

Estimating the Production of Arsenic-Bearing Residuals (ABR) From Maine's Drinking Water

John M. Peckenham

*Senator George J. Mitchell Center for
Environmental & Watershed Research*

University of Maine

Bladder Cancer Latest Annual Incidence Rate All Races (includes Hispanic) Both Sexes, All Ages

Counties (16)

Rank

Micromaps
for sorted column

1=Lowest
Cases per 100,000
20 25 30 35 40 45 50

□ U.S. (SEER+NPCR)

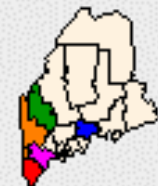
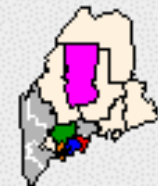
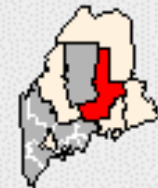
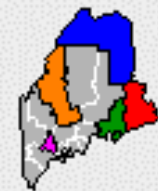
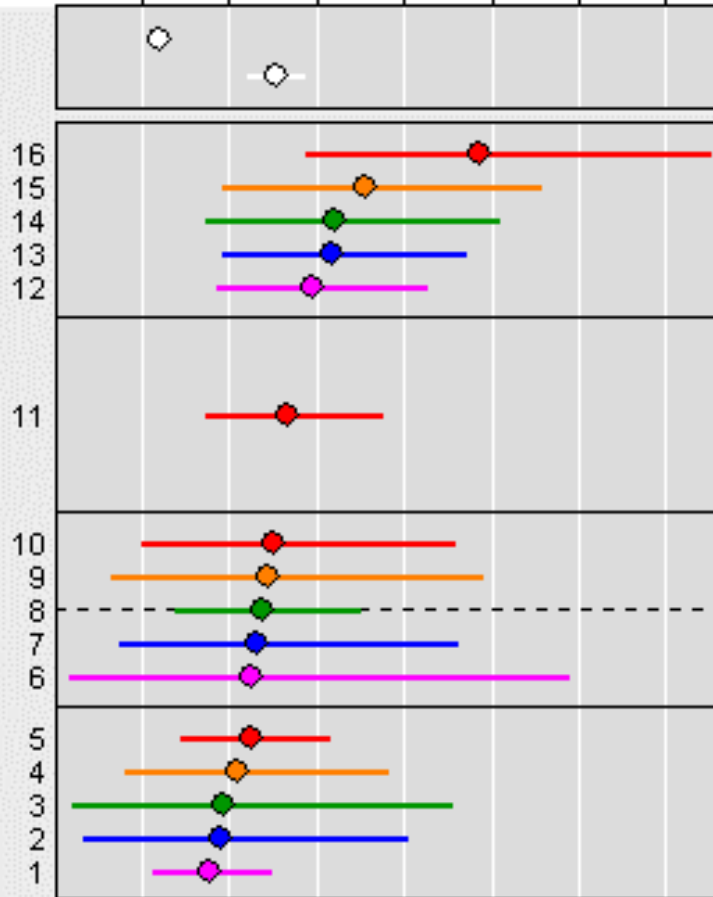
□ Maine

- Washington
- Somerset
- Hancock
- Aroostook
- Androscoggin

■ Penobscot

- Knox
- Sagadahoc
- Kennebec
- Lincoln
- Piscataquis

- York
- Oxford
- Franklin
- Waldo
- Cumberland

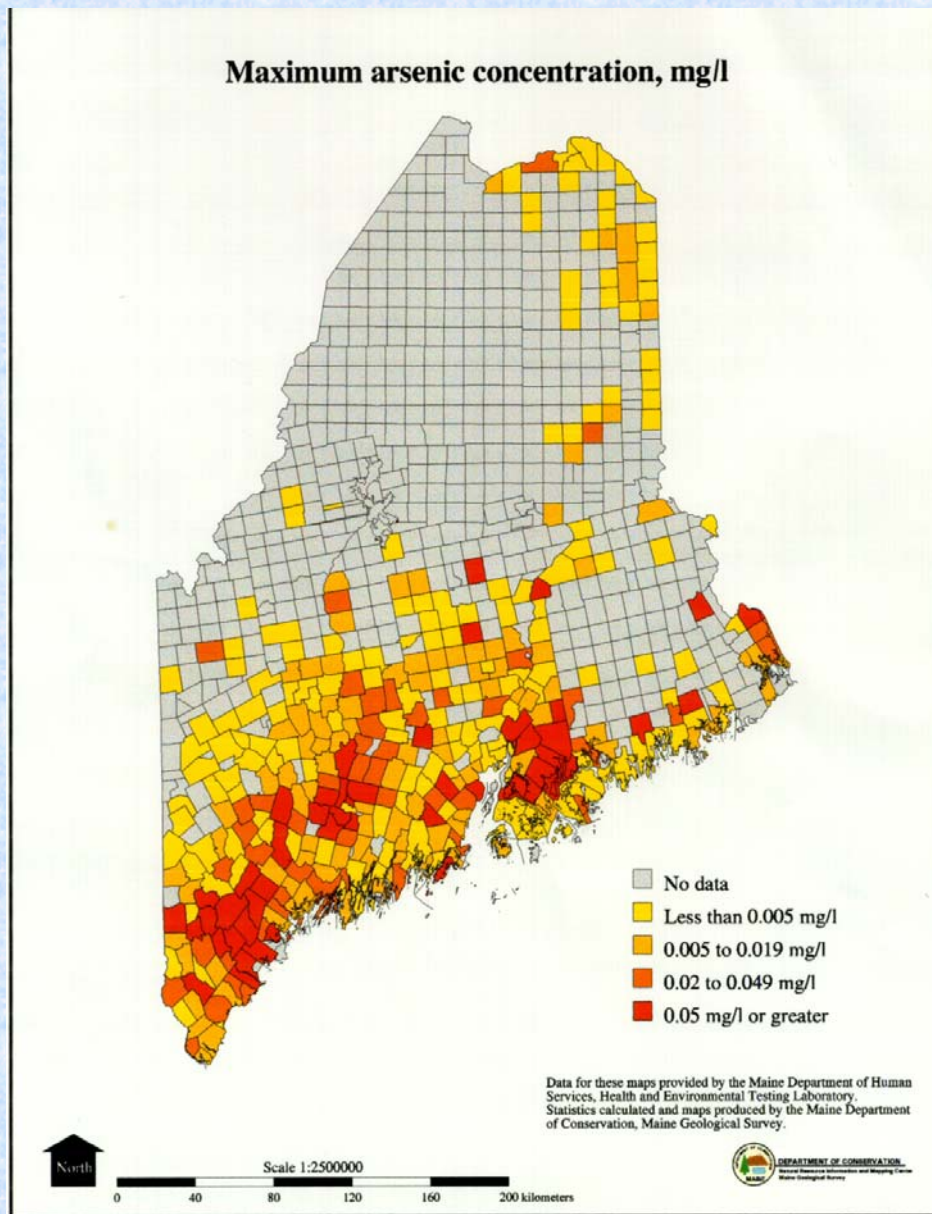


Key

- Value and 95% Confidence Interval
- ▭ Healthy People 2010 U.S. Target

- Median value for sorted column

ARSENIC IN MAINE'S GROUND WATER



Review of Statewide Private Well Test Data

1991 - 1994

13 % > 50 ppb

35 % > 10 ppb

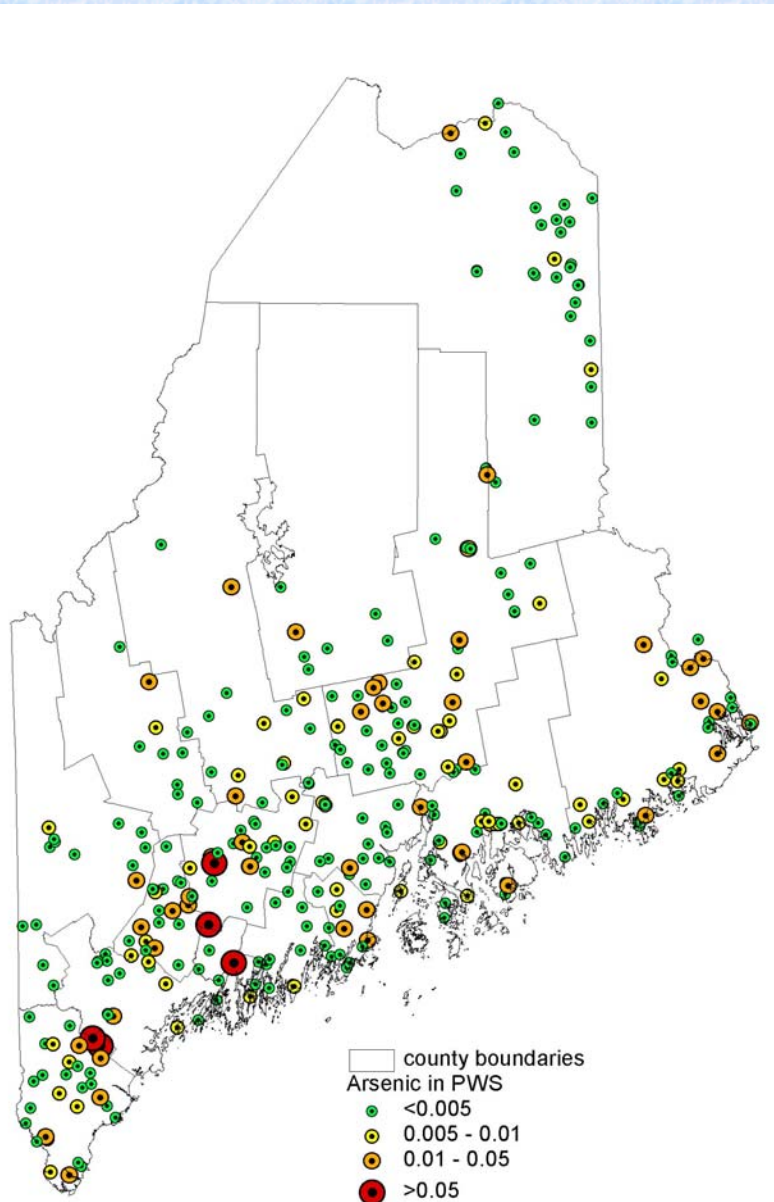
46 % > 5 ppb



ARSENIC IN MAINE'S GROUND WATER

Review of Statewide Public Well Test Data Source Water

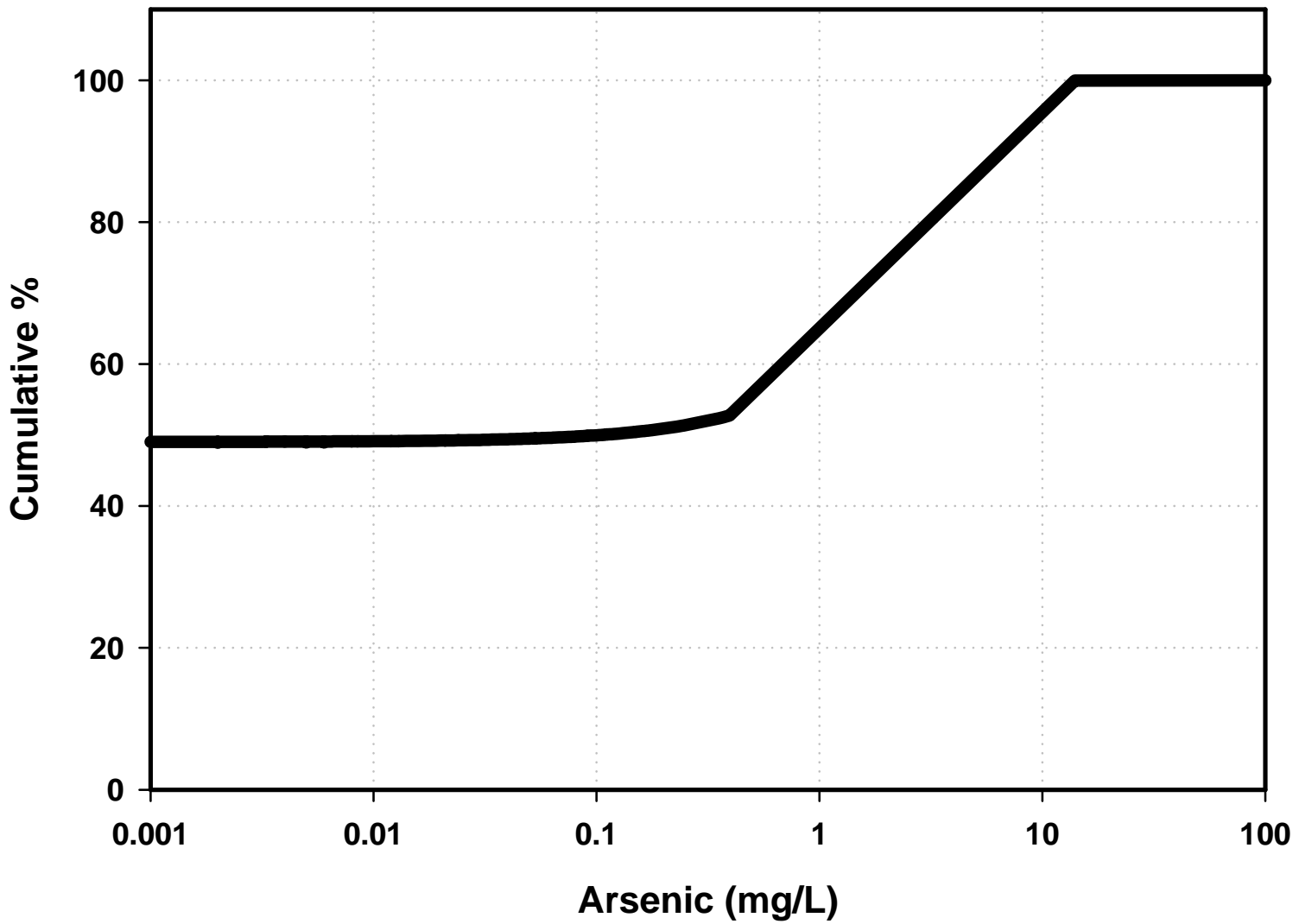
- 2 % > 50 ppb
- 16 % > 10 ppb
- 36 % > 5 ppb



Arsenic: All PWS

N = 4051

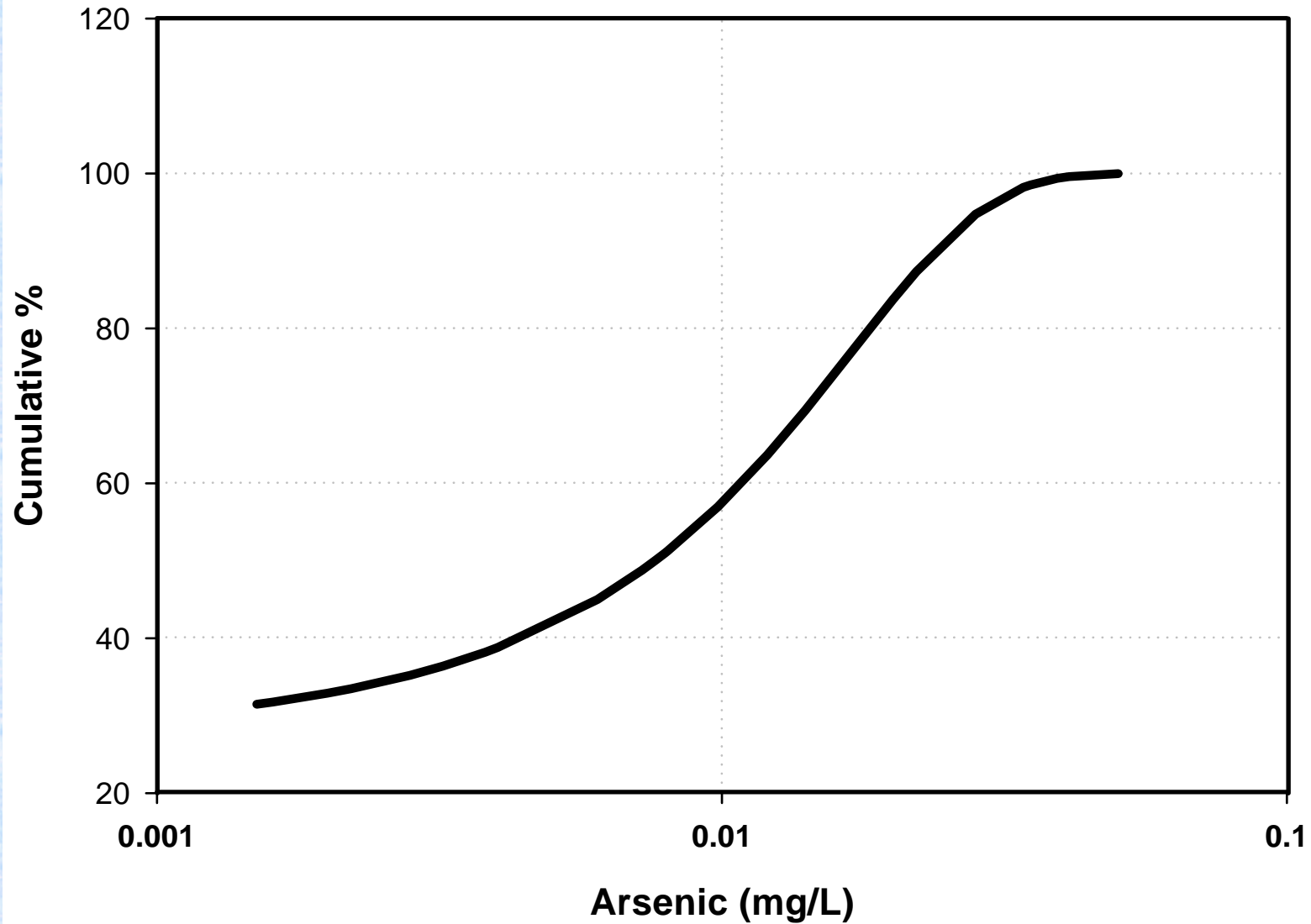
1999-2004



Arsenic (very small systems)

N=50

2000-2001

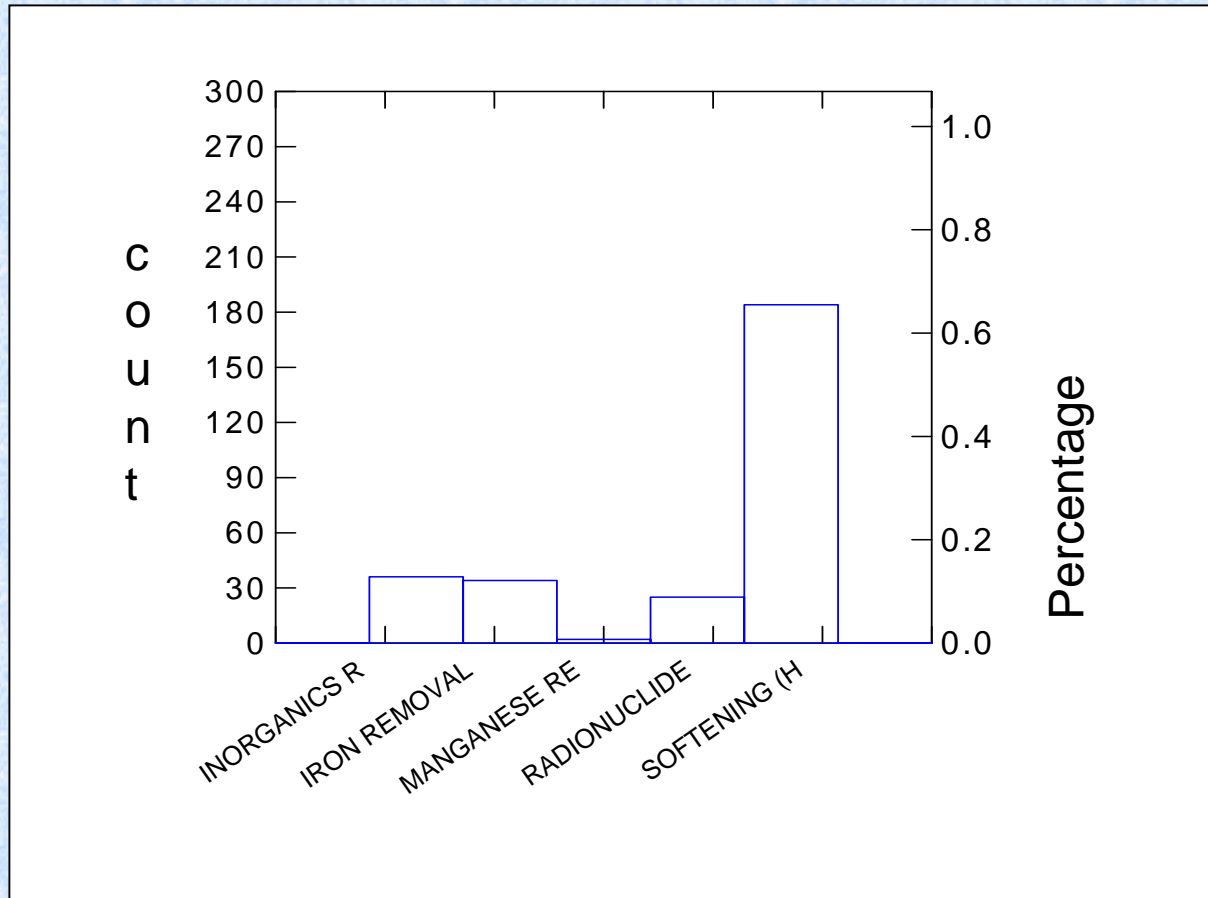


TECHNOLOGIES USED IN MAINE

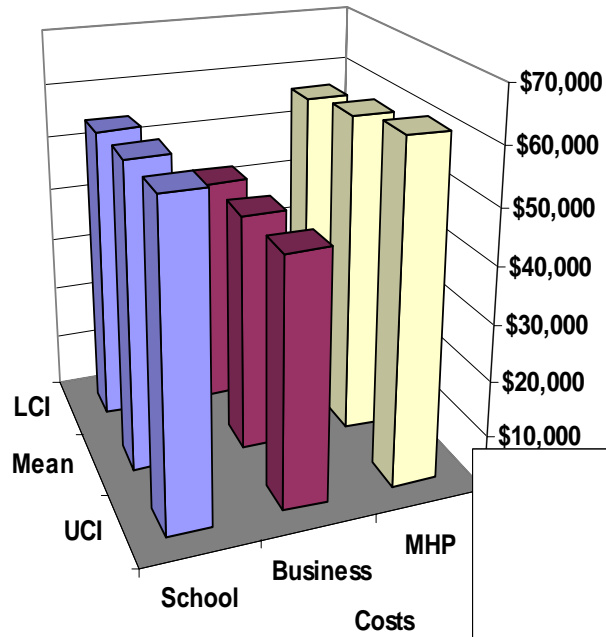
Type	Location	Capital Cost	O/M Cost	Life Cycle (years)
Activated Alumina	POU	\$600	\$1,000	~
Reverse Osmosis	POU	\$900	\$150	3-5
Reverse Osmosis	POE	\$9,000+	~	3-5
Iron Based Sorbent	POU	\$450+	\$100+/-	2-4
Iron Based Sorbent	POE	\$1,750+	\$100+/-	2-4

⇒ Costs Drive Technology Selection

Removal Techniques in PWS (N = 281)



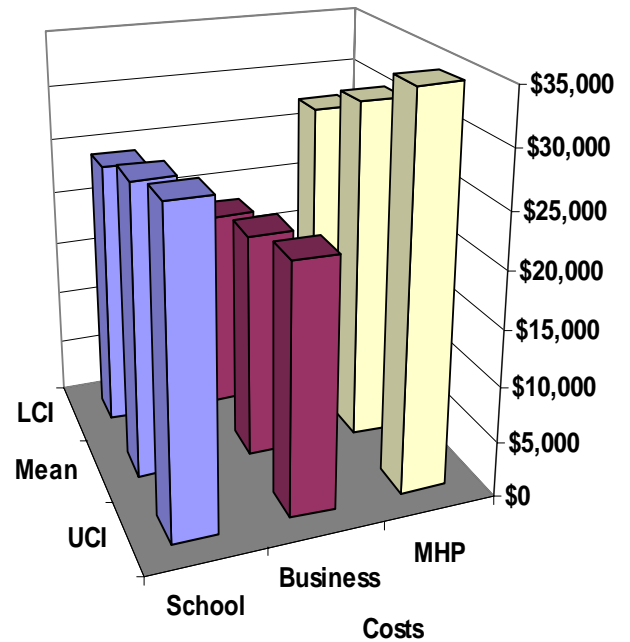
**Ion Exchange with Pre-Oxidation
Low Sulfate and Housing**



**Arsenic Removal Costs for
Small PWS**

\$20,000 to \$60,000/year.

**Activated Alumina with Disposal
pH = 7 to 8**



Maine 2005 Census Estimates

- Population: 1,320,505
- Households: 518,200
- PWS supply ~ 500,000 people
 - ~200,000 households
- Private Wells: ~300,000

WATER USE

Schools = 20 gallons/person/day

Businesses = 15 gallons/person/day

Mobile Home Parks = 65
gallons/person/day

Based on USGS Estimates.

ABR 1st Approximation

Private Wells

- 35% of wells >0.01 mg/L As
- 65 gpd/person = 163 gpd/household
- 300,000 households
- Range of Arsenic 0.01 to 0.05 mg/L

Low Estimate = **0.65** kg/day

High Estimate = **3.2** kg/day

ABR 1st Approximation

Small Public Supplies Using Wells

- 16% of wells >0.01 mg/L As
- N = 59 Community Supplies
- N = 72 Non-Community Supplies
- Mean Community Arsenic = 0.033 mg/L
- Mean Non-Community Arsenic = 0.023

Small Community Estimate = **1.5** kg/day

Non-Community Estimate = **0.027** kg/day

Sources & Sinks

(research needed)

- Sources

- Native Geology
- Secondary Mobilization
 - Agriculture (former use of pesticides & biosolids)
 - Land Disposal of Arsenical Materials



Sinks

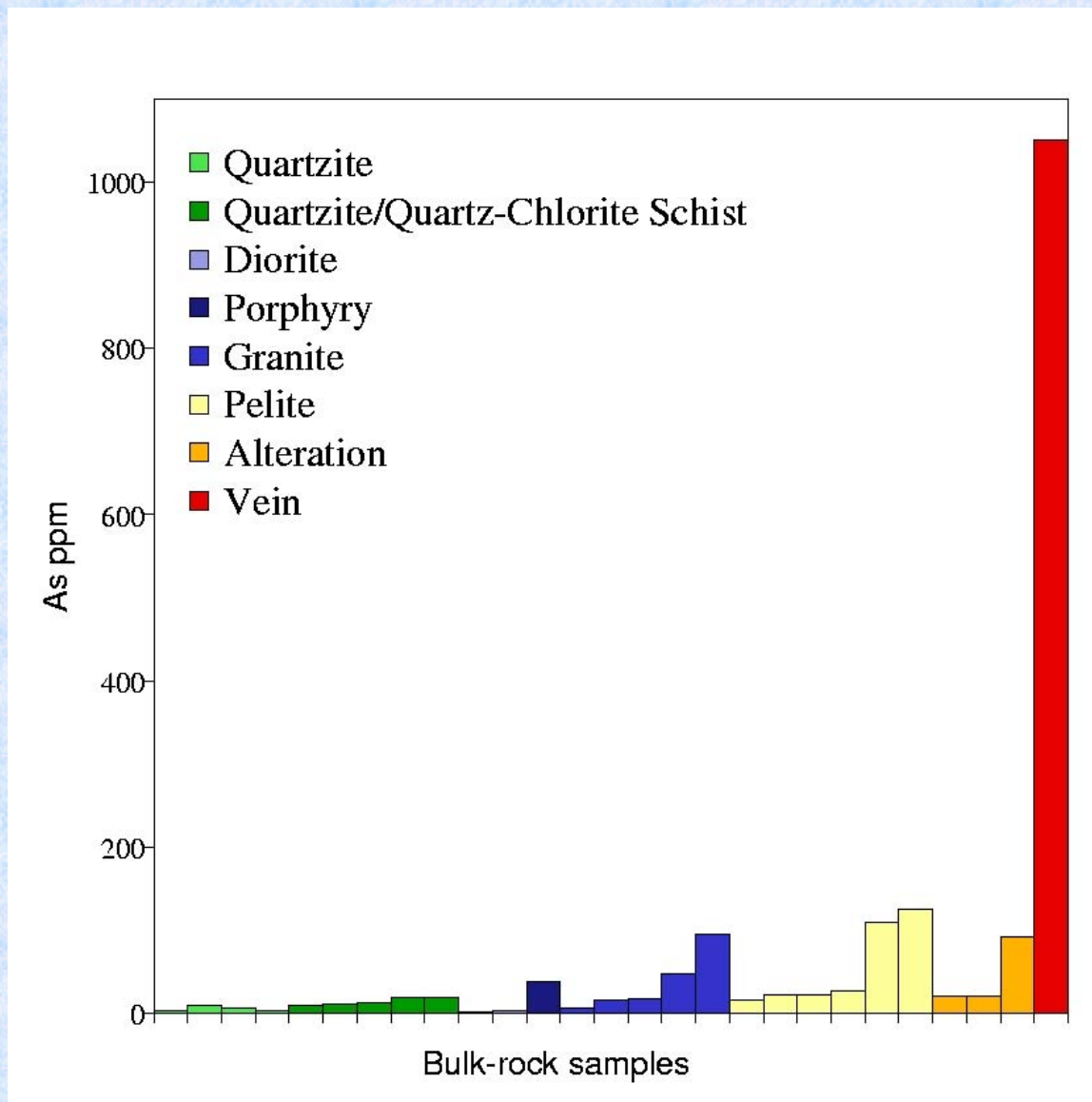
Septic Systems (20 to 100%)

WWTP (up to 100%)

Landfills (20 to 80% diverted from POU/POE)



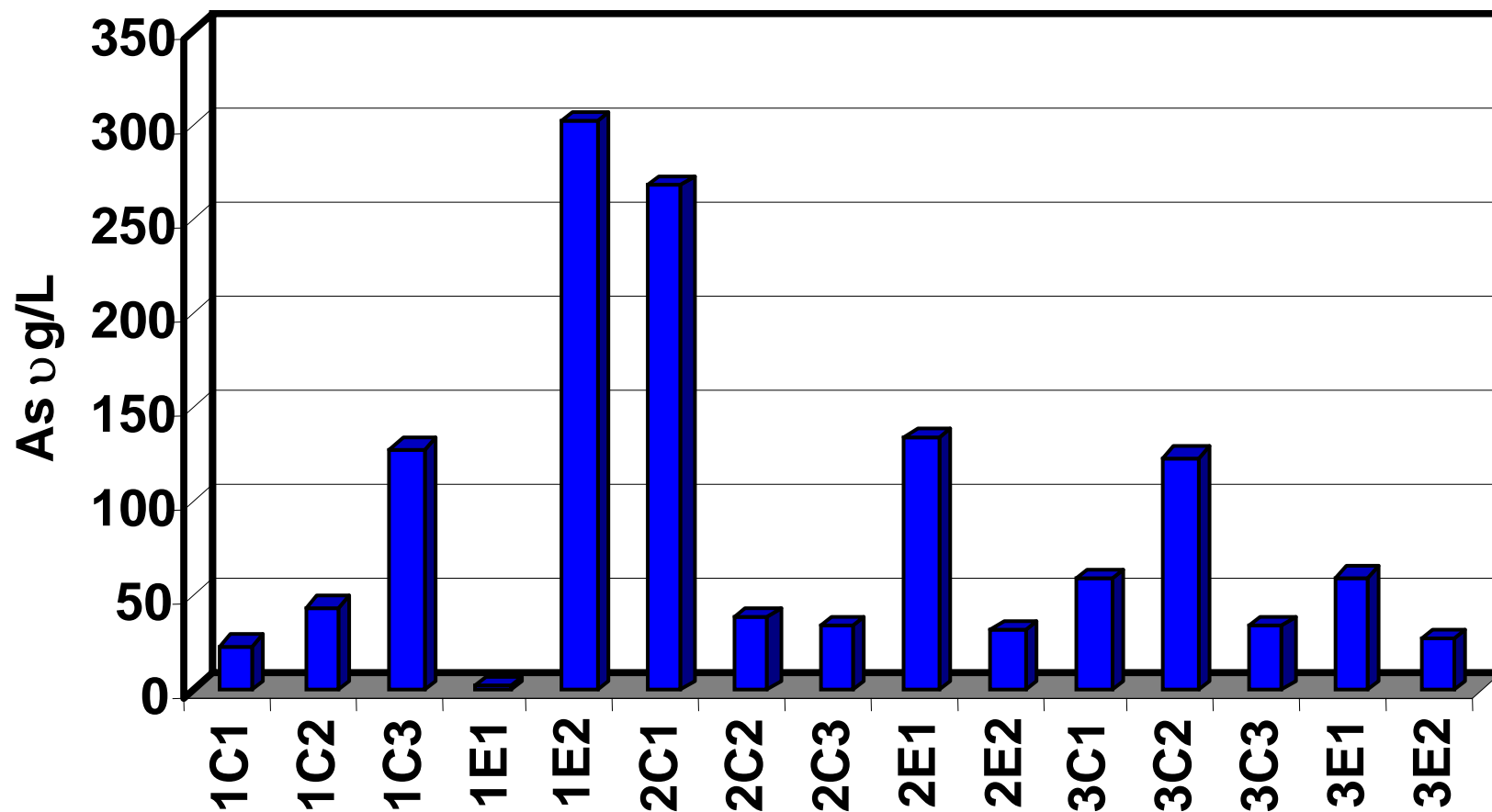
Bulk-rock As concentrations (Northport, Maine)



Courtesy of Gail Lipfert, 2006



Lysimeter Results 6/03 Arsenic



Lakehurst Acres

- Arsenic Removal System Installed (25 unit complex, ~ 40 residents).
- Arsenic Concentrations Were Reduced (RO).
- Lead went from 8 ppb to 3200 ppb!!! (MEG=10)
- Daily backwash to lessen load to POTW, alkalinity stripped by frequent backwash.

Closing Thoughts

- Total Daily Arsenic Passing Through Private Homes and Schools.

☹ 2.2 to 4.7 kg/day

Amount of Arsenic needed to affect one household for 1 year \cong 2.25 g.

Based Upon Mass Balance,

If ABR Recycles in the Environment

1,000 + Additional Households/Year Will Be Affected.

Plus: Fe, Mn, U, Ra,...

Information and Support Provided by:

Maine Drinking Water Program

U.S. EPA Region 1

Maine Department of Environmental Protection

Maine Geological Survey

U.S. Geological Survey (Charlie Culbertson)

Maine Waste Water Control Association

UMaine Research Colleagues-

Aria Amirbahman, Kathleen Bell, Kevin Boyle,

Gail Lipfert, Jean MacRae, and Andy Reeve.

CONTRACTORS SUPPLYING INFORMATION

Advanced Quality Water Solutions

Air and Water Quality, Inc.

Aroostook Water Care, Inc.

Everett J. Prescott, Inc.

Haskell's Water Treatment

Lowry Aeration Systems

Main Source Water Treatment

Norlens Water Treatment

Quot Homines, Tot Sententiae

(Publius Terentius Afer).

