



## **Citizen Science Pipeline Watch Protocols for Communities Concerned About Proposed Fracked Gas Pipelines**



**Documenting, Mapping, & Protecting Natural Communities That Could Be Lost**

**February, 2016**

## **Purpose of Natural Assessment Pipeline Watch and Community Watch-Dogging**

High pressure intrastate pipeline routes (Rights of Way) are extensive in nature and often cut hundreds of miles in a linear fashion which means direct impact to multiple habitats and waterbodies along these linear paths. Pipeline routes are often sited in rural and remote areas to avoid housing developments and human populations and cut costs and safety requirements, but this practice can mean more potential damage and cuts to high quality native and natural contiguous habitats, mature forests, and high quality streams where threatened and endangered and vulnerable species may call home. Sometimes these pipeline companies also propose to cut through preserved county, state, or local parks and preserved lands – again causing impacts to already small “island” natural refuges that have been preserved either by the taxpayers or limited private and community funds.

Pipeline companies are required by the agencies and specific environmental laws to document, report, and map a variety of habitats and resources along a proposed pipeline route as part of the multiple permitting processes that the state and federal agencies require. Some of this information is part of the Environmental Assessment or Environmental Impact Statements that may be required of the pipeline operator. However, much of this mapping may be done from a desk or computer, based on out of date information or older natural inventories that need updating, or with limited field surveys that are conducted by the pipeline operator who is applying for the permits to document conditions. Often, agencies who are in charge of reviewing this information submitted by the pipeline company are limited in staff time and facing budget cuts which means that there can be limited field verification or double-checking conducted by agency staff.

Past pipeline community monitoring conducted by Delaware Riverkeeper Network (DRN) has documented many cases where required resource reports, wetlands delineation reports, and pipeline maps are missing important information about the natural resources along the pipeline route that could be impacted. To help fill gaps and ground-truth, DRN has developed volunteer monitoring protocols for landowners and the community to help assess and ensure natural features along the proposed pipeline path are thoroughly and accurately mapped so the full scope of the damage and impacts to natural resources these pipelines could inflict is understood and documented before pipeline applications and permit actions are considered, approved, or denied by regulatory agencies. DRN also has a Pipeline watch module for pipeline construction monitoring and watch-dogging if a pipeline company is permitted to build its pipeline. That module is designed to alert regulatory agencies and the community to harm such as erosion control violations, lack of best management practices, and company short cuts that are causing or will cause pollution during pipeline construction.

With a multi-faceted citizen science and volunteer monitoring program that began in 1992, DRN believes that the local community is most knowledgeable about the environment and habitats where they live, work, and recreate. By training concerned volunteers in effective citizen science protocols, we have better protected the Delaware River Watershed from the harms that it faces using sound citizen science. The protocols in this guide are designed more in mind for large intrastate gas pipelines that are regulated by FERC, but similar protocols could potentially be used to monitor smaller gathering lines in the shale drilling regions with some modifications. This guide is provided in addition to a six- hour training for all volunteer monitors who become part of DRN's pipeline watch team.

**Your Safety Comes First! Follow these tips to ensure that you stay safe when monitoring:**

1. Work with a partner - NEVER work alone! A companion provides added security *and* is invaluable should an accident occur. Plus, it's more fun working in teams and working through the datasheets together- two heads are better than one.
2. Wear protective clothing - Long sleeves, durable pants, and waterproof boots will help you investigate the pipeline route thoroughly. You may have high grasses and thorny plants to walk through so you'll be thankful you had protective clothing even if it is a hot day. On cold days, wear layers, gloves, and hats.
3. Beware of ticks - Be sure to check yourself for ticks during and after you get home from your site. Wearing light-colored clothing will help you spot ticks. Deer ticks are the size of a pepper flake so be thorough!
4. Stay hydrated - Be sure to bring plenty of drinking water with you on your assessment. Dehydration is one of the biggest causes of accidents in the field – even in winter- so stay hydrated! If you feel dizzy or weak, find a shade tree, take a break, and drink plenty of water.

## **Suggested Field Equipment For Pipeline Assessments**

- Protocols and Field Guides
- Copy of signed and blank Landowner Consent forms
- Clipboard
- Pipeline alignment sheets and maps
- Smart phone with downloaded Geo Mapping Apps (iNaturalist, Topo Maps, Anecdata etc.)
- Camera/memory sticks/extra batteries
- GPS (Optional – DRN has 2005 eTrex Garmin models to lend out to monitors)
- Delaware Riverkeeper Network Monitor ID badge
- Datasheets
- Pencils and Erasers
- Tape Measure/Meter Stick (Optional)
- Drinking Water
- Sample bottles (if needed)
- Binoculars (Optional)
- Waders or Hip Boots (Optional)
- Compass (Optional)
- Sunscreen & Bug Spray
- Re-sealable Plastic Bags (only for common invasive plant ID – never pick rare plants)

## **Pipeline Watch Protocol –Mapping and Ground Truthing**

### **Basics on Pipeline Alignment Sheets/Maps**

**Before heading out to do natural resource monitoring along the proposed route, be sure to:**

- Subscribe to the pipeline docket on FERC website ([www.ferc.gov](http://www.ferc.gov)) to obtain needed monitoring materials and maps – usually these materials are available when the company files the formal application with its resource reports.
- If you are not the landowner, obtain written permission from the landowner to walk the pipeline path (DRN provides a Volunteer Monitor Code of Ethics to help gain permission). You may want to invite the landowner to join you so they too can learn what to look for and can help monitor.
- Obtain and print out pipeline alignment sheets (color best) for the mile post (MP) area of the pipeline you plan on monitoring (DRN can help you obtain these alignment sheets)
- Obtain the Resource 9. Aquatic resource report from the FERC docket if available. This report usually includes helpful tables for wetlands and stream crossings with important information you can use with the alignment sheets to ensure the information provided by the pipeline applicant is accurate. Depending on your ability, you may want to refer to other resource reports also such as Resource Report 3 - Fish, Wildlife, and Vegetation Report.

### **Register, Subscribe, and Search the Docket for Pipeline Project at FERC Website**

Become familiar with the FERC website [www.ferc.gov](http://www.ferc.gov) to be able to pull filings, plans, maps, and reports for the specific pipeline project you will be monitoring. Each pipeline project is given a FERC docket number that you can search. For example, Penn East Pipeline docket number is CP15-558 and TGP Orion Pipeline docket number is CP16-4. First, E-register with FERC online. This process of registering you will only have to do once – you will have to enter your name and email and other information and FERC will then send you log in information to the email you used to register.

After you are registered, you can subscribe to a specific pipeline project using the Docket number. By subscribing you will also receive in your email all the correspondence and reports and comments put on the record for the project. This is important as it will keep you up to date on surveying and construction activities underway or planned which, in some cases, can help you plan your monitoring. You can also submit comments, file complaints, and report pollution issues and monitoring observations and reports directly on the docket so that the information is

on the public record. You can find more instructions on how to subscribe on the FERC docket at [www.stopthepipelines.org](http://www.stopthepipelines.org) under the Pipeline Resources tab.

## **Obtain Alignment Sheets and Select Resource Reports to Assist with Monitoring**

For monitoring purposes, accessing pipeline alignment maps on the FERC docket for the pipeline project is essential. Alignment sheets are provided by the pipeline operator at the time that the formal application and resource reports are drafted and available online on the FERC website. These alignment sheets have important information that will help you in the field – in many instances these files are large files and are compiled into many downloadable pdfs to cover the entire pipeline route.

You will also want to obtain some of the resource reports, such as the aquatic resource report – Resource Report 2 - filed by the pipeline company which will help you verify wetlands and waterbodies during your assessments to ensure information provided by the company about the wetlands and streams is accurate and complete.

Resource Report 1 – General Project Description  
Resource Report 2 – Water Use and Quality  
Resource Report 3 – Fish, Wildlife, and Vegetation  
Resource Report 4 – Cultural Resources  
Resource Report 5 – Socioeconomics  
Resource Report 6 – Geological Resources  
Resource Report 7 – Soils  
Resource Report 8 – Land Use, Recreation, and Aesthetics  
Resource Report 9 – Air Quality and Noise  
Resource Report 10 – Alternatives  
Resource Report 11 – Reliability and Safety (Pipeline Facilities)  
Resource Report 12 – PCB Contamination

For example, for Penn East pipeline, alignment sheets and resource reports can be accessed at the FERC website library and the link below. It's a good idea to bookmark this location for the application for future reference:

[http://elibrary.ferc.gov/idmws/file\\_list.asp?document\\_id=14380457](http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14380457)

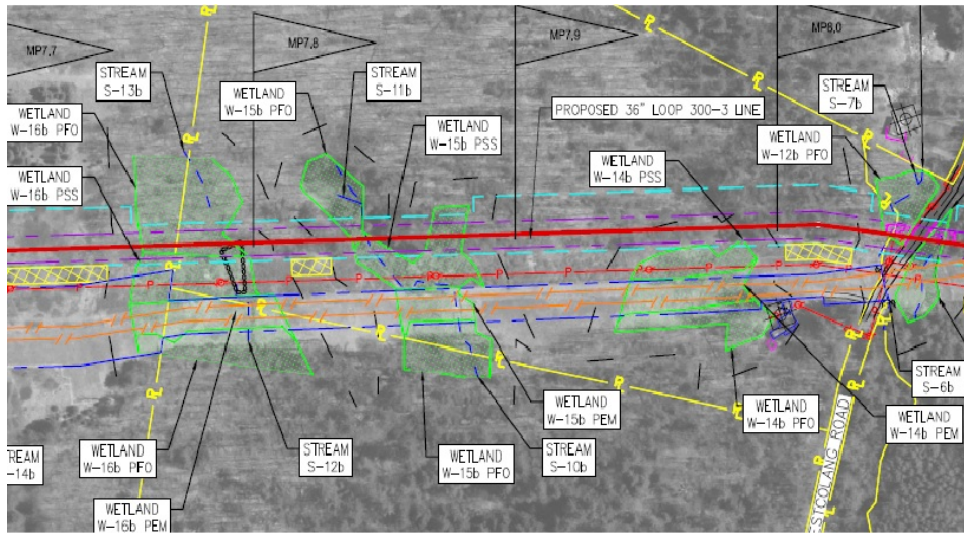
As the pipeline process and surveys continue after the formal application, the pipeline applicant may submit deviation maps from the original route over time. Landowners may or may not have these updated maps but it's something to keep in mind as the process continues and alternate routes are considered. For example, for the Penn East pipeline route, original maps and alignment sheets were provided at the time of the formal application that was filed on September 25, 2015 to FERC. In December, additional topos and aerials of alternate routes for



parts of this pipeline were submitted by the pipeline company and another set of deviations were submitted to the FERC docket again on February 22, 2016. This is a good reason to subscribe to the docket to be alerted of these proposed changes when new plans are filed.

## Overview of Pipeline Alignment Sheets

For DRN monitoring, items to field truth include wetlands, springs, vernal pools, and streams particularly to ensure all waterbodies are accounted for on the maps and the resource reports. Project alignment sheets map the location and ID of wetlands, mileposts, streams, and various other landmarks throughout the project corridor. The alignment sheets also depict the proposed Right of Way, (ROW) temporary work spaces (TWS), and additional temporary work spaces (ATWS) the pipeline company wants to build.



Example of Pipeline Project alignment sheet showing different wetland types in green polygons. Note each wetland should correspond with a wetlands reference table provided by the company in Aquatic Resource Report 2 filed with their application. Note the ROW Mile post (MP) marks also on this example which are helpful during assessments.

## Overview of Natural Features To Monitor

The U.S. Fish and Wildlife Service classifies wetlands by codes. Below is a chart showing the codes that are utilized and what the letters stand for. You will notice the aquatic resource 9 wetland tables will provide the type of wetland. The alignment sheets may or may not include the wetland type.

The Palustrine System was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie, which are found throughout the United States. It also includes the small, shallow, permanent or intermittent water bodies often called ponds (USFWS).

Another good resource to learn more about wetlands is the Environmental Protection Agency's (EPA's) Wetland Walk Manual (October, 1996) that is available for free download at the EPA's website.

### Wetland Types and General Descriptions

Display Color	Wetland Type	Map Code	Cowardin	General Description
R 0 G 136 B 55	Freshwater- Forested and Shrub wetland	PFO, PSS	Palustrine forested and/or Palustrine shrub	Forested swamp or wetland shrub bog or wetland
R 127 G 195 B 28	Freshwater Emergent wetland	PEM	Palustrine emergent	Herbaceous marsh, fen, swale and wet meadow
R 104 G 140 B 192	Freshwater pond	PUB, PAB	Palustrine unconsolidated bottom, Palustrine aquatic bed	Pond
R 102 G 194 B 165	Estuarine and Marine wetland	E2, M2	Estuarine intertidal and Marine intertidal wetland	Vegetated and non-vegetated brackish and saltwater marsh, shrubs, beach, bar, shoal or flat
R 1 G 144 B 191	Riverine	R	Riverine wetland and deepwater	River or stream channel
R 19 G 0 B 124	Lakes	L	Lacustrine wetland and deepwater	Lake or reservoir basin
R 0 G 124 B 136	Estuarine and Marine Deepwater	E1, M1	Estuarine and Marine subtidal water and wetland	Open water estuary, bay, sound, open ocean
R 178 G 134 B 83	Other Freshwater wetland	Misc. types	Palustrine wetland	Farmed wetland, saline seep and other miscellaneous wetland

Credit: US Fish and Wildlife Service



## **Documenting Wetland Types**

For pipeline watch purposes, documenting and ground-truthing the frequency and presence of forested wetlands (PFO) that could be impacted by the pipeline property is a priority. Field verifying that scrub shrub wetlands are indeed scrub shrub and not in fact forested is also important. Use the aquatic resource report and the delineation maps as you walk the pipeline to field truth wetland types and make sure there are no wetlands present that are not mapped or missed in the resource reports and maps. Below is a break out of wetland types you may document while monitoring.

### **PFO = palustrine forested**

Palustrine forested wetlands include all tidal and non-tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent.

### **PSS = palustrine scrub-shrub**

Palustrine scrub-shrub wetlands include all tidal and non-tidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent. The species present could be true shrubs, young trees and shrubs, or trees that are small or stunted due to environmental conditions.

### **PEM = palustrine emergent**

Palustrine emergent wetlands include all tidal and non-tidal wetlands dominated by persistent emergent vascular plants, emergent mosses or lichens, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Plants generally remain standing until the next growing season. Total vegetation cover is greater than 80 percent.

### **PUB = palustrine unconsolidated bottom**

Palustrine unconsolidated bottom ponds include all wetlands and deepwater habitats with at least 25 percent bottom-cover of particles smaller than stones (less than six to seven cm diameter) and a vegetative cover less than 30 percent.

### **PAB = palustrine aquatic bed**

Palustrine aquatic bed ponds include wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Aquatic beds generally occur in water less than two meters (6.6 feet) deep.

### **Some Common Wetland Indicator Plants**

Plants have a tolerance for how much moisture and wetness they can tolerate. Below are five key plants that are generally always found in wetlands. Guides for the smart phone (iNaturalist) and field guides highlight these common wetland indicator plants to help with plant identification. Taking good spot photos of unknown plants you observe is a basic tool for pipeline watch and a great way to seek ID help after your field monitoring with a botanist to obtain the proper plant identification.

Skunk cabbage (*Symplocarpus foetidus*)

Cinnamon fern (*Osmunda cinnamomea*)

Soft rush (*Juncus effuses*)

Buttonbush (*Cephalanthus occidentalis*)

Common Cattail (*Typha latifolia*)

### **Vernal Pools**

Special attention is needed to document or map vernal pools that may not have been identified or documented in the pipeline resource reports. Vernal pools are important wetland habitats that are often overlooked due to their ephemeral nature. Many vernal pools are not mapped or documented and may inadvertently or intentionally be destroyed during construction projects. The destruction of vernal pools can wipe out entire populations of obligate vernal pool species because they are no longer able to reproduce and cannot adapt to other bodies of water that contain fish. It is important to document vernal pools and the species utilizing them so that they remain an intact link in the ecosystem.

Vernal pools are intermittently to ephemerally ponded, small, shallow depressions usually located within an upland forest. They are typically flooded in spring or after a heavy rainfall, but are usually dry during summer. Many vernal pools are filled again in autumn. The substrate is dense leaf litter over hydric soils. Vernal pools typically occupy a confined basin (i.e., a standing waterbody without a flowing outlet), but may have an intermittent stream flowing out of it

during high water. Since vernal pools cannot support fish populations, there is no threat of fish predation on amphibian eggs or invertebrate larvae. Characteristic animals of vernal pools include species of amphibians, reptiles, crustaceans, mollusks, annelids, and insects. Obligate vernal pool amphibians include spotted salamander (*Ambystoma maculatum*), blue-spotted salamander (*A. laterale*), Jefferson's salamander (*A. jeffersonianum*), marbled salamander (*A. opacum*), and wood frog (*Rana sylvatica*). Fairy shrimp (*Anostraca*) are obligate vernal pool crustaceans, with *Eubranchipus* spp. being the most common. Obligate vernal pool species are species that breed exclusively in vernal pools.

Vernal pools vary widely in size from as small as 10 square feet to as large as an acre or more. Not all vernal pools are picturesque or even natural. There are also man-made holes and ditches that seasonally hold rainwater and may serve as vernal pools, provided that there is suitable nearby upland habitat for animals to migrate from. For example, some road side ditches serve as vernal pools and can be a critical habitat when other vernal pools are not available.

The Pennsylvania Natural Heritage Vernal Pool Identification Guide will be provided to volunteer monitors to use to identify vernal pools and the obligate amphibian species that rely on them to survive. A tutorial is also provided during the training to help volunteers document vernal pools and other wetlands that you may encounter as you monitor. If a vernal pool is suspected, take geo-referenced photos and consider follow up work and surveys during amphibian breeding season (usually early spring) to document obligate species – these surveys will assist with additional state vernal pool mapping through various state programs that DRN will pursue based on your data collection.

*What to look for when searching for vernal pools:*

- Dark stained leaves in an area with few trees often indicates an existing vernal pool during the dry phase.
- There may also be human-made features on the landscape that are functioning as vernal pools. Motor vehicle tire ruts often provide the shape and compaction needed to make small, linear wetlands. Consider retaining these small wetlands in roads that are no longer driven. A disadvantage of a road rut wetland is that it becomes a deathtrap for amphibians when a vehicle drives through it during the breeding season.
- Water bars used to stop erosion on roads may also become vernal pools. A water bar is a small dam placed across a road to slow flowing water. Most water bars are made so that they do not trap runoff, but divert the water in small amounts to the side of the road. Placing a shallow dip in front of a water bar can make a small vernal pool that also helps trap sediment.

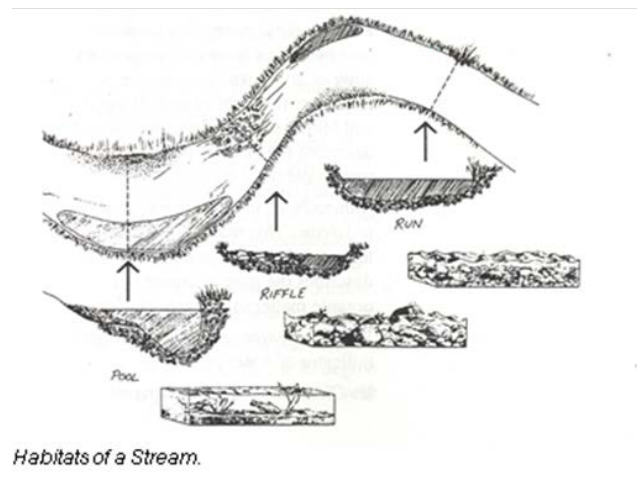


## Other Small Wetlands: Springs and Seeps

Springs are vital headwaters of many of our rivers. Like vernal pools, they provide important habitat for wildlife and plants. Also like vernal pools, springs and seeps may be unmapped or undocumented because of their small size. Their protection and maintenance ensure clean water for wildlife, plants, and for us. Springs are important to wildlife during the winter because their movement often keeps the water from freezing. Springs often may provide the only available source of drinkable water. Whether the surface waterflow is a seep or a spring is determined by the geology of the site and the water pressure below the surface. Seeps generally have a lower flowrate than springs and only rarely have a volume large enough to form a stream. Only 3 percent of the Earth's fresh water is found in streams, lakes, and reservoirs. The remaining 97 percent is underground. Groundwater is the safest and most reliable source of available freshwater. It is the primary water source for 50 percent of the American population. In rural areas, 95 percent of the people depend on ground water for their water supply (U.S. Fish & Wildlife Service).

## Stream Habitats

Many streams are made up of riffles, runs and pools. A riffle is a shallow section of a stream or river with rapid current and a surface broken by gravel, cobble or boulders. Pools are deeper and calmer areas whose substrate or stream bottom is made up of finer material such as silt. Riffles are instrumental in the formation of meanders, with deeper pools forming alternately. Stream scientists monitor riffle quality and the stream insects (macroinvertebrates) that live there to detect changes in stream health over time.

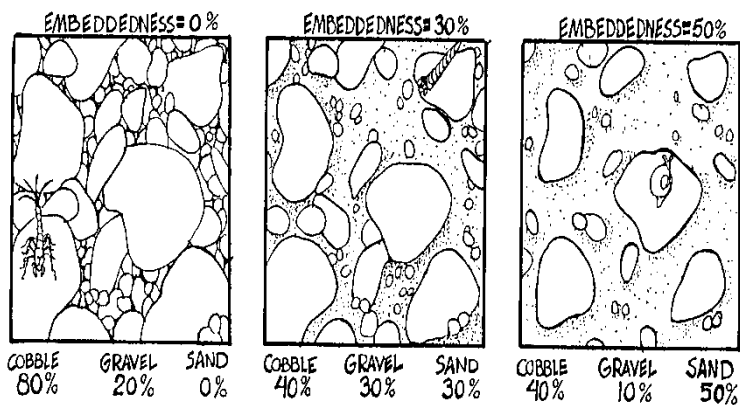


The material on the bottom of a stream, or substrate, has a great deal of influence on the types of organisms present and is an important stream health indicator. It can also be an indicator of human impacts. For example, in areas with a high housing density, streams may be carrying a

great deal of fine sediment that, as it settles out, smothers eggs and macroinvertebrates, damages fish gills, and buries habitat.

A typical pipeline ROW is often 100 feet wide. Across streams, companies may reduce the ROW size in the stream. At the same time, companies often place additional temporary work spaces near streams, wetlands, and waterbodies which can have short and long term ecological and floodplain impacts. Pipeline cuts using open trenching construction methods through streams can create long term ecological and cascading impacts and increase sediment loads during and after construction.

To help determine baseline stream conditions where the pipeline is proposed to cut, monitors can document existing riffle consolidation within the stream bed along the proposed ROW. If stream riffles are present within the stream at the proposed ROW cut, choose one reference riffle and document its consolidation over time. **Consolidation** is the degree of difficulty with which rocks in the riffle habitat can be dislodged. Determine consolidation by kicking or attempting to pick up some cobble-sized (grape fruit sized) rocks. The greater the degree of difficulty, or consolidation, the poorer the macroinvertebrate habitat. This measurement, ranging from “Loose” to “Moderate” to “Difficult to Dislodge”, is listed as “riffle consolidation” and can be recorded on the datasheet for each stream along the pipeline route you are monitoring.



*The greater the sand, silt, and mud, the poorer the fish spawning and macroinvertebrate habitat in stream riffles.*



## Riparian Buffers

Riparian (or streamside) vegetation is an important part of a healthy ecosystem. The presence or absence of riparian buffers directly affects water quality, water quantity, stream channel stability, and wildlife habitat. Unfortunately, many streams in the Delaware River Watershed lack these protective buffer zones. As a result, many of our waterways suffer from high levels of nutrients, high temperatures, and excessive sediment pollution. While transporting sediment is what waterways naturally do, excessive sediment and pollutants are carried by rainwater that runs off roads and lawns, playing fields, agricultural lands, and construction sites. A significant part of the sediment in our urban and suburban streams is due to excessive and unnatural stream channel erosion caused by poor stormwater management that sends increased volumes of runoff to our waterways.

### The Benefits of Streamside Vegetation

1. Woody vegetation and tall grasses along streambanks shade the water, helping to maintain cooler water temperatures many aquatic organisms require to survive.
2. Native plants provide food and cover for wildlife. Nesting, breeding, and roosting sites are common in riparian areas.
3. The roots of trees and shrubs not only stabilize stream banks, thus preventing erosion and stream bank failure; they also take up excess nutrients entering the stream from the surrounding lands. This root material also slows the velocity of a flooding stream thereby decreasing damage and allowing greater groundwater infiltration.
4. Fallen leaves and other plant debris provide food and shelter for many organisms.

For this survey, a riparian health index is included for each proposed pipeline stream crossing that could impact a stream. **The wider the natural riparian buffer, the more protection and the healthier the stream.** If a pipeline cut is allowed across a stream, this means more trees and natural vegetation will be impacted if an open trench cut, the general method pipeline companies use to cross streams and wetlands, is used. Choose the riparian width that best describes the size of the natural riparian buffer for both sides of the stream surrounding the proposed pipeline cut. Natural buffers can include three layers of vegetation, especially if they are healthy and diverse: trees, shrubs, and un-mowed herbaceous plants. Lawn or turf is manicured with short roots and does little to protect the stream, so lawn does not count as a natural healthy buffer. **Face downstream to determine left and right side of banks.** If steep slopes surround a particular stream, pay special attention to those areas. Steep slopes can lead to more damage and sediment pollution to the nearby stream due to stormwater runoff and inadequate construction

practices called Best Management Practices (BMPs).

## **Threatened and Endangered Plants and Animals – State and Federal**

The pipeline company is required to document what species are listed as threatened or endangered that may use or live along the pipeline route. Federally endangered species in the Delaware River Basin include only: bog turtle, dwarf wedge mussel, Indiana bat, northern long eared bat, Atlantic sturgeon, shortnose sturgeon, red knot, and roseate tern. Bald eagle was removed from the federal listing but the bird is still protected under the Bald and Golden Eagle Protection Act. Looking for large bald eagle nests is a good thing to be aware of as you walk the pipeline route. Pipeline companies in the Delaware River Basin have been required to re-route pipelines around wetlands that are home to bog turtles.

There are more listings for state listed species but in general those state restrictions are much less protective to the species than that of a federally listed plant or animal. The datasheet includes some of the state listed plants in NJ and PA that you might encounter, in this case, along the proposed Penn East Pipeline route. Resource Report 3 of the pipeline application is a good place to begin to see what at minimum, the pipeline company is stating occurs in the region of the proposed pipeline. There may be other species present that simply have not been documented in the region. The more monitoring eyes out over multiple seasons and times, the greater the likelihood of finding these rare and important species that are vulnerable. Delaware Riverkeeper Network is providing some guides of plant species you may encounter and the iNaturalist App available for free download for smart phones is also a great resource to use to document and determine plants along the proposed route.

Other places to check for state threatened or endangered species to see what species may be in the vicinity of the route include:

Pennsylvania State Threatened and Endangered Species:

<http://fishandboat.com/promo/grants/swg/swap/final2015/SWAP-CHAPTER-1-apx13.pdf>

New York State Threatened and Endangered Species:

<http://www.dec.ny.gov/animals/7494.html>

New Jersey State Threatened and Endangered Species:

<http://www.njfishandwildlife.com/tandespp.htm>

Delaware State Threatened and Endangered Species:

<http://www.dnrec.delaware.gov/fw/NHESP/information/Pages/Endangered.aspx>

## **Invasive Plant Species**

An invasive plant is a species, often from another country or region, that grows aggressively, spreads rapidly, and displaces other plants. The most aggressive of these plants can change the character and function of entire ecosystems if left uncontrolled. Invasive plants are not often eaten by resident insects and animals or affected by local diseases, so they are able to put all their energy into growth and reproduction. This makes them difficult to control, and once established, can require a great deal of effort and expense to restore the diversity and function to the habitat affected. Invasive plants grow very quickly and can overtake native plants in a few seasons.

Linear pipeline construction projects can rapidly spread these invading plants to other regions along the pipeline corridor. Plant seeds travel on construction equipment and raw disturbed soils from the pipeline construction can be colonized by these plants – often out competing native plant diversity that was present before the fragmentation and pipeline cut occurred. If you observe what may be an invasive plant along the proposed pipeline route, please document its presence and extent of colonization. Remember, a picture of a plant is very helpful for subsequent plant ID. The datasheet provides some common invasive plants you might encounter while you are monitoring and a field guide of invasive plants is also part of your monitoring packet.

## Photo Monitoring Tips

**Photo Monitoring** provides a visual record and is a crucial component for pipeline monitoring to document changes over time. Photos taken are used as a qualitative record of a site's condition. The two types used in photo monitoring are **photo points** and **spot photos**.

**Photo points are photographs taken from a specific location and angle each year or over time.** These photos must be taken from the exact same location and angle and under similar conditions from year to year so that any changes in conditions are evident. Take note if the pipeline is approved, the landscape will change drastically so keep that in mind when selecting reference objects to include the photo points. Photo points will be very valuable, especially at stream and wetland crossings and where steep slopes and forests are present. Continue to document conditions using established photo points, but also feel free to establish new photo points where and when you feel they are needed. **A spot photo documents a particular occurrence**, such as damage to a tree, a unique plant or animal you may find, erosion caused by a pipeline cut, the appearance of invasive plants, destruction due to construction, or other occurrences that catch the monitor's eye.

**Record basic photo information in the field on the datasheet where appropriate and if possible be sure to georeference each photo to capture location information. If you use iNaturalist or Picassa you may record info by adding captions in those programs in the field or back at home.** iNaturalist will automatically geo-reference the photo which is a plus to using a smart phone in the field. If you only have a camera (with no georeferenced capability), be sure to document the location of the photo on the datasheet and ideally use a GPS to write down or track the latitude and longitude for later data compilation.

If you are using an iPhone or smart phone, in Settings - under the tab "Privacy" - be sure you have location services selected "on" so that the location of the photo is documented with each picture.

### When Establishing A New Photo Point:

- **Include landscape features or "focal points"** that are unlikely to change and that can serve as a reference point in future years. These may include buildings, other structures, or natural features such as rock outcrops, large trees, or peaks. Remember that a 100 foot ROW can drastically change reference points. Pay special attention to stream and waterbody crossings and mature forests that could be greatly altered if pipeline cuts occur.
- **Take a picture of the photo point** for further documentation if you have a partner in the





Spot photo of Trillium, sp.

field (see picture on prior page).

- **If you cannot georeference your photos using a smart phone or GPS, mark the location and orientation of your photo point on a site diagram and on the photo inventory sheet.**

When taking a spot photo:

- **Convey the scale of the image** by including a ruler, person, automobile, or other object. Cardboard red arrows are in your monitoring binder and can be used to highlight specific objects in the photo.
- **Minimize shadows by taking close view photographs from the north (facing south).**
- **Give detailed information about the photo:** record time and date of photo, what the photo is meant to highlight, and where it was taken.

### **Additional Photo Tips**

- *Maintain a level (horizontal) camera angle*, unless the terrain is sloped.
- *Watch the weather.* Especially overcast days are not good for taking pictures. Mornings and late afternoons are best, when sunlight does not drown out the photo subjects and contrast is maximized. Medium and long view photos are best shot with the sun at the photographer's back.
- *"Data is in the eye of the beholder."* You may feel as though your photos convey little information. On the contrary, DRN staff and our scientist allies are often clued into other aspects of the site that you may not be aware of such as hydrology, the appearance of new invasive species, and other changes to the site. So, click away! We can never have too many good photos.

Remember if you don't know a plant or amphibian or wetland type, no worries, take several pictures so you can identify it later at home or ask DRN to help with identification. Photos can be used to later identify unknown plant species and wetland habitats. If you have a smart phone, use the iNaturalist App to identify species and log the photos under the specific pipeline project. Guides are available in iNaturalist for common species you may encounter.