Water and Sanitation in Rural Virginia

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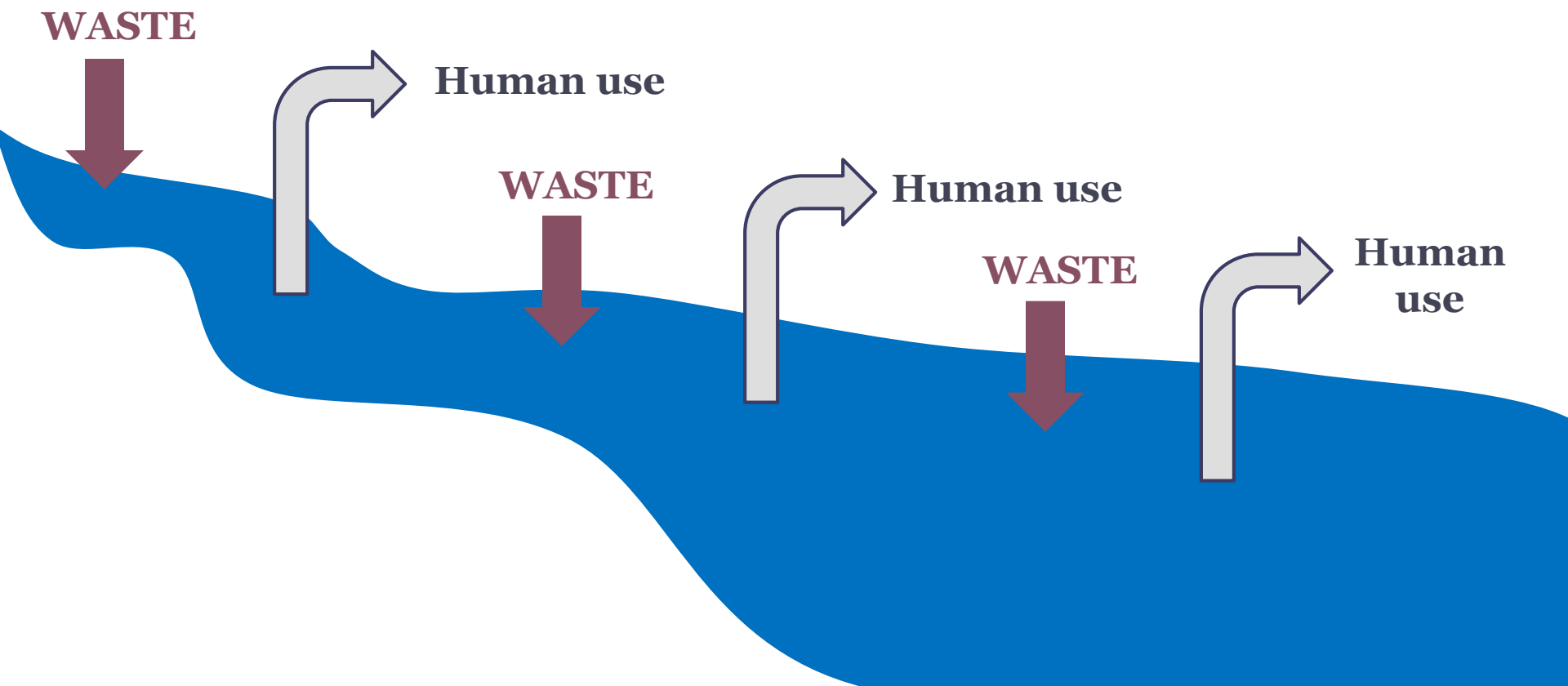
Initial Thank-yous!

Water and Sanitation: Definitions

Sanitation = provision of facilities and services for the safe disposal of human urine and feces (WHO)



Is this a problem in the United States?

The United States currently reports that 100% of the national population has access to improved water sources.

Table 2. Total and Percentage of Occupied Housing Units Lacking Complete Plumbing Facilities, 1990–2000

Census Year	Occupied Housing Units Lacking Complete Plumbing Facilities					
	Total	Percentage	Total – Rural	Percentage – Rural	Total – Urban	Percentage – Urban
2000	670,986	**0.64**	226,967	**1.03**	444,019	**0.53**
1990	721,693	**0.78**	405,855	**1.85**	315,838	**0.45**

~2 million people

Gasteyer, S. and R. Vaswani (2004). Still Living Without the Basics in the 21st Century: Analyzing the Availability of Water and Sanitation Services in the United States., Rural Community Assistance Partnership: Washington, DC: Full text available: http://www.rcap.org/sites/default/files/rcap-files/StillLiving/Still_Living_full.pdf

Today…

- ***Private Drinking Water Supplies in Virginia***
- ***Impacts of Inadequate Sewage Disposal on Benthic Ecology in the Coalfields***

Rural Drinking Water

Where does drinking water come from?

Public Drinking Water Plant

- Centralized treatment system
- Complex distribution system
- Subject to the Safe Drinking Water Act (MCLs, monitoring regimens, etc.)

Private Drinking Water Supply

- Well, spring, cistern
- Monitoring and maintenance is solely the homeowner's responsibility

Virginia Household Water Quality Program (VAHWQP)

- Long-running extension program (since 1989!)
- ***Overall goal*** is to improve the drinking water quality and health of Virginia families reliant on private water supplies
  - Educational programming on system construction and maintenance
  - Low cost water quality testing and results interpretation

Virginia Household Water Quality Program

Virginia Cooperative Extension

VirginiaTech Invent the Future

Virginia State

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PI: Brian Benham

Program coordinator: Erin Ling

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- Paired with homeowner survey information on system construction, system location, and perceived water quality

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GOAL: Use this dataset to identify common water quality of potential human health concern and to prioritize future research efforts.

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VAHWQP: Retrospective Findings (1989-2011) and Ongoing Research

Contaminant	Median Value	Max Value	Standard	EPA Standard Classification	% in Violation	n
Total coliforms	n/a	n/a	Absent	MCL	44%	14,208
E. coli	n/a	n/a	Absent	MCL	11%	13,794
Nitrate-N	0.46	79	<10 mg/L	MCL	3%	13,151
Fluoride	0	12.4	<4 mg/L	MCL	2%	13,681
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Chloride	20	4,160	<250 mg/L	SMCL	1%	14,497
Sodium	6.5	1,782	<20 mg/L	Guidance Level	26%	14,228
Manganese	0.002	28	<0.05 mg/L	SMCL	14%	14,213
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Sulfate	4.7	3,348	<250 mg/L	SMCL	6%	13,847

Microbial Contamination (Gastroenteritis)

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Microbial Contamination (Gastroenteritis)

In the VAHWQP data set, 44% of all samples were positive for total coliforms…

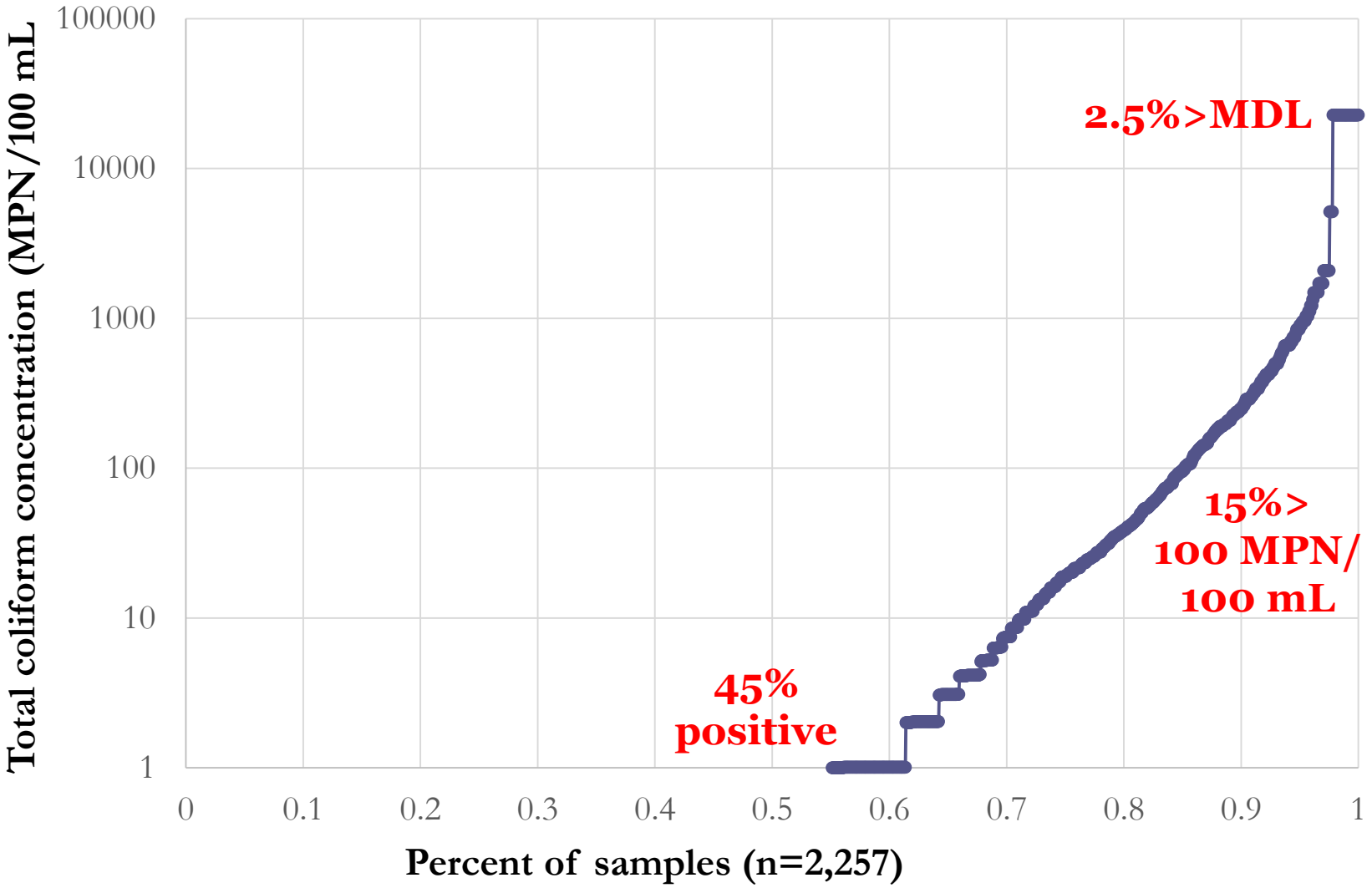
Study	Location	Percent TC +ve	Total # Samples
Sandhu et al., 1979	South Carolina	85%	460
Lamka et al. 1980	Oregon	35%	78
Sworobuk et al., 1987	West Virginia	68%	155
Bauder et al., 1991	Montana	40%	1,300
Kross et al., 1993	Iowa	45%	686
Gosselin et al., 1997	Nebraska	15%	1,808
Borchardt et al., 2003	Wisconsin	28%	194

Microbial Contamination (Gastroenteritis)

- Over half of those homeowners submitting samples indicated they had no treatment or "didn't know"
  - Only 96 homes indicated they used a chlorinator; of those 21% were positive for coliforms, 6% positive for *E. coli*

- Quantification of bacteria levels since Nov 2010

Microbial Contamination (Gastroenteritis)



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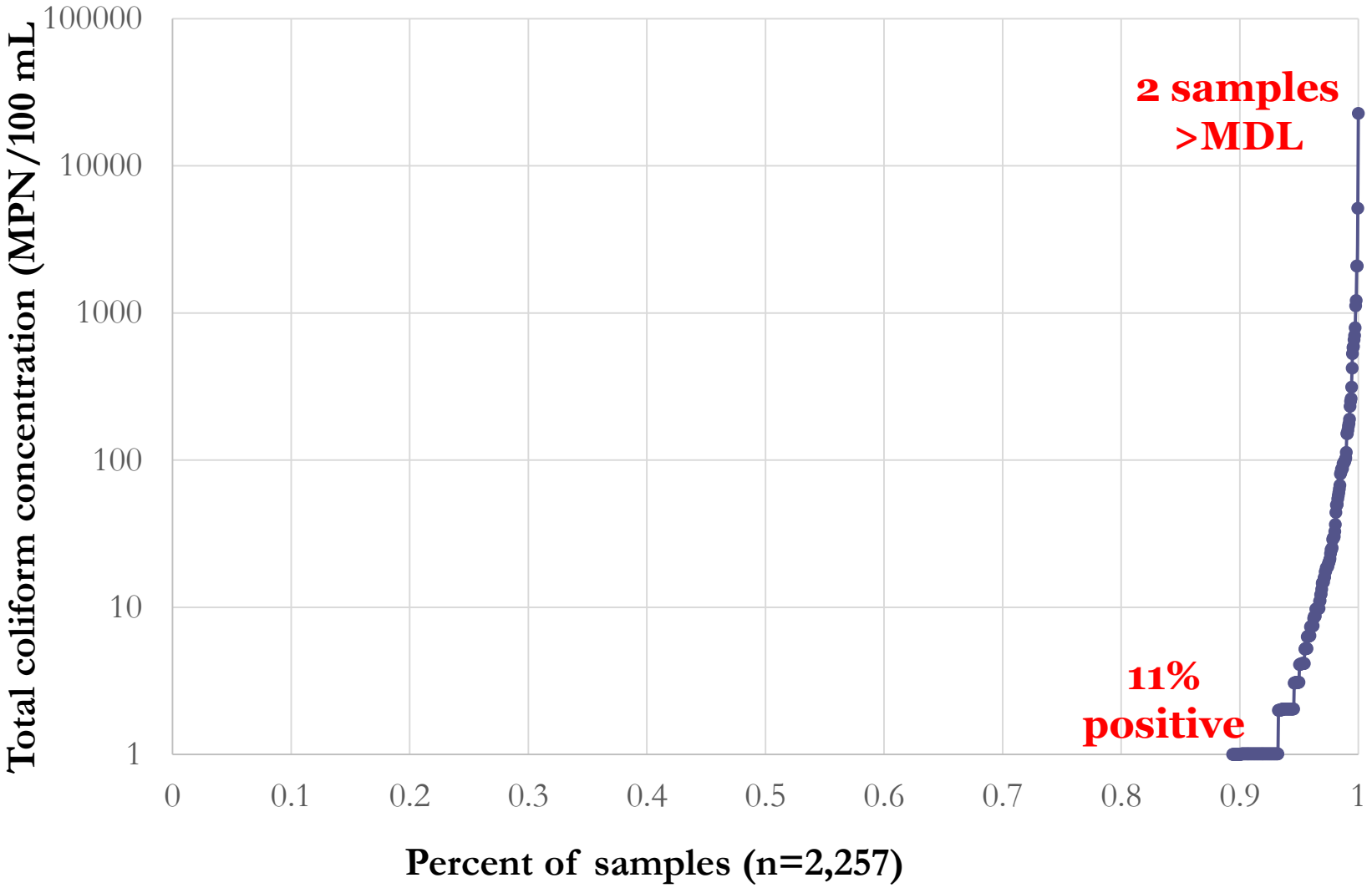

Sodium

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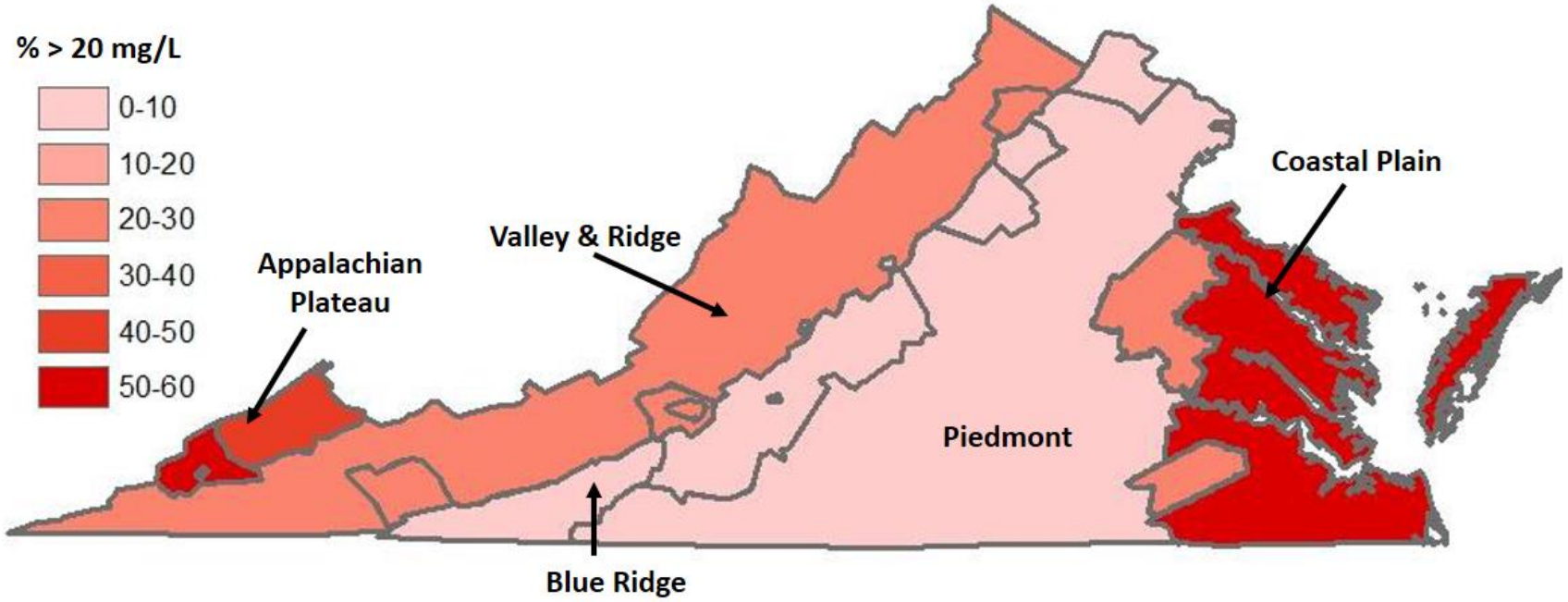
Sodium

Over 25% of samples submitted to VAHWQP exceeded the 20 mg/L USEPA recommended limit.



However, it is important to note that 1,310 samples were from systems with water softeners (78% >20 mg/L).

Fluoride, pH, and Dental Health

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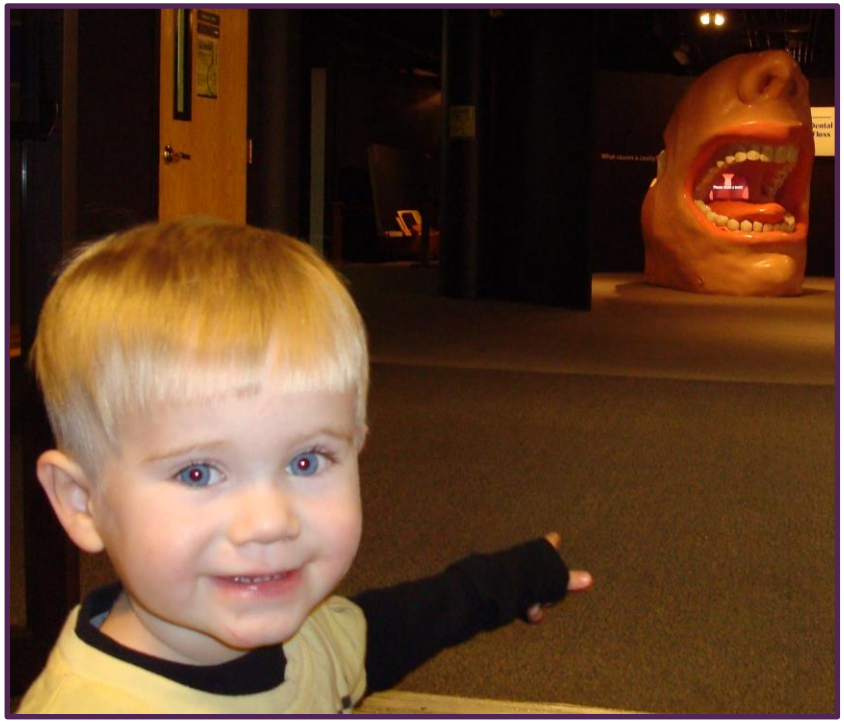
Fluoride, pH, and Dental Health

- 93% of samples fluoride levels <0.7 mg/L
  - mean and median concentration = 0 mg/L
- 3% of samples have pH<5.5



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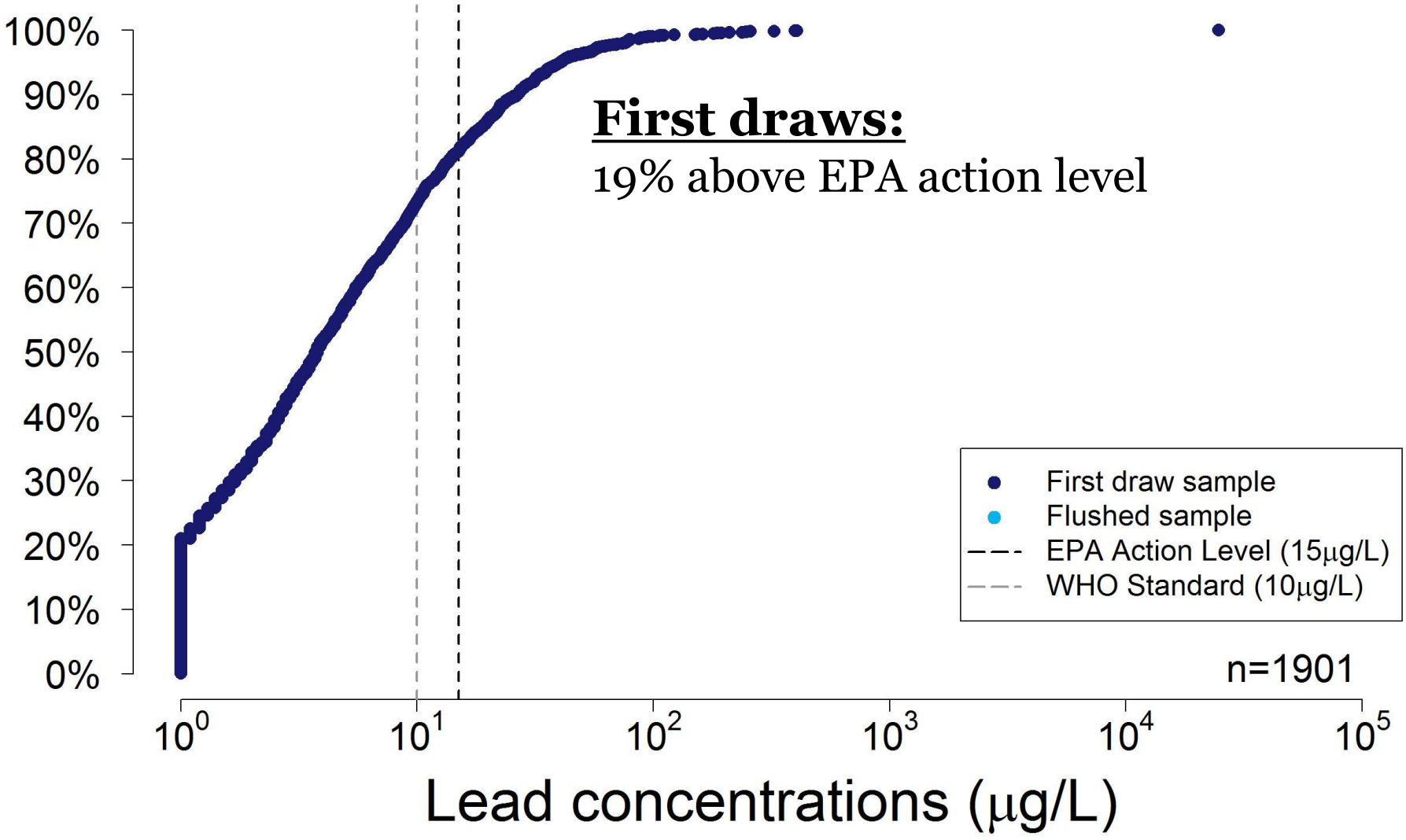
pH and Corrosion

- 28% of submitted samples had a pH below 6.5
- 16% of paired surveys indicated corrosion/pinhole links (1721/10486)
- Potential for corrosion? → ***Metals testing since Jan 2012***

Lead Concentrations (2012-2013)

First draws:
19% above EPA action level



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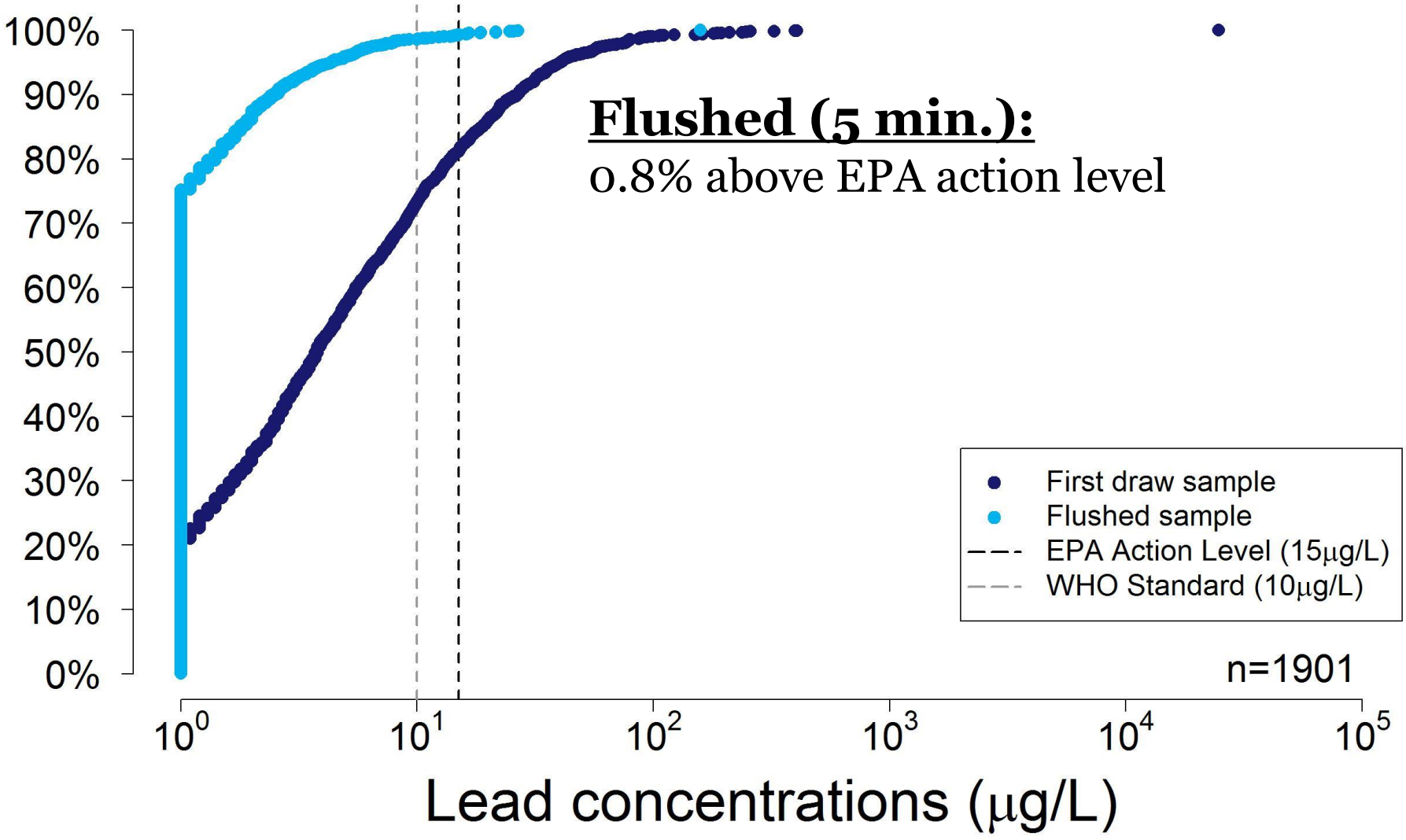


Sanitation in the Coalfields

Sanitation Challenges in Appalachia

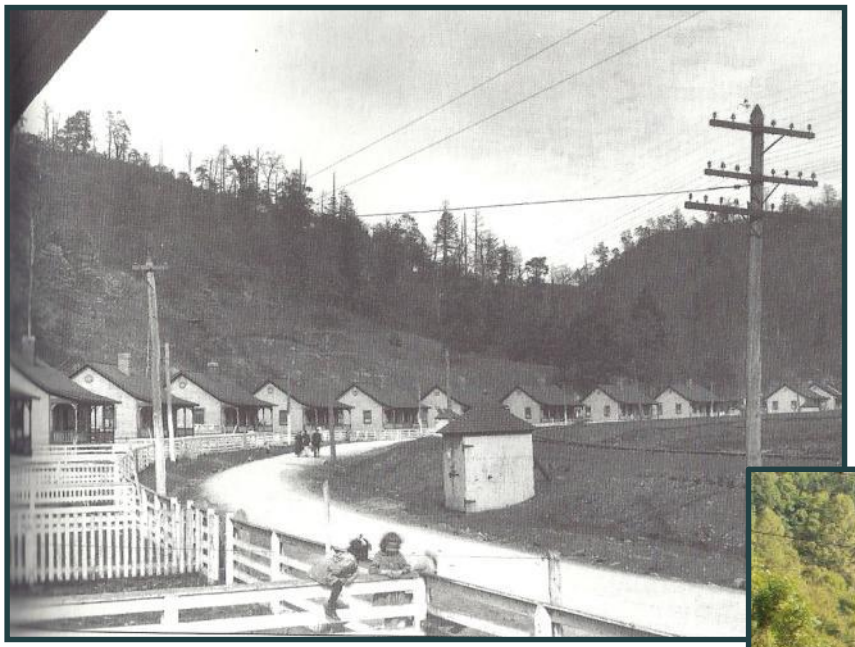
- Households without indoor plumbing*
  - ~19,000 homes in VA
  - ~7,000 in WV
  - ~14,000 in KY
- Inadequate wastewater treatment
- "Community lines" ("straight pipes")
  - Technically illegal and therefore difficult to quantify

*Gasteyer, S. and R. Vaswani (2004). Still Living Without the Basics in the 21st Century: Analyzing the Availability of Water and Sanitation Services in the United States. Rural Community Assistance Partnership: Washington, DC.

Sanitation Challenges in Appalachia

- Socio-economic
  - Physically remote
  - Few resources at the individual or gov't level
- Geographic
  - Thin soils & karstic geography make septic challenging
  - Communities concentrated in narrow valleys
  - Directly adjacent to streams

Sanitation Challenges in Appalachia



Stonega Coal Camp, circa 1915-20*

Stonega, VA, September 2012

*Torok, G. 2004. A Guide to Historic Coal Towns of the Big Sandy River Valley. Univ of TN Press, Knoxville.

Primary Regulatory Driver = Coal

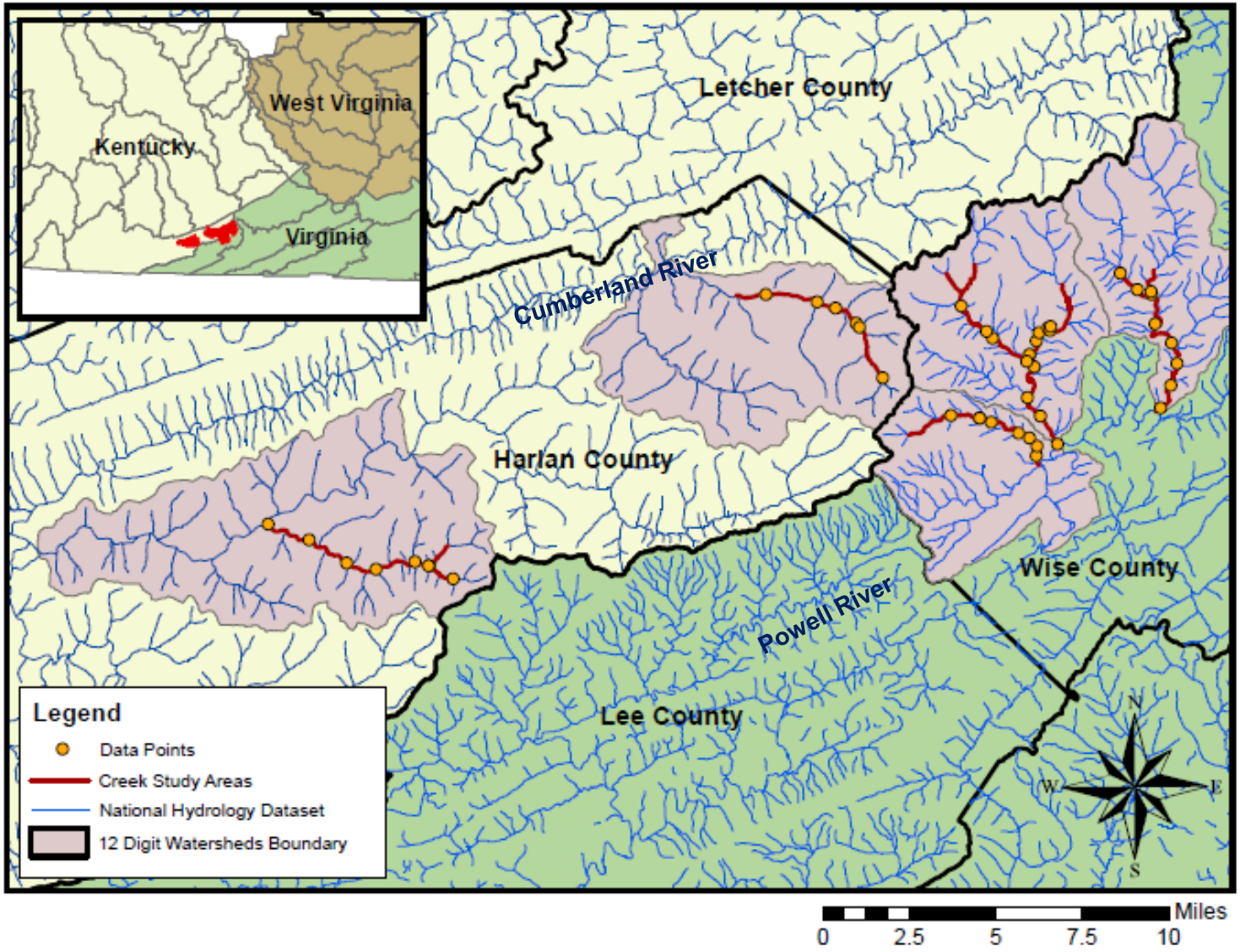
Mountaintop Removal Mining

Inadequate Sanitation

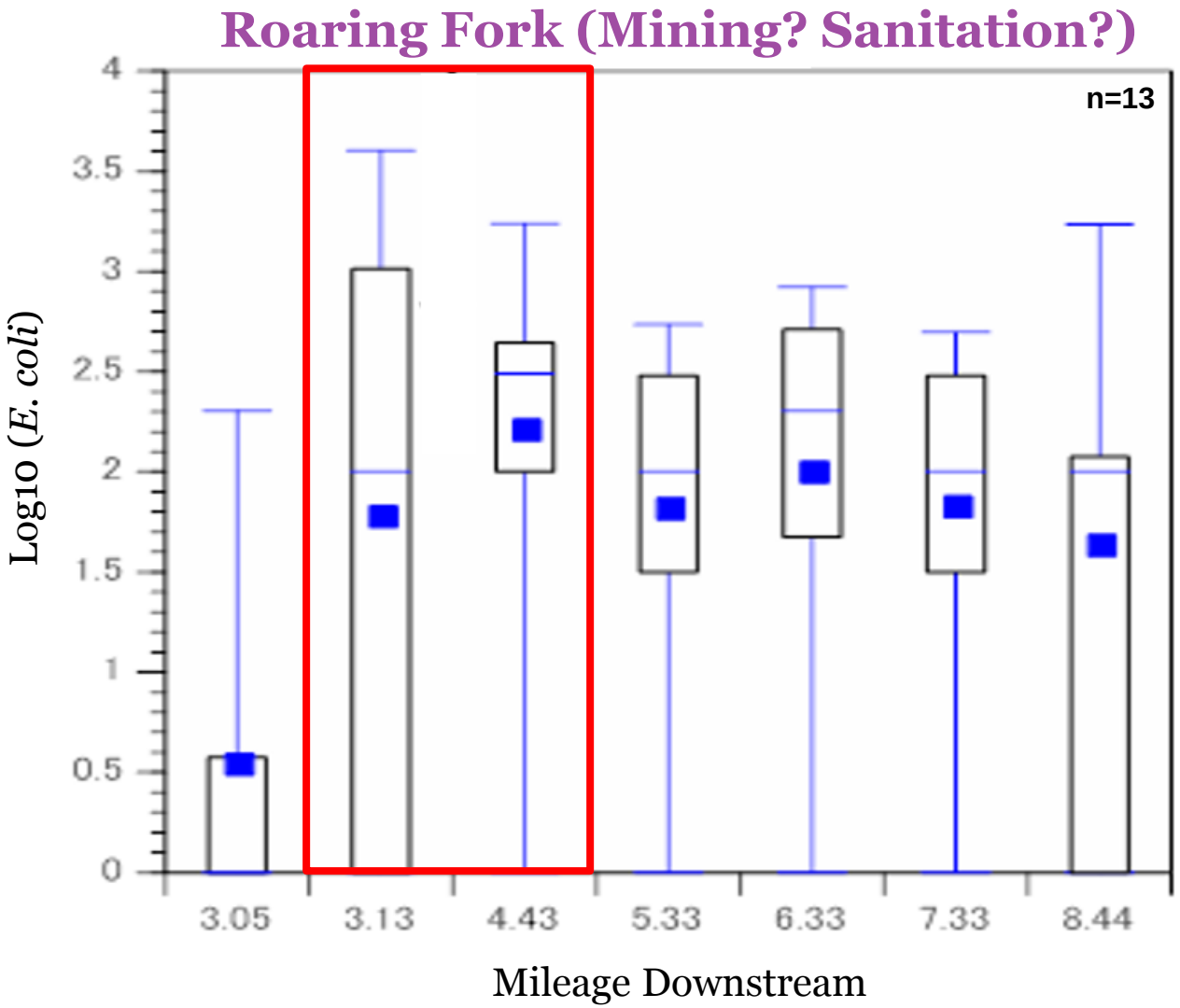
Sediments
TDS
Metals
Etc?

Organics
Microbes
TDS
Etc?

Watershed Study Cluster

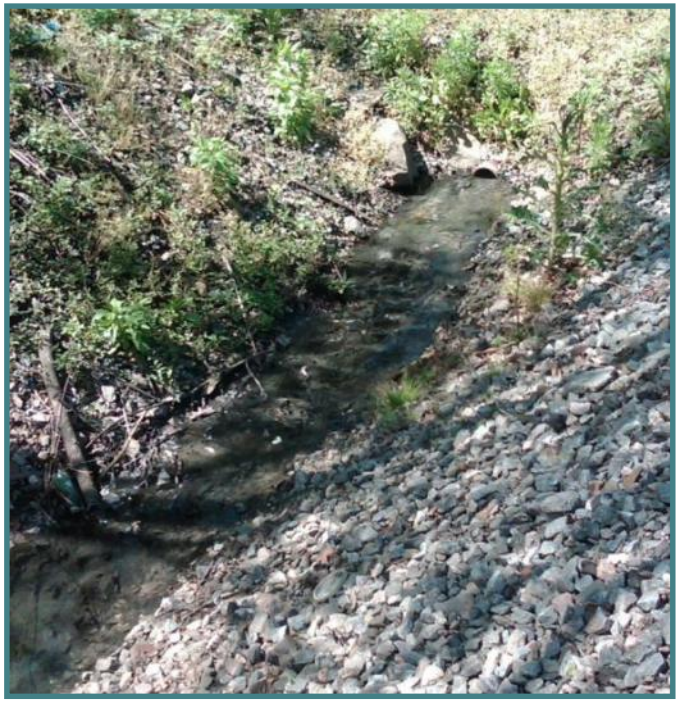


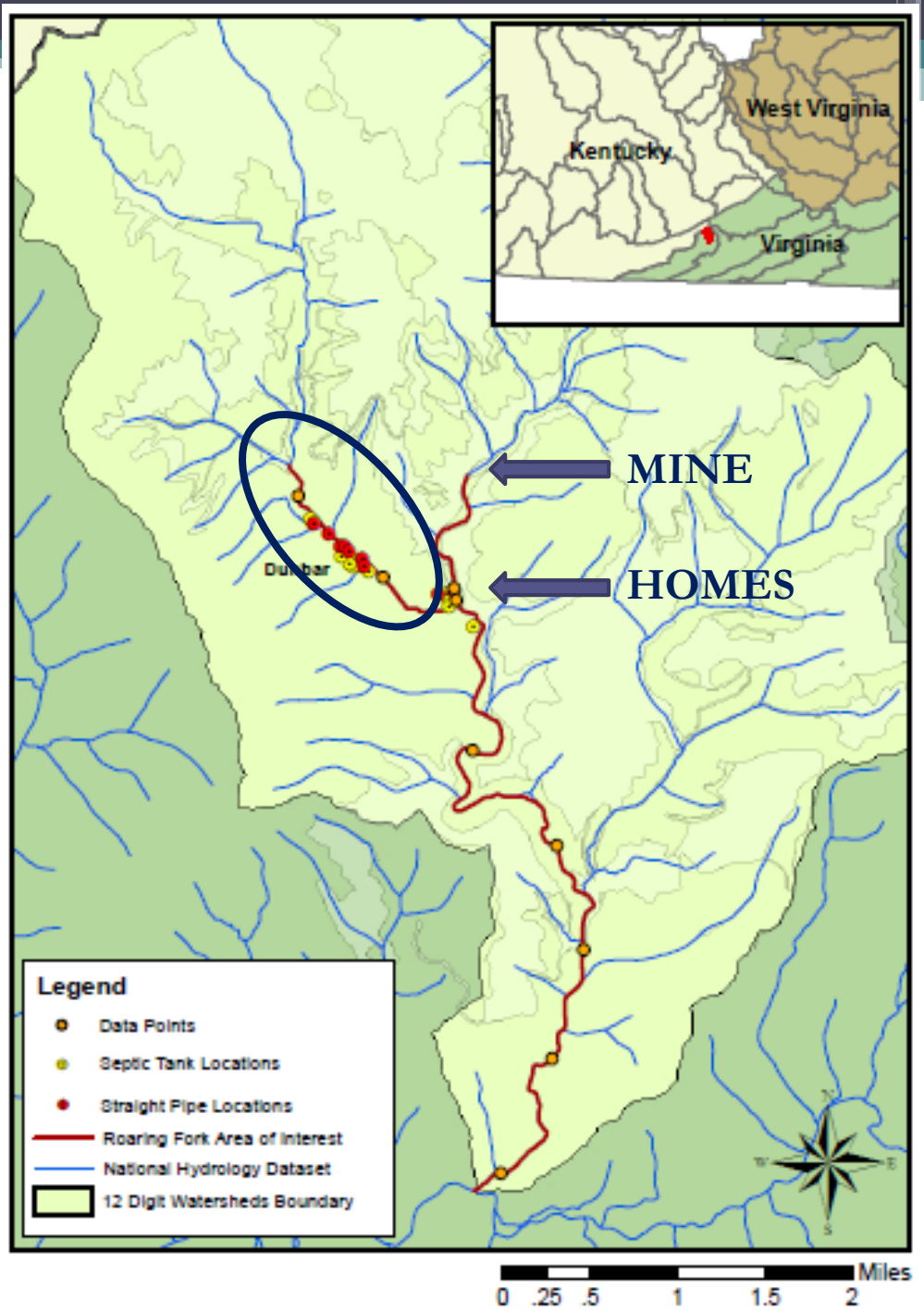
Preliminary points of interest



E. coli & Sewage

- Major tributary – Turning Branch & Community of Dunbar
- 21 straight pipes; 28 septic systems





Evidence of human exposure

Irrigation

Recreation

Evidence of human exposure

How do these communities obtain drinking water?

Evidence of human exposure

How do these communities obtain drinking water?

What's next?

- Clustered watershed study
  - Eight more months of monthly sampling
  - Benthic data analysis
  - Microbial source-tracking

- Rural drinking water
  - Homeowner perception and water quality
  - Re-sampling campaign (including lead profiling)

Acknowledgements

- Virginia Household Water Quality Program
  - Dr. Brian Benham and Erin Ling
- Collaborators
  - Dr. Marc Edwards (CEE), Dr. Daniel Gallagher (CEE), Dr. Emily Sarver (MinE), and Dr. Pete Ziegler (CALS)
- Sponsors
  - USDA-NIFA Rural Health Education Competitive Grant
  - Virginia Tech College of Agriculture and Life Sciences
  - Appalachian Research Initiative for Environmental Science

ARIES

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

VirginiaTech
College of Agriculture and Life Sciences

Questions & Discussion