SOUTHWEST PENNSYLVANIA ENVIRONMENTAL HEALTH PROJECT

www.environmentalhealthproject.org

2017 EHP CITIZEN SCIENCE TOOLKIT

Fracking Risks in Your Community: Measuring, Monitoring, and Mitigating

A CITIZEN SCIENCE ACTION GUIDE

SW Pennsylvania Office
2001 Waterdam Plaza, Suite 201, McMurray, PA 15317
Office: 724.260.5504 | Cell: 724.249.7501

Connecticut Office
760 Chapel Street, New Haven, CT 06510
Fax: 203.691.7606

WELCOME TO EHP'S CITIZEN SCIENCE TOOLKIT

Take charge of monitoring fracking exposures in your own community!

Welcome to the Environmental Health Project's Community.
By following the processes outlined in this toolkit, you will be joining the EHP Community and taking important steps toward protecting your family and your neighbors from the potential harms associated with unconventional oil and gas development (UOGD), commonly referred to as fracking. You will learn how to track health symptoms that are appearing today, as well as provide data for evaluating the longer-term health impacts of fracking. You will understand how to monitor the air and noise pollution associated with fracking activity. You will be able to document impacts on groundwater and potential risks to drinking water. Along the way, we share tips you can use to mitigate, or limit, your exposure.

What is the Environmental Health Project?
Our mission is to respond to individuals' and communities' need for access to accurate, timely and trusted public health information and health services associated with natural gas extraction.

Since 2011, EHP has provided our free services to fracking-affected communities and grassroots partners. Our 16-member team focuses primarily on SW Pennsylvania, but also collaborates on projects in New York and California. We coordinate with community-based organizations across the country.

Feel free to contact the experts at EHP for assistance with monitoring methods, analyzing and interpreting data, and to tell us how we can serve you! The contact information of individuals who can help with various air, water, and health monitoring and tracking projects is listed in the relevant sections below. Or, call or email our Pennsylvania office at 724-260-5504 to be directed to a staff member who can help.

Your Role as a Citizen Scientist
This toolkit will provide you with an easy-to-follow framework for taking steps to becoming a more informed, empowered member of your community!

By carefully following the procedures and protocols that are defined here, you will become a citizen scientist, and your efforts can have an impact that extends well beyond your community. Your data can be added to the findings of many others. Together, this information can help you, your community, researchers and scientists truly understand the type and level of fracking-related risks.

TABLE OF CONTENTS

Click on links below to navigate.

How to use this Toolkit:

We've designed this Toolkit as an eBook, for electronic use. Hyperlinks have been embedded throughout the text of the document; click on these to navigate around the document and to access outside resources.

For those using this Toolkit in hard copy, we recommend you also visit the eBook at www.environmentalhealthproject.org to access the many additional resources provided via links.

TOOLS

As a citizen scientist, you need tools to help you collect information about and understand the fracking activity in your area. Two important tools appear in this section: ***The FracTracker web tutorial*** *and the* ***Shale Oil and Gas Health Registry & Resource Network****. A third tool, the* ***Citizen Science Log****, appears in the Appendix.*

FRACTRACKER WEB TUTORIAL

The FracTracker web platform will help you identify your geographic proximity to fracking activity. With this information, you will be able to more accurately identify your potential risks, to use the Citizen Science Log to record any health symptoms you experience, and to use the Health Registry to add your unique observations to a growing body of research.

WHAT IS FRACTRACKER?

"INSIGHTS EMPOWERING ACTION" - WE HELP PEOPLE FIND, DOCUMENT, & UNDERSTAND OIL & GAS ACTIVITY NEAR THEM

FracTracker Alliance studies, maps, and communicates the risks of oil and gas development to protect our planet and support the renewable energy transformation.

With our online maps you can:

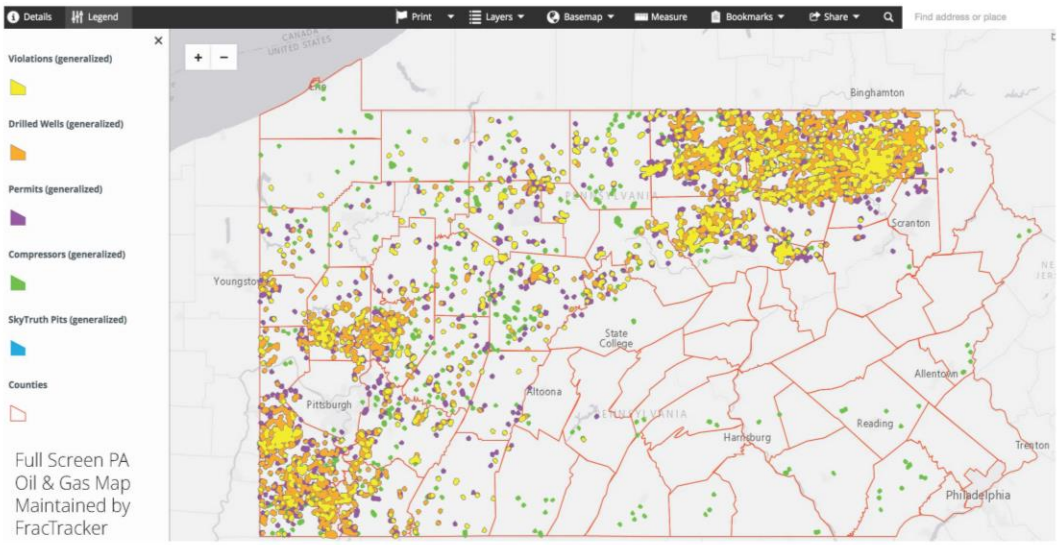
- Locate wells, compressor stations, and other oil and gas (O&G) facilities near you
- Determine your distance from an O&G site
- See patterns of O&G development and violations
- Follow the development of O&G projects, like pipelines

Visit FracTracker.org to learn more (site shown right).

NAVIGATING THE SITE & FINDING A MAP

USE THE FOLLOWING GUIDE TO LEARN MORE ABOUT NAVIGATING FRACTRACKER.ORG & OUR MAPS

1. Open your Internet browser on your computer or smart phone. We recommend using Safari, Chrome, or Firefox, not Internet Explorer.
2. Navigate to www.FracTracker.org by entering the URL in the address bar or searching for FracTracker using a search engine like Google.
3. Once on FracTracker.org, hover your mouse over the top toolbar button called "Topics" to select from a variety of articles about oil and gas drilling issues - such as pipelines.
4. Hover over "Regions" to explore information by an area instead.
5. To find your state (in the U.S.) select "State-by-State" from the drop down menu, and then click on your state in the map or sidebar on the next page (shown left).
6. Upon selecting your state of interest, you will be taken to a state-specific landing page where we share detailed oil and gas maps, statistics, related articles, and photos - where available.
7. Clicking on the oil and gas map at the top of each landing page will take you to a dynamic map showing where wells have been drilled or proposed in the state.
8. Additional data such as violations and watersheds may also be included.
9. Further down the landing page you may see different types of maps, from environmental justice concerns to pipelines and proposals like the Mariner East 2 map below:



WORKING WITH A FRACTRACKER MAP

FULL SCREEN VERSIONS OF FRACTRACKER MAPS LOOK LIKE THE PENNSYLVANIA SHALE VIEWER ABOVE. BELOW WE DISCUSS VARIOUS TOOLS AVAILABLE ON OUR DYNAMIC MAPS AND HOW TO USE THEM.

Zoom by scrolling your mouse roller or double clicking on the map. Select areas or points to bring up pop up boxes to learn more about the data being shown.

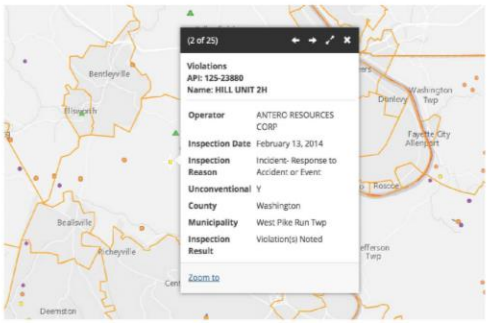
Top Toolbar (Left to Right):

- **Details** – Use this section to learn about the map and its data.
- **Legend** – Discover what the various symbols on the map mean. (On the PA map above, you can see violations, drilled wells, permits, compressor stations, pits, and counties).
- **Print** – Export the map as seen on the screen in a variety of file types, such as JPG and PDF files, and different resolutions.
- **Layers** – Toggle layers off to hide them from view.
- **Basemap** – Change the background image behind the data, such as Street View, National Geographic, or Topographic.
- **Measure** – Quantify an area or distance, or determine the latitude and longitude of a specific point. In the pop up box, choose which measurement option you would like, then click on the beginning point on the map. When you would like your measurement result, double click your mouse.
- **Bookmarks** – Save a spot on the map to refer to later.
- **Share** – Post a map on social media, or share via email.
- **Search box** – Find an area on the map, such as an address.

POP UP BOXES

SCROLLING THROUGH MULTIPLE RECORDS IN POP UP BOXES

When you select a point on the map, a pop up box will display. Click on the left and right arrows in the black toolbar to explore multiple records at one location.



ADDITIONAL RESOURCES

CHECK OUT OUR ONLINE TUTORIAL & FAQS OR CONTACT US!

If after reading these instructions you still have trouble finding what you need on FracTracker.org, or you need a more in-depth map training, just let us know. We would be happy to help!

The following online, interactive map tutorial is a great resource for working with our maps: fractracker.org/how-fractracker-works

We also have a free mobile app for tracking fracking for both iPhone and Android phones. Learn more: fractracker.org/apps

If you have additional questions or would like to request a training, please email: info@fractracker.org, or call: (717) 303-0403.

WWW.FRACTRACKER.ORG

THE SHALE GAS & OIL HEALTH REGISTRY & RESOURCE NETWORK

This national health registry is designed for people living within five miles of UOGD and serves as an important step toward understanding health conditions associated with shale oil and gas development. By registering, individuals will be contributing to important research on this public health problem.

How it works

On the registry home page, you can watch short videos to learn more, or get started by clicking the "Start Now!" button.

The registry questions are about nearness to UOGD sites such as wells, compressor stations, impoundment pits, and others. There are questions about symptoms which developed, or worsened, since nearby UOGD began. It takes approximately 20 minutes to complete the questionnaire. A short set of questions for industry workers is available and parents are encouraged to fill out questionnaires for their children. The registry is constructed on a secure platform designed to protect health information.

Researchers using data

A main goal of the registry is to provide a large amount of information to researchers who are studying the potential health effects caused by exposures to UOGD. A researcher using the registry data won't be able to see anyone's names or identifying information (unless an individual chooses to give that), but the researcher will be able to see what symptoms people report, whether they are new or pre-existing, and how often the symptoms are experienced. They will also be able to see what types of sites people report near their homes or near their children's schools or day cares. Again, individuals who join the registry can control which researchers can view the data they enter.

What's in it for you?

1) By registering with the Shale Oil & Gas Health Registry & Resource Network, individuals will be contributing to a large data set that researchers can view to inform their work. EHP can also use the data set to inform policy makers and others about the size and scope of the public health problem. So, participants in the registry will make a real difference.
2) As individuals enter their responses to the questions, they can see what percentage of other registrants answered the same way.
3) Twice per year participants will get updates from EHP on the registry as well as updates on recent research concerning shale oil and gas and health.

Please join the Shale Gas & Oil Health Registry & Resource Network. For more information, contact

- Beth Weinberger at (724) 263-5925 or bweinberger@environmentalhealthproject.org
- Or Jill Kriesky at (724) 260-5504 or jkriesky@environmentalhealthproject.org

EXPOSURE INFORMATION

If you live in close proximity to fracking, chemical exposure is likely. We've outlined the major contaminants, where they come from, and potential short- and long-term health effects.

TOXICOLOGY

Activities associated with UOGD and transport consistently produce air emissions known to cause both acute and chronic health effects. Emissions from some sources occur at a relatively steady rate, while those from other sources occur in episodic peaks. Some sources are only temporary. Weather conditions and wind direction may affect an individual's actual exposure. As a result of these factors, acute health symptoms related to air emissions may be persistent, episodic or temporary. Contamination of well water as a result of accidental spills, leaks, and well casing failures occurs more sporadically and less predictably than air contamination.

Exposures

The episodic intense peak exposures produced from some UOGD activities, which may last for minutes to several hours, can precipitate acute health symptoms, even though the total exposure averaged over a 24-hour or longer period appears acceptable. As with other air pollution, some individuals are at greater risk for health impacts. Children, developing fetuses, the elderly, and individuals with chronic respiratory or cardiovascular disease are most susceptible.

The Problem with Testing

Although the chart below describes the recognized health effects of some of the individual compounds identified as air contaminants originating from unconventional natural gas production and transport, actual exposures are to mixtures of these compounds. The health effects of exposures to chemical mixtures are incompletely studied and defined.

The performance of blood or urine tests to identify the specific chemicals to which an individual has been exposed often produces misleading results. Most of the chemicals of concern have short half-lives in the body and have other potential exposure sources. In addition, for some chemicals, the measured metabolites may also originate from more benign parent compounds. As a consequence, both false positives and false negative results occur, causing either unwarranted concern or inappropriate reassurance. Thus, as with most poisonings, treatment should be supportive and guided by symptoms.

Symptoms

Exposure to air contaminants associated with UOGD increases one's risk for developing or the worsening of pre-existing respiratory or cardiovascular disease. Further, some of the contaminants have adverse neurologic effects; others are carcinogenic.

Residents living in proximity to shale gas activities also frequently reported the development of additional symptoms that interfere with normal functioning, including anxiety, depression, difficulty focusing and feeling a loss of control. It is important to recognize and to address these disabling symptoms as they may be attributed to a wide range of social factors associated with shale drilling.

Most common new or worsening physical symptoms reported by individuals evaluated by EHP after onset of nearby UOGD activities include:

- Respiratory (cough, shortness of breath, wheezing, throat soreness or irritation, sinus problems, or nosebleeds)
- Dermal (rash, pruritus, or irritation)
- Neurological (headache or dizziness)
- Gastrointestinal (nausea or abdominal pain)
- Constitutional (sleep disruption or fatigue)
- Eye symptoms (pruritic, painful, or dry)

Potential health effects due to inhalation of low-level environmental air contaminants generated by unconventional natural gas development (UNGD) related activities			
Chemical	**Sources****	**Short term Exposures, Acute Health Symptoms**	**Long term Exposures, Chronic Health Effects**
Volatile Organic Chemicals (VOC's)	Well pads Compressor Stations Processing Facilities	Varies with individual chemical. See following examples: Benzene, Ethyl Benzene, Toluene, Xylene	Varies with individual chemical. See following examples
Benzene*	Same as above	Headache, dizziness	Aplastic anemia, leukemia
Ethyl benzene*	Same as above	Eye and throat irritation	Possible carcinogen
Toluene*	Same as above	Headaches, sleepiness, confusion	Possible permanent neurological problems
Xylenes*	Same as above	Eye, nose, throat , and skin irritation	Possible permanent neurological effects
Methylene Chloride	Well pads	Decreased attentiveness and decreased hand-eye coordination	Cancer
Formaldehyde	Well pads Compressor Stations Processing Facilities	Nose and eye irritation, impaired short term memory, asthma attacks	Asthma, eczema, nasal and throat cancer
Diesel Exhaust (contains VOC's & PM2.5)	Well pads Compressor Stations Truck traffic	Eye, nose, throat and lung irritation. Headaches, dizziness, nausea	Worsening respiratory disease, lung cancer
Hydrogen sulfide	Well pad	Eye, nose, and throat irritation. Asthma attacks	Eye, nose, and throat irritation. Worsening asthma
Polycyclic Aromatic Hydrocarbons	Well pads Compressor Stations Processing Facilities	Eye and skin irritation, asthma attacks, acute cardiac events, adverse effects on developing fetus	Contribute to the development or worsening of pulmonary or cardiac disease. Lung, skin, bladder cancer
Particulate Matter 2.5 (PM2.5)	Well pads Compressor Stations Processing Facilities	Asthma attacks, acute bronchitis, heart attacks in individuals with cardiac disease	Reduced lung function, chronic bronchitis
Ozone	Created by chemical reactions between NOx and VOC'S in the presence of sunlight.	Chest pain, coughing, throat irritation, congestion. Increased symptoms in bronchitis, emphysema, and asthma	Contributes to development of chronic lung disease and worsens pre-existing bronchitis, emphysema, and asthma.
Radon	Naturally occurring in shale. Contained in produced gas	None	Lung cancer
Carbon monoxide (CO)	Well pads Compressor Stations Processing Facilities	Decreased exercise tolerance, decreased vigilance, increased risk for cardiac ischemia in individuals with heart disease	Decreased exercise tolerance, decreased vigilance, increased risk cardiac ischemia
Nitrogen oxides (NOx)	Well pads Compressor Stations Processing Facilities	Respiratory symptoms, worsening asthma	Respiratory disease, worsening heart disease

*Chart does not include additional health effects occurring with higher level occupational exposures. Health information is primarily derived from EPA and ATSDR sources.

Sources:

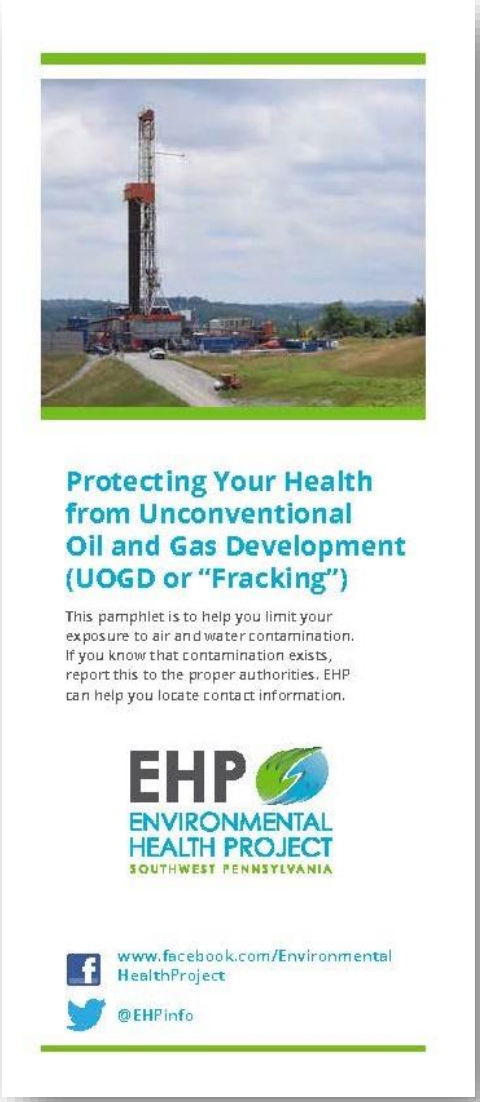
Well-pads: Include well head, flaring, diesel powered equipment, produced water storage pits and tanks, vehicles.
Compressor Stations: Located along natural gas pipelines to compress gas to a sufficient pressure to keep the gas moving within the pipeline.
Processing Facilities: Clean raw natural gas by removing impurities and separating out non-methane hydrocarbons and fluids.

REDUCING EXPOSURES

For citizen scientists monitoring UOGD pollution and anyone else, it's important to mitigate, or limit their exposures. Here, we offer tips on how.

Air contamination

Individuals should avoid exercising at times and places with increased air pollution present. Although the Air Quality Index, provided later in this Toolkit, gives useful guidance regarding regional air quality, it does not accurately portray the air quality in microenvironments where local sources, such as major roadways or UOGD activity, impact the air quality. Portable monitors, like the Speck which is described later in this Toolkit, are available to provide real time information regarding local pollution levels which can help to guide levels of physical activity. In addition, an individual's perception of air quality, e.g. the experience of odor or irritation, should also guide activity levels.



Indoor air quality is determined both by indoor sources of pollutants and infiltration of outdoor sources of air pollutants. Indoor sources of air contaminants should always be reduced to the extent feasible. The impact of outdoor sources on indoor air quality can be reduced with air conditioning, as well as with the installation of filters in the ducts of HVAC systems and the use of portable filter-based air cleaners.

Water contamination

Comprehensive water testing should be performed prior to any local gas drilling activity and then periodically after the onset of activity. Low cost tests for water conductivity, covered later in this Toolkit, are available for frequent monitoring of changes in water. Individuals should switch to drinking and cooking with bottled water if any changes in water are noted while awaiting comprehensive testing results. Shower and laundry locations should be ventilated, since some contaminants may volatilize from water resulting in inhalation exposures.

Protecting Your Health

For more information on health-protective measures, please refer to EHP's pamphlet, shown above, Protecting Your Health from Unconventional Oil and Gas Development.

MONITORING

The primary role of a Citizen Scientist is to be able to accurately monitor the pollution in your area. We have provided background information on contamination and protocols using technical equipment to monitor noise, water and air in your community. These guides tell you how and how often to collect your data. EHP can assist you with the analysis and interpretation of the data as needed. If you are interested in working with EHP to give your entire community the ability to track the wider effects, and analyze/interpret the results, we have included in the Appendix a sample budget for ongoing monitoring.

One approach for assessing pollution impacts in communities is to organize locally around the site that is of concern. You may want to identify a local resident as the primary contact person for participants in the project. This person should be easily available and able to respond to residents' needs for information and advice. One or two project members may be needed to manage environmental sampling protocols. This may include helping residents in setting up the equipment in this section. Keep in mind that analysis and interpretation of the data collected may require outside expertise. You can contact EHP for assistance in determining your needs.

MEASURING NOISE POLLUTION

One of the often-overlooked types of pollution observed near fracking sites is noise. Luckily, you can use simple tools like your smartphones to measure these levels and report any dangerous levels to your local and state governments.

Acceptable noise levels are based on the use of the area in question. For example, according to Environmental Protection Agency (EPA) guidelines:

- 45 decibels is associated with indoor residential areas, hospitals and schools
- 55 decibels is identified for certain outdoor areas where human activity takes place
- 70 decibels is identified for all areas in order to prevent hearing loss

Though the EPA and other bodies like the World Health Organization (WHO) suggest noise guidelines, they do not have any regulatory authority to enforce noise pollution problems. Instead, noise control is regulated by state and local governments. Consult with your local health or environmental regulatory agency for more information. Further information on noise and health is found on our website.

One easy way to monitor noise levels from UOGD is to use a smartphone sound measurement app. EHP recommends SoundMeter+, available for iPhones. (For best results, select "A" for waiting on the lower left of screen and "slow response" on the lower right hand screen of the app.) Sound monitoring apps are also available for other types of devices but have not been as rigorously tested. Read a review of

sound monitoring apps here. More sophisticated noise meters are available for community use, for rent or purchase, and can cost over $1,000. Contact EHP for more information.

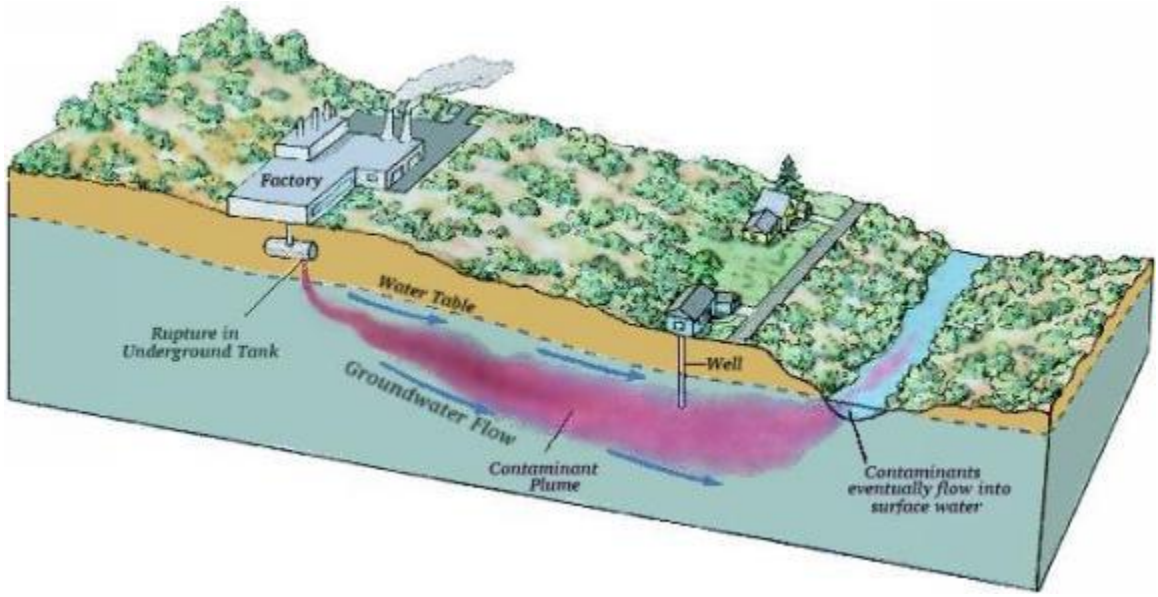
WELL WATER MONITORING GUIDE

Private well water quality is not regulated by the US EPA. In most states, well owners are responsible for monitoring their water quality. This is particularly challenging in areas where industrial development such as natural gas extraction activities are present. Gas well drilling activity, if properly conducted, does not necessarily contaminate groundwater, but poorly managed drill sites, leaky wastewater pits and accidental spills certainly impact the quality of surface water and of groundwater, which are the sources of private well water.

EHP has developed a water quality ranking system and monitoring strategy to encourage well owners to stay alert to the quality of their water and to take action when it is threatened by contamination. For more information, visit our website for the full version of this report.

Ground Water Contamination and Hazards to Aquifers

When pollutants are in the ground, they are carried by water through soils and aquifers in unpredictable ways. The groundwater system is dynamic and changing, therefore it is impossible for a single property owner to be sure of the safety of their well water in an aquifer that is threatened by industrial activities. Once an aquifer has been contaminated, any private well that draws water from the aquifer is at risk. A strategy of monitoring and testing well water can help keep well owners informed about their water quality.



Source: http://earthsci.org/education/teacher/basicgeol/groundwa/plume1.jpg

Local gas extraction activities can introduce a mixture of contaminants to groundwater. While properly drilled gas wells should keep contaminants from seeping into aquifers, some wells fail to do so, allowing methane and other chemicals to reach drinking water supplies. Unpredictable chemical releases also occur above ground. Some are caused by spills or truck accidents. Others occur when “produced water” (water that includes toxic chemicals that is stored in pits on the well site) leaks from improperly managed storage pits, or from other onsite accidents. Spilled liquids, if not cleaned up, may eventually make their way into the groundwater. Some of these chemicals will alter the taste, odor, or clarity of well water while others are difficult to detect. Certain chemicals used by the industry are highly toxic to

humans and animals. Combinations of chemicals may further increase toxicity. Without knowledge of local releases and spills, and without access to information on specific chemicals, a well owner's best recourse to protecting their water supply is to monitor and test regularly.

Our Strategy, in a Nutshell

EHP recommends a three-part strategy for water monitoring:

1. Baseline, annual, and bi-annual tests for contaminants
2. Weekly screening tests for pH and conductivity
3. Keeping a diary of test results and your own observations

Baseline, annual, and bi-annual tests: EHP recommends that residents test their water annually, as suggested by state environmental agencies such as the PA Department of Environmental Protection (DEP), for coliform bacteria, pH, nitrates and total dissolved solids (TDS). Other contaminants that may occur naturally in private well water in Southwestern Pennsylvania are methane, radon and arsenic, so testing for these each year may also be advisable. Please contact EHP for guidance on conducting these tests. If you live in areas of UOGD, we recommend baseline testing before drilling activity starts within 3 miles of your home. EHP recommends that you repeat some tests bi-annually (every six months), or as soon as screening tests reveal changes in water quality or if you have other indications that your well water has become contaminated. See checklist on the next page for a summary of these recommended tests and when to conduct them.

Weekly screening tests: We strongly advise that residents follow a strategy of monitoring with screening tests for *pH* and *conductivity* on a weekly basis. Monitoring weekly for pH and for conductivity can warn well users that a change in water chemistry has occurred, although it will not identify what chemicals have caused the change. The *pH* test measures the acidity level in water. *Conductivity* is a measure of the ability of water to conduct electrical current. Both of these measurements are sensitive to changes in water quality. This strategy alerts residents that further tests should be done. For those concerned about potential contamination, monitoring pH and conductivity is much less costly than testing repeatedly for specific contaminants related to UOGD. EHP can lend a conductivity monitor called the CATTfish, described in the handout below. You can purchase an inexpensive pH test, called litmus paper, at most hardware stores. In addition, we suggest residents sign up in the SkyTruth Alerts service, which alerts you when drilling permits are issued in your area so you will know what activities are taking place near your home.

Diary of test results and observations: We also recommend residents keep a diary of monitoring results and copies of all tests performed. Notes on perceived changes in water quality, such as taste, smell or clarity, along with any new industrial activity or accidents represent important data, too, and should be recorded.

For more information on well water monitoring, please refer to EHP's full report "Well Water Contamination: SWPA-EHP Ranking System and Monitoring Strategy".

Getting baseline tests done as soon as possible is important for an effective monitoring strategy. The more you can include in your baseline tests, the better. Thorough baseline tests include ALL of the following:

1**. PA DEP suggests you test the following each year, regardless of your environment:**

- ❑ coliform bacteria
- ❑ nitrates
- ❑ total dissolved solids (TDS)
- ❑ pH

2. We recommend you also test the following as part of your baseline test:

- ❑ ethane/methane, GRO (gas range organics), DRO (diesel range organics)
- ❑ conductivity
- ❑ chloride

3. Targeted water tests – for baseline and every 6 months during natural gas extraction activities. Although these tests are expensive, we encourage you to test for as many as you can, especially as a baseline:

- ❑ VOCs GRO DRO, surfactants, oil and grease
- ❑ strontium, sodium, ethane/methane
- ❑ barium, glycols, fluorides
- ❑ arsenic, calcium, iron
- ❑ potassium

Monitor your water for pH and conductivity in between targeted tests. This strategy can alert you to changes in water quality, but it may not be effective for all possible contaminants. This is why we recommend retesting every six months.

If you cannot afford many of these tests, monitoring for conductivity and pH, which are very inexpensive, will give you at least some information about your water quality. We think it is well worth the small amount of effort it takes to conduct these weekly tests.

These recommendations are our best advice based on the limited research that is available - the most essential and most cost effective. None of these strategies for monitoring your well water are 100% effective.

CATTfish WATER CONDUCTIVITY MONITOR

EHP recommends residents using well water and living within a three-mile radius of UOGD conduct weekly screening tests of their water. One of these tests, conductivity, can be assessed using a device called the CATTfish Water Monitor. EHP provides these free of charge for 1-2 months; please contact EHP for information about obtaining one. You can also purchase your own.

By measuring conductivity, the CATTfish can alert you to changes in water quality. For example, flowback water from fracking can include salty brines. If these reach your water well, your conductivity levels will likely rise higher than the normal range for drinking water. However, the instrument does not identify any chemical contaminants. When a significant change is detected, follow-up tests should be conducted by a certified lab as described above. Please note that water softeners may make readings inaccurate. See handout below or read the detailed report to learn how the CATTfish works.

Why The *CATTfish* is a Useful Tool

The *CATTfish* device was designed and built by Carnegie Mellon University and Mellonhead Labs. *CATTfish* stands for Conductivity And Temperature in your Toilet, and it will be doing just that, measuring the temperature and water conductivity in the tank (not bowl) of your toilet.

Conductivity is the ability of a sample of water to carry an electrical charge. The greater the charge the higher the conductivity will be. Readings found to be above average for a sample of water generally means that there are unseen particles suspended in the water, increasing the water's conductance. The *CATTfish* measures the amount of conducting particles floating around in your water. These can be anything from salts to larger complex molecules, some of which can be harmful to your health.

How to Use the *CATTfish*

Installation

1. Charge the *CATTfish* display box for roughly 1-2 hours via the USB cable before initial use.
2. Remove the top lid to the tank of your toilet and place the *CATTfish* sensor within the water of the tank. Make sure to keep it clear of the working mechanisms of the toilet in order to ensure clear readings with no damage.

Upkeep

1. The device should be charged every 3-4 weeks, about once a month. To do this, unplug the *CATTfish* display box from the sensor and use the USB charge cable and wall attachment to charge it for an estimated 2-3 hours. While the monitor is charging, it is recommended to also remove the white *CATTfish* sensor from the toilet tank and to wipe it down with a clean cloth in order to ensure no buildup will occur on the sensor.
2. After a monitoring period of 1-2 months, EHP will collect the device to download the recorded data for analysis. All the data is stored within the display box, so it is imperative that this box stays dry at all times. We recommend that you allow us to conduct the download process as part of the analysis.

How to Interpret Results

After you press the button to take a reading, a fish will swim across the screen to show that a reading has been taken. Readings will then appear on the screen, with the current reading taking up the left side of the screen and the average and max readings of the past 10 samples taking up the right side. All of these will be presented in terms of µs/cm. The current reading will also have the words "high, normal, or low" underneath the numbers. The device will collect and store data on water temperature to normalize the conductivity readings. These temperature readings will not be displayed on the screen.

When to be Concerned

Once the baseline conductivity level has been established for your unit, which may take up to a week, an increase of 200 units (µs/cm) from the average that lasts for more than a day or two warrants getting your water tested by a certified laboratory. An example of this would be if your average readings are 500, and for two days you receive current readings of 700 or higher, it would be worth noting and taking some form of action either by contacting us or some governmental authority. It is best to stop drinking and cooking with your water when the conductivity reaches outside the EPA's safe drinking levels, 30-1500 µs/cm, but we would recommend that an increase of 200 units over two or more days would be another reason to stop using your water. This is because it is impossible to tell what is contaminating your water without further testing, and prolonged exposure to small levels of contaminants has been shown to have similar effects as short exposures to high levels of contaminants.

Questions and Concerns

If you have any concerns about your health potentially relating to natural gas drilling activities, please call our office and speak with our nurse practitioner. EHP's team is also available to answer any other questions you may have, and is able to help you interpret and understand your CATTFish water monitor results.

To contact our office please call: 724-260-5504. Our office is open Monday-Friday from 8am-4pm. Another option is to send us an email at info@environmentalhealthproject.org and we will get back to you as soon as possible.

AIR MONITORING PROTOCOLS FOR COMMUNITIES

The protocols recommended here form a systematic approach to evaluating health impacts from air pollution exposures. Because EHP has found that releases from UOGD are episodic, continuous monitoring of at least one pollutant is necessary. Fine particulate matter ($PM_{2.5}$) can be monitored easily and at low cost. We also suggest periodic air sampling for volatile organic compounds (VOCs) and other chemicals that may be present. VOCs can be measured using Summa canisters. Sampling badges for formaldehyde or hydrogen sulfide may be added to the sampling protocol.

EHP has assisted numerous communities in monitoring air quality and can guide you through the process. It is helpful to have a local organizer as the primary contact person if more than one family decides to monitor their air quality. This section will help you to learn more about air pollution and sampling.

For residents within southwest Pennsylvania, the analysis and interpretation of the air monitoring data is conducted free of charge. When EHP can lend Specks to communities outside the region (subject to availability), the cost of downloading and interpreting the data must be covered. For an estimate of this cost for your community, please see the sample budget in the Appendix. You may also contact Celia Lewis at clewis@environmentalhealthproject.org to see if financial assistance is currently available.

Source: http://www.specksensor.com/

Particle Monitoring

Two Speck monitors (like the one pictured above) are used at each residence (minimum of 4 homes recommended)

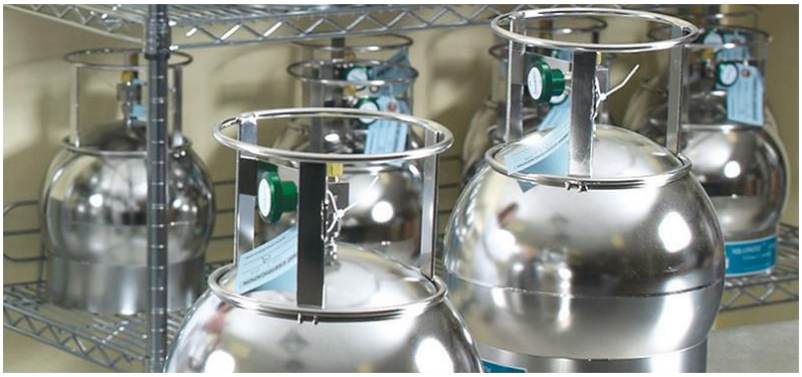
- Baseline: 32 days inside and outside each residence
- During construction: 32 days inside and outside each residence
- Post-construction: 32 days inside and outside each residence
- "Event" sampling in conjunction with Summa canisters

EHP personnel can assist residents in determining a good place to put monitors both inside and outside the house. A regular electrical outlet is required. The Speck monitor provides continuous readings of $PM_{2.5}$ in ug/m^3 and in particle counts, minute by minute. Inside monitors should be placed in a room with limited foot traffic and away from the kitchen where cooking generates significant PM. Rooms that are closest to the industrial source of pollution are preferable. Outside monitoring should occur in a sheltered area, such as a porch, within reach of an outlet. To the extent possible, the outdoor monitor should be on the side of the house adjacent to the pollution source and away from vehicle traffic.

PLEASE DO NOT UPLOAD DATA TO THE INTERNET. While it is possible to connect the Speck to the internet and upload the data while it is in use, this removes all the data from the device and hinders the analysis.

During the monitoring period we recommend that residents keep a simple diary to document information on events that may cause spikes in PM inside or outside the home such as cooking, vacuuming, truck traffic, plowing of nearby upwind fields, etc. Health symptoms and weather conditions should also be recorded.

The local organizer collects the Specks at the end of the monitoring period. Specks are sent to EHP for downloading and analysis by EHP staff. We then prepare a report interpreting the results for the community.



Source: http://alsoglobal.com

Volatile Organic Compound (VOC) Monitoring

- Baseline: Summa canister sampling under appropriate weather conditions at selected residences or locations
- During construction: Summa canister sampling under appropriate weather conditions at selected residences or locations
- Post-construction: periodic sampling under appropriate weather conditions at selected residences or locations

VOC monitor equipment is ordered directly from a certified environmental laboratory by the local organizer or by EHP. Mailing and analysis costs are generally included in the lab fees. Be sure to identify who in the community will be in charge of deploying the samplers.

Summa canisters:

Summa canisters (like those pictured above) are factory cleaned and certified ready-for-use. Time release regulators for summa canisters are each factory tested for accuracy and ready-for-use. If possible, canisters are placed at the height of about 4 to 6 feet above ground level to sample at the level of a person inhaling the air. Log the date and time of deployment and recovery on the chain of custody form that comes with the canister. More specific instructions are provided from the lab. Weather conditions should always be considered when sampling occurs (see below). At a minimum, samples should be taken downwind when winds are calm or light.

Location: Sampling can occur at a residence that is close to the site, or at a suitable location closer to the site, under stable weather conditions. Locations should be protected from direct sunlight and rain/snow/wind while also open to air flow. The same locations should be used for all phases of the project.

Sampling times: Summa canisters can sample for a range of time periods. For pre-construction, construction and post-construction we recommend 24 hours. The results provide a list of chemicals detected over the 24-hour period, but do not provide a continuous reading of chemical quantity over time.

For event sampling, post-construction short term sampling will be more appropriate: grab samples or three-hour samples can be used for short-term events; 12-hour samples can be used for overnight or daytime sampling. This decision should be made by your group in advance of the post-construction phase and the lab should be informed at the time the canisters are ordered.

Chemicals sampled: The EPA TO-15 sampler tests for a common suite of chemicals sampled for near compressor stations and other shale gas sites. Be sure to tell the lab to report Tentatively Identified Compounds (TICs) as well as these assist EHP to understand potential low-level exposures.

Formaldehyde badges:
A Radiello formaldehyde badge is a passive sampler hung outside near the summa canister sampler for the same 24-hour period. They can be hung from a low tree branch, placed and hung in a large covered dog crate, or otherwise hung in a location that protects the badge from rain but allows full air ventilation. The badges are factory sealed and ready-for-use. No calibration is needed. Badges are stored in a freezer before and after use and are mailed back to the lab with the accompanying freezer bag.

Summa canisters and formaldehyde badges are good for one use only. Additional samplers are needed for post-construction monitoring. One person can be responsible for returning the equipment to the lab in prepaid packages after use.

Hydrogen Sulfide badges are another option. These badges are similar to the Formaldehyde badges. Follow instructions from the Laboratory that provides the samplers.

Weather Conditions for Sampling
Close attention should be paid to local weather forecasts for the upcoming 24-hour period to determine when to sample. The canisters and badges should be used in calm, dry weather conditions. Days that are cloudy with calm or light winds and nights with calm or light winds are most suitable, when the source of emissions is upwind.

Use the local NOAA weather forecast and pay close attention to wind speed and cloud cover. Consult with EHP staff as necessary.

See "How's the Weather" below, which discusses the effects of weather and time of day on how pollutants travel from the site to nearby homes.

The Laboratory that EHP has used for summa canister, hydrogen sulfide and formaldehyde badges is www.alsglobal.com. You can use any of their labs located across the country, or find other environmental labs to use.

Contact information for the main ALS Laboratory:
Simi Valley ALS – Environmental
2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone: (805) 526 7161

SPECK AIR QUALITY MONITOR INSTRUCTIONS

The following letter is a document that can be shared by the organizer with each household that agrees to use the Speck monitors. It covers instructions that the residents must know to successfully monitor for particulate matter (PM).

Dear Resident,

These two Speck monitors are provided to you for a 32-day period. The monitors will record particulate matter concentrations ($PM_{2.5}$) in the air inside and outside of your home, and EHP will examine these concentrations to assess local exposures and health impacts. EHP uses this type of monitor to better understand air pollution issues related to natural gas development activities, and to advise you about any potential health impacts.

Getting Started:

Getting started with the Speck Air Quality Monitor is simple. Please follow these steps to ensure proper use of the monitors. PLEASE NOTE: DO NOT CONNECT THE SPECK TO THE INTERNET because this removes all the data from the device. EHP needs the data to remain on the Speck for analysis.

Speck 1 #_____

- **FIND AN INDOOR LOCATION**
  - Place the Speck in a room that has some air circulation, but a minimal amount of human activity, such as a bedroom or living room that is not in constant use.
    - **Please do not place it in your kitchen---the monitor is very sensitive to smoke and cooking gases.**
  - If possible, place the Speck on the side of the house (indoors) that is closest to the planned compressor station – or other relevant site.
  - Near a power outlet
    - If there is a power outage, **DO NOT WORRY**!---just document when power outage was…there will be no results for that time period.
  - Vacuuming and cooking can significantly/temporarily affect results. Please try to make a note of these and other activities if you notice a spike in PM on the monitor.
  - Keep the Speck dry.
  - Avoid direct exposure to sunlight or other bright light sources (i.e. fluorescent lights).
- **PLUG IN AND BEGIN**
  - Plug AC adaptor (provided with the device) into a 120V/60Hz wall outlet.
  - Connect AC adaptor to the Speck monitor
  - Once the AC adaptor is connected, the Speck will automatically turn on and begin to collect data.
- **DATA COLLECTION**
  - Once the Speck is turned on, it begins recording data.
  - The LCD screen on the Speck monitor will show the amount of particulate matter detected and a colored graph indicating air quality safety levels.
  - At this point, the monitor runs continuously. You will not have to do anything else with the device.

Speck 2 #_____

- **FIND AN OUTDOOR LOCATION**
  - The ideal location for an outside Speck monitor is on a porch, protected from rain, near an outlet and on the side of the house closest to the UOGD site.
    - It is important to keep the Speck dry during inclement weather. If you are not able to put it on a porch, an open shed or some other type of cover may also work.
  - Avoid direct exposure to sunlight or other bright light sources (i.e. fluorescent lights)
- **PLUG IN AND BEGIN**
  - Plug AC adaptor (provided with the device) into a 120V/60Hz wall outlet.
  - Connect AC adaptor to the Speck monitor (refer to figure on page 4).
  - Once the AC adaptor is connected, the Speck will automatically turn on and begin to collect data.
- **DATA COLLECTION**
  - The LCD screen on the Speck monitor will show the amount of particulate matter detected and a colored graph indicating air quality safety levels.
  - At this point, the monitor runs continuously. You will not have to do anything else with the device.
  - EHP will download the data from the Speck for analysis. PLEASE DO NOT DOWNLOAD DATA AT HOME AS THIS WILL DELETE THE INFORMATION.

HOME EXPOSURE AND HEALTH ASSESSMENTS

Whenever possible, EHP couples environmental monitoring with home exposure and health assessments in order to better understand the relationship between exposures and health impacts. In Pennsylvania, EHP may be able to provide a licensed healthcare professional to conduct these assessments. Outside of Pennsylvania, we work with local, state-licensed healthcare professionals to partner with EHP to complete these assessments.

The home exposure assessment includes questions related to proximity, type, and timing of gas development near the residence.

The health assessment includes questions on past medical history, occupational history, and current symptoms.

Both the home exposure assessment and the health assessment are also available in Spanish.

Note that these assessments are different than the Health Registry, described earlier. These assessments are a tool for addressing your health concerns with a healthcare provider, and should be completed with one or submitted to one. The Health Registry, on the other hand, you can complete by yourself online and select options regarding the type of researchers you want to see the information, the format in which they can view it, and whether you would want to be contacted by the researcher. We encourage those with health concerns potentially related to UOGD to use both tools.

WEATHER, AIR POLLUTION, AND YOUR HEALTH

Weather plays a big role in moving air pollution from its source to other locations. Certain weather conditions carry pollution away quickly, and others keep it close to the ground and near the source. Read on for more information and to learn about tools for monitoring air impacts if you live near UOGD.

EPISODIC EXPOSURES TO AIR POLLUTION

This handout explains how weather relates to episodic exposures.

Episodic Exposures to Unconventional Oil and Gas Development Air Pollution

Do you experience health symptoms that come and go?

Residents near unconventional oil and gas development (UOGD) often report that health symptoms come and go. The most common of these as reported to the SWPA Environmental Health Project (EHP) are respiratory problems, headaches, skin rashes and nausea. This pattern makes sense when you consider how exposure to UOGD pollutants often varies over time.

Air exposures at your home may be different on an hourly or daily basis because:

Air emissions are variable and sometimes extreme

UOGD is a complex industry with many stages and processes. Each stage and process can emit different mixtures of pollutants at varied levels of intensity. Even during well development, chemicals used at each well pad may vary and the gas produced from each well may have different chemical mixes.

Weather causes patterns of variability

In general, when you are downwind from a pollution source, if there is:

- Low wind speed on sunny days – pollutants tend to rise quickly and disperse
- Low wind speed on cloudy days – pollutants stay close to the ground as they travel downwind to nearby homes
- Low wind and high humidity – pollutants stay close to the ground
- High wind on sunny or cloudy days – pollutants move quickly away

Time of day

Nighttime tends to keep pollutants from rising quickly away– the cool air traps emissions close to the ground.

Homes may be close to multiple sources

The distance and direction of different sources within a few miles of a residence will affect the variability of exposures on any given day or night.

Local geography affects exposures

Pollutants tend to collect in valleys. Wind, cloud cover and time of day will affect how pollutants travel in valleys or over hills. Under certain conditions in valleys, air pollution can travel close to the ground for several miles.

You can anticipate when episodic exposures will occur by:

- Locating UOGD sources near your home, including well pads, compressors and tanks, and processing plants
- Learning which weather conditions will bring pollutants toward your home
- Watching the weather forecast for your area

What else can you do?

- Monitor levels of Particulate Matter (PM) in your home. A rise in PM levels can indicate air pollutants in the home. See the EHP "PM fact sheet" available at www.environmentalhealthproject.org
- Use air filters in your home to keep indoor air clean. EHP strongly recommends using air filters at night, particularly in sleeping areas and for vulnerable individuals (sick, elderly, or children) in the household.
- Keep your health care provider informed about your symptoms and concerns.
- For more information about your health and UOGD contact our office or check our website: www.environmentalhealthproject.org
- Talk to your healthcare provider if you are concerned about episodic exposures affecting you or your family's health. Potential symptoms include respiratory problems, skin rashes and headaches.
- Keep a health symptom diary.

Recommended PM monitors

- The Dylos particle monitor is easy to use in the home. It provides continuous readings of both small ($PM_{1.0}$ and larger) and large ($PM_{5.0}$) particles and displays particle counts as they occur. This unit costs about $200.00. Here is a link to a website that offers this product: http://www.iallergy.com/product1887.

- The Speck, developed by the Carnegie-Mellon University CREATE Lab, is a low-cost, indoor fine particulate ($PM_{2.5}$) monitor. This unit costs $200.00 and can be purchased at http://store.specksensor.com/products/speck.

Recommended air filter

There are many types of air filters for use in the home. We recommend the Austin Air HealthMate HM 400 because it has been shown to remove PM and chemicals as well as odors and dust from inside air. This filter is designed to clean rooms rather than an entire house and can be moved easily from room to room. It works best in homes that are well insulated. Contact EHP for more information.

To talk to our environmental health educator, to schedule an appointment with our nurse practicitioner or for additional information, please contact the

SOUTHWEST PENNSYLVANIA ENVIRONMENTAL HEALTH PROJECT

2001 Waterdam Plaza Drive, Suite 201 • McMurray, PA 15317 • 724.260.5504

www.environmentalhealthproject.org • info@environmentalhealthproject.org

HOW'S THE WEATHER? NATURAL GAS DRILLING, AIR POLLUTION & THE WEATHER

Exposure to air pollution from natural gas drilling activities will differ each day, depending on the weather. Please see the full report on our website for additional information.

EHP has developed an Air Exposure Model to help you:

- Use the weather to estimate whether it's a good, moderate or poor air quality day around your home.
- Estimate *how much* of certain pollutants are reaching your home from nearby UOGD. We look at volatile organic compounds (VOCs), particulate matter (PM), and formaldehyde.
- Decide whether there are actions you might take based on pollution estimates.

First, here's what we know about the weather:

- If the wind tends to blow toward your house from a pollution source, you're more at risk.
- Sunny days with no wind cause air emissions to rise quickly upward, away from nearby houses.
- Cloudy days with no wind cause air emissions to move slowly and stay closer to the earth's surface. The pollutants mix with the air very slowly.
- Sunny days with light to moderate wind allow the pollution to mix and rise more quickly and become less concentrated.
- Wind on cloudy days causes air emissions to move from the source more quickly. On these days more pollution could reach nearby homes that are downwind.
- At night, pollution is more likely to stay nearby than in the daytime because cool nighttime air stays low.

A word about contaminants

In this model we use VOCs (volatile organic contaminants), $PM_{2.5}$ (particulate matter or tiny particles in the air that are 2.5 microns in size) and formaldehyde as indicators of pollution exposure. We chose these chemicals because scientists have measured or estimated the amounts of these chemicals that come from UOGD sources. There are about 600 chemicals that can be used in this industry. Each site may use a different number and combination. We use these three as "indicators". They are common UOGD pollutants and if they are present, it is likely that other chemicals are also present.

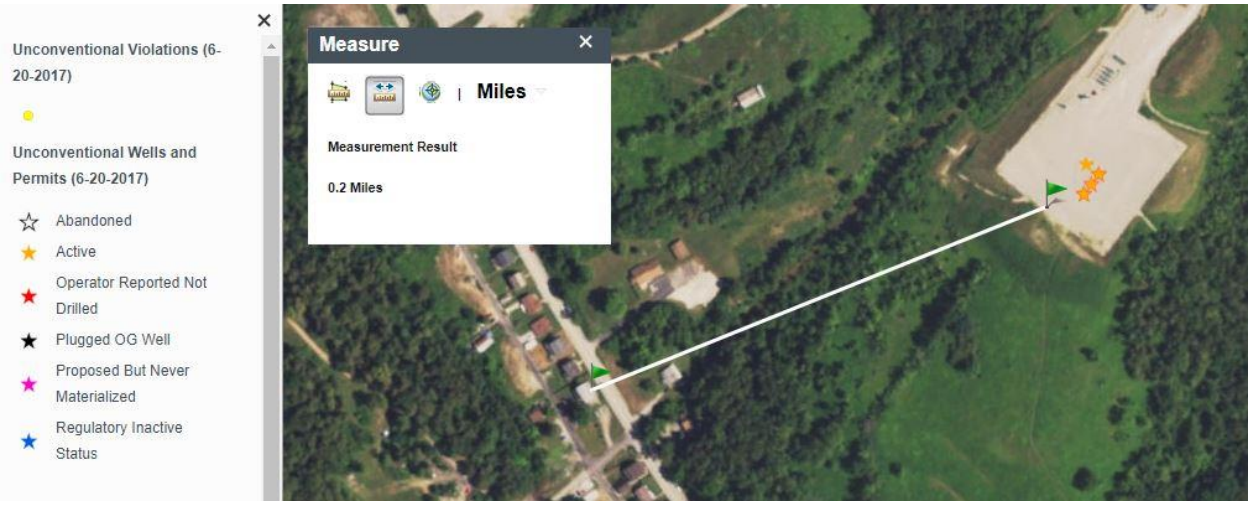
A compressor station in Washington County, PA

Using the EHP Air Exposure Model

Below we show how to use the air exposure model to measure the impact of a nearby compressor station on your air. EHP also produces charts for other gas extraction and development activities such as well pads with tanks and gas processing stations. Contact our office for further information.

Step 1: What's around you?

First, figure out about how far and what direction a pollution source is from your home. Some people have more than one source of pollution nearby, so note the different facilities within two miles and determine what direction each is from your house. FracTracker maps include a helpful measuring tool (see example below). However, if you need assistance estimating how far you are from extraction activities, contact EHP.



Step 2: What's the weather?

For a given time period you'll want to know a few simple things:

- ➢ Is it day or night?
- ➢ Is it cloudy, partly cloudy or clear?
- ➢ Which way is the wind blowing? Is it blowing *from* the direction of a pollution source *toward* your home? Is it calm?
- ➢ How windy is it?
  - Check your local weather forecast. Remember: a north wind comes from the north.
  - Use a small device called an anemometer, which measures wind speed.
  - Go outside and make your best guess about windspeed.

You can use the Beaufort Wind Scale to estimate the wind speed:

Miles per hour	
< 1	smoke rises
1-3	smoke drifts, weather vanes do not move
4-7	leaves rustle, wind is felt on face
8-12	leaves in motion, flags move
13 – 18	dust rises, branches move

Step 3: Find the weather "stability class".

Using the information from Step 2, find the "*stability class*" in Table A that best fits your weather conditions. Stability classes refer to how stable or unstable the movement of air is under different weather conditions. The letters and numbers in Table A will be used in Table B to determine your level of pollution exposure.

In this example, let's say that during the night there is broken cloud cover and there isn't much wind. E21 is the number you will use from this table.

Table A. Air Stability Classes[1]

Wind speed	**Day** Clear or just a few clouds	**Day** Scattered cloud cover. Less than 50% cloud cover	**Day** Broken cloud cover. More than 50% cloud cover	**Day** Overcast More than 80% cloud cover	**Night** Broken cloud cover. More than 50% cloud cover	**Night** Less than 50% cloud cover
<5 mph	A1	AB6	B11	D16	E21	F26
5 to 7mph	AB2	B7	C12	D17	E22	F27
7 to 11 mph	B3	BC8	C13	D18	D23	E28
11 to 13 mph	C4	CD9	D14	D19	D24	D29
>13 mph	C5	D10	D15	D20	D25	D30

Once you've identified the stability class that fits your conditions, you'll want to determine your level of pollution exposure and whether it might pose health risks.

[1] The letter-number combinations in Table A come from the originator of the stability class chart, meteorologist Frank Pasquill, D.Sc, FRS. The reference to his work is found at the end of this section.

The charts below are color-coded to give you a quick look at your health risks. The levels of risk are coded like this:

Color	Meaning (for Air Quality Purposes)
Green	**Good** There are no associated health risks/concerns
Yellow	**Moderate** Unusually sensitive people (those with heart/lung disease or asthma) should consider reducing extended or heavy exertion
Orange	**Unhealthy for Sensitive Groups** Unusually sensitive people, older adults, and children should avoid extended or heavy exertion
Red	**Unhealthy (for all)** People with heart or lung disease, older adults, and children should avoid extended or heavy exertion. Everyone else should reduce extended or heavy exertion
Purple	**Very Unhealthy** Everyone should reduce extended or heavy exertion

Step 4: Find your level of exposure

Tables B, C and D below show estimates of VOC, particulate matter ($PM_{2.5}$) and formaldehyde pollutants emitted from a compressor station. The amounts are measured in micrograms per meter cubed or ug/m^3. This is a common unit of measurement for chemical gases and particles found in air. It means that within the space of three cubic meters there are x micrograms of a substance in the air.

Let's say you live near a compressor station and the wind tends to blow toward your home from the station.[2]

- ➢ Find the distance from the compressor to your home in the top row.
- ➢ Then find your weather stability class (letter-number from Table A) along the left side.

If the compressor station is ½ mile from your house and it's a cloudy night without much wind (E21), you will find you may be exposed to 200 ug/m^3 (micrograms per meter cubed) of VOCs.

Table C shows an exposure of 73 ug/m^3 of $PM_{2.5}$.
Table D shows an exposure of 22 ug/m^3 of formaldehyde.

A note about the tables: In this model all emissions are assumed to be ground level, on level terrain, in summer conditions and constant over the day and year. Local topography will cause some variation in exposures. In particular, if you live in a valley below a source of pollutants, your risk will be higher than the levels on these charts on days of poor air quality. This is because the polluted air settles into valleys on poor air quality days and dilutes slowly.

[2] Remember, this table applies only to times when wind carries emissions from the compressor station toward your home. Important: If the air is still (wind <5 mph) it may pollute the whole area around the facility. In this case you may have exposures whether you live north, south, east, or west.

Table B. Air emissions of VOCs in ug/m^3 from a compressor station color-coded for levels of health risk (refer to Table E).

Stability Class	100 yds 0.1 km	360 yds 0.5 km	½ mile 1 km	1.2 miles 2 km	1.8 miles 3 km	3.1 miles 5 km	6.2 miles 10 km
A1	525	17	4	1	<1	<1	0
A-B2	400	26	7	1	<1	<1	<1
B3	275	25	8	1	<1	<1	<1
C4	400	67	23	6	3	<1	<1
C5	350	58	20	5	2	1	<1
AB6	575	37	11	2	1	<1	<1
B7	450	40	12	2	1	<1	<1
B-C8	375	52	18	4	2	<1	<1
C-D9	550	84	30	10	5	2	<1
D10	625	87	32	12	6	2	<1
B11	630	56	18	3	1	<1	<1
C12	750	125	44	12	5	2	<1
C13	475	79	28	7	3	1	<1
D14	725	100	37	14	7	2	<1
D15	630	87	32	12	6	2	<1
D16	1850	250	96	37	18	7	1
D17	1350	175	69	26	13	5	1
D18	850	100	44	17	8	3	<1
D19	725	100	37	14	7	2	<1
D20	625	87	32	12	6	2	<1
E21	2600	500	200	100	65	31	9
E22	1850	350	150	75	46	22	7
D23	850	100	44	17	8	3	<1
D24	725	100	37	14	7	2	<1
D25	625	87	32	12	6	2	<1
F26	4200	725	350	150	99	46	17
F27	3000	500	250	100	71	33	12
E28	1100	225	99	48	29	14	4
D29	725	100	37	14	7	2	<1
D30	625	87	32	12	6	2	<1

Table C. Air emissions of $PM_{2.5}$ in ug/m^3 from a compressor station color-coded for levels of health risk (refer to Table F).

Stability Class	100 yds 0.1 km	360 yds 0.5 km	½ mile 1 km	1.2 miles 2 km	1.8 miles 3 km	3.1 miles 5 km	6.2 miles 10 km
A1	175	5	1	<1	<1	<1	0
A-B2	125	8	2	<1	<1	<1	0
B3	75	8	2	<1	<1	<1	0
C4	125	22	7	2	1	<1	<1
C5	100	19	6	1	<1	<1	<1
AB6	175	12	3	<1	<1	<1	0
B7	150	13	4	<1	<1	<1	0
B-C8	125	17	6	1	<1	<1	<1
C-D9	175	28	10	3	1	<1	<1
D10	200	29	10	4	2	<1	<1
B11	200	18	6	1	<1	<1	<1
C12	250	41	14	4	1	<1	<1
C13	150	25	9	2	1	<1	<1
D14	225	33	12	4	2	<1	<1
D15	200	29	10	4	2	<1	<1
D16	625	87	32	12	6	2	<1
D17	450	62	23	9	4	1	<1
D18	275	39	14	5	2	1	<1
D19	225	33	12	4	2	<1	<1
D20	200	29	10	4	2	<1	<1
E21	875	150	73	35	21	10	3
E22	625	100	52	25	15	7	2
D23	275	39	14	5	3	1	<1
D24	225	33	12	4	2	<1	<1
D25	200	29	10	4	2	<1	<1
F26	1400	225	100	56	33	15	5
F27	1000	150	83	40	23	11	4
E28	375	78	33	16	9	4	1
D29	225	33	12	4	2	<1	<1
D30	200	29	10	4	2	<1	<1

Table D. Air emissions of Formaldehyde in ug/m^3 from a compressor station color-coded for levels of health risk (refer toTable G).

Stability Class	100 yds 0.1 km	360 yds 0.5 km	½ mile 1 km	1.2 miles 2 km	1.8 miles 3 km	3.1 miles 5 km	6.2 miles 10 km
A1	52	1	<1	<1	<1	0	0
A-B2	41	2	<1	<1	<1	0	0
B3	28	2	<1	<1	<1	0	0
C4	40	6	2	<1	<1	<1	0
C5	35	5	2	<1	<1	<1	0
AB6	57	3	1	<1	<1	0	0
B7	45	4	1	<1	<1	0	0
B-C8	38	5	1	<1	<1	<1	0
C-D9	56	8	3	1	<1	<1	<1
D10	63	8	3	1	<1	<1	<1
B11	63	5	1	<1	<1	<1	0
C12	75	12	4	1	<1	<1	<1
C13	47	8	2	<1	<1	<1	0
D14	72	10	3	1	<1	<1	<1
D15	63	8	3	1	<1	<1	<1
D16	175	26	9	3	1	<1	<1
D17	125	18	6	2	1	<1	<1
D18	86	12	4	1	<1	<1	<1
D19	72	10	3	1	<1	<1	<1
D20	63	8	3	1	<1	<1	<1
E21	250	52	22	10	6	3	1
E22	175	37	15	7	4	2	<1
D23	86	12	4	1	<1	<1	<1
D24	72	10	3	1	<1	<1	<1
D25	63	8	3	1	<1	<1	<1
F26	400	72	35	16	10	4	1
F27	300	52	25	12	7	3	1
E28	100	23	10	4	3	1	<1
D29	72	10	3	1	<1	<1	<1
D30	63	8	3	1	<1	<1	<1

Step 5: A closer look at your health risk
Tables E, F and G give you the level of health risk associated with the exposure that you found above.

Your level of 200 ug/m^3 of VOCs falls in the yellow category. At this level there could be health risks if you have pre-existing conditions. You can take the precautions we recommend on our website or contact your health provider for advice on limiting your risk.

Table E. Levels of Risk for VOC emissions in ug/m^3

Color	Meaning (for Air Quality Purposes)
Green (0-99)	**Good** There are no associated health risks/concerns
Yellow (100 - 299)	**Moderate** Unusually sensitive people (those with heart/lung disease or asthma) should consider reducing extended or heavy exertion
Orange (300 - 599)	**Unhealthy for Sensitive Groups** Unusually sensitive people, older adults, and children should avoid extended or heavy exertion
Red (600 - 1199)	**Unhealthy (for all)** People with heart or lung disease, older adults, and children should avoid extended or heavy exertion. Everyone else should reduce extended or heavy exertion
Purple (1200 and above)	**Very Unhealthy** Everyone should reduce extended or heavy exertion

These numbers are in ug/m^3 and correspond to the numbers in the VOC emissions charts.

Your level of 73 ug/m^3 of $PM_{2.5}$ falls in the red category which means that there are health risks for all. You should take the precautions we recommend on our website or contact your health provider for advice on limiting your risk.

Table F. Levels of Risk – Based on EPA Air Quality Index for Particle Pollution ($PM_{2.5}$) in ug/m^3

Color	Meaning (for Air Quality Purposes)
Green (0-14)	**Good** There are no associated health risks/concerns
Yellow (15-39)	**Moderate** Unusually sensitive people (those with heart/lung disease or asthma) should consider reducing extended or heavy exertion
Orange (40-64)	**Unhealthy for Sensitive Groups** Unusually sensitive people, older adults, and children should avoid extended or heavy exertion
Red (65-149)	**Unhealthy (for all)** People with heart or lung disease, older adults, and children should avoid extended or heavy exertion. Everyone else should reduce extended or heavy exertion
Purple (150 and above)	**Very Unhealthy** Everyone should reduce extended or heavy exertion

Table F corresponds to a table developed by the U.S. Environmental Protection Agency for $PM_{2.5}$. These numbers are in ug/m^3 and correspond to the numbers in the $PM_{2.5}$ emissions charts.
For more information on the EPA's take on air pollution visit it's AIRNOW website, [www.airnow.gov.](http://www.airnow.gov)

Your level of 22 ug/m^3 of formaldehyde falls in the green category which means that there are no associated health risks under these conditions.

Table G. Levels of Risk for Formaldehyde emissions in ug/m^3

Color	Meaning (for Air Quality Purposes)
Green (0- 99)	**Good** There are no associated health risks/concerns
Yellow (100 - 149)	**Moderate** Unusually sensitive people (those with heart/lung disease or asthma) should consider reducing extended or heavy exertion
Orange (150 - 299)	**Unhealthy for Sensitive Groups** Unusually sensitive people, older adults, and children should avoid extended or heavy exertion.
Red (300 - 599)	**Unhealthy (for all)** People with heart or lung disease, older adults, and children should avoid extended or heavy exertion. Everyone else should reduce extended or heavy exertion
Purple (600 and above)	**Very Unhealthy** Everyone should reduce extended or heavy exertion.

These numbers are in ug/m^3 and correspond to the numbers in the Formaldehyde emissions charts.

In this example, risk levels vary from good to moderate to unhealthy for one time period and weather condition. In such cases our advice is to take action based on the *highest* level of risk to limit your exposures. You should take the precautions we recommend on our website or contact your health provider for advice on limiting your risk.

Among the health effects EHP has seen most often are skin irritation, gastro-intestinal problems and respiratory problems. Visit our website to learn more.

The problem of multiple sources

If you have more than one source within 2-3 miles of your home, your exposures will vary according to the weather, the upwind source, and its distance from your home. Winds can also shift around during the day or night. While these conditions make it very difficult to assess your health impact, you can follow our general recommendations described in Reducing Exposures, earlier in this Toolkit.

Note about the air emission charts: Actual amounts and content of emissions are hard to come by. To give you an idea of how polluted your air might be depending on your proximity to drilling activity and the weather, we've done the following:

We've looked at publicly available reports for measurements of emissions. We used data from four sources:

- "Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements (Armendirez 2009)
- City of Fort Worth Natural Gas Air Quality Study Final Report, July 13, 2011
- Pennsylvania DEP Inventory of gas activities: http://www.portal.state.pa.us/portal/server.pt/community/oil_and_gas_reports/20297
- Railroad Commission of Texas Oil and Gas Well Records: http://www.rrc.state.tx.us/data/wells/wellrecords.php.

The air dispersion model is based on the work of meteorologist Frank Pasquill, D.Sc, FRS., author of Atmospheric Diffusion: The Dispersion of Windborne Material from Industrial and Other Sources, D. Van Norstand Company, Ltd., London, 1962.

All two-digit numbers were rounded *down* to the nearest "one." Numbers over 100 were rounded *down* to the nearest "25" and numbers over 1,000 were rounded *down* to the nearest "hundred."

This paper was written with the organization's best access to the publicly available data on emissions from UOGD sources. We will update our report when new, credible information is available.

YOUR LOCAL AIR QUALITY: GENERAL RECOMMENDATIONS

Source: https://pixabay.com/en/air-bag-wind-sock-wind-windy-sky-987933/

- During times of poor air quality, close windows and go elsewhere if possible.
- If you are home when the air is unhealthy, limit your activities. Under very unhealthy conditions no one should be outside.
- Filter your indoor air. See our website for details.
- Use weather forecasts to predict whether upcoming days will have good, moderate or poor air quality.
- Use this simplified guide to assess the air quality around your home. Look at the weather forecast so you can predict whether upcoming days are likely to be good, poor or moderate air quality days based on the wind direction and the location of nearby facilities. Remember, weather forecasts report wind direction by where the wind is coming *from,* not where it's blowing *to*.

Quick reference air quality guide:

Day/Night	Sun/Clouds	Wind	Air Quality
Day	Sunny	No wind	Healthy
Day	Sunny	Light wind	Healthy
Day	Sunny	Windy	Healthy
Day	Cloudy	No wind	Unhealthy
Day	Cloudy	Light wind	Unhealthy
Day	Cloudy	Windy	Moderate to healthy
Night	Less than half cloudy	No wind	Very unhealthy
Night	Less than half cloudy	Light wind	Unhealthy
Night	Less than half cloudy	Windy	Moderate to healthy
Night	More than half cloudy	No wind	Very unhealthy
Night	More than half cloudy	Light wind	Unhealthy
Night	More than half cloudy	Windy	Unhealthy

APPENDIX

CITIZEN SCIENCE LOG

If you are in an area close to fracking activity, you can use this log to record any environmental changes you observe, as well as any health symptoms that occur. Refer to the example provided as a reference. Once you have logged these over time, you can use them to complete the survey on the Health Registry. This will add data to assist ongoing public health research.

Date	**EXAMPLE:** 1/15/17				
Symptom(s)	Shortness of breath, headache				
Intensity	9 out of 10				
How long did it last?	3 hours				
Notes/ environmental observations	Occurred during flaring at well pad. Speck Air Quality monitor showed an increase in readings				

(table continues on next page)

Date					
Symptom(s)					
Intensity					
How long did it last?					
Notes/ environmental observations					

SAMPLE COMMUNITY MONITORING PROJECT BUDGET

This sample budget includes a range of services. However, not all services may be appropriate for all communities, and communities have the choice of which services to purchase.
This budget is for an eight-household community monitoring project.

Pre-construction monitoring			
	Cost	Number	Total
Equipment			
Health surveys			
Individual health survey forms Cost for up to 40 individuals are included in Analysis fees*		40	
Speck PM monitors			
2 Specks - per residence/location EHP free rental, valued at $3,200	$200/ Speck	16	$0
Community VOC air monitoring			
Summa Canisters	$200.00/ canister	4	$800
Formaldehyde	$80.00/ badge	4	$320
H2S	$100.00/ badge	4	$400
			$1,520
Analysis			
Management, Analysis,**			
Interpretation Reports			
(40 intakes, 16 Specks; 4 each of samplers)			**$7,500**
Total cost for community			**$9,020**

* If more than 40 health surveys are conducted, the cost is $190 for each additional individual
**Prices subject to change based on Lab fees
Post-construction budget is similar