Water Resources Council
of Tompkins County

Fact Sheet
2014-01

ARSENIC IN YOUR WELL WATER?

Inside This Circular

Arsenic concentrations exceeded the U.S. Environmental Protection Agency's drinking-water maximum contaminant level of 10 micrograms per liter (µg/L) in 8 percent of groundwater sample sites in Tompkins County during 2000—2012.

Photo of a typical home well

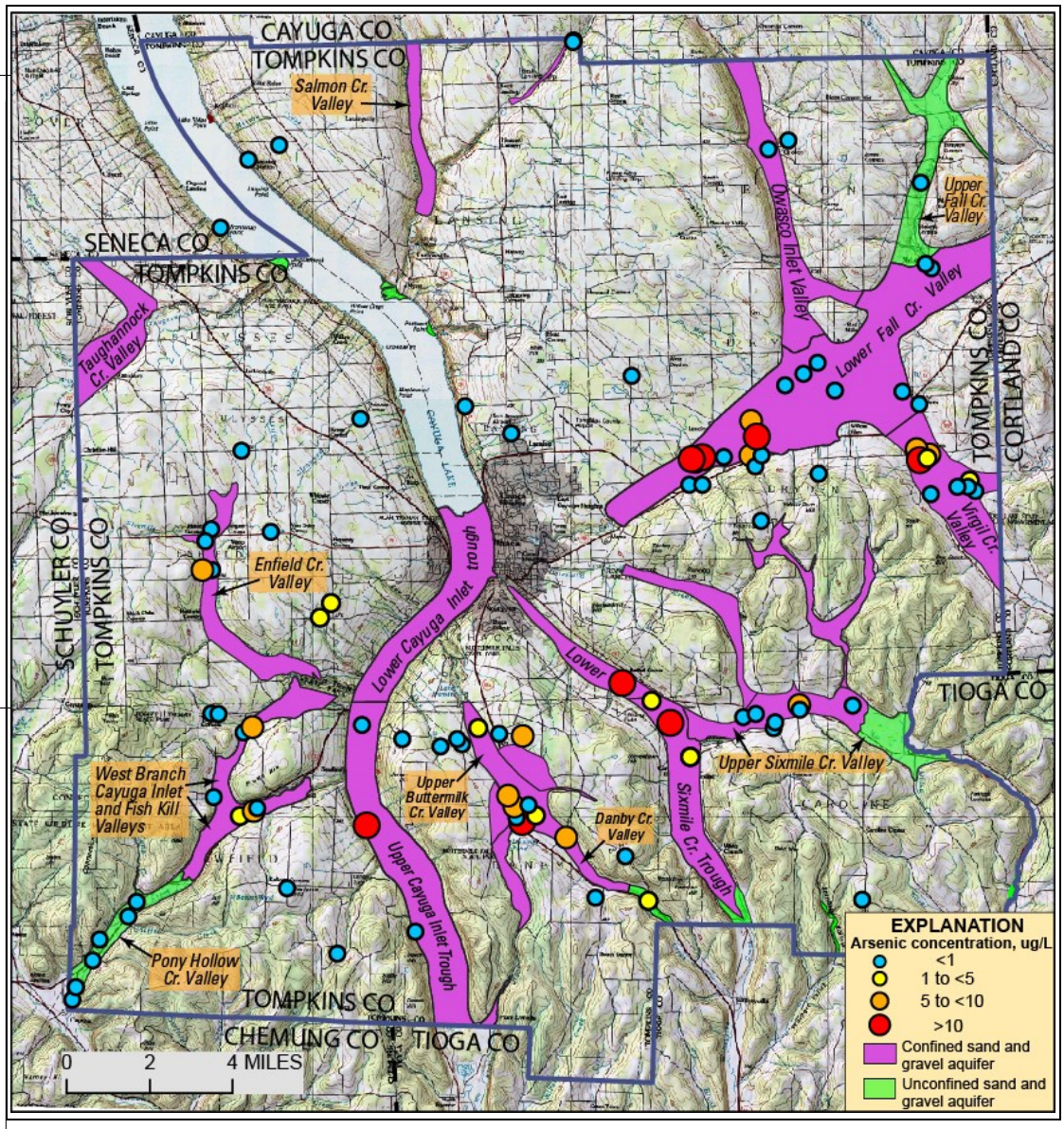

Figure 1.– Map showing groundwater sample sites in Tompkins County where arsenic was analyzed.

INTRODUCTION

Arsenic is a toxic element that occurs in some well water in Tompkins County at concentrations above the drinking water standard of 10 micrograms per liter (µg/L). Arsenic in water is colorless, odorless, and tasteless. Arsenic is relatively abundant in nature. Most instances of arsenic contamination in groundwater are found from naturally occurring minerals. The most important sources of elevated arsenic in groundwater are from iron oxides, which occur as coatings on mineral grains, and from pyrite.

GLOSSARY

Aquifer: An underground body of porous materials such as sand, gravel, or fractured rock, filled with water and capable of supplying useful quantities of water to a well.

Confined or artesian aquifer: Groundwater in these aquifers is confined under pressure between layers of poorly permeable sediments or rock, such as clay or shale.

Unconfined aquifer: An aquifer in which the water table is exposed to the atmosphere through openings in overlying material; the water is not confined under pressure.

Water table: The top of the water surface where all void spaces in the unconsolidated sediments and in the fractured bedrock are filled with groundwater (saturated zone) in an unconfined aquifer.

Potentiometric surface: A surface representing the altitude to which water will rise in a well that taps an confined aquifer.

Of the samples collected from confined sand and gravel aquifers, 19% (almost 1 out of 5 wells) had elevated arsenic concentrations equal to or greater than 10 µg/L.

ARSENIC IS A HEALTH RISK

Table 1.--Lifetime risks of dying of cancer from arsenic in tap water, based on the National Academy of Sciences' 1999 risk assessment[1].

Arsenic level in tap water (in micrograms per liter, µg/L)	Approximate total cancer risk assuming two liters (2.1 quarts) consumed per day
0.5 µg/L	1 in 10,000
1 µg/L	1 in 5,000
3 µg/L	1 in 1,667
4 µg/L	1 in 1,250
5 µg/L	1 in 1,000
10 µg/L	1 in 500
20 µg/L	1 in 250
25 µg/L	1 in 200
50 µg/L	1 in 100

[1]National Research Council, 1999, Arsenic in Drinking Water; National Academies Press, Washington D.C. 330p.

Arsenic is a known human carcinogen that causes cancer of the skin, bladder, lung, kidney, and liver. It also causes increased risk of cardiovascular disease, peripheral neuropathy, skin discoloration, skin growths, and diabetes. The major exposure pathway for arsenic in residential well water is drinking and cooking with the untreated water.

DOES ARSENIC OCCUR OFTEN?

At 100 sites, groundwater from wells that tap the glacial aquifers and the Devonian-age fractured-bedrock aquifers in Tompkins County were sampled by the Tompkins County Health Department (TCHD) and the U.S. Geological Survey (USGS) and analyzed for arsenic during 2000–2012. Elevated arsenic concentrations (greater than or equal to 10 µg/L) were detected in 8 percent of sample sites; moderate concentrations (5 to <10 µg/L) were found in 13 percent; low-to-moderate concentrations (1 to <5 µg/L) were found in 13 percent; and low concentrations (<1 µg/L) were found in 66 percent of sample sites. The state and federal drinking-water standard is 10 µg/L.

WHERE ARE ELEVATED ARSENIC CONCENTRATIONS FOUND?

Elevated arsenic concentrations (> 10 µg/L) were associated with strongly reducing conditions which are prevalent in confined sand and gravel aquifers (also known as artesian aquifers) such as those found in Virgil Creek, lower Sixmile Creek, and Fall Creek valleys (see fig. 2 for types of aquifers and fig. 1 for where these aquifers are located). Of the samples collected from the confined sand and gravel aquifers, 19% (almost 1 out of 5 wells) had elevated concentrations of arsenic equal to or greater than 10 µg/L. Moderate arsenic concentrations (5 to 10 µg/L) were found in some confined sand and gravel aquifers and sometimes in the shallow (upper) zones of shale/siltstone (bedrock) aquifers. Low arsenic concentrations were associated with oxygen-rich conditions that are present in unconfined aquifers, such as that found in Pony Hollow Creek Valley, and with wells finished in deep zones of bedrock. Arsenic concentrations were <1 µg/L in all 12 sample sites from unconfined aquifers.

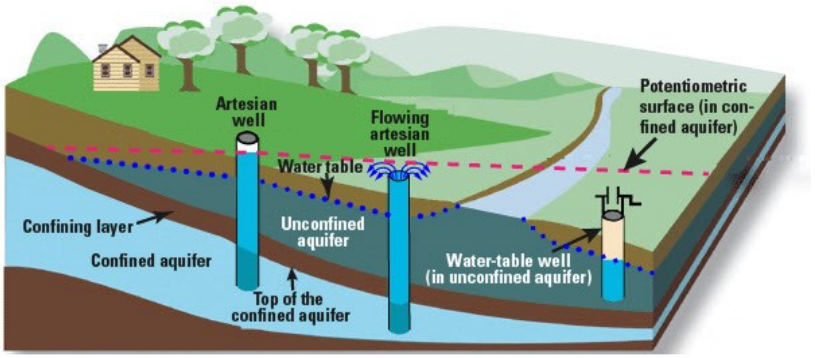

Figure 2.—Types of aquifers and wells

Source: Modified from Environment Canada

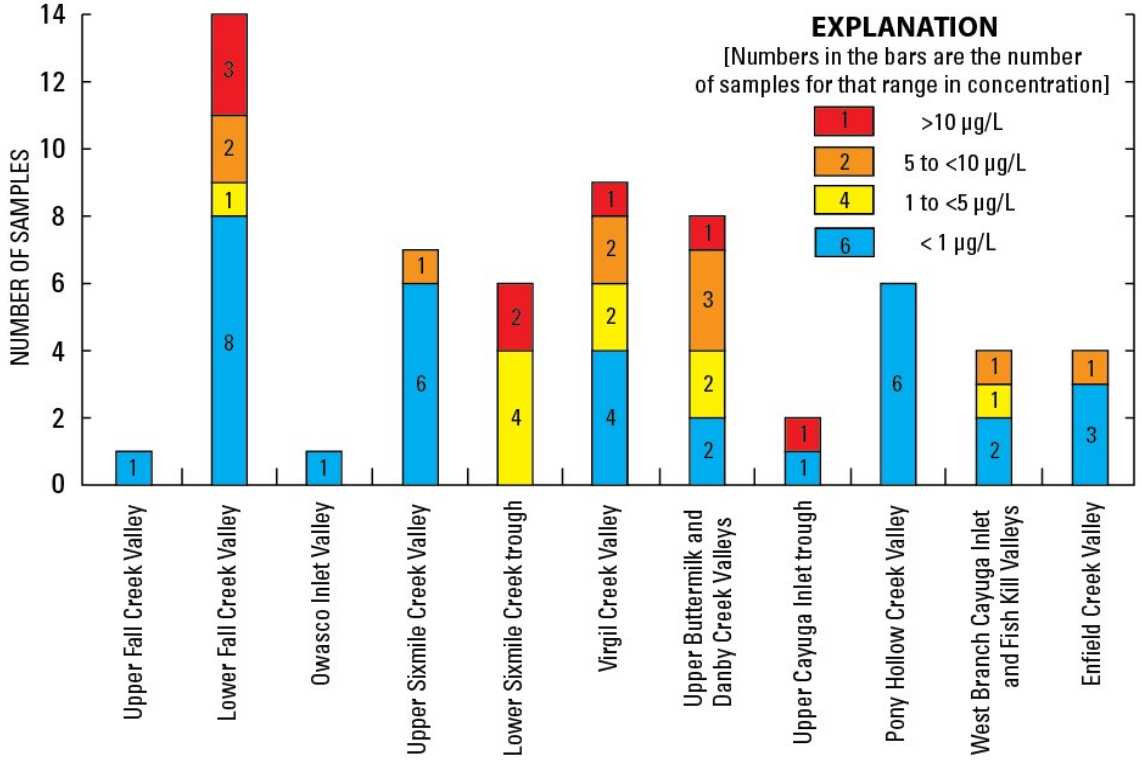

Figure 3.—Distribution of arsenic concentrations from groundwater samples in the major valley-fill aquifers in Tompkins County, New York. Location of valleys shown in figure 1.

CAN WE PREDICT WHERE ELEVATED ARSENIC CONCENTRATIONS ARE TO BE EXPECTED?

Arsenic concentrations in groundwater in Tompkins County have considerable spatial variability and are difficult to predict on a well-by-well basis; however, the risk of having high concentrations is greater in some areas than in others. High concentrations of arsenic are more likely to be found in confined sand and gravel aquifers (figs. 1 and 3). Conversely, we can predict with a fair amount of certainty where arsenic is not found in elevated concentrations such as in unconfined aquifers and in deep zones of bedrock (200-400 feet deep).

WHO SHOULD HAVE THEIR WATER TESTED?

If you are getting your water from a private groundwater well, it is up to you to make sure that your water is safe to drink.

It is especially important to have the water tested for arsenic if your well is finished in a confined sand and gravel aquifer. To design an arsenic treatment system, additional testing will be needed.

The U.S. Environmental Protection Agency (USEPA) recommends that you test your well once each year for total coliform and E. coli bacteria, nitrate, total dissolved solids, and pH levels; and test for common ions and trace metals every two years.

NYS certified water testing labs can usually be found in the telephone book under "Laboratories-Testing" or "Water Analysis."

For people who are supplied by public water systems, the USEPA and the NYS Department of Health set standards and regulations for the presence and levels of arsenic and of over 90 other contaminants in drinking water. The public can view the chemical test results of their water on the Annual Water Quality Report which can be obtained from the water purveyor.

It is especially important to have the water tested for arsenic if your well is finished in a confined sand and gravel aquifer.

Treatment Options

Arsenic removal requires special considerations. Water softeners and granular activated carbon filters do not remove arsenic. Although arsenic can occur in two species, commonly referred to as As3(III) and As5(V), the tests for these species are not widely available. Instead of testing for individual species of arsenic, most commercial labs test for total arsenic. For this reason, if your well requires arsenic treatment, it is important to choose a treatment system that removes both arsenic species.

The preferred treatment technology for arsenic removal of both species, As3(III) and As5(V), is a whole-house granular ferric adsorption system (see table below). It effectively removes both arsenic species from all water in the home, is easy to operate and maintain, and the arsenic is not returned to the environment via regeneration.

For water treatment at a single tap in the home, a granular ferric adsorption point-of-use system can be installed. This system uses under-sink cartridges (fig. 4). These systems typically produce only two quarts per minute and are used to provide treated water for drinking and cooking only. Cartridges are typically changed once per year.

In order to prevent fouling of an arsenic treatment system, pretreatment of the water may be needed where water contains iron at greater than 500 µg/L, manganese at greater than 50 µg/L, sulfate at greater than 1 milligram per liter (mg/L) and/or a hardness greater than 300 mg/L.

Figure 4.—Photographs of a ferric adsorption point-of-use filtration system installed beneath a kitchen sink.

Arsenic Treatment Option Summary[1]

Treatment type	Preferred	Process and maintenance	Chemical use	Waste generated	Arsenic species removed	Typical media life	Average installation cost[2]	Average maintenance cost[2]
Granular ferric adsorption whole house	First choice	Simple	None	Low	As(III) and As(V)	2-3 years	$2,740	$0.67-1.00/day
Granular ferric single tap cartridges	Second choice	Simple	None	Low	As(III) and As(V)	1 year	$365	$0.32/day
Anion exchange whole house	No	Complex	Salt	High	As(V) only	10 years	$2,000	$0.27/day
Reverse osmosis single tap	No	Moderate	Disinfectant	Low	As(V) only	3 years	$700	$0.33/day

[1] New Jersey Geological Survey, 2007, Arsenic water treament for wells in New Jersey, New Jersey Geological Survey Information Circular

[2] Costs are approximate, contact water treatment purveyor for current costs

Prepared in 2014 by the Aquifer Committee of the Tompkins County Water-Resources Council

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The Tompkins County Water Resources Council (WRC) advises the Tompkins County Legislature on matters related to water resources management and planning, and is charged with identifying problems, proposing priorities, and promoting the coordination of activities in the management and protection of the County's water resources. For more information about the Water Resources Council, contact the Tompkins County Planning Department at 274-5560 or visit website http://www.tompkins-co.org/planning/committees/WRC/index.htm