compare conductivity readily between the two methods. If you choose to measure stage it is ideal if you can measure both stage and cross-sectional area on at least 4 occasions capturing varying flow levels. That way a direct comparison can be drawn between stage and cross-sectional area.

## Quality Assurance

Quality assurance/quality control (QA/QC) procedures are extremely important to the success of the TU stream monitoring program. QA/QC procedures ensure that a system is operating correctly and that the system's output is correct, whether that output is manufactured goods, a service, or in our case, data. In short, those procedures lend credibility to the data we generate. That the data are credible is a key concern of scientists and environmental regulators who may use our data. We also want to be assured that our data are accurate and meaningful.

Twice per year volunteers will send samples to ALLARM. The samples should be sent via mail, no longer than 48 hours after collecting the sample, and do not need to be kept cold during this process. The address to mail the samples is:

ALLARM
Dickenson College
5 North Organge St
Carlisle, PA 17013

One of the two samples should be taken at a time of low flow in the stream (fall) and the other should be taken at a time of high flow in the stream (spring). When the samples are taken exactly is up to the volunteer as long as one sample is from low flow and one from high flow conditions though the ALLARM lab will only analyze samples during the following dates.

February 1 - April 15
June 1 - July 10
September 15 - November 20

The samples will be tested for quality assurance/quality control for conductivity, pH and water clarity. Sample may undergo analysis for other parameters including barium, strontium and bromide. The sample should be mailed in along with a QA/QC Data Form within 48 hours of collection. These forms can be found in *Appendix C*.

### Taking Water Samples

As noted earlier, you will take water samples on two occasions and send to ALLARM for QA/QC analyses. In addition, there may be times that you will be called upon to take a water sample from a stream for later analysis of water quality parameters. Your TU monitoring kit contains plastic bottles for this purpose. It is important that these water samples be taken properly, so the resulting analytical data will be valid. This is particularly critical should you take a sample during a pollution event. Proper procedure for taking a water sample follows.

1. *Put on the latex gloves, in case you determine that the water you are sampling is contaminated.*
2. Label the bottle with the sample site name, date, and time.
3. Remove the cap from the bottle just before sampling. Avoid touching the inside of the bottle or the cap. If you do so, discard the bottle and use another.
4. It's preferable to secure a sample from near the center of the stream, but conditions may dictate that you secure the sample from the bank. If you enter the stream, try to disturb as little bottom sediment as possible. In any case, be careful not to collect water containing stream bottom sediment. Facing upstream, collect the water sample on your upstream side, in front of you.
5. Hold the bottle near its base and plunge it (opening downward) below the water surface. Collect a water sample 8 to 12 inches beneath the surface, or mid-way between the surface and the bottom if the stream reach is shallow.
6. Turn the bottle underwater into the current and away from you. In slow-moving stream reaches, push the bottle underneath the surface and away from you in an upstream direction. Rinse the bottle three times this way before filling it.
7. Fill the bottle completely and replace the cap, closing it tightly.
8. Record the sample number, date, time, and location information in your field notebook and complete the information on the QA/QC Data Form (in Appendix C).
9. QA/QC samples should be shipped to ALLARM within 48 hours of collection from the stream.

In cases where there is a visible layer floating on the surface of the water (e.g., an oil slick) take a sample of that surface layer as well. Follow the sampling procedure outlined above, except hold the mouth of the bottle at the water/air interface to capture the floating material. Be sure to record in your field notebook that it is a surface sample.

### Taking Soil and Sludge Samples

Unlike materials discharged to a stream, liquid or solid material that has been dumped on the ground surface, roadway, or in a drainage ditch is not likely to migrate. These materials are best sampled by staff of state agency personnel. The best course of action when encountering sludge or contaminated soil is to record your visual observations and the GPS coordinates in your field notebook and await arrival of appropriate agency personnel. However, there may be situations when it is imperative to obtain a sample immediately (during a heavy rainstorm, for instance). You will need latex gloves, a plastic or metal trowel, and a zip-lock bag for this purpose. Follow the procedure below when taking a soil or sludge sample.

1. Put on the latex gloves.

2. Label the bag with the sample number/location, date, and time. Number your samples as given in Water Samples section above.

3. Prior to sampling open the zip-lock bag, being careful to avoid touching the inside of the bag. If you do, use another.

4. Using the plastic trowel, scoop up a sample of the material and place it in the bag. One cupful should be adequate.

5. Push excess air out of the bag and zip it closed.

6. Record the sample number, date, time, and location information in your field notebook.

7. As soon as you return home, place the sample in the refrigerator. Keep the sample cool until you turn it over to appropriate agency officials.

To avoid cross contamination, the trowel should be thoroughly cleaned between samples. If you take a second sample, clean the trowel as best you can before securing it. Upon returning home, wash the trowel in detergent, rinse thoroughly with tap water, and allow to air dry.

### Reporting Your Data Online

Each time you monitor your data should be uploaded to the online data portal at www.citsci.org. Directions on how to sign up for and use www.citsci.org can be found in *Appendix D*.

In addition to water quality monitoring, TU volunteers conduct periodic visual observations of streams, riparian areas, and areas of earth disturbances for unconventional shale gas wells, access roads, and pipelines. Reconnaissance is conducted by driving or preferably walking and making visual observations, looking for anything out of the ordinary (i.e. conditions that may indicate environmental damage resulting from gas development activities). The table below provides some more specific guidance. More detailed guidance is provided in the form of a checklist, which can be found in *Appendix E.*

**Table 2. Observations that may indicate a threat to streams or other resources**

| Observation | Possible Indication |
|---|---|
| Muddy, sediment-laden water in ditches or streams | Accelerated erosion from access road or other land disturbance |
| Erosion rills or washouts on access roads or other disturbed areas | Failure of erosion and sedimentation control measures; accelerated erosion |
| Any change in water color or appearance, especially an oily film on the water surface | Discharge of waste or contaminated water to the stream |
| Discolored water or streambed where a tributary or spring enters the stream | Possible indication of contamination in the tributary or spring |
| Sediment or turbidity in a water body in the absence of recent precipitation, or abnormal, persistent foam or bubbles | Accidental or illegal discharge from a pond, tank or other source |
| Unusual, usually organic odors | May indicate presence of waste or contaminated materials nearby |
| Changes in conductivity, pH, or other water quality parameter | Possible spill or other discharge reaching the stream |
| Dead fish or other organisms in the water or along the bank | Discharge of waste or contaminated water |
| Water hoses in or adjacent to stream | Possible unauthorized water withdrawal |
| Black or unusually colored sludge on the land surface, especially in a ditch or depression | Possible illegal dumping of liquid or solid waste material |
| Tanker trucks in unusual or unexpected locations | Possible unauthorized water withdrawal |
| Gas bubbling from a pool, puddle, or stream, or a strong sulfur odor | Escape of free natural gas from a well or pipeline (Be very cautious!) |

When conducting visual reconnaissance, you should adhere to the same general rules discussed above under STREAM WATER QUALITY MONITORING. In addition to the checklist (see *Appendix E*), it is helpful to have a pocket camera, GPS unit, binoculars, and of course, your field notebook along. The GPS unit can be used to record the coordinates of anything of interest. Should you observe any of the conditions noted in Table 1 or the checklist, photographs are invaluable.

Participants in the TU Water Quality Monitoring Project are provided a variety of materials and equipment, including a sturdy field notebook for recording notes. Whether you are doing routine monitoring or observing a pollution incident, you should always record your observations and other important information in the field notebook. Place the day, date, and time at the top of the page, followed by a physical description of the location (for example, Atkins Road bridge over Fishing Creek, one mile downstream of the Methodist Church). This helps anyone conducting follow-up investigations to find the exact location. In addition, recording the latitude and longitude using a GPS unit is very helpful. The final piece of general information to record in the notebook is the current weather conditions, along with the weather conditions during the past 12 hours (if you know). Since materials are often washed into streams via runoff, tracking recent rain events is very important.

Following this general information, write a detailed physical description of what you observed. This typically involves visual observations, but also could include smells and sounds. Describe any vehicles or equipment you observe. It will be helpful to record the license number, company name, and any other ID number on vehicles.

Photographs are extremely helpful when documenting a pollution event or other incident. Although participants are not provided with a camera, we hope that you will have your smartphone or personal digital camera along. Make sure that the date/time stamp on your camera is accurate. Record the number and subject of each photograph in your field notebook (for example, Photograph 4 – Fishing Creek looking downstream from Atkins Road bridge).

If you observe a pollution incident, it is extremely important to investigate further, both upstream and downstream. This information can be extremely helpful in identifying the origin of any contaminants. For example, if you record specific conductivity much higher than normal, it may be due to an influx of briny water from drilling or other oil/gas activity. Moving upstream to the next bridge and finding normal, low specific conductivity indicates that the source is somewhere between the two bridges. In like manner, if you observe a fish kill, attempt to trace it upstream until there is no longer evidence of fish mortality.

As a final notation, when you leave the site, record the time in the field notebook. When you move to a new location, record all of the same types of information in your field notebook.

## WHOM TO CONTACT. . . . AND WHEN

If there is an imminent threat to human life or property (such as free gas bubbling from the ground or water), contact the local Emergency Management Agency (dial 911).

Othewise, it is important that reports are made through the West Virginia Water Quality Monitoring Program. This ensures that there is a second set of eyes and ears on the issue, and that we are only reporting verified potential pollution events, which maintains the credibility of the program. Additionally, following this reporting chain of command will help to ensure that the correct agencies are contacted.

If you need to report an incident or issue, please send an email to the contacts listed below with the subject: POLLUTION REPORT: Laurel Creek (stream name is for example, please provide the name of the stream you report concerns). Please follow up your email with a phone call to the program coordinator, then follow the order listed, to confirm that your email was received.

1. Jake Lemon: Mid-Atlantic Angler Science Coordinator; Trout Unlimited
   Email: jlemon@tu.org (primary contact)
   Phone: 814-779-3965

2. Kathleen Tyner: Outreach Manager; West Virginia Rivers Coalition
   Email: ktyner@wvrivers.org
   Phone: 304-637-7201

3. Autumn Bryson: Program Director; West Virginia Rivers Coalition
   Email: abryson@wvrivers.org
   Phone: 304-992-6070

4. Angie Rosser: Executive Director; West Virginia Rivers Coalition
   Email: arosser@wvrivers.org
   Phone: 304-437-1274

5. REGIONAL COORDINATORS (to be added for specific trainings)

**PERSONAL SAFETY CONSIDERATIONS**

As important as documentation of a pollution event is, it should not be pursued at the risk of your personal safety. Some important safety suggestions are enumerated below.

1. *Do not touch, walk, or wade in water or soils that may be contaminated.* If you suspect that water/soils are contaminated, take pictures and document what you visually see, then contact the appropriate authorities. Avoid contact with contaminated water/soils.

2. *To avoid contacting contaminated material, always wear gloves when taking samples of materials that you suspect are contaminated.* Latex gloves are available from Wal-Mart or any drugstore for about 50 cents per pair.

3. *Do not place yourself in a physically dangerous situation* (for example, scaling a cliff or wading in extremely high water). Remember, there are always risks when wading in streams and it is possible to drown in even an inch of water.

4. *Avoid confrontation.* If someone becomes confrontational, or if you are physically threatened, leave the scene.

5. *Be very cautious if you suspect that free gas is bubbling from the ground or water.* It could be ignited by any spark or flame. Immediately contact the local Emergency Management Agency.

TU volunteers participating in the TU Pipeline Monitoring Program are covered under our liability insurance policy for any injuries to persons or property resulting from volunteer monitoring activities, contingent upon volunteer monitors closely following the above rules. If you are injured or your property damaged while conducting monitoring pursuant to these protocols and rules, contact Jake Lemon, jlemon@tu.org or 814-779-3965 immediately.

# APPENDIX A

## TROUT UNLIMITED

## CONSERVATION SUCCESS INDEX

## WEST VIRGINIA-VIRGINIA

## MONITORING STRATEGY

TROUT
UNLIMITED

**Trout Unlimited's Conservation Success Index:**
**Monitoring Strategies for Central Appalachian Trout Habitats - *April 2014***

Trout Unlimited's Conservation Success Index (CSI) is a compilation and assessment of information related to a species' distribution, populations, habitat features, and future threats. The CSI assembles spatial data available from national, state, and non-profit resource management agencies into a database and summarizes the data by watershed. These watershed-scale summaries are interpreted within an analytical framework and assigned a categorical score of 5 (high) to 1 (low), allowing for the investigation and comparison of conditions and threats within and across watersheds.

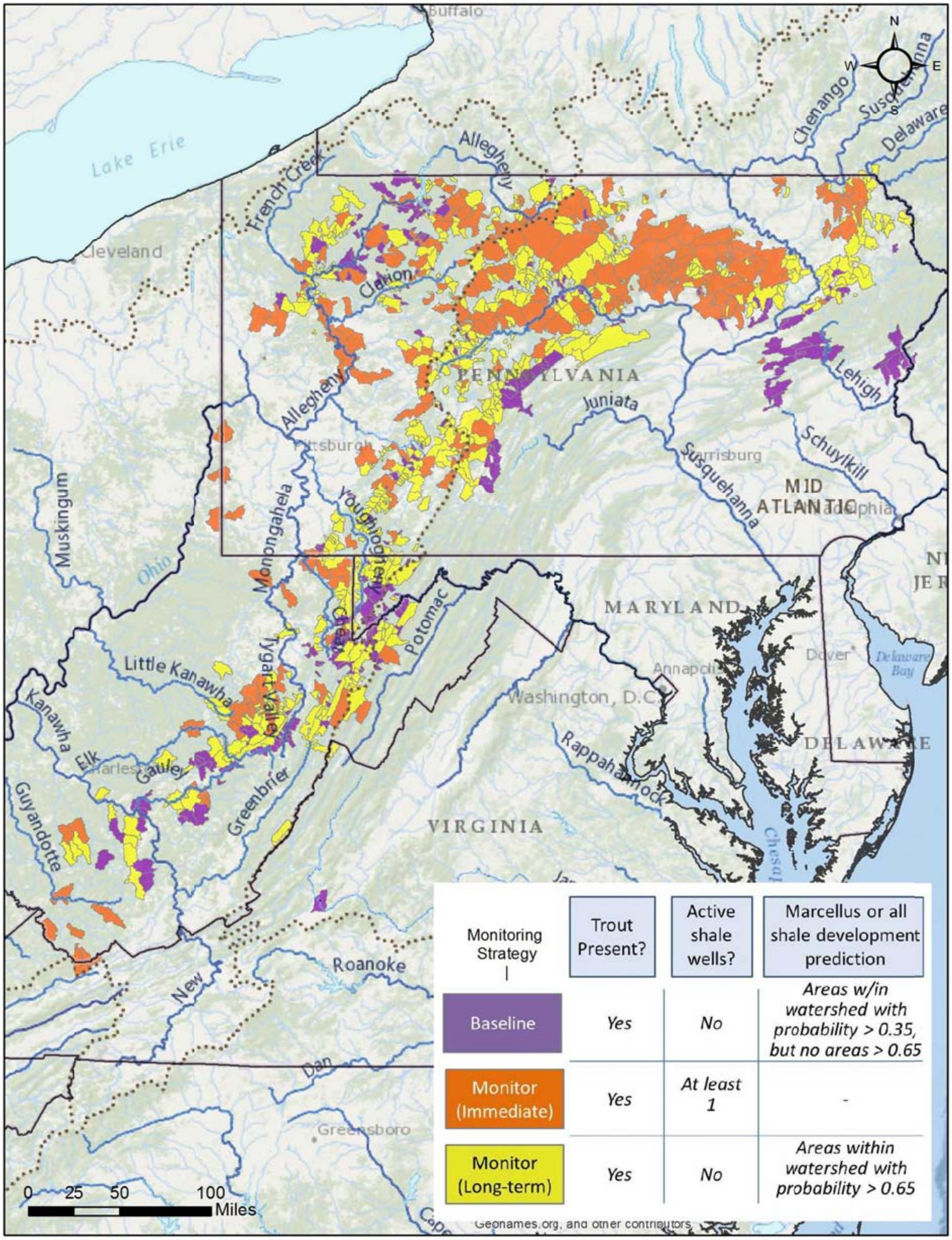
This analysis builds upon the CSI for eastern brook trout, completed in 2007, and the Pennsylvania-specific trout habitat CSI developed in 2010. The Central Appalachian CSI uses newly available data - brook trout habitat patch data developed by the Eastern Brook Trout Joint Venture and new projections of shale gas development in the Marcellus and other shale gas formations developed by The Nature Conservancy - to characterize the condition of trout populations, their habitats, and threats they may face in the future across PA, WV, VA, and MD.

CSI information has been summarized to provide a landscape-scale perspective of water quality monitoring opportunities related to shale gas development in watersheds with trout.

- **Baseline monitoring strategies** occur in watersheds without active shale gas development, but with a geological setting similar to some existing shale development. These watersheds lack locations highly likely to be developed in the future and may serve as long-term reference sites.
- **Immediate monitoring strategies** are appropriate in watersheds with existing shale gas development. These watersheds warrant monitoring to track water quality variables of importance, including changes in conductivity resulting from spills of produced water and sedimentation in streams from construction activities. Baseline data may provide a valuable reference for observations from these watersheds.
- **Long-term monitoring strategies** occur in watersheds which lack existing shale gas development, but contain areas identified as high probability locations of future development. Monitoring in these watersheds now provides baseline data for key water quality variables likely to be affected by future development, including temperature and sedimentation.

These strategies should be considered in light of the limitations of the shale gas development models, which are robust in predicting the location of future development based solely on the pattern of current development. As shale gas extraction technologies evolve and as new formations are developed, that pattern will inevitably change. The development models do not anticipate those changes, and the CSI monitoring strategies (Figure 1) will warrant revision and refinement as shale gas development occurs throughout the region. CSI results area available as an interactive webmap. Additional information, including details on data sources and analyses, is available in the full Central Appalachian CSI report.

**Figure 1:** Water Quality Monitoring Strategies for monitoring the impacts of shale gas development in trout habitat in the Central Appalachians.




| Monitoring Strategy | Trout Present? | Active shale wells? | Marcellus or all shale development prediction |
|---|---|---|---|
| Baseline | *Yes* | *No* | *Areas w/in watershed with probability > 0.35, but no areas > 0.65* |
| Monitor (Immediate) | *Yes* | *At least 1* | - |
| Monitor (Long-term) | *Yes* | *No* | *Areas within watershed with probability > 0.65* |

# APPENDIX B

# LANDOWNER ACCESS PERMISSION FORM

TROUT UNLIMITED

# LANDOWNER ACCESS AUTHORIZATION

Trout Unlimited has developed a stream surveillance program. The program is designed to help TU volunteers collect baseline water quality data on West Virginia and Virginia's coldwater streams and to monitor the impacts of Marcellus Shale gas development. While TU volunteers make every effort possible to monitor streams from publicly accessible locations, on occasion, the most effective monitoring locations can only be accessed from private lands. In those cases, TU members should seek written permission from the private landowner, using this form.

I, ________________________________, owner of ________________________, do hereby
(name of property owner) (address of property)

authorize and agree to permit ______________________________ of the _________________________
(Volunteer name) (TU Chapter)

to enter my property for the purpose of conducting stream surveillance, including visual assessments

and water quality monitoring, on __________________________________, accessible from my property,
(stream name)

beginning ________________.
(specific date)

This permission allows the above-named individual to carry out weekly, bi-weekly, or monthly water quality tests and visual assessments, while exercising due diligence in protecting the above-referenced property and personal safety and health.

_________________________________________________ __________________
Property Owner signature Date

_________________________________________________ __________________
Volunteer Monitor signature Date

To find out where to submit this form, please contact:

Jake Lemon
Mid Atlantic Angler Science Coordinator
jlemon@tu.org

# APPENDIX C

# WATER QUALITY QA/QC & CHAIN OF CUSTODY DATA SHEETS

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# STREAM MONITORING FIELD DATA SHEET

**MONITOR:** ___________________ **DATE:** _________________ **TIME:** ________________

**STREAM NAME:** ______________________________________________________________

**NAMING CONVENTION:**________________________________________________________

**LOCATION DESCRIPTION:** ____________________________________________________

| | | | | |
|---|---|---|---|---|
| **WEATHER & PRECIPITATION:** | **Clear** | **Cloudy** | **Partly Cloudy** | **Fog/Haze** |
| | **Rain** | **Drizzle** | **Intermittent Rain** | **Snow** |

**PRECIPITATION LAST 48 HOURS:** **None** **Trace** **Light** **Moderate** **Heavy**

**STREAM FLOW:** **Low** **Normal** **High**

**WATER CONDITION:** **Clear** **Cloudy/Off Color** **Muddy**

| Parameter | Units | Replicate 1 | Replicate 2 | Average |
|---|---|---|---|---|
| Conductivity | µS/cm | | | |
| pH | units | | | |

**TURBIDITY:** ___________cm converts to ___________ NTU

**AIR TEMPERATURE:** ________°F **WATER TEMPERATURE:** ________°F

| STREAM DEPTHS: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |

**STREAM WIDTH:** ___________ Feet **AVERAGE DEPTH:** __________ Feet

**CROSS-SECTIONAL AREA =** _____________ **X** ____________ **=** ___________ **FT$^2$**

Width Avg. Depth

**STAGE:**_________ **FEET**
**(OPTIONAL)**

# STREAM MONITORING FIELD DATA SHEET

**MONITOR:** __________________ **DATE:** ________________ **TIME:** _______________

**STREAM NAME:** ___________________________________________________________

**NAMING CONVENTION:**______________________________________________________

**LOCATION DESCRIPTION:** __________________________________________________

| | | | | |
|---|---|---|---|---|
| **WEATHER & PRECIPITATION:** | **Clear** | **Cloudy** | **Partly Cloudy** | **Fog/Haze** |
| | **Rain** | **Drizzle** | **Intermittent Rain** | **Snow** |

**PRECIPITATION LAST 48 HOURS:** **None** **Trace** **Light** **Moderate** **Heavy**

**STREAM FLOW:** **Low** **Normal** **High**

**WATER CONDITION:** **Clear** **Cloudy/Off Color** **Muddy**

---

| Parameter | Units | Replicate 1 | Replicate 2 | Average |
|---|---|---|---|---|
| Conductivity | µS/cm | | | |
| pH | units | | | |

**TURBIDITY:** ___________cm converts to ___________ NTU

**AIR TEMPERATURE:** _______°F **WATER TEMPERATURE:** _______°F

| STREAM DEPTHS: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |

**STREAM WIDTH:** ___________ Feet **AVERAGE DEPTH:** __________ Feet

**CROSS-SECTIONAL AREA =** _____________ X ____________ = ___________ $FT^2$

Width Avg. Depth

**STAGE:**_________ **FEET**
**(OPTIONAL)**

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# VOLUNTEER WATER QUALITY MONITORING

## Quality Control Instructions – Collecting a Duplicate Sample

Alliance for Aquatic Resource Monitoring (ALLARM) is pleased to provide quality control (QC) assistance to volunteers who monitor streams within the Chesapeake Bay Watershed – a service partially funded by the Chesapeake Monitoring Cooperative (CMC).

Quality assurance and quality control (QA/QC) procedures are an important part of a stream monitoring program, and should be followed consistently to help ensure the credibility and quality of the data being collected. ALLARM helps volunteers implement QA/QC procedures in a variety of ways, including duplicate sample analysis, where volunteers collect and send a water sample to the ALLARM laboratory for analysis.

Here's how the ALLARM Quality Control Program works:

Volunteer:

Conducts stream monitoring as usual → Collects a water sample and records the results on the QC Form → Sends the water sample and the QC Form to ALLARM

ALLARM:

Analyzes the water sample using the same and other equipment → Compares the results between the volunteer and ALLARM → Sends the analysis and comparison results to the volunteer

For specific directions, please see the Quality Control Form on the back of this page. Remember to:

- Label the QC bottle with your name, site name, and the collection date.
- Fill the QC bottle completely with stream water and close the lid tightly to avoid leaks.
- Pack a small box with your water sample and Quality Control Form and mail it to ALLARM.

If you have questions, please contact:

Jinnie Monismith, ALLARM Assistant Director
monismij@dickinson.edu
717.245.1021

ALLARM will notify you with the analysis and comparison results within one month of processing your water sample. Thank you for collecting information about the health of streams in the Chesapeake Bay Watershed and participating in the ALLARM Quality Control Program!

For more information on ALLARM, please visit www.dickinson.edu/ALLARM.

# VOLUNTEER WATER QUALITY MONITORING

## Quality Control Form

1. Fill out the label on your QC bottle. Record your bottle # here: _______________________________

2. Enter the stream and face upstream. Rinse your QC bottle and cap *three* times by filling the bottle with stream water, then pour the rinse water out downstream. Next, fill your QC bottle completely with stream water and close it tightly with the cap.

3. Record your results in the boxes below.

| Parameter | Units | Equipment | Result |
|---|---|---|---|
| Conductivity | µS/cm | LaMotte Tracer PockeTester (1749) | |
| pH | pH units | ColorpHast pH strips (2 – 9) | |
| Stage | ft | Gage stick | |
| Transparency | cm | Transparency tube (120 cm) | |

4. Fill out the information in the boxes below.

| Volunteer Information | | Sample Information | |
|---|---|---|---|
| Name | | Site Name | |
| Mailing Address | | Stream Name | |
| | | Latitude Coordinate | |
| Email Address | | Longitude Coordinate | |
| County Monitored | | Collection Date | |
| TU Chapter or other affiliation | | Collection Time | |

5. Pack a small box with your QC bottle and this QC Form and mail it to:

ALLARM
Dickinson College
5 N Orange Street
Carlisle, PA 17013

# APPENDIX D

# MAKE YOUR DATA COUNT

# Make Your Data Count!

**INSIDE THIS ISSUE:**



## Citsci.org

Citsci.org is a non-profit organization based out of Colorado State University in Fort Collins, Colorado. Citsci specializes in providing citizen science volunteer groups with tools for the entire research process including: creating new projects, managing project members, building custom data sheets, analyzing collected data, and mapping of monitoring or survey locations.

TU teamed up with Citsci in September of 2012 and released the online dataportal in January of 2013. Through Citsci, the program can now compare their conductivity and turbidity measurements to flow online, map their locations and see where others are monitoring in their area, and utilize a variety of educational materials available on the project homepage!

## How to Register for Citsci.org

1.) Navigate to www.citsci.org

2.) Click the Log-in button at the top of the page and create a Log-in

3.) Log-in and navigate to your profile page

4.) In the top left-hand corner, beside your email address, please click the "validate your email" tab.

5.) *Check your email for a message from CitSci and follow the instructions in the email.*

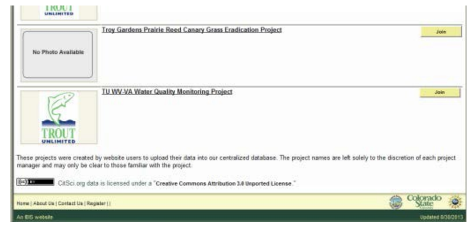

For a video on how to register and use Citsci.org, please follow this link

www.youtube.com/watch?v=asPzO9MtF_s

or go to www.youtube.com and search for "Trout Unlimited's CCC Dataportal User's Guide 1"

## How to Join the Project

- After you have created a log-in and validated your email address, navigate to the "**Projects**" tab at the top of the CitSci home page.
- Find the "**TU WV-VA Water Quality Monitoring Project**" and click the "join" button to the right of the project

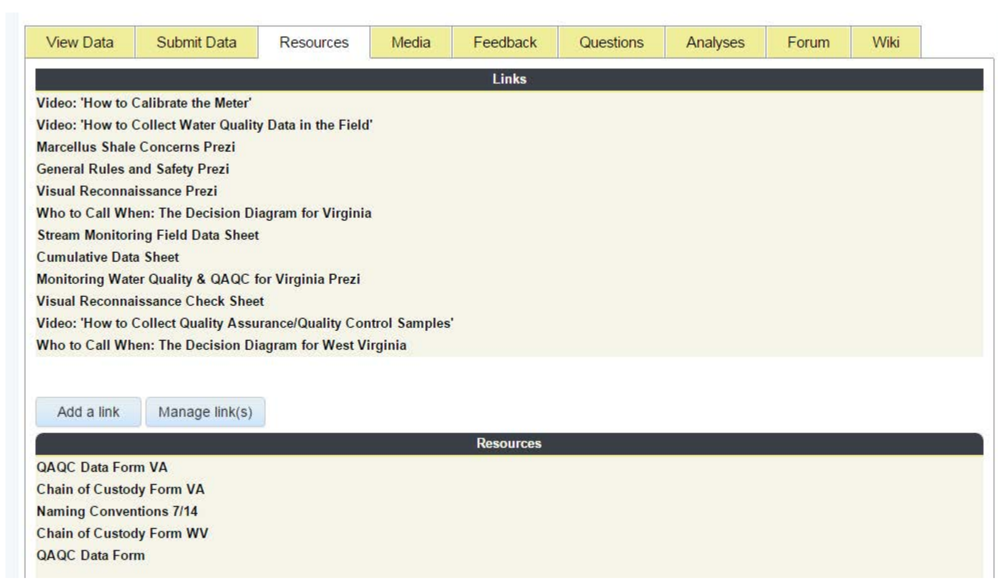



- Your membership will be approved within a day. If done on a weekend, it may take longer.

## Accessing Educational Materials

Need a refresher on the correct way to collect your stream parameters or calibrate your meter? No problem, videos documenting the monitoring process are available on your **Project Profile** page, under the **Resources** tab.

You can also find presentations used during trainings, replacement data sheets and other useful documents.




### GPS Tid Bits!

- Longitude is negative! (e.g., -78.20605)
- Latitude is positive! (e.g., 40.89526)
- The Datum is WGS_84
- Your coordinates should be in decimal degrees (hddd.ddddd)

*Please familiarize yourself with the Project Home Page!*

# How to Enter Data

Entering data using the online data portal is very simple. The data entry sheet is set-up very similar to your field data sheet and should take only a few minutes to enter your monitoring data.

**From the Project Home Page:**

- Locate the "Submit Data" Tab at the bottom of the page and click "Enter Data".

**Date of the Observation:**

- Please enter the date of observation, which is the date the data was collected.
- For Recorder, select your name from the drop-down box .
- Enter any comments related to the data collected.

**Location Information:**

- Select your naming convention from the drop down box. You can navigate directly to your naming convetion by clicking the drop down box and typing it in.
- If you do not have a naming convention please send the stream name and the GPS coordinates for your site to Jake Lemon.

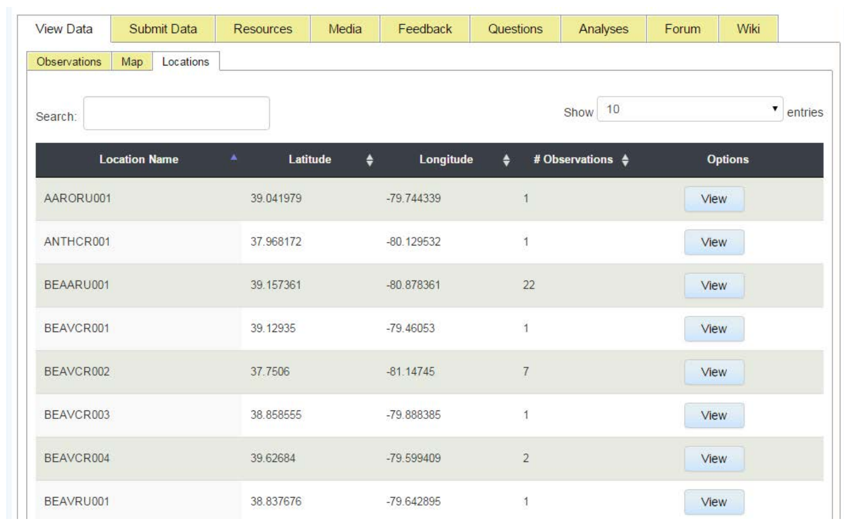
**Site Characteristics:**

- Fill out the data sheet with your collected parameters
- Upload any photos you have taken.
- Click Submit!

# How to View and Edit Data

**From the Project Home Page:**

- Locate the "View Data" tab at the bottom of the page.
- Choose the "Locations" option underneath the "View Data" tab.
- Search for your location by typing it in the search box.
- Click "View" beside your sites to see your information, graphs and data observations.
- Click "View" beside your observation to see data for that submission.
- Click "Edit" beside the parameter you want to change and type in the correct information.


View Data | Submit Data | Resources | Media | Feedback | Questions | Analyses | Forum | Wiki

Observations | Map | Locations

Search: Show 10 entries

| Location Name | Latitude | Longitude | # Observations | Options |
|---|---|---|---|---|
| AARORU001 | 39.041979 | -79.744339 | 1 | View |
| ANTHCR001 | 37.968172 | -80.129532 | 1 | View |
| BEAARU001 | 39.157361 | -80.878361 | 22 | View |
| BEAVCR001 | 39.12935 | -79.46053 | 1 | View |
| BEAVCR002 | 37.7506 | -81.14745 | 7 | View |
| BEAVCR003 | 38.858555 | -79.888385 | 1 | View |
| BEAVCR004 | 39.62684 | -79.599409 | 2 | View |
| BEAVRU001 | 38.837676 | -79.642895 | 1 | View |

# Mapping Application

**From the Project Home Page:**

- Locate the "View Data" tab.
- Choose the "Map" option underneath the "View Data" tab
- Use the plus/minus controls to zoom in/out on the map.

For more detailed instruction on how to view and map data, please follow this link…[www.youtube.com/watch?v=lYbFY8aPjqg](www.youtube.com/watch?v=lYbFY8aPjqg) or go to www.youtube.com and search for "Trout Unlimited's CCC Dataportal User's Guide 2"

# APPENDIX E

# VISUAL OBSERVATION CHECKLIST

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**TU Water Quality Monitoring Program**
**Checklist for Visual Observations**

**Location:** ____________________________________________________________

**Latitude:** ___________________________________________(decimal degrees)

**Longitude:** __________________________________________(decimal degrees)

## Earth Disturbance

**Access Road:**

☐ Mud/sediment on Township / State Road that access road enters

☐ Mud/sediment entering public road ditch from site

☐ Access road to site not stabilized with clean gravel

☐ Access road crosses stream with access road drainage directly emptying into stream

☐ Access road carrying drainage from site directly to road ditch or stream

☐ Road banks not stabilized with mulch, seeding, vegetation, etc.

**Pad/Storage Pond/Staging Areas:**

☐ Earth disturbance to edge of water body with no controls to stop or filter

☐ Clean water entering site from uphill (no diversion ditch)

☐ Outlets of sediment control structures go directly to water body without filtering/cleaning

☐ Diversion ditch

☐ Sediment pond

☐ Road drainage

☐ Silt barrier (fence, hay bales, tubes, etc.)

☐ Soil stockpile areas not stabilized if open longer than 20 days

☐ Outlets of ditches, sediment control structures, etc. are not stabilized and are causing erosion

**Receiving Streams:**

☐ Visual evidence of sediment entering stream, pond, wetland or other body of water

☐ Sediment plume

☐ Discolored water

☐ Increased sediment deposition on the stream bottom

## Spills and Discharges

☐ Unusual odor in water
☐ Persistent foam or bubbles in absence of high level of agitation
☐ Dead fish or other organisms in the water or along the bank
☐ Discolored water, especially an oily film on the water surface
☐ Increased bank erosion (may indicate a high water event)

## Water Withdrawal

☐ Water hoses in or adjacent to stream
☐ Unusually low flow in the stream not related to drought conditions
☐ Trucks parked beside streams where there are no signs posted that it is a withdrawal area.

## Gas Migration or Leakage

☐ Gas bubbling from a pool, puddle, or stream
☐ Odor due to mercaptan compounds