Version 1.4

Alliance for Aquatic Resource Monitoring

Marcellus Shale Gas Extraction: A study design and protocol for volunteer monitoring

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Note: This manual is designed to be a dynamic document. We expect changes as we conduct training workshops across the region and continue to learn from our interactions with professionals in the field and with volunteers. Please feel free to send us your comments, corrections, and suggestions!

Acknowledgements:

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Background on ALLARM:

The Alliance for Aquatic Resource Monitoring (ALLARM) is a project of the Environmental Studies Department at Dickinson College. Since its founding in 1986, ALLARM has become a nationally recognized technical and programmatic support center for community organizations interested in watershed assessment, protection, and restoration. ALLARM's program goals are to:

1) Enhance local action for the protection and restoration of Pennsylvania watersheds by empowering communities with scientific knowledge and tools to implement watershed assessments;
2) Provide Dickinson College students with opportunities to participate in community-based participatory research thereby enhancing the quality of undergraduate science education; and
3) Be the leader in volunteer monitoring in Pennsylvania and a national model for college-community partnerships.

Through the work of student and professional staff, ALLARM offers comprehensive services to enable groups to use critical scientific tools to enhance environmental quality and fully participate in community decision-making. The program staff includes a Director, an Assistant Director, a faculty Science Director, and 12-14 undergraduate student staff.

For more information on please visit: www.dickinson.edu/ALLARM or email: ALLARM@dickinson.edu

Why Develop a Study Design?

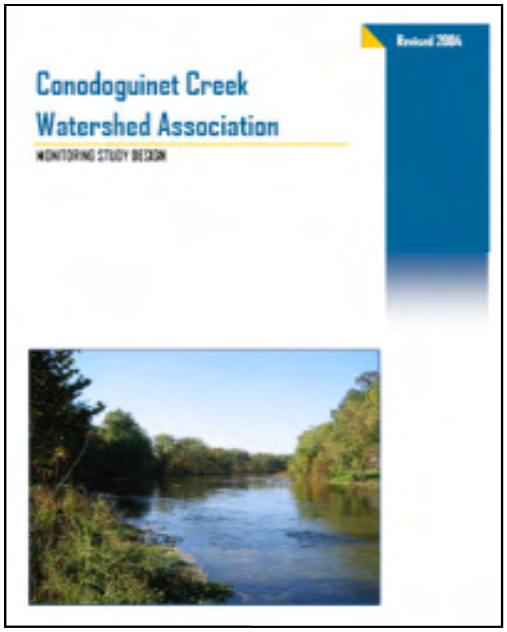
The study design process[1] facilitates the essential decisions that need to be made in a monitoring study. Developing a study design serves several purposes:

- It helps you focus on what you are trying to achieve with your monitoring program;
- It prevents waste of time and money on equipment/procedures that are inappropriate for your group or goals;
- It helps you match your monitoring program to your watershed goals;
- It clearly documents your sampling and analysis methods;
- It clearly outlines your quality assurance and quality control procedures; and
- It minimizes the impact of changing personnel on the continuity of your monitoring activities.

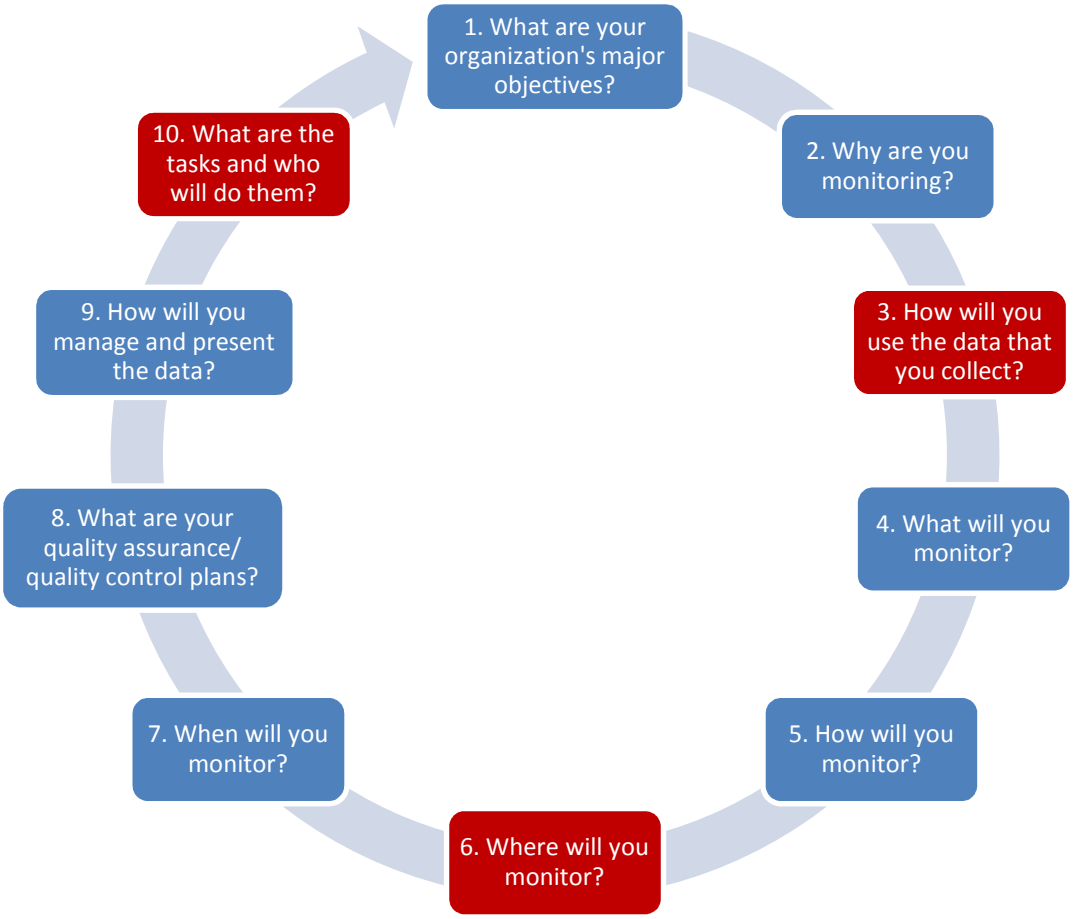
Study designs are dynamic plans that should be revisited as needed to determine if the data you are collecting are answering the questions that prompted you to monitor and to determine if your methods are appropriate.

[1] ALLARM has developed a Study Design Manual which explains in detail how to develop a study design; this can be accessed at: http://www.dickinson.edu/about/sustainability/allarm/content/Toolkit/.

This study design has been developed for projects with the goal of monitoring small streams and their watersheds for early detection of the impacts from Marcellus Shale gas extraction in PA. For most of the steps in this study design, there are suggested standard protocols and prescriptive measures. For a few steps, there are instructions on how the group needs to customize the plan to fit their own needs. It is our hope that groups throughout the state will follow these protocols so that the results will be directly comparable and so that a statewide database can be easily established. On the other hand, groups who have other goals and who desire to meet their goals using different protocols are encouraged to use this design as a template and customize it to meet their needs.



Study Design Steps:

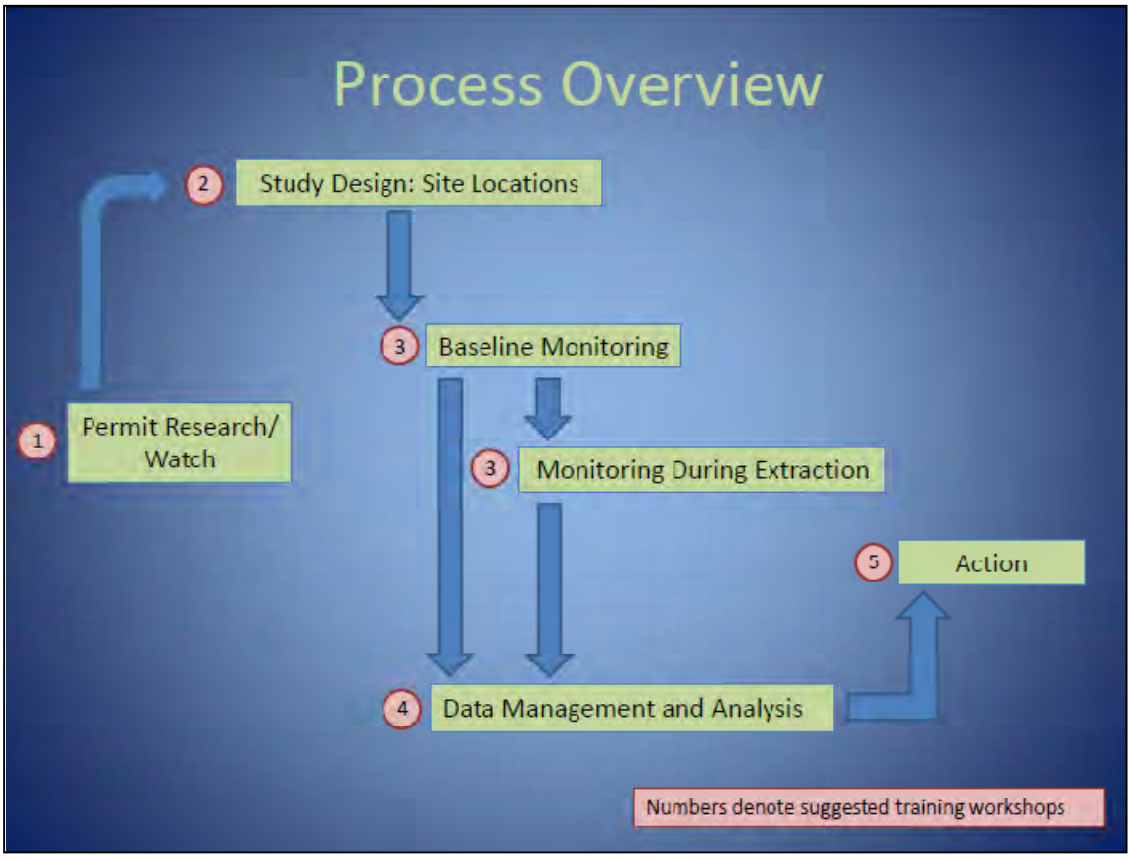


The study design wheel that is pictured above takes you through all of the questions that should be answered in a study design plan. In the case of monitoring for Marcellus Shale gas extraction impacts, the answers to all of the questions except for 3, 6 and 10 will be given to you so that standard protocols can be followed by volunteer monitoring groups throughout the state. During the first workshop, your group will complete the study design by addressing these three questions (noted in red in the study design wheel above).

Overview of the Monitoring Plan:

The monitoring process can be broken down into six main categories:

1) **Permit research:** The process for monitoring the impacts of Marcellus Shale gas extraction starts with the identification of active, inactive and proposed drilling and infrastructure sites. Volunteers will be trained in accessing this information from a number of online sources.
2) **Site locations:** Documentation of extraction activities will allow volunteer monitors to locate sites for monitoring that will provide information on any impacts that might occur due to these activities. The number and location of sites will also depend on the resources of the group.
3) **Baseline monitoring:** Volunteers will be trained to collect field data on water chemistry, flow, and visual impact (observational monitoring) at these chosen sites. Ideally, sites will be monitored for 3 months to a year before the extraction activities begin. This will provide baseline data to compare to data after the activities have begun and will establish a baseline relationship between flow and water chemistry as well as establish natural background levels of chemicals and normal landscape conditions.
4) **Monitoring during extraction:** When drilling begins, volunteers will continue to monitor the same parameters, keeping careful watch for deviations from baseline conditions.
5) **Data management and analysis:** Throughout the monitoring process, data will be entered into a data management program and carefully scrutinized for indications of impact.
6) **Action:** If significant deviations from baseline conditions are documented, volunteers will take action as they see fit.



The Study Design Plan

The following study design plan is organized by the steps in the study design wheel (page 3). For most steps, the appropriate information has been entered to be consistent with the standardized protocol that we are encouraging volunteer monitoring groups to use. For three of the steps, there are questions that prompt you to fill out the appropriate information which will be customized for your watershed.

Step 1: What are the major objectives of this project?

The objectives of this project can be summarized as two major goals:

1) Early detection of contamination of small streams and of disturbance in the surrounding watersheds of gas extraction activities.

2) Prevention of future environmental impact through the continuing presence of watchful residents.

Does your group have other goals? Are they realistic within the constraints of the group resources? If so, be sure to list them here and consider them in each step of the study design.

Step 2: Why are you monitoring?

Marcellus Shale gas extraction activities may be a significant threat to our water resources. A summary of water-related impacts of Marcellus shale operations include:

- Impact of withdrawals and consumptive use of large amounts of water on small streams and local water supplies;
- Potential for surface and ground water contamination from poor casing of well bores, accidental spills, flooding of well pads in floodplains, and the poor handling, treatment and disposal of fracking and flowback fluids;
- Runoff from well pads, pipelines, increased trucking activity and access roads;
- Air pollution from transport vehicles, compression stations, pipelines and well pad activities, much of which translates into water pollution; and
- Fragmentation of sensitive lands adjacent to water bodies.

Experience in the state has demonstrated that spills and accidents are common[2].

[2] Go to: http://www.chec.pitt.edu/MSGEcommunity.html for an updated compilation of such occurrences across the state.

Step 3: How will you use the data you collect?

Your group needs to discuss this question before completing your study design. Now that we have determined the objectives, you need to look ahead and think about how you are going to use your data. In doing so, it is important to keep in mind what your resources are.

Determine what action you expect to take with your data and who will use the data. Remember to align your data use objectives with your monitoring objectives.

Common data audiences include:

- Volunteer monitoring groups
- University and research scientists
- Gas companies
- Community
- Local government
- State and Federal Government

Examples of data use include:

- Reporting incidents to state and local officials;
    - Possible implementation of a certification or memorandum of understanding process
- Calling companies to report findings and to seek mitigation;
- Publicizing monitoring activities in newspaper articles, op ed pieces, letters to the editor, etc.;
- Testifying at permit application hearings; and
- Discussing findings with landowners

Envision data outputs. For example perhaps your primary concern is developing a strong baseline database and simply informing the gas companies that you have these data and are watching for any changes (to help promote better management practices). Perhaps you are interested in documenting the impact from increased trucking activities and you are photographing road damage. How can these data best be used to achieve your goals?

It is a common default for groups to identify the State/Federal Government as the audience for the data. Often people will determine that the group will collect data and then assumes the state will use it. Unless a relationship is established with a governmental entity upfront that they will use the data or be an audience for the data, ALLARM recommends that the group think along other lines as well. How can the group best analyze the data and use the data to communicate to others?

Record your intended data uses in the space below:

_____

_____

_____

Step 4: What will you monitor?

The actual training on the details of the monitoring will take place in a second workshop.

There are three groups of stream and landscape evaluation measures that you will use:

1) chemical analysis,
2) flow measurement, and
3) observational or visual monitoring.

Detailed information and directions for each evaluation measure can be found in Step 5 and in the appendices of this manual.

1) Chemical analysis

Background

Frack Water

In the hydrofracking process, a large amount of water is injected into the well under pressure to fracture the rock and release the gas. This is called the frack water. It contains a large number of additives, the exact concentrations of which are considered proprietary information. Additives include a proppant (such as sand), scale inhibitors (such as ethylene glycol), surfactants (such isopropanol), antibacterial agents (biocides), corrosion inhibitors, and friction reducers.

Flowback Water

The frack water mixes with a natural brine which is found in the shale and between 20-80% returns to the surface. That water, known as flowback water often contains high concentrations of chlorides, sodium and sulfates, metals, such as barium, iron, manganese, arsenic, strontium, lead, cadmium, chromium, and aluminum; naturally occurring radioactive materials such as uranium, radium, and radon, methane, and bacteria.

These waters can reach the environment and contaminate water resources through well casing leaks, surface spills and leaks, incomplete treatment of flowback water in wastewater treatment plants, and migration through bedrock. Water quantity problems can also occur since withdrawal of water for fracking may decrease the flow in a stream, whereas discharge of flowback water may increase the flow. Both conditions can cause harm to the stream's habitat and/or biota.

Indicator Chemicals: Total Dissolved Solids

Since there are hundreds of different chemicals found in the waters associated with gas extraction, it is not possible to test for each possible constituent. For our testing we are using a single indicator chemical: Total Dissolved Solids (TDS) as measured by electrical conductance (conductivity). A large increase in TDS is an indicator that the water may be impacted by spills or leaks from gas extraction and other activities.

Signature chemicals: Barium and Strontium

In addition to using TDS as an indicator parameter, we will also use signature parameters, that is, those chemicals that point to gas extraction activities as the cause for the increase in TDS. Although the composition of flowback water varies quite a bit, two parameters are almost always found: Barium (Ba) and Strontium (Sr).[3] These two analytes will serve as our signature chemicals. Simply put, if TDS is high, we then test for Ba and Sr, and if they are high also, we assume that the source of impact is Marcellus Shale flowback water.

The following table is adapted from the New York Department of Conservation Supplemental Generic Environmental Impact Statement On the Oil, Gas and Solution Mining Regulatory Program, and is based on flowback water samples from PA and WV. Notice the very high concentrations of the indicator and signature chemicals in flowback water in comparison to water quality criteria in PA.

Parameter	Median concentrations in flowback samples (mg/L)	PA water quality criteria (mg/L)	PA drinking water criteria (mg/L)	Potential health & environmental effects
Total Dissolved Solids	93,200	500	500	Variable; includes many chemicals
Barium	661	10	2	Increase in blood pressure
Strontium	821	0.050	none	Musculoskeletal toxicant

[3] The New York Department of Environmental Conservation completed a draft Environmental Impact Statement on the gas regulatory program in September, 2009. They reported typical concentrations of flowback constituents based on limited samples from PA and WV. There were more than 75 different chemicals listed.

2) Flow Measurement

The volume of water that flows past a given point during a given time period is called its flow or discharge. Simply put, this is the amount of water in the stream. Knowledge of the flow is critical in evaluating:

1) Water quantity changes that may be due to either excessive withdrawals or spills, and

2) The normal relationship between the concentration of TDS and the amount of flow in the stream. Understanding this relationship helps to decide whether increases or decreases in TDS are simply due to changes in flow, or to a contamination event.

3) Observational Monitoring (Visual Assessment)

Visual Assessment is a powerful tool which allows volunteers to evaluate management practices and their impact on the physical conditions of the ecosystem. Impacts can be documented through photography.

We will systematically make and record observations on land disturbances, spills and discharges, gas migration or leakage, and compliance with sedimentation and erosion plans.

Step 5: How will you monitor?

In this section, we will give an overview of the methods that will be used to monitor the parameters that were chosen in the last step. The actual step-by-step protocols for all of the methods are explained in the appendices.

1) Chemical Analysis

Indicator Chemical: TDS (Total Dissolved Solids)

TDS is typically measured in the field using an electronic meter. ALLARM tested a variety of popular TDS meters and determined (through trial tests with untrained volunteers) that the LaMotte Tracer PockeTester exceeds all other meters tested in terms of accuracy, precision, and ease of use.

TDS meters are, in reality, conductivity meters. That is, they work by applying a voltage between two or more electrodes. Positively charged ions (e.g. sodium, calcium, and magnesium) will move toward the negatively charged electrode, and negatively charged ions (e.g. chloride, sulfate and bicarbonate) will move toward the positively charged electrode. Because these ions are charged and moving, they constitute an electrical current, which is then measured by the meter. So TDS meters actually measure charged particles, and then use an equation to convert that measure to total dissolved solids in mg/L. That conversion is approximate and the conversion equation varies with water chemistry. For that reason, we have chosen meters that will report both the conductivity measurement and the TDS result. As with all electronic meters, TDS meters need to be calibrated prior to each use. Standard solutions and training will be provided for volunteers to learn how to successfully calibrate and use the LaMotte Tracer PockeTester.

The LaMotte Tracer PockeTester offers direct reading on conductivity, total dissolved solids, salinity and temperature. Its memory can store up to 15 readings. Further specifications are in the table to the right. The cost is $89.95. The life expectancy of the electrode is 5 years with reasonable care. Electrodes can be replaced for $44.00.

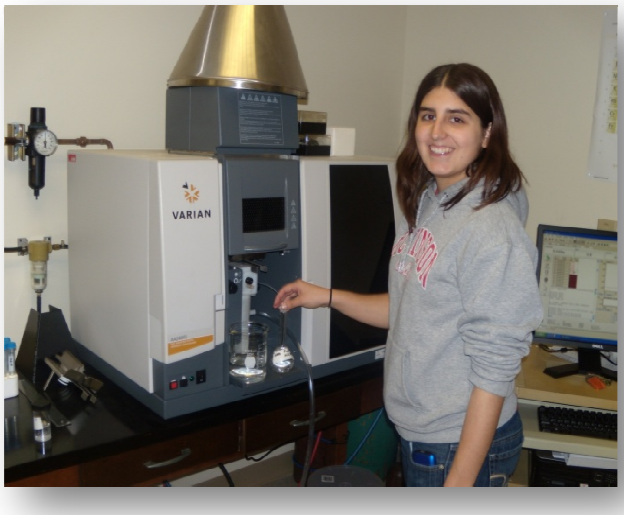
Specifications	
Conductivity Range	0 to 199.9 µS
	200 to 1999 µS
	2.00 to 19.99 mS
TDS Range	0 to 99.9 mg/L
	100 to 999 mg/L
	1.00 to 9.99 g/L
Salinity Range	0 to 99.9 mg/L S
	100 to 999 mg/L S
	1.00 to 9.99 g/L S
Accuracy	EC, TDS, Salt: ± 2% FS
Temperature	±1°C (1.8°F)

Appendix A gives detailed directions on sample collection, meter calibration and use of the LaMotte Tracer PockeTester.

Signature Chemicals: Barium and Strontium

Although the components found in flowback water vary quite a bit, barium and strontium are almost always present in rather high concentrations, and will therefore be used as our signature chemicals – chemicals whose presence points to flowback water as the source of contamination.

Barium and strontium are metals that are associated with minerals naturally found in the shale rock formation and that are therefore dissolved into the brine that is also found within the shale. Although natural in origin, barium and strontium are toxic elements when found in high concentrations.



Since there are no accurate field kits for measuring concentrations of barium and strontium, these components will be measured in the ALLARM Community Aquatic Research Laboratory[4] using a Varian Atomic Absorption Spectrometer (pictured here). Volunteers will use acid-washed bottles supplied by the ALLARM laboratory to collect samples, and then send them to the lab where the analysis will take place.

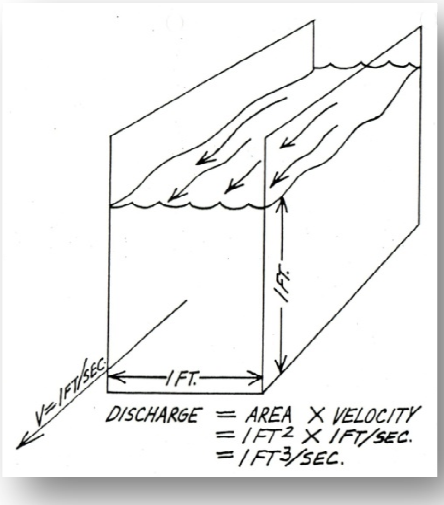
2) Flow Measurement

Measuring discharge in a stream is a complex and time-consuming task. It requires measuring the cross sectional area (width x average depth) and the average velocity of the stream. The standard formula is:

Q = (0.8)* w* d *v

Where:

- Q = discharge in cubic feet/sec (cfs)
- w = width of the stream across a given transect (ft)
- d = average depth of the stream at the transect location (ft)
- v = average velocity of the stream in the transect vicinity (ft/sec)
- 0.8 = an empirically-derived correction factor



A wide, deep stream will have a greater discharge than a shallow, narrow stream, assuming their flow velocity is the same. Conversely, two streams of similar size may have quite different discharges if the flow velocity differs.

[4] Most certified laboratories can test for barium and strontium in water samples. The cost may range from $15 per sample per element to $50 per sample per element. However, if groups feel that they need DEP-accredited laboratory data and can afford such, we recommend taking samples to professional laboratories in the area. A list of such can be found at: http://resources.cas.psu.edu/WaterResources/pdfs/certifiedlabs.pdf.

For our purposes, it is sufficient to produce a surrogate measure of flow that will indicate relative increases and decreases of flow at any given site location. **This surrogate will simply be the product of width and depth, or cross-sectional area.** This measure can only be used to compare relative flows at a given site and cannot be used to compare flows between sites. However, it should be sufficient to detect unusually high or low flows that are not related to recent precipitation patterns (and could therefore indicate water withdrawal or discharges) and/or to determine if unusually high TDS measurements are simply due to flow conditions or might suggest a water contamination event[5].

A detailed protocol for measuring depth and width of small streams is found in Appendix B.

3) Observational Monitoring (Visual Assessment)

Visual documentation of drilling activities is a powerful way for volunteers to help provide needed oversight of drilling activities. This visual assessment method consists of a checklist of possible observations that indicate impact from gas extraction activities. It is divided into four sections: land disturbances, spills and discharges, water withdrawal, and gas migration and leakage. For each section there is a list of observations that, if found, likely indicate impact. The checklist data form is found in Appendix C.

Checklist for Gas Related Earth Disturbance

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

If you find any of the features in this checklist, there is a high probability that the company is violating its sedimentation and erosion plan.

Checklist for Spills and Discharges

Discharges of polluted water to streams, whether intentional or not, can have a significant impact on water quality and stream biota. In extreme cases, fish kills can occur. Every producing gas well also produces some water, which is stored in a tank at the well site and periodically trucked to a treatment facility as required by Pennsylvania law. But spills do occur; and regrettably, “midnight dumping” occasionally does take place. These events can occur and important evidence can disappear before anyone takes notice, especially on more remote streams. Early detection and prompt reporting are crucial.

[5] Upon request, ALLARM will provide protocols and training for those groups who would like to do more sophisticated measurements of discharge, using either floating objects or flow meters to measure velocity, staff gages to measure stage, and calibration curves for converting stage to discharge.

Checklist for Gas Migration or Leakage

Leakage of natural gas into soil, springs, and waterways results from a pipeline break or a breech in the gas well casing. This is not so much an environmental problem as a concern for human health and welfare. As it is colorless and odorless, when gas is routed to a pipeline mercaptan compounds are added to provide an odor for detection. Natural gas mixes with atmospheric oxygen, and any spark or flame can ignite the mixture. This situation is particularly dangerous when someone's potable water supply is contaminated.

Cost of equipment needed for monitoring

The following table summarizes the costs for all equipment needed to complete monitoring. You may purchase items directly from ALLARM (at cost) or purchase items directly from the suppliers. Each supplier (and their web address) is listed below. Supplier prices do not include tax or shipping and handling charges. Depending on your budget, you may want to share equipment among volunteers or have a complete set of equipment for each volunteer monitor. Once purchased, most equipment will last indefinitely. The PockeTester's electrode has a life expectancy of ~5 years. Replacement electrodes can be purchased for $44. Calibration solution prices are based on monitoring one site for one year.

Item	Cost	Source
TDS and Flow Measurement Kit • LaMotte Tracer PockeTester • Calibration solution • Calibration beaker • Distilled water bottle • Sample collection bottle • Gage stick	$125	ALLARM
Sample bottles for Ba and Sr	No cost	ALLARM Community Aquatic Research Laboratory
Laboratory testing for Ba and Sr	No cost	ALLARM Community Aquatic Research Laboratory
LaMotte Tracer PockeTester	$90	LaMotte Company: www.lamotte.com
Calibration solution	$14	AquaPhoenix Scientific: www.aquaphoenixsci.com
Calibration solution beaker	$3	AquaPhoenix Scientific: www.aquaphoenixsci.com
Distilled water wash bottle	$8	AquaPhoenix Scientific: www.aquaphoenixsci.com
Sample bottle	$5	AquaPhoenix Scientific: www.aquaphoenixsci.com
Tape measure	Optional	
Waders	Optional	

Step 6: Where will you monitor?

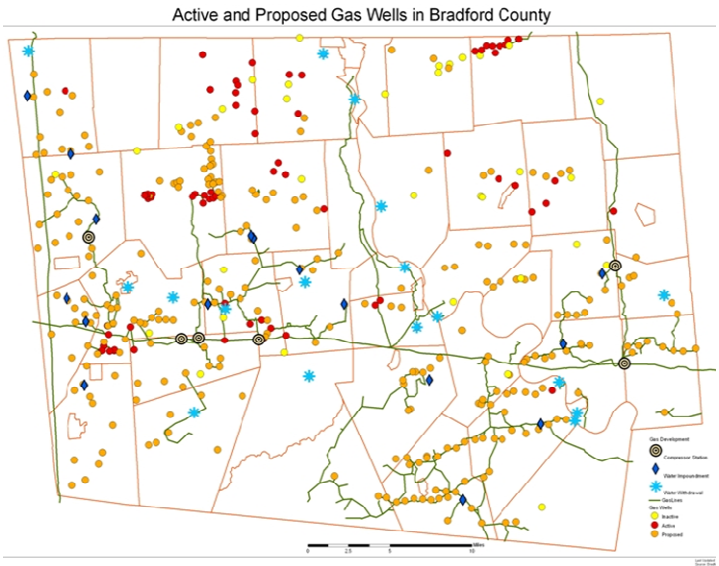
In this step you will determine your monitoring site locations. Site locations can be a balancing act; however you must always keep in mind the overall goals of your monitoring program and make sure your sites produce data that can address these goals.

Part I. How do we find out where the drilling sites are?

For Marcellus Shale gas extraction impact monitoring, the first consideration in most cases will be the location of the gas extraction activities. Permit applications for drilling are made public in a timely fashion by the PA Department of Environmental Protection (DEP), and can be accessed by signing up for

eNotices: http://www.ahs2.dep.state.pa.us/eNOTICEWeb/. DEP also publishes an updated excel spreadsheet of all active wells every two weeks[6]; click on 'Alphabetically by County Name': http://www.dep.state.pa.us/dep/deputate/minres/oilgas/reports.htm. Permit applications and site locations for water withdrawal or discharges within the Susquehanna River Basin can be found on the Susquehanna River Basin Commission (SRBC) website: http://www.srbc.net/wrp/. And finally, a privately-managed website called rIstore compiles all eNotices and updates compilation tables every day: http://www.rlstore.com.

During the first workshop, ALLARM will demonstrate permit information access using all of these sources. In addition, ALLARM will bring maps of the watersheds represented at the workshop showing drilling activities up to several weeks prior to the date of the workshop. Groups should use the maps for determining site locations, and then use the permit research skills learned at the workshop and continue to update the maps in the future.



Map made by Vinca Krajewski and Simona Perry, Dickinson College, 03.31.10.

Part II. How do we choose our sites?

Before you make any decisions about site location, you should use the base maps that are provided to enter any information that is important to you and that will help determine priority site locations. For example, use your knowledge of the watershed to denote areas of special interest such as high quality stream reaches, swimming holes and fishing areas, forested or pristine sections, areas with endangered or high value species, stream reaches with other potential impacts such as agricultural or industrial activities, and so on. Ultimately your site selection will be prioritized on the basis of the juxtaposition of areas of interest with areas of extraction activities.

Other site location considerations include:

- *Accessibility*: Can you easily access the site? Are there public lands you can use? Bridges? Friendly neighbors? If you need to access the stream from someone's property, you will need to get the landowner's permission.
- *Resources and number of sites*: How many sites can you support given your resources? Look at the cost chart on p. 13 to help answer this question. Can you share equipment between volunteers? How many volunteers do you have? What are your time constraints?

[6] This compilation does not include wells in the permit application stage.

- *Safety*: Can you wade in your streams? In order to collect representative water samples, ALLARM recommends that samples be taken from the center of the stream. If you cannot safely wade in your streams, you will want to consider bridges as sampling locations. Or you will need to explore purchasing or building a sampling pole.

You will want to make note of the site locations you choose as well as why you chose those sites and a brief description of each site.

Site Number	Brief Description of Location

Once you have determined your sites, you will want visit those sites to document the exact locations and give them site numbers. You can use Global Positional Units (GPS) to obtain longitude and latitude coordinates that can be entered into Geographic Information Systems (GIS) for mapping purposes. If GPS is not available, use United States Geological Survey (USGS) county topographic maps to mark locations.

Once site locations are determined, ALLARM recommends giving the site a name with the initials of the waterway and the stream mileage (stream miles from the site to the mouth of the waterway; if a tributary it is the mileage from the site to the confluence). ALLARM can help groups calculate stream mileage using a Geographic Information System. For example:

Name of stream: Conodoguinet Creek
Mileage from site to confluence with Susquehanna River: 1.3 miles
Site name: CC 1.3

Remember: Monitoring is an ongoing project where decisions are revisited based on results. That is, study design is a process of constant revision and site locations may be added or removed as the situation changes in terms of the groups' resources, goals, results of the monitoring, and the status of drilling activities. Consider the sites that you have just located as a first pass on site locations and be open to revision as the circumstances change.

Step 7: When will you monitor?

The ideal study would measure everything everywhere all the time. Unfortunately, this is never possible, and so scientists settle for sampling the environment. The more samples you take, the more secure you can be that your results match the "true" results. But the number of samples will depend once again on the resources available – time, personnel, equipment, and of course, money.

The fact that we are looking for leaks and spills, which are transient events, makes the sampling frequency even more challenging. A spill or leak may impact the chemistry of a stream at any one spot for a very short period of time, as it moves downstream and becomes diluted. Water chemistry is a snapshot in time of conditions; often it does not tell us too much about what happened yesterday or even several hours ago. However, there are other more long-lasting clues to recent contamination events – the kinds of clues that we may discover when we do observational monitoring – for example, impacts on instream habitat, erosion rills on the land or even gases bubbling from the ground.

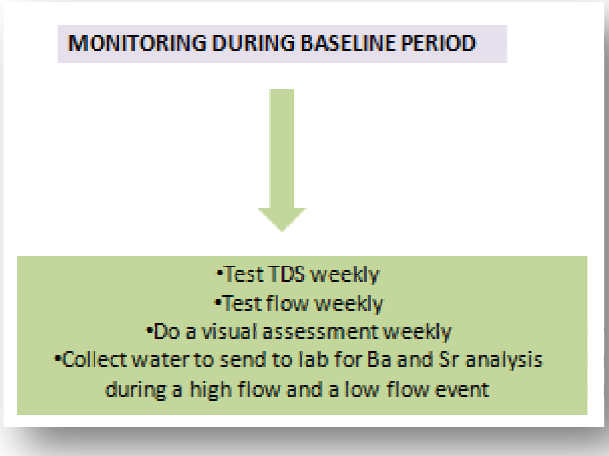
We are recommending that volunteers monitor their sites once per week as a compromise between the ideal and the practical. You need to determine a clear monitoring schedule up front so that monitors are consistent and understand the time commitment and expectations from the beginning.

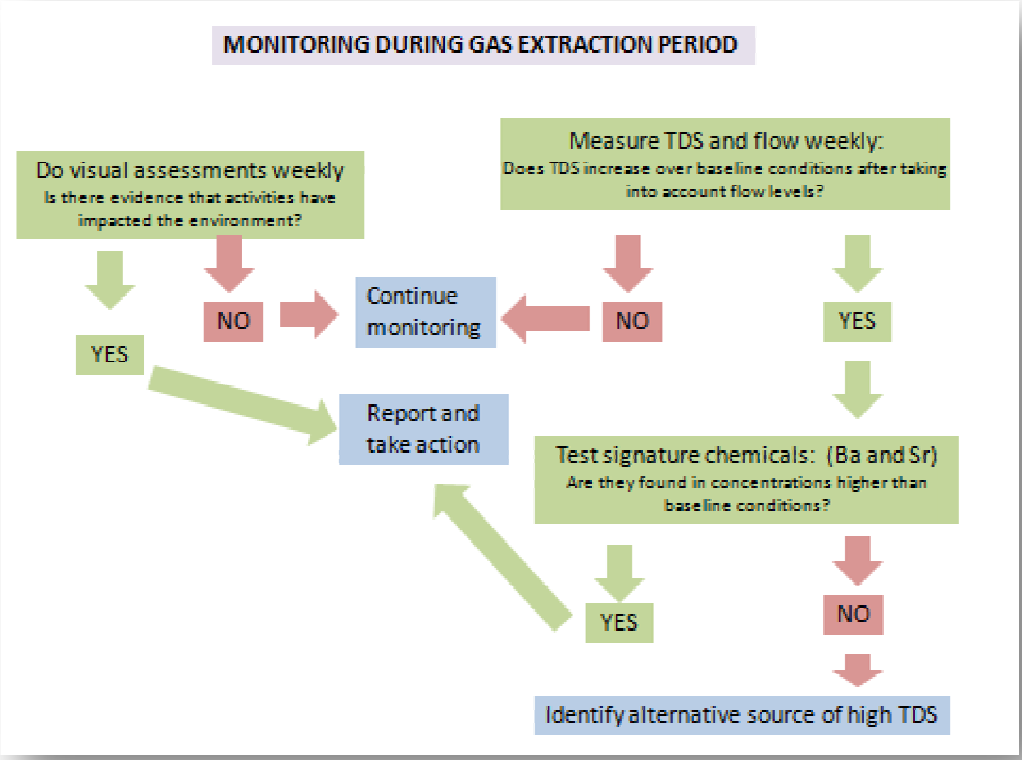
During the baseline data collection period (prior to the onset of drilling activities), we recommend:

- weekly monitoring of TDS
- weekly monitoring of stream level
- weekly visual assessment

In addition, volunteer monitors should send water samples to the ALLARM laboratory for analysis of Ba and Sr during one high flow event and one low flow event during the baseline data collection period. Ideally this baseline collection period will last a full year, but this ideal condition will not always be met.

After drilling begins, volunteers should continue the weekly protocol. Samples for analysis of Ba and Sr should only be collected if TDS concentrations are found to be higher than expected based on baseline conditions. This protocol is diagrammed below:





HELPFUL HINT: Since you will be monitoring once per week, choose a day of the week and get into a routine of monitoring at some point during that day. Building your monitoring activities into your routine helps you maintain your commitment. If you miss a week, just skip it and continue to monitor the following week.

Step 8: What are your quality assurance/quality control measures?

Quality assurance refers to the measures you take to ensure that your data meet the standards of quality that you define (the plan); quality control refers to the actions you implement to achieve your quality assurance objectives (the steps). Essentially in this step you are determining the actions you will take to assure that your data meet your data quality objectives.

In most cases, we anticipate that the data quality objectives include that the data must be credible and of sufficient value to solicit a timely response for mitigation. Explaining our quality assurance plan to regulators and companies is one way to assure that the data are viewed as credible and sufficient to warrant a timely response.

The actions we will implement to achieve these quality assurance objectives are:

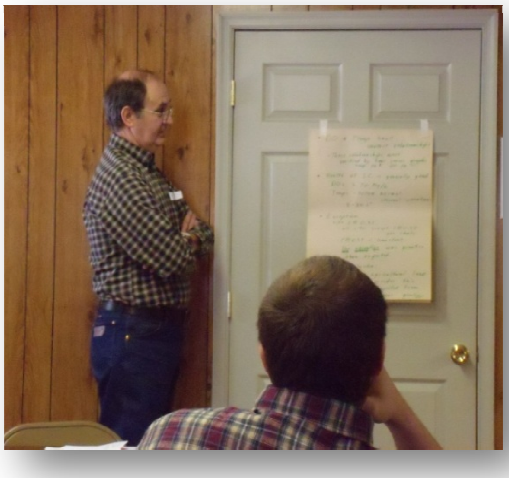
- *Training requirements*: All volunteers will receive training from service providers in the state of PA such as ALLARM. This training will consist of close examination of the monitoring manuals, laboratory training on equipment, and field training including chemical monitoring, flow measurement, and visual assessment.

- *Care and calibration of equipment*: The TDS meters will be calibrated using standard solutions before each use and they will be stored according to manufacturer specifications between uses.

- *External QA/QC measures*: All volunteers will be required to pass a split sample quality control test. Monitors will use the TDS meters to test the stream water and then collect an extra set of water samples to send with their data to the ALLARM lab. At the lab, the water will be tested using the monitors' equipment as well as more sophisticated equipment and results will be compared to the data collected by the volunteers. If the precision is within acceptable limits, the volunteers will have passed the quality control test and can continue monitoring. If the precision is outside the acceptable limits, ALLARM will make suggestions to the volunteers and they will try again.

- *Documentation of procedures*: It is essential that all of your methods are clearly documented so that anyone can see your quality control plan and action. This manual, along with other manuals with more detailed instructions on methods, provide the necessary records to insure credibility.

Step 9: How will you manage your data?

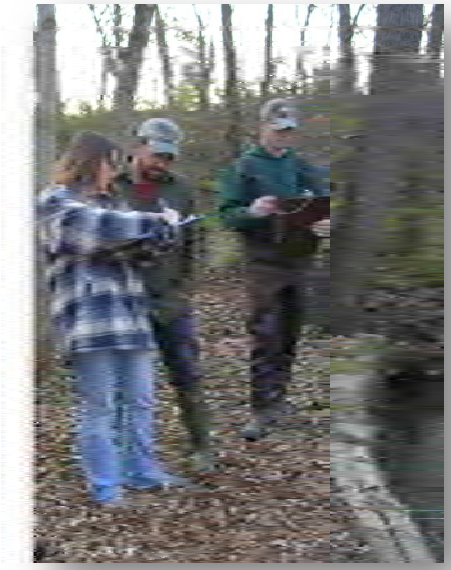


Since we are attempting to detect impacts of gas extraction activities and then to act in a timely manner, it is essential that all data are compiled and examined carefully as they are collected. That is, in this particular project, data cannot be archived and examined at a later date for patterns, but need to be compiled and examined on a weekly basis.

For these reasons, we suggest that a data manager who is willing to compile and examine the data be identified. All volunteers will submit data on a weekly basis to this person, who will compile the numbers and observations and work with data collectors to determine if the data reveal a problem that needs to be addressed. Turning the data into information and the information into quick action will require establishing a strong communication network among the participants.

ALLARM can offer data interpretation and data communication workshops upon request. In addition, ALLARM has sample data sheets, Excel databases, and data interpretation instructions as a part of the "Data Management" section of the Technical Assistance Toolkit. (http://www.dickinson.edu/about/sustainability/allarm/content/Toolkit/). Appendix D1 contains a decision tree to help guide your choices and Appendix D2 contains a table with the names and numbers of offices to contact with your findings.

Step 10: What are the tasks and who will do them?



This final step is a task that must be completed before the monitoring can begin. There are many responsibilities and roles that come with maintaining a successful volunteer monitoring program. It is important that responsibilities are shared so that volunteers are not overburdened.

Think through your monitoring plan and develop a timeline with the different tasks that need to be accomplished to achieve your goals. Look at the list of tasks and see if any can be grouped together. Afterwards develop titles for different roles and job descriptions.

Possible monitoring positions:

- *Program Coordinator*: Checks in with monitors, keeps track of training schedule, maintains QA/QC results and needs, and reminds volunteers of monitoring dates.
- *Permit Watch Coordinator*: The group expert on following permit applications and helping groups update watershed maps with the latest information.
- *Volunteer Trainer*: Someone who understands the monitoring methodology and procedures, has accreditation, or has gone through a train-the-trainer program.
- *Data Management Coordinator*: Collects data sheets, enters data into database, and conducts data analysis.
- *Data Entry Volunteer*: A volunteer that double checks that the data have been entered into the database correctly.
- *Equipment Manager*: Keeps a schedule with reagent expiration dates, is responsible for ordering and distributing supplies.
- *Volunteer Monitors*: Carries out monitoring.

Use the table below to develop a list your tasks, assign roles to participants, and develop a timeline for participation.

Task	Task Description	Assigned to Whom	Targeted Action Time

References:

New York State Department of Environmental Conservation, Division of Mineral Resources. 2009. *DRAFT Supplemental Generic Environmental Impact Statement On The Oil, Gas and Solution Mining Regulatory Program*, available on line at: http://www.dec.ny.gov/energy/58440.html

River Network and PA DEP Citizen Volunteer Monitoring Program. 2001. *Designing Your Monitoring Program: A Technical Handbook for Community-Based Monitoring In Pennsylvania*.

Zerbe, F. and C. Wilderman, 2010. Monitoring Impacts of New Gas-drilling Technologies, *The Volunteer Monitor*, 21(1), Spring 2010.

Appendix A1:
Detailed directions for chemical monitoring of conductivity and TDS

You may measure the conductivity and TDS of the water by inserting the meter directly into the stream, but it may be difficult to read the display. Therefore, if you would prefer, you can collect a water sample in a bottle and do the measurement when you return to streamside.

Sample Bottle Preparation

To prepare your bottle, you should thoroughly wash and rinse a container. The container must be large enough so that the meter electrodes can be fully immersed in the water.

Sample Collection

This sample collection protocol applies to collecting water samples for field measurement of TDS as well as to collecting water samples to send to the ALLARM laboratory for analysis of signature chemicals (Ba and Sr). This method is designed to collect a water sample that is small enough in volume to be conveniently collected, transported, and handled, while accurately representing the quality of the entire stream segment at the point in time when the sample was taken.

1) **Sampling location:** You should collect your sample away from the stream bank in the current, ideally in the middle of the stream. Do not sample stagnant water.

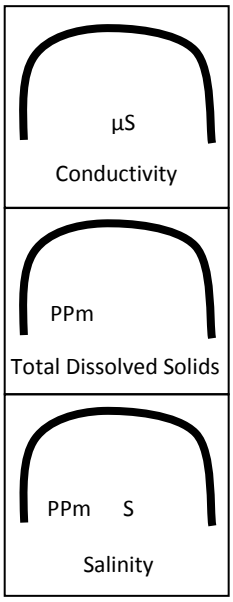
2) **Entering the stream:** Enter the stream downstream of your sampling location to avoid introducing any disturbed sediment into the sample. Move to the center of the stream, if possible, and collect a water sample facing upstream from where you are standing (the water will be flowing towards you).

3) **Rinsing the sample bottle:** Rinse the bottle and cap of your sampling bottle with stream water, being careful not to touch the insides of the bottle or cap with your hands. Totally fill the bottle and cap with water. Pour out the rinse water downstream from where you are sampling (behind you) to avoid reintroducing the rinse water back to the collected sample. **Repeat 3 times.**

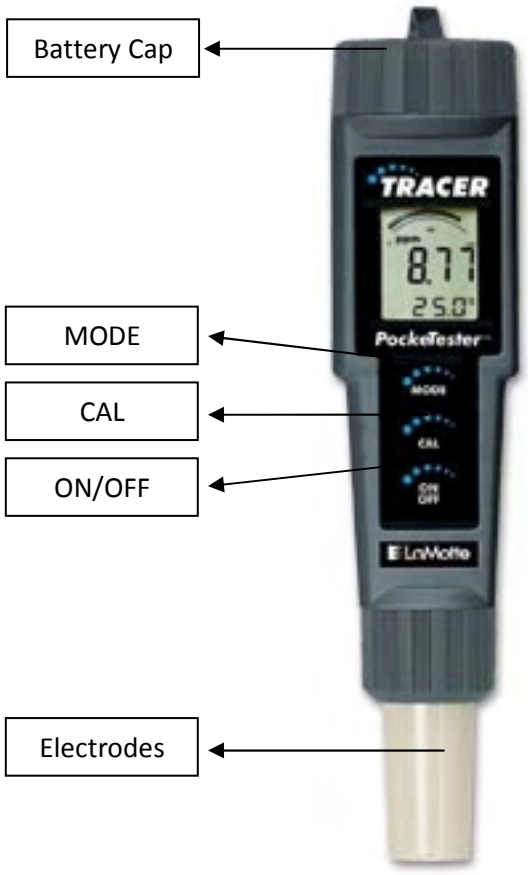
4) **Collecting a sample:** Prepare to fill the bottle by slightly tilting the mouth towards you. This will position the bottle opening away from the direct flow of the stream current. Lower the bottle into the stream current, attempting to smoothly and evenly sample the entire depth of the stream. Try to get the same volume of sample at each depth. Keeping the sample bottle slightly tilted will prevent the bottle from totally filling, which will allow for thermal expansion during shipping/transportation (if necessary). Cap the filled bottled.

Conductivity/Total Dissolved Solids Measurement: LaMotte Tracer PockeTester

Step 1: Calibrate the meter (home)



1. Turn the meter on by pressing the **ON/OFF** button.
2. Take off the bottom cap covering the electrodes.
3. The meter must be in conductivity mode (*"µS" will be displayed above the reading; to change modes, press the **MODE** button for 3 seconds).*
4. Place the meter in 20 mL of 1413 µS/cm standard calibration solution. Press and hold the **CAL** button for ~2 seconds. "CAL" will appear on the bottom of the screen and 1413 will flash on the screen.
5. The device will automatically recognize and calibrate to the conductivity standard. 1413 will stop flashing and the display will briefly read "SA" and "End". *("SA" will not appear if the calibration fails.*)
6. Rinse the meter with distilled water, shake dry, and turn the meter off.



Note: If sampling weekly, meters should be calibrated every other week.

Step 2: Measure the conductivity and TDS of a water sample (field)

1. Turn on the meter by pressing the **ON/OFF** button.
2. Take off the bottom cap covering the electrodes.
3. "SELF CAL" will flash and then disappear on the display.
4. Make sure the meter is in conductivity mode (*"µS" will be displayed above the reading; to change modes, press the **MODE** button for 3 seconds).*
5. Place the meter directly into the stream, making sure the electrodes are completely immersed in the water.
    a. If you prefer, you may take a water sample from the middle of the stream and place the meter in the clean sample container.
        i. Enter the stream downstream from your monitoring point to avoid introducing disturbed stream sediment to the sample.
        ii. Move to the center of the stream, if possible.
        iii. Collect the water sample using a clean sample bottle facing upstream from where you are standing (water is flowing towards you).
6. Allow the reading to stabilize.
7. Record the conductivity measurement on your data sheet.
8. Hold the **MODE** button for approximately 3 seconds (*TDS will flash on the bottom of the display and "ppm" will be in the top left corner of the display. There should not be an "S" above the reading – that is the salinity mode*).
9. Allow the reading to stabilize.
10. Record the TDS measurement on your data sheet.
11. When finished, rinse the meter with distilled water and turn the meter off.

Chemical and Flow Monitoring Data Sheet

Sample Site: _____ **Date:** _____ **Time:** _____

Sample Site Location: _____**Latitude**:_____**Longitude:**_____

Monitor's Name: _____

****

Circle the description that best matches your observation:

Weather & Precipitation: Clear Cloudy Partly Cloudy Fog/Haze

Rain Drizzle Intermittent Rain Snow

Precipitation last 48 hours: None Trace Light Moderate Heavy

****

Parameter	Units	Replicate 1	Replicate 2	Average
Conductivity	µS/cm			
Total Dissolved Solids	mg/L			

Enter the width and depth of the stream in tenths of feet below:

Surrogate Stream Flow:_____ feet (width) x _____ feet (depth) = _____ ft^2 (cross-sectional area)

Inches to feet conversion

1 inch = 0.08 ft	5 inches = 0.42 ft	9 inches = 0.75 ft
2 inches = 0.17 ft	6 inches = 0.50 ft	10 inches = 0.83 ft
3 inches = 0.25 ft	7 inches = 0.58 ft	11 inches = 0.92 ft
4 inches = 0.33 ft	8 inches = 0.67 ft	

Appendix A2:
Detailed directions for chemical monitoring for Barium and Strontium

Sample Bottle Preparation

Please use the bottles that ALLARM has supplied to you for collecting samples for Barium and Strontium analysis. ALLARM has double acid washed these bottles (with hydrochloric and nitric acid) and rinsed them thoroughly with deionized water. Use one bottle per site.

Sample Collection

Follow directions under sample collection in Appendix A1. In addition, **Label the bottle** with your name, the site number and location, and the date and time of the sampling.

Sending Samples to the ALLARM Laboratory for Signature Chemical Analysis

Place your water sample (check to be sure the cap is securely fastened) and completed data sheet securely into a small box. Seal the box with packaging tape and send to:

ALLARM
Dickinson College
5 N. Orange Street
Carlisle, PA 17013

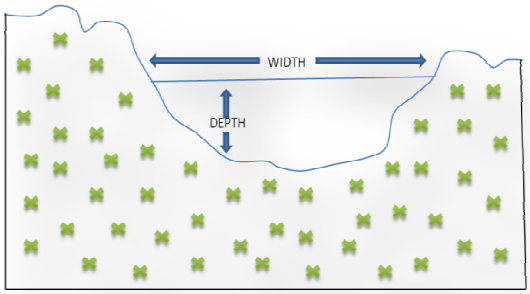
Please notify ALLARM that a sample has been shipped by sending an e-mail to woodwarj@dickinson.edu or calling 717.245.1021 and leaving a message.

Appendix B:
Detailed directions for flow monitoring

You will be taking a surrogate flow measurement every week when you go to your site to measure TDS and to do a visual assessment. You can purchase the materials needed to measure flow (option A) from ALLARM or you can construct your own. Be sure to enter the depth and the width on the data sheet used for chemical monitoring (Appendix A1).

1) **Choosing a stream reach:** Choose an area around your site that has easy access and is wadable under most flow conditions. It is also best to choose a reach that is uniform in depth across the width of the stream; this is usually the case with reaches that are straight, rather than curved.

2) **Measuring width:** Stretch a measuring tape or string across the stream and measure the distance from one bank to the other, starting at the edge of the water and extending perpendicular to the direction of the stream channel to the edge of the water on the opposite bank. Read the measurement in feet. If the tape reads in feet and inches, convert the final number to the nearest tenth of a foot.



3) **Measuring depth:** Measure the depth along the transect that you have defined in your width measurement using your gage stick. This depth measurement is also called the stage or height of the stream.

OPTION A. DEPTH MEASUREMENT USING THE GAGE STICK

Choose a spot that you can identify and return to every week and that is approximately the average depth. To determine this, on the first field day, measure depth every foot across your transect and average those numbers. Then locate the position where depth is approximately equal to that average.

To be sure you can return to the same spot each week, find some reference points (i.e. rocks, trees, etc.) that will help you locate the spot, even under different flow conditions.

OPTION B. USING A MORE PERMANENT STAFF GAGE

There are several ways to install a more permanent gage stick or staff gage that will withstand varying flows and that you can use to read the depth of the creek every week. You can pound a calibrated gage stick into the stream bed. You can embed the staff in a heavy object, such as a tire filled with cement. If your site is near a bridge, you can attach a staff to one of the bridge piers, or even calibrate the pier directly.

Appendix C: Visual Assessment Form

Observations for Gas Related Earth Disturbances

Streams:

- ❑ Visual evidence of sediment entering stream, pond, wetland, or other body of water
  - Sediment plume
  - Discolored water
  - Increased sediment deposition on the stream bottom

Access Roads:

- ❑ Mud/sediment/drainage from access road travels to main road
- ❑ Mud/sediment/drainage from access road enters road ditch
- ❑ Access road not stabilized with clean gravel
- ❑ Access road crosses stream and drainage from road empties directly into stream
- ❑ Access road banks are not stabilized (no mulch, seeding, vegetation, etc.)

Drill Pad, Storage Pond, and Stages Areas:

- ❑ Earth has been disturbed to edge of water body and there are no controls to stop or filter runoff
- ❑ Clean water enters the site from uphill with no diversion ditch
- ❑ Outlets of sediment control structures go directly into a water body without filtering or cleaning runoff
- ❑ Outlets of sediment control structures are not stabilized (no mulch, seeding, vegetation, etc.)

Observations for Spills and Discharges

Streams:

- ❑ Unusual order in the water
- ❑ Discolored water (such as an oily film on the water surface)
- ❑ Persistent foam and/or bubbles (where there isn't normal agitation)
- ❑ Dead fish and/or other organisms are in the water or along the bank

Observations for Gas Migration or Leakage

Streams:

- ❑ Gas bubbling to surface
- ❑ Unusual order (due to mercaptan compounds)

Appendix D1: Decision Tree

TURNING DATA INTO ACTION

Making decisions on whether data are "actionable" is a complex process. The decision trees in this section are designed to help guide you through that process. There is a tree for each of our three monitoring parameters: visual assessment, chemical monitoring, and flow monitoring.

Below is a brief summary of the steps in our protocol for data collection, interpretation, and action. The decision trees are then found on the next pages.

STEP 1. COLLECTING BASELINE DATA. Collect baseline data for as long as possible. Each week, fill out the data sheets, examine them for any outliers or unusual values, and then send the data to your data manager for archiving and graphing.

The purpose of our baseline data is to determine the relationship between TDS and flow and the natural seasonal fluctuations in TDS and flow. Once these background relationships are established, it will be easier to determine if there is an impact from gas extraction activities.

STEP 2. COLLECTING WATCHDOG DATA. Once gas extraction activities begin, continue to collect weekly data as before. At this stage, the important thing is to examine each week's results very closely to ascertain whether or not there are any values that differ from what we would expect based on the baseline data.

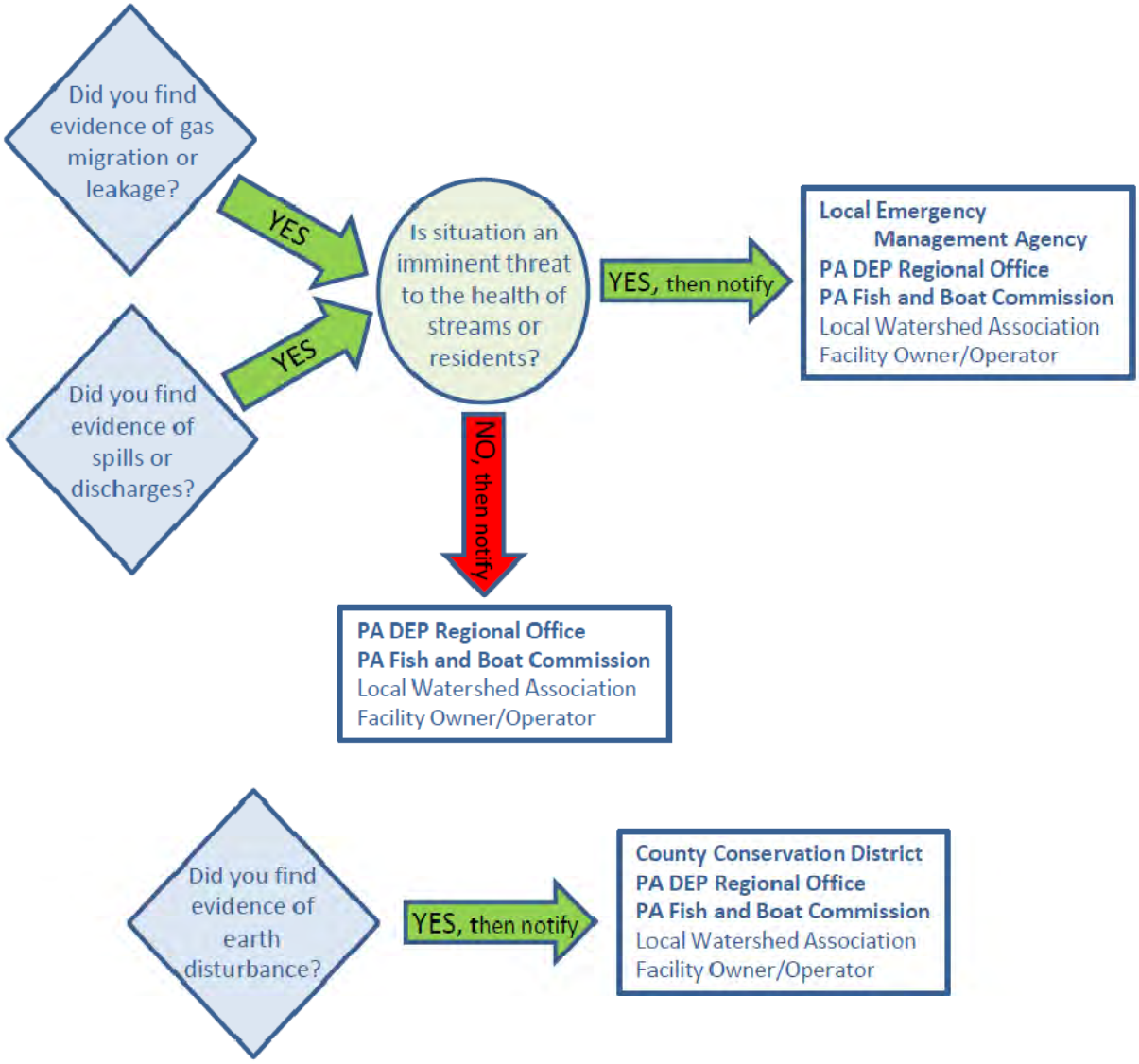
STEP 3. TAKING ACTION. If you find data that indicate there may be an impact, you need to determine if this event is reportable, and if so, to whom to report. Use the decision tree to help in this process.

Ultimately, you need to use your judgment on whether to report your findings or not. It is better to err on the side of caution but it is also important not to repeatedly "cry wolf." One of the advantages in working with groups and in partnership with local agencies is that you can consult them for advice on whether or not an event that you have observed is actionable.

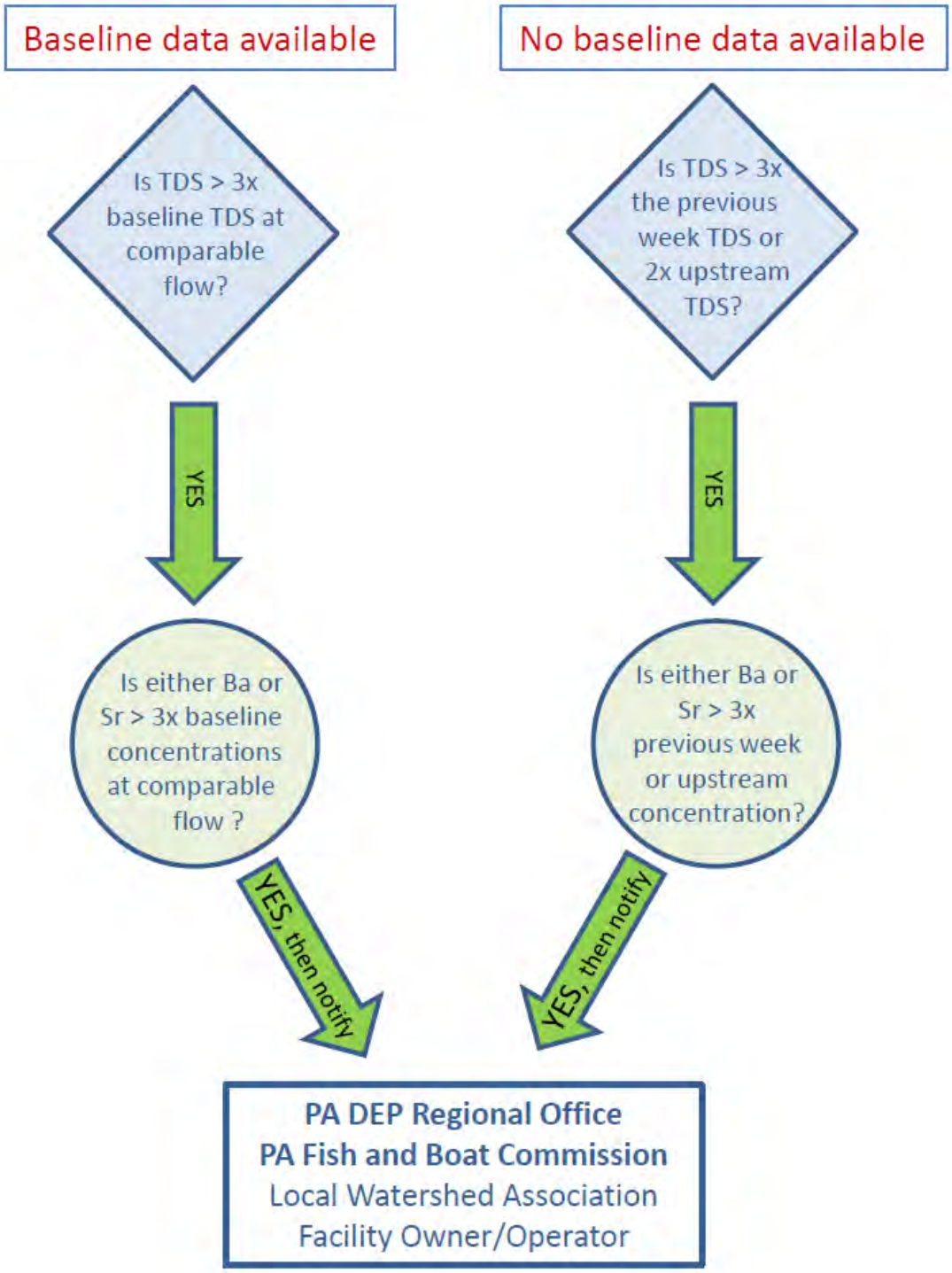
When you report an event, be sure to identify yourself as someone who has been monitoring the stream for gas extraction impacts and has been trained to do so by ALLARM at Dickinson College. Explain that ALLARM is providing quality control services to assure that your data are credible. Also explain that you have been collecting baseline data and are aware of what constitutes healthy conditions of the stream system. Do not be shy about your credentials or training.

STEP 4. ARCHIVING DATA. These data should also be sent to your data manager for archiving. Even if no actionable events occur (hopefully), the data can be graphed and utilized to increase our knowledge of stream TDS and flow patterns -- knowledge that ultimately should lead to better management practices.

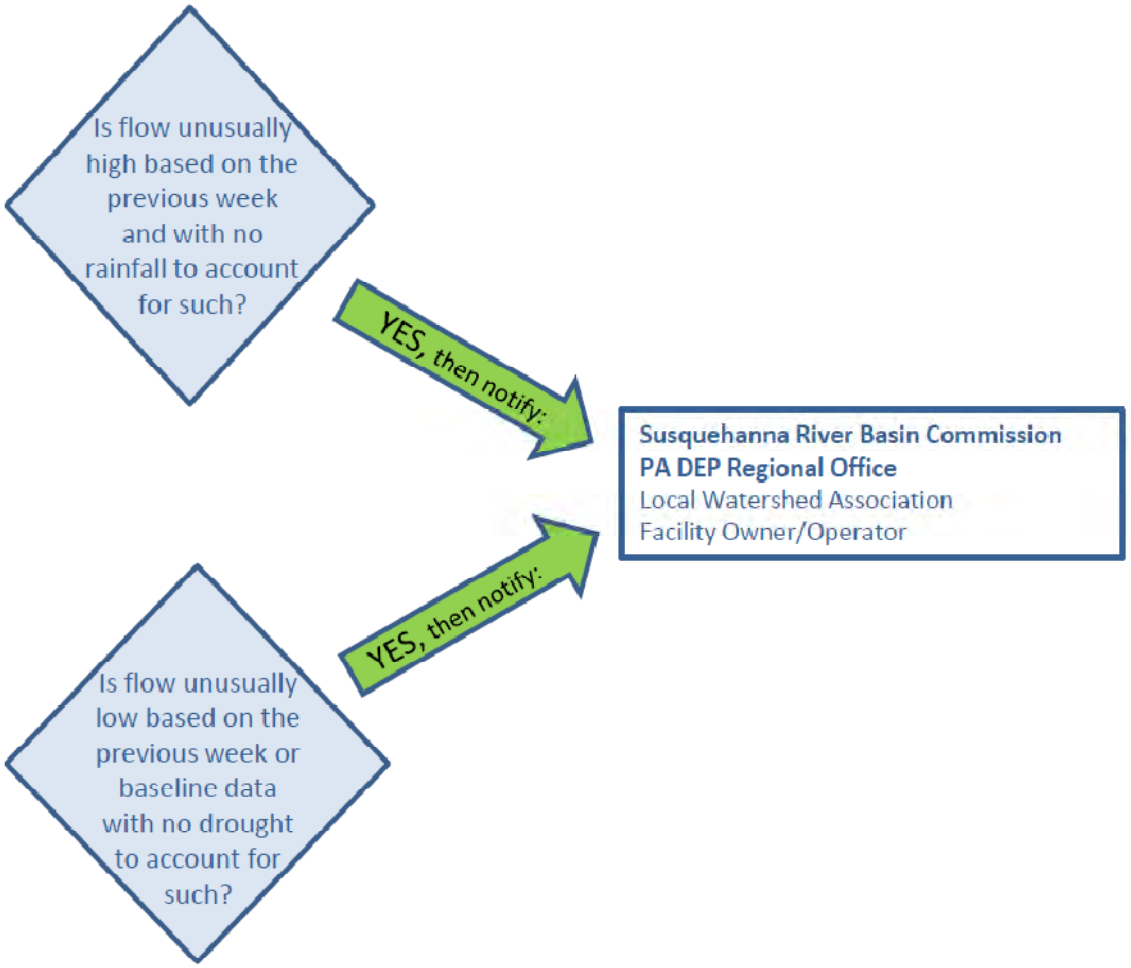
VISUAL ASSESSMENT DECISION TREE



CHEMICAL MONITORING DECISION TREE



FLOW MONITORING DECISION TREE



Appendix D2: Contact Information

AGENCY CONTACT INFORMATION BY COUNTY

COUNTY	PaDEP REGIONAL OFFICE	Pa FISH & BOAT COMM. REGIONAL OFFICE	COUNTY CONSERVATION DISTRICT	Pa GAME COMMISSION REGIONAL OFFICE
Adams	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Gettysburg, PA 17325 (717) 334-0636	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Allegheny	Southwest Regional Office Pittsburgh, PA (412) 442-4000	Southwest Regional Office Somerset, PA (814) 445-8974	Pittsburgh, PA 15208 (412) 241-7645	Southwest Regional Office Bolivar, PA (724) 238-9523
Armstrong	Southwest Regional Office Pittsburgh, PA (412) 442-4000	Southwest Regional Office Somerset, PA (814) 445-8974	Kittanning, PA 16201 (724) 548-3425	Southwest Regional Office Bolivar, PA (724) 238-9523
Beaver	Southwest Regional Office Pittsburgh, PA (412) 442-4000	Southwest Regional Office Somerset, PA (814) 445-8974	Aliquippa, PA 15001 (724) 378-1701	Southwest Regional Office Bolivar, PA (724) 238-9523
Bedford	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Bedford, PA 15522 (814) 623-7900 ext. 4	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Berks	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southeast Regional Office Elm, PA (717) 626-0486	Leesport, PA 19533-0520 (610) 372-4657	Southeast Regional Office Reading, PA (610) 926-3136
Blair	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Hollidaysburg, PA 16648 (814) 696-0877 ext. 5	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Bradford	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northeast Regional Office Sweet Valley, PA (570) 477-3221	Towanda, PA 18848 (570) 265-5539	Northeast Regional Office Dallas, PA (570) 675-1143
Bucks	Southeast Regional Office Norristown, PA (484) 250-5900	Southeast Regional Office Elm, PA (717) 626-0486	Doylestown, PA 18901 (215) 345-7577	Southeast Regional Office Reading, PA (610) 926-3136
Butler	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northwest Regional Office Meadville, PA (814) 337-0444	Butler, PA 16001-6501 (724) 284-5270	Northwest Regional Office Franklin, PA (814) 432-3187
Cambria	Southwest Regional Office Pittsburgh, PA (412) 442-4000	Southwest Regional Office Somerset, PA (814) 445-8974	Ebensburg, PA 15931 (814) 472-2120	Southwest Regional Office Bolivar, PA (724) 238-9523
Cameron	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Emporium, PA 15834 (814) 486-2244 ext. 5	Northcentral Regional Office Jersey Shore, PA (570) 398-4744

COUNTY	PaDEP REGIONAL OFFICE	Pa FISH & BOAT COMM. REGIONAL OFFICE	COUNTY CONSERVATION DISTRICT	Pa GAME COMMISSION REGIONAL OFFICE
Carbon	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Northeast Regional Office Sweet Valley, PA (570) 477-3221	Lehighton, PA 18235 (610) 377-4894 ext. 4	Northeast Regional Office Dallas, PA (570) 675-1143
Centre	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Bellefonte, PA 16823 (814) 355-6817	Northcentral Regional Office Jersey Shore, PA (570) 398-4744
Chester	Southeast Regional Office Norristown, PA (484) 250-5900	Southeast Regional Office Elm, PA (717) 626-0486	Kennett Square, PA 19348 (610) 925-4920	Southeast Regional Office Reading, PA (610) 926-3136
Clarion	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northwest Regional Office Meadville, PA (814) 337-0444	Clarion, PA 16214 (814) 226-4070	Northwest Regional Office Franklin, PA (814) 432-3187
Clearfield	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Clearfield, PA 16830 (814) 765-2629	Northcentral Regional Office Jersey Shore, PA (570) 398-4744
Clinton	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Mill Hall, PA 17751 (570) 726-3798	Northcentral Regional Office Jersey Shore, PA (570) 398-4744
Columbia	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Bloomsburg, PA 17815 (570) 784-1310	Northeast Regional Office Dallas, PA (570) 675-1143
Crawford	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northwest Regional Office Meadville, PA (814) 337-0444	Meadville, PA 16335 (814) 763-5269	Northwest Regional Office Franklin, PA (814) 432-3187
Cumberland	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Carlisle, PA 17013 (717) 240-7812	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Dauphin	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Dauphin, PA 17018 (717) 921-8100	Southeast Regional Office Reading, PA (610) 926-3136
Delaware	Southeast Regional Office Norristown, PA (484) 250-5900	Southeast Regional Office Elm, PA (717) 626-0486	Media, PA 19063 (610) 892-9484	Southeast Regional Office Reading, PA (610) 926-3136
Elk	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Ridgeway, PA 15853 (814) 776-5373	Northcentral Regional Office Jersey Shore, PA (570) 398-4744

COUNTY	PaDEP REGIONAL OFFICE	Pa FISH & BOAT COMM. REGIONAL OFFICE	COUNTY CONSERVATION DISTRICT	Pa GAME COMMISSION REGIONAL OFFICE
Erie	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northwest Regional Office Meadville, PA (814) 337-0444	Erie, PA 16509 (814) 825-6403	Northwest Regional Office Franklin, PA (814) 432-3187
Fayette	Southwest Regional Office Pittsburgh, PA (412) 442-4000	Southwest Regional Office Somerset, PA (814) 445-8974	Lemont Furnace, PA 15456 (724) 438-4497	Southwest Regional Office Bolivar, PA (724) 238-9523
Forest	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northwest Regional Office Meadville, PA (814) 337-0444	Tionesta, PA 16353 (814) 755-3450	Northwest Regional Office Franklin, PA (814) 432-3187
Franklin	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Chambersburg, PA 17202 (717) 264-5499	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Fulton	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	McConnellsburg, PA 17233 (717) 485-3547	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Greene	Southwest Regional Office Pittsburgh, PA (412) 442-4000	Southwest Regional Office Somerset, PA (814) 445-8974	Waynesburg, PA 15370 (724) 852-5278	Southwest Regional Office Bolivar, PA (724) 238-9523
Huntingdon	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Huntingdon PA 16652 (814) 627-1627	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Indiana	Southwest Regional Office Pittsburgh, PA (412) 442-4000	Southwest Regional Office Somerset, PA (814) 445-8974	Indiana, PA 15701-3571 (724) 471-4751	Southwest Regional Office Bolivar, PA (724) 238-9523
Jefferson	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Brookville, PA 15825 (814) 849-7463	Northwest Regional Office Franklin, PA (814) 432-3187
Juniata	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Mifflintown, PA 17059 (717) 436-8953 ext. 5	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Lackawanna	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Northeast Regional Office Sweet Valley, PA (570) 477-3221	Mayfield, PA 18433 (570) 281-9495	Northeast Regional Office Dallas, PA (570) 675-1143
Lancaster	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southeast Regional Office Elm, PA (717) 626-0486	Lancaster, PA 17601 (717) 299-5361	Southeast Regional Office Reading, PA (610) 926-3136

COUNTY	PaDEP REGIONAL OFFICE	Pa FISH & BOAT COMM. REGIONAL OFFICE	COUNTY CONSERVATION DISTRICT	Pa GAME COMMISSION REGIONAL OFFICE
Lawrence	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northwest Regional Office Meadville, PA (814) 337-0444	New Castle, PA 16101 (724) 652-4512	Northwest Regional Office Franklin, PA (814) 432-3187
Lebanon	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Lebanon, PA 17042 (717) 272-3908 ext. 4	Southeast Regional Office Reading, PA (610) 926-3136
Lehigh	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Southeast Regional Office Elm, PA (717) 626-0486	Allentown, PA 18104 (610) 391-9583	Southeast Regional Office Reading, PA (610) 926-3136
Luzerne	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Northeast Regional Office Sweet Valley, PA (570) 477-3221	Shavertown, PA 18708 (570) 674-7991	Northeast Regional Office Dallas, PA (570) 675-1143
Lycoming	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Montoursville, PA 17754 (570) 433-3003	Northcentral Regional Office Jersey Shore, PA (570) 398-4744
McKean	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Smethport, PA 16749 (814) 887-4001	Northcentral Regional Office Jersey Shore, PA (570) 398-4744
Mercer	Northwest Regional Office Meadville, PA (814) 332-6945 – bus. hours 1-800-373-3398 – after hours	Northwest Regional Office Meadville, PA (814) 337-0444	Mercer, PA 16137 (724) 662-2242	Northwest Regional Office Franklin, PA (814) 432-3187
Mifflin	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	Burnham, PA 17009-1837 (717) 248-4695	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Monroe	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Northeast Regional Office Sweet Valley, PA (570) 477-3221	Stroudsburg, PA 18360 (570) 629-3060	Northeast Regional Office Dallas, PA (570) 675-1143
Montgomery	Southeast Regional Office Norristown, PA (484) 250-5900	Southeast Regional Office Elm, PA (717) 626-0486	Collegeville, PA 19426 (610) 489-4506	Southeast Regional Office Reading, PA (610) 926-3136
Montour	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Danville, PA 17821 (570) 271-1140	Northeast Regional Office Dallas, PA (570) 675-1143
Northampton	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Southeast Regional Office Elm, PA (717) 626-0486	Nazareth, PA 18064-9211 (610) 746-1971	Southeast Regional Office Reading, PA (610) 926-3136

COUNTY	PaDEP REGIONAL OFFICE	Pa FISH & BOAT COMM. REGIONAL OFFICE	COUNTY CONSERVATION DISTRICT	Pa GAME COMMISSION REGIONAL OFFICE
Northumberland	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Sunbury, PA 17801 (570) 286-7114 ext. 4	Northeast Regional Office Dallas, PA (570) 675-1143
Perry	Southcentral Regional Office Harrisburg, PA (484) 250-5900	Southcentral Regional Office Newville, PA (717) 486-8227	New Bloomfield, PA 17068 (717) 582-8988 ext. 4	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Philadelphia	Southeast Regional Office Norristown, PA (484) 250-5900	Southeast Regional Office Elm, PA (717) 626-0486	Philadelphia does not have a Conservation District.	Southeast Regional Office Reading, PA (610) 926-3136
Pike	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Northeast Regional Office Sweet Valley, PA (570) 477-3221	Hawley, PA 18428 (570) 226-8220	Northeast Regional Office Dallas, PA (570) 675-1143
Potter	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Coudersport, PA 16915 (814) 274-8411 ext. 4	Northcentral Regional Office Jersey Shore, PA (570) 398-4744
Schuylkill	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Southeast Regional Office Elm, PA (717) 626-0486	Pottsville, PA 17901 (570) 622-3742 ext. 5	Southeast Regional Office Reading, PA (610) 926-3136
Snyder	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Middleburg, PA 17842 (570) 837-3000	Southcentral Regional Office Huntingdon, PA (814) 643-1831
Somerset	Southwest Regional Office Pittsburgh, PA (412) 442-4000	Southwest Regional Office Somerset, PA (814) 445-8974	Somerset, PA 15501 (814) 445-4652 ext. 5	Southwest Regional Office Bolivar, PA (724) 238-9523
Sullivan	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northeast Regional Office Sweet Valley, PA (570) 477-3221	Dushore, PA 18614 (570) 928-7057	Northeast Regional Office Dallas, PA (570) 675-1143
Susquehanna	Northeast Regional Office Wilkes-Barre, PA (570) 826-2511	Northeast Regional Office Sweet Valley, PA (570) 477-3221	Montrose, PA 18801 (570) 278-4600 ext. 280	Northeast Regional Office Dallas, PA (570) 675-1143
Tioga	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Wellsboro, PA 16901 (570) 724-1801 ext. 5	Northcentral Regional Office Jersey Shore, PA (570) 398-4744
Union	Northcentral Regional Office Williamsport, PA (570) 327-3636	Northcentral Regional Office Pleasant Gap, PA (814) 359-5254	Lewisburg, PA 17837 (570) 524-3860	Northcentral Regional Office Jersey Shore, PA (570) 398-4744

Pennsylvania DCNR Forestry Offices

State Forest	Office Location	Telephone Number
Bald Eagle	Milmont	570.922.3344
Buchanan	McConnellsburg	717.485.3248
Clear Creek	Clarion	814.226.1901
Cornplanter	North Warren	814.723.0262
Delaware	Swiftwater	570.895.4000
Elk	Emporium	814.486.3353
Forbes	Laughlintown	724.238.1200
Gallitzin	Ebensburg	814.472.1862
Lackawanna	Scranton	570.963.4561
Loyalsock	Dushore	570.946.4049
Michaux	Fayetteville	717.352.2211
Moshannon	Penfield	814.765.0821
Rothrock	Huntingdon	814.643.2340
Sproul	Renovo	570.923.6011
Susquehannock	Coudersport	814.272.3600
Tiadaghton	South Williamsport	570.327.3450
Tioga	Wellsboro	570.724.2868
Tuscarora	Blain	717.536.3191
Weiser	Cressona	570.385.7800
William Penn	Elverson	610.582.9660