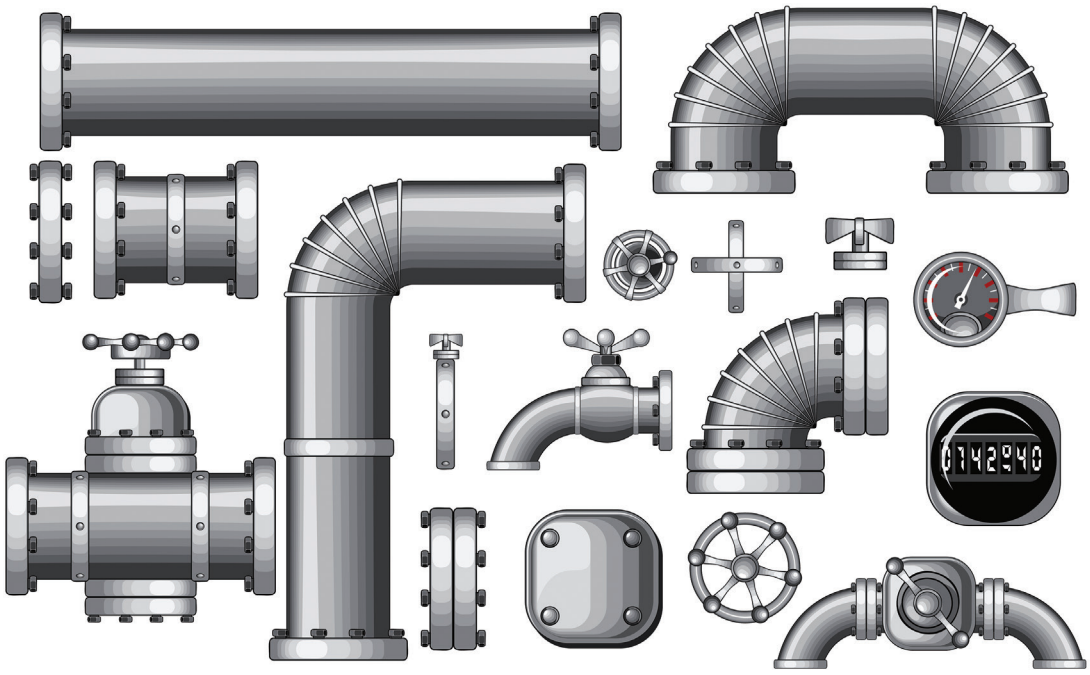

Illustrations are not intended to be representative of actual water well system components.

Lead Presence in Well Systems

Lead is a naturally occurring metal that does not alter the taste, odor, or color of water (1). When used in metal pipes, lead can be identified as a dull grey metal, soft enough to be scratched with a house key (1).

Due to the known health effects from lead exposure, the U.S. Environmental Protection Agency (EPA) has set regulations intended to limit the amount of lead in drinking water. Water distributed by public water systems is regulated via the Safe Drinking Water Act and the Lead and Copper Rule.

While the public health goal for lead concentrations is zero, recorded as the maximum contaminant level goal (MCLG), there is an EPA-regulated action level of 15 µg/L for public water supplies (2). This action level is based on tap water samples within the water system. If more than 10% exceed the 15 µg/L threshold, the water system must apply a treatment technique to lower the corrosiveness of the water (2). State and local regulations may be more restrictive.

Because these regulations do not apply to private well systems, and the cost of testing is the responsibility of the well owner, lead is rarely quantified in groundwater supplied by private wells (5).

Sources of Lead

Lead occurring in residential water well systems is typically from erosion of geologic material or leached from piping or fittings due to corrosion.

Health concern levels of lead are most often introduced in residential well systems from human-made sources (2) but contamination from naturally occurring lead is possible. Where lead is found native to the groundwater, it is usually due to localized geologic occurrences of aquifer materials containing lead-bearing minerals (12). Granitic formations have been associated with elevated levels of lead, particularly those containing minerals such as amphibole, potassium feldspar, quartz, and sodium feldspar (1).

More commonly, household plumbing is the primary source of lead in drinking water (2). The Reduction of Lead in Drinking Water Act went into effect on January 4, 2014. The Act has reduced the lead content allowed in water system and plumbing components by changing the definition of lead free in Section 1417 of the Safe Drinking Water Act (SDWA) from not more than 8% lead content, to not more than a weighted average

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of 0.25% lead with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and plumbing fixtures. The SDWA applies to public water systems or facilities providing water for human consumption.

The SDWA prohibits the introduction into commerce, as well as the installation or repair, of products not meeting the above stated weighted average, including products found in stocked inventories of coated or uncoated brass or bronze products, although some exemptions may apply. As of March 2015, there was no U.S. mandatory requirements for lead-free product testing or third-party certification under the SDWA. Some products may have been voluntarily submitted for testing and/or certification. Products that have not been certified may still meet the lead-free requirement.

Homes with copper pipes installed before 1986 may have been joined with lead solder. Solder alone can be enough to cause dangerous levels of lead in drinking water—one case in North Carolina recorded 800 ppb lead at the tap (4). Lead solder was the only source of lead found in this particular home (4).

Less common in more recently constructed houses, lead pipes can also be the source for lead introduction where corrosive waters may be moved through the plumbing system. These are most often found in homes built before 1930 (1) but local conditions may vary. The age of the home alone is not enough to determine the presence or absence of lead pipes.

Some older well components may also be a source of lead. Prior to the mid-1990s, lead packers were sometimes used to help seal the well above the well intake or screen (13; 8), and some types of submersible pumps had brass fittings that have a potential to leach lead due to corrosion (6; 8; 1). Other well components that may contain lead include screens (1) or other components within the well (5). Driven point wells may have been "shot" with lead to clear the screen (5).

Corrosion

Lead is amphoteric, meaning it is able to react as a base and as an acid. It can corrode both below and above a natural pH. The lowest corrosion is shown between the acid pH of 6.5 to 7 and the alkaline range from 7 to 8.5. Thus, both below pH 6.5 and above pH 8.5 lead corrosion accelerates rapidly.

Lead in piping and fixtures is released more readily in corrosive water. Keep in mind though, any kind of water could potentially contain health concern levels of lead (6). The presence of lead pipes, solder, or brass can introduce enough lead to be a potential risk in even relatively noncorrosive water if the water is in contact with these materials for an hour or more (6).

Lead occurring in residential water well systems is typically from erosion of geologic material or leached from piping or fittings due to corrosion.

Water that is warm (generally considered to be that consistently above 60°F), has a low pH, or lower total dissolved solids (TDS) is generally more corrosive than water that is not. Naturally soft water is more corrosive than naturally hard water (1; 6).

To reduce water's corrosiveness, public water systems often install corrosion inhibitors (5). In a survey reported by Pieper et al., only 5% of the 2000 private residential water system owners responding

in Virginia had acid neutralizers installed to control lead leaching (5).

Corrosion can also be caused by galvanic action due to the connection of dissimilar metals (15; 3). This type of corrosion is capable of completely dissolving piping and creating leaks, etc.

Another potential cause of corrosion is the use of pipes as grounds for electrical equipment—including telephones (1). Electric current may travel through metal pipes and into the water, facilitating corrosion (1). Eliminate any instances of grounding to pipes where corrosion is an issue.

While corrosive water does not represent a direct health risk to humans and animals in and of itself, the presence of lead-leaching components in a well system or household components is a real concern—especially in older houses and/or well systems.

Two factors affect how much lead may be leaching into your drinking water:

- The length of time water is in contact with lead before being used
- The corrosiveness of the water (due to either high pH or low pH).

Based on these two measures, according to the U.S. Geological Survey, parts of the United States may have residential water well systems yielding potentially corrosive groundwater. Its research suggests if private well users are not aware their source water is corrosive, are not treating for it, or have lead-content pipes, plumbing fittings, or well system components, they may be at risk for having lead in their drinking water.

The USGS has not done detailed source water–tap water studies to conclusively demonstrate the linkage between potentially corrosive groundwater and lead in tap water as the Survey does not have the tap water sample data to draw that type of conclusion nationally since the USGS rarely collects tap water samples.

The Survey looked at groundwater quality data in a USGS database and evaluated the potential corrosivity of untreated groundwater using two commonly used indices relating to whether or not the groundwater will potentially leach lead if it comes in contact with lead-bearing pipes or plumbing fittings.

Options vary in cost and ease of implementation, so what works best for one private well owner may not have the same advantages for another.

The Langelier Saturation Index (LSI) uses pH, hardness, calcium, and alkalinity and other commonly measured properties to determine whether or not the water is likely to form a protective calcium carbonate scale when it comes in contact with metal pipes.

The second index evaluates the potential for leaching of lead and copper via galvanic corrosion of metal pipes and plumbing fixtures. USGS groundwater quality allowed the Survey to calculate LSI and CSMR values for approximately 21,000 and 27,000 wells respectively and summarized the results nationally and by state.

The National Ground Water Association urges residential water well users in regions where corrosive water levels have been detected to call upon a water well system professional to audit your water system for any components that may have lead content.

Groundwater coming into the residential water distribution system should be tested at least once for lead before a home purchase or at a transfer of ownership, particularly if the home is older (with plumbing installed before the early 1990s), if young children will be frequenting the home (under six years of age), or if there are signs of corrosive water. It is recommended water quality testing in a newly constructed water well system should be completed within 48 to 72 hours following construction completion or within whatever parameter is established by local rule. If household well system components are determined to be the likely source of unsafe lead levels, the homeowner has three options. Options vary in ease of implementation, so what works best for one private well owner may not have the same advantages for another:

1. Replace the problem components with new components that meet current federal requirements.
2. Treat water that is being consumed with appropriate treatment technologies. Potential treatment options for lead in water can include filters, reverse osmosis units, and distillers. The system should be certified under NSF/ANSI standards for lead reduction, which means that the system has been independently verified to be able to reduce lead from 0.150 mg/L to 0.010 mg/L or less.

Private wells with high lead levels could be due to the water's low pH. When pH levels drop below 7.0, water becomes acidic which can cause lead to leach from plumbing fixtures. By adding a chemical like soda ash to the water to boost pH above 7.0, the system can help reduce both lead and copper leaching attributable to low pH.

If you do choose to use a water treatment system, remember most water treatment systems have replaceable components or require regular service, so be sure to follow the manufacturer's maintenance instructions and replace filters at the recommended interval.

3. Flush water that has been sitting in your water system for an amount of time equal to flushing four well volumes. This time will vary due to well size and pumping capacity. You may need to take several water samples from different taps to determine the effectiveness of this step. Work with a water well system professional to determine your well volume.

Private well owners seeking more information, or to find answers to frequently asked questions, can do so at the Water Quality Association's website, *www.wqa.org/Learn-About-Water/Common-Contaminants/Lead*.

References:

U.S. EPA. 2002. *Drinking Water From Household Wells*. http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=200024OD.txt

U.S. EPA. 2012. *Drinking Water Contaminants, National Primary Drinking Water Regulations*. http://water.epa.gov/drink/contaminants/

U.S. EPA. 2012. *Water: Private Wells, Human Health.* http://water.epa.gov/drink/info/well/health.cfm

U.S. EPA. 2015.*How to Identify Lead Free Certification Marks for Drinking Water System and Plumbing Product* . http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100LVYK.txt

Works Cited:

1. **UMass Extension.** *Healthy Drinking Waters for Massachusetts: Lead in Priate Drinking Water Wells.* Amherst, Massachusetts: University of Massachusetts, 2007.
2. **U.S. EPA.** *EPA Fact Sheet: Update on Lead Leaching from Submersible Well Pumps and Private Drinking Water Systems.* Washington, D.C.: U.S. EPA, 1995.
3. **Cuppett, J.** *Lead and Copper Corrosion: An Overview of WRF Research.* s.l.: Water Research Foundation, 2015.
4. *Out of Plumb: When Water Treatment Causes Lead Contamination.* **Renner, R.** 12, s.l.: Environmental Health Perspectives, 2009, Vol. 117, pp. A 542-7.
5. *Profiling Private Water Systems to Identify Patterns of Waterborne Lead Exposur* . **Pieper K.J., L. Krometis, D. Gallagher, B. Benham, and M. Edwards.** 21, s.l.: Environmental Science & Technology, 2015, Vol. 49, pp. 12697-12704.
6. **Swistock, B., and A. Galford.** *Lead in Drinking Water.* State College, Pennsylvania: Penn State Extension, 2016.

7. *Private water wells in Minnesota: Recommended tests for contaminants*. **Convery, M.P.** 5, 2005, Minnesota Medicine, Vol. 88, pp. 46-8.
8. **Minnesota Department of Health.** *Lead in Well Water Systems*. St. Paul, Minnesota: Minnesota Department of Health, 2015.
9. **Missouri Department of Natural Resources: Water Protection Program – Public Drinking Water Branch.** *Lead in Drinking Water from Submersible Pumps*. Jefferson City, Missouri: Missouri Department of Natural Resources, 2006.
11. **Farrell-Poe, K., L. Jones-McLean, and S. McLean.** *Lead in Private Water Wells*. Tucson, Arizona: Arizona Cooperative Extension, University of Arizona, 2010.
12. **Ohio Department of Health, Residential Water and Sewage Program.** *Lead in Drinking Water from Private Water Systems*. Columbus, Ohio: Ohio Department of Health, 2014.
13. **Centers for Disease Control.** *Lead and Drinking Water from Private Wells*. [Online] 2015. [Cited: February 2, 2016.] www.cdc.gov/healthywater/drinking/private/wells/disease/lead.html.
14. **DeSimone, Leslie, Peter McMahon, and Michael Rosen.** *Water Quality in Principal Aquifers of the United States, 1991–2010*. Reston: USGS, 2014.

Contact:

National Ground Water Association
601 Dempsey Road
Westerville, OH 43081
(800) 551-7379
pr@ngwa.org

The National Ground Water Association is a not-for-profit professional society and trade association for the global groundwater industry. Our members around the world include leading public and private sector groundwater scientists, engineers, water well system professionals, manufacturers, and suppliers of groundwater-related products and services. The Association's vision is to be the leading groundwater association advocating for responsible development, management, and use of water.

Address 601 Dempsey Road, Westerville, Ohio 43081-8978 U.S.A.
Phone (800) 551-7379 • (614) 898-7791 **Fax** (614) 898-7786
Email ngwa@ngwa.org **Websites** NGWA.org and WellOwner.org