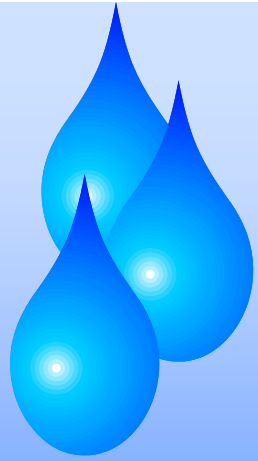


# QUALITY OF DRINKING WATER FROM PRIVATE WELLS IN GEORGIA

**Leticia Sonon, D. E. Kissel  
R. Hitchcock, and P. Bush**

Agricultural and Environmental Services Laboratories (AESL)  
University of Georgia





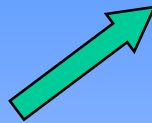
Soil, Plant, and  
Water Lab

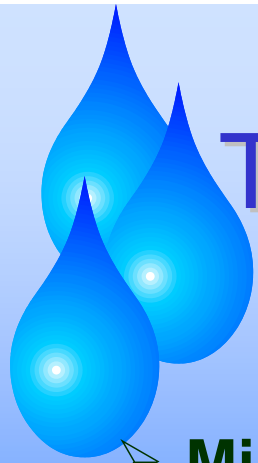
Feeds and Env.  
Water Lab

**Ag and Env. Services  
Labs (AESL)**

Pesticides and  
Hazardous Waste Lab

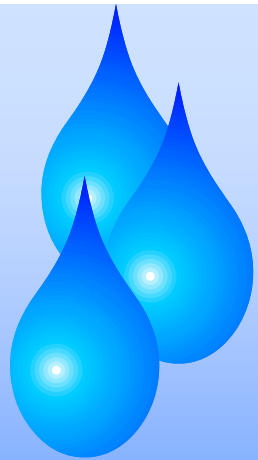
Trace Analysis Lab





# TYPES OF WATER QUALITY TESTS (UGA-AESL)

- **Mineral Tests** - determine if mineral levels high enough to affect either health or the aesthetic and cleaning capacities water. Includes primary and secondary contaminants.
- **Bacteriological Tests** – check if water is free of disease-causing bacteria, but AESL tests for total coliform and E. coli only.
- **Other Tests** – Pesticides and others are generally performed only if there is reason to believe a specific contaminant has infiltrated the water system such as pesticides or other industrial and petroleum contaminants.



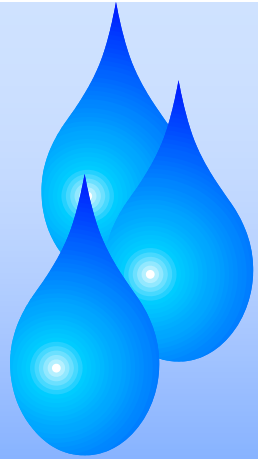
# Reasons for testing

**Visible** - scale or scum, unusual color, stains, green hair

**Taste** - bitter, salty, metallic, industrial chemicals or pesticides

**Smell** - rotten egg, gasoline or oil, chlorine, detergent odor

**Others** - cat doesn't drink water



# Sample Submission and Analysis

## Chemical testing

- acid-washed containers
- easy access to local extension office
- acidified sample
- ICP-AES

## Bacteria testing

- Sterile containers
- 24-hr holding time



# EPA water quality standards

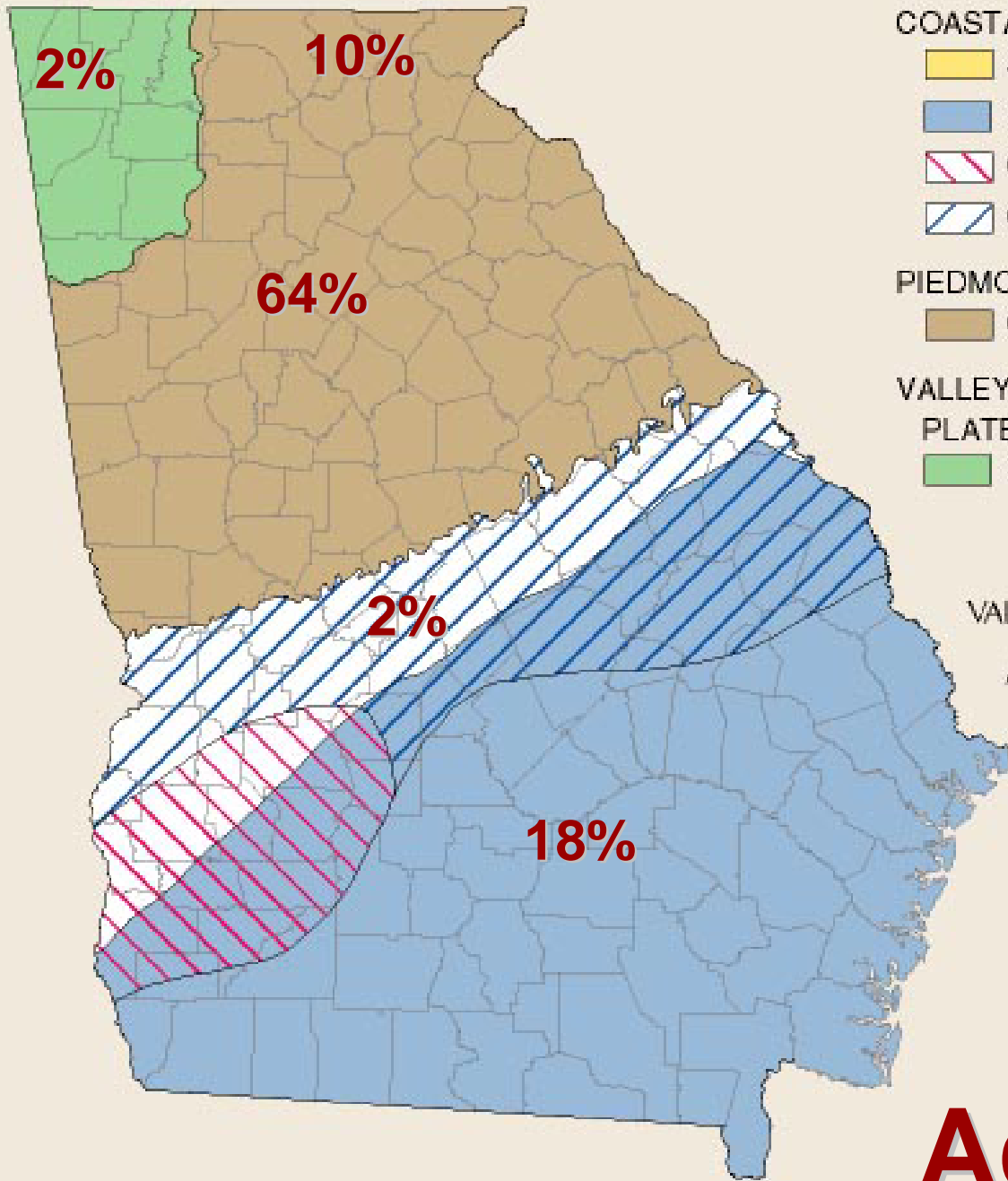
Parameter	Primary	Secondary
Chromium	0.1 ppm	
Copper	1.3 ppm	1.0 ppm
Lead	15 ppb	
Nitrate-N	10 ppm	
Iron		0.3 ppm
Manganese		0.05 ppm
Zinc		5.0 ppm
Sulfate		250 ppm







# Number of Well Water Samples

(July 1994 – June 2008)

- 31,593 for chemical testing  
Primary: Cd, Cr, Cu, Pb,  
Secondary: Al, Fe, Mn, Zn
- 4,669 for bacteria testing  
Total coliform  
*Escherichia coli*
- Others: NO<sub>3</sub><sup>-</sup>, Hg



**COASTAL PLAIN AQUIFERS**

-  Surficial aquifer system (not a principal aquifer)
-  Floridan aquifer system
-  Claiborne, Clayton, and Providence aquifers
-  Cretaceous aquifer systems

**PIEDMONT AND BLUE RIDGE AQUIFERS**

-  Crystalline-rock aquifers

**VALLEY AND RIDGE AND APPALACHIAN PLATEAU AQUIFERS**

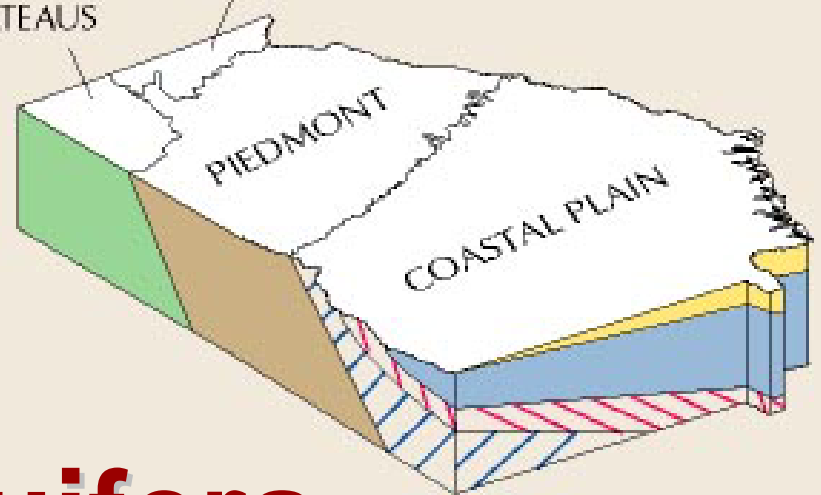
-  Paleozoic-rock aquifer

VALLEY AND RIDGE AND APPALACHIAN PLATEAUS

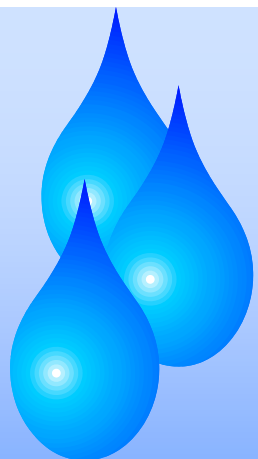
BLUE RIDGE

PIEDMONT

COASTAL PLAIN



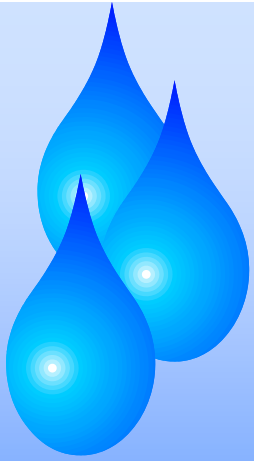
# Aquifers



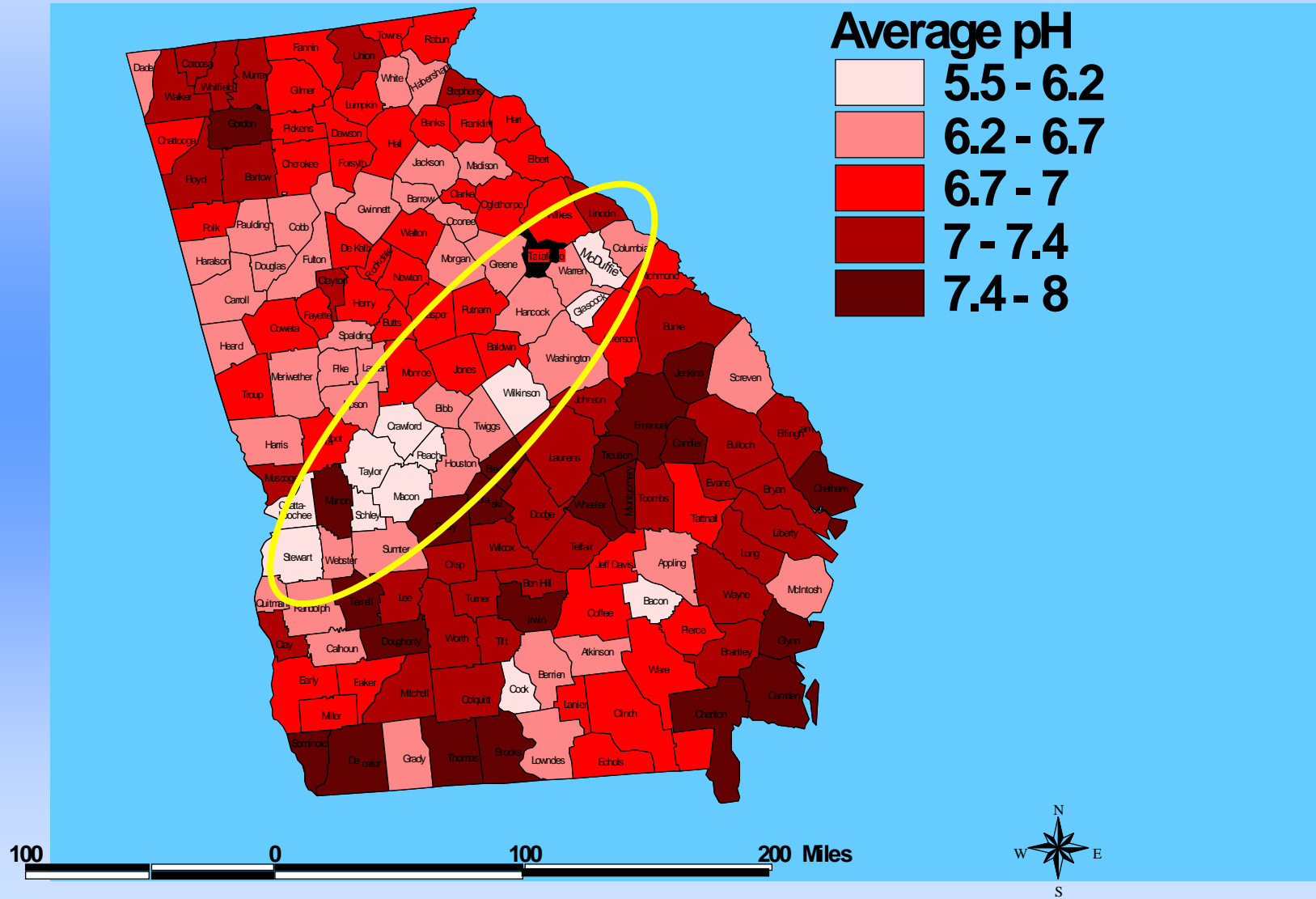
## pH of well water samples

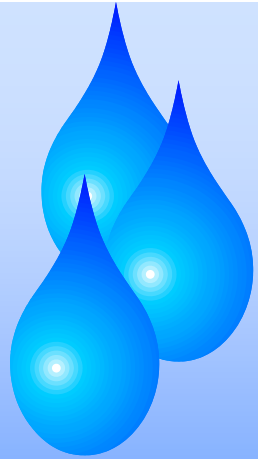
Province	Total Samples	Water pH (% of total wells tested within a province)		
		<6.5	6.5-8.5*	>8.5
Blue Ridge	3070	25	74	1
Limestone Valley	575	11	88	1
Southern Piedmont	20199	27	72	1
Atlantic Coast Flatwoods	1536	17	83	0
Southern Coastal Plain	5609	22	78	0
Sand Hills	604	46	53	1
<b>Georgia (Overall)</b>	<b>31593</b>	<b>26</b>	<b>74</b>	<b>1</b>

\* EPA recommended pH range



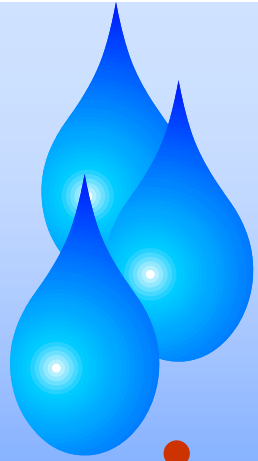
# pH





# Copper (Cu) and Lead (Pb)

- Cu: 5% > MCL  
Pb: 4% > MCL
- So. Piedmont
- Sandhills



# Causes



- Household plumbing fixtures
- Corrosive waters
  1. generally soft (hardness  $<50$  ppm)
  2. slightly acidic (pH  $<6.5$ )
  3. less buffered owing to low alkalinity ( $<50$  ppm  $\text{CaCO}_3$ )



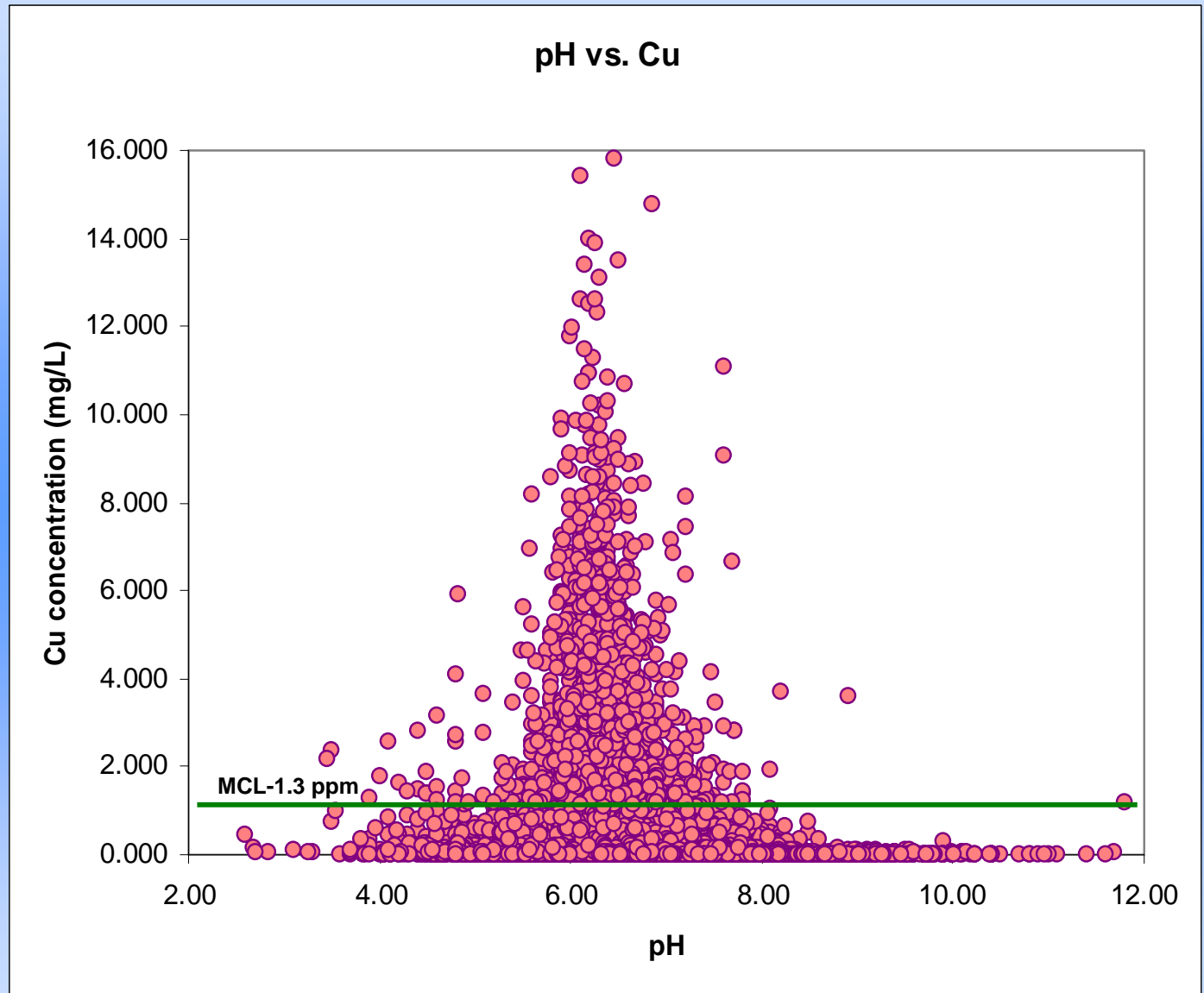
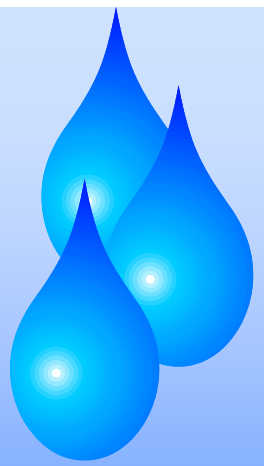
# Saturation Index: Corrosive, Scaling or Balanced?

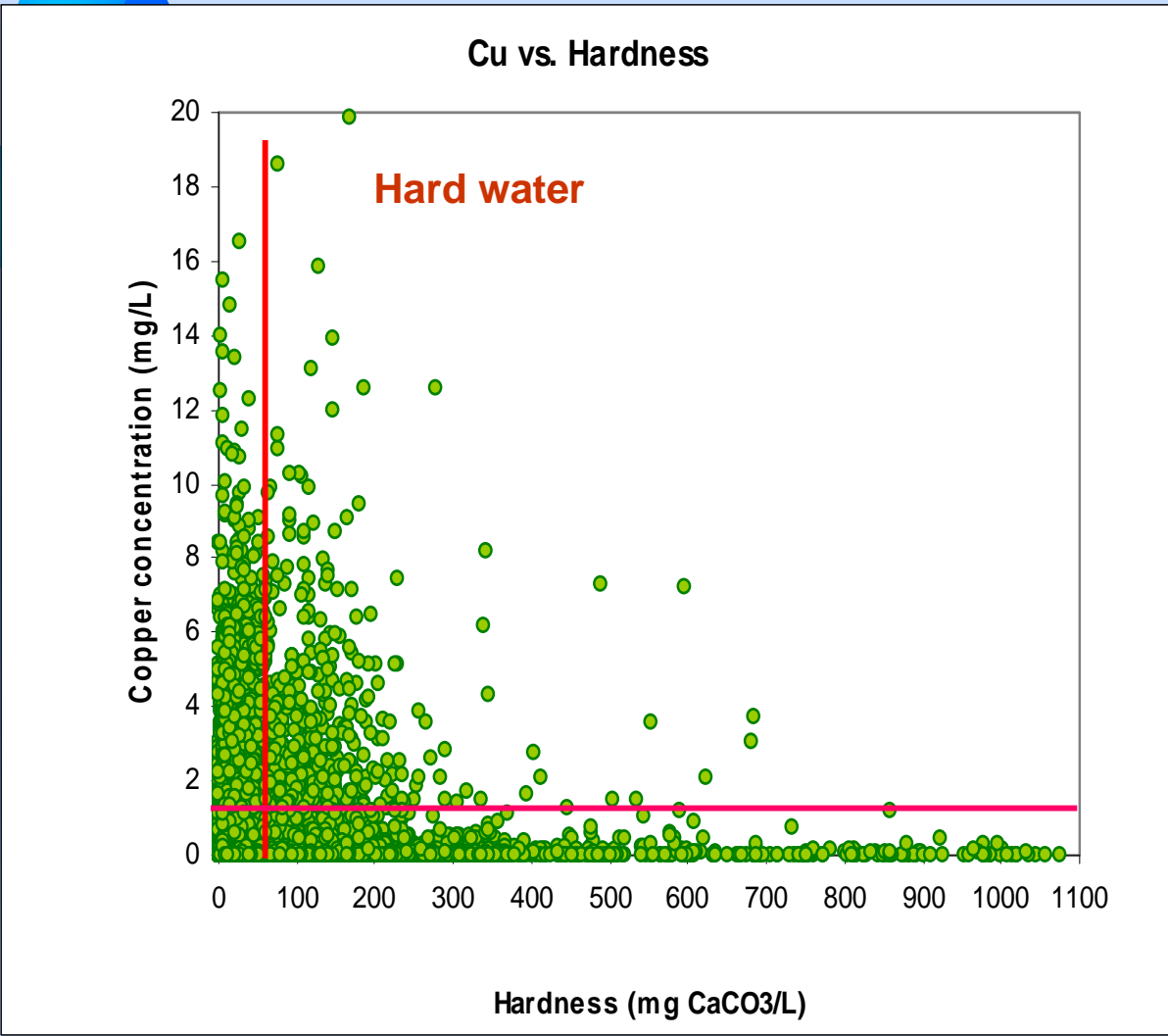
## Corrosive

- Reduces the lifetime of the pump and plumbing
- Leaks
- Toxic metals can be leached from plumbing
- Stains on fixtures
- Metallic taste

## Scaling

- Fills hot water heaters with solids
- Causes blockages in plumbing
- Reduces flow
- Spots on glassware, utensils, and dishes





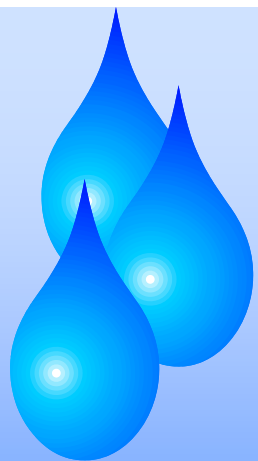
soft water ( $\leq 17.1$  ppm)

slightly hard water (17.1-59.85 ppm)

moderately hard water (59.85-119.7)

hard water (119.7-179.55)

very hard water ( $> 179.55$ )



# Treatment Options

## Removal through:

- Reverse osmosis
- Distillation
- Ion exchange

## Some other tips:

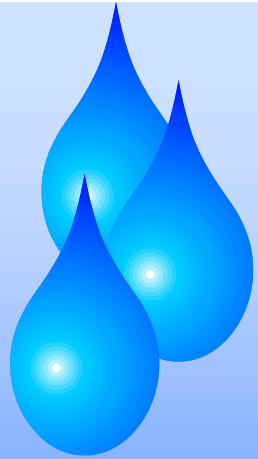
- Avoid drinking from hot water lines since lead and copper are more soluble at elevated temperatures.
- Allow the cold water tap to run for one minute before drinking is advisable. Water that has stood over night will have higher levels of lead and copper.

To minimize occurrence of lead in drinking water, the EPA Safe Water Drinking Act of 1988 allows only lead-free pipe and solder in drinking water systems.



## Mercury and nitrate in well waters tested.

Province	Mercury		Nitrate	
	Sample #	>MCL	Sample #	>MCL
Blue Ridge	14	0	345	0
Limestone Valley	1	0	117	0
So. Piedmont	56	2	3204	2
At. Coast Flat.	2	0	147	6
So. Coastal Plain	29	3	1882	4
Sand Hills	5	20	132	5
Georgia	107	3	5827	3

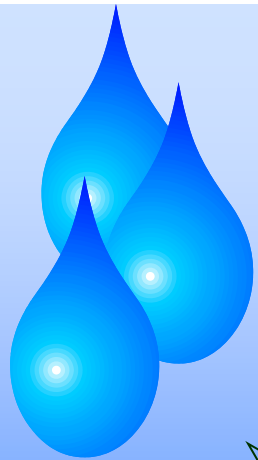


## Nitrate (10 ppm $\text{NO}_3\text{-N}$ ):

- Sewage leaks
- Livestock waste
- N fertilizers

## Mercury (2 ppb):

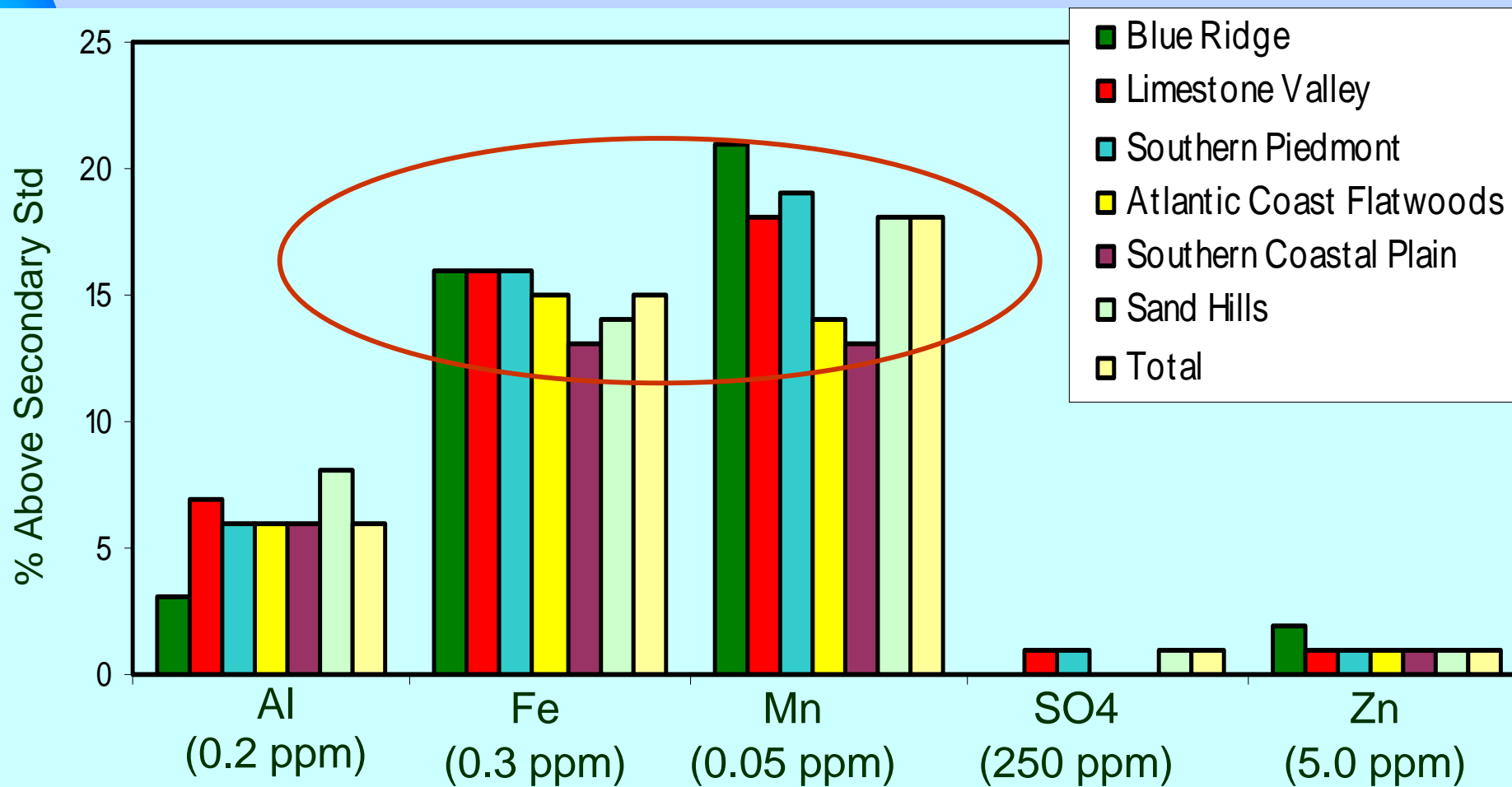
- Mining, spills, improper disposal of Hg containing electrical products
- Earth's crust through geological activity

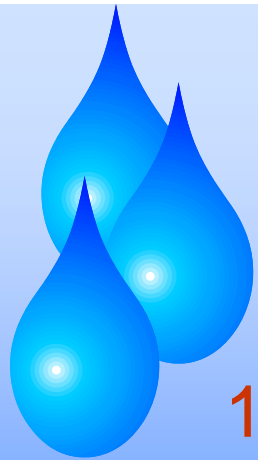


# Secondary Contaminants

- Elevated levels of iron (Fe) and manganese (Mn) are two of the most common water quality problems in Georgia's groundwater.
- These problems occur statewide and in both shallow and deep groundwater.

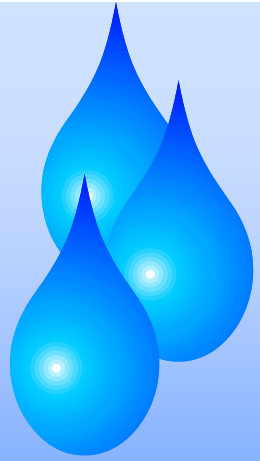
## Secondary contaminants > MCLs



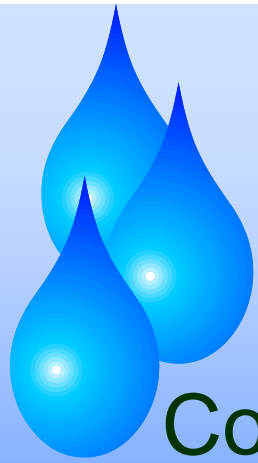


# Treatment Options

1. Oxidation - chlorine bleach, permanganate (green sand), or aeration using an air pump, removal formed sediments with filtration. Chlorination works because it both kills iron-bacteria and removes the iron.
2. Filtration
3. Water softener



# Bacteria testing



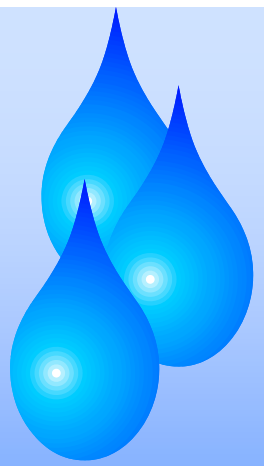
# Total coliform and *E. coli*

## Coliforms

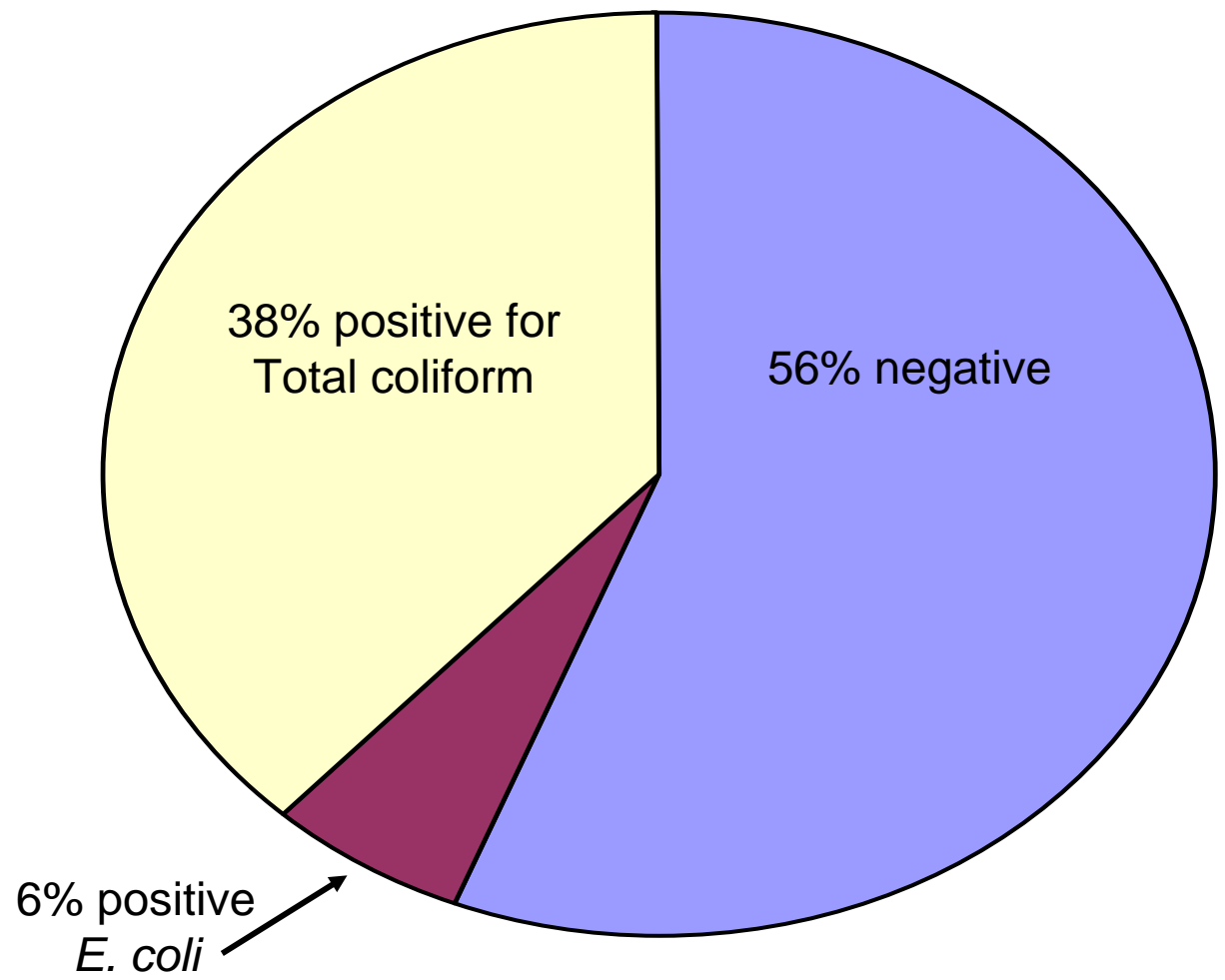
- naturally present in environment
- found in digestive system of humans and animals
- Not harmful but indicates presence of other disease-causing organisms

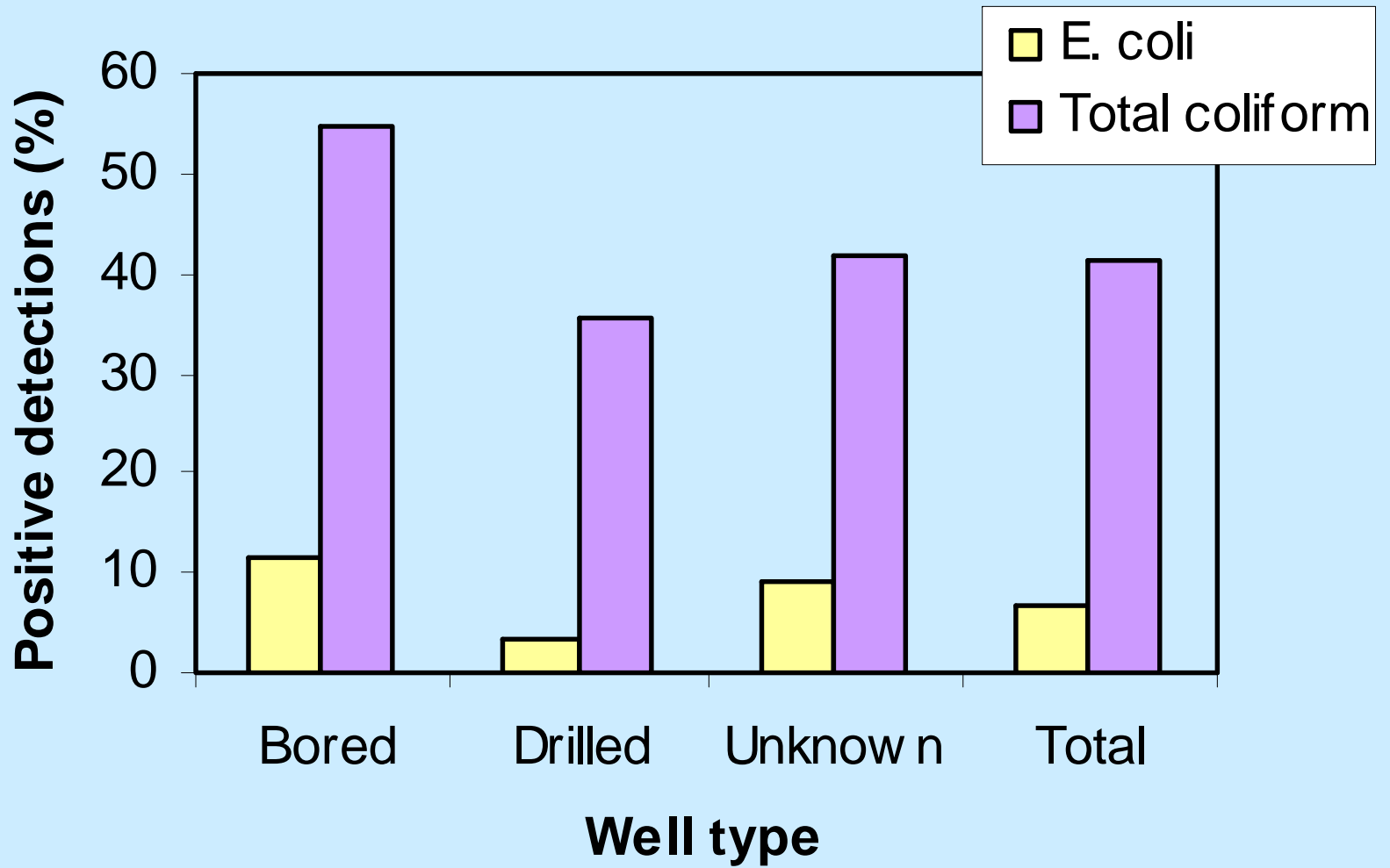
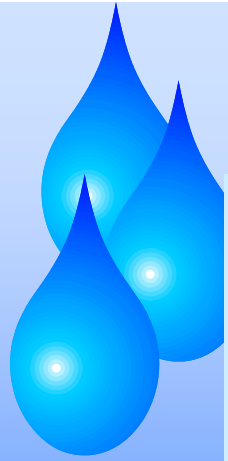
## *E. Coli*

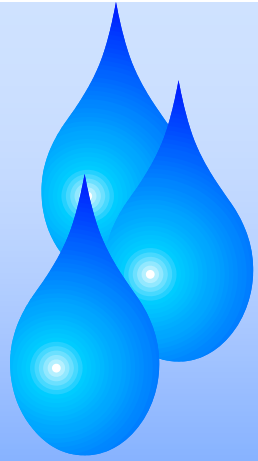
- Come from human and animal fecal waste
- pathogenic



### Percent of Wells Tested Positive/Negative for Bacteria







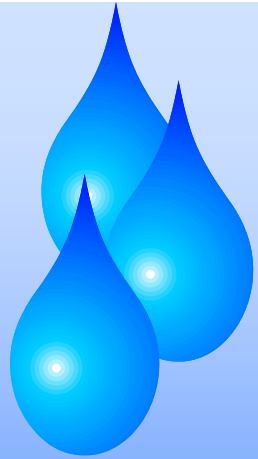
# Types of wells



**Bored**



**Drilled**



- Recommend yearly testing for nitrate in shallow wells (<100 ft.).
  
- Continuing public education –
  1. Household water quality circulars
  2. UGA WELLCAM videos of common construction problems
  3. Risk assessment (GA Farm\*A\*Syst)
  4. Access to analytical lab services
  5. Support from UGA Water Specialists



# Using the Saturation Index

<b>Index</b>	<b>Interpretation</b>
<b>-5.00</b>	<b>Severe Corrosion</b> -corrosion control is recommended
<b>-2.00</b>	<b>Moderate Corrosion</b> -corrosion control should be considered
<b>0.00</b>	<b>Balanced</b> -no treatment is recommended
<b>2.00</b>	<b>Moderate Scale</b> -softening will decrease hardness and reduce scaling
<b>5.00</b>	<b>Severe Scale</b> -scale build-up in hot water heaters will be excessive

