Using Volunteers to Collect Ground Water Information: Examples from New Hampshire

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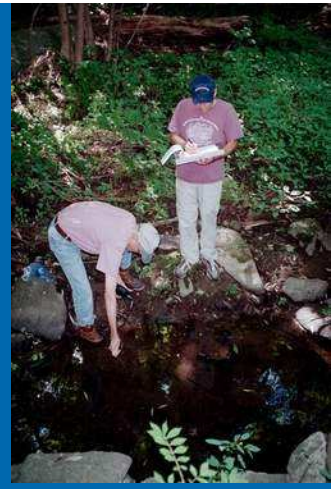
NH Department of Environmental Services

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

NEW HAMPSHIRE 1839 2001 GEOLOGICAL SURVEY

Today's Presentation

- Volunteers for surface water monitoring
- Data gaps and needs?
- Hollis and Dublin, NH Examples
- Questions



User Submitted News
Thursday, April 8, 2010

Water monitors on the Oyster River.

Courtesy photo

DURHAM — Want to play an active role in protecting the local environment?

The Oyster River Water Quality Monitoring Program keeps an eye on the ecological health of the river and its tributaries in the towns of Durham, Madbury, Lee, and Barrington. The program is sponsored by the University of New Hampshire Water Supply, Oyster River Watershed Association and New Hampshire's Department of Environmental Services.

This program is run by volunteers. Presently there are opportunities for new volunteers to get involved. This is a good way to get some real field experience in monitoring water quality and is both a real service to the community and a lot of fun. You can be involved as a volunteer monitor in three different ways.

1) Physical monitoring (oxygen, turbidity, conductance, pH, temperature.)

This year we will monitor the river once a month from May through November. Sampling will take place on a Friday or Saturday morning and will run from about 8 am until 11 am. You can participate in one or more of these sampling trips. (You don't have to commit to the entire season of sampling.) Volunteers for physical monitoring have to take a 2-hour training session run by

New Hampshire DES.

Citizen Science in Full Flight

from the (Raleigh, N.C.) *News and Observer*

... Nonscientists ... throughout North Carolina and the nation are participating in a smorgasbord of projects, studying birds, amphibians, plants, mammals, chemistry, dinosaurs, climate change, light pollution, the galaxy--the list goes on.

Citizen science involves nonscientist volunteers gathering and reporting data for scientific studies. Less often, they help analyze it. Participating is a two-way street. It not only funnels data to scientists faster than they could accumulate it using only trained researchers, it also gives citizens a window to science.

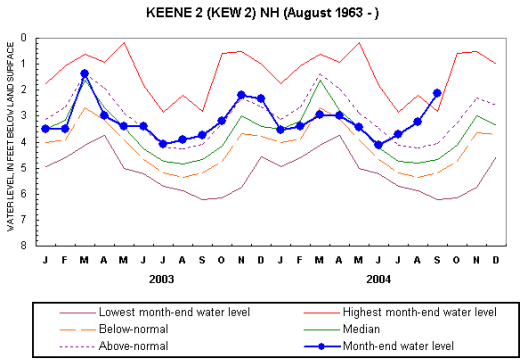
....Increasing scientific literacy among the lay public and increasing conservation actions should be two goals of every citizen science project, said Rick Bonney, director of program development and evaluation at the Cornell Laboratory of Ornithology.

(enews@americanscientist.org)

GROUNDWATER LEVEL MEASUREMENT NETWORK

1 **Surficial Monitoring Well Locations**

11 **Bedrock Monitoring Well Location**



1 - Albany (2 Wells)

2 - Barnstead

3 - Campton

4 - Colebrook

5 - Concord (2 Wells)

6 - Deerfield

7 - Enfield

8 - Errol

9 - Franklin

10 - Greenfield

11 - Hooksett (Bedrock Well)

12 - Keene

13 - Lancaster

14 - Lee

15 - Lisbon

16 - Nashua

17 - New London

18 - New Durham

19 - Newport (2 Wells)

20 - Ossipee

21 - Shelburne

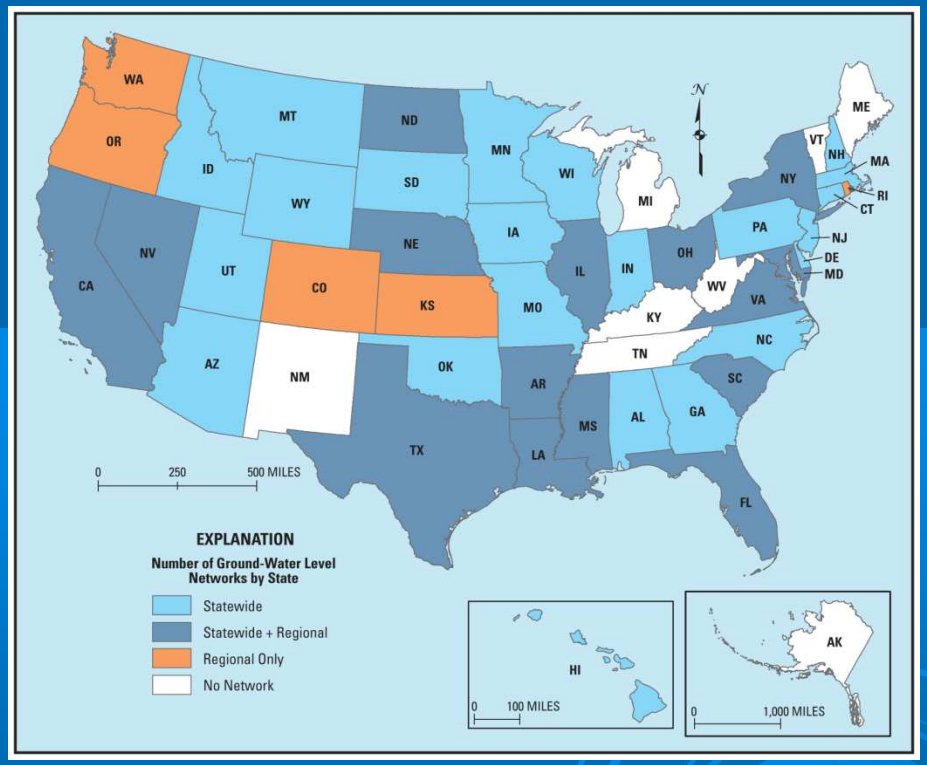
22 - Warner

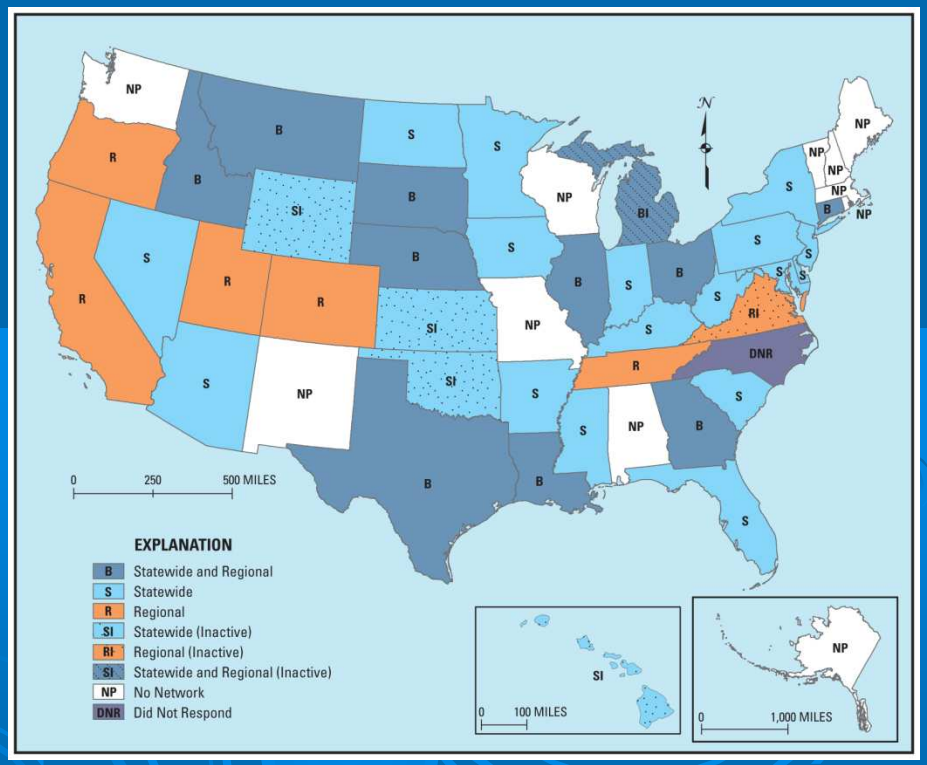
Perceptions of Groundwater

- The public cannot "see" ground water
- "out of sight—out of mind"

Statewide GW Monitoring Programs

- **“Patchwork Quilt” of networks**
- **42 States have statewide WL network, 17 have statewide QW network (32 statewide or regional)**

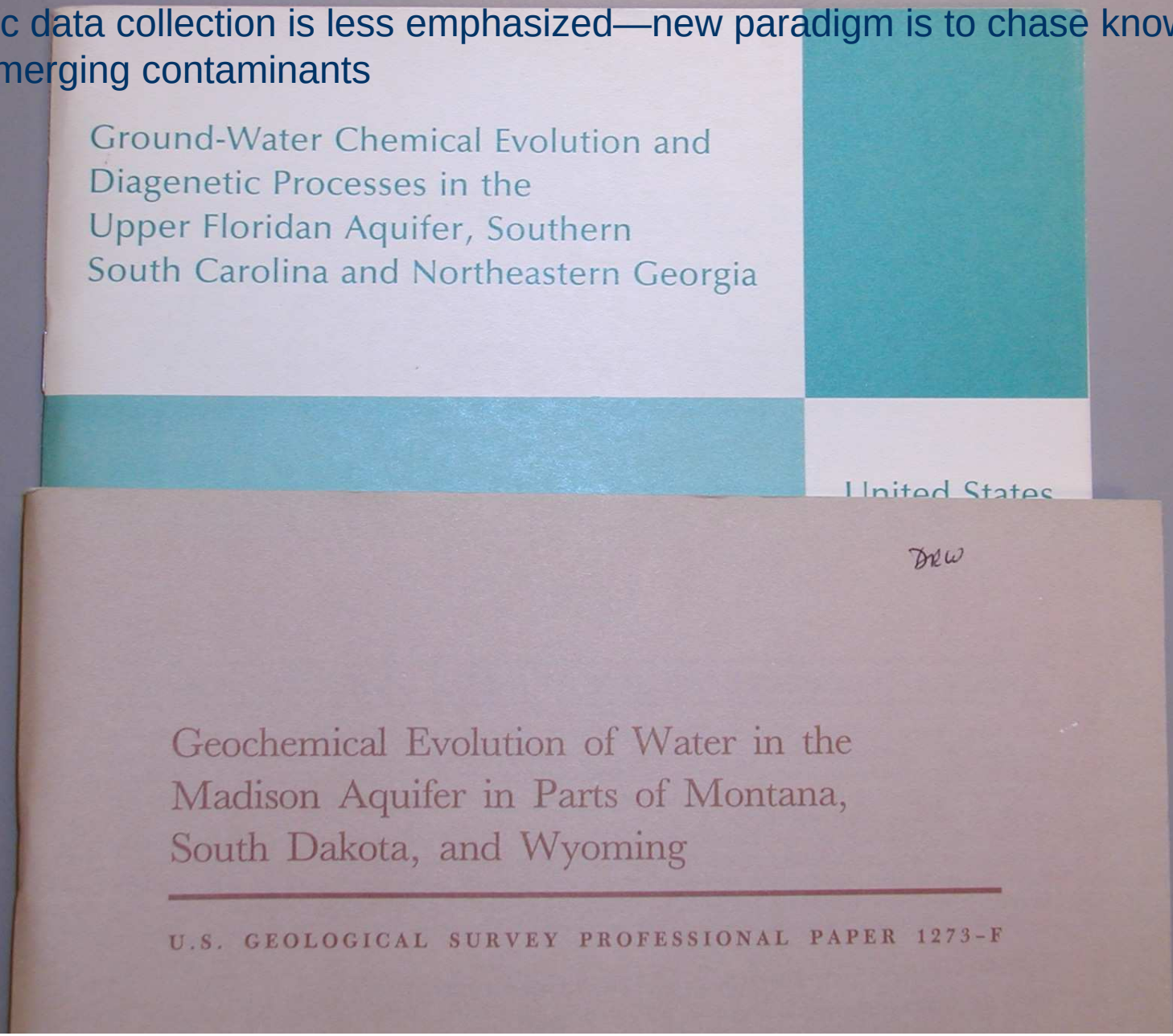




(Source: AASG, NGWA, GWPC)

Paradigm shift in water quality data collection

Basic data collection is less emphasized—new paradigm is to chase known or emerging contaminants



Bias in Available Data Sets

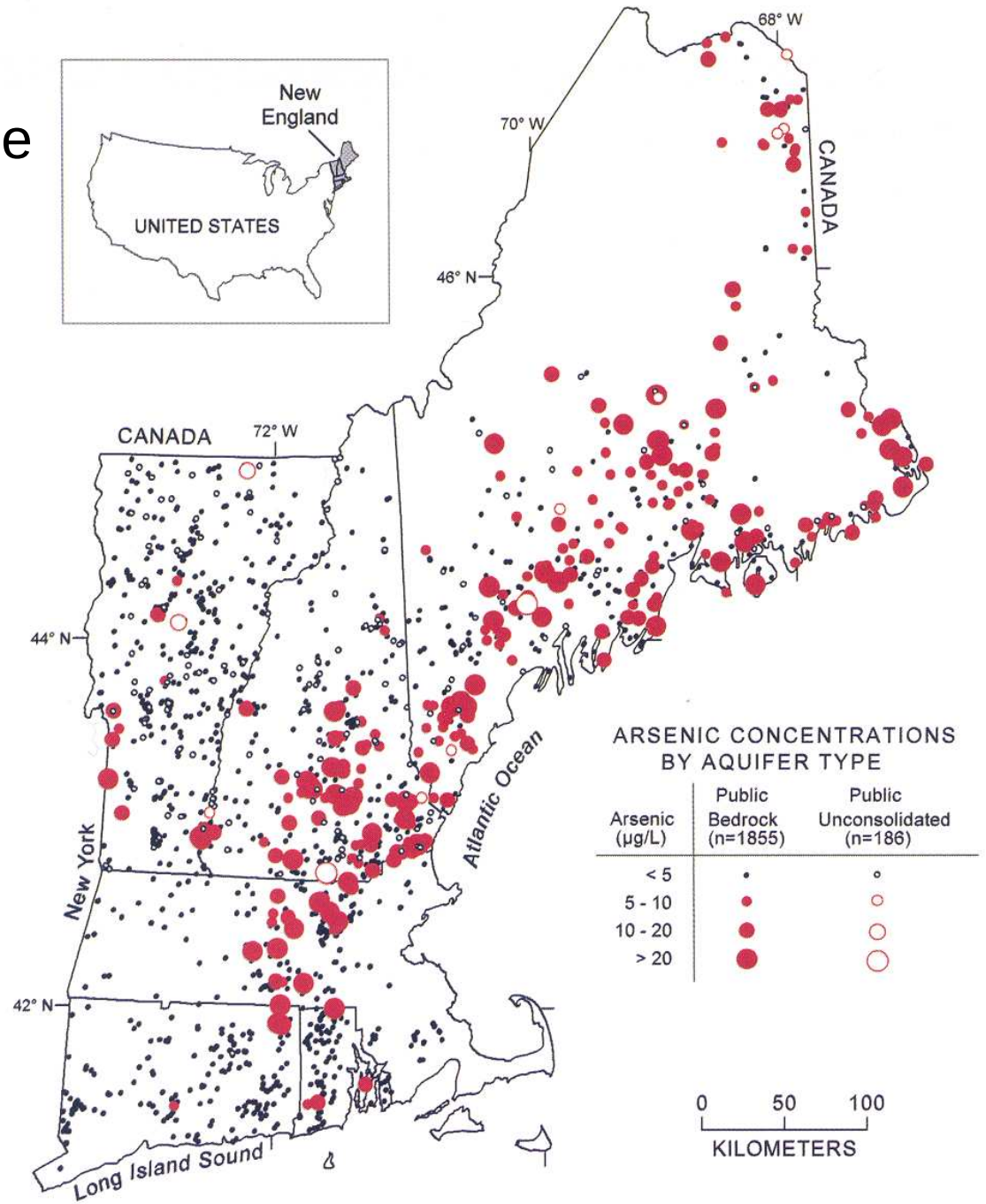
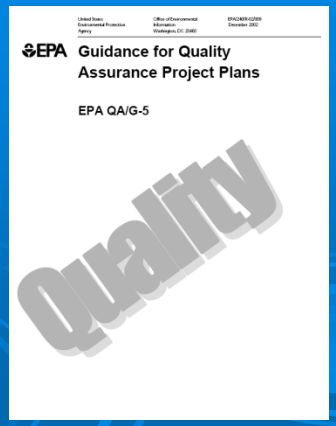


FIGURE 1. Arsenic concentration in source waters to public-supply wells in New England. (USGS, 2003)

Additional Thoughts:

- New technologies and analytical advancements allow scientists to look at minute quantities
- Emerging contaminants draw resources (e.g., endocrine disrupters, pharmaceuticals)



Private Well Initiative

- Private Well Initiative (PWI) to educate the public about the need to sample their water supply
- Emphasizes harmful contaminants or regulated parameters

- Private wells quality not regulated by EPA or the states
- The public looks to government to tell them what they need to be concerned about in their ground water
- We are missing a huge opportunity to collect addition useful information needed to characterize ground water that does not cost too much more than the PWI recommended parameters

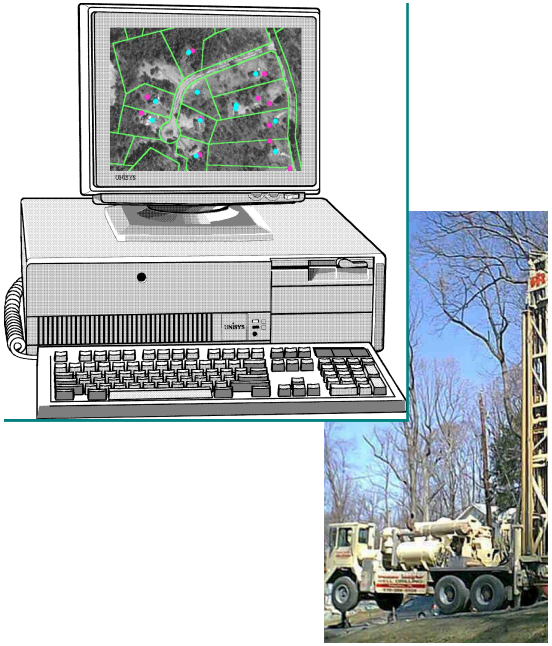
- Groundwater Study Partnerships
- Towns of Hollis and Dublin, NH

Study Background

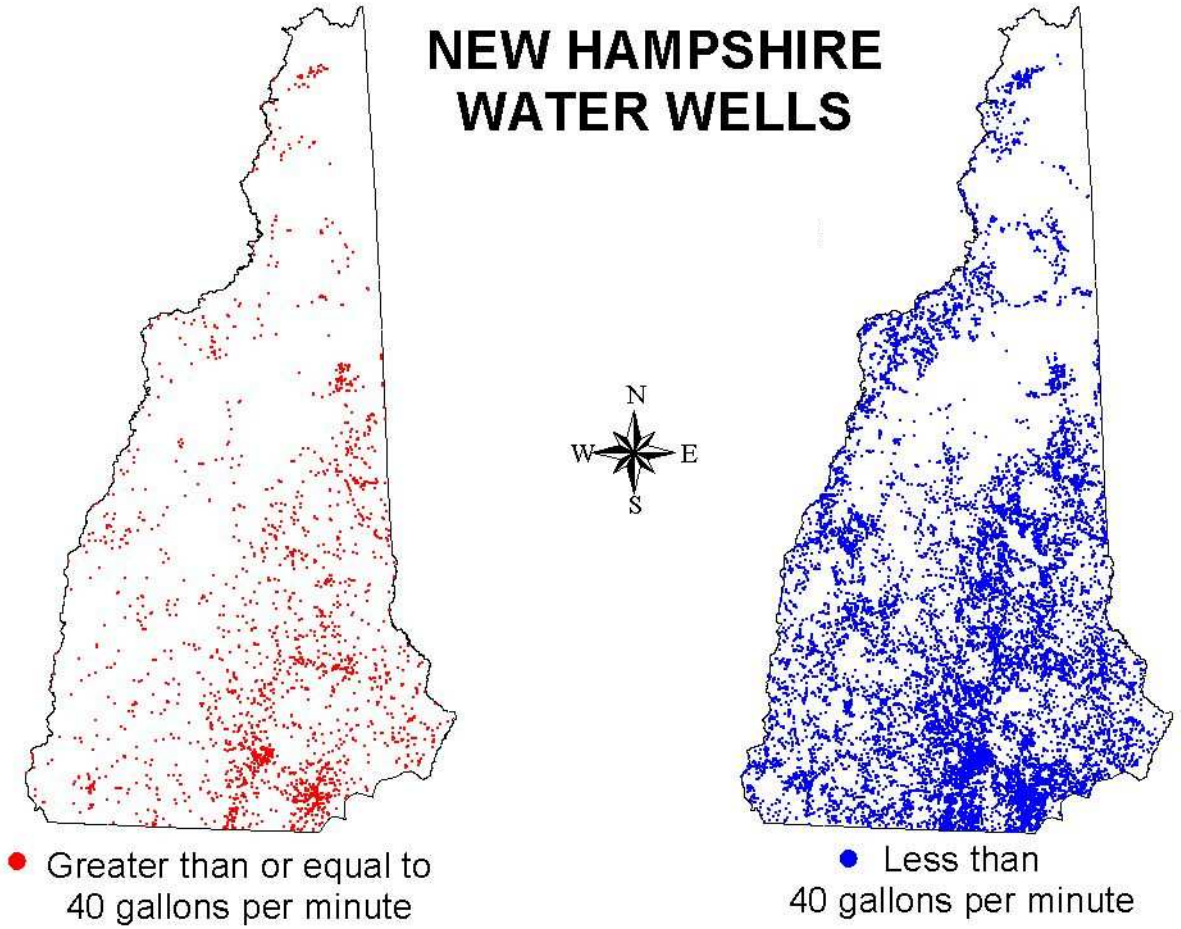
- Cooperative project between towns and NH Geological Survey
- Samples collected by cooperative effort by residents and NHGS staff
- Residents paid for analysis with some support from the town (Dublin)
- Community leaders coordinated sampling, made appointments, provided access
- Samples analyzed by NHDES state lab and EPA labs
- Data analyzed by NHGS

Concept

- Geology affects water quality
- Need robust suite of analytes to look at associations with water quality, natural contaminants, etc
- Create baseline data for monitoring
- Create tools for residents for planning, residential developments, source water protection



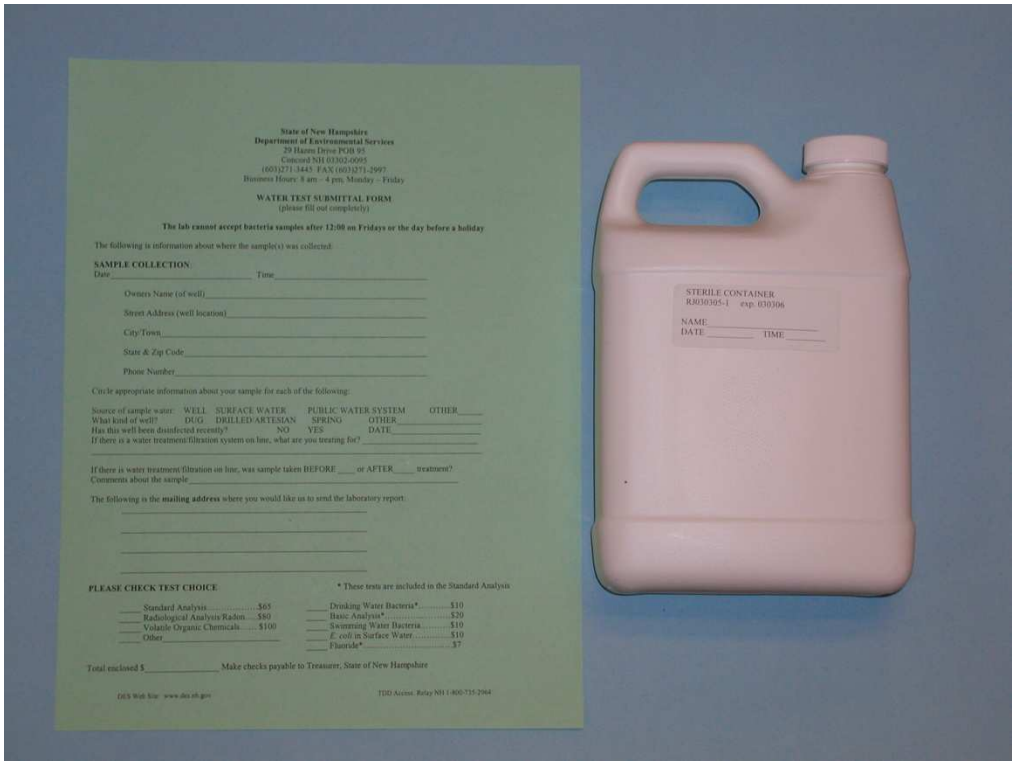
Over 116,240 wells in database, with over 59,884 georeferenced (March 2010)



In cooperation with
The NH Water Well Board

Water wells provide a great window into the subsurface for mapping and other geologic applications

Each participant will receive a sample kit in a zip-loc bag, which includes 1) a 1.0 liter sample bottle, and 2) a form to be completed and returned with the sample bottle. Please print you name and “Hollis Study” on the bottle and zip-loc bag with an indelible pen (e. g. Sharpie).



Fill the sample bottle with water.

Bedrock Geology - Hollis, NH

De9: Exeter Diorite
(Early Devonian)

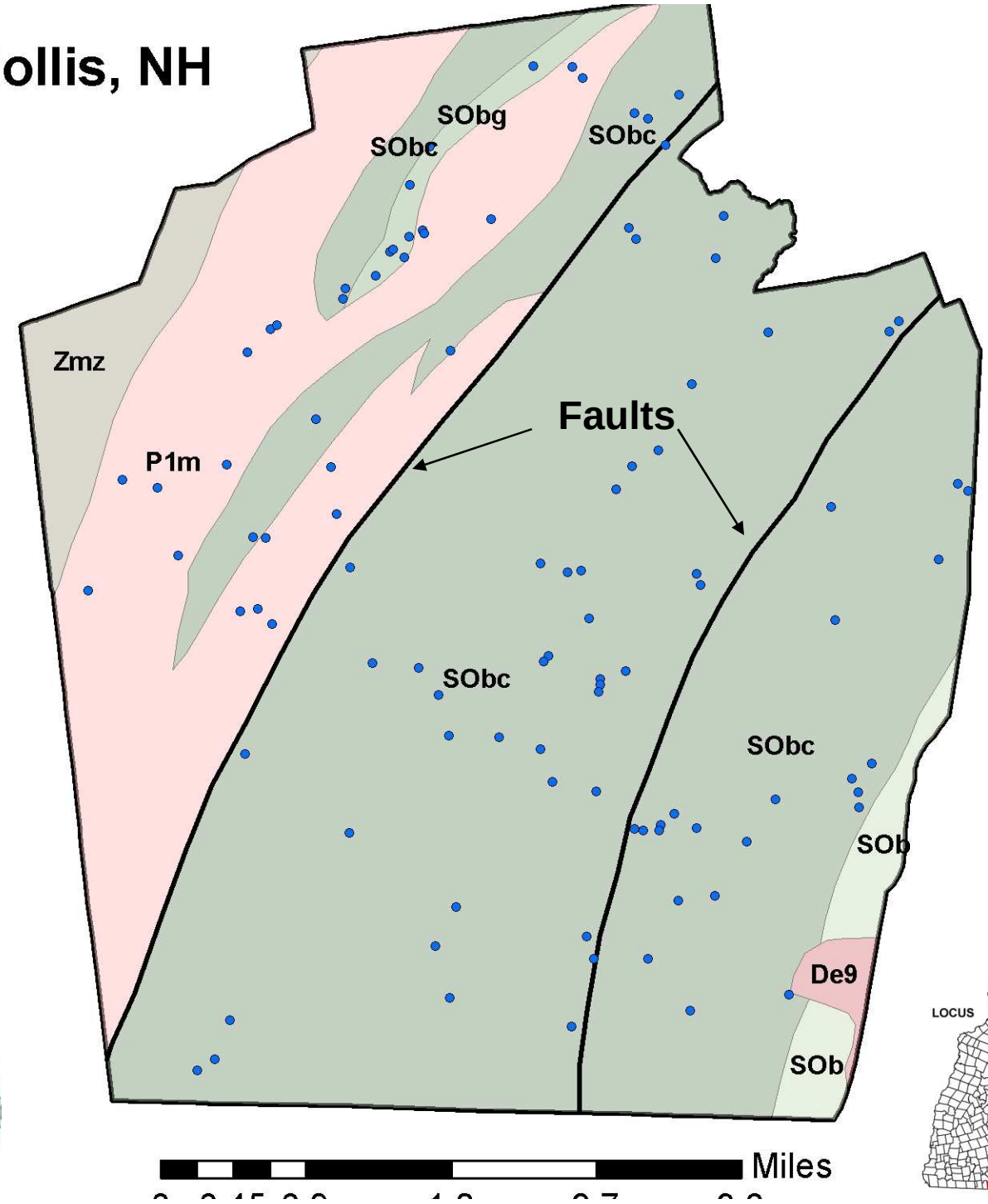
P1m: Gray biotite granite

SOb: Berwick Formation

SObc: Berwick Formation
(Unnanmed Mamber)

SObg: Berwick Formation
(Gove Member)

Zmz: Massabesic Gneiss
Complex4 (Late Proterozoic)



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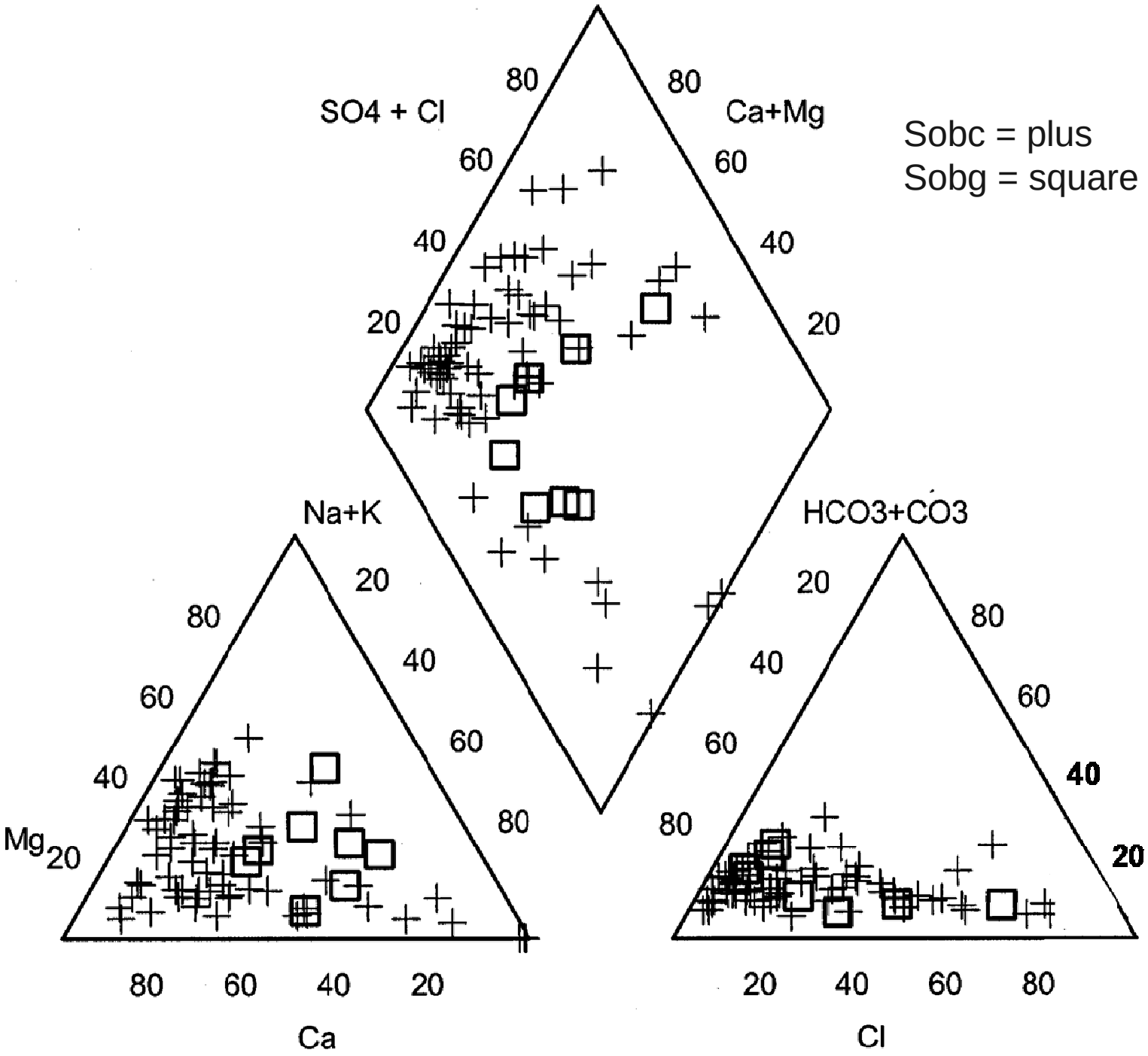

SO4 + Cl
Ca+Mg
Na+K
HCO3+CO3
Mg
Ca
Cl
80
60
40
20
Sobc = plus
Sobg = square

Differences in Alkalinity and Hardness

- Average HCO3 (SObc) = 137 mg/L
- Average Hardness (SObc) = 133 mg/L

- Average HCO3 (SObg) = 53 mg/L
- Average Hardness (SObg) = 44 mg/L
- Hardness: > 150 mg/L – very hard
  100 - 150 - hard
  60 - 80 - med hard
  < 60 - soft

- The NH Bedrock map (Lyons and others, 1997) indicates that the SObc has up to 15% calc-silicate minerals compared to only 5% in the SObg

Comparison of As in S0b and P1m

- Mean As (S0b) = 0.0121 mg/L
- Mean As (P1m) = 0.0012 mg/L

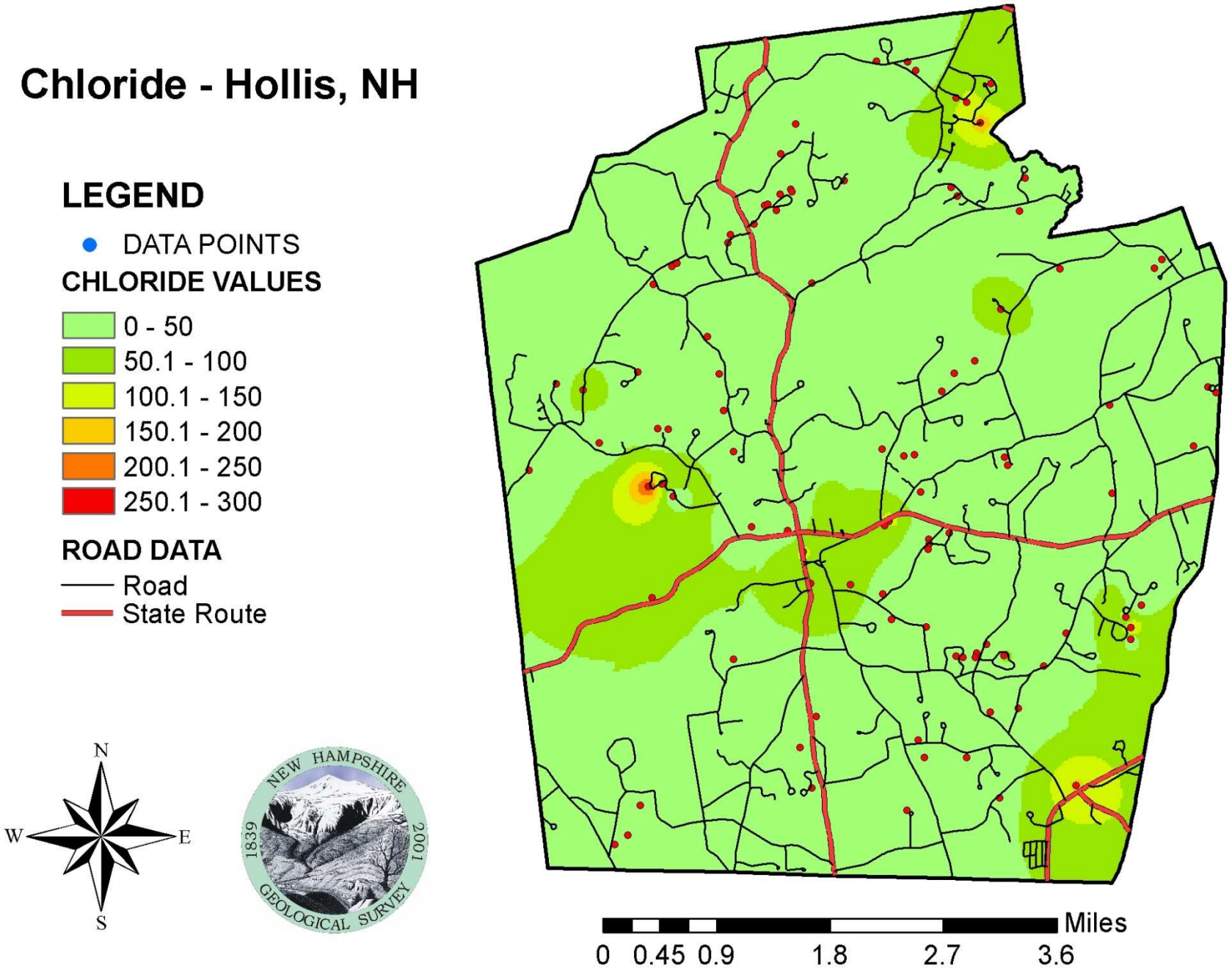
T-test

Ho: Mean(S0b) = Mean (P1m) (log transformation)

Ho: Rejected , p = 0.0001247 (99.9 % confidence)

Thus, the concentration of As in wells in the SOb are statistically different from the wells in the P1m. Wells in Sob have average concentration of As that is 10 times higher than P1m.

Chloride - Hollis, NH



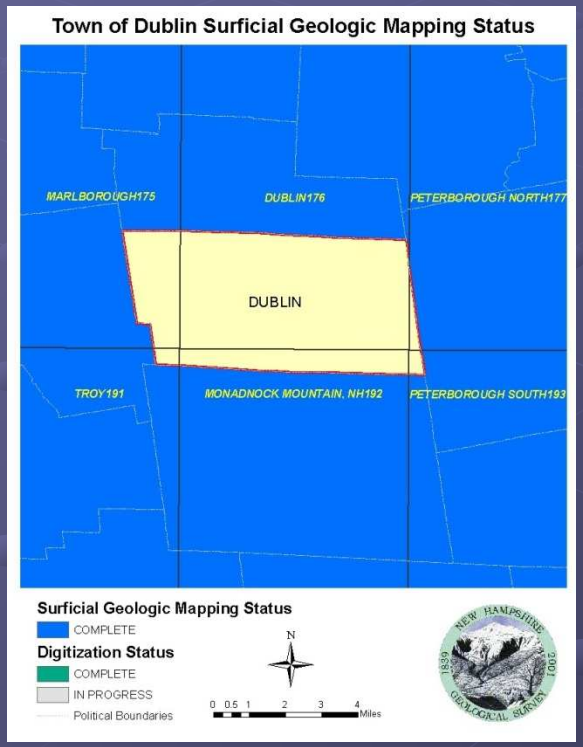
Dublin, NH Project

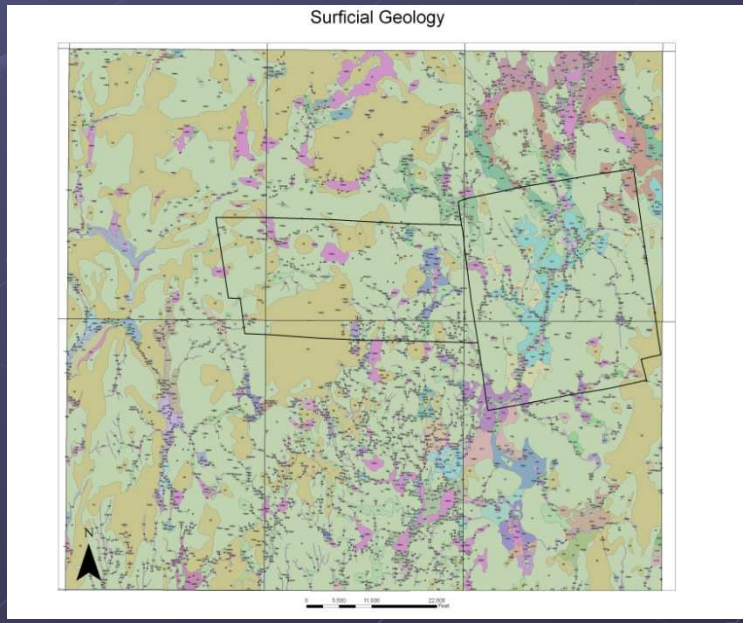
- **Data will be used for:**
  - **Aquifer delineation and protection**
  - **Ground water exploration (e.g. high yield wells)**
  - **Water quality evaluation and monitoring**
  - **Land-use planning and development**
  - **Identification of resources (e.g. sand and gravel deposits)**

Dublin, NH Water Study -

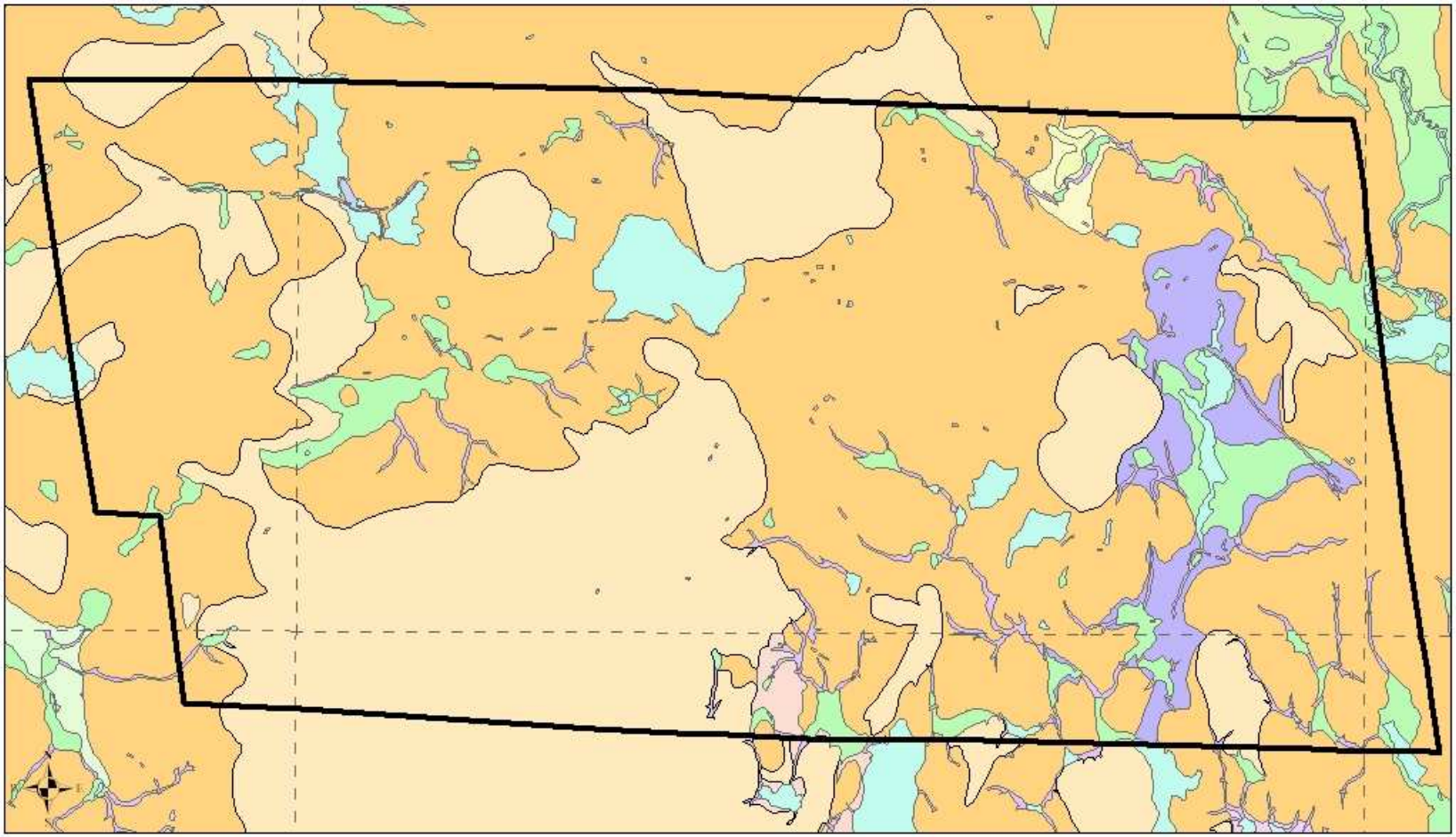
- 77 samples
- Interest from Peterborough

NHGS Partnership with Dublin, DES Lab, US EPA

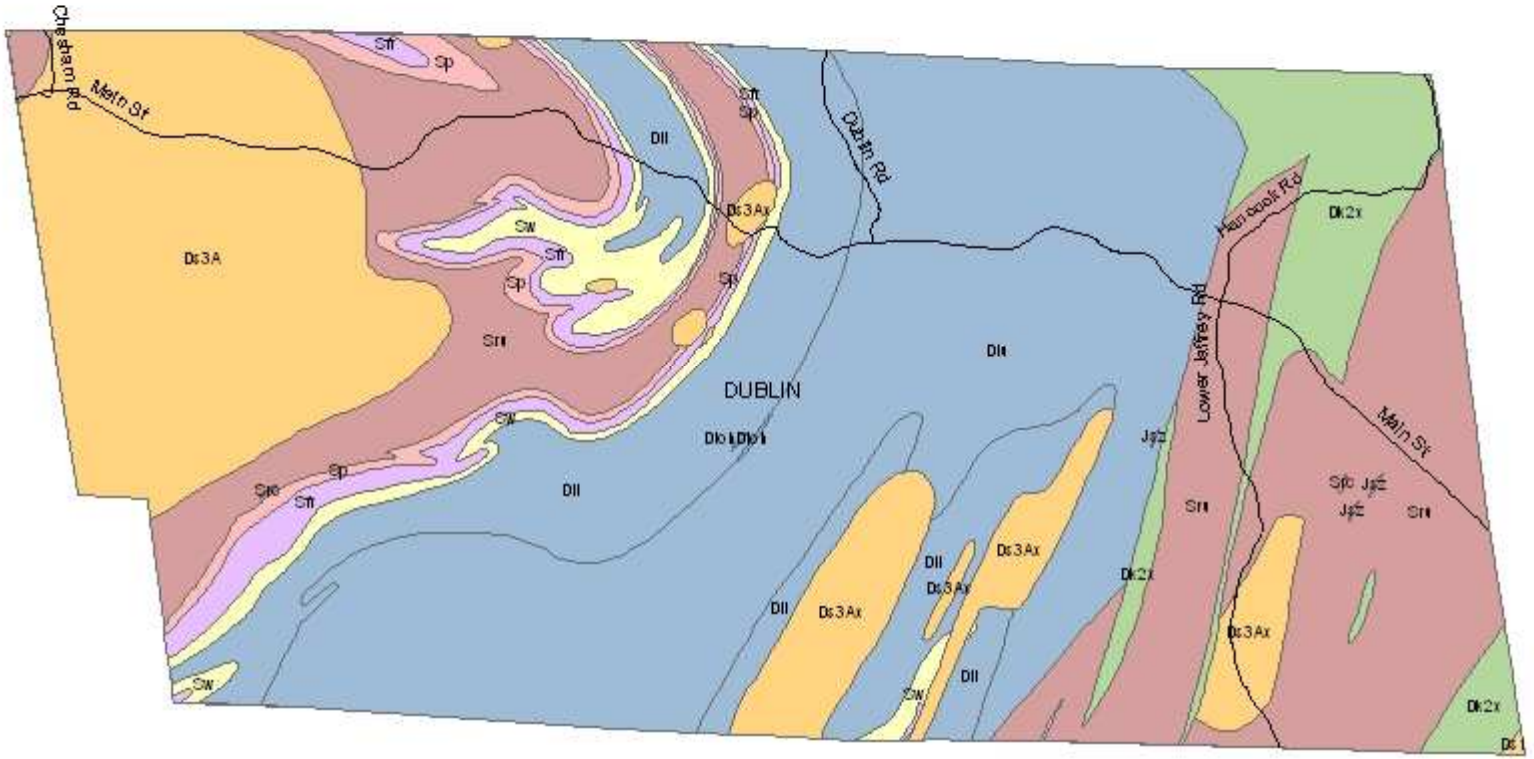




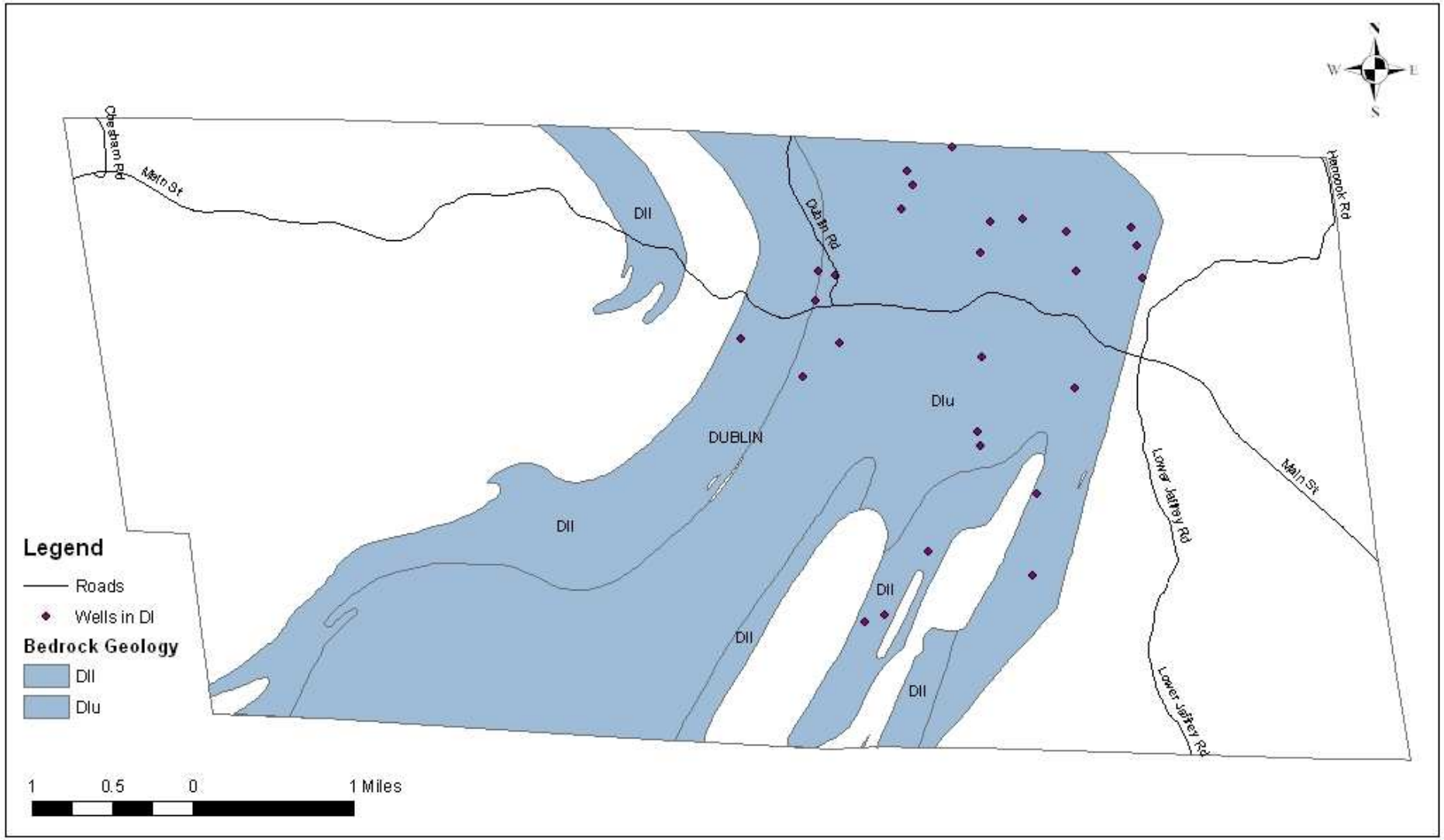
Rectified Surficial Geology at 1:24,000



Bedrock Geology of Dublin at 1:24,000 scale (Thompson and others, 2008)



Distribution of Dl (Littleton Fm –Schist with calc-silicate zones)

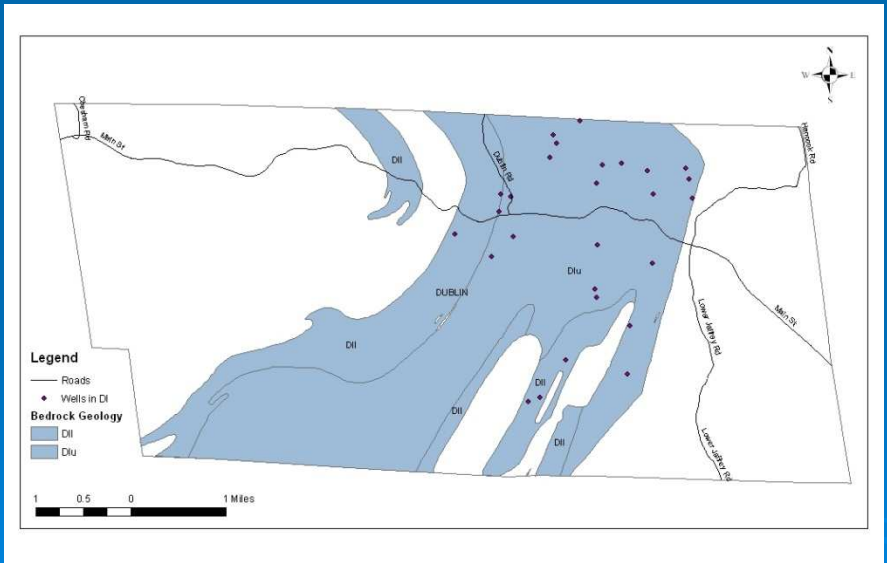


Ex. 1: Arsenic vs. well depth, and well planning

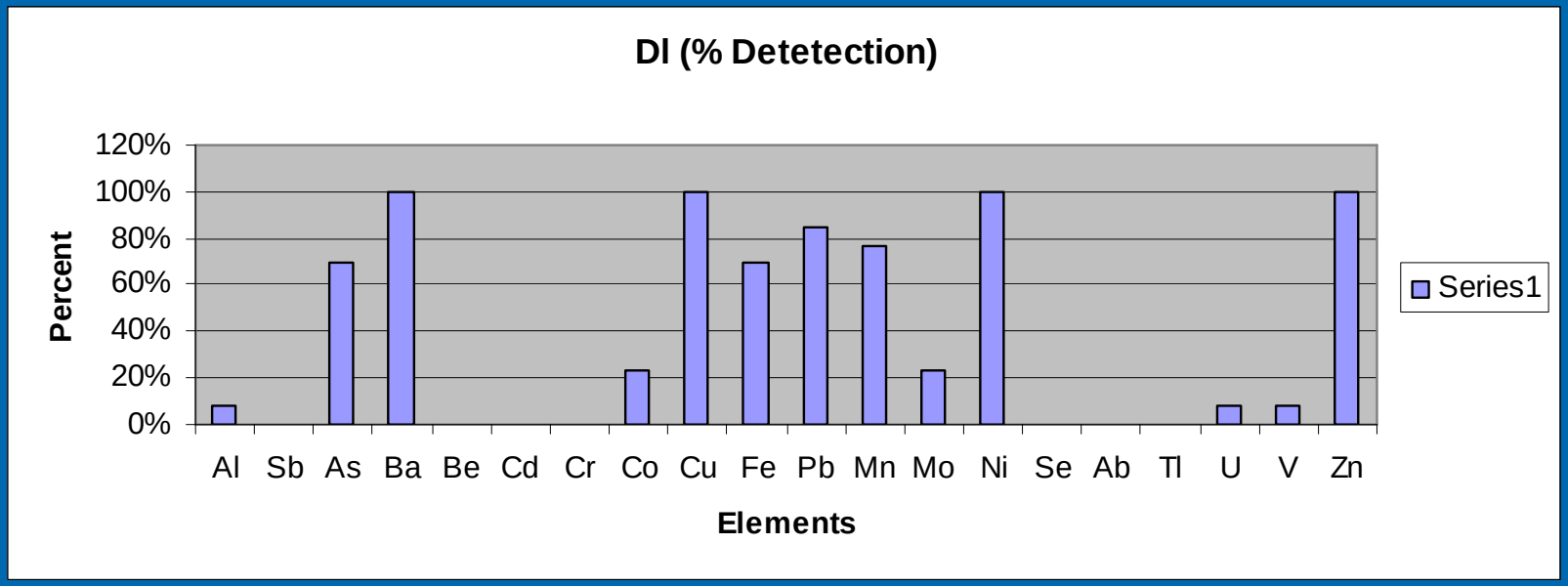
Mean Arsenic concentrations:

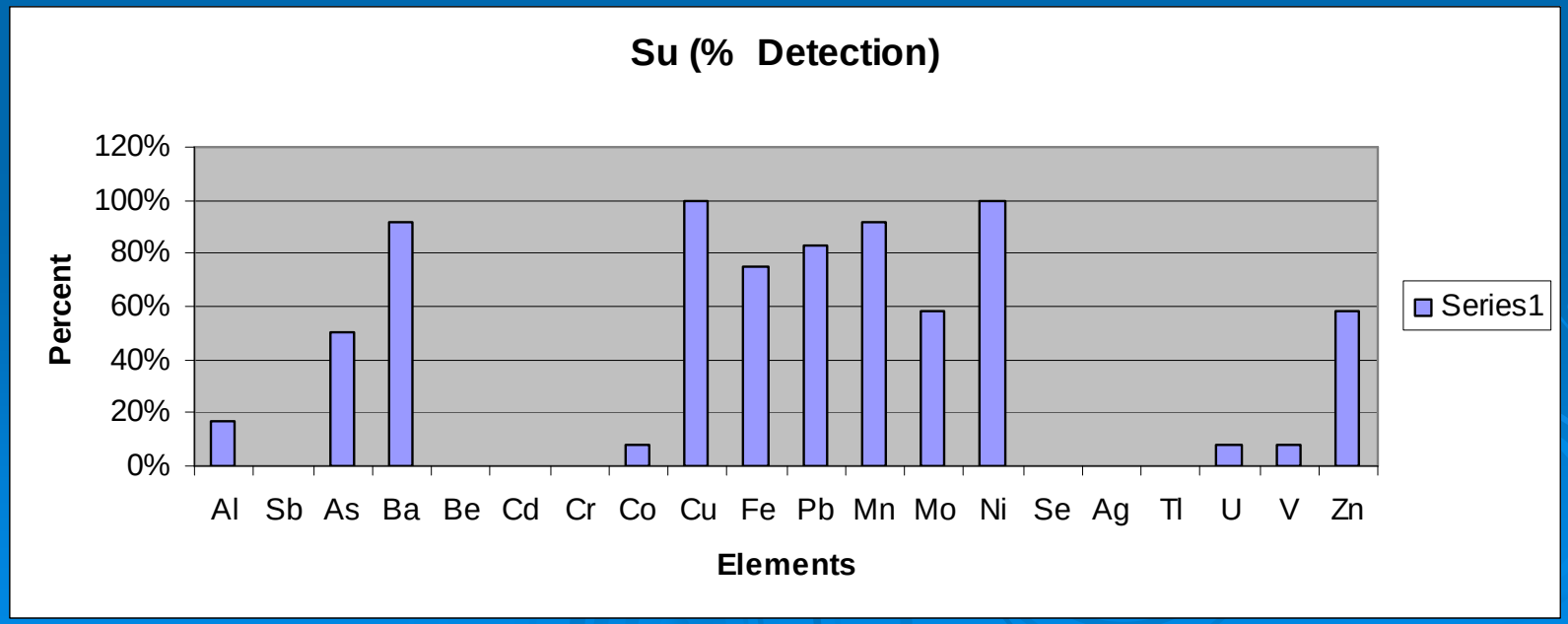
6 wells < median depth of well: 1.65 ug/L

6 wells > median depth of wells: 10.7 ug/L



Littleton Fm (Dl)	
Well Depth	**Arsenic (ug/L)**
80	**2.6**
85	**1.4**
120	**0**
125	**1.8**
200	**0**
240	**4.1**
300	1.3
350	**3.8**
400	**0**
400	**1.4**
410	**11**
500	**0**
600	**48**


Dl (% Detetection)
120%
100%
80%
60%
40%
20%
0%
Percent
Al Sb As Ba Be Cd Cr Co Cu Fe Pb Mn Mo Ni Se Ab Tl U V Zn
Elements
Series1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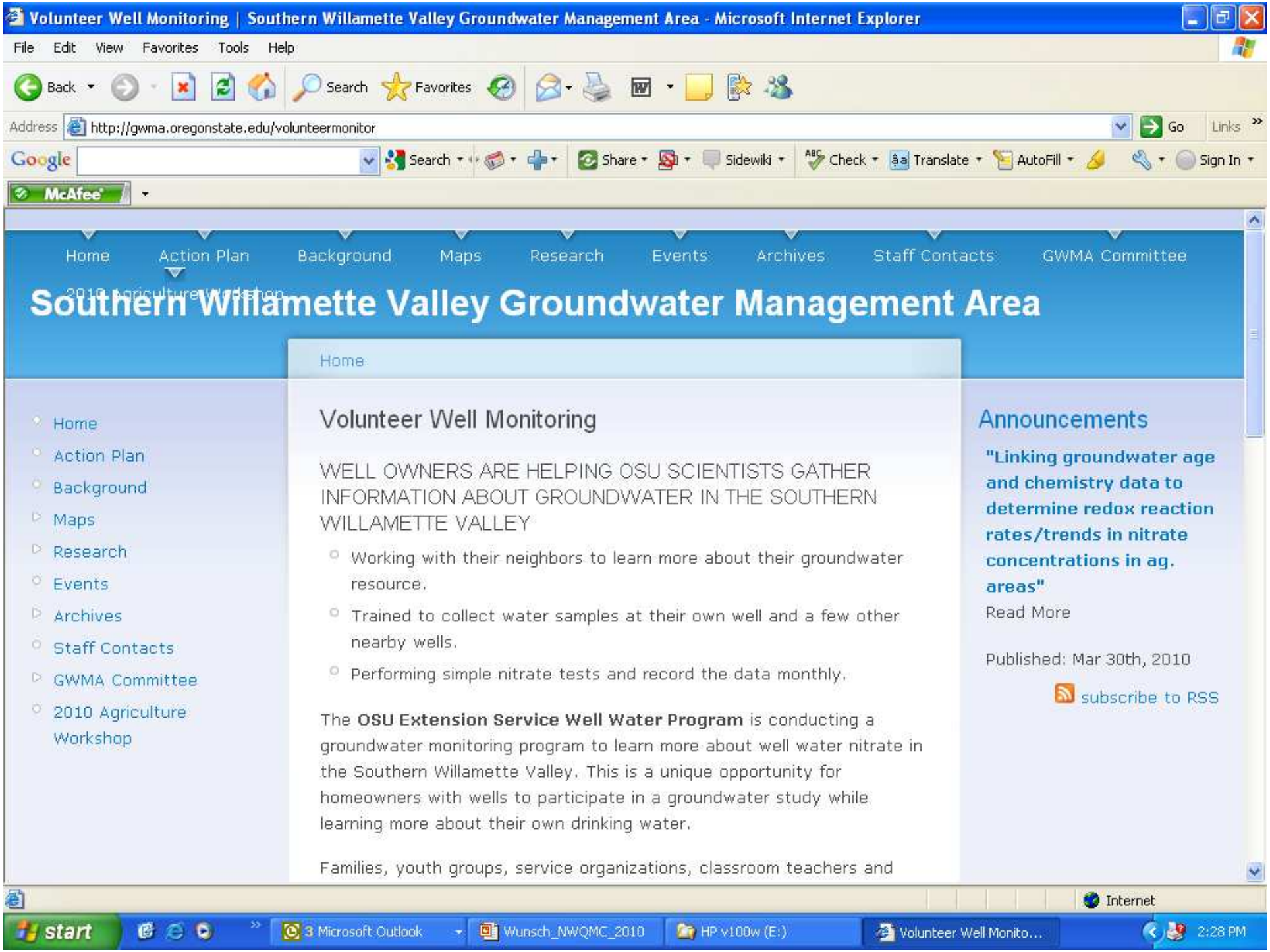
Percent
Al Sb As Ba Be Cd Cr Co Cu Fe Pb Mn Mo Ni Se Ag Tl U V Zn
Elements
Series1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GWMA Committee
2010 Agriculture Workshop
Volunteer Well Monitoring
WELL OWNERS ARE HELPING OSU SCIENTISTS GATHER INFORMATION ABOUT GROUNDWATER IN THE SOUTHERN WILLAMETTE VALLEY
Working with their neighbors to learn more about their groundwater resource.
Trained to collect water samples at their own well and a few other nearby wells.
Performing simple nitrate tests and record the data monthly.
The OSU Extension Service Well Water Program is conducting a groundwater monitoring program to learn more about well water nitrate in the Southern Willamette Valley. This is a unique opportunity for homeowners with wells to participate in a groundwater study while learning more about their own drinking water.
Families, youth groups, service organizations, classroom teachers and
Announcements
"Linking groundwater age and chemistry data to determine redox reaction rates/trends in nitrate concentrations in ag. areas"
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Conclusions:

- Using volunteers and partnerships with towns, etc. is a way to capture high-quality groundwater data to fill data gaps
- Working with volunteers provides a great opportunity to educate people about groundwater


Questions?