Arsenic in Arizona Soil, Water and Air

Arsenic is a naturally occurring element present for millions of years throughout Arizona's rocks and soil. While it's part of the natural environment, activities like mining can sometimes bring it to the surface, raising questions about its presence in our water, soil, and air. Learn about the origins of arsenic, its effects on health, what the Arizona Department of Environmental Quality (ADEQ) is doing to address it, and clear, practical steps you can take to protect yourself and your family from exposure to arsenic in the natural environment.

Arsenic in Arizona

- **Geologic Origin of Arsenic in Arizona**

  Arsenic is especially common in certain types of Arizona rocks. The rocks that contain valuable copper, molybdenum and gold ores also contain higher levels of arsenic. Ores are rock formations containing valuable minerals sought by miners. These deposits were produced by deep underground hydrothermal activity giving us some of the richest mining areas in the world. Arizona's unique geology means that these mineral-rich formations act as a natural source for arsenic all across the state. While it is found throughout Arizona, relatively high levels of arsenic are most commonly found in the western, central, and southern regions of the state. In particular, Pinal and Yavapai Counties have been identified as areas with some of the state's highest concentrations in water and soil.

- **Where Arsenic is Found in the Environment**

  The primary process for moving arsenic from these solid rocks and ores into the environment is natural weathering and erosion. Over millions of years, forces like wind and rain slowly break down the stone, dissolving the trapped arsenic into water or releasing it as small particles into the soil. Once released from rock, arsenic travels through different pathways depending on the environment. In surface water, such as rivers and lakes, arsenic attaches to tiny particles of clay or iron minerals in the dirt. These sediments are then washed downstream by rain and can be deposited in low open areas during flood events.

  For groundwater, arsenic moves into underground aquifers as water percolates down through layers of rock and soil. Groundwater chemistry such as high alkalinity or low oxygen are common in deep water wells and can trigger reactions that force arsenic to detach from soil particles and dissolve into the groundwater.

  Arsenic also reaches the air through both natural and human-led processes. Natural sources, including volcanic eruptions, contribute a significant portion of global arsenic emissions. Human activities such as burning fossil fuels and smelting metal ores also release arsenic into the atmosphere as fine, dust-like particles. This airborne arsenic eventually settles back onto the landscape, where it can contaminate soil and water far from its original source. Once in the soil or water, arsenic can be absorbed by plants, such

as rice and various vegetables, further spreading the element through the environment and the food chain.

- **Arizona Mining**

  Mining operations play a major role in bringing mineral rich rocks to the surface to be processed. When miners dig up deep bedrock to find valuable metals like copper, they expose these arsenic-bearing rocks to the environment for the first time. Arsenic is also found in the waste materials left behind by mining, such as tailing piles and slag.This process increases the surface area of the rocks that are exposed to the elements.

  Another way mining operations historically involved arsenic is through smelting, where minerals were heated to extremely high temperatures to extract metals. Historically, smelters did not have pollution controls like today. To figure out if arsenic in the soil came from human activities like smelting rather than nature, scientists can use microscopes to look for spherical-shaped particles or check if the contamination is concentrated at ground surface.

- **What does background mean?**

  A background arsenic level refers to the amount of arsenic that is naturally present in the environment, such as in soil, rocks or water, as a result of the local geology and natural earth chemistry. Because certain types of rocks naturally contain high amounts of arsenic, what is considered a “normal” level can vary significantly from one town to the next. Scientists and regulators do not set clean up standards for soil to be cleaner than these natural background levels, and ADEQ can’t compel a company to clean up to below natural levels.

  To find the natural baseline, environmental scientists collect numerous samples from unpolluted areas and use statistical methods to calculate a representative concentration for the site. These methods range from simple arithmetic means and 95th percentiles to more complex thresholds like Upper Prediction Limits and 95-95 Upper Tolerance Limits. For data that does not follow a normal distribution, specialists apply additional statistical methods to ensure background levels are calculated accurately.

Health Concerns from Exposure to Arsenic

According to environmental research, the primary ways people can come into contact with arsenic include dietary intake, potable water, soil and the atmosphere.

- **Food Consumption:** Ingesting food represents a common route of arsenic exposure for the general population. Fish and shellfish may naturally accumulate high levels of organic arsenic compounds. Additionally, exposure may come from produce cultivated in areas irrigated with impacted water sources.
- **Drinking Water:** Consumption of water is a common exposure pathway. Well water (groundwater) may contain a form of arsenic characterized by significantly higher toxicity.

Natural geological formations can leach arsenic into the groundwater, or surface water, that supplies public water systems and private wells.

- **Soil Ingestion:** This is a particular concern for young children, who may inadvertently ingest dirt through hand-to-mouth contact while playing in outdoor environments.
- **Inhalation:** Dust can be inhaled during soil-disturbing activities like gardening. Furthermore, the atmosphere can carry fine particles released by industrial processes, such as the smelting of metal ores or the combustion of fossil fuels like coal where proper emission controls were not used.

When assessing how a substance like arsenic impacts the human body, health experts generally divide the consequences into acute and chronic effects. Acute health effects result from a high dose of a substance over a brief, short-term period, typically 14 days or less. Acute exposure is generally not a concern with Arizona soil or water and is typically from a direct exposure to an arsenic poison or arsenic hazardous waste.

Chronic health effects develop from repeated or continuous exposure to lower levels of arsenic over a long period of time, usually greater than a year. Ultimately, whether a person gets sick depends heavily on the specific dose, the duration of exposure, and how frequently they come into contact with it.

Resources

- Arizona Department of Health Services (ADHS) – What you should know about Arsenic in Arizona Groundwater (bit.ly/ADHS_As_GW)

How ADEQ Programs Address Arsenic

Safe Drinking Water

ADEQ protects the public from arsenic in drinking water through its Safe Drinking Water program, which regulates and monitors the public water supply for over 7 million people. The program enforces a health-based standard for arsenic called the Maximum Contaminant Level (MCL), which is set at 10 parts per billion (ppb). Public water systems (PWS) must routinely monitor their water quality, and compliance is determined by a Running Annual Average (RAA), which is the average of four quarterly samples over a year, reflecting the chronic health risk of arsenic exposure. ADEQ enforces these rules and has the authority to take legal action against systems that fail to meet this health standard. Background levels of arsenic are not applicable to public water supplies and all drinking water systems must meet the MCL regardless of source or cause.

To help water suppliers comply and safeguard public health, ADEQ offers a free Technical Assistance Program to eligible small water systems, providing comprehensive technical, managerial, and financial support, including system evaluations and guidance on securing funding. The program also uses a proactive predictive analytics program that forecasts when a system might exceed the arsenic standard. This advanced warning allows water suppliers to react faster and implement long-term solutions before violations occur, ensuring the continued delivery of safe drinking water.

If members of the public have questions regarding their drinking water, they should contact their public water supply provider directly. Consumers can find their specific arsenic levels listed in their utility's annual consumer confidence report if they are served by a community PWS.

Groundwater Protection Programs

ADEQ regulates arsenic in groundwater through its Aquifer Protection Program (APP). This program enforces the Aquifer Water Quality Standard (AWQS) for arsenic, which is the same as the 10 ppb drinking water standard. Facilities such as mines and wastewater treatment plants must have an APP permit and are required to monitor their discharge and groundwater quality to prevent further contamination. They must use the published and accepted Best Available Demonstrated Control Technology to prevent or treat discharges that do not meet the AWQS. Since arsenic is naturally occurring, if a facility is in an area where natural background levels already exceed the standard, a site-specific limit is established to ensure the facility does not cause any further degradation of the aquifer.

Groundwater monitoring is a proactive way ADEQ determines whether arsenic is migrating into domestic wells or drinking water systems. While private wells are not regulated, ADEQ protects public health through its voluntary Groundwater Quality Monitoring Program. Through this program, ADEQ collects samples from private wells and has them tested by a certified laboratory to check compliance with the AWQS. Well owners receive the full laboratory report, and if arsenic levels exceed the standard, ADEQ directs them to ADHS for guidance on health risks and water treatment options.

Resources

- APP permits contact – GroundwaterPermits@azdeq.gov
- Groundwater monitoring contact: GWMonitoring@azdeq.gov

The Solid and Hazardous Waste Programs

ADEQ is responsible for implementing the requirements of the federal Resource Conservation and Recovery Act (RCRA). Under RCRA, waste containing arsenic can be classified as a hazardous waste due to its toxicity or categorized as a "listed hazardous waste". Facilities may dispose of arsenic-containing wastes at municipal solid waste landfills only if they demonstrate the waste is non-hazardous. RCRA requires facilities to use a specific laboratory method, the Toxicity Characteristic Leaching Procedure, to determine if a waste is hazardous. A result below 5 parts per million (ppm) is non-hazardous, a result at or above 5 ppm is hazardous.

Hazardous arsenic wastes are subject to disposal restrictions and must be managed as a hazardous waste or treated until the leachable arsenic concentration falls below the 5 ppm before disposal. There is a federal exemption for arsenical-treated wood or wood products if they are being used as intended. Permitted landfills are required to monitor groundwater against the arsenic standard of 10 ppb.

If a regulated facility generates arsenic within its waste stream, ADEQ actively works with permitted landfills to ensure compliance with the AWQS. If arsenic concentrations in soil or water

are tested and determined to be hazardous, the facility must clean them up or dispose of them accordingly. Because Arizona has no permitted hazardous waste landfills, facilities must dispose of all hazardous wastes at permitted facilities outside of Arizona.

Resources

- Program contact – HazardousWasteICU@azdeq.gov

Surface Water Protection: Rivers, Streams and Lakes

Arizona evaluates surface water quality against strict arsenic criteria designed to protect public health, agriculture, and wildlife. When testing reveals a surface water standard exceedance, the waterbody is classified as impaired. While Arizona's highly mineralized geology and natural geothermal features, such as hot springs, elevate baseline arsenic levels, human activities can make it worse. Important contributors to these impairments include stormwater or snowmelt interacting with old and inactive mining operations, as well as increased erosion from land-use disturbance. To address these threats, ADEQ identifies pollutant sources, outlines clean up strategies, and implements or supports targeted restoration projects, ranging from treatment to nature-based erosion control.

The Arizona Pollutant Discharge Elimination System (AZPDES) program issues permits that can require arsenic monitoring for wastewater treatment plants, industrial facilities, and municipal or industrial stormwater discharges to surface waters (such as rivers, lakes, and creeks). Test results are evaluated against Arizona's surface water quality standards, which are determined on a facility-by-facility basis. Wastewater treatment plants must test their biosolids for arsenic to determine if they meet federal standards before they can be land applied.

Resources

- Surface water quality – Integrated Reports (bit.ly/ADEQ_SWQ) and Watershed Improvement & Protection (bit.ly/ADEQ_Watershed)
- AZPDES permits contact – azpdes@azdeq.gov

Remedial Programs

The Remedial Programs section regulates the cleanup of soil and groundwater contamination in Arizona through the Water Quality Assurance Revolving Fund and the Voluntary Remediation Program. Remedial programs also coordinate with the U.S. Environmental Protection Agency (EPA) on federal Superfund sites in Arizona through the Federal Programs Unit. Because arsenic occurs naturally in soil and rock throughout Arizona, it is frequently detected at cleanup properties.

Arizona law establishes soil remediation levels (SRL) that determine the concentration of contaminants facilities can leave in soil or that, if exceeded, require clean up. The pre-determined arsenic SRL for residential and non-residential/industrial use is 10 ppm (parts per million). Facilities can accomplish soil cleanups by meeting the 10 ppm SRL, developing a site-specific SRL for arsenic, or cleaning up to background levels. Once ADEQ approves an appropriate arsenic SRL, cleanup methods can include excavation and disposal, treatment in place, or

capping and containment. Background arsenic levels are often higher than the generic SRL because of Arizona's highly mineralized geology. Cleanups may be subject to a public comment period, giving interested parties an opportunity to provide input.

Air Quality

To protect public health, ADEQ enforces federal standards directly at the industrial sources. Arsenic is classified as a Hazardous Air Pollutant and if a facility has the potential to emit significant amounts of these pollutants, they are regulated. These rules require facilities to install control technology to capture emissions like arsenic, ensuring harmful substances are controlled.

ADEQ also evaluates how these emissions disperse into surrounding neighborhoods after they are released. ADEQ uses computer modeling to compare a facility's potential emissions against specific health-based guidelines from ADHS and EPA Regional Screening Levels. By evaluating the modeled air quality data we can accurately verify that both short-term and long-term community exposure remain well within the strict safety limits required to protect your health.

If arsenic is released within a regulated facility's process, permit limits are set for each facility to ensure public health standards are met. The permitted facilities are required to operate and maintain each piece of air quality control equipment to limit arsenic (and other) emissions. To verify facility compliance with emission limits, ADEQ requires facilities to conduct periodic performance testing of air quality control equipment. ADEQ inspects permitted facilities and reviews emission data to determine compliance with permitted limits.

Resources

- Air quality permits contact – airpermits@azdeq.gov

What You Can Do

To protect yourself and your family from arsenic exposure, you should focus primarily on managing your drinking water and minimizing contact with contaminated soil and dust.

Managing Your Drinking Water

- **Do not drink contaminated water:** If your water has elevated arsenic levels (above 10 ppb), do not use it for drinking, cooking or mixing baby formula. Use an alternate source, such as bottled water, until the issue is resolved.
- **Never boil the water to remove arsenic:** Boiling water does not remove arsenic. In fact, because boiling evaporates the water, it actually leaves the arsenic behind in a more concentrated and dangerous form.
- **Bathing is safe:** Arsenic does not easily absorb through skin, you can safely continue using untreated water for bathing, washing hands, washing clothes, and washing dishes.

If your home relies on a private well, test your water for arsenic at least every three years or whenever you notice a change in taste, odor, or appearance. If the test result is above 10 ppb,

install a certified water treatment system: standard household water softeners, sediment filters, and basic carbon filters, like standard refrigerator pitchers, will not remove arsenic. To properly treat the water, install a certified Reverse Osmosis system, distillation unit, or adsorptive media filter. You can use a smaller system that treats a single kitchen tap or a whole-house system.

It is critical to regularly change the filters or treatment media according to the manufacturer's schedule. If you wait too long, the filter can become completely saturated and start releasing arsenic back into your tap water.

Managing Exposure from Soil and Dust

- **Wash hands frequently:** Children are especially vulnerable to exposure because they often put their hands in their mouths. Make sure they wash their hands immediately after playing outside in the dirt.
- **Cover bare dirt:** If you have open patches of bare soil in your yard, cover them with grass, mulch, or other ground cover to keep contaminated dust from blowing around.
- **Keep your home clean:** Regularly sweep and clean the inside of your home to remove contaminated dirt and dust that may have been tracked inside on shoes.
- **Protect yourself while gardening:** Always wear gloves when working in the dirt or flower beds to prevent breathing in dust or accidentally swallowing soil.

Resources

- ADHS Health Effects of Drinking Water with Arsenic (bit.ly/ADHS_As_DW)