
**Well Water Contamination:
SWPA-EHP Ranking System and Monitoring Strategy**

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Well Water Contamination: SWPA-EHP Ranking System and Monitoring Strategy*

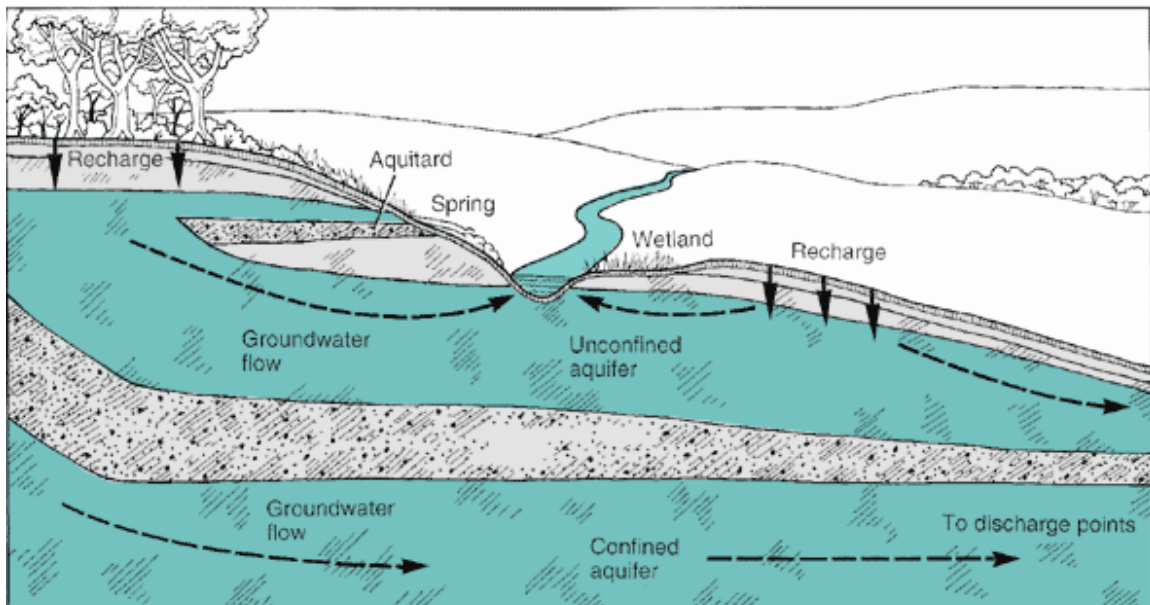
Private well water quality is not regulated in the United States. Well owners are responsible for monitoring their water quality. This is particularly challenging in areas where industrial development such as natural gas extraction activities are present. Gas well drilling activity, if properly conducted, 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. SWPA-EHP has developed this 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.

Ground Water Contamination – A Particular Concern

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 water quality.

An Explanation Of Groundwater Movement

It is important to understand how water gets to your well. Groundwater flows from recharge zones (areas where rain and snowmelt enter the ground) through the earth to aquifers, where the water gathers between rocks and soils.

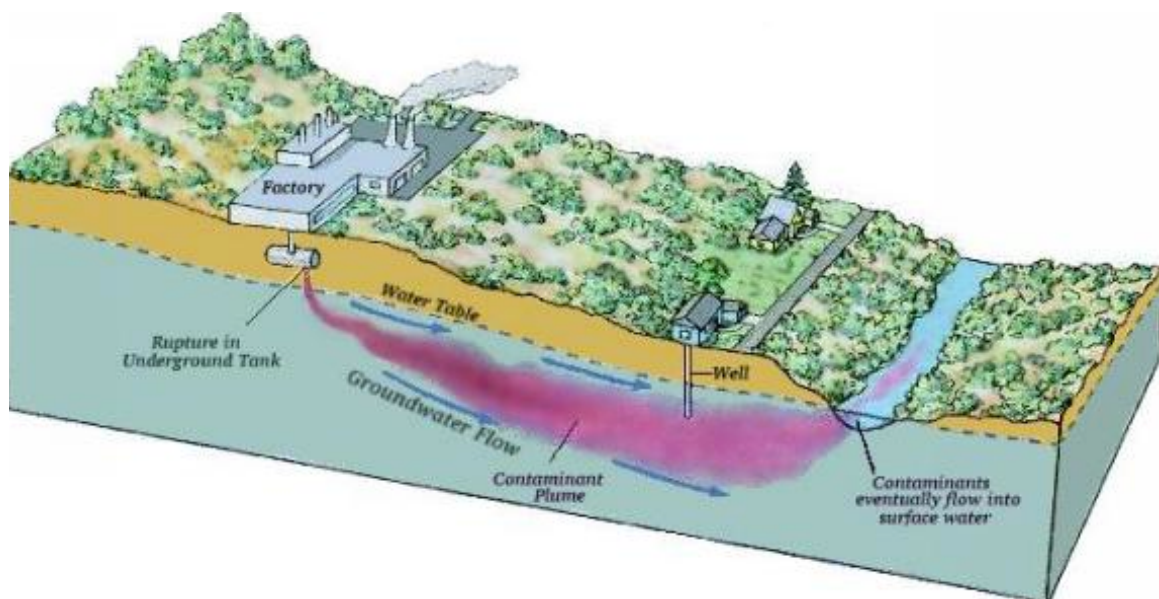


Source: Pennsylvania League of Women Voters: Groundwater Primer. Accessed 5.1.2012.
<http://wren.palwv.org/download/primer.pdf>

* This document is a “work in progress” and we will continue to update it as more information becomes available. Please check back with us periodically to find out if we have made changes to our recommendations.

The distance water travels can vary greatly. The rate of travel depends upon the characteristics of the material the water moves through. The movement can be very slow – less than a foot a day. Water underground could also travel a mile or more a day if conditions allow for it. The rate also depends upon the amount of rain or other sources of water added to the recharge area. It depends as well upon the depth of the water table (the depth at which water saturates the ground, filling in all air pockets in the soil). Even the direction of the water flow can be modified if nearby wells pump large amounts of water from the aquifer. The force of that water being drawn to the surface affects the direction and flow of the groundwater.

If a source of pollution is present in the recharge zone or between the recharge zone and the aquifer, the well water supply could be contaminated. The contamination of a well could occur at any time, even many months after pollution enters the groundwater.



Source: Earth Science Australia accessed 5.1.2012
<http://earthsci.org/education/teacher/basicgeol/groundwa/plume1.jpg>

Hazards To Aquifers

Local gas extraction activities can introduce a mixture of contaminants to groundwater.¹ 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.² 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.³ Spilled liquids, if not cleaned up, eventually make their way into the groundwater. Some of these chemicals will

¹ Rozell, Daniel J. and Sheldon J. Reaven, 2011. Water Pollution Risk Associated with Natural Gas Extraction from the Marcellus Shale. In Risk Analysis: DOI: 10.1111/j.1539-6924.2011.01757.x

² USEPA. 2011. Draft Investigation of Ground Water Contamination near Pavillion, Wyoming. Office of Research and Development, National Risk Management Research Laboratory, Ada, Oklahoma, 74820.

³ See Pennsylvania Department of Environmental Protection Gas Well Compliance Reports for records of spills and violations:

http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/OG_Compliance

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.

In Pennsylvania the responsibility of notifying residents of spills or accidents lies with local jurisdictions. Each municipality determines if, when and how to let people know if their groundwater supply is threatened. If a spill occurs in one township, but the local aquifer serves other towns, there is no guarantee that all affected well owners will learn about the spill.

In addition, under current law, some of the most hazardous chemicals used in the natural gas industry are not disclosed by gas drilling companies. Information about these contaminants will be provided to the well user or their health care provider only under very restricted circumstances, after the potential harm to human health may have occurred.⁴ 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

SWPA-EHP recommends that residents test their water annually, as suggested by the PA Department of Environmental Protection (DEP), for coliform bacteria, pH, nitrates and total dissolved solids (TDS).⁵ Other contaminants that may be naturally occurring in private well water in Southwestern Pennsylvania are methane, radon and arsenic, so testing for these may also be advisable on an annual basis. For those living in areas of natural gas extraction activities, we recommend baseline testing before drilling activity starts within three miles of your home.

We strongly advise that residents follow a strategy of monitoring with screening tests on a weekly basis. We suggest testing for specific contaminants every six months, or as soon as screening tests reveal changes in water quality, or you have other indications that your well has become contaminated. Monitoring weekly with screening tests for pH and for conductivity can warn well users that a change in water chemistry has occurred, although without identifying 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 the industry. In addition, we suggest residents sign up with the PA DEP e-notice program, which will alert you when drilling permits have been issued in your area so you will know what activities are taking place near your homes.⁶

We also recommend residents keep a diary of monitoring results, as well as 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 should also be recorded. Contact SWPA-EHP for assistance with pH and conductivity monitoring. SWPA-EHP's detailed testing recommendations are listed in the next section.

⁴ From PA House Bill 1950 Act 13: (10) A vendor, service company or operator shall identify the specific identity and amount of any chemicals claimed to be a trade secret or confidential proprietary information to any health professional who requests the information in writing if the health professional executes a confidentiality agreement and provides a written statement of need for the information indicating all of the following: (i) The information is needed for the purpose of diagnosis or treatment of an individual. (ii) The individual being diagnosed or treated may have been exposed to a hazardous chemical. (iii) Knowledge of information will assist in the diagnosis or treatment of an individual.

⁵ http://www.portal.state.pa.us/portal/server.pt/community/private_water_wells/20690#Testing

⁶ <http://www.ahs2.dep.state.pa.us/eNOTICEWeb/>

**The Ranking System and Monitoring Strategy:
Managing Well Water In Regions With Gas Extraction Activities**

Both federal and state water quality regulators recommend that households using well water apply the same standards as those developed for community water supplies when determining their water quality. Federal and state standards are based on Maximum Contaminant Levels (MCL), Maximum Contaminant Level Goals (MCLG), and Secondary Maximum Contaminant Levels (SMCL) (See pages 9-11 for a full explanation of drinking water standards).

SWPA-EHP has developed a unique ranking system for well water quality near Marcellus shale drilling activities. While our strategy incorporates some state and federal water standards, we recommend more rigorous management because of the unpredictability of chemical releases during gas extraction and the potential release of highly toxic materials in very high concentrations. This system ranks four levels of water quality and recommends a set of actions for each level to help well owners assess, monitor, and respond to changes in their household water. We suggest you use this strategy as long as the natural gas industry is active within three miles of your private water supply. If your water becomes contaminated, treatment options may be available. Contact the SWPA-EHP office for further information.

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
- 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 | • surfactants | • oil and grease |
| • strontium | • sodium | • ethane/methane |
| • barium | • glycols | • flourides |
| • 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 very limited research that is available. We are working with members of the local community over the next year to determine which of these tests are most essential and most cost-effective. None of these strategies for monitoring your well water are 100% effective. Potentially, contamination will occur undetected. But these strategies are still extremely valuable when one considers the consequences of living with contaminated water.

Keep in mind that our rationale and strategy recommendations may not support a legal case. Our focus is to provide the very best advice available for protecting public health, regardless of legal or political concerns.

SWPA-EHP Ranks and Actions

Ranks

- A. **Pristine** – No contaminants or sources within three miles in a region with natural gas extraction activities
- B. **Threatened** – Near sources of contaminants (within three miles)
- C. **Contaminated** – Contaminant(s) found below MCL standards – Do not drink
- D. **Polluted** – Contaminants found that exceed EPA MCL standards - Do not drink, cook or bathe with polluted water. Keep pets and livestock from drinking polluted water.

Actions

- A. **Pristine** – no contaminants or sources within three miles in a region with natural gas extraction activities

Action:

1. Conduct baseline tests.
2. Monitor for changes using pH and conductivity tests every week. The normal range for pH in Southwestern PA is 6.5 – 8.5. The normal range for conductivity is <775.
3. Test every six months using the SWPA targeted water tests (optional).
4. Test annually using the PA DEP private well water recommended tests.
5. If conductivity or pH exceeds the normal range for your area, or if contaminants are found in the baseline tests, then:
 - do not drink the water
 - conduct targeted tests
 - move to level C
 - notify the PA Department of Environmental Protection (DEP) and the PA Department of Health

- B. **Threatened** – Near sources of contaminants (within three miles)

Note: Compliance with federal or state MCLs is not sufficient to assure the safety of a dynamic water aquifer in an area with active extraction activities, including vehicular transportation of hazardous chemicals.⁷

Action:

1. Conduct baseline tests.
2. Monitor for changes using pH and conductivity tests every week. The normal range for pH in Southwestern PA is 6.5 – 8.5. The normal range for conductivity is <775.
3. Test every six months using the SWPA targeted water tests.
4. Test annually using the PA DEP private well water recommended tests.
5. If conductivity or pH exceeds the normal range for your area, or if contaminants are found in the baseline tier tests, then:
 - do not drink the water
 - conduct targeted tests
 - move to level C
 - notify the PA Department of Environmental Protection (DEP) and the PA Department of Health

⁷ Trucks that carry hazardous materials must show a placard that defines the type of material transported. See <http://www.pHpHmsa.dot.gov/hazmat/info-center>.

C. **Contaminated – one contaminant below EPA MCL standards**

Action:

1. Drink bottled water.
2. Limit bathing and cooking with well water.
3. If there is only one contaminant, divide the given MCL by 2. If the amount of contaminant found in your water is over 1/2 of the MCL, then:
 - stop using the water for drinking, bathing or cooking
 - treat the water system
 - notify the PA DEP and the PA Department of Health
 - test for contaminants after treatment
 - retest for contaminants after one month
 - monitor for changes in pH and conductivity every week. The normal range for pH in Southwestern PA is 6.5 – 8.5. The normal range for conductivity is <775.

Example:

If there is one contaminant, divide the MCL by 2.

Hypothetical water test results:

Glyphosate: .1 mg/L (MCL .7mg/L)

Divide the MCL by 2.

$.7/2 = 0.35$

The contaminant is not above 0.35 mg/L. Continue to monitor your water. You can continue to use your water.

Contaminated – 2 contaminants below EPA MCL standards.

Action:

1. Drink bottled water.
2. Limit bathing and cooking with well water.
3. Ventilate all water use areas (kitchen, laundry, bathrooms) in the home with window or exhaust fans that discharge to the exterior of the house.
4. If there are 2 contaminants, divide the lower of the two MCLs by 4. If either contaminant is over 1/4 of that MCL, then:
 - stop using the water for drinking, bathing or cooking
 - treat the water system
 - notify the PA DEP and the PA Department of Health
 - test for contaminants after treatment
 - retest for contaminants after one month
 - monitor for changes in pH and conductivity daily. The normal range for pH in Southwestern PA is 6.5 – 8.5. The normal range for conductivity is <775.

Example:

If there are 2 contaminants, divide the lowest MCL by 4.

Hypothetical water test results:

Arsenic: 0.001 mg/L (MCL .01mg/L)

Ethylbenzene: 0.002 mg/L (MCL 0.7mg/L)

Divide the lowest MCL (which in this instance is Arsenic at 0.01) by 4.

$.01/4 = .0025$

Neither contaminant is above .0025 mg/L. Continue to monitor your water. You can continue to use your water.

Contaminated – 3 or more contaminants below MCL standards.

Action:

1. Drink bottled water.
2. Limit bathing and cooking with well water.
3. Ventilate all water use areas (kitchen, laundry, bathrooms) in the home with window or exhaust fans that discharge to the exterior of the house.
4. If there are 3 or more contaminants, divide the lowest MCL by 10. If any contaminant is over 1/10 of that MCL, then:
 - stop using the water for drinking, bathing or cooking
 - treat the water system.
 - notify the PA DEP and the PA Department of Health
 - test for contaminants after treatment
 - retest for contaminants after one month
 - monitor for changes in pH and conductivity daily. The normal range for pH in Southwestern PA is 6.5 – 8.5. The normal range for conductivity is <775.

Example:

If there are 3 or more contaminants, divide the lowest MCL by 10. If any contaminant is over 1/10 of that MCL level, treat the water system and break the pathway of exposure if possible.

Hypothetical water test results:

Nitrates: 4 mg/L (MCL 10mg/L)

Barium: 0.5 mg/L (MCL 2mg/L)

Benzene: 0.0002 mg/L (MCL 0.005 mg/L)

Divide the lowest MCL (which in this instance is Benzene at 0.005) by 10.

$0.005/10 = 0.0005$

Two of the three contaminants are above 0.0005. Stop drinking, cooking and bathing with your water.

- D. **Polluted** – Exceeds EPA MCL standards - Do not drink, cook or bathe with polluted water. Keep pets and livestock from drinking polluted water.

Action:

1. Notify the PA DEP and the PA Department of Health.
2. Treat the water system. Filtration systems and advanced off-gassing techniques should be considered.
3. Test for specific contaminants and continue to monitor for changes using pH and conductivity.

Why We Recommend Daily and Weekly Well Water Monitoring

SWPA-EHP has devised this ranking system to manage well water quality in areas threatened by groundwater contamination. We developed this system to help people make informed decisions about monitoring and using their water. The system is based primarily on an analysis of EPA's well test results from Pavillion, Wyoming⁸. In its study, EPA tested 49 wells near natural gas extraction activities for a broad array of contaminants. The results show that well contamination was not uniform – not all wells were contaminated, and contamination differed among wells. The variable movement of groundwater affects the movement of chemicals and can determine which wells become contaminated.

⁸ http://www.epa.gov/region8/superfund/wy/pavillion/EPA_ReportOnPavillion_Dec-8-2011.pdf

Because groundwater moves continuously and at varying rates, SWPA-EHP believes it is necessary for homeowners to monitor their wells for changes in water quality on at least a weekly basis. Our analysis of the Pavillion well data shows that changes in pH and conductivity can serve as useful markers of changes in water quality. Wells with increases in these measurements also tended to show increases in other contaminants. The suggested screening tests are inexpensive and easy to conduct. Thus, if no changes are observed, well owners can avoid spending money on costly tests and continue to monitor and use their water. When alerted to changes in water quality, they will know that their water should be tested by a reliable source. We suggest keeping a written record of all water tests and unusual events such as odors, tastes, and loss of water clarity.

SWPA-EHP has also reviewed the results of water tests conducted in Pennsylvania. We found that when results in conductivity and pH were high, other contaminants were likely to be present. This again indicates that as screening tests, these can serve as “markers” for other possible contaminants. SWPA-EHP will continue to review the results of water tests in Pennsylvania as data becomes available. Please contact us if you would like to include your water test results in our ongoing analysis.

SWPA-EHP also believes it is important for private well owners to understand that the MCL health standards developed by the EPA address exposure to single contaminants only. If there are multiple contaminants, the combined hazards must be taken into consideration. While the federal government uses a “hazard index” formula when there are multiple contaminants are found in water, it is the opinion of SWPA-EHP that if more than three chemicals are present, the “hazard index” formula is not an appropriate test for risk to human health. The SWPA-EHP strategy takes a more conservative approach to determining health risks associated with potential contaminant interactions.

By using the above strategy you can reduce health risks, but this strategy is not a substitute for responding to any health symptoms experienced when drinking, cooking with or showering and bathing in a threatened or contaminated water system. Contact your health provider if you are concerned about your health. In addition, SWPA-EHP recommends that you monitor the health of animals at your home. If your animals become sick, you should carefully consider testing the quality of your well and surface water.

An Explanation Of Drinking Water Standards⁹

The U.S. Environmental Protection Agency (EPA) was authorized by the 1974 Safe Drinking Water Act and its amendments to establish limits on the concentration of certain contaminants that are allowed in public drinking water systems. These limits or standards are set to protect public health by ensuring good water quality. EPA standards for drinking water fall into two categories: Primary Standards and Secondary Standards.

1. National Primary Drinking Water Standards

Primary standards protect consumers from microbial contaminants, radioactive elements, and toxic chemicals. The EPA sets a non-enforceable goal and an enforceable goal for each drinking water contaminant that poses a health concern. The non-enforceable, maximum contaminant level goal (MCLG) is based entirely on health considerations; as a health goal, it is set at a level at which no adverse health effects should occur. The maximum contaminant level (MCL) represents an enforceable limit. The MCL is the highest concentration of a contaminant allowed in public drinking water systems.

The MCL is set as close as possible to the MCLG for any particular contaminant. However, the MCL also takes into consideration the ability of laboratories to detect the contaminant at low levels, the feasibility of treatment, and the cost of maintaining the levels of the contaminant below the MCL.

2. National Secondary Drinking Water Standards

Secondary standards relate to aesthetic contaminants that cause offensive taste, odor, color, corrosivity, foaming, or staining. The concentration limit is called the secondary maximum contaminant level (SMCL). Secondary standards are not enforced; they are guidelines for water treatment plant operators and state governments attempting to provide communities with the best quality water possible.

Health Advisories

EPA also issues Health Advisories which provide information on contaminants that can cause human health effects and are known or anticipated to occur in drinking water. Health Advisories are guidance values based on non-cancer health effects for different durations of exposure (e.g.; one-day, ten-day, and lifetime). They provide technical guidance to EPA regional offices, state governments, and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination.

How Standards Are Set

Primary standards for drinking water contaminants are based on three criteria:

1. The contaminant causes adverse health effects.
2. The contaminant is detectable in drinking water.
3. The contaminant is known to occur in drinking water.

How EPA Sets Primary Drinking Water Standards

In setting Primary Standards for a drinking water contaminant, the EPA first looks at the toxicological data on that contaminant, usually obtained from acute and chronic animal studies. (Human clinical or epidemiological data are used when available, but scientific data linking human health to drinking water contaminants are limited). Experts use this information to estimate the concentration of the contaminant that may be toxic and the concentration level, if any, at which the contaminant causes no adverse health effects. These standards, however, do not address multiple contaminants.

⁹ Adapted from: The State of Connecticut Department of Public Health Environmental Health Section, Private Well Program 450 Capitol Avenue, MS#51REC, PO Box 340308, Hartford, CT 06134 *Publication Date: May 2009*

Acute and Chronic Health Effects

Toxic doses of chemicals cause either acute or chronic health effects. An acute effect usually follows exposure to a large dose of a chemical and occurs almost immediately. Examples of acute health effects are nausea, vomiting, lung irritation, skin rash, dizziness, and even death.

The levels of contaminants found in drinking water are seldom high enough to cause acute health effects. Levels of some contaminants may cause chronic health effects, which occur after long term exposure to small amounts of a contaminant. Examples of chronic health effects include cancer, organ damage, disorders of the nervous system, reproductive / fertility problems, and damage to immune system. Children, infants and the elderly are especially sensitive to contamination and may not be fully protected by current drinking water standards.

Acceptable Daily Intake

The acceptable daily intake (ADI) is the daily dose of a substance (including a safety margin) that a person can ingest over a lifetime without suffering adverse health effects. The ADI is used to establish the MCLG for a contaminant, which in turn is used to set the enforceable MCL.

Risk Estimate

If a contaminant causes cancer, it is assumed that no concentration is safe. Consequently, the MCLG is set at zero, a level that is not always possible to achieve. However, at very low levels the risk of cancer becomes so small that it is considered negligible. Therefore, regulatory officials must decide what level of risk is acceptable. The risk estimate is the level of exposure to a chemical estimated to cause this “acceptable level” of risk.

Current Public Drinking Water Standards

The EPA is required to update the list of regulated contaminants every 5 years. Currently, EPA regulates over 80 contaminants found in drinking water. Although the EPA oversees public drinking water quality, regulatory officials in each state ultimately set and enforce drinking water standards for EPA-regulated and other contaminants. States are permitted to set standards that are stricter, but not less stringent, than those set by EPA. When a standard is exceeded, the EPA, through the designated state agency, requires that the contaminant level be reduced to the MCL. The corrective treatment is left to the individual water system.

Private Well Owner Responsibility

As a private well owner, you are responsible for ensuring the quality of your own drinking water. Homeowners with private wells are generally not required to test their drinking water to meet standards. However, you can use the public drinking water standards as guidelines when evaluating the quality of your drinking water.

Public water systems provide treated, potable water to their customers for a fee. The cost of public water includes the costs of protecting the water source, managing and training personnel to use the water supply equipment, monitoring the water for contaminants, obtaining professional engineers' opinions and advice, making improvements to the water treatment and distribution system, planning for expansion, reporting to State and Federal agencies, and managing the financial aspects of the business.

Private well owners should consider the cost of well water maintenance and protections as a budget item, just as if they were paying a water bill. Improvements to water wells, treatment systems and plumbing are a necessary expense that directly benefits the homeowner. Although some treatment systems are expensive, the cost is often less than the price paid by the owner in health effects or nuisance problems.

Drinking Water Standards Are Not Absolute

Setting drinking water standards is an imperfect process influenced by economic, political, and social considerations, in addition to scientific data. Data that relate human health responses to

chemicals in drinking water are limited, and scientists have difficulty predicting the effects of drinking small amounts of chemicals for many years. Furthermore, standards do not take into consideration the presence of multiple chemicals, which may increase or decrease the toxicity of a particular contaminant.

For these reasons, it is important to understand that primary drinking water standards do not guarantee that water with a contaminant level below the standard is risk-free, nor do they indicate that water with a higher level is unsafe. Drinking water standards represent conservative judgments of scientists and regulatory officials based on all available information on the health effects of drinking water contaminants.

Testing your drinking water will tell you what is in your water at the time the sample is collected. Test results from 6 months ago represent the water quality of the well 6 months ago. Even though the levels of most naturally occurring contaminants may stay fairly consistent, they may also slowly increase or decrease over time, or can have a seasonal fluctuation, depending on water levels. For those concerned about contamination due to natural gas extraction activities, it is important to stay vigilant. Water quality can and does change, and the timing of potential contamination is unpredictable.

Glossary

MCL: maximum contaminant load

MCLG: maximum contaminant load goal

ADI: acceptable daily intake

EPA: Environmental Protection Agency

PA DEP: Pennsylvania Department of Environmental Protection

Link to MCL standards for PA:

http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/lib/watersupply/PA_MCLs_06.pdf

This document and the recommendations SWPA-EHP has made are the result of careful research based on the available data. Although there are few studies on the effects of natural gas drilling activities on water, we examined the existing studies thoroughly in order to provide information that would be most useful to residents. We will continue to look for more information that will improve SWPA residents' ability to monitor the safety of their well water.

SWPA-EHP would not have been able to develop this analysis and set of recommendations without the on-going support of the Heinz Endowments, the Pittsburgh Foundation and the Claneil Foundation.