The Office of Science is pleased to present the following seminar

Private Wells and Groundwater Quality

May 31, 2012

9:00 - 9:30 - Using the Private Well Testing Act Results to evaluate Groundwater Quality- Judy Louis, Ph.D., Office of Science

9:30 – 10:00 - Coliform Bacteria Detections in Private Wells in New Jersey: Influence of Sample Number, Hydrogeology, Season, Laboratory and Method - Thomas Atherholt, Ph.D., Office of Science

10:00 – 10:30 – Break (Demonstation of web project)

10:30 – 11:00 - Radionuclides in Rock Aquifers of the Highlands and Piedmont Provinces, New Jersey: Geological Sources and Distribution in Groundwater – Zoltan Szabo, USGS

11:00 – 11:30 - Multiple-Contaminant Private Well Water Treatment-Arsenic, Radionuclides, and More – Steve Spayd, Ph.D., NJGS

11:30 – 12:00 - Occurrence of Pharmaceuticals, Personal Care Products and Other Organic Wastewater Compounds In Shallow Groundwater– Ray Bousenberry, NJGS

Using the Private Well Testing Act Results to Evaluate Groundwater Quality in NJ

By

Judy Louis, Ph.D.

Office of Science

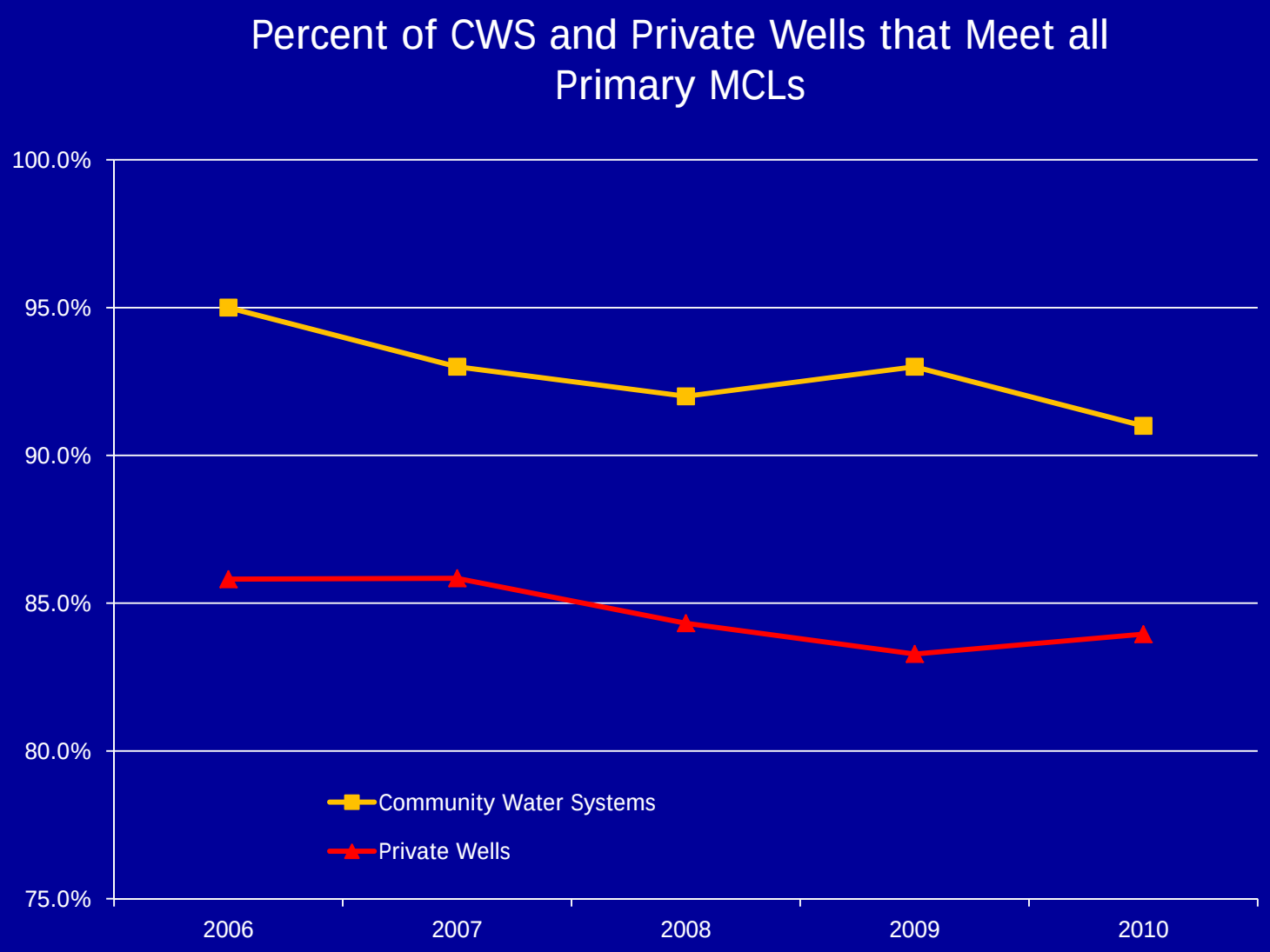
Private Wells in NJ

- Why do we care about private wells?
- What have we learned from the PWTA about overall groundwater quality in NJ?
- Are there regions in the state with specific groundwater problems?

Why do we care about private wells ?

Private Wells in New Jersey

- Estimated that there are 400,000 private wells in New Jersey.
- Estimated that 13% of the population (1,130,000 people) have private wells for their drinking water supply.


Percent of CWS and Private Wells that Meet all Primary MCLs
100.0%
95.0%
90.0%
85.0%
80.0%
75.0%
2006
2007
2008
2009
2010
Community Water Systems
Private Wells

The Private Well Testing Act was designed to inform a buyer about the quality of their raw well water.

What does PWTA Measure?

PRIMARY STANDARDS

Total Coliform (if positive, fecal or E. coli)

26 Volatile Organic Chemicals with MCLs

Inorganics

- Arsenic (12 northern counties)
- Mercury (9 southern counties)
- Nitrates

Radiological

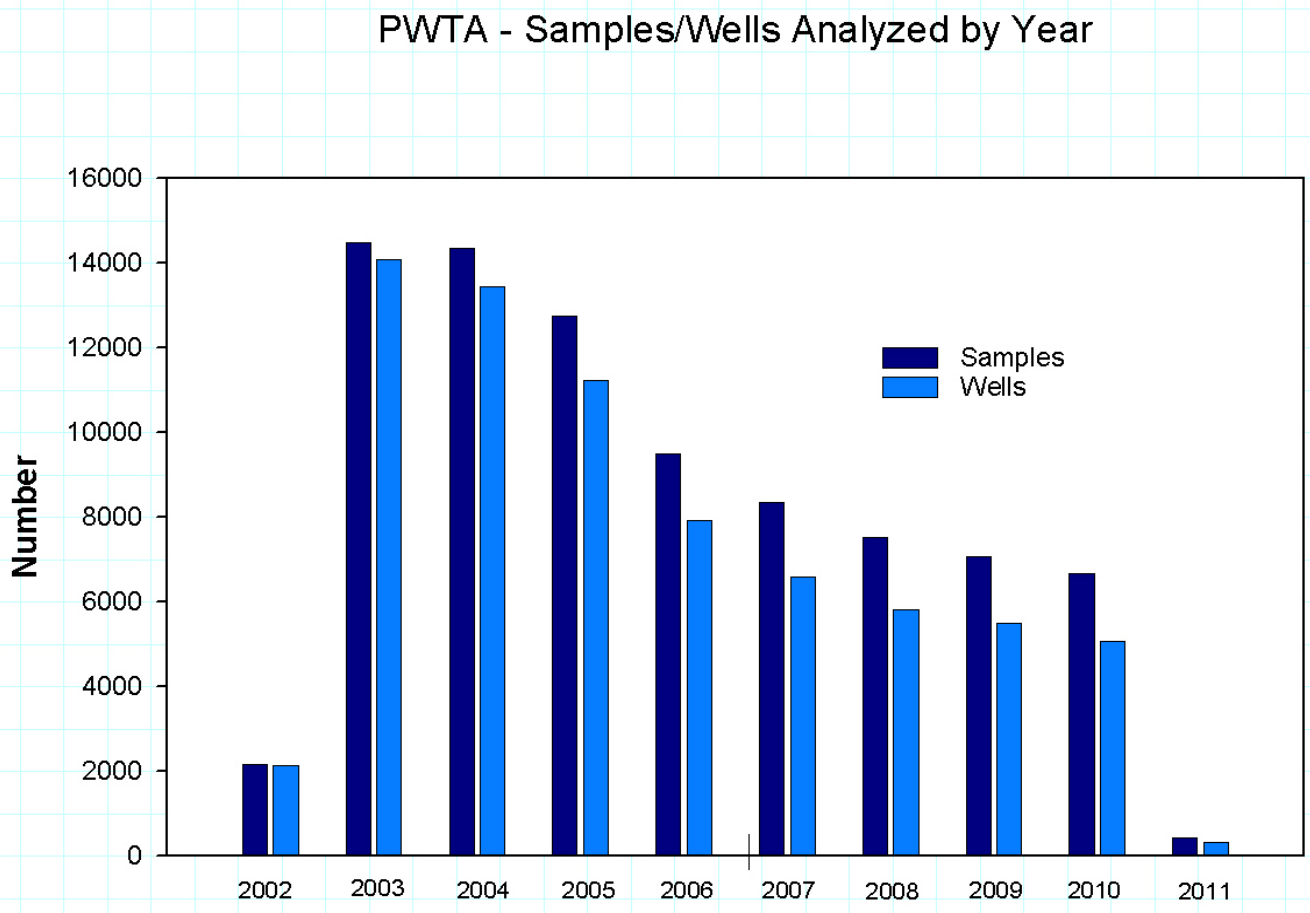
- Gross Alpha (12 southern and central counties)

SECONDARD STANDARDS

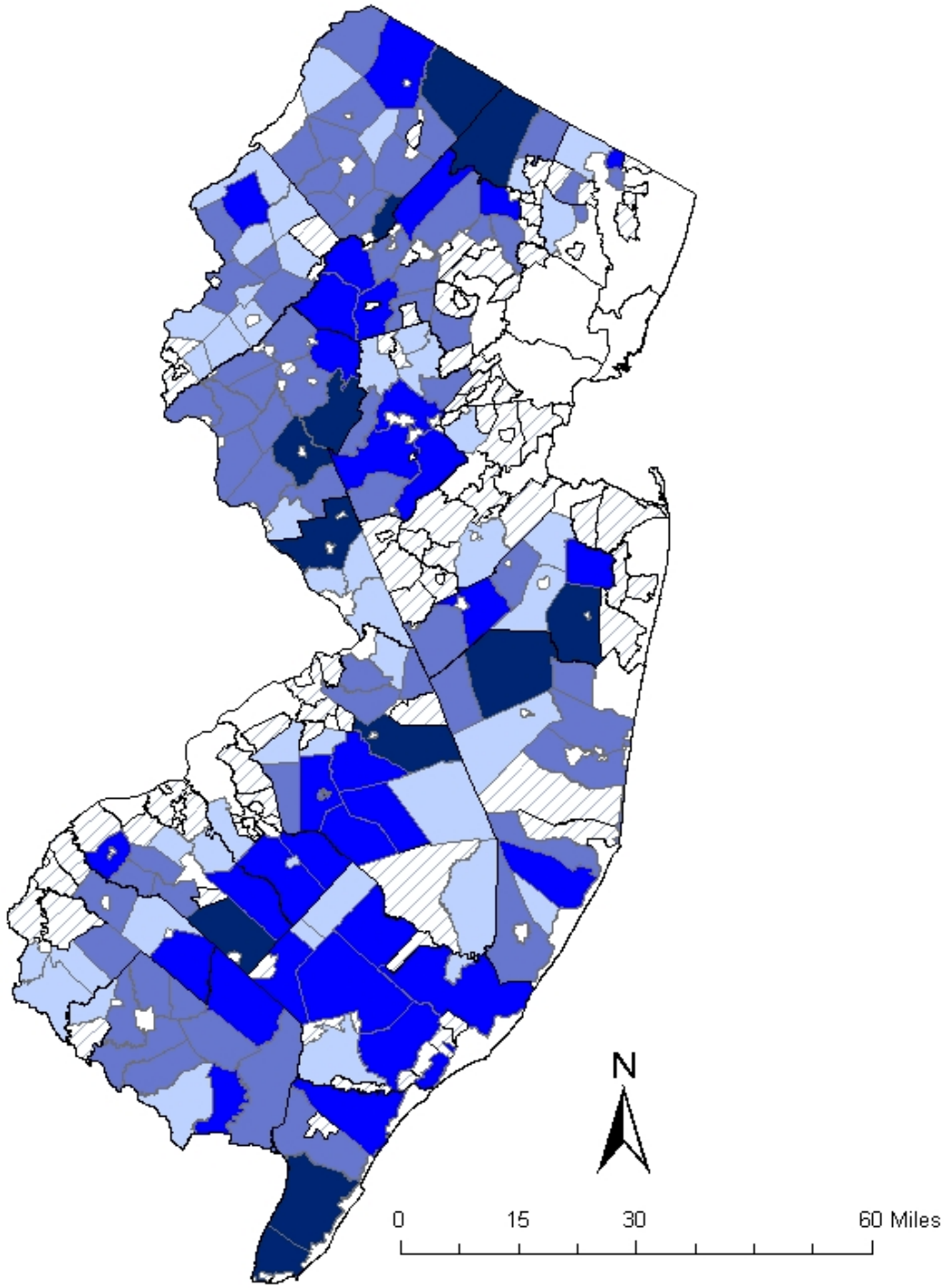
- Iron, Manganese & pH

Number of Samples/Wells Tested

- From September 2002 through January 2011
  - 83,071 Samples
  - 71,484 Wells


PWTA - Samples/Wells Analyzed by Year
Number
16000
14000
12000
10000
8000
6000
4000
2000
0
Samples
Wells
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

Number of Private Wells Tested in NJ Municipalities



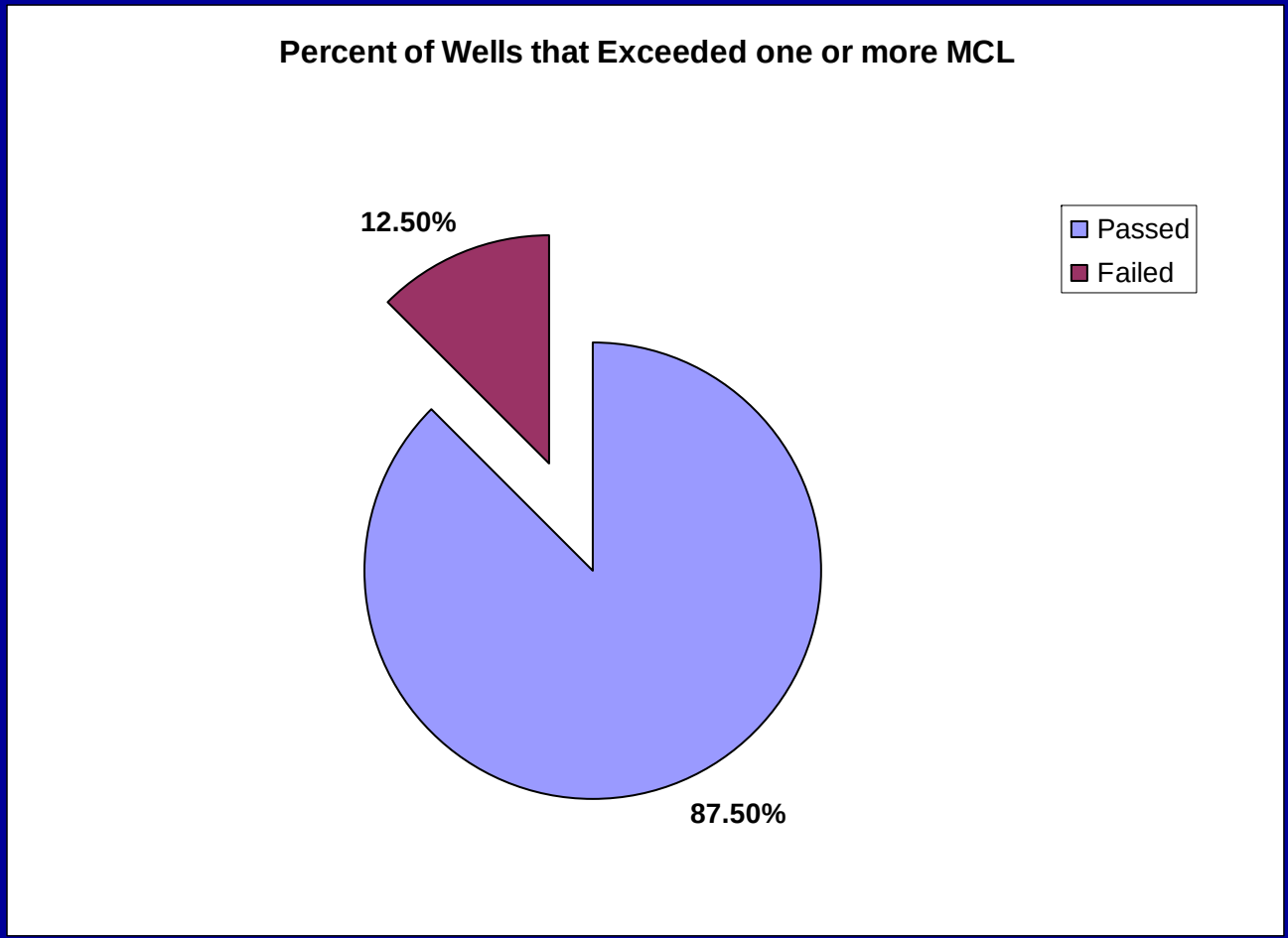
PWTA - 9/2002 to 1/2011

Wells Tested

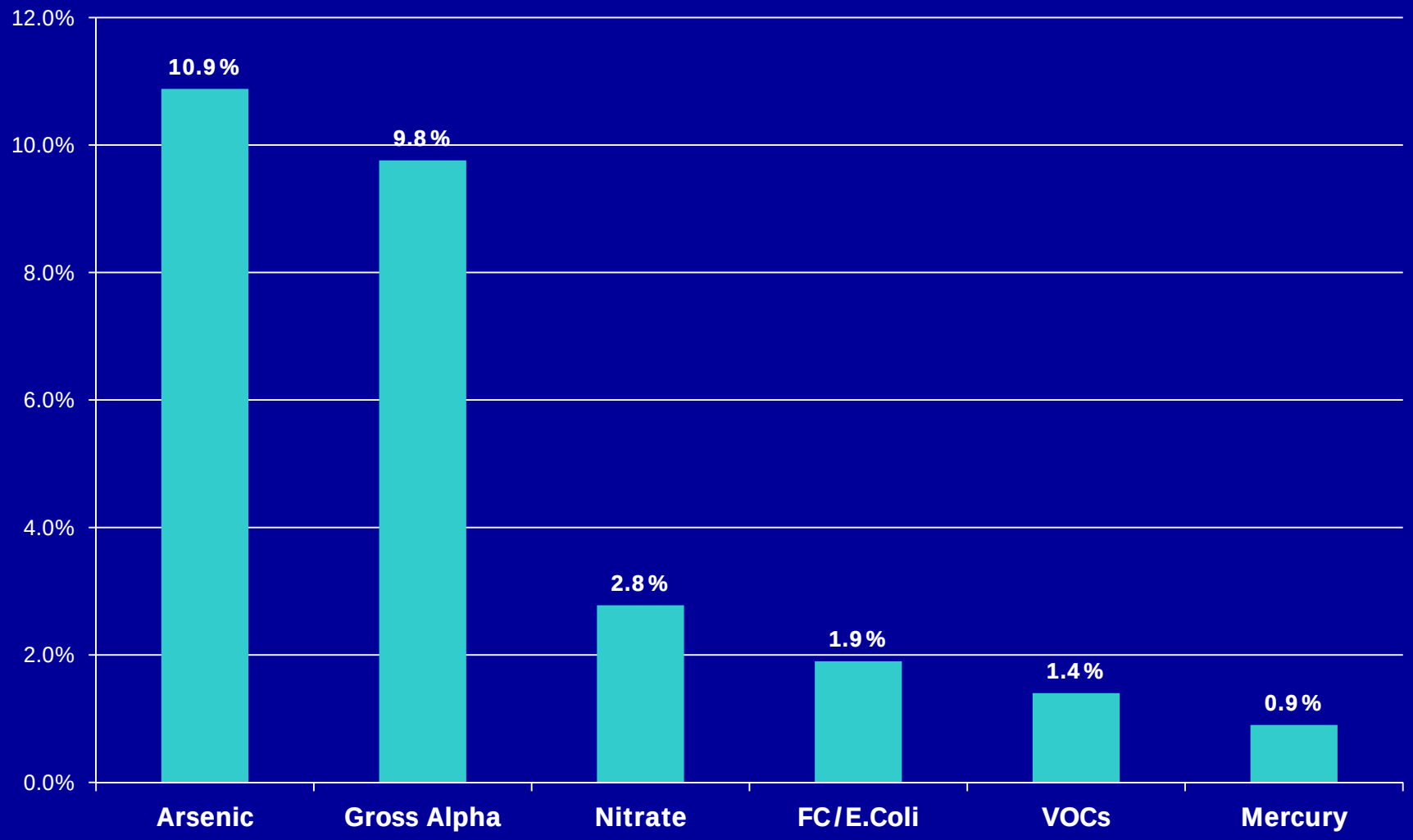
- 10 to 100
- 101 to 250
- 251 to 500
- 501 to 1000
- 1001 to 1956

0 to 9 wells

What have we learned from the PWTA about overall ground-water quality in NJ?


Percent of Wells that Exceeded one or more MCL
12.50%
87.50%
Passed
Failed

Percent of Wells that exceed MCLs in NJ

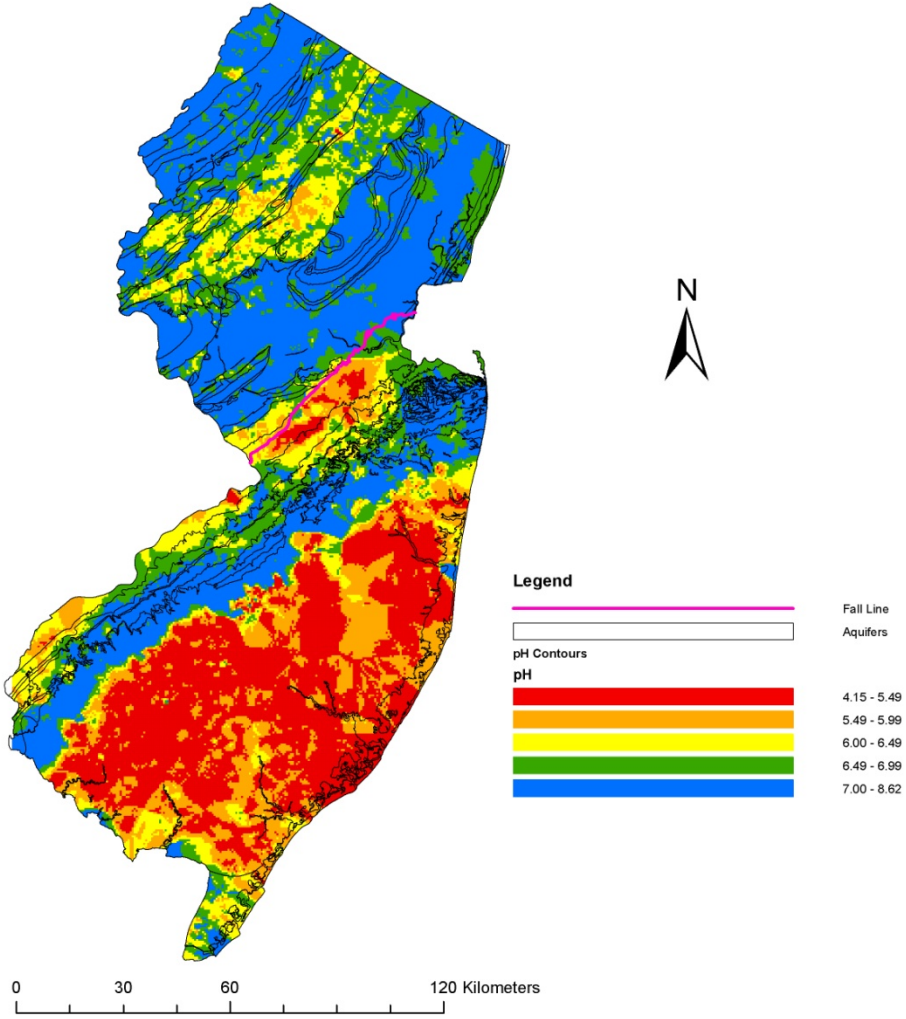


VOC table
Number Exceeding MCL

VOC	NJ MCL (ug/l)	Exceed MCL
Trichloroethylene	1	316 (0.50%)
Tetrachloroethylene	1	228 (0.36%)
Carbon Tetrachloride	2	83 (0.13%)
Benzene	1	79 (0.13%)
Methylene Chloride	3	58 (0.09%)
MTBE	70	42 (0.07%)

Are there regions in the state with specific groundwater problems?

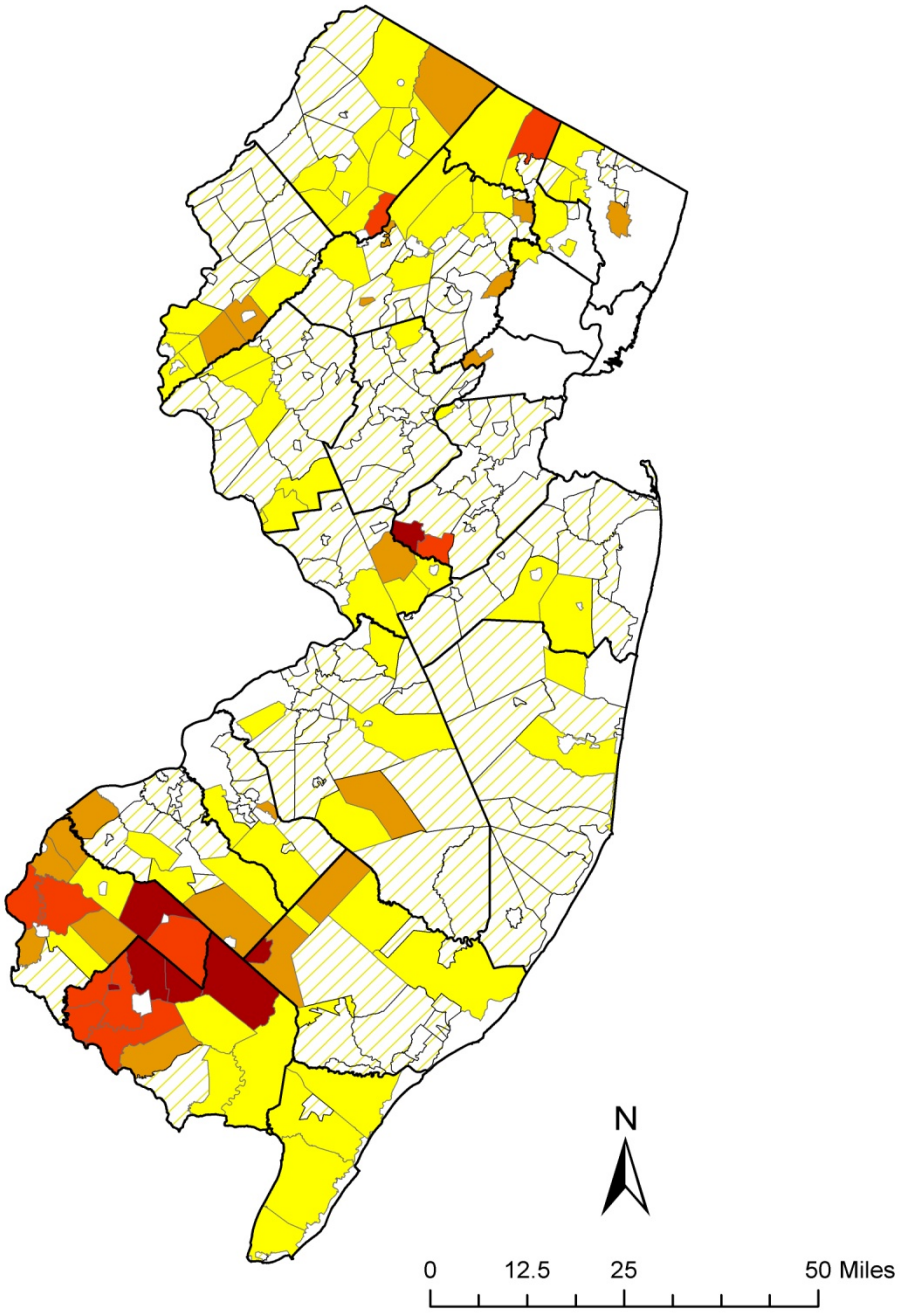
NJ Ground Water pH Contours



Nitrate

- USGS National Studies – High nitrate concentrations in groundwater result from high inputs of nitrogen and well drained soils.
- Overall 2.78% of Wells tested exceed the MCL of 10 mg/l

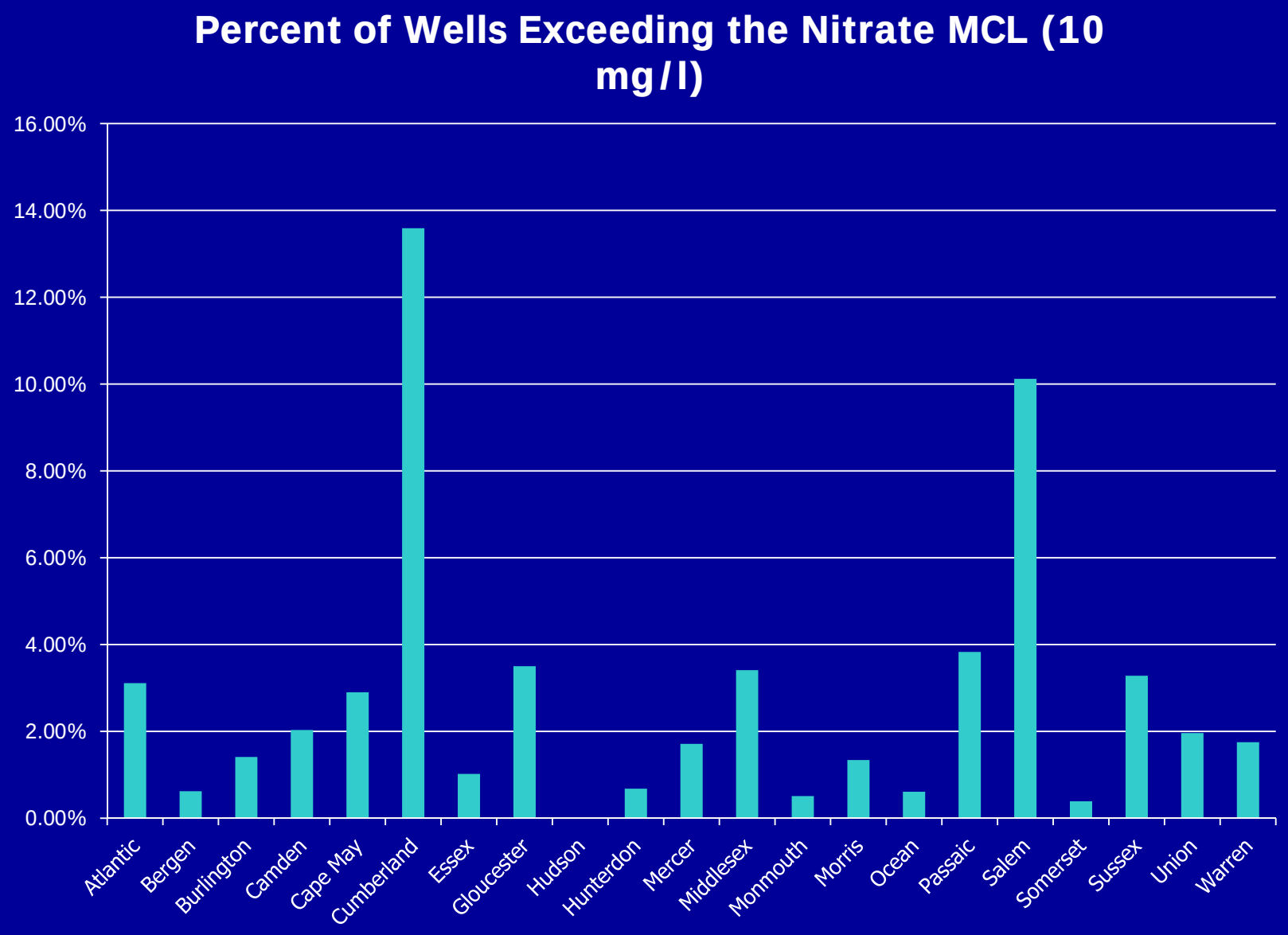
PWTA Results by Municipality
Nitrate Exceedances

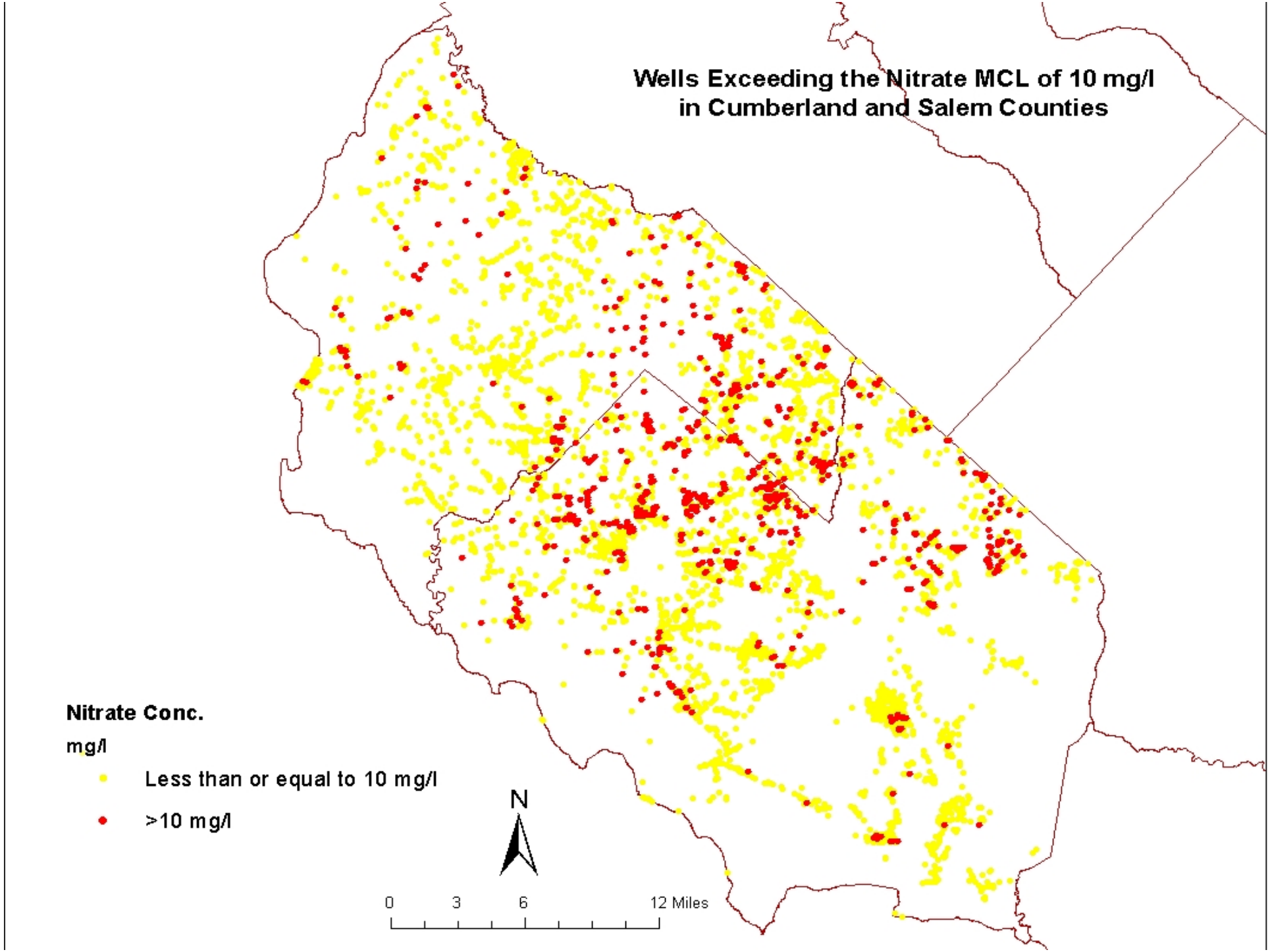


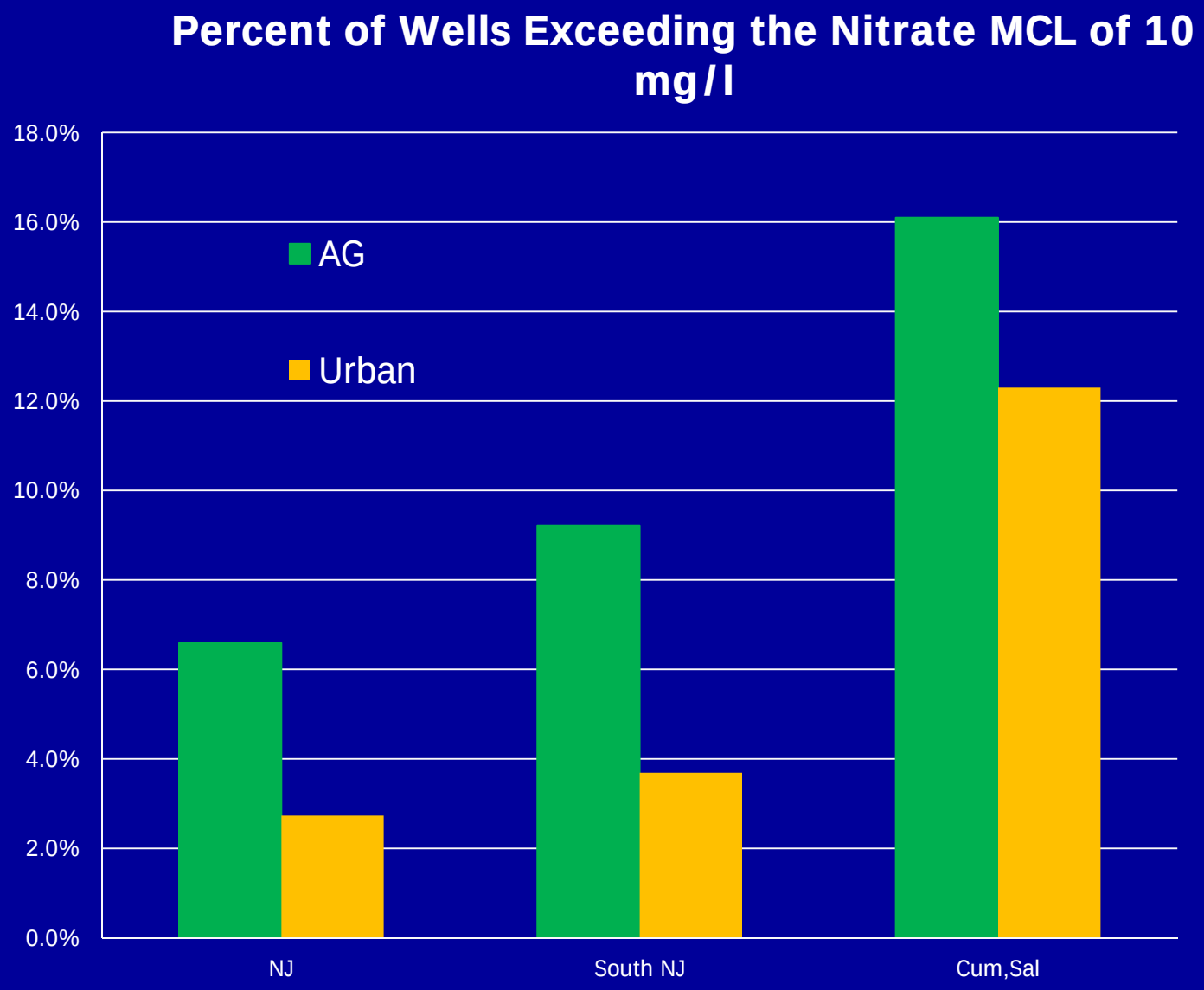
Percent of Wells Exceeding the Nitrate Standard

MCL = 10 mg/l

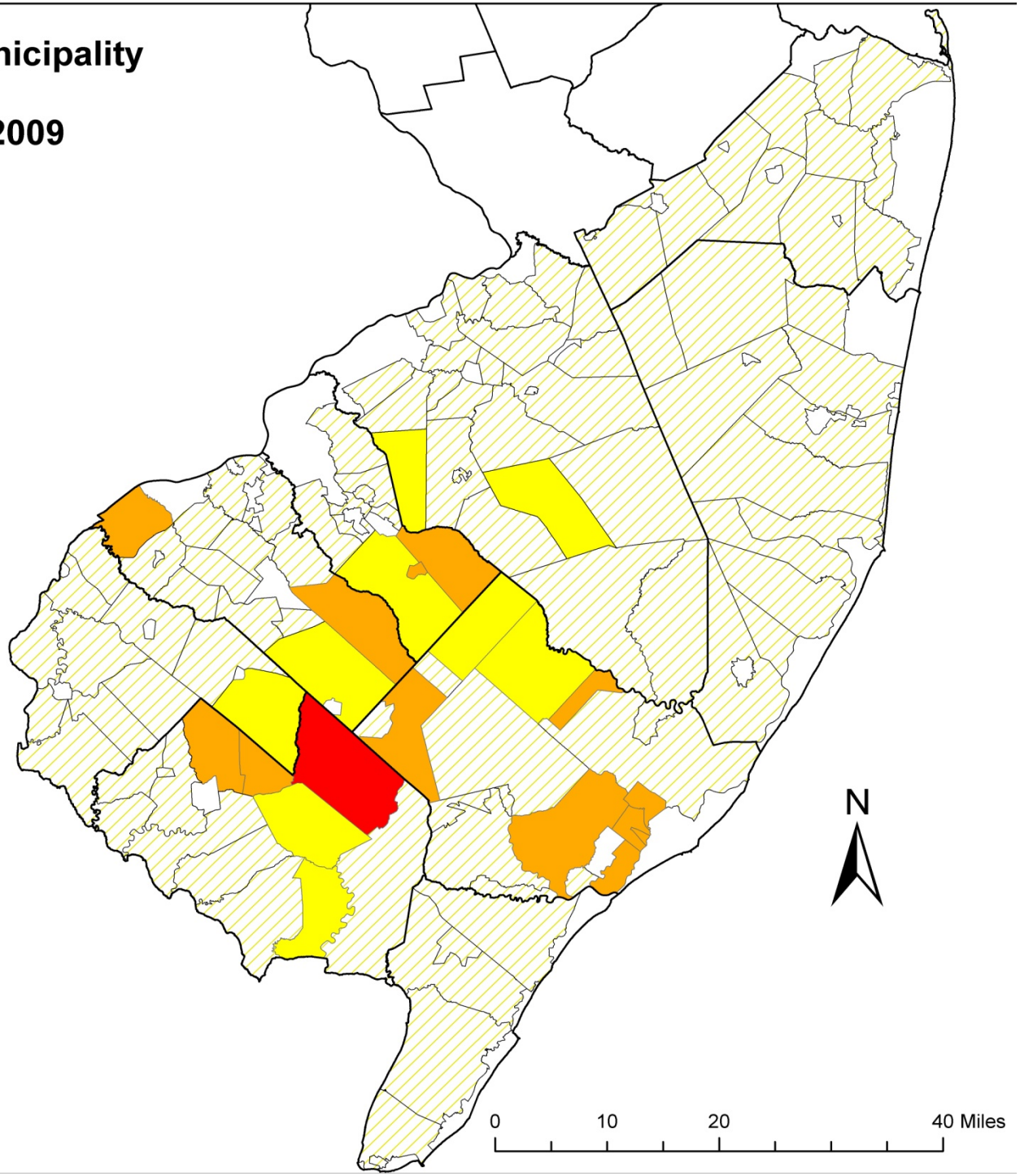
- 0 to 9 Wells Tested
- Less than or equal to 1%
- >1% to 5%
- >5% to 10%
- >10% to 20%
- >20%


Percent of Wells Exceeding the Nitrate MCL (10 mg/l)
16.00%
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
Atlantic
Bergen
Burlington
Camden
Cape May
Cumberland
Essex
Gloucester
Hudson
Hunterdon
Mercer
Middlesex
Monmouth
Morris
Ocean
Passaic
Salem
Somerset
Sussex
Union
Warren


Wells Exceeding the Nitrate MCL of 10 mg/l
in Cumberland and Salem Counties
Nitrate Conc.
mg/l
Less than or equal to 10 mg/l
>10 mg/l
N
0
3
6
12 Miles


Percent of Wells Exceeding the Nitrate MCL of 10 mg/l
18.0%
16.0%
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
AG
Urban
NJ
South NJ
Cum,Sal

PWTA Mercury Results by Municipality
31,412 Wells Tested
September 2002 to April 2009



Percent Exceeding the Mercury MCL

MCL = 2 ug/l

- 0 to 9 Wells Tested
- less than or equal to 1%
- >1 to 2.5%
- >2.5 to 5%
- >5%

Physiographic Provinces of New Jersey

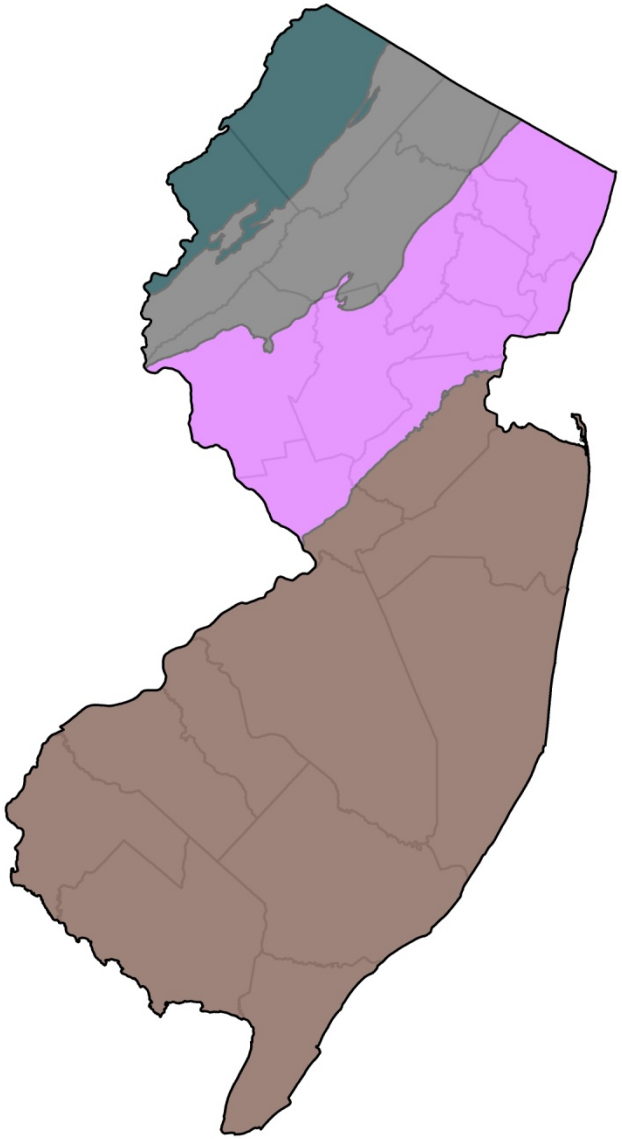
Provinces

Valley and Ridge
meta-sediments and limestones
fracture and cavernous flow

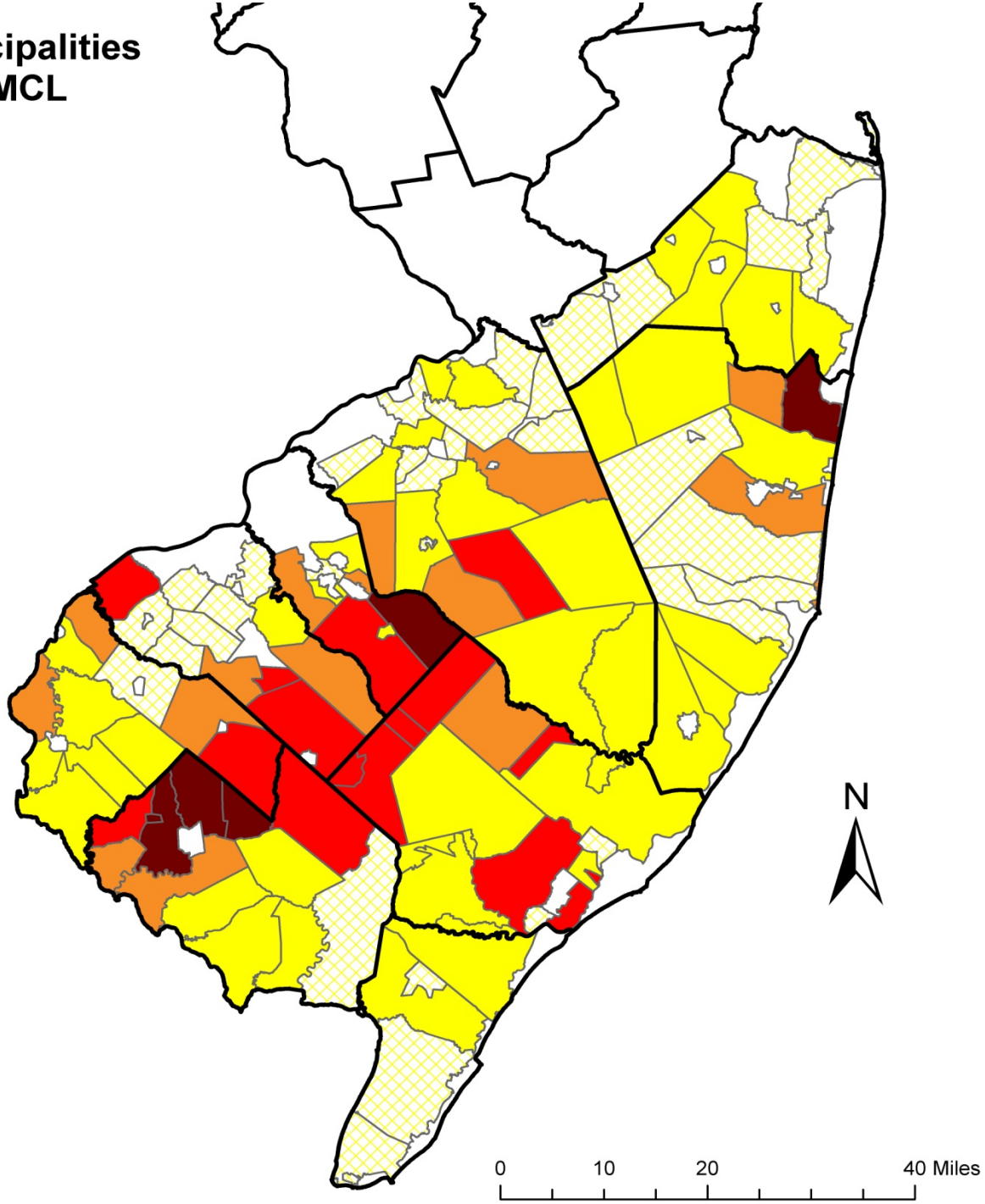
Highlands
granites and schists
limited fracture flow

Piedmont (Newark Basin)
marine shales and sandstone
fracture and bedding plane flow

Coastal Plain
unconsolidated sands, gravels and clay
porous flow



Percent of Private Wells in Municipalities Exceeding the Gross Alpha MCL
MCL = 15 pCi/L

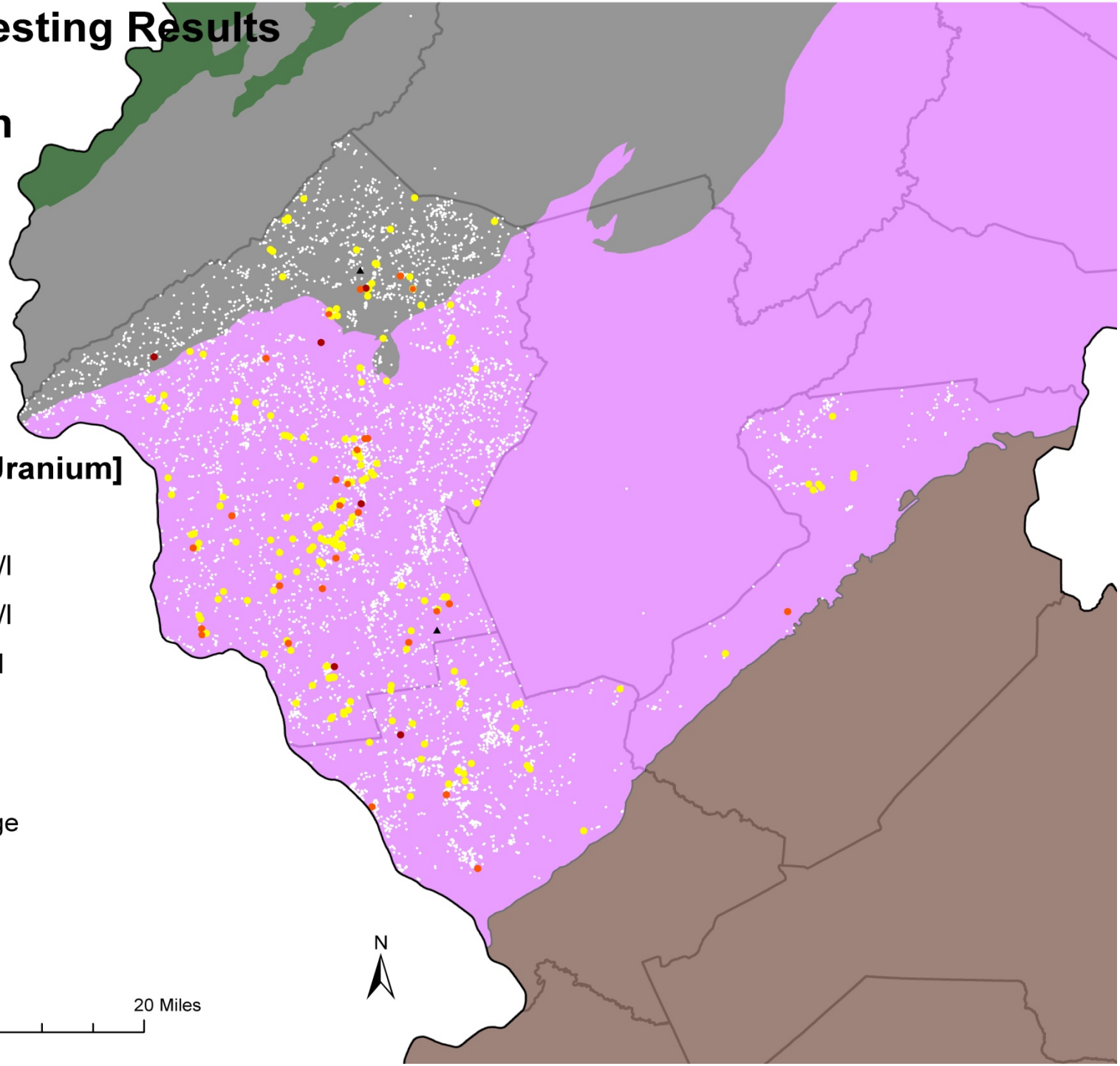


PWTA Results 9/2002 to 4/2009

% Exceeding the MCL

- 0 - 9 wells Tested
- Less than or equal to 1%
- 1-10%
- >10-20%
- >20-40%
- >40%

Private Well Testing Results
6,248 Wells
Gross Alpha in Piedmont and Highlands



Gross Alpha

MCL = 15 pCi/l - [Uranium]

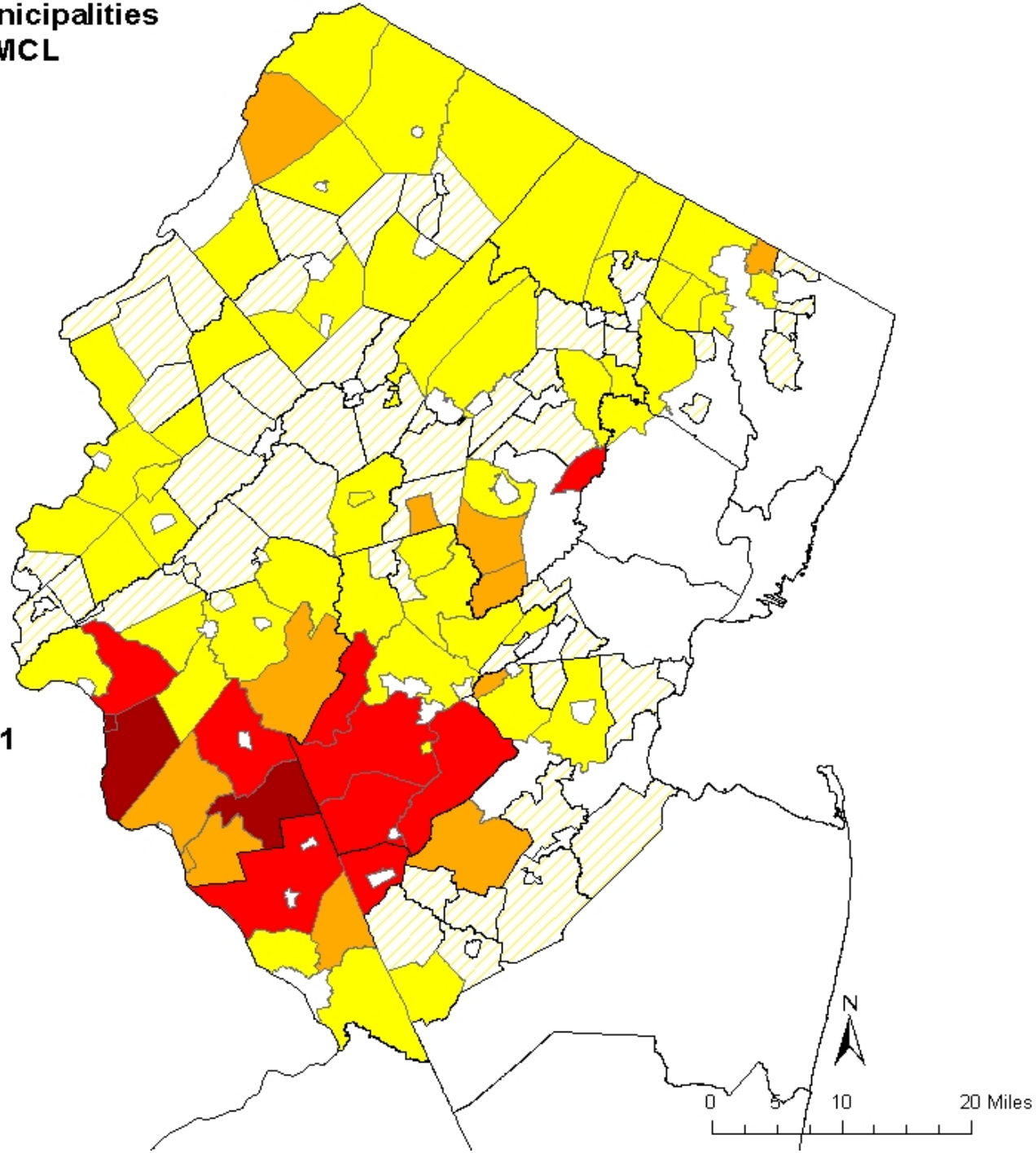
- < 15 pCi/l
- > 15 - 35.1 pCi/l
- > 35.1 - 70 pCi/l
- > 70 - 140 pCi/l
- > 140 pCi/l

Provinces

- Valley and Ridge
- Highlands
- Piedmont
- Coastal Plain

0 5 10 20 Miles

Percent of Private Wells in Municipalities Exceeding the Arsenic MCL
MCL = 5 ug/l



PWTA Results 9/2002 to 1/2011

% Exceeding MCL

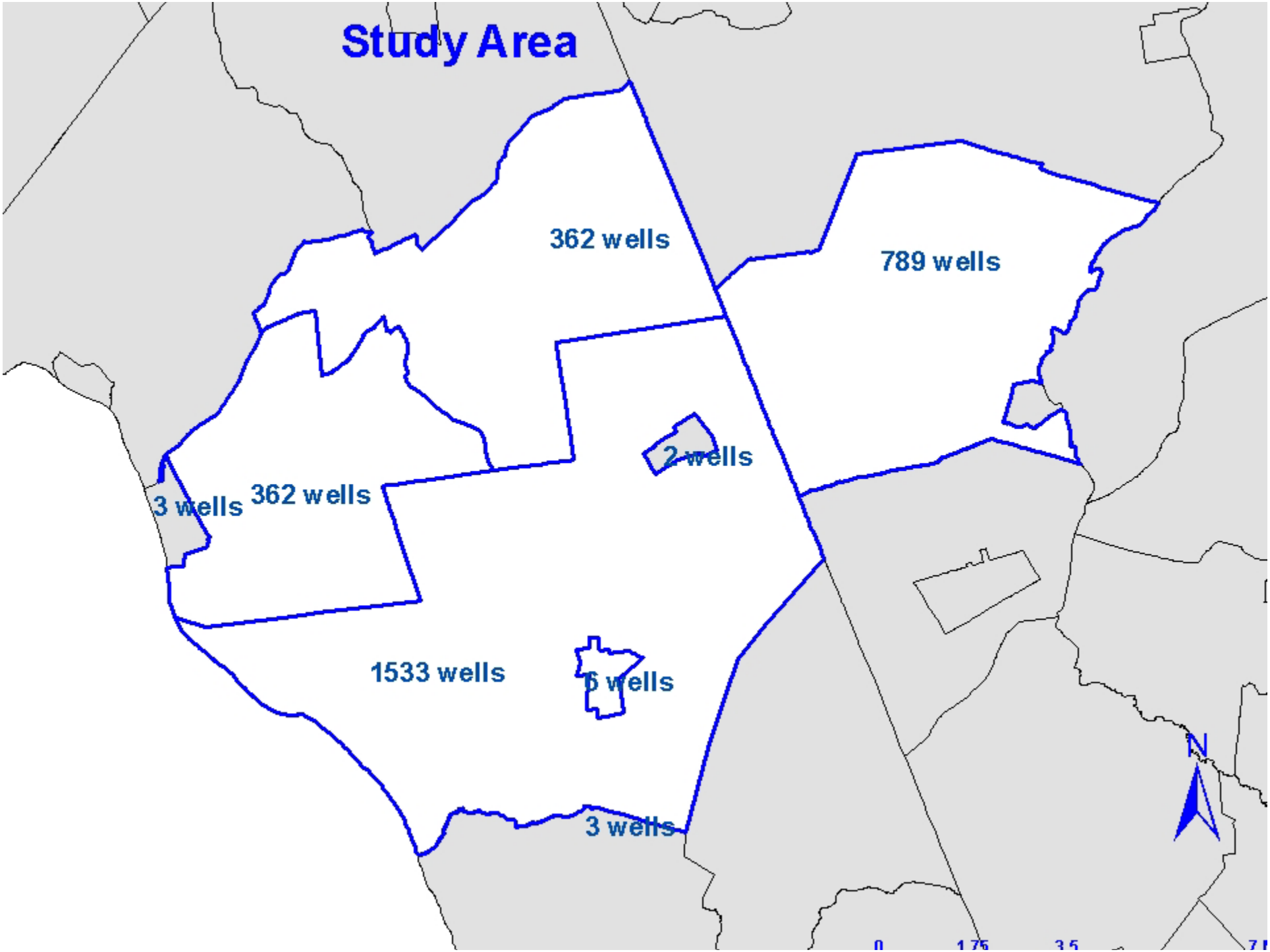
- less than or equal to 1%
- >1 to 10%
- >10 to 20%
- >20 to 40%
- >40%

0 to 9 wells tested

Arsenic Exceedances

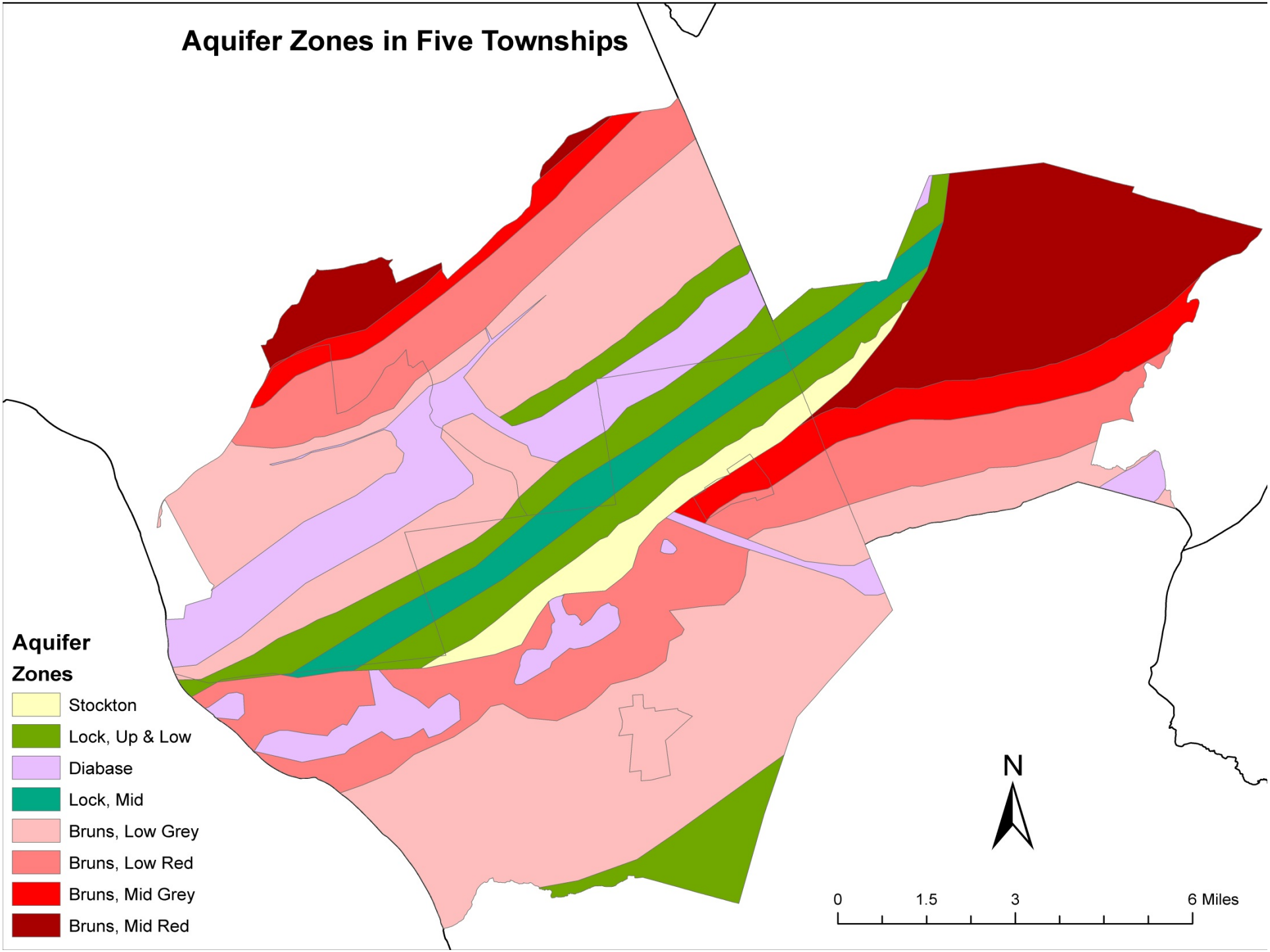
Overall 11.2% exceed the NJ MCL, 3.6% exceed the Federal MCL

Province	Exceedance of NJ Standard (5 ug/l)	Exceedance of Federal Standard (10 ug/l)
Valley and Ridge	1.4%	0.5%
Highlands	1.2%	0.5%
Piedmont	16.8%	5.6%
Coastal Plain	1.0%	0.7%

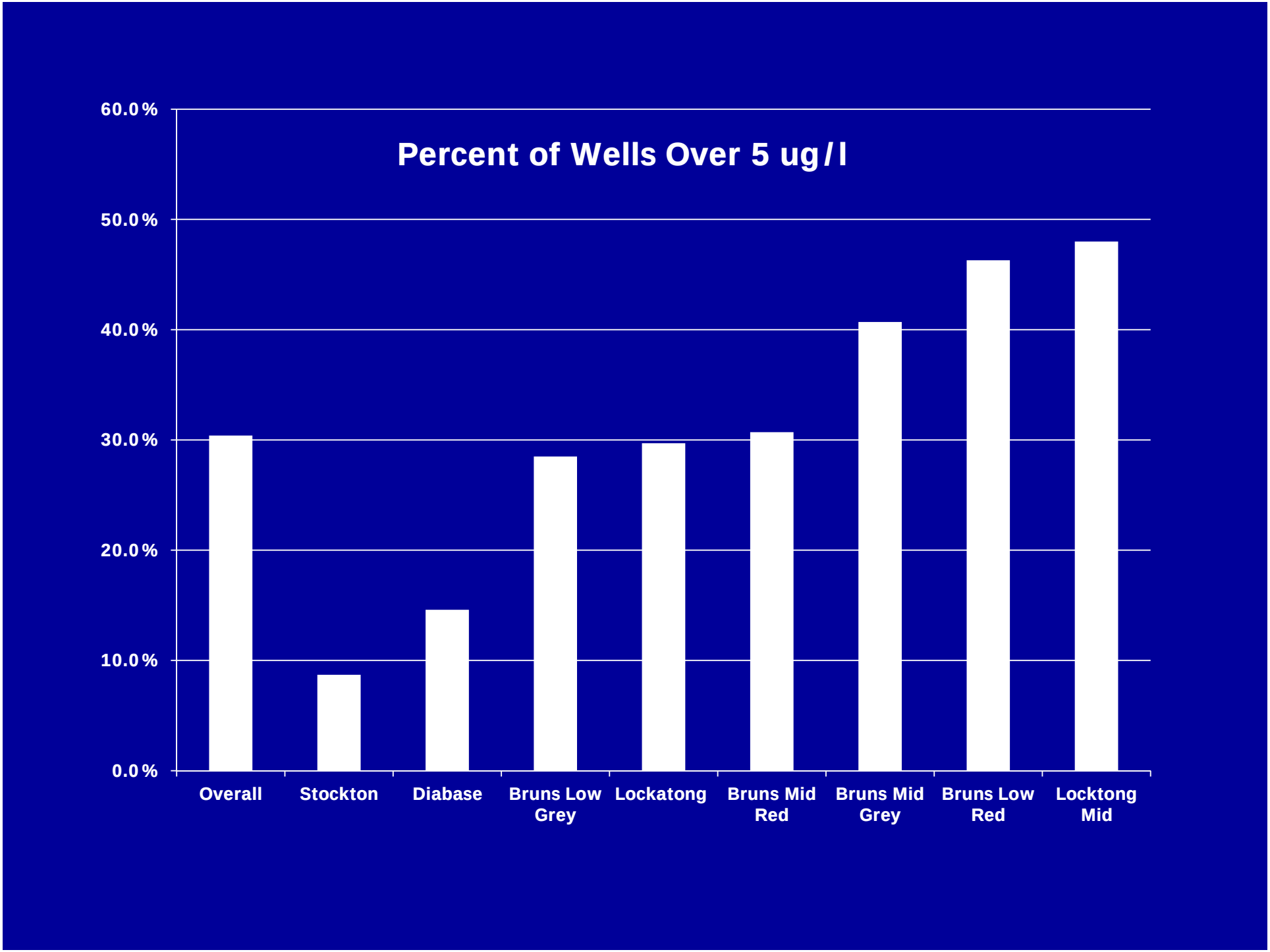

Study Area
362 wells
789 wells
2 wells
3 wells
362 wells
1533 wells
6 wells
3 wells
N
0
1.75
3.5

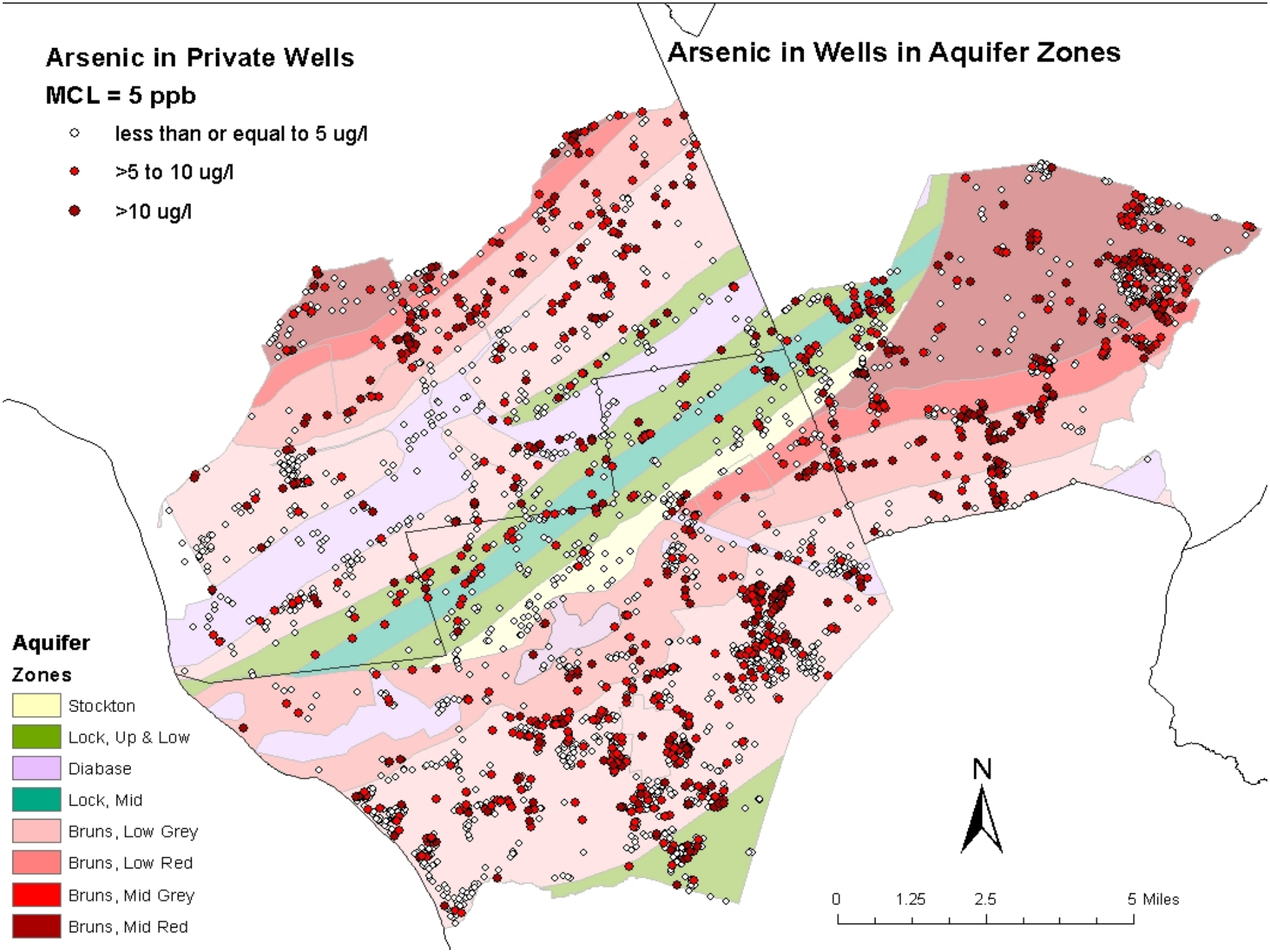
Aquifer Zones for Five Municipalities

Aquifer	Zone	Lithology
Brunswick	Brunswick, Middle Red	Mostly red mudstone
	Brunswick, Middle Grey	Mostly grey mudstone and grey and black shale
	Brunswick, Lower Red	Mostly red mudstone
	Brunswick Lower Grey	Mostly grey mudstone and grey and black shale
Lockatong	Lockatong, Middle	Mostly black and gray mudstone and siltstone with minor red mudstone
	Lockatong, Upper and Lower	Gray and black mudstone and siltstone, and sandstone with lesser red mudstone and siltstone
Stockton	Stockton	Light gray to reddish sandstone with some mudstone and siltstone
Diabase		Igneous rock


Aquifer Zones in Five Townships
Aquifer Zones
Stockton
Lock, Up & Low
Diabase
Lock, Mid
Bruns, Low Grey
Bruns, Low Red
Bruns, Mid Grey
Bruns, Mid Red
N
0
1.5
3
6 Miles

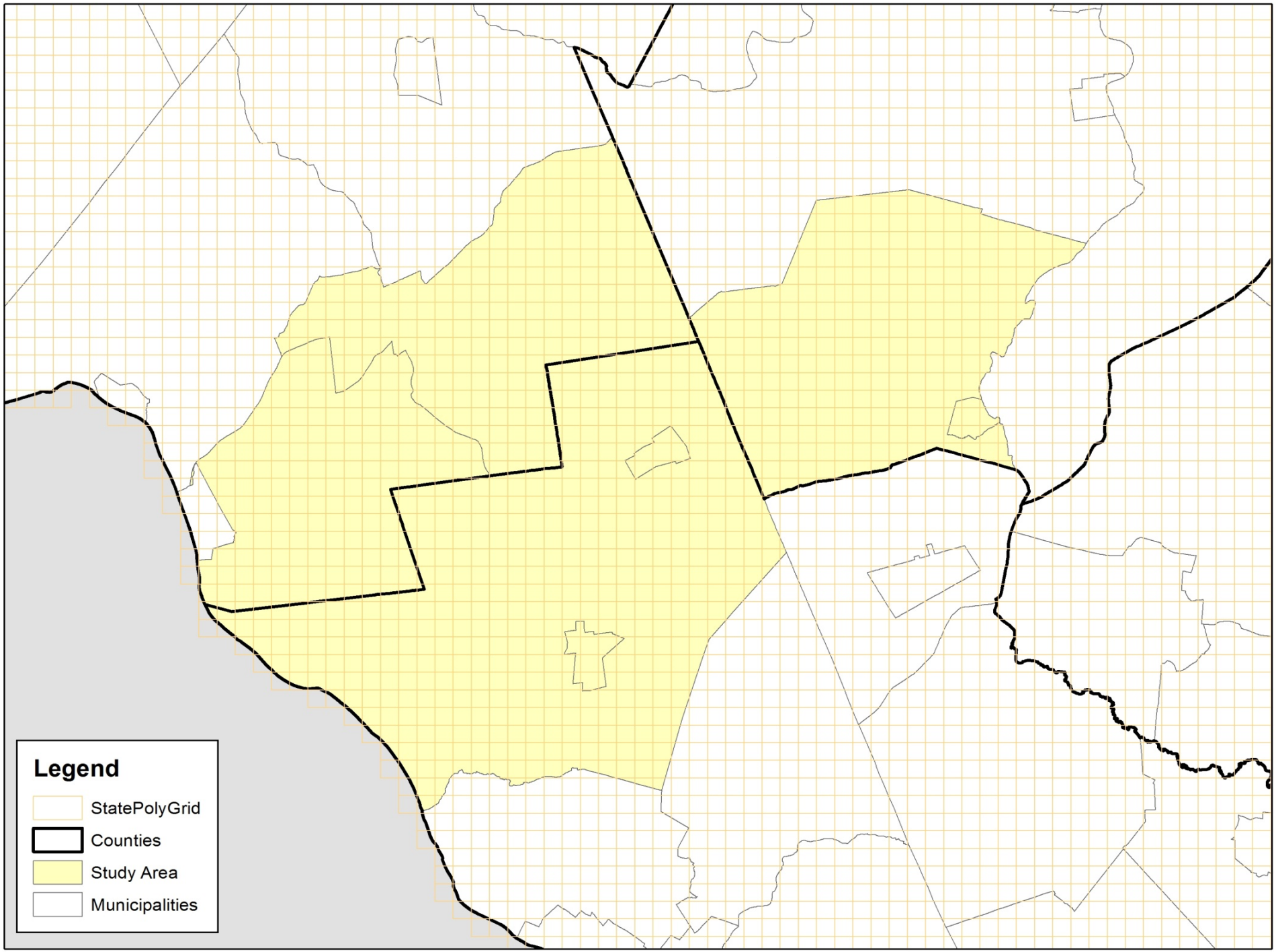
Aquifer	Wells Tested	Sq. Miles	Wells/Sq. Mile
Stockton	104	4.11	25.30
Lock, Up & Low	350	16.68	20.76
Diabase	192	15.07	12.74
Lock, Mid	100	6.09	16.42
Bruns, Low Grey	1328	48.63	27.31
Bruns, Low Red	354	26.62	13.30
Bruns, Mid Grey	194	7.87	24.65
Bruns, Mid Red	492	18.26	26.94
Overall	**3099**	**143.51**	**21.59**

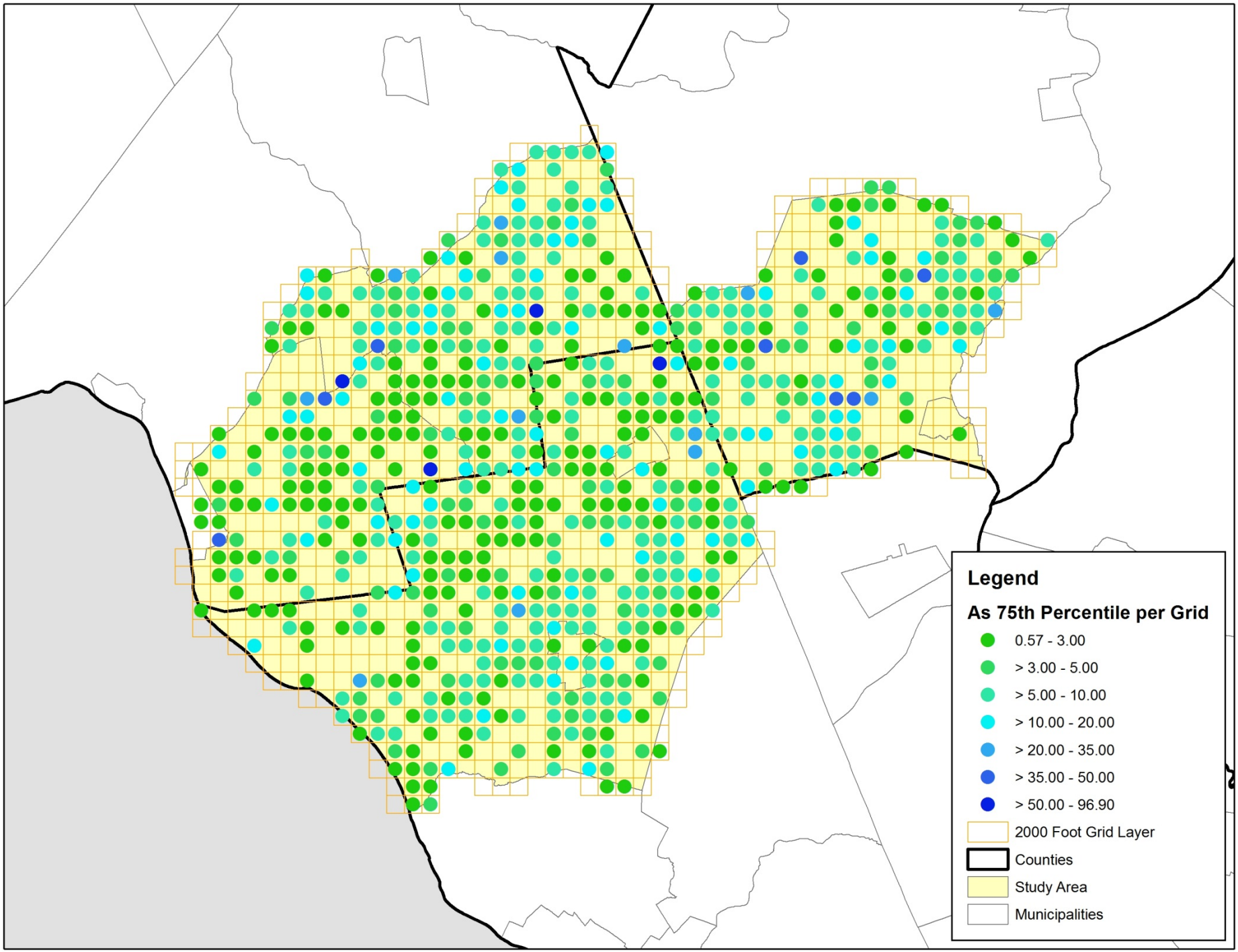

Percent of Wells Over 5 ug/l
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Overall
Stockton
Diabase
Bruns Low Grey
Lockatong
Bruns Mid Red
Bruns Mid Grey
Bruns Low Red
Locktong Mid

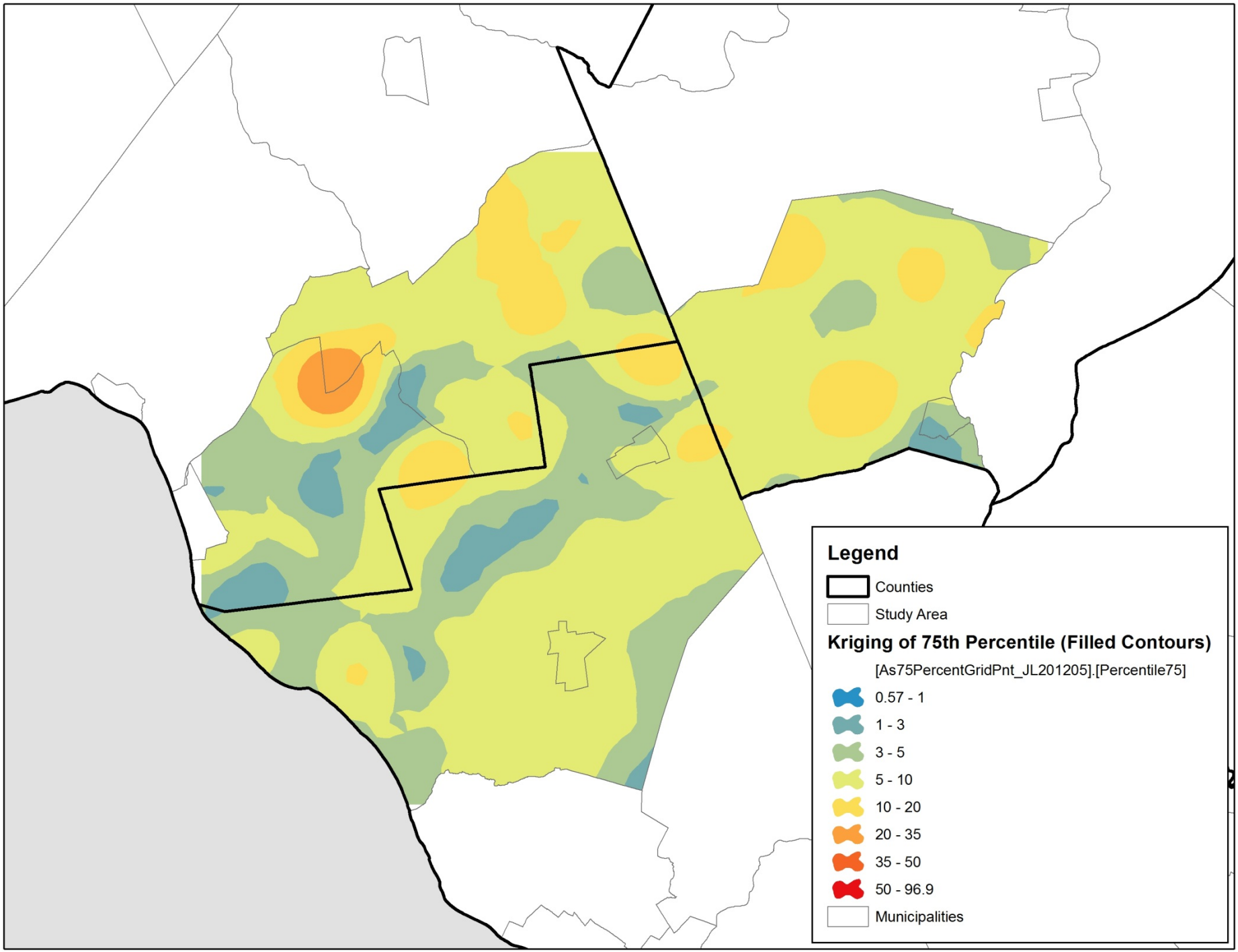

Arsenic in Private Wells
MCL = 5 ppb
less than or equal to 5 ug/l
>5 to 10 ug/l
>10 ug/l
Arsenic in Wells in Aquifer Zones
Aquifer Zones
Stockton
Lock, Up & Low
Diabase
Lock, Mid
Bruns, Low Grey
Bruns, Low Red
Bruns, Mid Grey
Bruns, Mid Red
N
0
1.25
2.5
5 Miles

"Geostatistics" is the generic name for a family of techniques which which are used for mapping of surfaces from limited sample data and the estimation of values at *unsampled* locations.

One basic technique "ordinary kriging" uses a weighted average of neighbouring samples to estimate the 'unknown' value at a given location.


Legend
StatePolyGrid
Counties
Study Area
Municipalities


Legend
As 75th Percentile per Grid
0.57 - 3.00
> 3.00 - 5.00
> 5.00 - 10.00
> 10.00 - 20.00
> 20.00 - 35.00
> 35.00 - 50.00
> 50.00 - 96.90
2000 Foot Grid Layer
Counties
Study Area
Municipalities


Legend
Counties
Study Area
Kriging of 75th Percentile (Filled Contours)
[As75PercentGridPnt_JL201205].[Percentile75]
0.57 - 1
1 - 3
3 - 5
5 - 10
10 - 20
20 - 35
35 - 50
50 - 96.9
Municipalities

Future Work

- Utilize geostatistical techniques to map nitrate, gross alpha, arsenic, and mercury in the state.
- The data will be presented in a 2000 ft x 2000 ft grid to mask actual locations.
- The resulting maps can be used to encourage testing in areas with groundwater problems.

For Additional Information

- Contact: judy.louis@dep.state.nj.us
- PWTA website:

  http://www.state.nj.us/dep/pwta