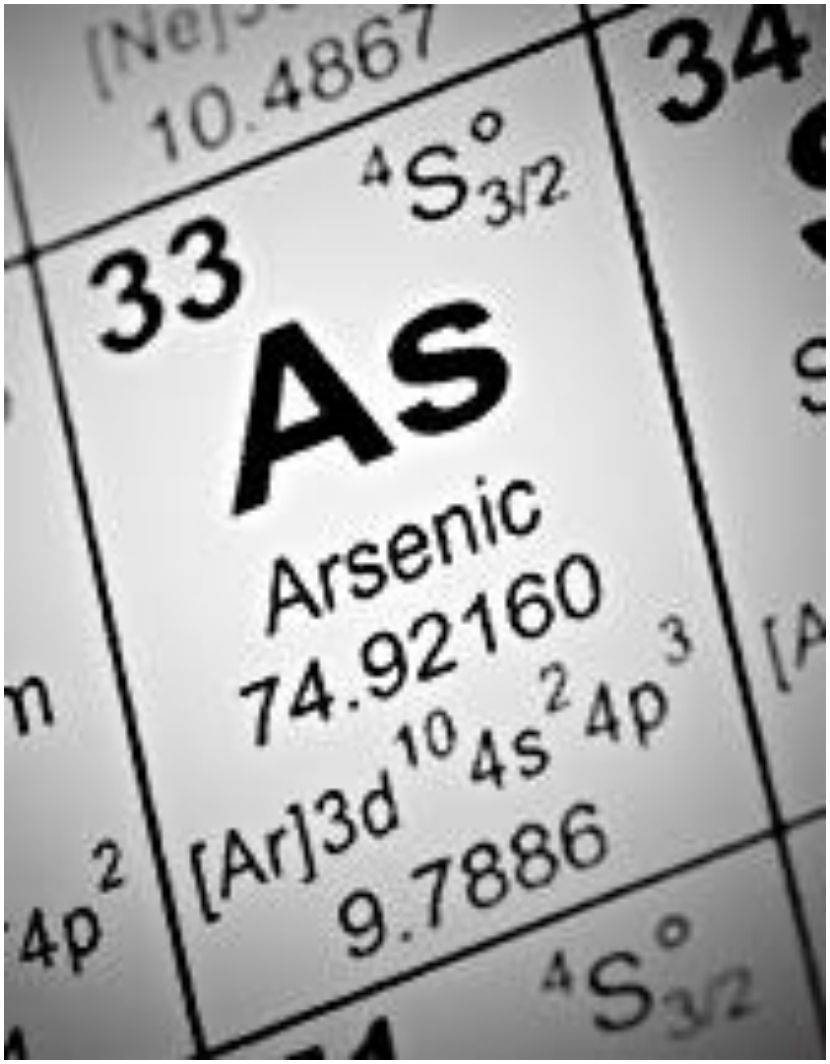
Evaluating Distributions of Arsenic in Groundwater Resources of Lebanon, Connecticut

Meredith Metcalf and Laura Markley (Eastern Connecticut State University)
Gary Robbins (University of Connecticut)
William Warzecha (CT Department of Energy and Environmental Protection)
Margaret Thomas (Connecticut Geological Survey)

Arsenic



- Metalloid that is toxic when inhaled or ingested.
- Found naturally, as well as in man-made products.
- Short-term exposure:
  - Vomiting, diarrhea, dehydration, vertigo, cardiac problems, etc.
- Long-term exposure:
  - Skin changes, sensory and motor nerve defects, cancer, etc.

Arsenic is a Global Concern

China's arsenic contamination risk is as

By R

Scien

BREAKTHROUGH: Chinese government admits one-fifth of farm lands heavily

con

cad

'Environmental catastrophe' declared in Chile as arsenic contamination detected in water at up to 360 times accepted levels

Monday

Tags: a

Contamination of drinking-water by arsenic in Bangladesh: a public health emergency

Allan H. Smith,[1] Elena O. Lingas,[2] & Mahfuzar Rahman[3]

ARSENIC OCCURRENCE IN THE U.S.

Columbia University receives $16.8 million NIEHS award

releas

Thursday, Septe

Tags: health new

100 percent of children are found to be exposed

pesticid

Sunday, July 21, 20

Tags: children, arse

New St in Grou

by Theodoric Mey

ProPublica, Aug.

Print

FDA's New Finding About Arsenic Levels in Rice

Dr. Besser with information about arsenic levels in rice

s.

FDA finally admits conventional chicken contai

Sunday, October

Tags: conventior

FDA data show arsenic in rice, juice, and beer

Here's an

arsenic in

Published: Febru

regarding

Near-zero levels of arsenic found to significant reasoning

Tuesday, April

by Mike Adams

Editor of Natura

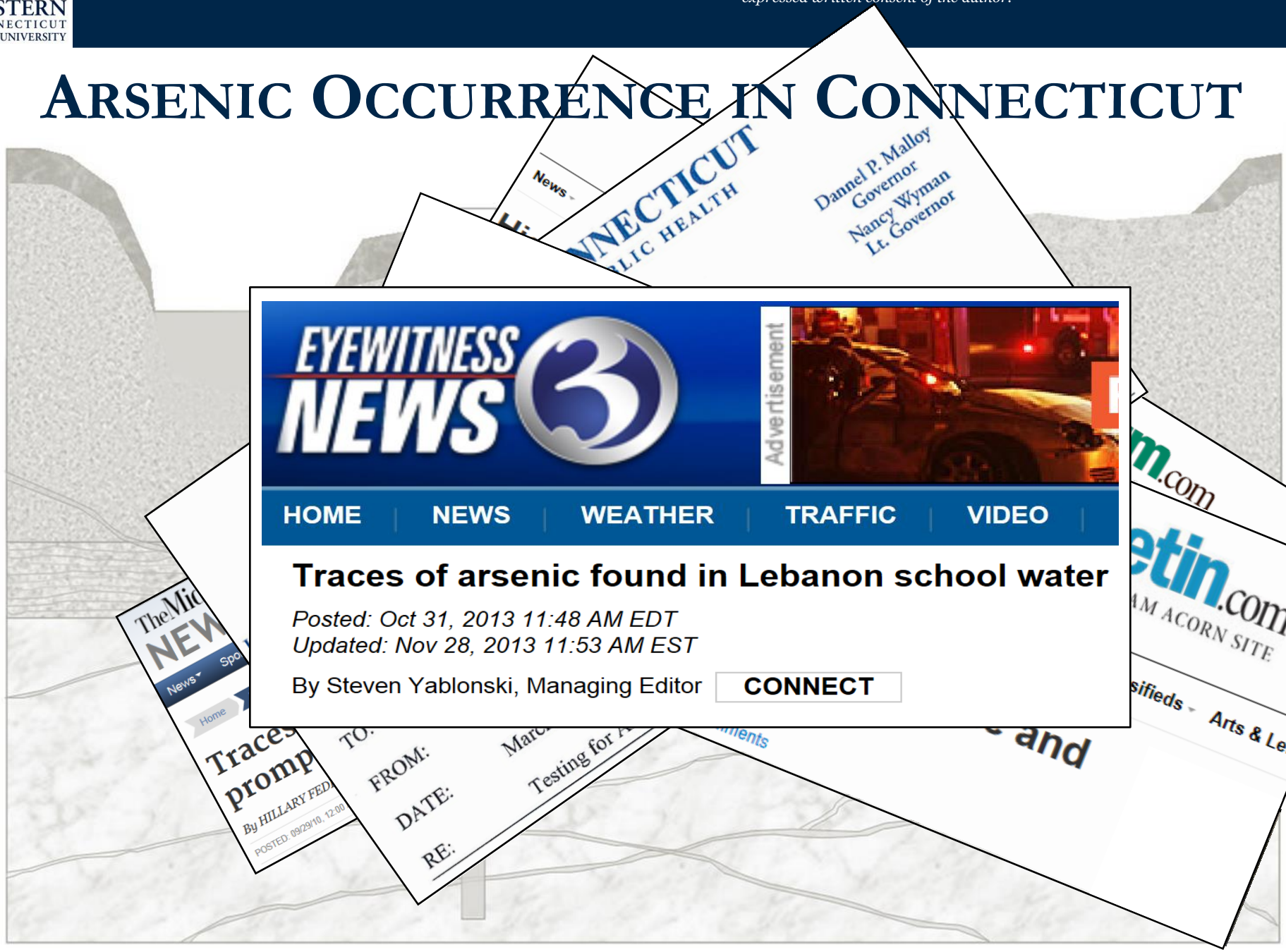
Tags: arsenic,

Private household wells heavily contaminated with arsenic in Texas, Michigan, California, Idaho, Arizona and more

Wednesday, July 09, 2014 by: David Gutierrez, staff writer

Tags: arsenic contamination, private wells, drinking water

Arsenic Occurrence in Connecticut



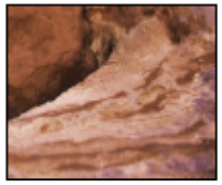
ARSENIC DISTRIBUTIONS IN CONNECTICUT

PRIVATE DRINKING WATER IN CONNECTICUT

Publication Date: January 2013

Publication No. 3: Arsenic in Private Drinking Water Wells

Arsenic is a metal that has no smell or taste. Arsenic is naturally present in bedrock in many places throughout CT. When a drinking water well is drilled into bedrock containing arsenic, the arsenic can get into the well water. We know that there are private wells in locations across CT with high levels of arsenic. The only way to find out if your well has high arsenic is to test. We recommend that homeowners test their private well at least once for arsenic. This fact sheet provides homeowners with information about the health effects from arsenic, how to test well water for arsenic and what to do if your well water has high levels of arsenic.



How Does Arsenic Get Into Drinking Water & How Can I Find Out If My Well Is Contaminated?

Depending on local environmental conditions, arsenic can leach from soils or mineral deposits into groundwater. However, the extent to which this occurs in Connecticut bedrock wells is uncertain. A survey in Eastern Connecticut[1] found that contamination is not widespread, but also, not predictable. Therefore, the only way to know if your well is contaminated is to test the water.

What Are The Potential Health Effects Of Arsenic In Drinking Water?

The EPA and expert scientific committees have classified arsenic as a human cancer-causing agent. Research indicates that people living in areas where water concentrations are very high are more likely to have bladder, lung, or skin cancer. They are also more likely to have problems with their skin, and with their cardiovascular, immune and neurological systems. These toxic effects of arsenic exposure developed after many years of exposure.

How Much Arsenic Is Safe To Drink?

The Federal government sets safe drinking water standards for public water. The EPA drinking water standard for arsenic (i.e., the Maximum Contaminant Level, or MCL) is 0.01 mg/l (10 ug/l; 10 ppb). The Department of Public Health supports 0.01 mg/l as a health-based guideline for private wells.

Usually, arsenic contamination is measured in units of milligrams per liter (mg/l), which is equivalent to parts per million (ppm). Otherwise, the units may be micrograms per liter (ug/l), which is equivalent to parts per billion (ppb), and 1000 times lower than ppm.

Produced by 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
Phone: 860-509-7296 Fax: 860-509-7295 www.ct.gov/dph

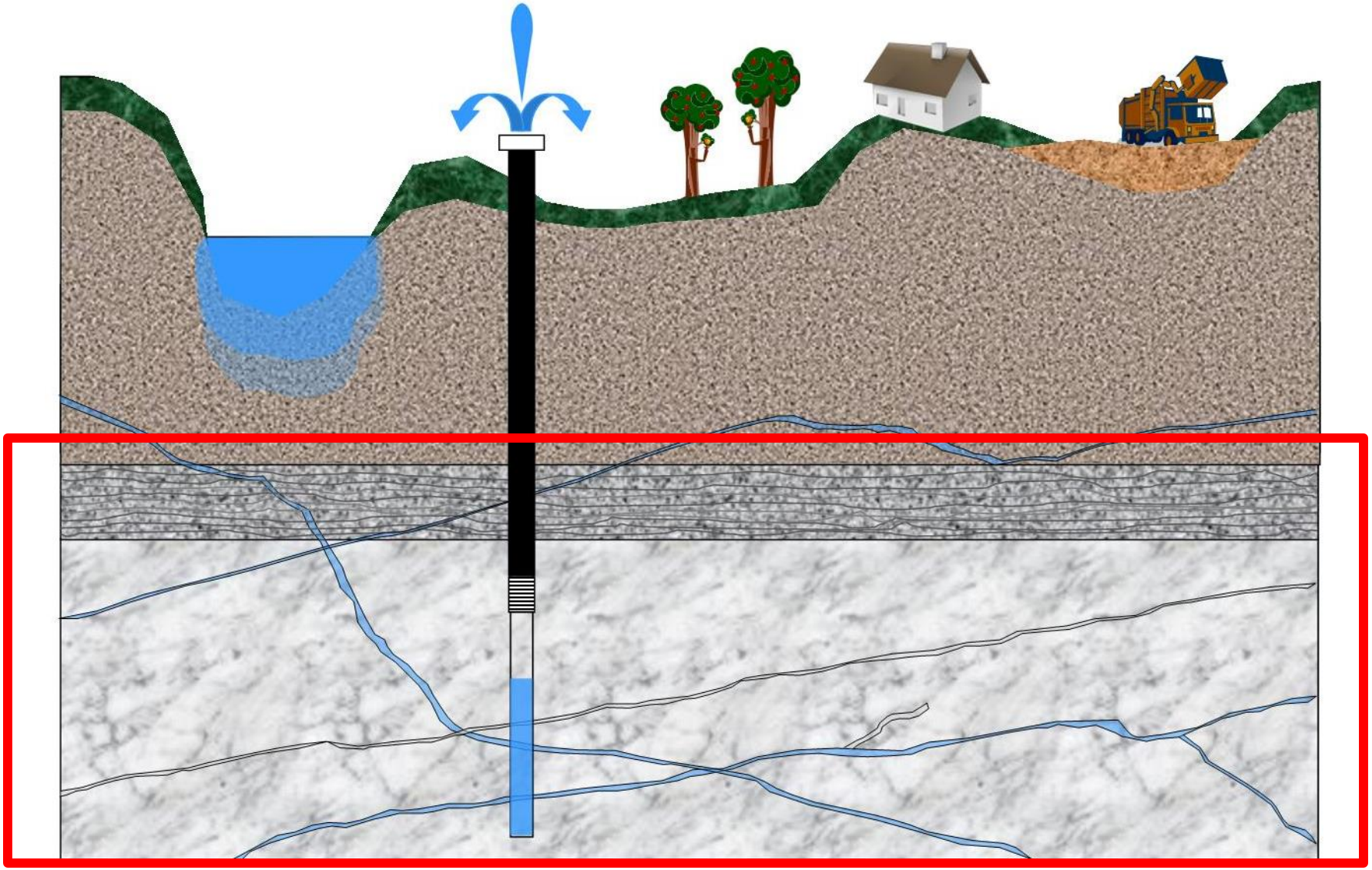
"…arsenic can leach from soils or mineral deposits into groundwater. However, the extent to which this occurs…is uncertain."

"… in Eastern Connecticut… contamination is not widespread, but also, not predictable."

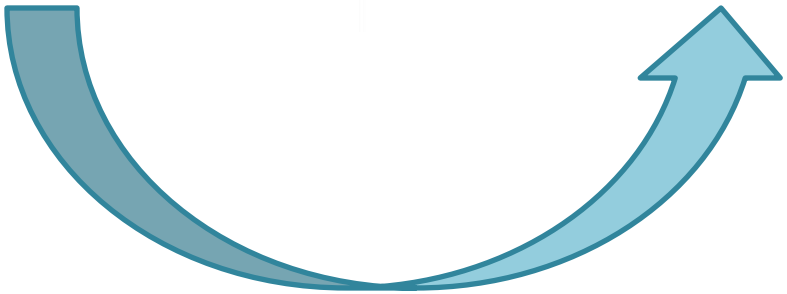
LEBANON, CONNECTICUT

- Known for its unique role in the Revolutionary War.
- Characterized by extensive agricultural lands (dominant economical activity).
- Bedroom community for Eastern and University of Connecticut faculty, as well as workers from urban centers such as Norwich, Willimantic, and Colchester.

THEORIES OF ARSENIC IN THIS AREA



From a Hydrogeologic Perspective…



EASTERN CONNECTICUT STATE UNIVERSITY

METHODOLOGY

wnprnews Connecticut's Public Media Source for News and Ideas

News ▾ | Programs ▾ | Arts ▾ | Health ▾ | Education ▾ | Politics ▾ | Business ▾

The Colin McEnroe Show
A Salute to Hamlet

Divestiture
Connecticut UCC Agrees to Non-Violent Protest of Violence in West Bank

Clean Water 2:18 PM TUE JUNE 24, 2014

Have You Wondered How Arsenic Enters a Well? You're Not Alone

Share | Tweet | +1 | E-mail | 0 Comments | Print

By PATRICK SKAHILL

Undergraduate Laura Markley samples a private well. The water will be tested for arsenic and compiled into a database managed with the help of Meredith Metcalf at ECSU. Testing in Lebanon is being done on a volunteer basis, with all testing costs covered.

Meredith Metcalf Eastern Connecticut State University

- Local newspaper article seeking volunteers for water quality testing free of charge.
- 100 well-distributed water samples were obtained across Lebanon and analyzed at DPH.
- Well completion reports were obtained from the local health department to determine groundwater flow directions.

CONNECTICUT ENERGY ENVIRONMENT

Keeping Connecticut Healthy
DPH
Connecticut Department of Public Health

USE OF GIS

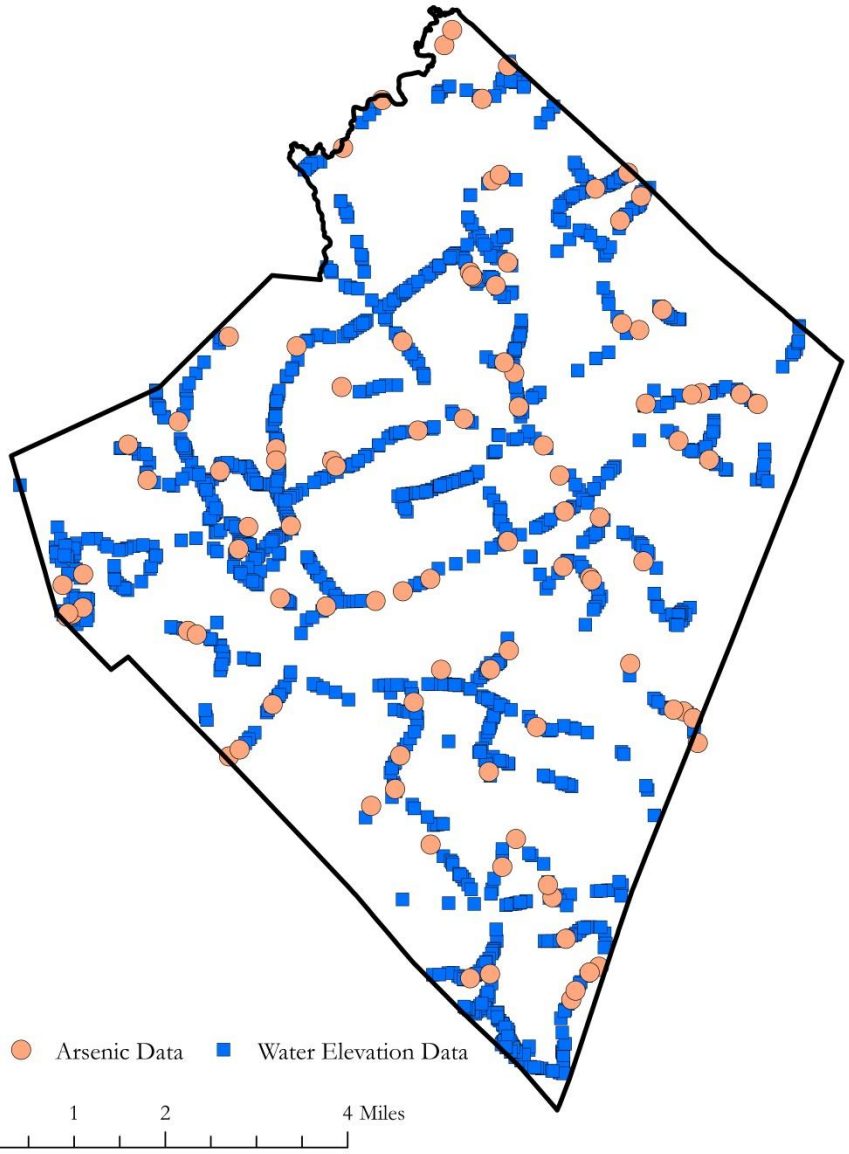
METHODOLOGY

- Wells analyzed for arsenic and flow conditions were geocoded by address.
- Arsenic concentrations were interpolated to observe distribution patterns.
- Distributions were analyzed as a function of:
  - Type of well (dug well or bedrock well)
  - Filtered or not filtered sample
  - Lithology (rock type)
  - Other constituents
  - Groundwater flow

USE OF GIS – SAMPLE DISTRIBUTION

METHODOLOGY

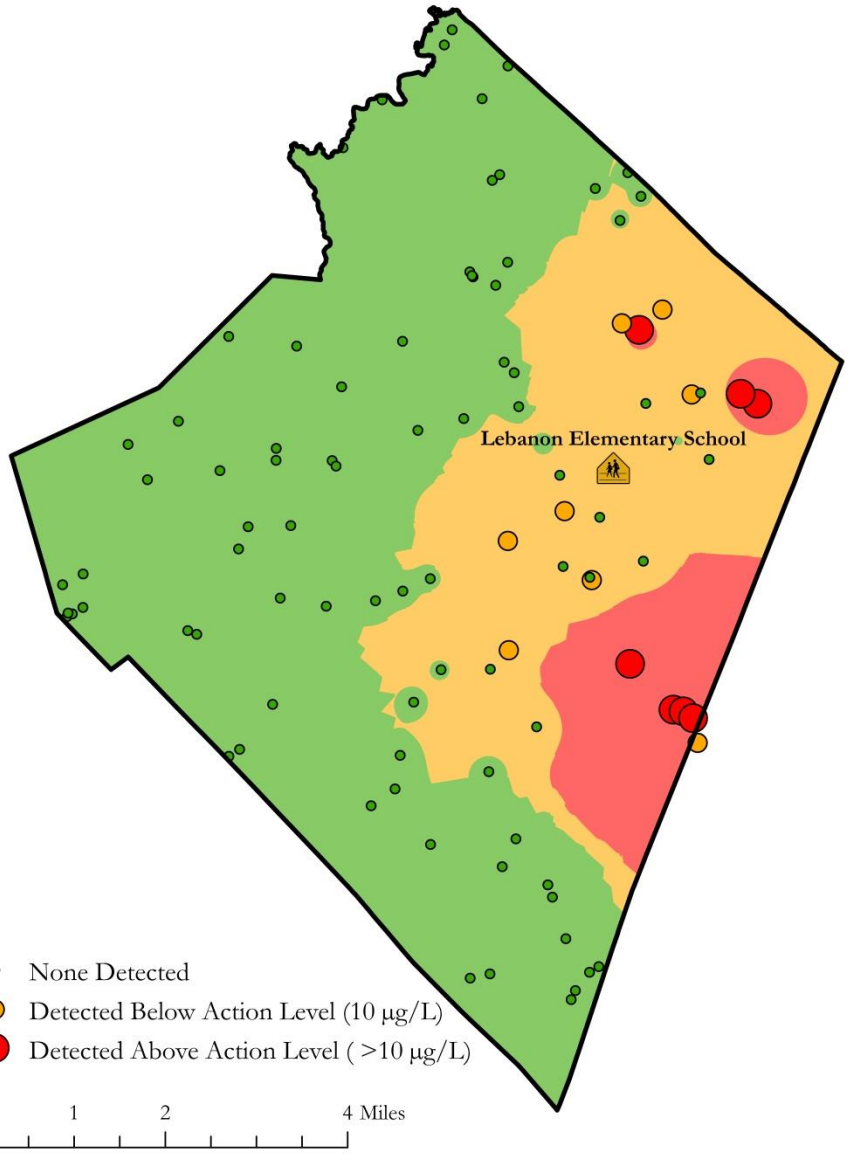
- 100 samples analyzed for arsenic in 2014.
- > 1,550 well completion reports with depth to water (when well was drilled).



Arsenic Distribution

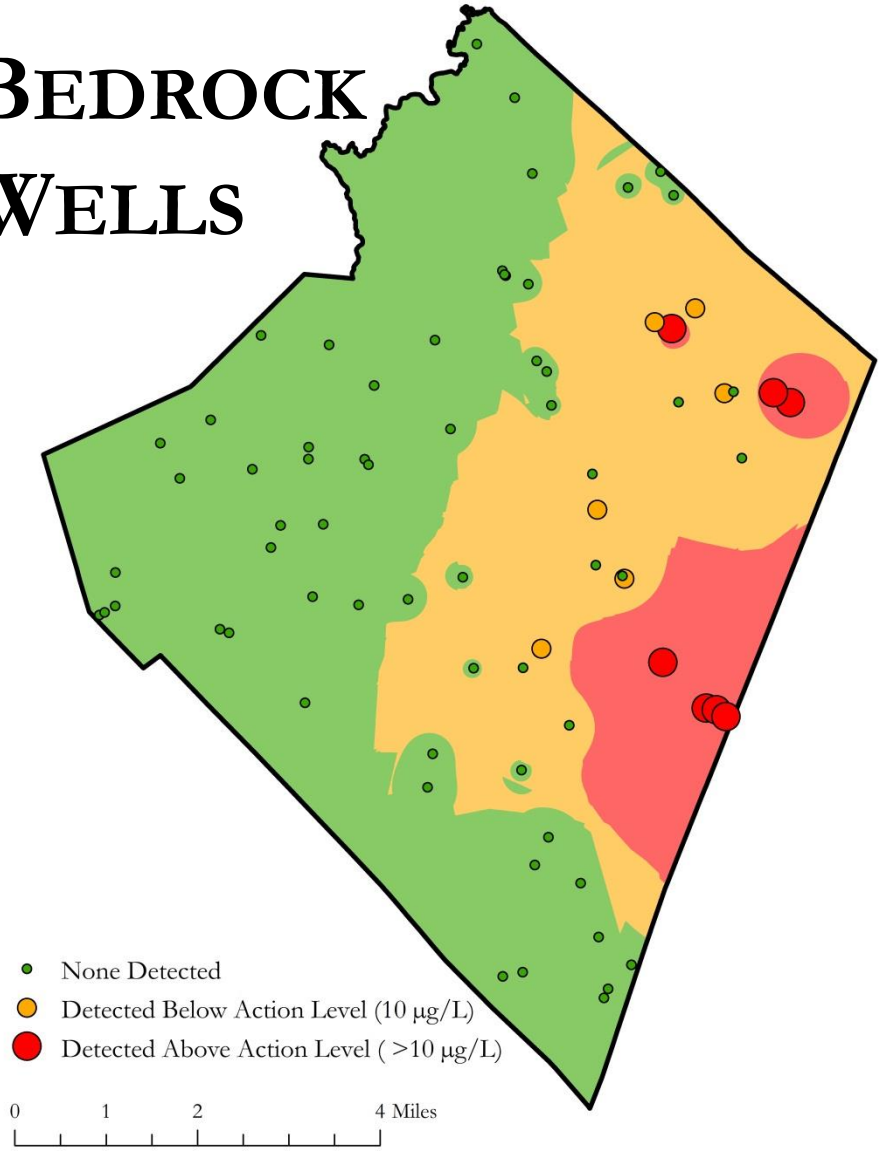
Results

- 15% of samples tested positive for arsenic.
- 7% of samples had arsenic concentrations exceeding the EPA Drinking Water Standard (10 µg/L).
- Lebanon Elementary School is located in an area expected to have arsenic based on results from summer 2014.

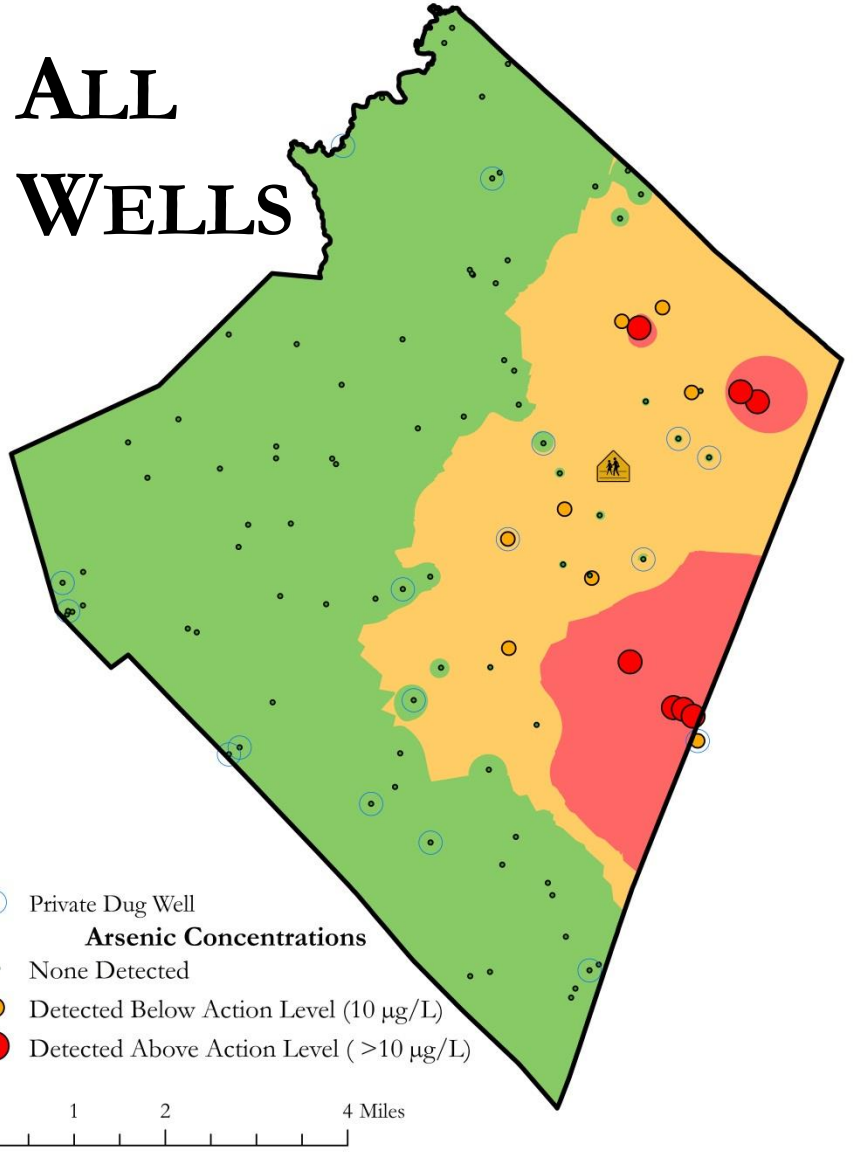


Arsenic Distribution – Type of Wells

Bedrock Wells



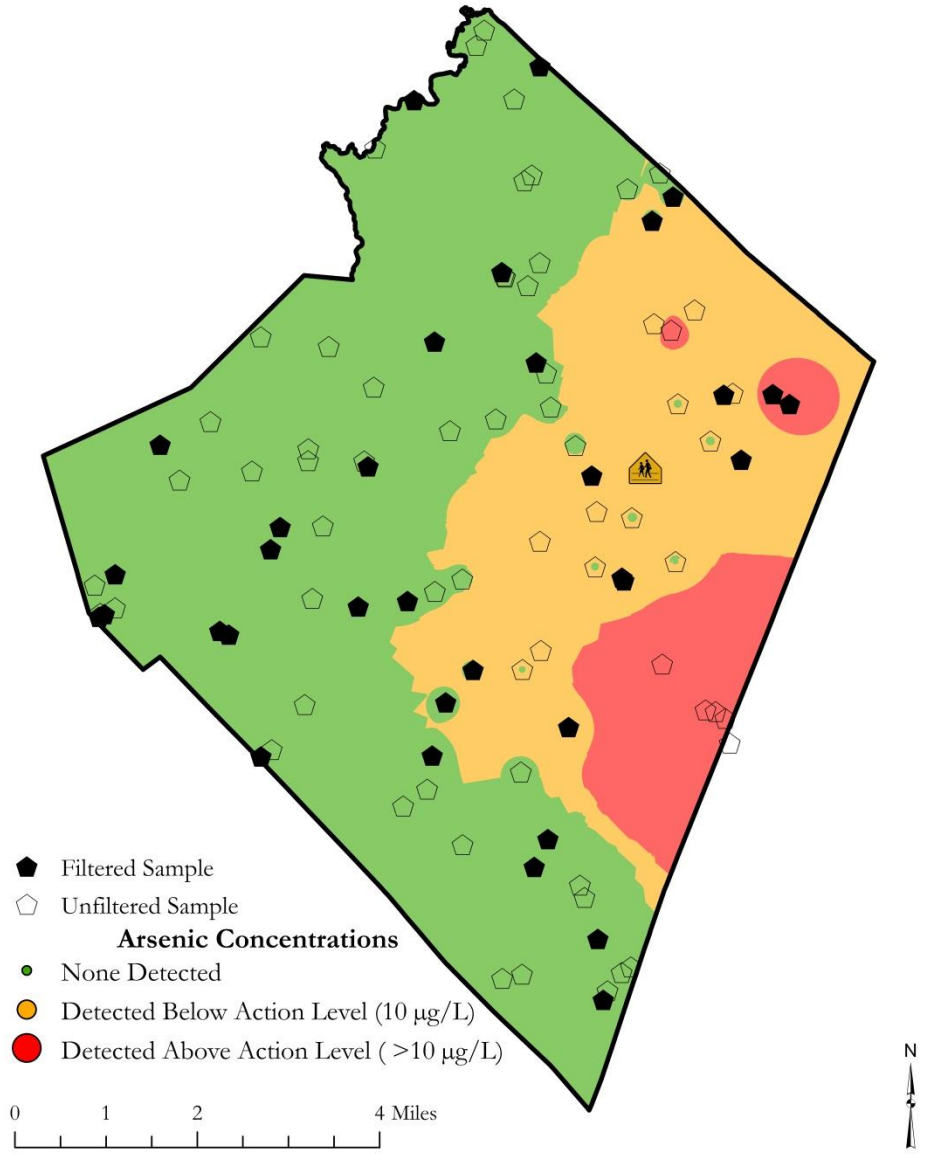
All Wells



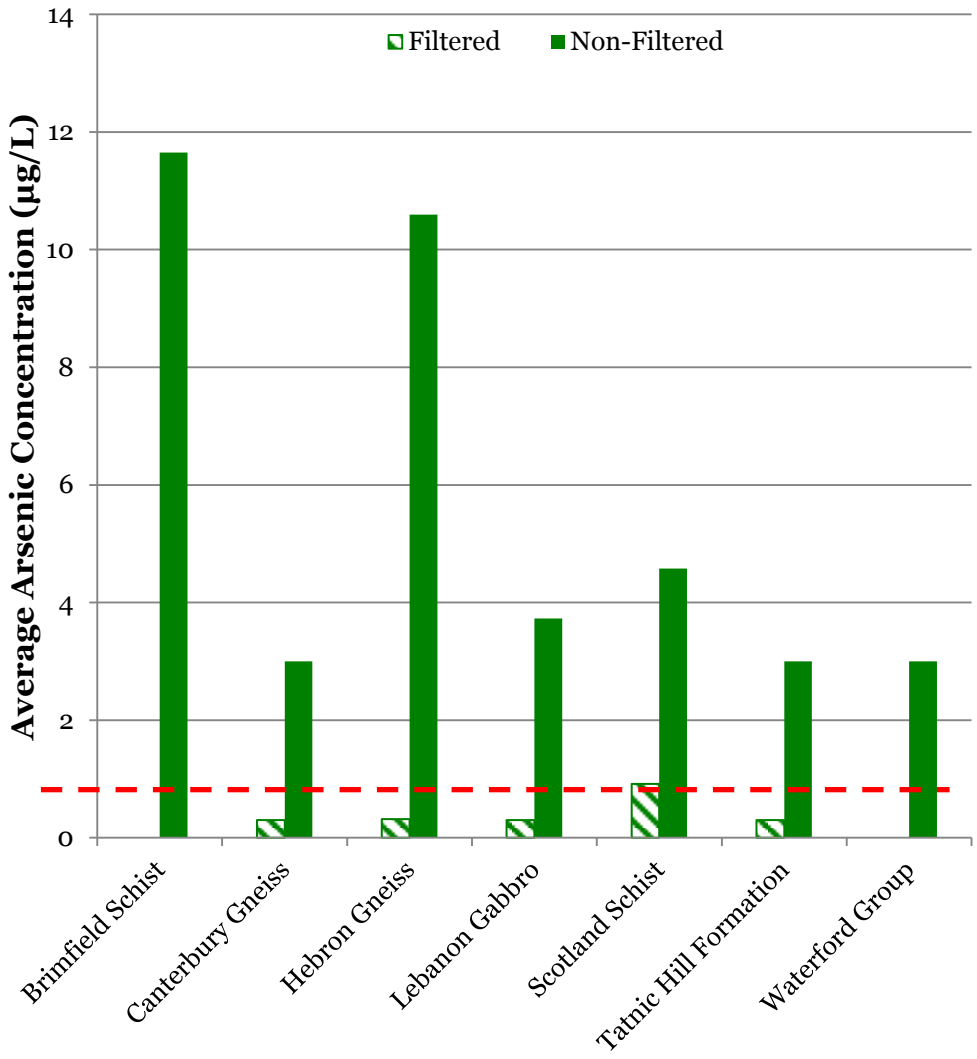
Arsenic Distribution – Filtered Sample

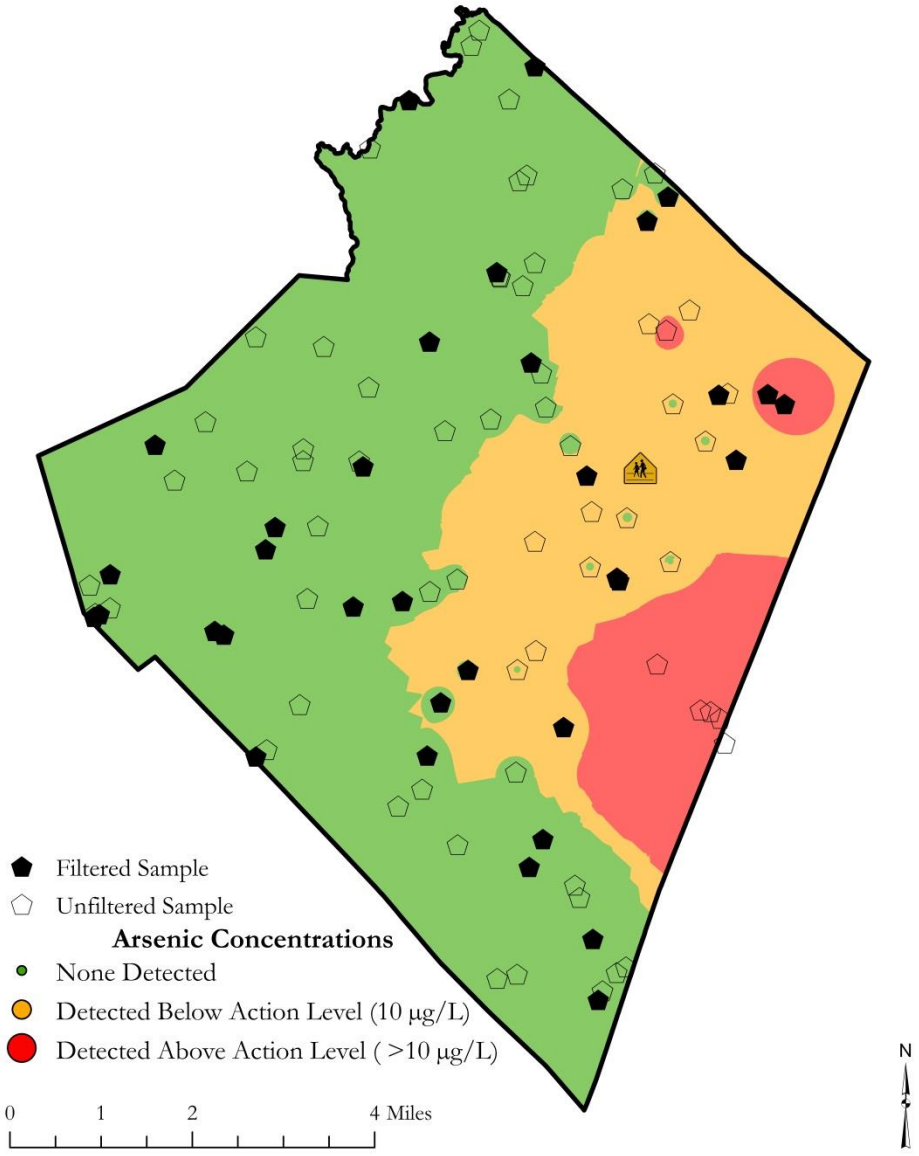
RESULTS

- 66% of samples were NOT filtered.
  - 11% of samples were not filtered and tested positive for arsenic.
  - 5% of samples were not filtered and had arsenic concentrations exceeding the EPA Drinking Water Standard (10 µg/L)..

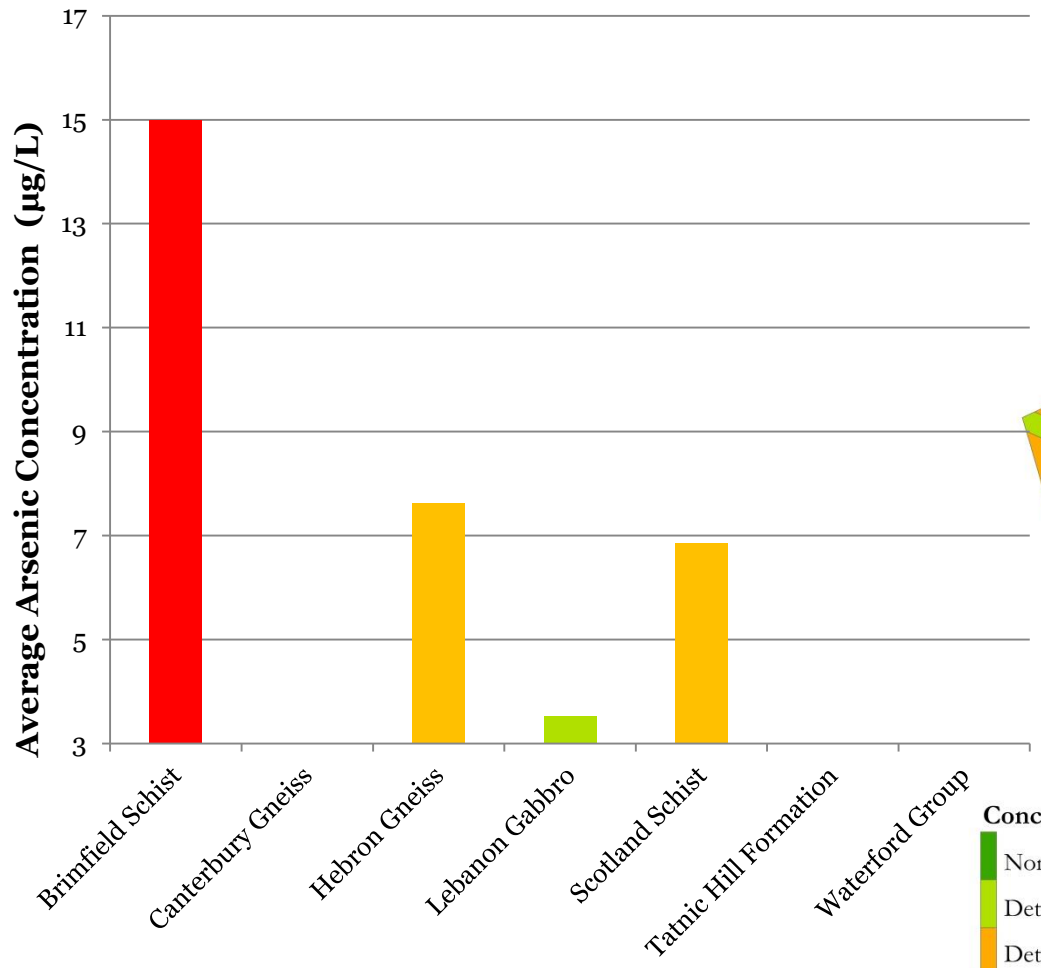


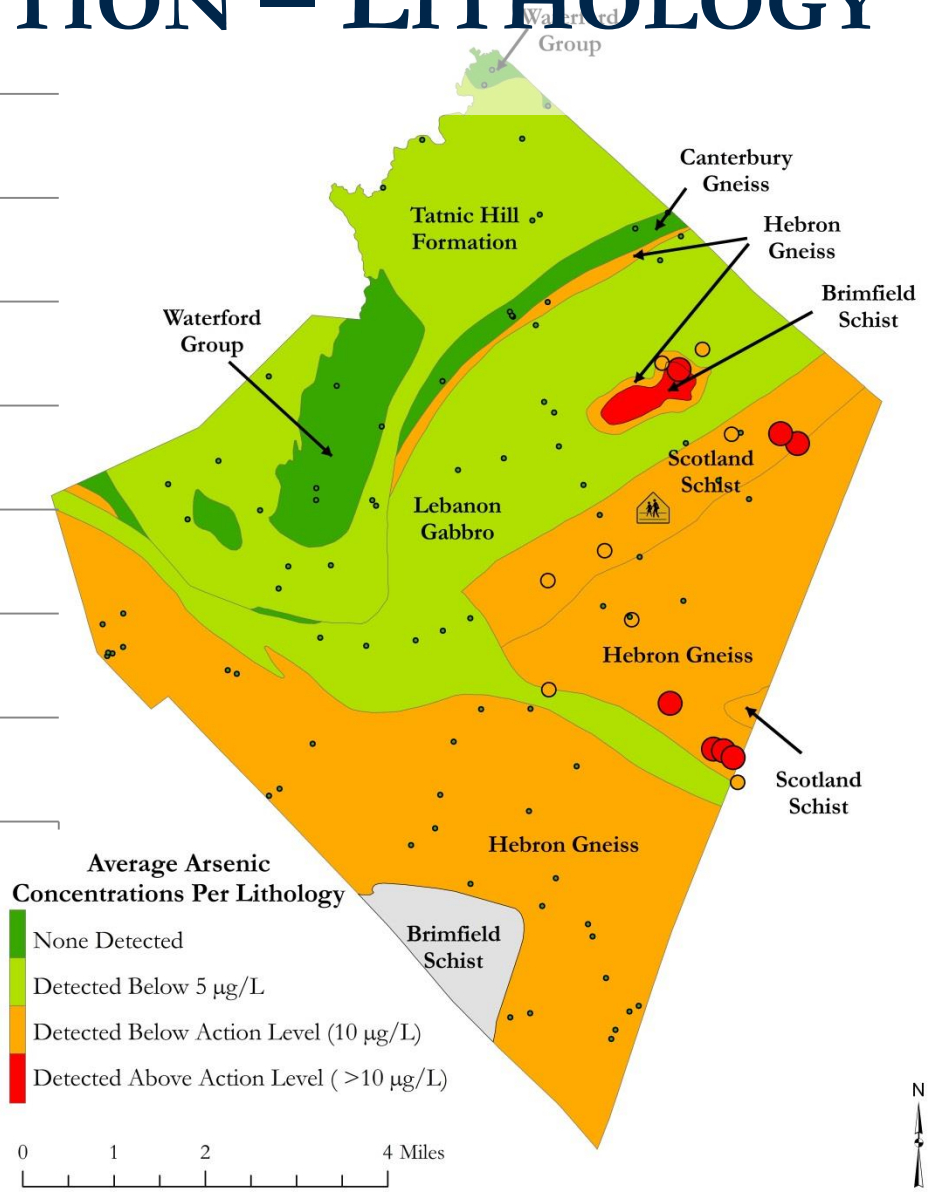
Arsenic Distribution – Filtered Sample



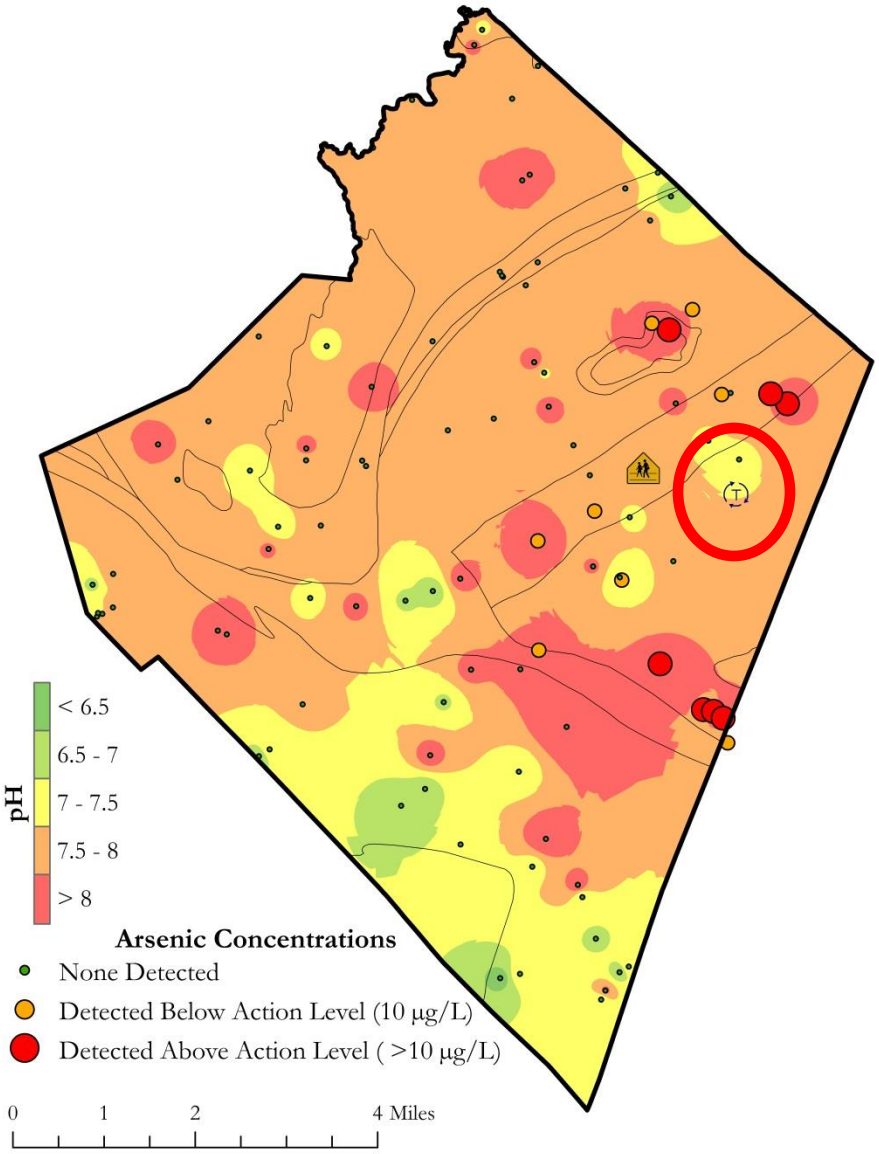


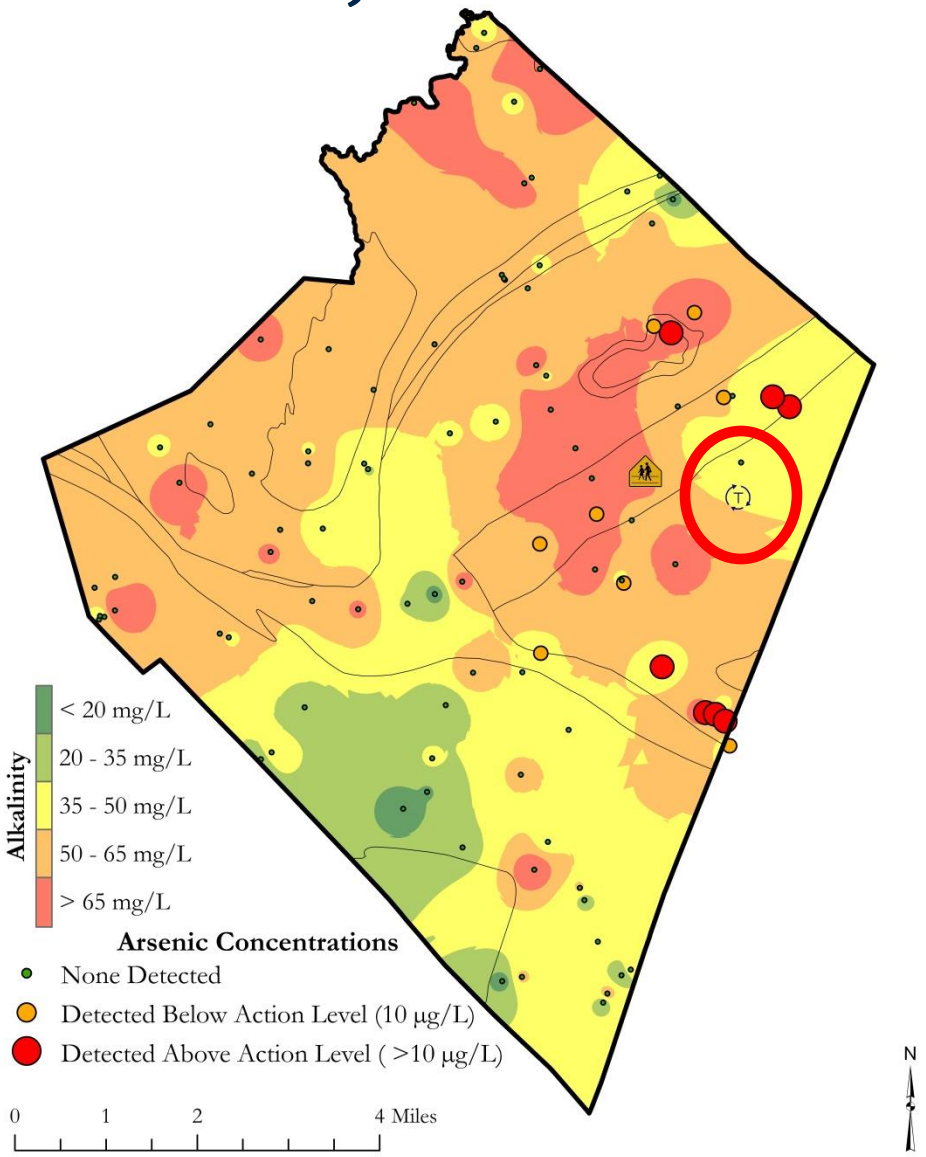
Arsenic Distribution – Lithology



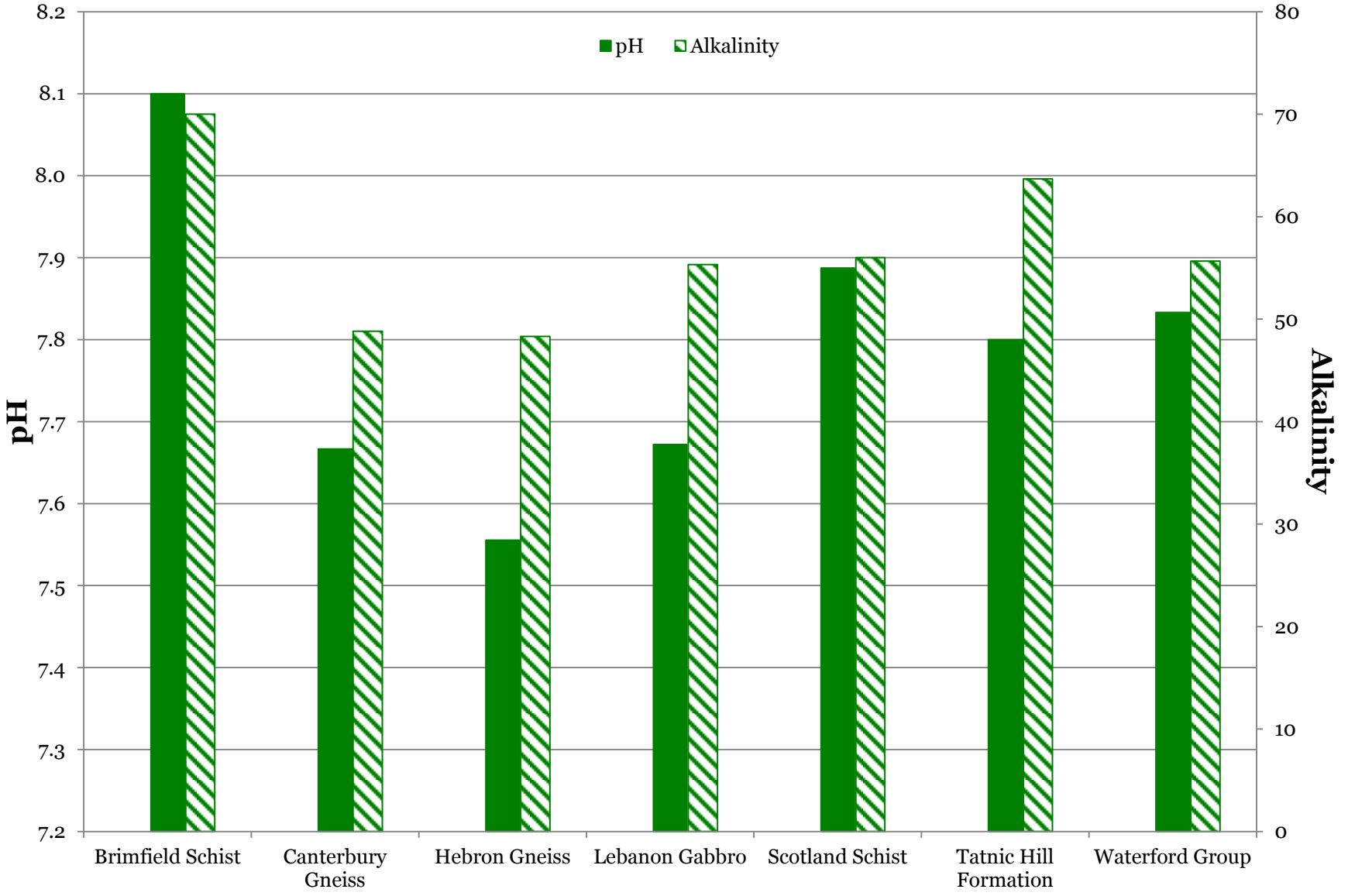


Arsenic Distribution – pH, Alkalinity

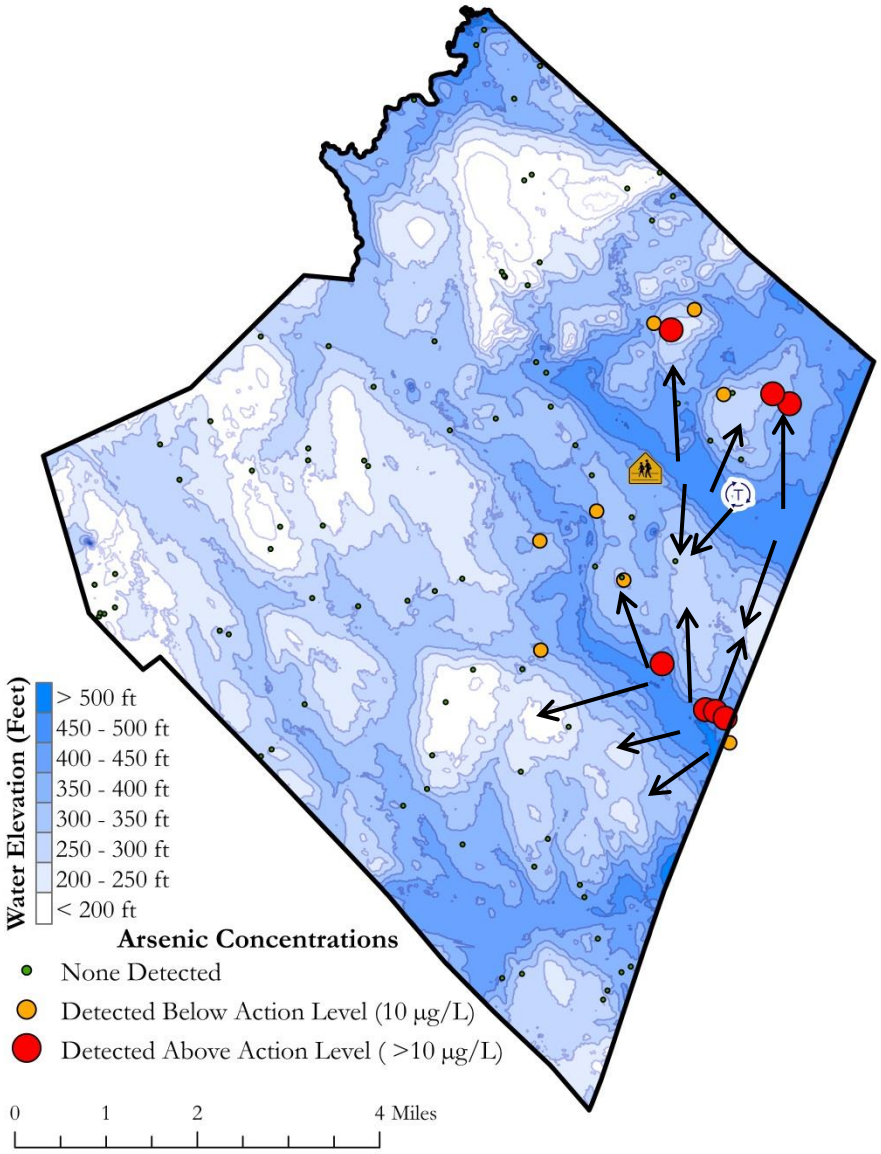


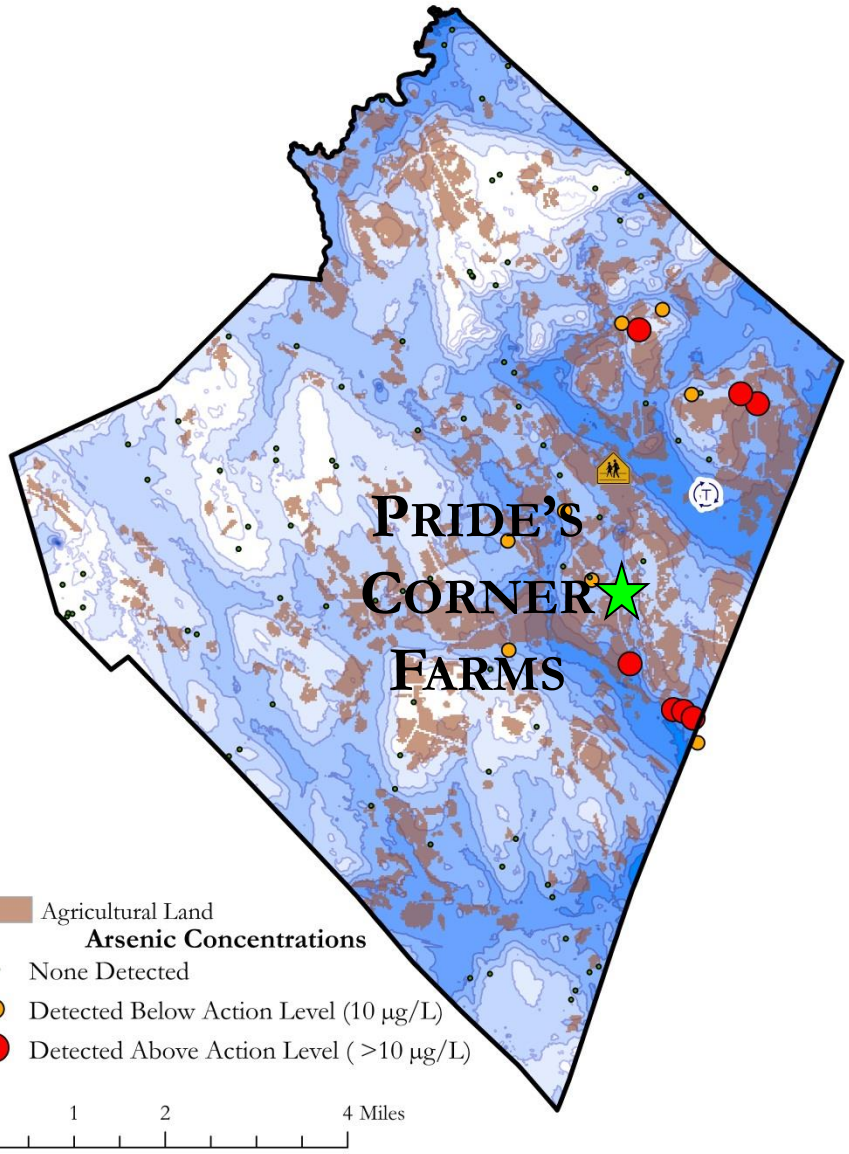


Arsenic Distribution – pH, Alkalinity



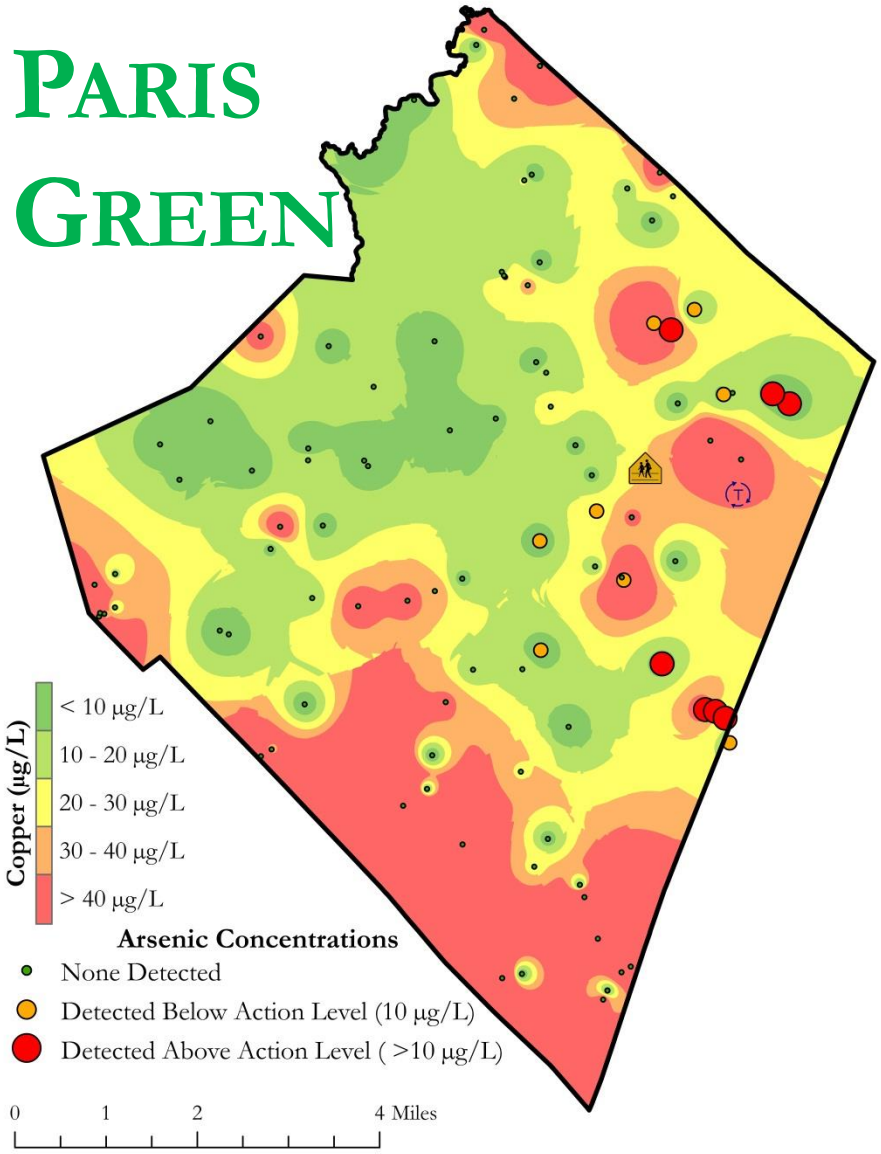
ARSENIC DISTRIBUTION – GROUNDWATER



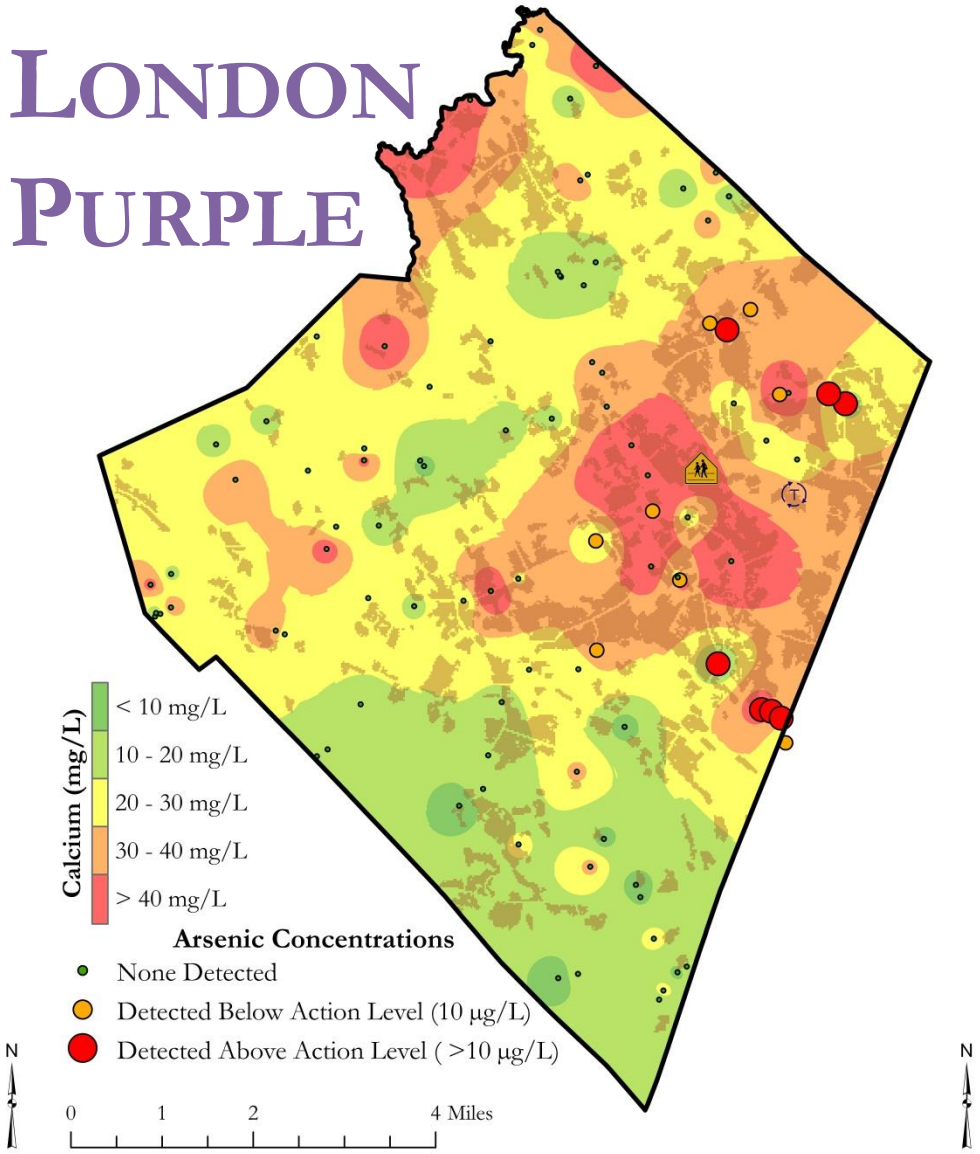


Arsenic Distribution – Pesticides

Paris Green

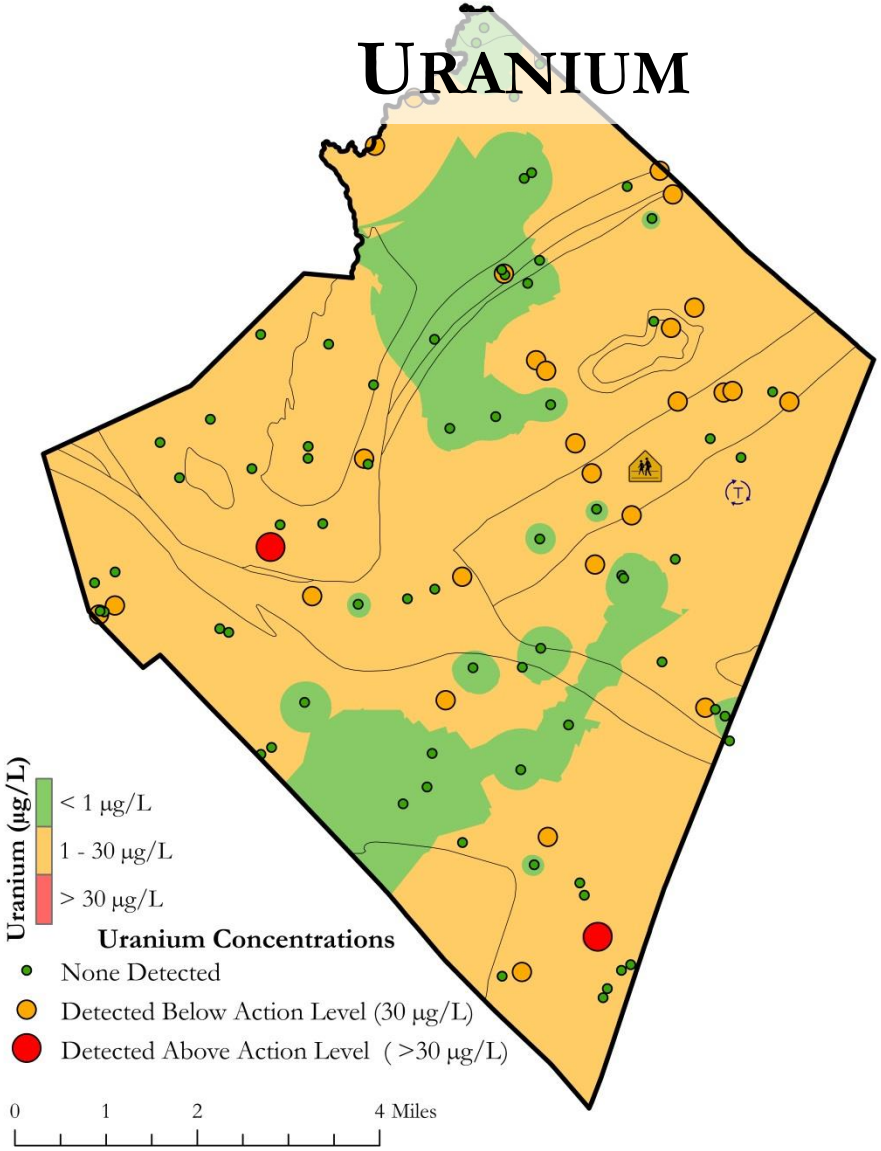


London Purple

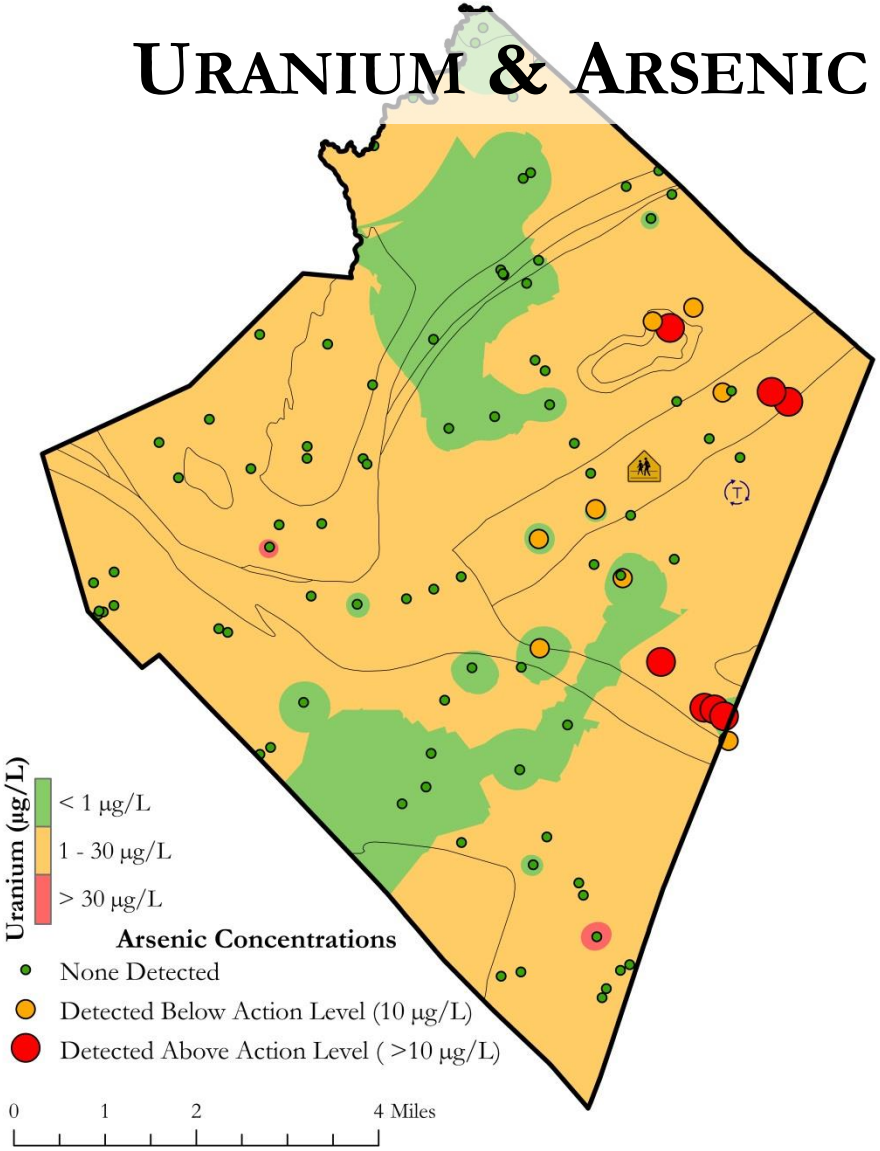


URANIUM & ARSENIC DISTRIBUTION

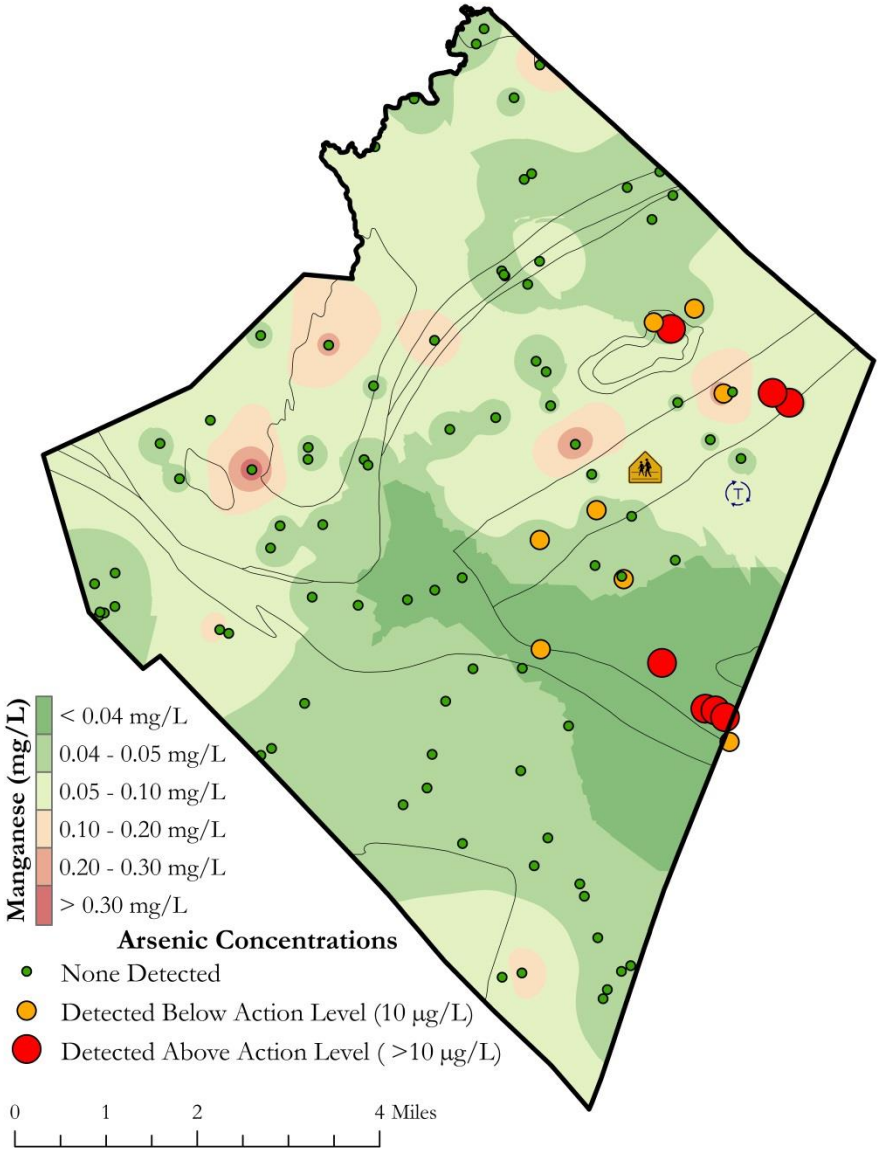
URANIUM

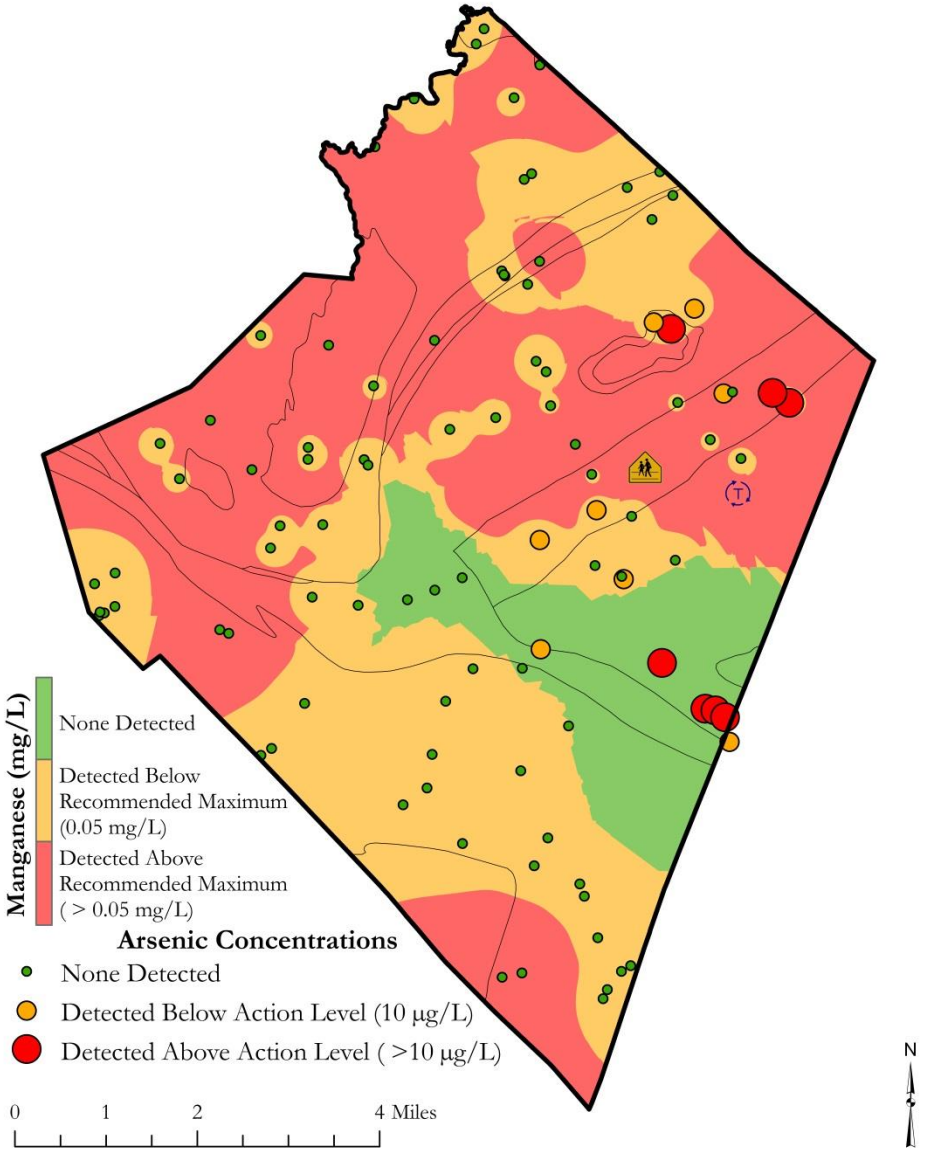


URANIUM & ARSENIC



Arsenic Distribution – Manganese



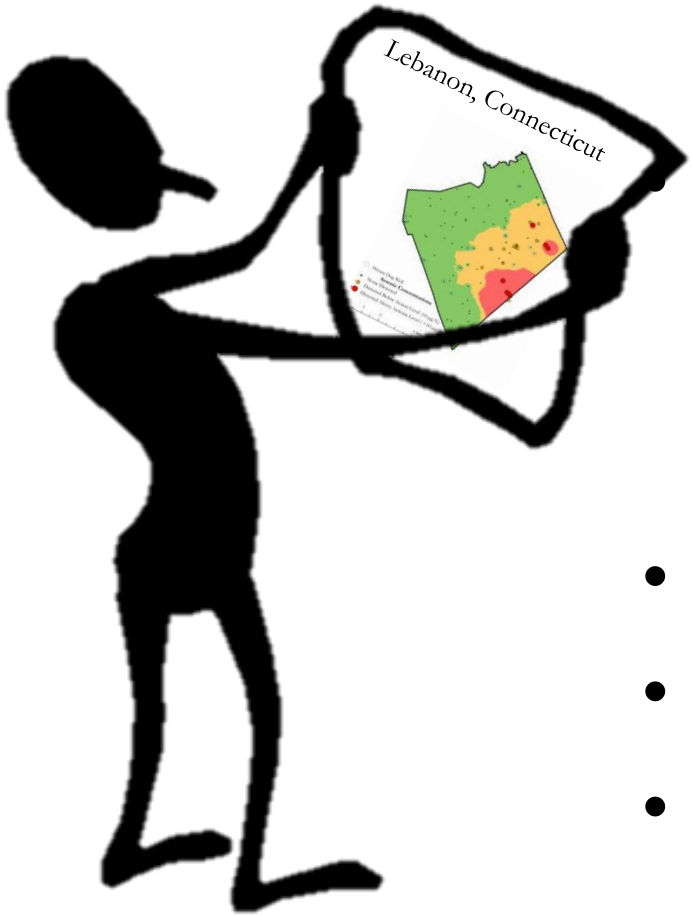


What Does it Mean for Lebanon?

Conclusions

- Arsenic occurs in dug wells and bedrock wells.
  - Multiple sources of arsenic contamination.
  - Cross contamination.
- Arsenic occurs in the Brimfield Schist, Scotland Schist, and the Lebanon Gabbro.
  - Multiple sources of arsenic contamination.
- Groundwater flow and water quality indicate arsenic concentrations are not likely due to the former landfill.
- High As in areas of high pH and low Mn suggest that arsenic complexation may be occurring, groundwater is aged, and/or wells are intersecting calc-silicate rocks.

What's Next



- 3-Dimensional evaluation of wells, rock types, and arsenic.
- Several homes will be visited to analyze for additional parameters:
  - Dissolved oxygen, Oxidation-Reduction Potential, etc.
- Installation of bedrock wells.
- Installation of piezometer clusters.
- Water quality of homes, bedrock wells, and clusters monitored temporally.

EASTERN CONNECTICUT STATE UNIVERSITY

THANK YOU TO…

TOWN OF LEBANON CONNECTICUT

CONNECTICUT ENERGY ENVIRONMENT

Keeping Connecticut Healthy

DPH

Connecticut Department of Public Health