Little Blue Run Impoundment
Community Well Water Sampling

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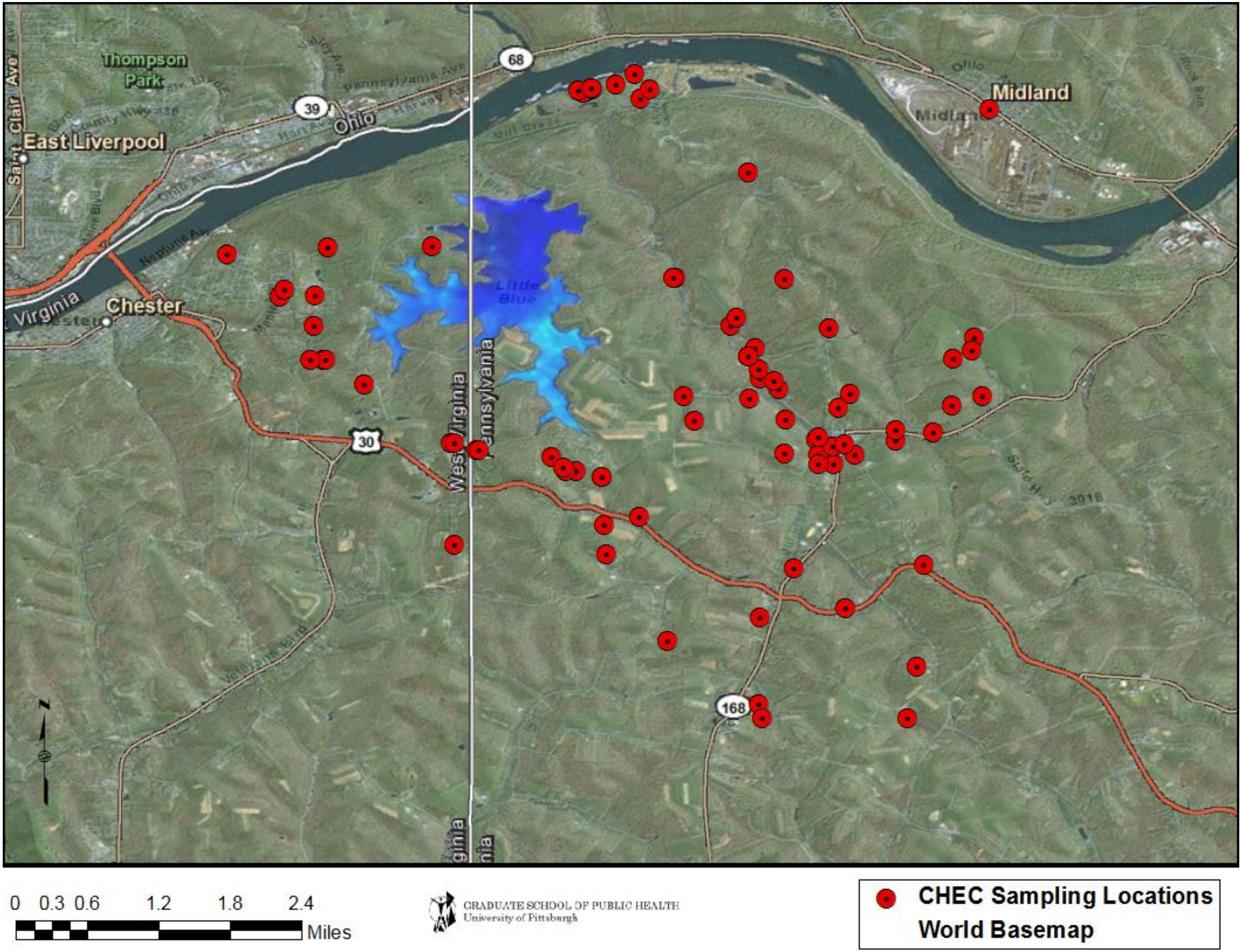
A very special THANK YOU to all the participants who volunteered to have their well water tested for this project!!!!

THANK YOU also for your patience in what sometimes is a slow process

We want to stress the importance of having private drinking water tested regularly, especially in proximity to Little Blue Run

General Information

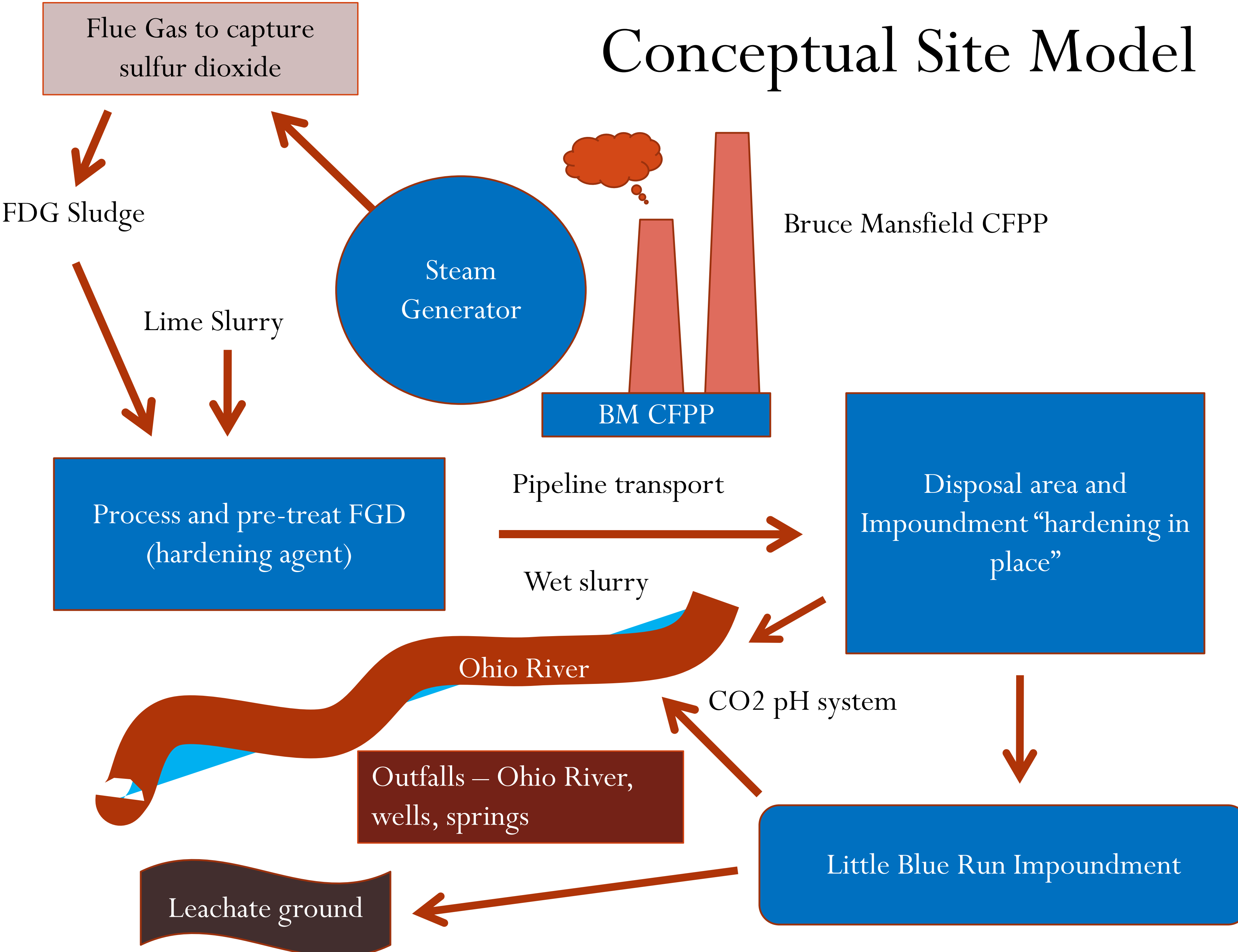
- 85 total samples from 81 different community resident's wells.
- Samples taken on November 1, 2, 3, and 22 of 2010
- Samples analysis by the RJ Lee Group, Inc., Monroeville, PA
- Methods for sample analysis:
  - EPA method 200.7-PA for drinking water
  - 26 Inorganics, Salts and General Parameters
- A Multiparameter probe was used on each site
- Information related to depth, elevation, and physical location were recorded for each site.


Thompson Park
East Liverpool
Chester
Midland
Ohio
West Virginia
Pennsylvania
Little Blue
68
39
30
168
Pennsylvania Ave
Harvey Ave
Ohio Ave
Neptune Ave
State Hwy 3018
0 0.3 0.6 1.2 1.8 2.4
Miles
GRADUATE SCHOOL OF PUBLIC HEALTH
University of Pittsburgh
CHEC Sampling Locations
World Basemap

What is Know and Unknown

- Drinking water is NEVER truly pure
- The amounts of materials in water can fluctuate seasonally and vary according to depth and location
- It is often difficult to know what is in waste systems such as Little Blue
- These types of waste impoundments are highly variable
  - Concentrations of metals, and these leach into the ground and water are poorly understood (Hansen, 2006)
- Often strategies to control waste in these sites are not put into place prior to design (Reardon, 1995)
- Sampling for metals, etc. is not perfect, there are analytical and human errors involved

Conceptual Site Model



CHEC Sample #: 11-01-###

RJL Sample #: PA041120100018-###
Sample Date: 11/01/2010

Chemical	EPA Primary Drinking Water Standard [µg/L (PPB)]	Sample Results [µg/L (PPB)]
Antimony	6	0.489
Arsenic	10	0.333
Barium	200	265
Beryllium	4	0.0205
Cadmium	5	< 0.0200
Copper	1000	1.51
Fluoride	2000	343
Lead	5	0.037
Mercury	2	< 0.200
Selenium	50	< 2.00
Thallium	2	< 0.0200
Uranium	30	< 2.00
Chemical	**EPA Secondary Drinking Water Standard [µg/L (PPB)]**	**Sample Results [µg/L (PPB)]**
Aluminum	200	< 20.0
Iron	300	832
Manganese	50	742
pH	6.5-8.5	7.96 pH Units
Silver	100	< 2.00
Total Dissolved Solids	500000	276000
Zinc	5000	< 5.00
Chemical	**Unregulated**	**Sample Results [µg/L (PPB)]**
Boron	N/A	61
Calcium	N/A	28700
Molybdenum	N/A	0.678
Potassium	N/A	2320
Sodium	N/A	35800
Strontium	N/A	510

All study participants received certified laboratory results from RJ Lee Group, Inc., as well as a table comparing these results to USEPA drinking water standards in µg/L, pronounced “micrograms per liter.” (also called ppb or “parts per billion”)

The primary standards are based on specific human health concerns, whereas secondary standards are based on aesthetic factors.

History of Little Blue/Data

- Feb 10, 1973
  - Proposed methodology for sludge disposal at Little Blue Run
- Oct 11, 1974
  - A permit is granted for the "Little Blue Run Development Area," as a "stack gas scrubber waste disposal site" under the PA Solid Waste Management Act which allowed for the discharge of industrial waste to surface waters.
    - No liner or leachate collection system is included in this permit
- Aug 1976 – Foundation Treatment for Little Blue
  - 420ft. Sloping dam construction study
    - Included Topography, geology, hydrology, subsurface investigation, seepage
- Numerous Notices of Violations concerned citizens and researchers.
  - For example - July 31, 1989 – discharge TSS 194mg/l, pH 10.5 in violation of NPDES

History of Little Blue (cont.)

- May 12, 1989
  - Groundwater Assessment
    - Statistical correlation analysis (Cl, Ca, Na) Supernate vs. Monitoring wells.
- May 29, 1990
  - Bearing Capacity (Gai Consultants) Identifying and Characterizing "current sludge mixture."
- Sept 25, 1992
  - Waste Analysis and Classification
    - Sludge analyzed - metals, VOCs, nutrients, pH, etc.
- July 12, 1993
  - Effect of Brine on Clays
    - Physico-chemical reactions

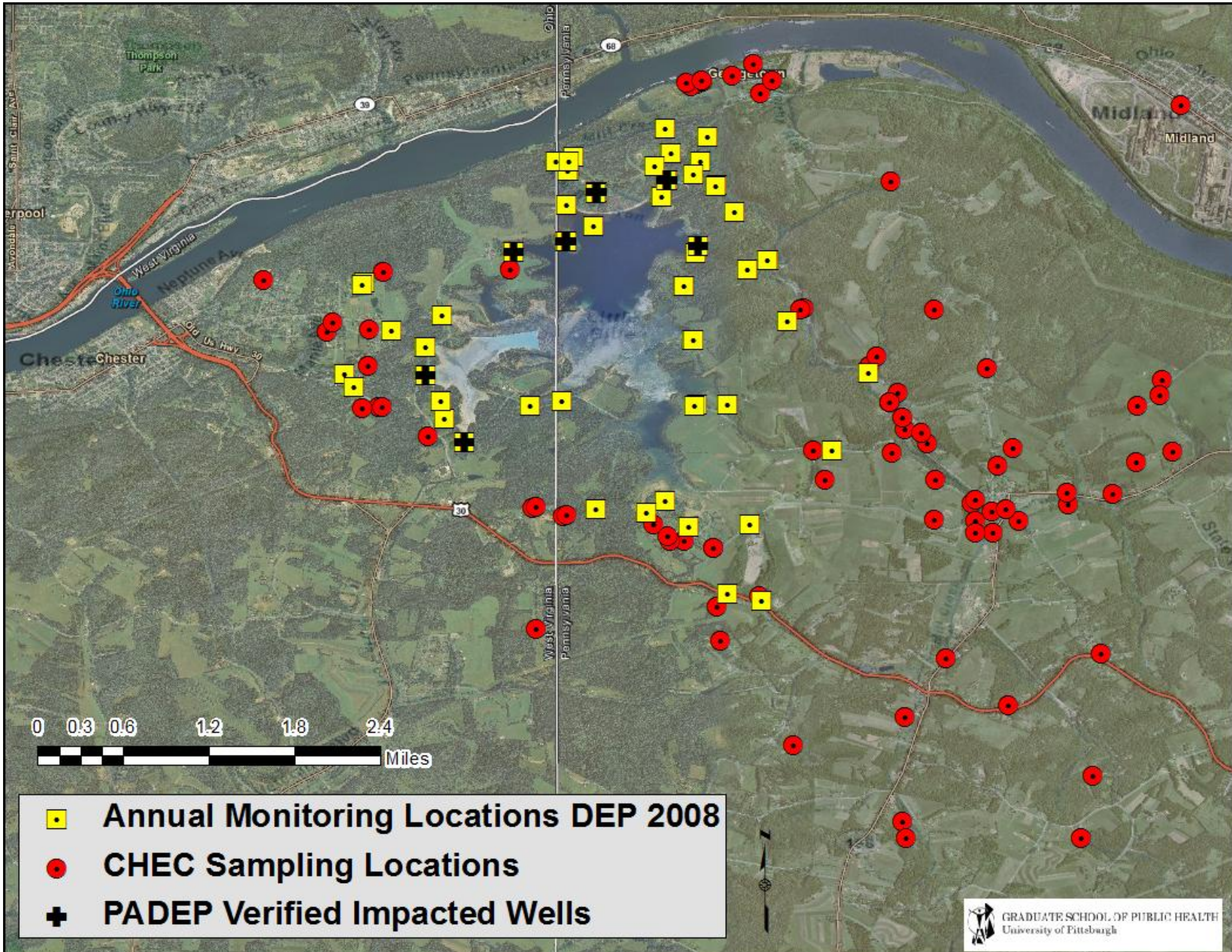
History of Little Blue (cont.)

- Multiple LBR Embankment Monitoring reports
  - Dam Weir outflow, rainfall, GPM 3 springs, 2 Abutments, piezometer readings
- 1995
  - FGD Sludge Fresh Water Effects Study (Strength v. Permeability)
- 1997
  - Hydrogeologic Characterization
    - Conductivities, storage co, transmissivity, hydraulic gradients, ground water velocities, depths, 3D groundwater flow (slug tests)
- 2007
  - Time Trend Graphs 1990-2007 (Dec)
    - Flow, pH, Conductance, Temp
- 1895-2009 Quarterly/Annual ground and surface water sampling analysis

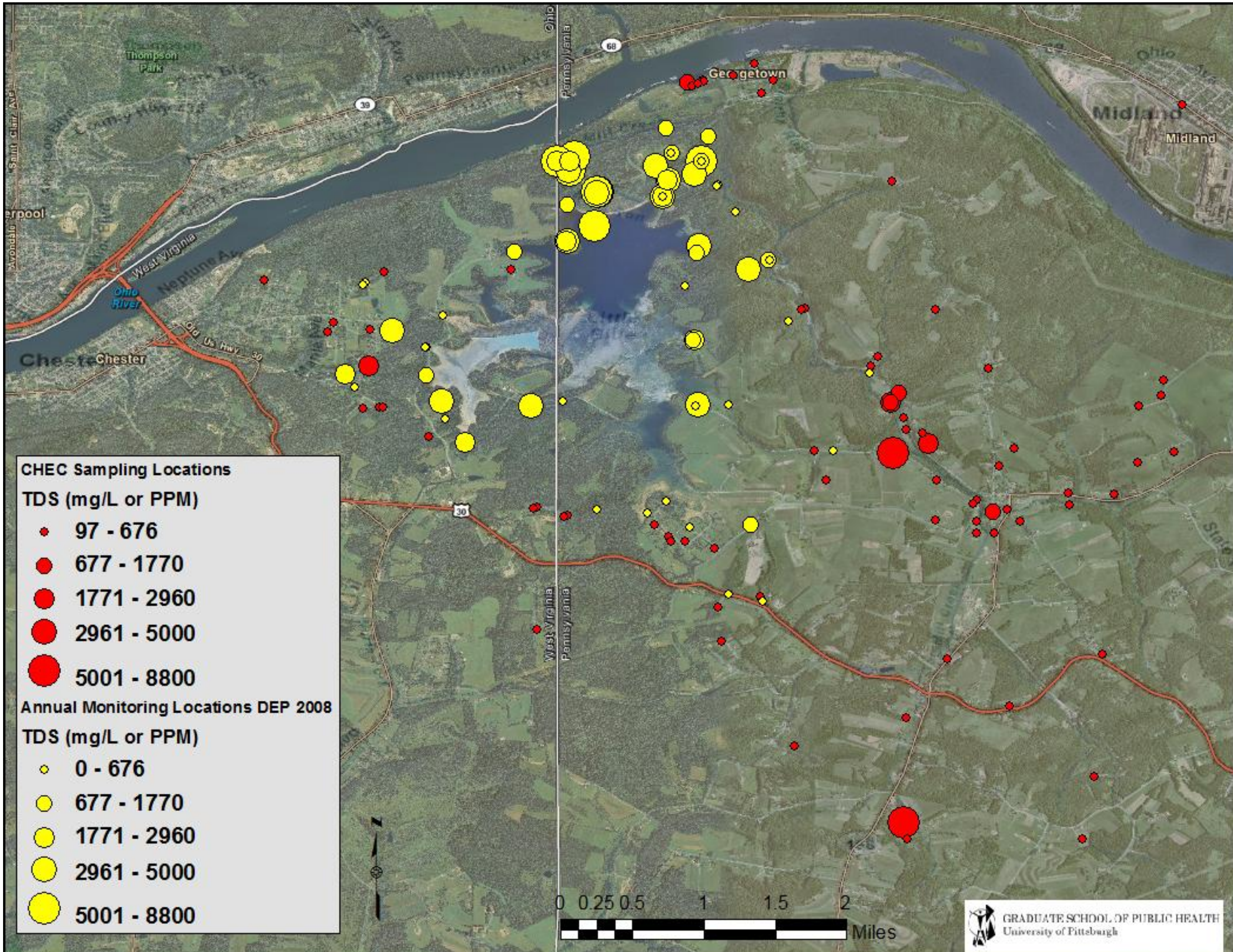
Summarized Results of CHEC Sampling Drinking Water Standards

- Only one sample exceeded the USEPA primary drinking water standard for arsenic (sample: 11.5 µg/L, standard: 10.0 µg/L)
- 14 samples exceeded the secondary drinking water standard for iron (Fe)
- 29 samples exceeded the secondary drinking water standard for manganese (Mn)
- 4 samples exceeded the secondary drinking water standard for total dissolved solids (TDS)
- 2 samples exceeded the secondary drinking water standard for aluminum (Al)
- 1 sample exceeded the secondary drinking water standard for fluoride (F)

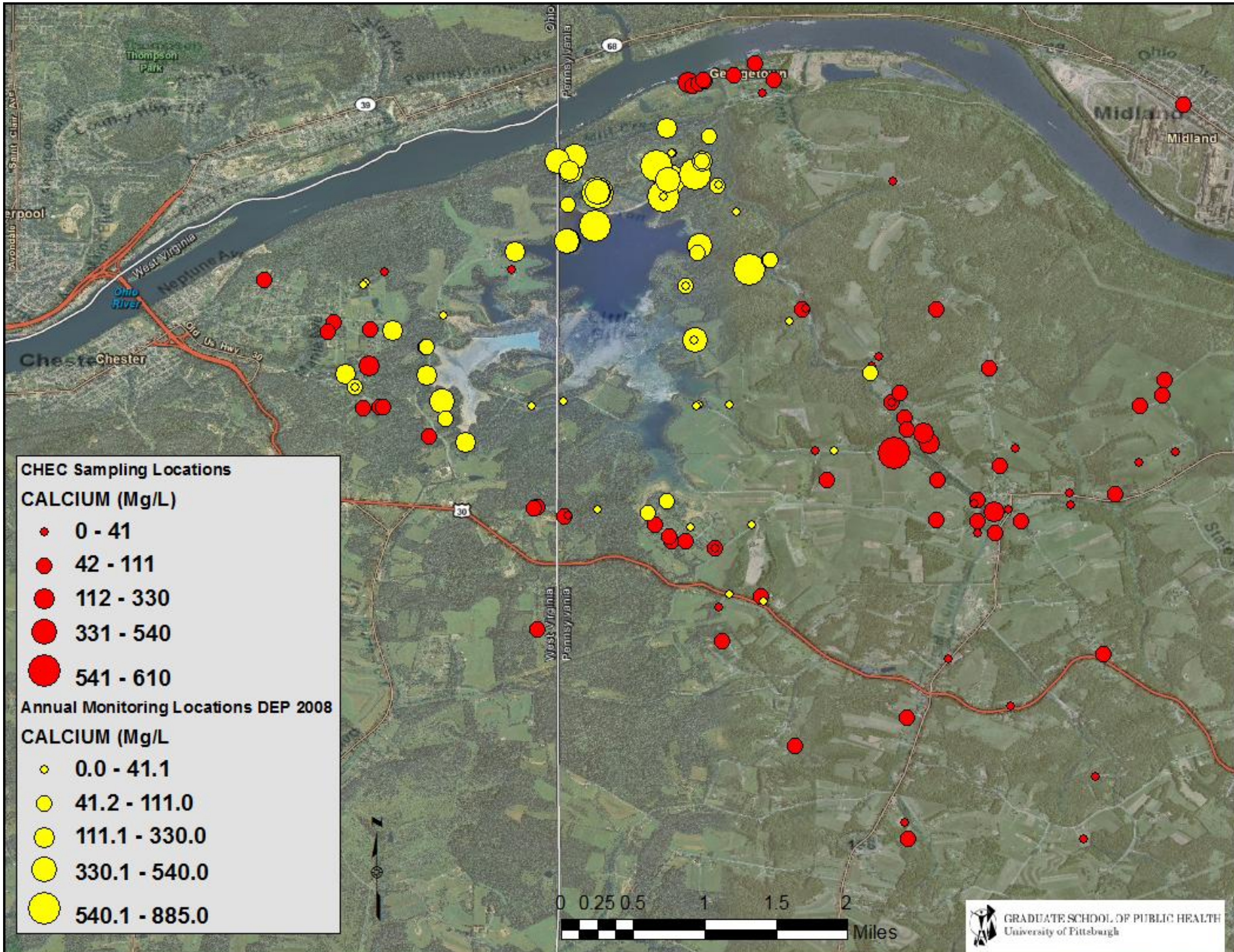
CHEC Sampling Locations 2010
PADEP 3rd Quarter Sampling Locations 2008



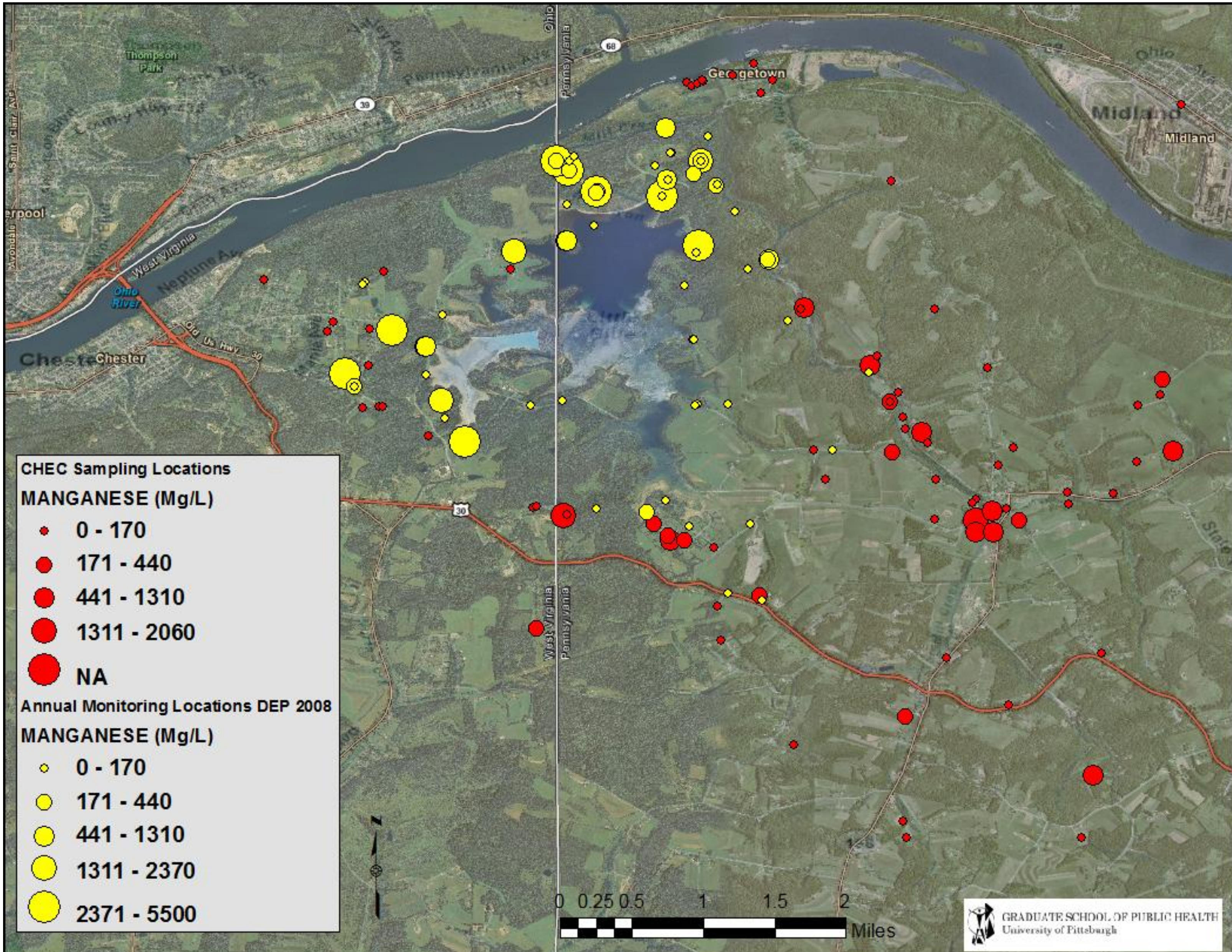
Comparisons to PADEP 3rd Quarter Sampling 2008
Total Dissolved Solids (Mg/L)



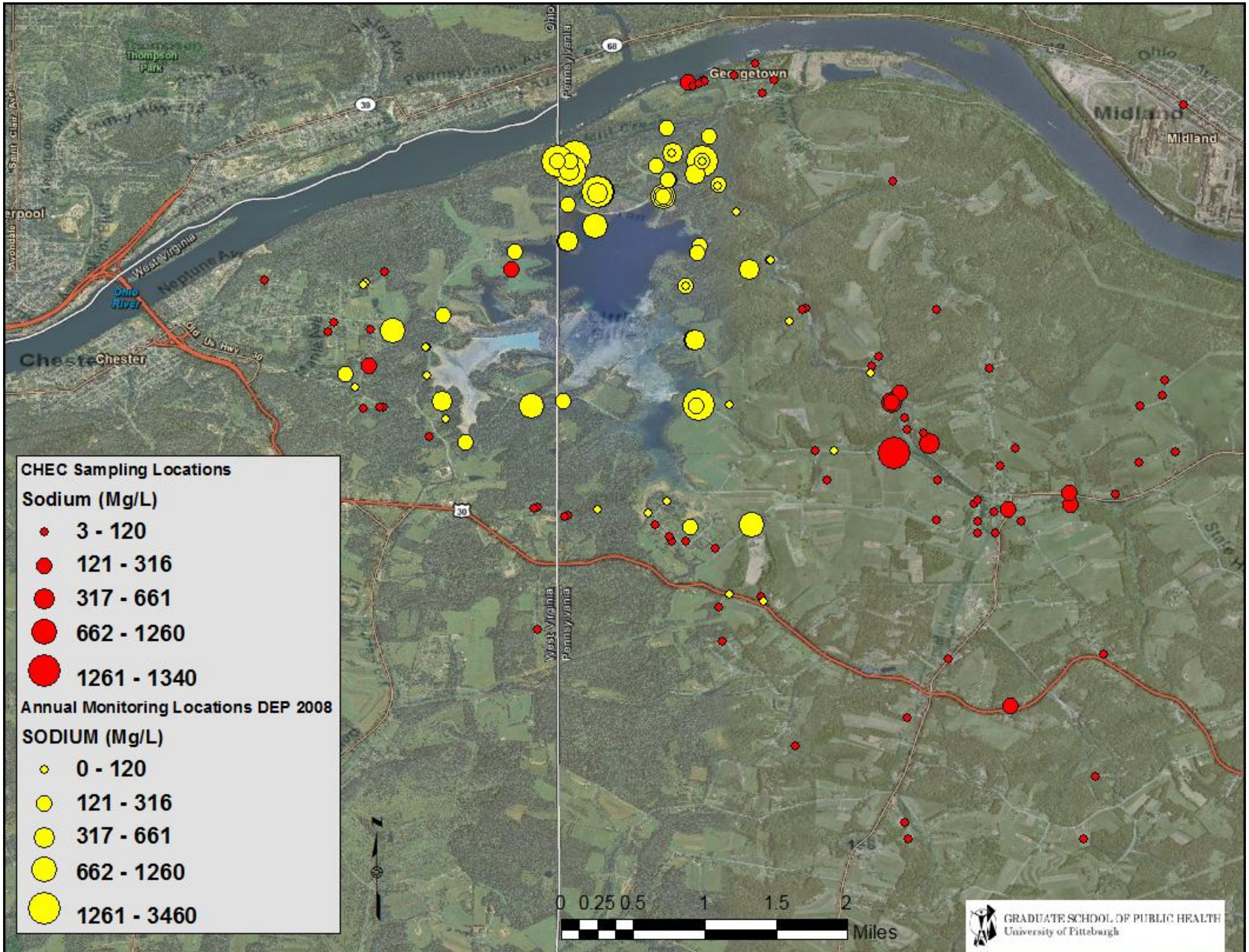
Comparisons to PADEP 3rd Quarter Sampling 2008
Calcium(Mg/L)

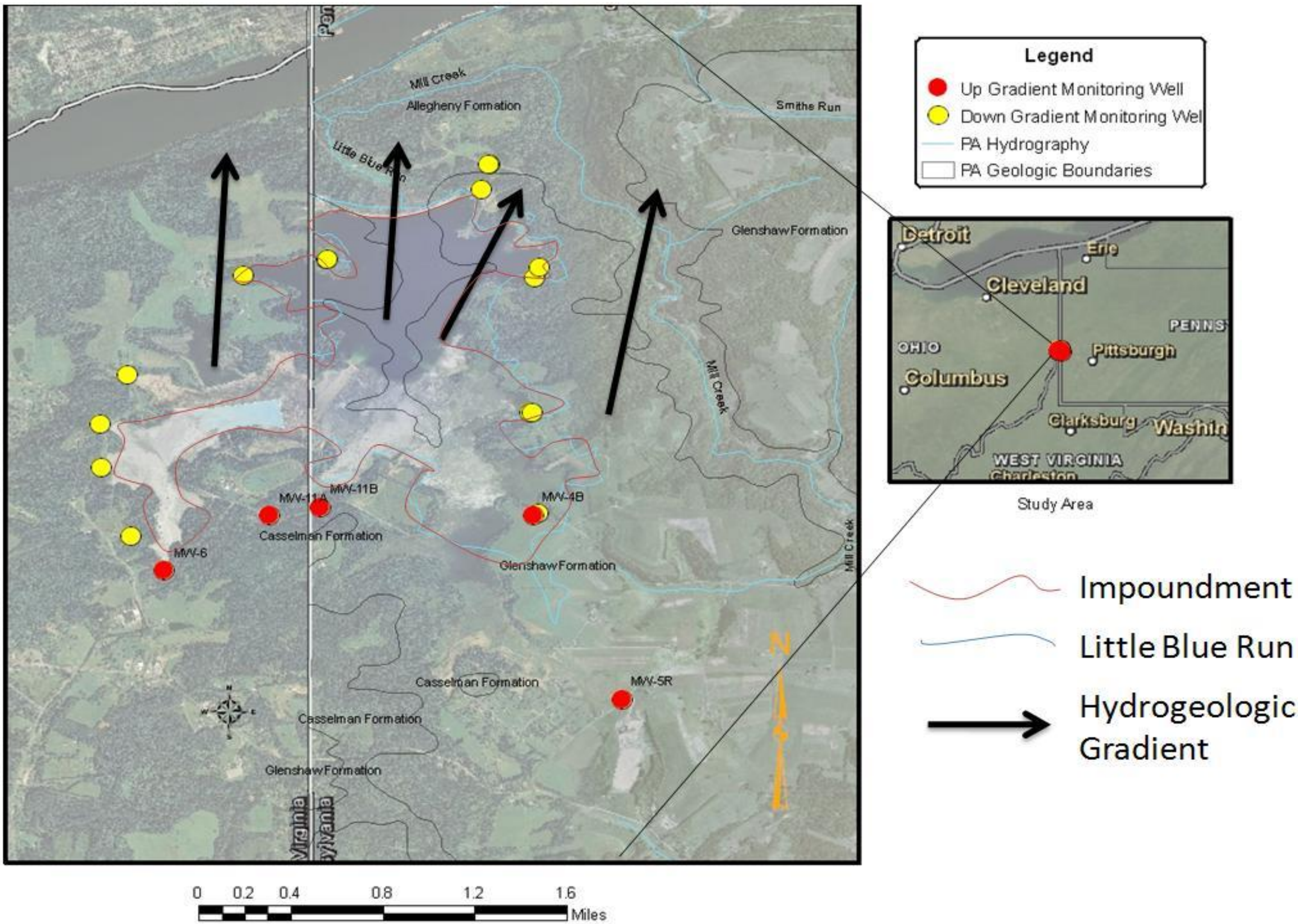


Comparisons to PADEP 3rd Quarter Sampling 2008 Manganese(Mg/L)



Comparisons to PADEP 3rd Quarter Sampling 2008 Sodium(Mg/L)





Legend
Up Gradient Monitoring Well
Down Gradient Monitoring Wel
PA Hydrography
PA Geologic Boundaries
Mill Creek
Allegheny Formation
Smiths Run
Little Blue Run
Glenshaw Formation
Mill Creek
MW-11A
MW-11B
MW-4B
Casselman Formation
MW-6
Glenshaw Formation
Casselman Formation
MW-5R
Casselman Formation
Glenshaw Formation
Virginia
Pennsylvania
Detroit
Erie
Cleveland
PENNS
OHIO
Pittsburgh
Columbus
Clarksburg
Washin
WEST VIRGINIA
Charleston
Study Area
Impoundment
Little Blue Run
Hydrogeologic Gradient
0 0.2 0.4 0.8 1.2 1.6
Miles

Up-gradient vs. Down-gradient DEP Data

Constituent	Units	Groundwater				
		Up-gradient	#	Down-gradient	#	Interstitial Water*
Alkalinity	mg/L as CaCO3	320	(79)	234	(99)	54
pH	standard units	8	(73)	7.39	(99)	8.82
Specific Conductance	µS/cm	811	(74)	2960	(99)	6350
Temperature	degrees Celsius	15		15		15
Laboratory Analyses (All values are for the dissolved fraction)						
Dissolved Solids (TDS)	mg/L	560	(71)	2200	(99)	5070
Arsenic	µg/L	< 10	(71)	< 10	(99)	NA
Boron	µg/L	251	(54)	247	(98)	NA
Calcium	mg/L	11.1	(74)	173	(99)	565
Carbon (Total Organic)	mg/L	1	(71)	1	(71)	NA
Chloride	mg/L	31.5	(75)	278	(99)	509
Chromium	µg/L	< 2	(24)	< 2	(24)	NA
Fluoride	mg/L	1.3	(71)	0.46	(99)	4.6
Iron	µg/L	40	(67)	40	(99)	40
Magnesium	µg/L	5,150	(68)	640	(99)	121000
Manganese	µg/L	530	(36)	230	(83)	30
Nitrogen, as NH4	mg/L	0.32	(57)	**0.49**	(99)	0.1
Nitrogen, as NO2 + NO3	mg/L	0.05	(59)	0.05	(99)	0.22
Potassium	mg/L	2.09	(62)	17.29	(99)	87.1
Selenium	µg/L	< 3	(24)	< 3	(24)	NA
Sodium	mg/L	207.5	(62)	304.6	(99)	778
Sulfate	mg/L	6.25	(62)	241	(99)	2930

Best Judgment of LBR Impact on Ground Water (PADEP and CHEC)

- Increase in TDS
- Increase in Calcium (Ca)
- Increase in Sulfate (SO_4)
- Increase in Chloride (Cl)
- Increase in Potassium (K)
- Increase in Sodium (Na)
- Decrease in Magnesium (Mg)

Manganese in Sample Results

- Number of samples: 83
- Minimum: 0.9 µg/L
- Maximum: 2060 µg/L
- Mean: 166.69 µg/L

EPA secondary drinking water standard:
0.05mg/l or 50 µg/L

Health Advisories					
Manganese	10-kg Child				
	One-day (ug/l)	Ten-day (ug/l)	RfD (mg/kg/day)	DWEL (ug/L)	Life-time (ug/L)
	1000	1000	0.14	1600	300

Manganese – Health Risks

- The body regulates uptake of Mn
- Below 300 µg/L, no adverse health effects are expected
- 5.2% of USGS sampled domestic wells contain >300 µg/L (n=2,159)
- 18 sampled wells near LBR contained >300 µg/L
- Evidence shows possible neurological health problems related to exposure above this level may occur, particularly in infants, young children, people with low iron levels, and people with chronic liver disease
- Water with high Mn levels should not be used to make infant formula

Before & After Purification Systems from Same Well Sampled Twice

Control vs. Purification	Boron (mg/L)	Iron (mg/L)	Manganese (mg/L)	Strontium (mg/L)	Antimony (mg/L)	Molybdenum (mg/L)	Fluoride (mg/L)	Barium (mg/L)	Calcium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Zinc (mg/L)	Arsenic (mg/L)	Copper (mg/L)	Lead (mg/L)	Nickel (mg/L)	Selenium (mg/L)	TDS (mg/L)
Before	38.1	92.6	12	881	0.085	0.862	228	212	44200	1530	11300	5.3	0.53	2.84	0.015	0.2	1	268000
After Water Softener & Reverse Osmosis	38.2	41.2	0.45	15	0.066	0.748	218	1	76.4	190	53400	5.8	0.653	11.5	0.015	4.36	1	214000
Before	136	253	366	3310	0.535	0.316	346	3490	83200	7180	232000	480	1.96	48.7	1.73	2.54	7.96	1240000
After Water Softener	139	2	0.45	443	0.154	0.131	353	444	11800	12400	331000	42.5	1.52	77.1	1.32	3.74	6.27	1270000

Water softener & reverse osmosis decreased: iron, manganese, antimony, calcium, potassium, TDS, while sodium increased

Water softener alone decreased: iron, manganese, strontium, barium, calcium, zinc, arsenic, while potassium and sodium increased

Carbon Filter & Water Softener Samples Vs. Samples Average

Sample Type	Aluminum (mg/L)	Boron (mg/L)	Iron (mg/L)	Manganese (mg/L)	Strontium (mg/L)	Fluoride (mg/L)	Barium	Calcium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Zinc (mg/L)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Total Dissolved Solids (mg/L)
Carbon Filter, No Softener	10.0	42.8	12.0	0.5	123.0	130.0	92.3	67500.0	1190.0	9220.0	35.7	0.1	7.4	0.4	1.0	280000.0
Water Softener	10.0	93.6	18.3	0.5	15.0	236.0	1.0	34.4	78800.0	113000.0	2.5	0.6	2.8	0.2	1.0	464000.0
All Samples Avg.	26.0	224.1	1617.7	166.6	671.5	389.4	241.4	63718.2	4696.0	81626.6	23.2	0.9	11.8	2.0	2.6	601000.0

Compared to sample means of all samples, a carbon filter displayed lower levels for all constituents sampled

The water softener also displayed lower levels for all samples compared to the mean concentrations

Conclusions of CHEC Sampling

- 29 sampled wells had Manganese (Mn) concentrations above the secondary USEPA drinking water standard
- There are some health concerns for manganese
- 14 samples had Iron (Fe) concentrations above the USEPA secondary drinking water standard
- Only 1 sample of elevated arsenic (11.5 ppb)
- The large majority of sampled water does not seem to be impacted, yet this is a snapshot sample
- The use of water softeners, carbon filters, and reverse osmosis systems displayed decreased levels of many metals and salts including Fe and Mn
- Spatial variations seem somewhat similar to DEP sampling in 2008
- DEP monitoring values were higher in 2008 on average for most metals and salts sampled. Calcium statistically significantly higher not including impacted wells ($p<0.01$)

Recommendations

- Pitcher-type or faucet carbon filter units can remove some forms of iron and manganese
- Boiling water is not recommended to remove iron and manganese
- It is important to have well water tested at least annually due to proximity to LBR
- We did not test for coliform bacteria, testing should also occur annually or when there is a change in taste, color or odor

Special Thanks

- To all the volunteers and community members
- RJ Lee Group, Inc.
- The Heinz Endowments
- Shannon Kearney
- Chuck Christen
- Amanda Barry

Thank You for Your Attention

Questions?

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