EARTHWORKS™

MARCELLUS OGAP
OIL & GAS ACCOUNTABILITY PROJECT

# Understanding your water and air tests

*The air and water quality reports that you receive from a laboratory may be several pages long and contain both data and technical descriptions. This information sheet explains how to understand key aspects of the reports and the connection between numbers and potential health impacts.*

## Laboratory reports

The section of laboratory reports with the analysis of your water or air sample will be called Analytical Results, Analytical Report, Certificate of Analysis, or something similar. Within this analysis, a result will be provided for each parameter measured. You may have had your water tested for metals, semi-volatile and volatile organic compounds (SVOCs and VOCs), methane, radioactive substances, microbiological organisms (like coliform), and general water chemistry parameters such as pH (acidity), temperature, and total dissolved solids (TDS). Laboratory analyses of air canister samples typically only measure volatile organic compounds, although some sulfur compounds may also be included.

The results report will vary depending on the lab (for example, the order of the columns may differ and there may be a Chemical Abstract Service number, or CAS, column). But it will look something like this:

| Parameter/Analyte | Result | Units | Method Reporting Limit | Qualifier | Method |
|---|---|---|---|---|---|
| Barium | 0.50 | mg/L | 0.01 | | EPA 200.7 (water) |
| Arsenic | 0.0011 | mg/L | 0.0010 | | EPA 200.8 (water) |
| Benzene | ND | μg/L | 0.50 | U | EPA 524.2 (water) |
| Benzene | 1.0 | $\mu g/m^3$ | 0.47 | ND | TO-15 (air) |

## Common terms and definitions

<u>Parameter/Analyte.</u> A substance or characteristic (like temperature) measured in water or air samples.

<u>Result.</u> The concentration or value measured during the analysis. ND means "not detected."

<u>Units.</u> The units of measure used to express a test result. Typically, water test results will be reported in milligrams per liter (mg/L). One mg/L is approximately equal to one part per million (ppm), which means one part contaminant per one million parts of water. Results may also be reported in micrograms per liter (μg/L), which is approximately equivalent to parts per billion (ppb), or one part contaminant per one billion parts of water. Drinking water standards are often reported in mg/L, so if your test results are reported in μg/L you may need to convert to mg/L in order to compare your results to the standard.

There are 1,000 micrograms in one milligram, so to convert from μg/L to mg/L divide your result by 1,000.
*Example:* 5 μg/L = 5 ÷ 1,000 = 0.005 mg/L

Other units of measure may be given, depending on the parameter being tested. For example, total coliform bacteria may be reflected as “present” or “absent,” or as number of bacteria in 100 milliliters (mL) of water. Radon and other radioactive substances are measured in picocuries per liter (pCi/L); hardness is often measured as mg/L or grains per gallon (gpg); conductivity may be measured as Siemens per centimeter (S/cm) or microSiemens/cm (uS/cm); and turbidity is often expressed in Nephelometric Turbidity Units (NTU). Other aspects (such as pH) aren’t expressed in terms of concentration and therefore have no units.

Air tests results are typically reported in micrograms of VOC measured per cubic meter of air ($\mu g/m^3$) or parts per billion by volume (expressed as either ppbv or ppb). Sometimes they are expressed in parts per million by volume (ppmv or ppm). Unlike with water tests, where µg/L is approximately the same as ppb, with air tests $\mu g/m^3$ is not the same as ppbv. To convert ppbv to $\mu g/m^3$ or vice versa, you have to know the molecular weight of the compound of interest. (To find out more, see Columbia Analytical’s fact sheet in the Resource section below.)

Method Report Limit (MRL) or Reporting Limit (RL). This value is the lowest amount of a substance that can be determined by the laboratory with a high degree of precision and accuracy. Because instruments are sensitive and there may be day-to-day fluctuations, some labs establish MRL as three times the method detection limit (MDL) or greater. *It is important that laboratory MRLs are lower than the drinking water standard*, so make sure to use a lab that has equipment sensitive enough to detect chemicals at lower concentrations.

If “< MRL” appears in the “Result” column, then your test result was below the MRL set by the laboratory. This does not necessarily mean that the chemical was not present in your water. For example: Your water has a concentration of 8 µg/L of benzene. If the lab’s MRL is 10 µg/L, the lab report will show that the chemical was not detected because the lab doesn’t have the ability to measure benzene at a concentration of 8 µg/L. Unfortunately, in this case the drinking water standard is 5 µg/L, so the actual concentration of benzene in your drinking water is above the level that is acceptable but the lab used said benzene was “not detected.” If a lab was used with an MRL of 3 µg/L, it would have detected benzene, and you would have known that there was a problem with your water.

Qualifier. These notations provide more information regarding the analysis. For example, a qualifier of ND or U typically means that a compound was not detected or undetected; J may indicate that the concentration of the compound was estimated. Definitions of the qualifiers should be provided by the laboratory in the report.

## What do test results say about risks to your health?

Even with the results from comprehensive water and air tests, there’s no simple answer to this important question. The establishment of water and air quality standards is a complicated and lengthy scientific process that may also be influenced by economic and political factors.

Drinking water supplies and the air around us may contain hundreds or thousands of substances, but both federal and state government regulatory agencies have established standards, or legal limits, for just a fraction of these. For example, the U.S. Environmental Protection Agency (EPA) has established primary drinking water standards for only about 90 individual contaminants that can adversely affect public health and are known or anticipated to occur in water. In addition, the impacts of exposure to multiple chemicals (even at low concentrations) for long periods of time isn’t well understood. Finally, different people react differently to exposures, and some people (like children, the elderly, and those with underlying health conditions) may be more vulnerable.

Nonetheless, you can gauge whether there might be health effects by comparing the contaminants in your water to health-based standards that do exist. This is most easily done by comparing your water test results to the Maximum Contaminant Levels (MCLs) that have been set for drinking water by both the EPA and Pennsylvania's Department of Environmental Protection (DEP). MCLs reflect the highest concentrations allowed in public water systems, but also serve as a good guideline for water quality in private water wells. EPA and DEP also regulate secondary contaminants in drinking water that can cause problems that are cosmetic (such as discoloration of skin or teeth) or aesthetic (such as taste, odor, or color). *If your water test has contaminants above the MCL, you should strongly consider not using the water.*

Understanding the potential health impacts related to air tests is more difficult. EPA has established National Ambient Air Quality Standards (NAAQS) for the most common air pollutants that are considered harmful to public health and the environment. For these "criteria pollutants," EPA's "primary" air quality standards are designed to protect the most sensitive populations (children, the elderly, and asthmatics). Unfortunately, there are only six criteria pollutants (carbon monoxide, lead, nitrogen dioxide, ozone, particle pollution, and sulfur dioxide). Pennsylvania has developed ambient air quality standards for three additional pollutants (beryllium, hydrogen sulfide, and fluorides).

EPA also regulates 187 toxic or "hazardous air pollutants" that are known or suspected to cause cancer or other serious health effects. However, this is done by controlling the amount of a pollutant that is released by industrial facilities. Safety standards do not exist for contaminants in the air that we breathe.

Some health-based air limits exist for the indoor workplace. The Occupational Health and Safety Administration (OSHA) sets Permissible Exposure Limits (PELs) for approximately 500 substances to protect workers from the health effects of hazardous substances. PELs are enforceable limits on the amount or concentration of a substance in the air or, in some cases, that shouldn't come in contact with skin. These limits are based on an 8-hour time-weighted average exposure.

OSHA limits provide a general sense of what's considered safe, even though they can't be directly applied to results from air canister tests outside a home. PELs are set to protect workers who may be exposed in the workplace over a typical 8-hour shift. If you measure the air in your yard, it's unlikely that you are being exposed to concentrations of chemicals found in the canister for 8 hours since not many people spend 8 hours a day outside in one place. However, it's also possible to be exposed to different concentrations over longer periods of time at home than at work.

OSHA PELs will likely be much higher than the concentrations measured in an air canister. *If the canister test result is above the PEL for any of the chemicals, you should seek advice from an environmental or public health professional.* But even if the concentration is below the PEL, it's not easy to understand exactly what that means. Your canister test will likely have captured air over a 24-hour period (you can find out the sampling time from the person or organization that conducted the sampling). The concentration reported is the average concentration over that period. The air may have contained a consistent concentration of chemicals during that entire time, or there may have been periods during which you were exposed to higher concentrations of a chemical or chemicals (for example, when a pipeline or compressor was venting gas, or wastes were being emptied into a nearby impoundment pit and volatile chemicals escaped into the air), as well as periods when you were exposed to low or negligible concentrations of chemicals. *The only* *way to know the variation in exposures is to have some sort of continuous monitoring, or to take many canister samples over shorter periods of time.*

Federal and state agencies determine the potential for health impacts from exposure to hazardous substances in a variety of ways: risk assessments, exposure investigations, health assessments, and other studies. One tool often used is EPA's Integrated Risk Information System (IRIS), which evaluates information on health effects that may result from exposure to environmental contaminants. The IRIS system provides information on oral "reference doses" and inhalation "reference concentrations" (RfDs and RfCs, respectively) for health effects known or assumed to come from exposure to certain chemicals. California's Office of Environmental Health Hazard Assessment (OEHHA) has developed a similar set of acute, 8-hour, and chronic Reference Exposure Levels (RELs) that it uses to perform risk assessments related to toxic emissions from industrial facilities.

Such values should not be compared directly to your air or water tests, since they are used by health professionals to assess the public health risks of a given substance in a given situation. However, looking at these websites may help provide a perspective on your exposure—as well as a measure of comfort if you see that the concentrations of chemicals in your samples are below the RfD, RfC, or REL levels.

## Resources

1. "How do I convert from ug/L to ppbv and vice versa?" Columbia Analytical Services: www.caslab.com/Air-Testing/FAQ.php#q1
2. Drinking Water Interpretation Tool (PennState) allows you to enter your results and see how they compare to drinking water standards: www.psiee.psu.edu/water/dwit.asp
3. "How to interpret test results from a private well" (Colorado Department of Public Health and Environment) outlines drinking water standards, sources of contaminants, and symptoms associated with exposure: www.colorado.gov/cs/Satellite/CDPHE-Lab/CBON/1251594505164
4. *Well Water Contamination: SWPA-EHP Ranking System and Monitoring Strategy* (Southwest Pennsylvania Environmental Health Project) outlines different courses of action to take depending on your water test results: www.environmentalhealthproject.org
5. EPA drinking water standards available at: http://water.epa.gov/drink/contaminants/index.cfm
6. PA DEP Maximum Contaminant Levels and secondary drinking water standards available at: http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/DrinkingWaterPortalFiles/watersupply/pa-mcls_06.pdf
7. EPA National Ambient Air Quality Standards: www.epa.gov/air/criteria.html
8. PA DEP Ambient Air Standards available at: www.dep.state.pa.us/dep/deputate/airwaste/aq/standards/standards.htm
9. EPA Hazardous Air Pollutant information: www.epa.gov/ttn/atw/allabout.html
10. OSHA Permissible Exposure Limits information: www.osha.gov/dsg/topics/pel/index.html
11. OSHA Table of Air Contaminant Limits: www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992