# West Virginia Pipeline Monitoring Manual

TROUT UNLIMITED

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v.3

# Table of Contents

# Acknowledgments

This pipeline monitoring field manual is modeled after Trout Unlimited (TU)'s Pennsylvania Pipeline Monitoring Manual which was developed in summer of 2015. Information contained herein was developed by TU, building off of TU's internal materials, as well as materials developed by the Delaware Riverkeeper Network and the Alliance for Aquatic Resources Monitoring (ALLARM) based at Dickinson College.

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

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# Introduction

For more than 7 years, unconventional shale gas resources have been extracted from the Marcellus Shale formation in several states across Central Appalachia using hydraulic fracturing and horizontal drilling. These technologies, when combined, create additional potential risks to the region's storied trout streams. In response, TU worked with the West Virginia Rivers Coalition (WVRC) to launch a volunteer-based shale gas monitoring program in West Virginia and Virginia to monitor streams in areas where shale gas development is occurring and to collect baseline water quality data in watersheds where drilling is not yet occurring but is expected to in the future. Today, we have an active network of volunteer stream stewards monitoring high priority streams across parts of West Virginia underlain by Marcellus Shale.

Now, the energy industry is actively seeking to build new major natural gas pipelines to move produced gas to eastern markets. Areas that have yet to see shale gas extraction, such as the Monongahela National Forest, may experience major pipeline development and related impacts as new pipelines are proposed and constructed across Central Appalachia. Building upon our existing network of volunteers conducting shale gas monitoring in West Virginia, TU is working with partners to engage and train volunteers to monitor streams and collect baseline data prior to pipeline construction and to identify potential impacts during and after pipeline construction.

Through participation in this Pipeline Monitoring Program, West Virginia citizens who value cold, clean water can assist state and federal agencies in protecting these resources through stream monitoring and field surveillance. Volunteers will complete routine stream monitoring and inspections of stream conditions, report problems to appropriate agencies and upload data to TU's online data portal. Through these efforts we can establish baseline watershed health in advance of pipeline construction activities, promote early detection and reporting of problems that may develop during construction and evaluate long term impacts that may occur due to pipeline development. West Virginia citizens who fish, recreate in or live near watersheds with intact native and wild trout habitat are well positioned to be the eyes and ears on the ground, protecting their local streams from potential degradation.

This manual provides guidance and instruction for TU'S Pipeline Monitoring Program volunteers.

# Introduction to Natural Gas Pipelines

**Types of Natural Gas Pipelines**

A series of pipelines, of different sizes and materials, are used to move natural gas from a wellhead to the end consumer. The three primary types of pipelines that are found along this route are gathering lines, transmission lines and distribution lines. For the purposes of this program, monitoring will be focused on gathering lines and transmissions lines, as these most often overlap with high quality coldwater streams and their watersheds.

*Gathering Pipelines*

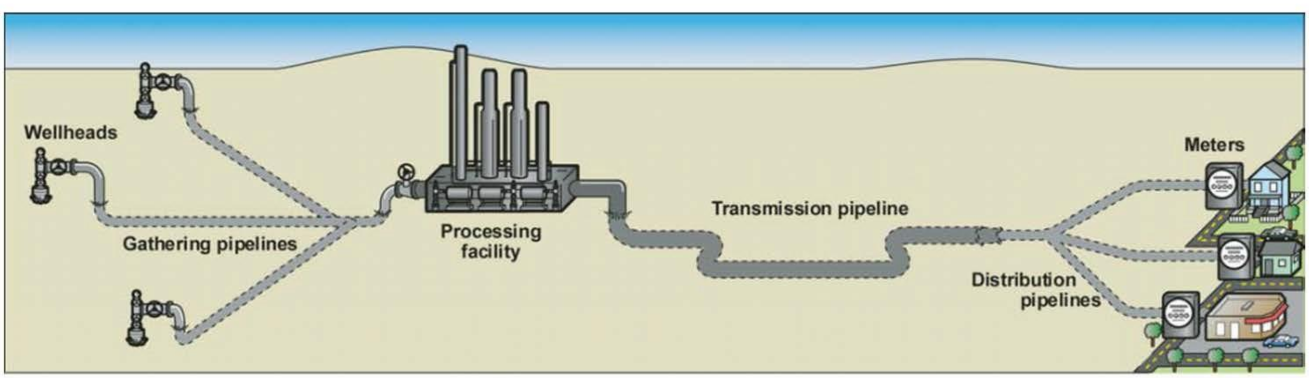
Gathering lines move natural gas from the wellhead to a natural gas processing plant or to a larger mainline pipeline. Typically constructed of steel pipe, gathering pipelines are usually 6 to 24 inches in diameter, and cleared right-of-ways for gathering lines can range from 30 to 150 feet wide. Gathering lines can vary widely in length depending on the proximity to the nearest transmission line or gas processing plant.

*Transmission Pipelines*

Transmission lines move natural gas across larger distances from areas of extraction to areas of consumption or export. Transmission lines are constructed of large steel pipes which are usually 24 to 42 inches in diameter and can require cleared right-of-ways of up to 200 feet for construction and work space. Permanent cleared right-of-way areas can be up to 125 feet. Transmission lines are considered interstate if they cross state lines and intrastate if they do not.

*Distribution Pipelines*

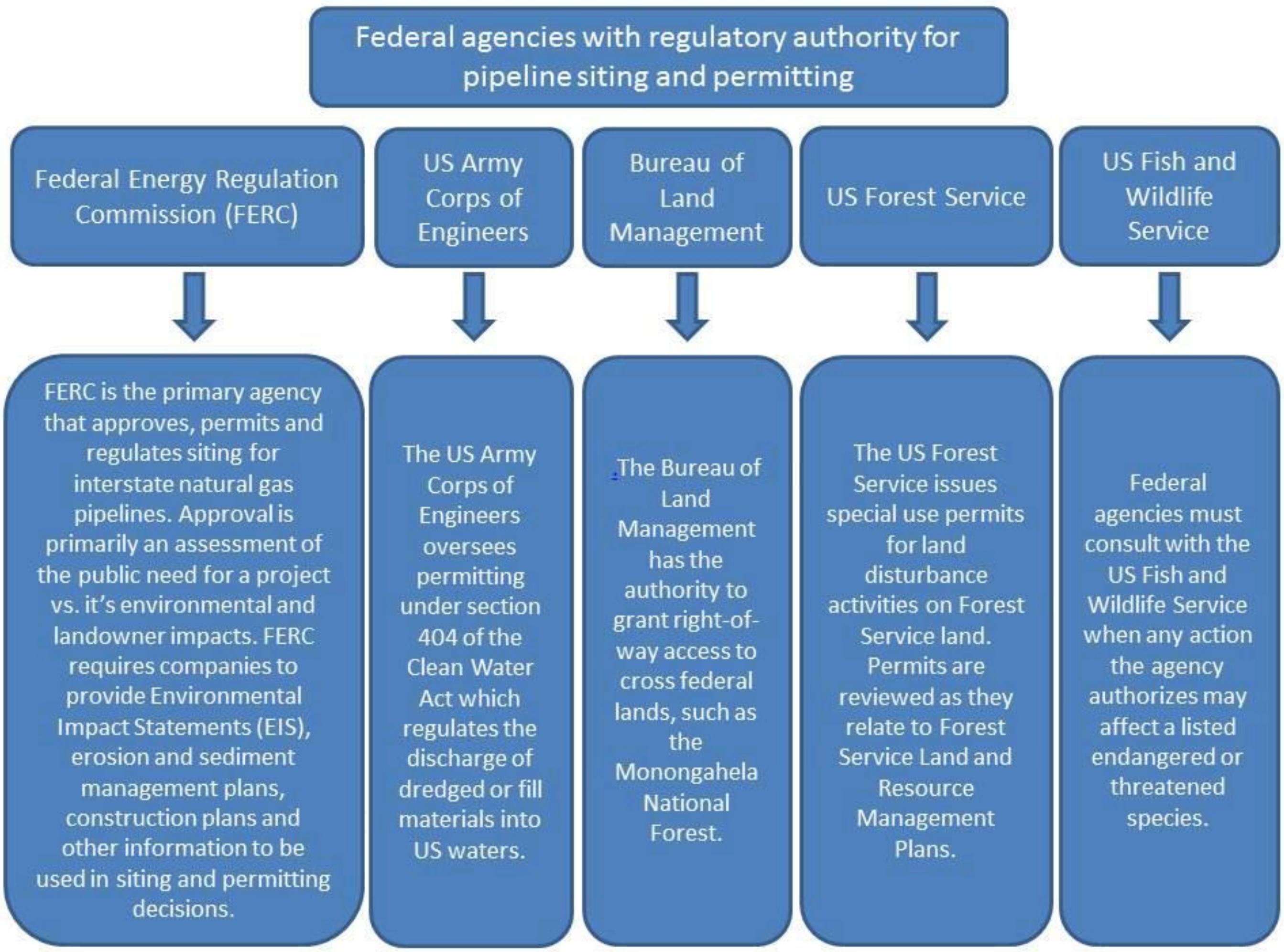
Distribution lines are located in towns and cities and carry natural gas to the end consumers, such as homes and businesses. They are generally 2 to 24 inches in diameter and constructed of steel, cast iron, plastic or copper.

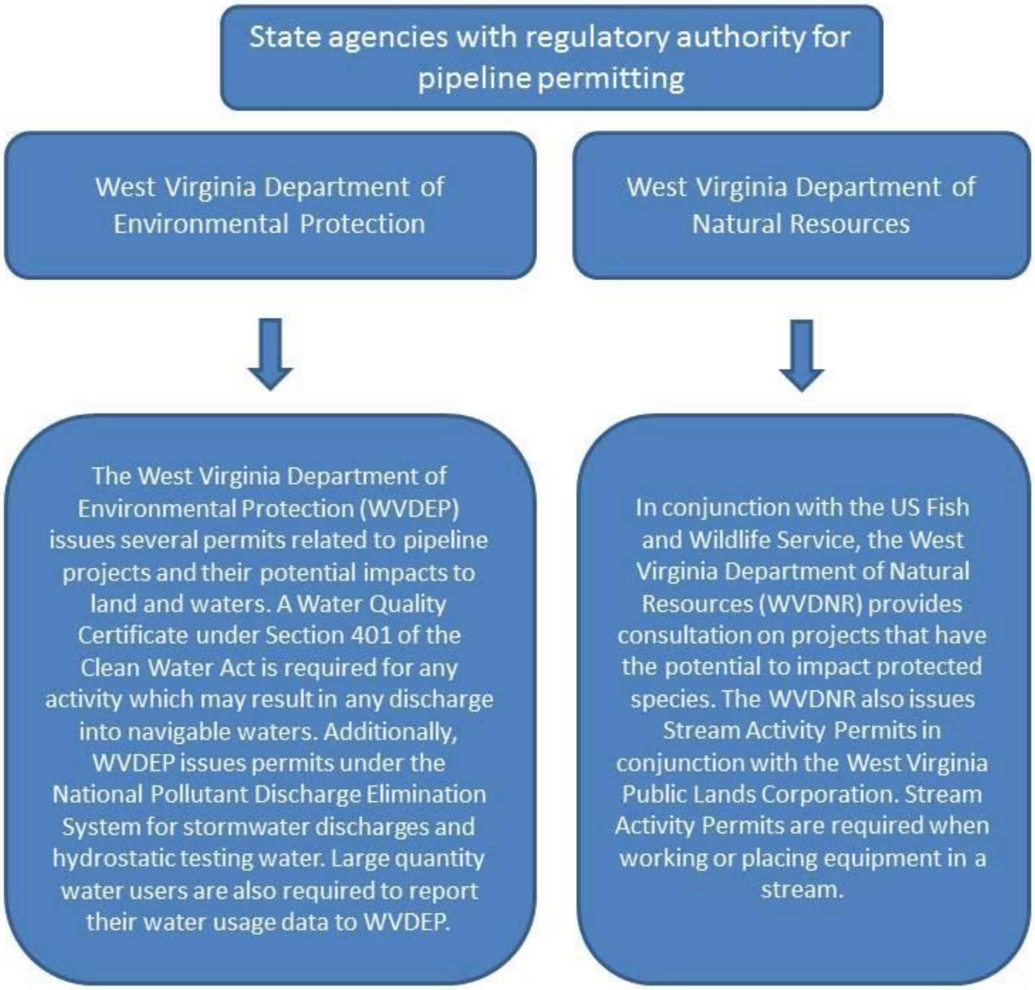



Source: PHMSA.

**Pipeline Regulation**

Different aspects of pipeline siting and construction are regulated by various state and federal agencies. Some agencies have no regulatory authority but may be consulted on particular aspects of pipeline projects. For example, the U.S. Forest Service provides input on siting where pipelines are proposed to cross national forest lands. Other agencies regulate safety in pipeline construction and maintenance including the U.S. Department of Transportation and the Pipelines and Hazardous Materials Safety Administration. The type of regulations that apply to a given pipeline often depend upon whether a pipeline crosses state lines and is considered an interstate pipeline. Below is a list of agencies and their respective roles in reviewing, approving and permitting interstate pipelines, related to protection of streams and rivers. This list is not intended to be exhaustive.






**Pipeline Construction Process**

Depending upon whether the pipeline is proposed to cross state lines or is located wholly within a state, different federal and/or state regulatory requirements apply. After the pipeline operator obtains the required federal and state authorizations and permits and meets regulatory requirements, pipeline construction can begin. The first step in the construction process is surveying and staking along the pipeline right of way, which for interstate pipelines usually occurs during the Federal Energy Regulatory Commission (FERC) pre-filing and Environmental Impact Statement (EIS) process. The right-of-way will then be cleared of trees, brush, boulders and any other matter that may interfere with construction. Once the path has been cleared, topsoil is removed and stockpiled along the edge of the right-of-way. The right-of-way may also be graded to ease construction activities. The pipeline right-of-way will likely cross water bodies along its path. Construction methods used to cross streams and rivers is discussed in the next section.

Pipe sections are laid out along the pipeline path and a trench is dug. Then the pipeline is assembled. In some cases, assembly is done in place, welding the sections together and bending the pipes where needed to fit the route of the pipeline. Once the pipeline is assembled, it is lowered into the trench and the trench is backfilled. Other times, the pipeline is assembled and welded directly in the trench. The next step is hydrostatic testing, where water is pumped through the pipeline at high pressures, to ensure pipeline strength and the absence of leaks.

Temporary erosion and sediment control devices must be installed before and during initial earth disturbance. Upon completion of pipeline construction, permanent runoff control devices are installed and the right-of-way will be re-vegetated. Erosion and sediment control and re-vegetation will be covered in more detail in later sections.

**Types of Pipeline Stream Crossings**

In the water-rich areas of Central Appalachia, numerous waterbodies, streams and rivers will be crossed by natural gas pipelines. There are several methods used to cross streams based upon size and width of the waterbody, cost, site conditions, seasons, and, in some cases, input from outside organizations and agencies, such as Trout Unlimited.

**Wet Crossing Methods**

*Open-Cut Wet Ditch*

A wet ditch crossing simply involves excavating a trench across the stream bed without any diversion of the in stream flow.


*Open-Cut Wet Ditch.* Photo credit: notennesseepipeline.org

**Dry Crossing Methods**

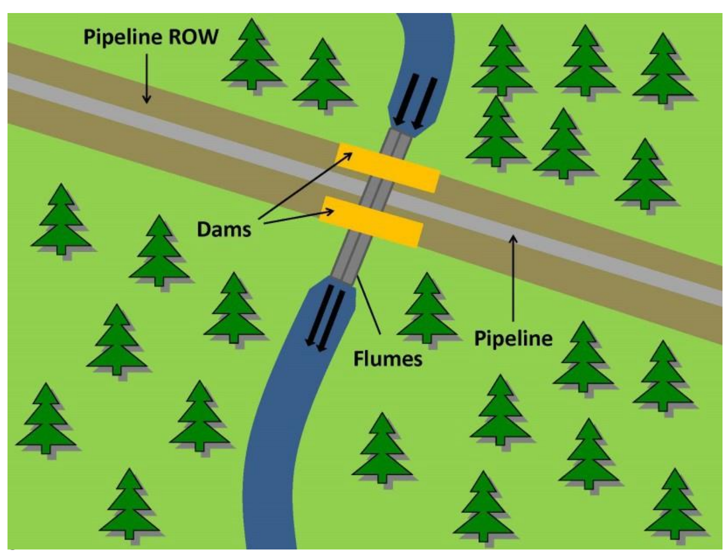
A dry crossing method involves working instream while there is no water in the work area. There are several different methods for dry stream crossings.

*Open-Cut Dry Ditch*

A dry open cut entails crossing an intermittent or ephemeral stream while the stream is dry. There is no water flow in the stream and thus no flow-through device is used. Dry open cuts may also occur when a stream is frozen.

*Flume*

A flume crossing entails constructing a dam to dry out the work area and then large pipes are installed to move water from one side of the dam to the other. These flume pipes act much like culverts that carry stream water under a road. The number, length and diameter of the flume pipes that will be used will depend upon stream flow. When the trench has been excavated, the pipe laid and the trench backfilled, the

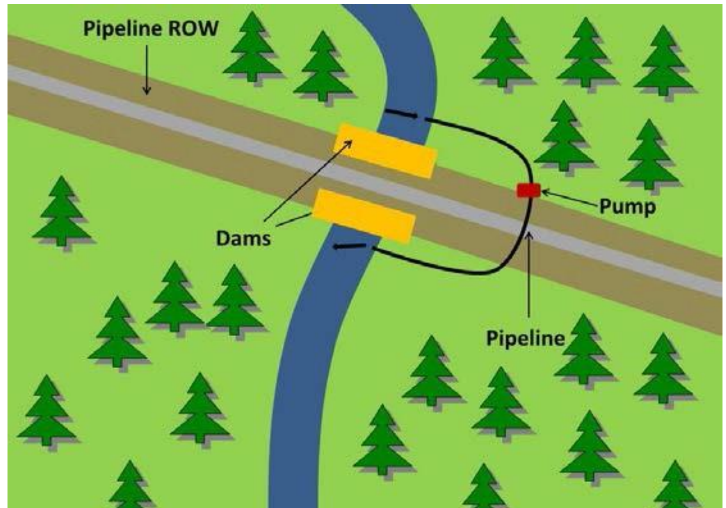


dam and flume pipe(s) will be removed returning the stream flow to the crossing site.

*Water flows through flume pipes to bypass in-stream construction area.*

*Dam and Pump*

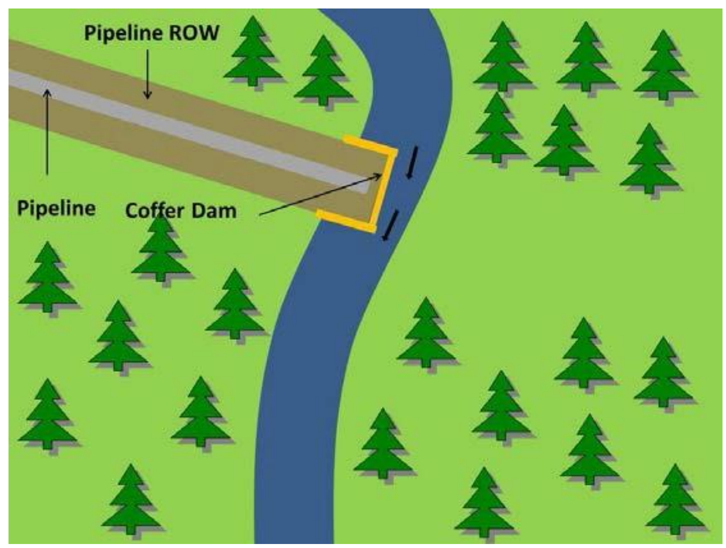
A dam and pump crossing entails constructing a dam in the work area and running hoses from the stream, upstream of the dam, around the pipeline right-of-way/crossing area and back into the stream below the dam. A pump is used to move water from the upstream section to the downstream section. A screen covers the pump intake to prevent aquatic organisms from being pulled through the pumping system. When the trench has been excavated, the pipe laid and the trench backfilled, the dam will be removed returning the stream flow to the crossing site.




*Water is pumped from above the temporary dam back into the stream below the dam.*

*Coffer Dam*

In a coffer dam crossing, only a portion of the stream channel width is dammed at any given time. This is used for crossings with high flows that preclude the use of flume or dam and pump crossings. Typically, coffer dam crossings are completed in two stages. The trench is dug in the dammed portion, the pipeline laid, the trench backfilled and the dam removed returning flow to the area. The next segment of stream will then be dammed and the process repeated.




*Only a portion of the stream is dammed.*

**Boring Techniques**

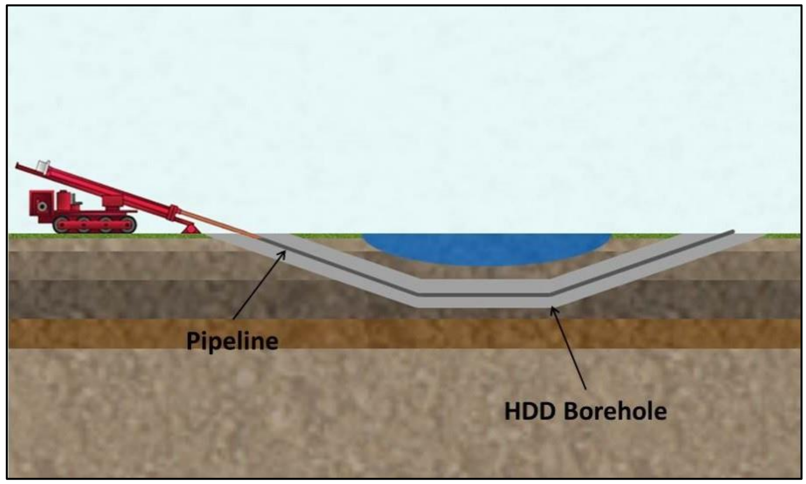
There are several boring techniques that may be used to cross streams and other waterbodies. These methods avoid disturbance of the stream bed by excavating underneath the stream channel.

*Conventional Bore*

For a conventional bore, two pits are constructed on either side of the waterbody; a bore pit and a receiving pit. These pits are excavated to the depth needed for the pipeline to pass under the stream channel. A boring machine is lowered into the bore pit and tunnels under the waterbody using a rotating auger. Once the borehole is excavated, the pipeline is pulled through from the bore pit to the receiving pit.

*Horizontal Directional Drilling (HDD)*

HDD involved drilling a smaller pilot hole, followed by a drill string, which is attached to a reaming device. The reaming device follows the pilot drill and enlarges the diameter of the borehole. While drilling the borehole, a slurry of bentonite clay and water, also known as drilling mud, is circulated to lubricate the drill bit, remove cuttings and to stabilize the borehole. Once the borehole is drilled to the appropriate diameter, pre-fabricated pipe is run through an entry point on one side of the stream to an exit point on the other.




*Direct Pipe*

Direct Pipe® is a process where the borehole is excavated and a prefabricated pipeline installed in a single step. It involves welding the pipeline to the rear of a microtunneling machine. A device called a pipe thruster is used to push the direct pipe machine, along with the pipeline, under the stream channel. The head of the microtunneling machine rotates, excavating and transporting material through the pipeline to the surface as the microtunneling machine and pipeline are thrust under the stream channel.

*Direct Push*

Direct push drilling creates a borehole by hammering, rather than rotating, the drill string under the stream channel. The direct push head is hammered through the ground under the stream channel and followed by the pre-fabricated pipe.

# Issues and Concerns

There are number of aspects of natural gas pipeline development that can affect streams, riparian areas and aquatic life, some of which are discussed below.

**Stream Crossings**

Natural gas transmission lines carry gas across long distances. Because of the rich and widely distributed stream resources across Central Appalachia, numerous high quality streams and rivers may be crossed during pipeline construction. The various methods of stream crossings have the potential to negatively affect stream biota and their habitat.

Open cut wet ditch stream crossings require in-stream trenching while water is flowing through the work area. This will mobilize sediments into the water column transporting them downstream which can negatively affect downstream biotic communities and their habitat. Trenching may also reduce the stability of the stream bed, if restoration of in-stream habitat at the stream crossing site is inadequate or practices are improperly installed. Sedimentation issues may have short-term and/or long-term effects on the biotic communities at the crossings site and downstream of the site.

Open cut dry ditch, flume, dam and pump and coffer dam stream crossings all have the potential to reduce the stability of the stream bed which can result in mobilization of sediments and transport downstream. Additionally, trenching will disturb in-stream habitat at the site in the short-term and may have long-term effects on in-stream habitat if restoration is not completed or effective.

HDD and other boring method crossings may result in bentonite blowouts. If the pressure within the borehole becomes too high for the surrounding geology to withstand, bentonite clay (or drilling mud) can erupt to the surface, discharging in the stream. Bentonite clay can clog fish gills and smother in-stream habitat.

Finally, if the pipe is not buried deep enough below the stream bed, it is possible that scour and high water events can cause pipeline damage, releasing natural gas into the streams, which at high concentrations can be fatal to fish and other aquatic organisms.

**Land Disturbance in the Watershed**

In some cases, pipeline routes may follow ridge lines or higher elevation areas where they do not cross stream channels. Even if the pipeline right-of-way does not cross a stream channel, any land disturbance upslope of a waterbody has the potential for water quality impacts. Land disturbances in upland areas can result in stream sedimentation issues during rain events, as water passing through the disturbed area will pick up sediment and may carry it to the stream channel if not managed properly. Deposition of sediments into the stream negatively affects the aquatic ecosystems by smothering habitat, interfering with feeding, reducing dissolved oxygen and clogging fish gills.

**Wetland Impacts**

Wetlands serve important hydrologic functions within many watersheds. Wetlands can trap sediments, remove other pollutants from water before reaching a stream and reduce peak flows during rain events. Wetland areas adjacent to streams will often be impacted by pipeline development construction. A loss of wetlands and wetland function within a watershed can increase sediment and nutrient loading as well as change the hydrologic characteristics of a stream. While volunteers will be monitoring primarily for stream-related impacts, it is important to understand the connection between adjacent wetlands and streams and how construction activities in or adjacent to wetlands may be impacting stream health.

**Vegetation Removal**

When clearing right-of-ways for pipeline installation, all trees and larger vegetation will be removed. Vegetation removal is of particular concern in heavily forested watersheds. Forests are integral in maintaining high water quality in headwater streams and providing shade cover for aquatic life that depend upon cold, clean water. The ground litter and forest cover that trees provide prevent rain from mobilizing sediments on the forest floor. Additionally, as water runs downslope, ground litter, tree roots and ground vegetation can trap sediments, stopping the downslope movement of these sediments. Deep tree roots also stabilize slopes, helping to prevent slope failure or landslides. Forests, especially those found in the riparian area, also serve to reduce other non-point source pollutions, including those from domestic, agricultural and industrial sources. Additionally, conversion from forests to cleared land can affect hydrologic functions in the watershed. This can result in increased peak stream flows intensifying the potential for erosion and local flood events.

**Access Roads, Staging Areas and Temporary Work Spaces**

There are areas of disturbance related to pipeline development in addition to the pipeline right-of-way itself. New roads may need to be constructed or existing roads improved in order to access remote pipeline construction areas. Access roads allow construction machinery, delivery trucks and other vehicles to access the pipeline construction site. Staging areas are where work equipment and pipeline materials are stored and where construction workers park. Staging area construction involves the removal of topsoil and laying a gravel pad. Gravel is removed and topsoil replaced after the staging area is no longer needed. Temporary work spaces are areas that are temporarily disturbed to allow for construction of the pipeline. They are located adjacent to the pipeline right-of-way and can range in size depending on topography and other factors. Access roads, staging areas and temporary work spaces all require soil disturbance and may cause conversion from forests to cleared areas. These types of infrastructure carry the same risks to water quality discussed in the *Land Disturbance* and *Vegetation Removal* sections.

**Types of Erosion and Sediment Management at Work Sites & Erosion Control Concerns**

Pipeline companies are tasked with minimizing erosion and sedimentation in areas of pipeline construction. Temporary erosion controls should be installed immediately after initial disturbance of soil and must be maintained throughout construction and re-installed as necessary. Once the trench is backfilled, permanent erosion control structure should be installed. The following are some examples of erosion controls. Pictures of each will be provided during the training presentations.

*Sediment Barriers*

Sediment barriers are designed to stop the flow of sediments beyond the perimeter of the construction area. Examples of sediment barriers include silt fences, hay or straw bales, compacted earth, sand bags and silt socks. Most sediment barriers are designed to either filter water as it leaves the work site or cause sediment to be deposited before water leaves the work site.

*Slope Breakers and Row Diversions*

Slope breakers or row diversions are designed to reduce the velocity of runoff and divert it off of the work area, and they are often installed where construction is occurring on slopes. They may be constructed of soil, silt fence, hay or straw bales, or sand bags.

*Trench Plugs and Trench Breakers*

Trench Plugs are designed to segment the excavated pipeline trench prior to backfilling of the trench. This serves to reduce runoff velocities and volume to minimize erosion within the trench. They are typically constructed of earth or sand filled sacks, or synthetic foam. Trench breakers are plugs that are left in the trench when it is backfilled. When a trench is backfilled, often the fill material is more porous than the surrounding soil, creating a pathway for water to flow sub-surface. This can cause dewatering of wetland areas and erosions downslope of the pipeline right-of-way. Trench breakers are designed to slow subsurface water flow along the trench.

*Mulch*

Mulch is applied on all slopes within the construction area to reduce wind and water erosion. Mulch may consist of straw, hay, wood fiber, erosion control fabric or other materials. Liquid mulch binders are used to anchor mulching materials.

*Revegetation*

After the trench is filled, the construction area should be re-seeded with permanent vegetation to stabilize the construction area. Stabilization matting may also be used.

**Erosion Control Concerns**

Even when erosions controls are installed there is the potential for a reduction or loss of function in preventing sediment from leaving the construction site. There are a few different causes for the reduction in function of erosion controls.

*Improper Installation*

There are best management practices developed by pipeline companies and state and federal agencies that dictate the methods for erosion control installation based upon factors such as local topography and the location of wetlands and waterbodies. For example, these methods may state that silt socks should be staked into the ground at particular intervals, or that temporary row diversions or slope breakers should be installed at specific intervals based upon the topography of the work areas. Improper installation of erosion controls can lead to a loss of function or complete failure to reduce erosion and sedimentation. There have also been cases where no erosion controls were installed during pipeline construction. Failure to install erosion controls will likely result in increased sedimentation and erosion issues.

*Lack of Maintenance*

If erosion controls are not maintained properly, they may fail or lose some or all of their function. Erosion controls should be inspected regularly and repaired quickly if damaged or ineffective. Examples of a lack of maintenance include: failure to replace a silt fence that has been damaged during a rain event; not maintaining fresh gravel on access roads or staging areas; and permitting silt socks to become buried by sediment, allowing runoff to flow over them.

*Failure*

At times, even if erosion control devices are installed using the proper methods and maintained correctly, they still fail. There is a higher likelihood of failure of erosion control devices in areas of steep terrain during storm events. Large volumes and velocities of runoff can breach silt fences or overtop silt socks, causing sediment to leave the construction area and enter nearby waterbodies.

**Restoration**

Construction of the pipeline could require earth disturbance of up to 100 feet on either side of the pipe centerline, for a total 200-foot wide corridor. After construction, the right-of-way will be narrowed with some of work areas that were used for construction activities being re-vegetated with trees and shrubs. A smaller permanent right-of-way on either side of the pipe centerline will be vegetated with grasses and will then be regularly mowed or treated with herbicide.

Pipeline right-of-way restoration typically consists of re-seeding permanent vegetation after backfilling of the trench. Stabilization mats may also be used in areas with a high likelihood of erosion. Also, as previously mentioned, permanent erosion controls such as row diversions or slope breakers may be used. Re-vegetation and restoration of the right-of-way carry many of the same potential risks from inadequate or failing erosion control practices that occur during construction. If seeding and permanent erosion control devices are not installed correctly or are not maintained properly, issues with erosion and sedimentation may occur and result in excessive turbidity in streams. Also, in areas of steep slopes and wet climates, re-vegetation may not prevent erosion and/or slope failure. Soil compaction poses another potential long term issue. The large equipment used in pipeline construction can compact soil in the right-of-way, decreasing its permeability and ability to infiltrate precipitation. This can result in an increase in stormwater runoff velocity and volume leading to erosion issues downslope from the pipeline right-of-way.

Restoration is also required at stream crossings. Riparian areas should be re-vegetated with native plants to a similar density of adjacent undisturbed lands. If not properly restored riparian areas may lose buffering function in protecting water quality. Stream banks should be returned to pre-construction contours to prevent erosion issues. The continued stability and habitat function of stream beds can be negatively impacted at pipeline stream crossings. When backfilling stream bed trenches in coldwater fisheries, clean gravel or native cobbles must be used in the upper one foot of the trench. If stream restoration is not completed successfully, channel materials may be mobilized causing long term effects on habitat both at the crossing site and downstream.

# Pipeline Monitoring Strategy

### Phases of Monitoring

Water quality monitoring will be divided into three phases: baseline monitoring prior to construction, and monitoring during construction and post-construction. The goals for each monitoring phase are detailed below.

> ***Baseline****:* Baseline monitoring is performed to establish the water quality, flow and geomorphological conditions within a stream in advance of pipeline development within the watershed. Data collected during baseline monitoring will be used as a reference point to identify potential pollution events during- and after- pipeline construction. Baseline data will also be used to evaluate any long-term changes that may occur within the stream as a result of pipeline construction. During baseline data collection, streamside measurements and sample collection will be completed by volunteer monitors.
>
> ***During Construction:*** Monitoring conducted during pipeline construction is performed to identify potential pollution events, notify appropriate authorities as needed, and ultimately stem further damage to the stream system. During pipeline construction, streamside measurements and sample collection will be completed, as well as visual reconnaissance of erosion and sedimentation control practices performance.
>
> ***Post-Construction*****:** Monitoring will continue after pipeline construction has commenced within the watershed. Post-construction monitoring is conducted to identify potential pollution events that may occur due to failure or lack of maintenance of permanent erosion control devices. Additionally, data collected post- construction will be used to evaluate any long-term changes that may occur within the stream.

### Selecting Monitoring Sites

Monitoring sites will be chosen based upon a variety of factors including, among others: the locations of wild and native trout populations and intact habitat according to TU's Conservation Success Index (CSI)*;* areas where pipelines are proposed to cross or parallel a stream channel; stream characteristics; access; and availability of volunteers.

Monitoring sites are chosen and prioritized by using TU's CSI scientific analysis to pinpoint ecologically-sensitive streams that may be at risk from major natural gas transmission pipeline construction. *See Appendix E for more information about TU's CSI analysis.*

A three-step process is used to identify sampling locations.

*First*, wild and native trout streams where pipelines are projected to cross the stream channel are identified by overlaying proposed major natural gas transmission pipeline routes with the CSI mapping/data layers. Additionally, wild and native trout streams where the projected pipeline right-of-way crosses the watershed but not the stream channel are identified, such as where a pipeline will parallel a stream.

*Next*, the point(s) of potential impact along the stream are identified. Any area where a stream channel is crossed by a proposed pipeline is considered a point of potential impact. There may be additional point(s) of potential impact where the pipeline passes through a watershed, but does not cross the stream channel itself. These flow pathways will be mapped to identify likely locations of drainage from the pipeline right-of-way to the stream. Locations along the stream where drainage from the pipeline right-of-way is likely to enter will be considered a point of potential impact.

*Finally*, monitoring sites will be established for critical watersheds that may be impacted by potential pipeline development. Downstream monitoring locations will be established as close as possible to the point of potential impact, but at least 25 yards below, to allow for any potential stream contaminants to fully mix throughout the stream. Stream access locations will be identified using maps and local knowledge. Monitoring sites will be established at the closest stream access location to the point of potential impact. Ideally, all sites will be within a half-mile of the point of potential impact, but sites may be located further downstream if there is no other closer option for access. Where possible, a site upstream of the point of potential impact will be established. This site will serve as a reference to be used in isolating the source of potential pollution events. Upstream sites will be established as close to the point of potential impact as possible. Establishing upstream locations may often be infeasible, as many streams will be crossed at their headwaters and access may be limited in those areas due to their remote location.

**Local Monitoring Site Prioritization**

Volunteers groups will work with TU's Eastern Shale Gas Monitoring Coordinator to utilize volunteer resources to maximum benefit locally and across the affected watersheds and water quality monitoring program as a whole.

Monitoring sites will be prioritized based upon a combination of factors including: the type of potential pipeline impact (i.e. stream channel crossing, clearing of forested watershed area, etc.); erosion potential within the watershed; the quality of trout populations and habitat; the value of the stream as a recreational resource and the potential for impact due to other land uses within the watershed. Site prioritization will also take into account the specific volunteer's location and areas of interest.

Though all of these factors will be taken into account, the following hierarchy will generally be used in prioritizing monitoring sites for baseline data collection. Level 1 will be considered the highest priority and Level 4 the lowest priority. This is a general prioritization plan and may be adjusted based upon local conditions and factors.

| Priority Level | Description |
|---|---|
| 1 | Downstream sites on wild and native trout streams where the proposed pipeline will cross the stream channel |
| 2 | Downstream sites on wild and native trout streams where the pipeline right-of-way passes through the watershed. |
| 3 | Upstream sites on wild and native trout streams where the proposed pipeline will cross the stream channel. |
| 4 | Upstream sites on wild and native trout stream where the pipeline right-of-way passes through the watershed. |

Though upstream sites are a lower priority for baseline sampling than downstream sites, they do provide useful information in characterizing potential pipeline impacts and should be monitored if an upstream site can be accessed and there is volunteer capacity to do so. Monitoring upstream sites allows for characterization of differences in water quality and flow as a result of pipeline construction and provides information that will help in pinpointing the source of a pollution event. Even if upstream sites are not monitored regularly, due to volunteer capacity, they should always be monitored if a pollution event is suspected.

**Site Documentation**

Site documentation is used to record site-specific information such as location, directions, access information, study reaches and bankfull width. Recording, documenting and making this information available to any volunteer that may monitor at a site ensures that all volunteers are monitoring in the correct location and that the correct study reach and bankfull widths are used for pebble counts. Information recorded during the site documentation process includes: GPS coordinates for the site, a description of the site location, travel and access directions as well as study reach and bankfull elevation for pebble counts. Photographs are taken of the site to provide more detail on site location, access, study reach and bankfull width. Where possible, site documentation will be completed by volunteer coordinators or program staff prior to initiating volunteer monitoring. In some cases, it may be necessary for volunteer monitors to perform site documentation themselves. Site documentation forms and instructions are provided in *Appendix D*.

**Monitoring Schedule**

The frequency that you will monitor will depend upon the monitoring phase you are in. Refer to the tables below for information on when to collect you streamside measurements, complete pebble counts and collect water samples.

| *Baseline Monitoring* | | |
|---|---|---|
| **Parameter** | **Monitoring Frequency** | **Other Instructions** |
| Turbidity | Monthly | None |
| pH | Monthly | None |
| Water Temperature | Monthly | None |
| Stage | Monthly | None |
| Conductivity | Monthly | None |
| Pebble Counts | Once before construction | Late Summer/Early Fall |
| QA/QC | Twice a year | Once during low flow in fall and once within 24 hours of a rain event in the spring. |

| *During Construction* | | |
|---|---|---|
| **Parameter** | **Monitoring Frequency** | **Other Instructions** |
| Turbidity | Weekly/after rain events | None |
| pH | Weekly/after rain events | None |
| Water Temperature | Weekly/after rain events | None |
| Stage | Weekly/after rain events | None |
| Conductivity | Weekly/after rain events | None |
| Visual Recon | Weekly/after rain events | None |
| Pebble Counts | None | None |
| QA/QC | After rain events and if pollution event suspected | Sample within 24 hours of a rain event if possible. If pollution event is suspected, take a sample and pictures and contact TU. |

| *Post-Construction for the first 6 months: This is general guidance. The need for higher frequency monitoring after construction will depend on site-specific conditions. Consult with TU staff on a post-construction monitoring plan. If re-vegetation is not taking, more frequent monitoring may be needed.* | | |
|---|---|---|
| **Parameter** | **Monitoring Frequency** | **Other Instructions** |
| Turbidity | Twice a month | None |
| pH | Twice a month | None |
| Water Temperature | Twice a month | None |
| Stage | Twice a month | None |
| Conductivity | Twice a month | None |
| Visual Recon | Twice a month | None |
| Pebble Counts | Once within 6 months of construction | None |
| QA/QC | Twice a year and if pollution event suspected | Once during low flow in fall and once within 24 hours of a rain event in the spring. |

| *Post-Construction AFTER 6 months: Or other period of time based upon site-specific conditions* | | |
|---|---|---|
| **Parameter** | **Monitoring Frequency** | **Other Instructions** |
| Turbidity | Monthly | None |
| pH | Monthly | None |
| Water Temperature | Monthly | None |
| Stage | Monthly | None |
| Conductivity | Monthly | None |
| Visual Recon | Monthly | None |
| Pebble Counts | Once a year | Late Summer/Early Fall |
| QA/QC | Twice a year and if pollution event suspected | Once during low flow in fall and once within 24 hours of a rain event in the spring. |

# Key Pipeline Water Quality Parameters and Habitat Measures

As a pipeline monitoring volunteer, you will take periodic measurements of certain water quality parameters. To provide some context for, and an understanding of, what we are measuring, we provide a brief discussion of key pipeline water quality parameters and habitat measures below.

**Turbidity**

Turbidity is a measure of water clarity – i.e. how much the material suspended or dissolved in the water decreases the passage of light through it. Turbidity is measured in Nephalometric Turbidity Units (NTU).

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 levels can increase water temperatures because suspended particles absorb heat. This in turn reduces the concentration of dissolved oxygen because warm water holds less dissolved oxygen than cold water. Higher turbidity levels can also reduce the amount of light penetrating the water, which reduces photosynthesis and the production of dissolved oxygen. 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. Additionally, high turbidity can negatively affect recreational experiences and can have impacts on human health.

The development of pipelines within a watershed has the potential to increase stream turbidity levels through two primary mechanisms.

1. Overland Flow – Along pipeline right-of-ways, which can range from 50 to 200 feet wide, native trees and vegetation are cleared. The removal of vegetation from the ground surface increases erosion and sedimentation potential of soils. Also, the disturbance of soil in the watershed increases the potential for erosion and sedimentation issues. The increase in erosion and sedimentation potential is compounded in steep terrain. If effective best management practices are not put into place, rainwater flowing overland towards a stream will pick up loose soils, ultimately increasing stream turbidity as the stormwater enters the stream.
2. Disturbance of Stream Channel – Several methods of pipeline stream crossings require trenching within the streambed to lay and bury pipe sections. This trenching disturbs and loosens substrate and soil below the stream bed which can mobilize these particles in the water column, increasing turbidity in the stream.

**Pebble Counts**

Pebble Counts are a method of characterizing the composition of the streambed. The composition or size of particles in the substrate influences many aspects of a stream, including channel form, erosion rates, sediment supply and in-stream aquatic habitat. Envision a steep fast flowing mountain stream with boulders, cobbles and pebbles strewn about the stream bottom. Now picture a slow moving valley stream with a stream bottom of small pebbles, sand and silt. Pebble counts are a method of numerically documenting the difference in stream bed composition of these two types of streams, and other types, by collecting data that characterizes the composition of stream bed materials. By tallying the size of materials in the streambed, we can graph the particle size distribution for that particular stream, and then compare that graph to later pebble counts looking for changes. Pebble counts may capture more subtle differences in stream bed composition that are not obvious to the naked eye. This is useful in characterizing changes in stream morphology, channel structure and long term-sediment related impacts that may occur as a result of pipeline-related development.

# Other Measures of Coldwater Stream Health

Pipeline monitoring volunteers will take other streamside measurements to characterize the overall health of the stream. While these parameters may not be directly affected by pipeline development, they may capture indirect pipeline-related impacts or pollution events unrelated to pipeline development. Additionally, by establishing baseline health, volunteers are protecting streams from different potential sources of future degradation.

**Conductivity**

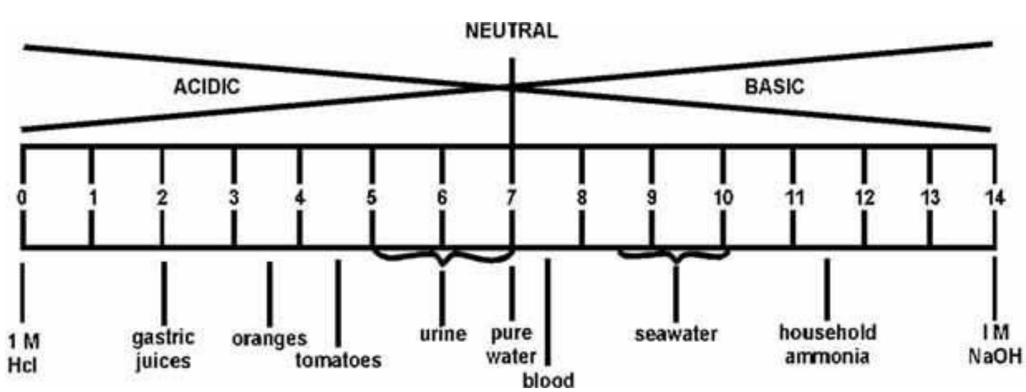
Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum 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. For this reason, conductivity is reported as microsiemens (µS/cm) at 25 degrees Celsius (25 C). The conductivity of rivers in the United States generally ranges from 10 to 1500 µS /cm, with mountain streams in West Virginia generally falling in the low end of that range.

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.

Conductivity is a “bulk” parameter which measures a variety of contaminants in water. In this way, it is a good tool to measure a variety of impacts to stream health. Mining, urbanization and a variety of industrial activities can lead to increased conductivity in streams.

**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 native eastern brook 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.

**Water Temperature**

The rates of biological and chemical processes in water depend on water 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, such as brook trout, 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). Brook trout generally prefer water temperatures that do not exceed 68 degrees F.

# Stream Water Quality Monitoring

### General Rules and Personal Safety Considerations

The following are a few general rules of conduct when performing stream monitoring and/or reconnaissance. Stream stewards should always adhere to these rules.

1. *Always be courteous* to landowners, pipeline workers and others you meet on the stream; avoid confrontation. If someone becomes confrontational, or if you are physically threatened, leave the scene and contact TU's eastern shale gas monitoring coordinator.
2. *Respect private property*; do not trespass on posted property. Seek permission before entering private property. For a landowner permission form, please see *Appendix C*. Please note that due to safety and liability reasons, you are prohibited from entering active pipeline construction sites without permission. Pipeline construction sites include the pipeline right-of-way, the temporary work space adjacent to the pipeline and equipment staging areas.
3. *If you suspect something unusual or concerning, your first call should be to TU's Eastern 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. *Do not touch, walk or wade in water or soils that may be contaminated without wearing protective clothing*. Hip boots or waders will prevent your clothing and skin from contacting contaminated materials. If you have walked or waded in contaminated water or soil, place your hip boots or waders in a plastic garbage bag. After returning home, wash them with mild detergent and rinse thoroughly before wearing them again.
5. *To avoid contacting contaminated material, always wear gloves when taking samples of materials that you suspect are contaminated.* Latex gloves are available from any drugstore for about $.50/pair.
6. *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.
7. *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.
8. *Use good judgment and abstain from drugs or alcohol while monitoring.* For your safety, please do not use drugs or alcohol while travelling to/from your monitoring site or completing your monitoring activities.

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.

**Monitoring Kit**

A limited number of monitoring kits will be provided to volunteers at each pipeline monitoring training. It may be necessary to share a kit with other volunteers, but additional kits can be purchased from Trout Unlimited. The monitoring kit contains the following materials:

*Basic Monitoring Kit Components*

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

*Pipeline Monitoring Kit Components*

- Gravelometer
- Samples Collection Bottles

***Note: If you have already been trained in TU's shale gas monitoring program and currently have access to a shale gas monitoring kit, then you will only be receiving the kit components related to pipeline monitoring.*

**Streamside Measurements**

*Measuring Turbidity*

Turbidity in streams, particularly headwater streams, is a very good indicator of stream health and erosion and sedimentation impacts. 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 120 cm secchi tube.

To begin, remove the secchi disk from the tube and rinse the tube to ensure removal of any residual materials. Approach your sample site walking upstream, and facing upstream, 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 tube to the zero centimeter mark. Your reading should be taken immediately so that sediment does not have time to settle at the bottom of the tube. If you notice sediment settling, it is a good idea to put your hand over the opening of the tube and shake it to re-suspend the sediment.

Your reading should be taken in open, but out of direct sunlight. You may have to turn your back to the sun to shade the sample. Take off your sunglasses before taking a secchi tube reading. 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.

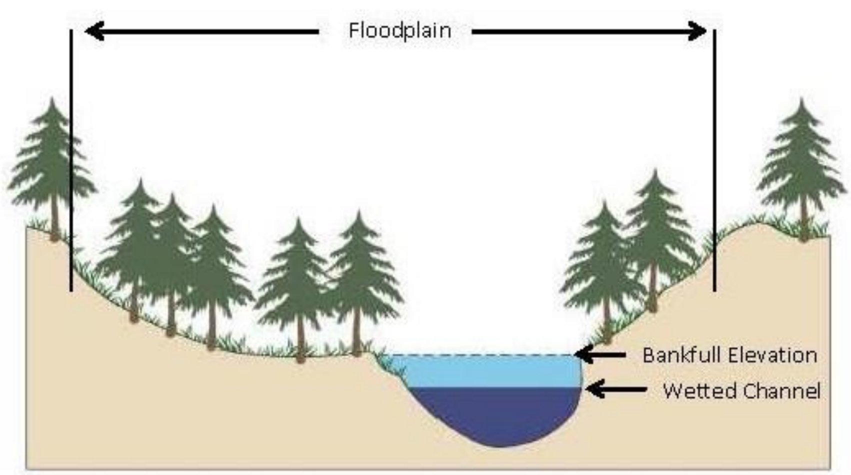
| Depth to Turbidity Conversion | | | | | |
|---|---|---|---|---|---|
| cm | to | NTU | cm | to | NTU |
| 6 | = | 240 | 39 | = | 16 |
| 7 | = | 200 | 41 | = | 15 |
| 9 | = | 150 | 43 | = | 14 |
| 12 | = | 100 | 46 | = | 13 |
| 18 | = | 50 | 48 | = | 12 |
| 19 | = | 45 | 51 | = | 11 |
| 20 | = | 40 | 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 |

*Completing Pebble Counts*

Pebble counts are a method of documenting stream bed composition by collecting a representative sample of bed material. The most efficient basic technique is called the Woman pebble count. This requires at least two people: a volunteer with a gravelometer to walk through the stream taking samples and measuring them, and a volunteer note taker who remains on the bank with a field notebook or survey data sheet, tallying the measurements by size class. Size classes are based upon ranges of particle sizes such as those shown in the chart below.

| Size Category | Size Range/Description |
|---|---|
| Silt/Clay | Very Small, Smooth Feel |
| Sand | Very Small, Grainy Feel |
| Fine Gravel | 2-16 mm |
| Coarse Gravel | 17-64 mm |
| Cobble | 65-256 mm |
| Boulder | 257-1025 mm |
| Bedrock | >1025 mm or large solid surface |
| Woody Debris | sticks, leaves etc. |

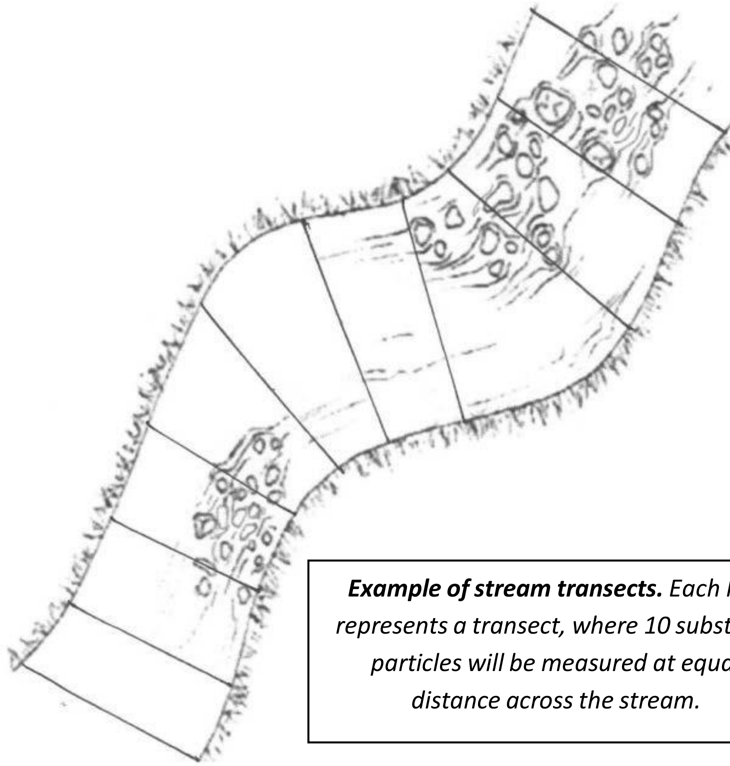
To complete a pebble count, you must first identify the stream reach where you monitor. Ideally, your stream reach will be 100 meters, though this may be reduced due to access issues. Then, you will identify the boundaries of the stream channel or the bankfull elevation at those riffle sections. This is not necessarily the present wetted stream channel. Rather, it is the point on the edge of the stream channel where any further rise in water would result in flooding.




There are three primary indicators of bankfull elevation: stream bank shape, vegetation and substrate particle size. Often the edge of the stream channel, or bankfull elevation, will be signified by a change from a steep bank to a gentler slope. Also, most perennial woody vegetation will not grow in the stream channel and the point near the stream where they are not present may signify the bankfull elevation.

Finally, smaller substrate particles will be deposited on the edge of the stream channel, so sand and silt may indicate the location of bankfull elevation. For a detailed description of how to identify the bankfull elevation of your stream, see *Appendix A*. Bankfull elevation and stream reach will be identified once during site documentation.

You will be taking measurements along ten equally-spaced transects in your sample reach. For example, if you have access to 100 meters of stream, you will take measurements at transects every ten meters. If you only have access to 30 meters of stream, you will take measurements at transects every three meters. Sample ten substrate particles at each transect. Please use the same transects every time you conduct pebble count.



***Example of stream transects.*** *Each line represents a transect, where 10 substrate particles will be measured at equal distance across the stream.*

After bankfull elevation and stream transects are identified, you are ready to begin your pebble count. Start the collection at the lower (downstream) end of the study reach at the bankfull elevation you identified. Not looking at where you are pointing, touch the stream bottom directly in front of the toe of your wader with your index finger and pick up the first particle you touch. It is important to avert your gaze as you will likely tend to bias your particle selection to larger particles if you are looking at your sample area. Measurements will be made in millimeters using a gravelometer. Simply, find the smallest hole on the gravelometer that the particle will pass through and call out the measurement corresponding with that hole. Measure embedded particles or those too large to be moved in place. For these, measure the smaller of the two exposed axes. For the example below, (B) would be the smaller of the two axes. Call out the measurement. The note taker will tally the measurements by size class and repeat back the information to the volunteer in-stream for confirmation.

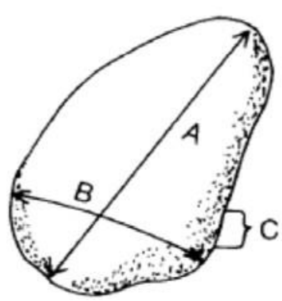



Diagram courtesy of West Virginia Department of Environmental Protection, [http://www.dep.wv.gov/WWE/getinvolved/sos/Pages/SOPpebble.aspx](http://www.dep.wv.gov/WWE/getinvolved/sos/Pages/SOPpebble.aspx)

Take one step across the channel in the direction of the opposite bank and repeat the process, continuing to pick-up particles until you have completed your 10 transects and measured 100 substrate particles. You will want to measure substrate particles in approximately equal distances along the transect (i.e. measure about every two feet if your stream is twenty feet wide). For small streams, you will want to step in a heel-to-toe fashion. For larger streams, a striding step between measurements may be necessary to cover the sampling area. The note taker keeps count of the number of samples measured. Continue your traverse until you reach the opposite bank so that all areas between the bankfull elevations are representatively sampled. You may have to duck under bank top vegetation or reach down through brush to get an accurate count. Move upstream at the predetermined distance and make additional transects to sample a total of at least 100 particles.

*Measuring Conductivity, Water Temperature and Air Temperature*

The pocket meter provided in your monitoring kit will measure temperature, conductivity, total dissolved solids and salinity. The salinity and total dissolved solids functions will not be used. You will receive detailed training on how to use the meter during the Pipeline Monitoring Program training. Here we will discuss general procedure and tips for field use.

It is recommended that you calibrate the meter at home, before heading to the stream, using the calibration beaker and solution provided in the monitoring kit. Experience has shown that the meter reading will drift with warming or cooling of the calibration solution. Conducting the calibration indoors at home eliminates this problem. It is a simple process and takes less than two minutes. You should calibrate before every sampling trip. Refer to the calibration training video on www.citSci.org resources tab for detailed instructions on how to calibrate your meter. 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 the 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 air temperature shown on the meter screen on the field data sheet.

You should measure conductivity near the center of the stream, at a location where there is some water movement but not a fast current. Experience has shown 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. Using the mode button, set the meter to measure "conductivity (µs)". Place the meter tip in the water so that the electrodes are submersed. Allow the conductivity reading to stabilize, then record the conductivity value on the field data sheet. This is a good time to record the water temperature as well. Water temperature is recorded in degrees Fahrenheit and is the number directly below your conductivity reading.

### *Measuring pH*

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, stage) 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.

### *Measuring Stream Flow*

Measuring stream flow is an important metric that can help us understand the fluctuations between stream flow and conductivity and changes in stream characteristics. If you are a volunteer in our shale gas monitoring program and already use discharge or cross-sectional area to measure flow, please continue using that measurement.

If you are a new volunteer, please measure stream stage as your surrogate for a flow measurement. There are two primary methods of measuring stage.

#### From a permanent structure

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, 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 return to each time you monitor. An example would be a guard rail post that is close to the center of the stream and either mark the post or record the location in your field notebook (i.e. 7$^{th}$ post from left, facing upstream) so you don't forget. Next, lower the tape until it touches the surface of the water. Choose a spot on the guard rail or post, such as the top of the guard rail, as your reference point and record the distance from that location to the surface of the water. You will measure stage from this reference point every time you monitor. Record your measurement in tenths of a foot. When measuring stage from a bridge your measurement will increase as stream flow decreases and the surface of the water drops. As your stage measurement increases, so should your conductivity readings.

#### In-stream

Stage can also be measured in the stream using a gage staff. Choose a location in the stream that is easy to identify and return to each time you monitor. This location must be covered by water, even during low flow conditions, but will be wadeable during most flow conditions. It is a good idea to find reference landmarks such as rocks or trees that will help you return to the exact same point each time you sample. Each time you monitor, take a depth measurement at this spot using your gage staff, and record your stage measurement in tenths of a foot. When measuring stage in the stream your measurement will increase as stream flow increases and the surface level rise. As your stage measurement increases, conductivity readings should decrease.

**Lab Analysis**

*Quality Assurance Quality Control*

Quality assurance/quality control (QA/QC) procedures are extremely important to the success of the TU Pipeline Monitoring Program. QA/QC procedures ensure data is being properly collected, handled, processed and maintained. In short, these 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.

*Taking Water Samples for QA/QC*

You will take water samples twice a year, according to the monitoring schedule at the end of this section and send them to the Alliance for Aquatic Resources Monitoring (ALLARM) at Dickinson College for QA/QC analysis. In addition, there may be times that you will be called upon to take a sample due to a suspected contamination event. 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 sample during a pollution event. Proper procedure for taking a water sample is as follows.

1. Put on latex gloves if you are sampling due to a suspected contamination event.
2. Label the bottle with your site name (i.e. MILLCR001), sample number (i.e. MILLCR001-1), collection date and your name.
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 is preferable to secure a sample from near the center of the stream, but conditions may dictate that the sample is taken from near the bank. If you enter the stream, try to disturb as little bottom sediment as possible. Approach your sample location walking upstream so that you do not 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 the water sample 8 to 12 inches beneath the surface, or mid-way between the surface and the bottom if the stream 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 twice this way before filling it.

7. Recap the bottle carefully, remembering not to touch the inside.
8. Record the site name, sample number, sample date, and time in your field notebook.
9. Fill out your QA/QC data form, found in Appendix G.
10. QA/QC samples should be shipped to ALLARM within 24 hours of collection from the stream.

ALLARM
Dickinson College
5 N Orange Street
Carlisle, PA 17013

*Reporting Your Data Online*

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

**Monitoring Checklist**

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 to confirm that you are at the correct location identified on the site documentation form.
2. Note weather conditions.
3. Note stream flow and water conditions.
4. Take a 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 turbidity measurement.
10. Take stage measurement.
11. Take water samples for QA/QC (if collecting, see Monitoring Schedule).
12. Record pH.
13. Perform visual reconnaissance.
14. Take photographs.
15. Complete pebble count (if collecting, see Monitoring Schedule; if conducting first pebble count establish bankfull elevations).

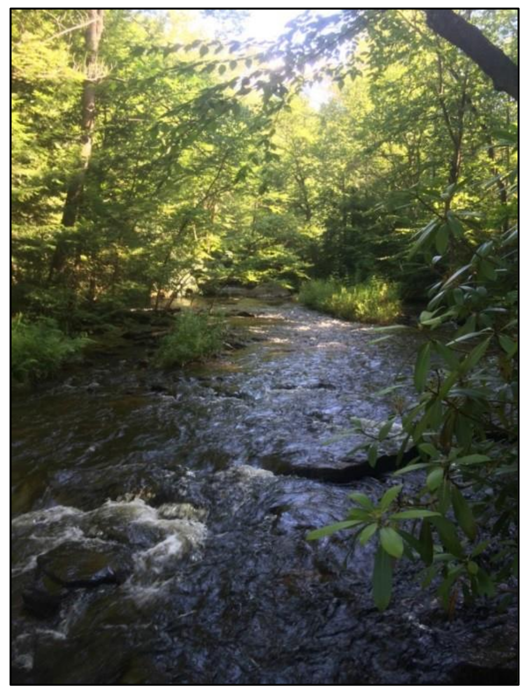
# Visual Reconnaissance

**Importance of Visual Reconnaissance**

In addition to water quality monitoring, pipeline monitoring volunteers will conduct visual observations of streams, riparian areas and areas of earth disturbances for 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 pipeline development activities). Visual reconnaissance has proven to be the most effective way for volunteers to identify pollution events caused by shale-gas related activities and is an integral part of the pipeline monitoring program.
It also provides volunteers with the tools to identify potential issues before they cause harm to streams.

**Conducting Visual Reconnaissance**

During the pipeline monitoring training, you will receive detailed instructions on what to look for during visual reconnaissance, when to conduct reconnaissance and what to do with the information you have collected. When conducting visual reconnaissance you should adhere to the same general rules discussed in the *Stream Water Quality Monitoring* section on page 20. In addition to the visual reconnaissance checklist in *Appendix F*, you should be sure to have a camera and GPS (if you have one) when performing visual observations. Using a smartphone to take pictures is ideal, as GPS coordinates of the location where the photo was taken will be embedded in the photo file. Please make sure that the date/time stamp on your camera is accurate. This is very important should your photographs be used in an investigation at a later time.



You will first take a photo of the stream at your sample location each time you monitor, and upload it to www.citsci.org along with your data. An example of a good stream picture is on the right. These pictures can be used to identify and characterize changes in stream characteristics.

Using your checklist, look for indications of potential pollution in the stream, at the pipeline work site and at access roads and staging areas (if applicable). If an option detailed on the checklist is observed, check the observed box and take a photo of what you see. Depending on what you are observing you may want to take multiple pictures. It is good to have a close- up picture of the specific problem you observed as well as zoomed out picture that shows adjacent  areas and gives broader context to the observation. If you are using a digital camera and also have access to a GPS device, take the GPS coordinates. Record the required info and write a detailed description of what you observed on the incident report form, including the number/name of the photograph that was taken (i.e. Photograph 4 – silt socks buried in sediment allowing sediment laden runoff to pass over them near Laurel Creek pipeline crossing). If you observe a pollution incident, it is important that you investigate further, both upstream and downstream. If you observe discolored water and/or high turbidity readings, it may be due to erosion issues due to pipeline construction or could be due to other causes, natural or man-made. Moving upstream of the stream crossing or potential point of impact to the next access area and finding normal water clarity indicates that the source lies somewhere between the two measurements, further pinpointing where sediment is entering the stream. Once investigation is complete, contact TU's Eastern Angler Science Coordinator to report your observation.

Some examples of observations that may indicate pollution near pipeline work sites are given below. More detailed guidance is provided in the checklist in *Appendix F*.

**What To Look For**

***In the Stream***

When performing visual reconnaissance in streams you will primarily be looking for indications of erosion and sedimentation issues such as the following.

*Sediment plume in the stream*

*Increased Sediment Deposition on Stream Bed*

Photo courtesy of *Jake Lemon*

*Increased Bank Erosion*

Photo courtesy *of Jake Lemon*

*Stream Water Discolored*

Photo courtesy of *Rick Webb*

Other examples for what to look for in the stream include (also provide in checklist in *Appendix F)*:

- *Oily film on water surface*
- *Dead fish in the water or on stream bank*
- *Other visual evidence of sediment entering the stream*

***In the pipeline right of way, work site, access roads and staging areas***

When performing visual reconnaissance near a pipeline work site you will primarily be looking for lack of erosion controls or failed erosion controls as well as indications of sediment moving off the construction site.

*Earth disturbance to edge of water body with no erosion controls*

Photo courtesy of *Autumn Environmental*

*Failed Silt Fence*

Photo courtesy of *Autumn Environmental*

*Buried and overtopped silt sock*

Photo courtesy of *Jake Lemon*

*Tear in silt fence fabric*

Photo courtesy of *Autumn Environmental*

*Bentonite Blowout*

*Photo credit: Mountain Watershed Association*

*Improper installation of erosion controls*

Photo courtesy of the *Pennsylvania Council of Trout Unlimited*

*Erosion gullies on access road*

Photo courtesy of the *Pennsylvania Council of Trout Unlimited*

*Muddy Access Road*

Photo courtesy of the *Pennsylvania Council of Trout Unlimited*

*Water Bypassing Erosion Control*

Photo courtesy of *Autumn Environmental*

*Equipment in Stream*


Photo credit: *notennesseepipeline.org*

Other examples for what to look for at the right of way, work site, access roads and staging areas include (also provide in checklist in *Appendix F)*:

- *Signs of sediment discharge outside construction area (sediment stained leaves/vegetation)*
- *Topsoil piles are not stabilized*
- *Row diversions not installed (if right of way on a slope and withing 50 feet of a waterbody)*
- *Erosion gullies in right-of-way*
- *Trench plugs not installed in trench on slopes leading to stream crossing*
- *No mulching on slopes. Just bare soil.*
- *Mulching lost due to wind or water erosion*
- *Mud tracked on main road from right-of-way*
- *Lack of gravel on access roads*
- *Sediment laden runoff running into access road ditches to stream without filtration (silt fence, silt sock, etc.)*
- *Final grading, topsoil replacement and installation of permanent erosion control structures not completed within 20 days of backfilling trench (10 days in residential areas)*
- *Seeding of disturbed soils not completed within one week of final grading*
- *Construction debris not removed after re-vegetation is complete*
- *After first growing season, vegetation is not comparable in density and cover to adjacent undisturbed lands*

# Whom to Contact…And When

**When to Report**

It is important that potential pollution issues are reported in a timely manner and to the right people. If any of the following events occur, please report the event to the appropriate contacts identified at the end of this section.

- You observed something listed in the Visual Reconnaissance checklist.
- You measured a high turbidity reading for your site when there has been no recent precipitation event.
- Your measured turbidity reading downstream of the pipeline crossing or potential point of impact is higher than a turbidity reading taken upstream.
- Your measured turbidity reading after a precipitation event is higher than baseline readings taken after a precipitation event.
- Your conductivity reading taken downstream of the pipeline crossing or potential point of impact is 2 times higher than the conductivity reading taken upstream.
- Your conductivity reading is 2 times that of a previous conductivity reading taken at a similar flow.
- You observe or measure anything that, in your opinion, may indicate a pollution event.

**How to Report**

If high turbidity or conductivity readings are measured at your site you should:

- Take measurements upstream of the pipeline crossing or point of potential impact if possible.
- Take a water samples both upstream and downstream and send it to ALLARM.

If you observe a sedimentation event in the stream you should:

- Investigate upstream to attempt to find the source
- Take the GPS coordinates of the location where the issue was observed
- Take pictures of what you observed
- Take a water sample and send it to ALLARM

If you observe an issue with erosion controls or sediment management that isn't yet affecting the stream you should:

- Take GPS coordinates of the location where the issue was observed
- Take pictures of what you observed

**Whom to Contact**

It is important that reports are made through the West Virginia Pipeline 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 **pipelinereport@wvrivers.org** with the subject: PIPELINE 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 the contacts listed below, following the order listed, to confirm that your email was received.

1. Jake Lemon: Eastern Shale Gas Monitoring Coordinator; Trout Unlimited
   Email: jlemon@tu.org (primary contact)
   Phone: 814-779-3965

2. Autumn Crowe: Program Director; West Virginia Rivers Coalition
   Email: acrowe@wvrivers.org
   Phone: 304-992-6070

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

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)

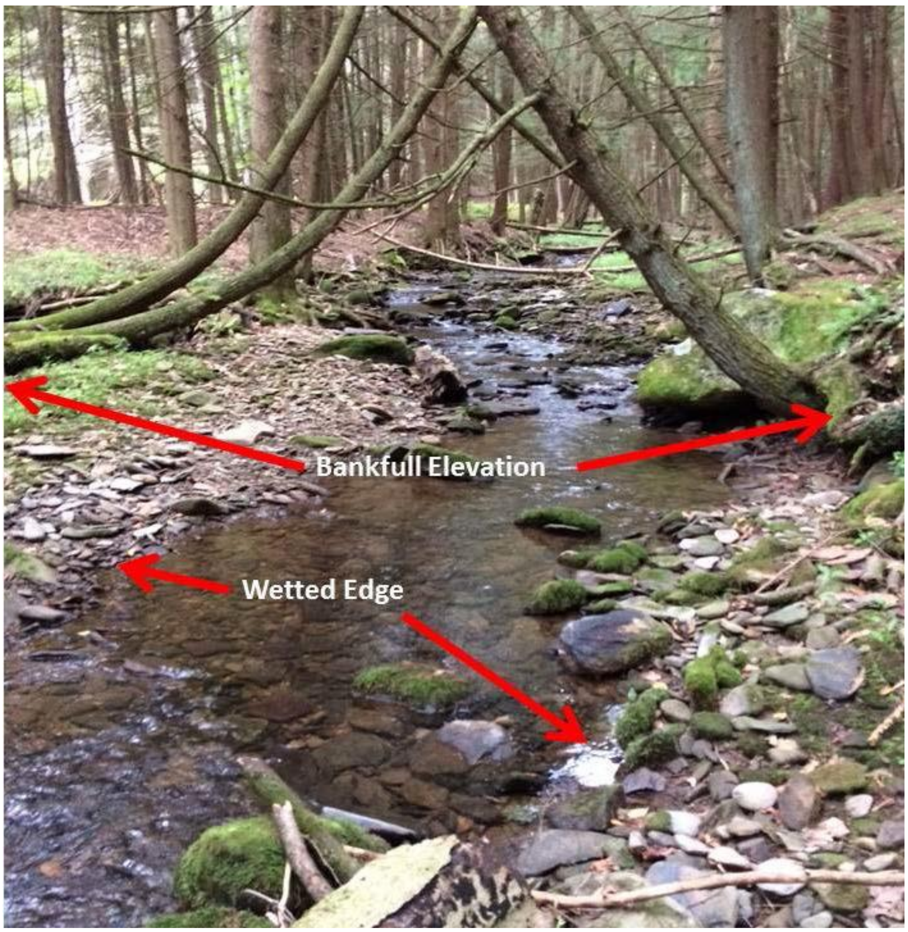
# APPENDIX A

## IDENTIFYING BANKFULL ELEVATION

TROUT UNLIMITED

**What is Bankfull Elevation and Why is it Important?**

Bankfull elevation is the point on a river bank where any further rise in stream flow would result in water leaving the channel and spilling into the floodplain. Essentially, it represents the edge of the stream channel. There may or may not be water flowing in the entire stream channel at a given time. Conversely, the stream wetted edge signifies the edge of flowing water in the stream at a particular time. The benefit of knowing bankfull elevation in conducting pebble counts is that you are able to identify a consistent sample area that encompasses the entire stream channel. The wetted channel can fluctuate on a day-to-day basis, but the bankfull channel remains fairly stable.



**Tips for Idenifying Bankfull Elevation**

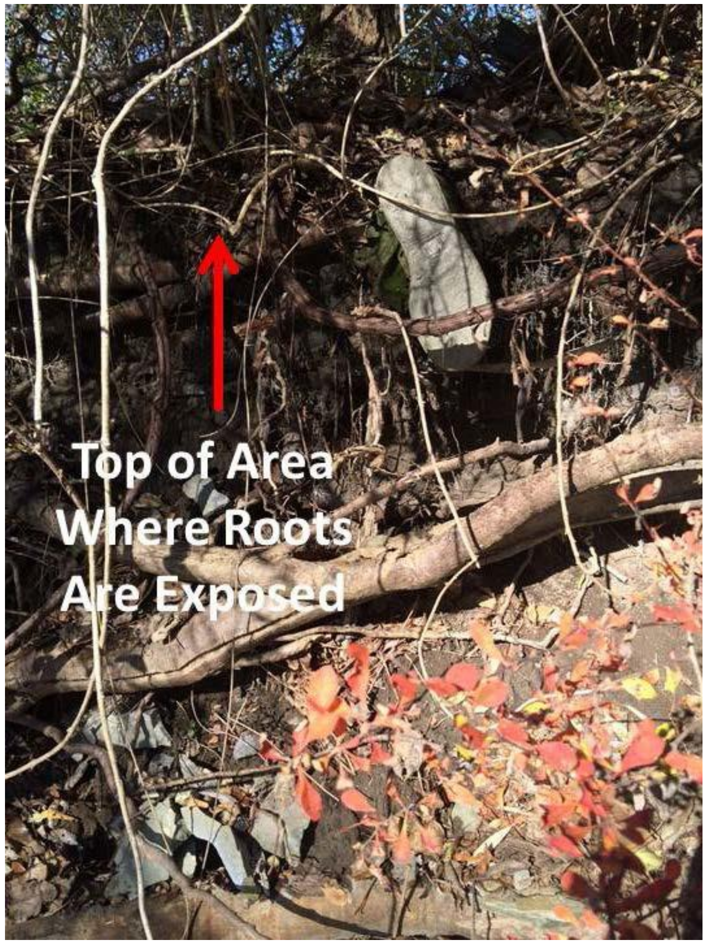
Bankfull elevation, though useful, can be tricky to determine. That said, by using some basic indicators you can approximate bankfull elevation. These indicators observed by themselves may not show the bankfull elevation. Rather, you should look at all indicators collectively and decide which best shows the edge of the stream channel. This process is somewhat subjective but use your personal judgment identify the area that sees water flow on a fairly regular basis.

1. Look for an abrupt change in the slope of the bank. If the stream bank goes from a steep slope and flattens to a more gentle slope, this can indicate the bankfull elevation.


2. Look for the lowest extent of woody vegetation. The presence of living trees in an area suggests that it is not often inundated with water.


*The lower extent of woody vegetation is an indicator of bankfull elevation. Annual grasses, such as those between the black line and stream, are not.*

3. Look for the top of the zone of exposed roots.




4. Look for a change in the size of substrate (from coarse material to fine material).

5. The first flat surface **above** stream point bars. Point bars are an accumulation of cobbles, gravels, sands and silts deposited on the inside edge of a stream bend/meander.


Further information on how to identify bankfull stage can be found at the following sites:

http://www.maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/stream-survey-manual/survmanv2_mainbody.pdf

http://www.vtwaterquality.org/rivers/docs/assessmenthandbooks/rv_apxkidbankfullstage.pdf

# APPENDIX B

## MAKE YOUR DATA COUNT: HOW TO USE TU'S ONLINE DATABASE

TROUT UNLIMITED

# 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.*

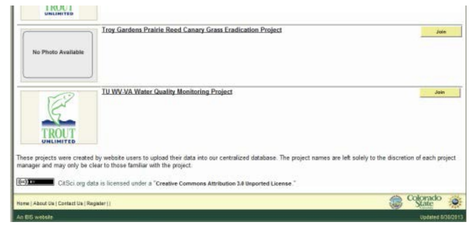

For a video on how to register and use Citsci.org, please follow this link

[www.youtube.com/watch?v=asPzO9MtF_s](www.youtube.com/watch?v=asPzO9MtF_s)

or go to [www.youtube.com](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.

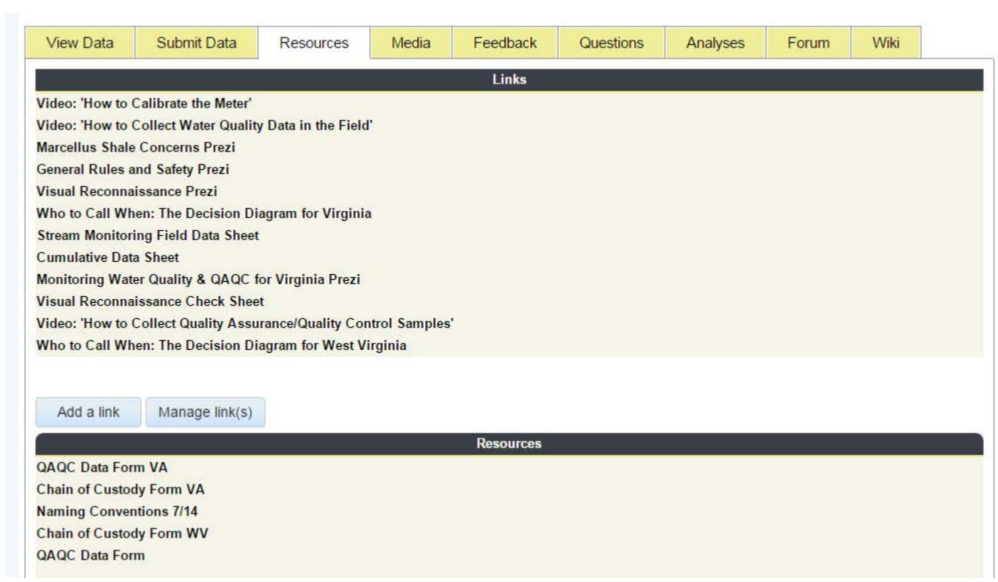
## Accessing Educational Materials

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!*

# Make Your Data Count

## 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.

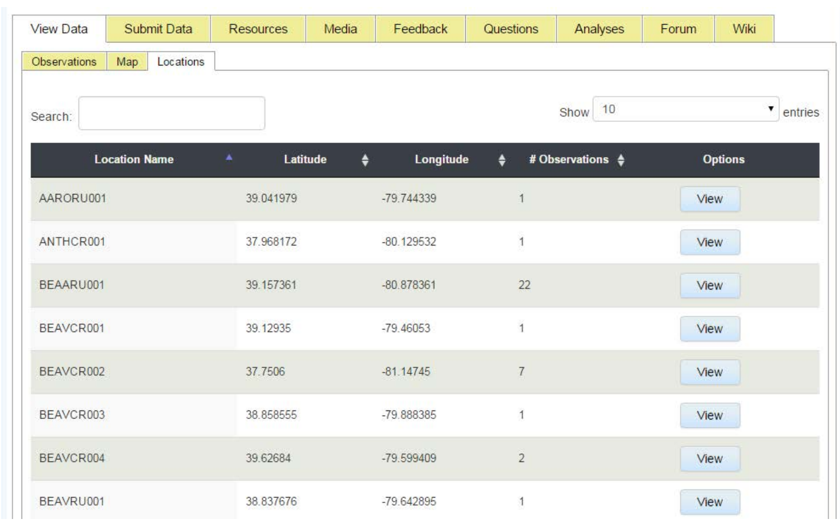
**Site Characteristics:**

- 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.




| 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 C

PROPERTY ACCESS PERMISSION FORM

# LANDOWNER ACCESS AUTHORIZATION

Trout Unlimited (TU) and the West Virginia Rivers Coalition (WVRC) has developed a stream surveillance program, called the *WV/VA Pipeline Monitoring Program.* This program is designed to help TU and WVRC volunteers collect baseline water quality data on West Virginia and Virginia's coldwater streams and to monitor the potential impacts of natural gas pipeline development. While TU and WVRC 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, volunteers 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 ______________________________
(Volunteer name)

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

Please submit this form via email to:
Jake Lemon
Eastern Angler Science Coordinator
jlemon@tu.org

# APPENDIX D

# SITE DOCUMENTATION

TROUT
UNLIMITED

**Site Documentation Instructions**

1. Enter stream name and date of documentation on the Site Documentation Form.

2. Identify access to stream. If access is on private property, please contact the property owner to ask if you can access the stream to conduct water quality monitoring from their land. If they approve, please have them fill out the landowner permission form. Send this form to Jake Lemon at jlemon@tu.org. If stream is located on public land, no permission form is needed but it will be important for TU's eastern shale gas monitoring coordinator to know your latitude/longitude coordinates.

3. Describe how to find and access the stream in the "Travel/Access Directions" box. Also take photographs of the access. For example: *Drive west on state highway 38, after 8.5 miles turn right onto Mill Run Road. Park at first bridge over Mill Run. Best access is on right side of the bridge facing upstream. See picture 1 and 2 for reference.*

4. Take GPS coordinates of the sampling location in decimal degrees and record these coordinates on your Site Documentation Form.

5. Provide any relevant information on the stream, referring to the appropriate pictures, in the "Station Description and Comments" box. This can include sample site suggestions, directions from landowners, observations on flow and safety, etc. For example: *There is a deep pool directly upstream of the bridge. It is necessary to walk upstream about 10 meters to locate riffles that would work well for sampling. Stream was dry at time of site documentation suggesting that flow in this section of stream is seasonal. See picture 3 and 4 for reference.*

6. Provide a description and photos of the location of the bankfull elevation. For example: *Facing upstream, bankfull elevation on the left side of the stream is indicated by a line of woody vegetation shown in picture 5. On the right side of the stream, bankfull elevation is indicated by an abrupt change in slope of the bank shown in picture 6.*

7. Provide a description and photos of the study reach. For example: *Due to lack of access to private property, the study reach runs from the bridge upstream 30 meters. The upstream and downstream boundary of the study reach are show in picture 7 and 8.*

**Pipeline Monitoring Sampling Site Documentation**

| **Stream Name:** | **Date:** |
|---|---|
| **Coordinates** | |
| Decimal Degrees Latitude | Decimal Degrees Longitude |
| **Estimated Coordinate Accuracy (if available):**_______________ ☐ feet ☐ meters | |
| **Travel/Access Directions:** | |
| **Station Description and Comments:** | |
| **Bankfull Elevation Description:** | |
| **Study Reach Description** | |

| |
|---|
| **Site Documentation by:** |
| **Station Pictures** (provide filename, date, description) |
| |
| |
| |
| |
| |
| |
| |

# APPENDIX E

# TROUT UNLIMITED CONSERVATION SUCCESS INDEX

# Trout Unlimited's Conservation Success Index: Pipeline Monitoring Strategy

Trout Unlimited's Conservation Success Index (CSI) is a compilation and assessment of information related to 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 summarized the data by watershed. These watershed-scale summaries are interpreted within an analytical framework and assigned a categorical score, allowing for the investigation and comparison of conditions and threats within and across watersheds.

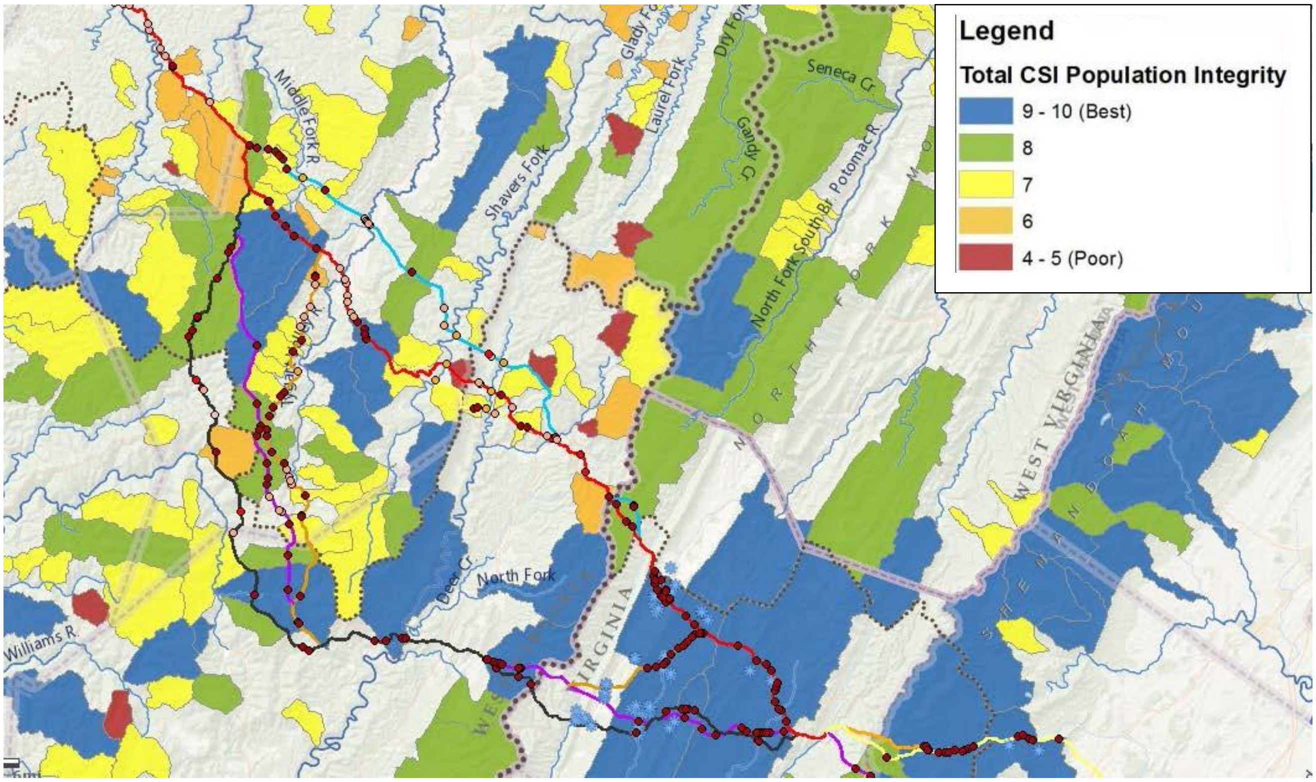
The analysis builds upon the CSI for Eastern Brook Trout, completed in 2007, and the Pennsylvania-specific trout habitat CSI developed in 2010. The Central Appalachian CSI uses the best available data, including brook trout habitat patch data developed by the Eastern Brook Trout Joint Venture (EBTJV), to characterize the condition of trout populations, their habitats and threats they may face in the future across PA, WV, VA and MD.

The CSI includes two indicators within the Population Integrity group – population status and patch size. Both indicators are comprised of single factors. The population status indicator reflects the EBTJV population designation for the habitat patch. Highest scores are assigned to populations with brook trout as the only trout species present (allopatric populations). Moderately high scores are assigned to brook trout populations that co-occur with natural reproducing rainbow trout (sympatric populations). Sympatric populations of brook and brown trout receive moderate scores due to their competition. Subwatersheds with naturally reproducing rainbow and/or brown trout, but no brook trout, receive moderately low scores, while stocked only patches or unknown status receive low scores. Subwatersheds without trout are treated as unoccupied or unassessed patches and are not scored.

Habitat patch size is scored based on total acreage and only scored for habitat patches with brook trout present. Largest patches receive highest scores due to the increased resiliency and likelihood of persistence afforded by habitat diversity and connectivity within large patches, while lowest scores are assigned to small patches that are not likely to persist through disturbances and genetic bottlenecks.

Proposed major natural gas pipeline routes are overlaid with Eastern Brook Trout population integrity and habitat integrity patch data to identify coldwater streams that may be impacted by pipeline development.

Example of mapping strategy using proposed Atlantic Coast Pipeline routes.




*Lines show proposed pipeline routes and alternate routes for the proposed Atlantic Coast Pipeline. These routes are based upon the best available information as of January 2016. Red dots represent stream crossings in EBTJV wild and native trout patches.*

# APPENDIX F

## VISUAL RECONNAISSANCE CHECKLIST

TROUT UNLIMITED

# Pipeline Visual Assessment Checklist

| In the Stream | | | | |
|---|---|---|---|---|
| **Description** | **Observed (✓)** | **Photo(s) Taken (✓)** | **GPS Coordinates Recorded (✓)** | **Incident Report Completed (✓)** |
| Sediment plume | | | | |
| Stream water discolored | | | | |
| Increased sediment deposition on the stream bottom | | | | |
| Dead fish or other organisms | | | | |
| Increased bank erosion | | | | |
| Oily film on water surface | | | | |
| Bentonite Blowout | | | | |

| Stream Crossings | | | | |
|---|---|---|---|---|
| **Description** | **Observed (✓)** | **Photo(s) Taken (✓)** | **GPS Coordinates Recorded (✓)** | **Incident Report Completed (✓)** |
| Streamflow not diverted away from disturbed ground | | | | |
| Downstream of crossing is muddier than upstream | | | | |

| Pipeline Work Site | | | | |
|---|---|---|---|---|
| **Description** | **Observed (✓)** | **Photo(s) Taken (✓)** | **GPS Coordinates Recorded (✓)** | **Incident Report Completed (✓)** |
| Earth disturbance to edge of water body with no erosion controls | | | | |
| Erosion gullies | | | | |
| Bare Soil: No mulch | | | | |
| No trench plugs on slopes leading to stream crossing | | | | |
| Failing Slopes | | | | |
| Failed BMPs (erosion controls) | | | | |
| Signs of sediment discharge outside of construction area | | | | |

| Access Roads | | | | |
|---|---|---|---|---|
| **Description** | **Observed (✓)** | **Photo(s) Taken (✓)** | **GPS Coordinates Recorded (✓)** | **Incident Report Completed (✓)** |
| Lack of gravel | | | | |
| Mud or sediment on main road | | | | |
| Erosion gullies | | | | |

| Hydrostatic Discharges | | | | |
|---|---|---|---|---|
| **Description** | **Observed (✓)** | **Photo(s) Taken (✓)** | **GPS Coordinates Recorded (✓)** | **Incident Report Completed (✓)** |
| Erosion Gullies | | | | |
| Oily sheen, discoloration or chemical odor | | | | |
| Sediment flowing into stream | | | | |

| Restoration | | | | |
|---|---|---|---|---|
| **Description** | **Observed (✓)** | **Photo(s) Taken (✓)** | **GPS Coordinates Recorded (✓)** | **Incident Report Completed (✓)** |
| Vegetation in right-of-way is not taking | | | | |
| Failing Slopes | | | | |
| Erosion Gullies | | | | |
| Stream banks are undercut and eroding | | | | |
| Stream substrate material differs from upstream and downstream reaches | | | | |

# Incident Report Form

---

**Name:** ________________________ **Date:**___________ **Time:**_____________

**Stream Name:**_____________________ **Pipeline Project:**________________

**County:**________________________ **State:**__________________

**Construction Status**

☐ Pre-construction ☐ Active Construction ☐ Post-Construction

**Latitude:**________________________ **Longitude:**_______________________

**Issue Description:**

**Photo Descriptions**

**Photo 1:**

**Photo 2:**

**Photo 3:**

**Photo 4:**

**Photo 5:**

**Photo 6:**

**Photo 7:**

# APPENDIX G

## WATER QUALITY MONITORING FORMS

TROUT UNLIMITED

## PIPELINE MONITORING FIELD DATA SHEET

**MONITOR:** ________________________________ **DATE:**_______________**TIME:** ______________

**STREAM NAME:** ____________________________________________________________________

**NAMING CONVENTION:**_______________________________________________

(Circle one for each category)

**WEATHER:** Clear Cloudy Partly Cloudy Fog/Haze

**PRECIPITATION:** 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**

**STAGE:**__________**FEET**

**CROSS SECTIONAL AREA:**__________**FEET**

***You will collect either stage or cross-sectional area, not both.***

**Comments:**

**PEBBLE COUNT DATA SHEET**

**Site Name:** **Date:**

**Monitor Names:** **Study Reach Length (meters):**

| Size Categories | Size Ranges (mm) or Description | Tallies (counts) |
|---|---|---|
| Silt/Clay | very small, smooth feel | |
| Sandy | very small, grainy feel | |
| Very Fine Gravel | 2-4 | |
| Fine Gravel | 5-8 | |
| Medium Gravel | 9-16 | |
| Coarse Gravel | 17-32 | |
| Very Coarse Gravel | 33-64 | |
| Small Cobble | 65-90 | |
| Medium Cobble | 91-128 | |
| Large Cobble | 129-180 | |
| Very Large Cobble | 181-255 | |
| Small Boulder | 256-512 | |
| Medium Boulder | 513-1024 | |
| Large Boulder | 1025-2048 | |
| Very Large Boulder | >2048 | |
| Bedrock | Large Unbroken Rock Surface | |
| Woody Debris | Leaves, sticks etc. | |

***Study reach should be at least 30 meters if possible. 100 meters is ideal. Upon completion you should have 100 tallies.***

# 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