Safe Drinking Water: Now and in the Future

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GUIRR Roundtable
June 2010

Agenda

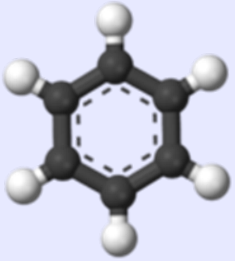
- Drinking Water Quality
  - Where have we been?
  - Where are we now?
  - Where are we going?
    - A Drinking Water Strategy for the 21st Century
- Drinking Water Quantity
  - Where have we been?
  - Where are we now?
  - Where are we going?
    - Stationarity is Out – Resiliency in In
- The Bigger Picture
  - Sustainable communities
  - Global drinking water
  - Technology and education

Quality Challenges: a range of potential contaminants

- *Acute Health Risks* **- effects from short term exposure**
  - Bacteria (e.g., *E.coli)*
  - Viruses (e.g., Hepatitis-B)
  - Protozoa (e.g., *Cryptospordium*, *Giardia*)
  - Nitrate

Crypotosporidium

- *Chronic Health Risks* **- long term exposure**
  - Chemicals: metals (e.g., arsenic), synthetic organics (e.g., pesticides), and volatile organics (e.g., benzene)
  - Disinfectants and byproducts (e.g., chlorine, chloroform)
  - Radiation (e.g., radon)

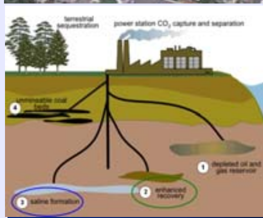


Benzene

Quality Challenges: risks come from every direction

- **Long Standing**
  - Point Sources (e.g., POTWs, Industrial)
  - Septic Systems
  - Polluted Runoff (e.g., Urban, Agriculture, Forestry, Mining)
  - Air Deposition
  - Changing Landscapes
- **Emerging**
  - Energy Production (GS and HF)
  - Pharmaceuticals and Personal Care Products
  - Climate Change



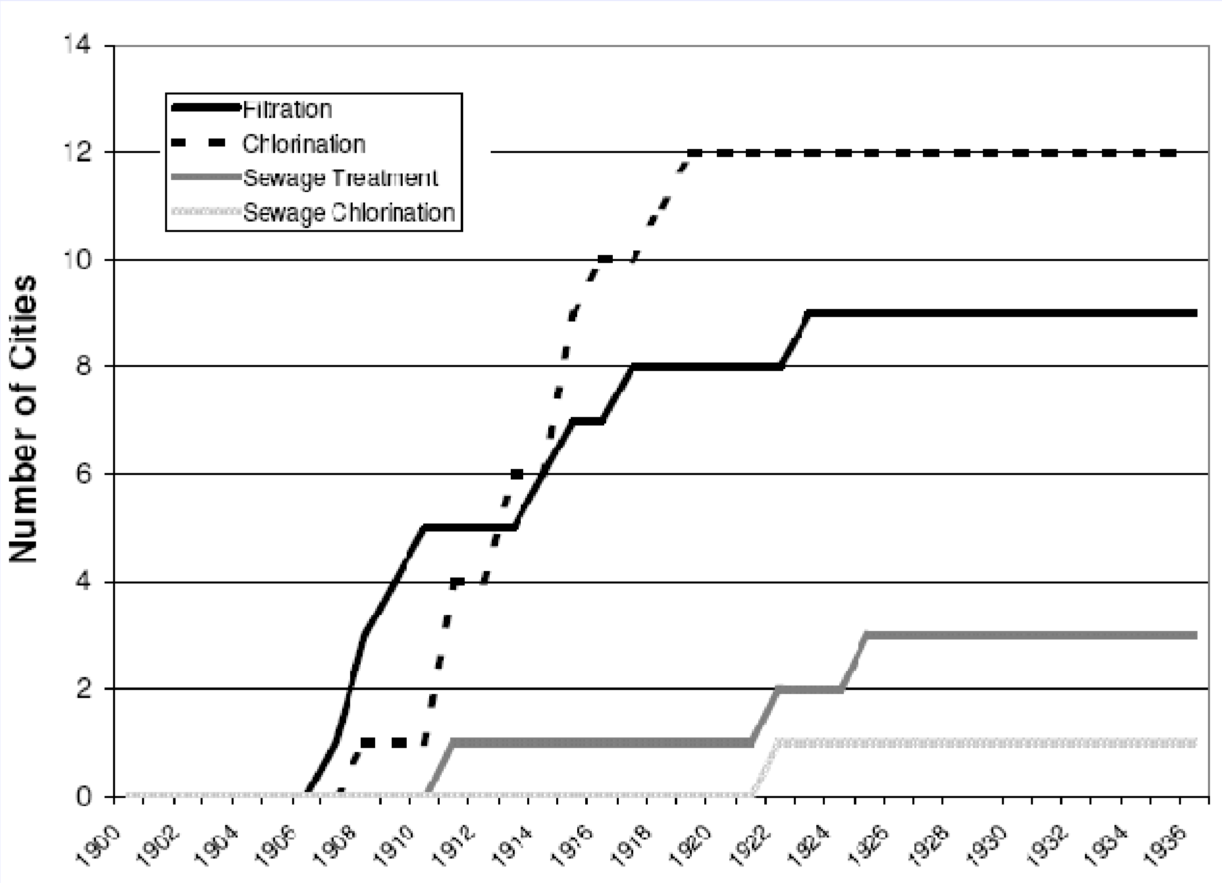




Quality – The past

Cartoon by Zim, 1919

- The challenge?
  - Waterborne disease
  - Insufficient infrastructure
- The solution?
  - Source protection
  - Filtration
  - Chlorination

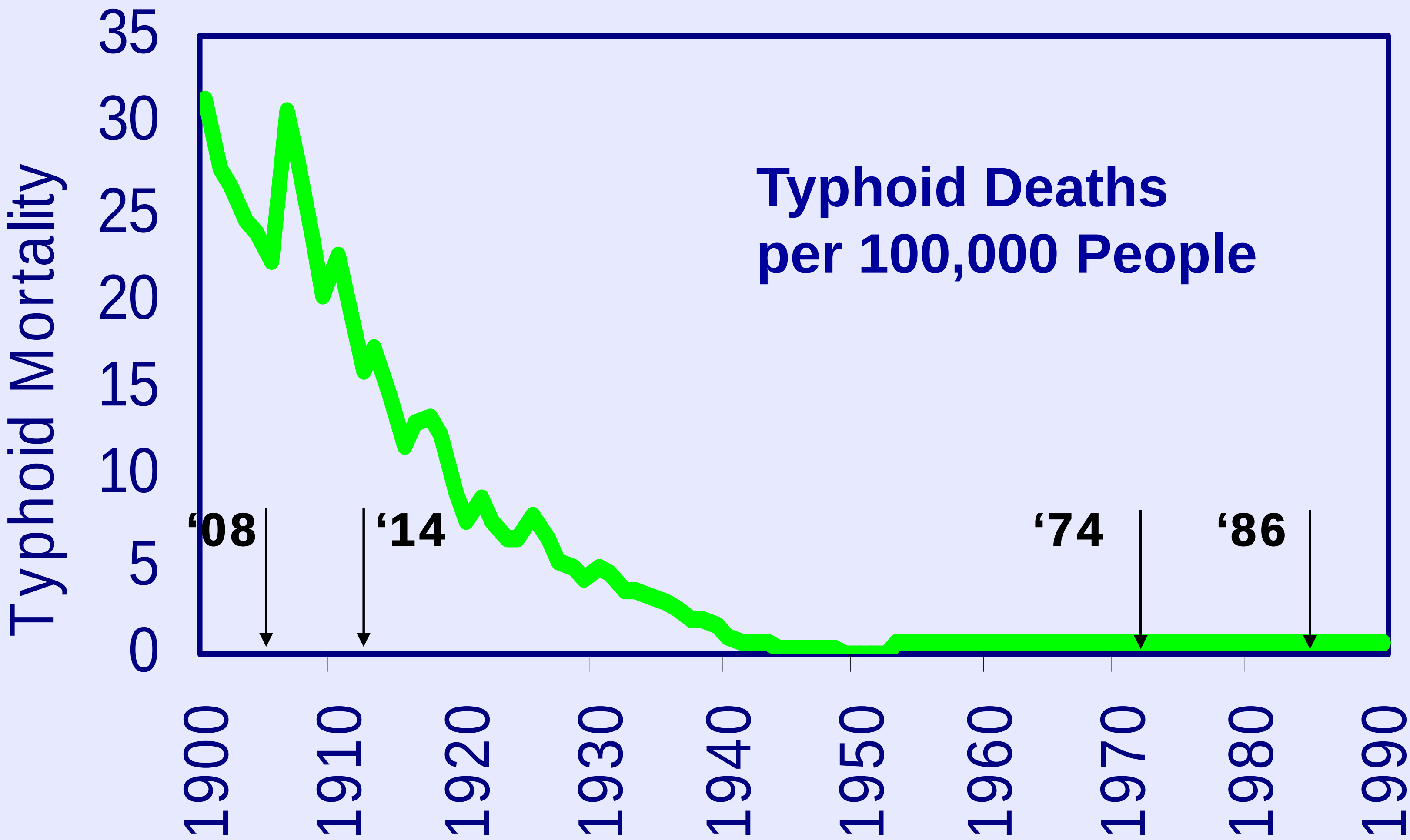
Emerging treatment



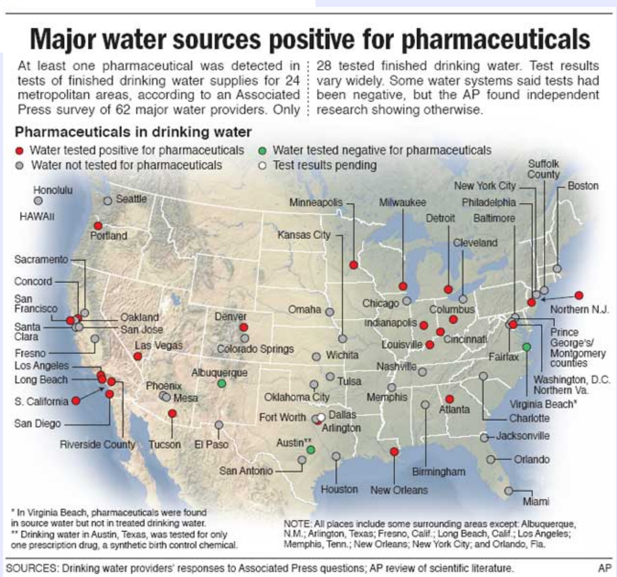
Baltimore, Chicago, Cincinnati, Cleveland, Detroit, Jersey City, Louisville, Memphis, Milwaukee, New Orleans, Philadelphia, Pittsburgh, and St. Louis

The Role of Public Health Improvements in Health Advances: The 20th Century United States, David Cutler and Grant Miller, NBER Working Paper No. 10511, May 2004 http://www.nber.org/papers/w10511.pdf

Drinking water treatment reduced waterborne disease

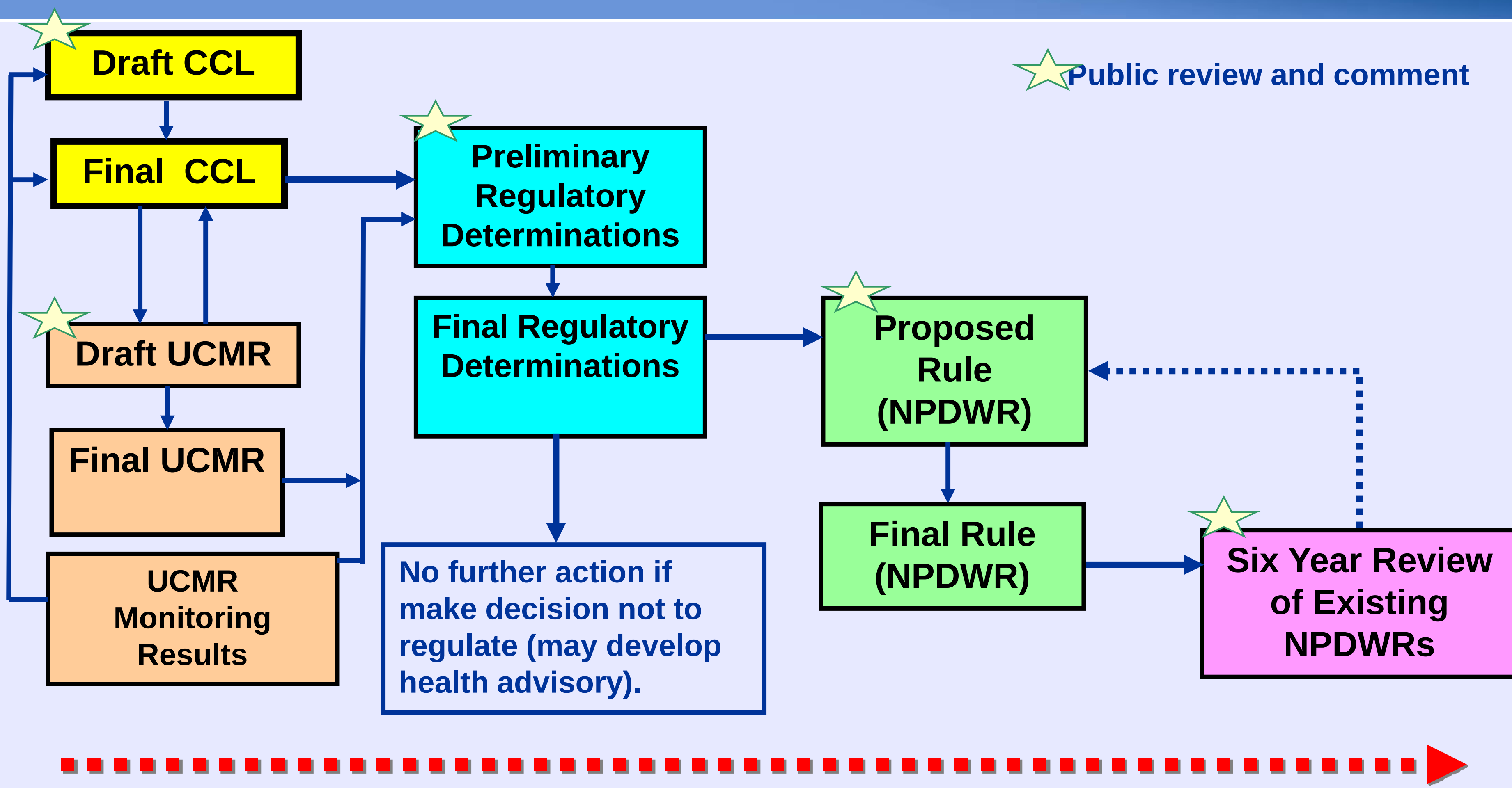


Quality - Today



- The good news?
  - Most of the population receives water that meets federal standards for more than 90 contaminants
- The challenge?
  - Potpourri of 80,000+ chemicals in commerce
  - Better detection, but limited health information at low concentrations
  - Increased public awareness and expectations
- The solution?
  - A new approach for evaluating contaminants

1996 SDWA Systematic Regulatory Development Process



At each stage, need increased specificity and confidence in the type of supporting data used (e.g. health and occurrence).

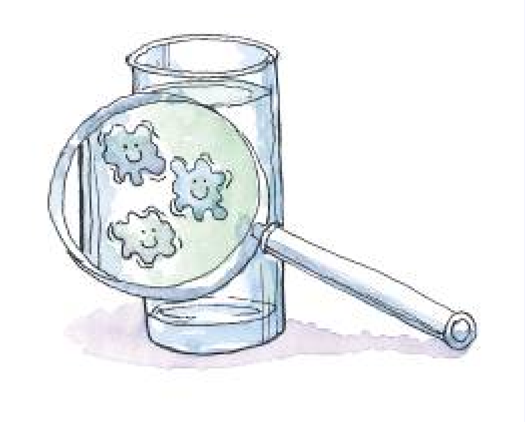
Drinking Water Strategy - Goals

- **Provide more robust public health protection** in an open and transparent manner

- **Assist small communities** to identify cost and energy efficient treatment technologies.

- **Build consumer confidence** by providing more efficient sustainable treatment technologies to deliver safe water at a reasonable cost.

Drinking Water Strategy – Four Principles



- Address contaminants as groups rather than one at a time
- Foster development of new drinking water treatment technologies
- Use the authority of multiple statutes to help protect drinking water
- Partner with states to share more complete data from monitoring at public water systems

Quantity Challenges

- Long-standing
  - Meeting demand
  - Public expectations – people expect water to be there when they want it
  - Drought
- Emerging
  - Climate change
  - Competition for resources (e.g., energy vs. water, municipal vs. agricultural use)

When the well's dry, we know the worth of water

Quantity -The past

- If you needed water, you drilled a well or built a dam

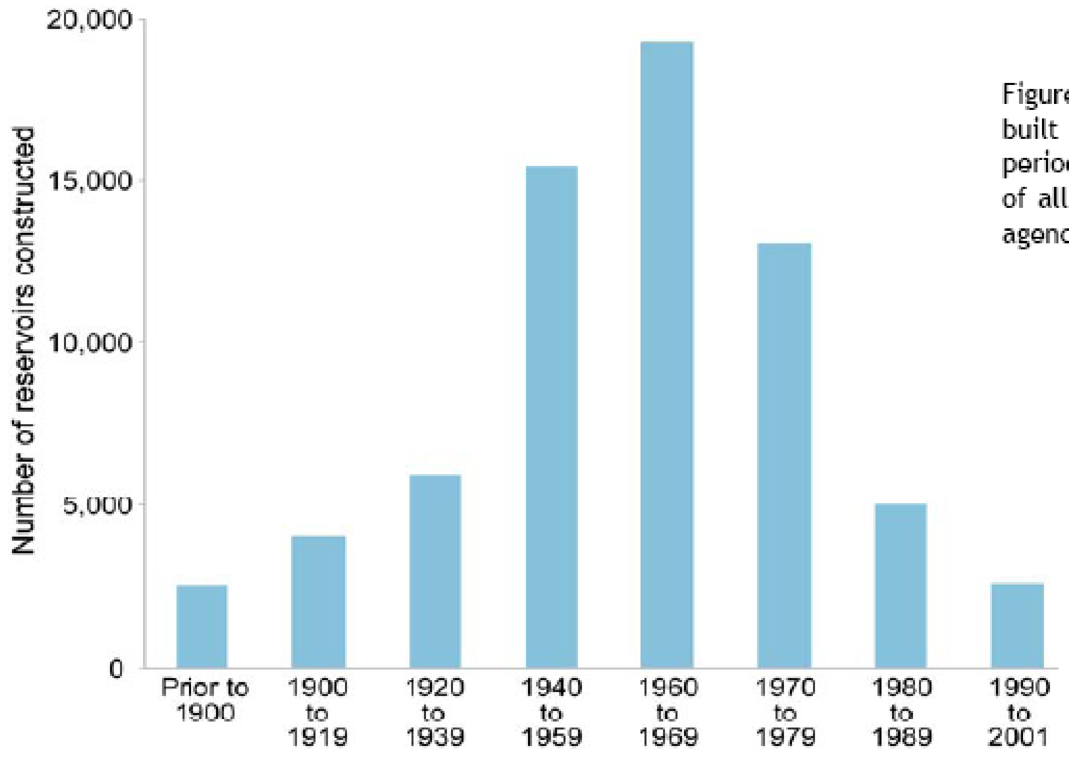
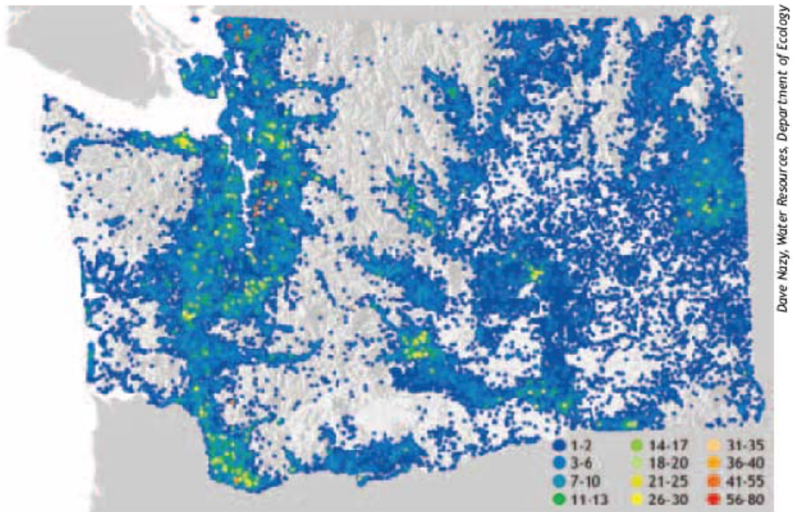


Figure 3.1. The number of reservoirs built in the United States by time period. This figure includes dams of all sizes recorded by regulatory agencies (Gleick, 2000).

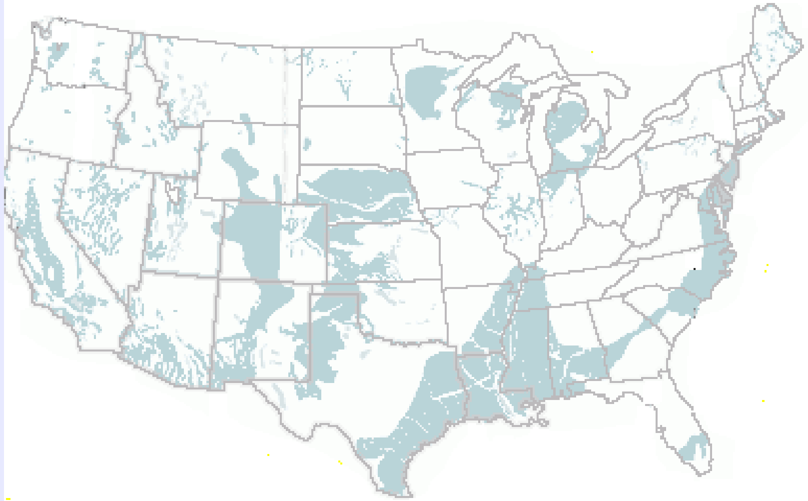
Today

- It’s not that easy to build dams and reservoirs
- Abundance of ground water wells and associated overpumping is depleting aquifers faster than they can recharge

Water well logs per 40 acres - 2009



Each dot represents a group of the estimated 1 million water wells drilled in Washington State since the 1940s

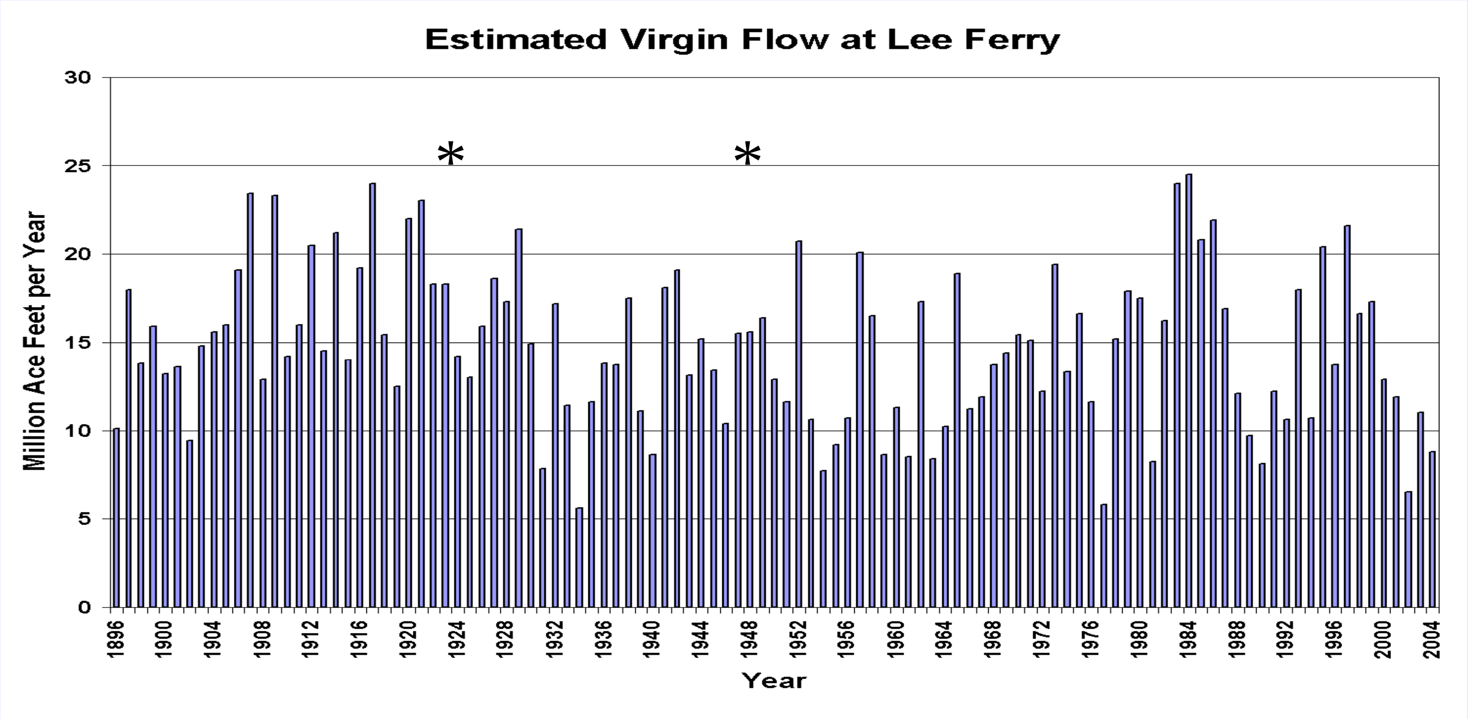


Areas where subsidence has been attributed to ground-water pumpage (Land Subsidence in the United States, USGS Circular 1182)

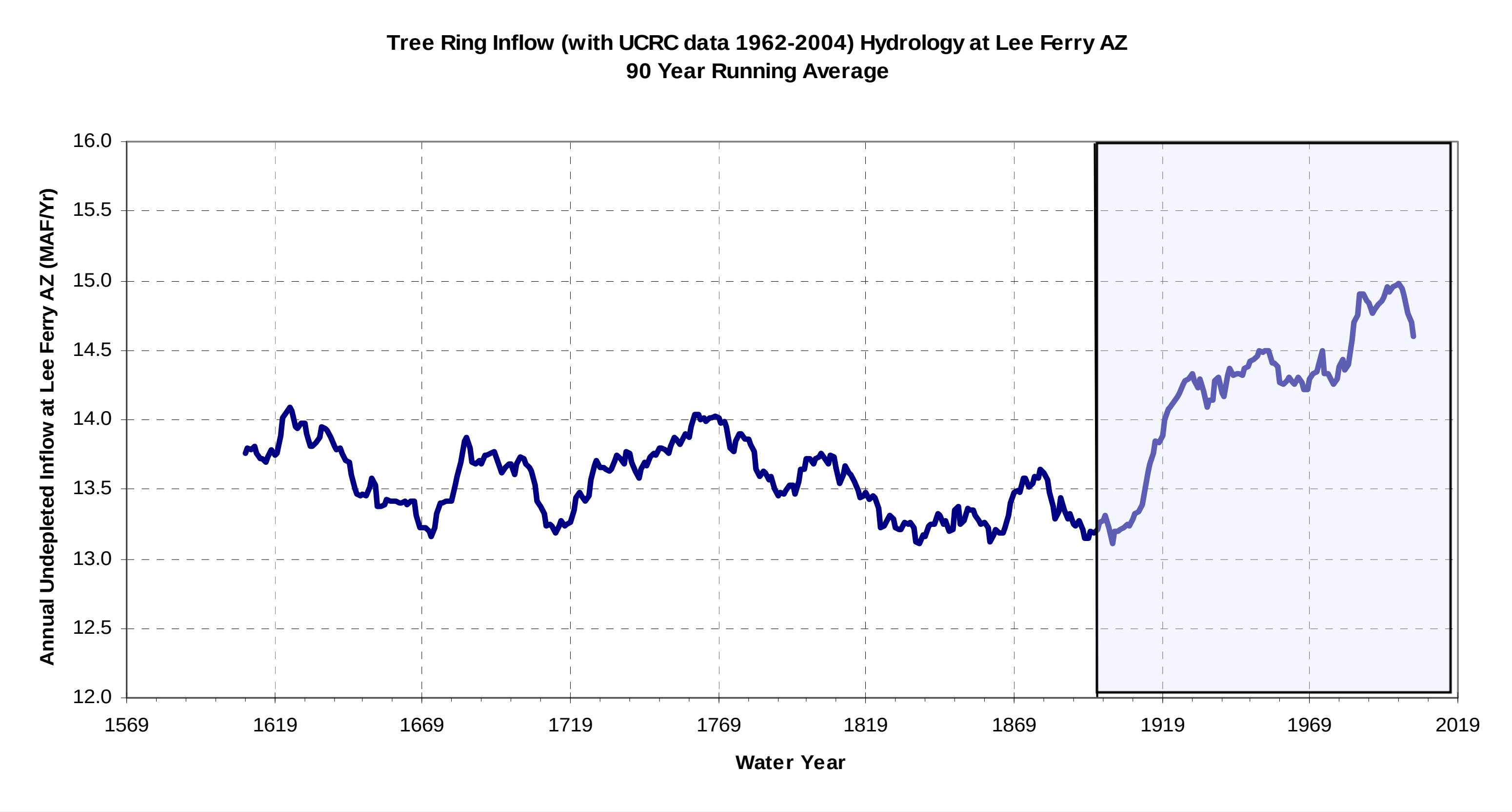
- And building a dam does no good if there is no precipitation to fill it

Stationarity?

- It seemed to make sense to predict the future based on the past
- Colorado compact* allocations based on historical flows in the 1900's

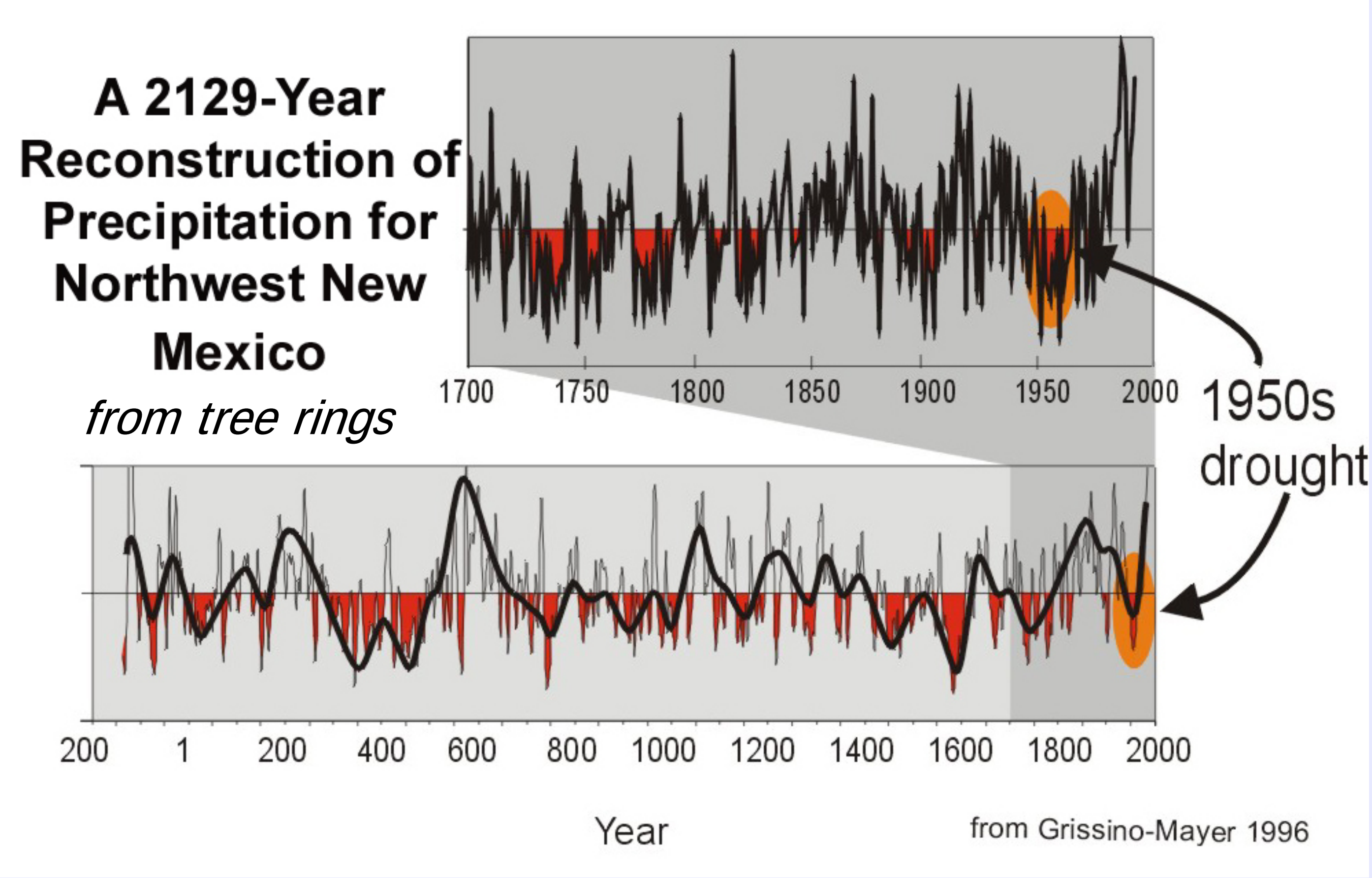


- But what if the history you looked at didn't go back far enough to pick up variability?



This and previous slide adapted from presentation on Policy Implications of the Colorado River Compact, Eric Kuhn, GM, Colorado Water Conservation District http://www.crwcd.org/page_154

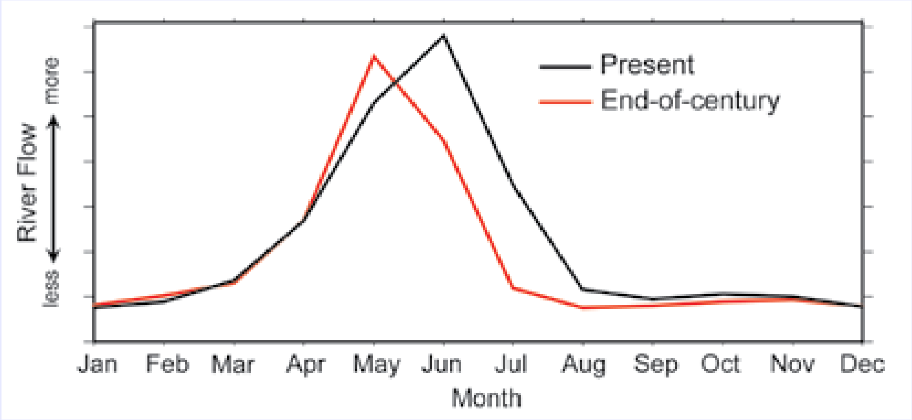
How bad a drought is bad?



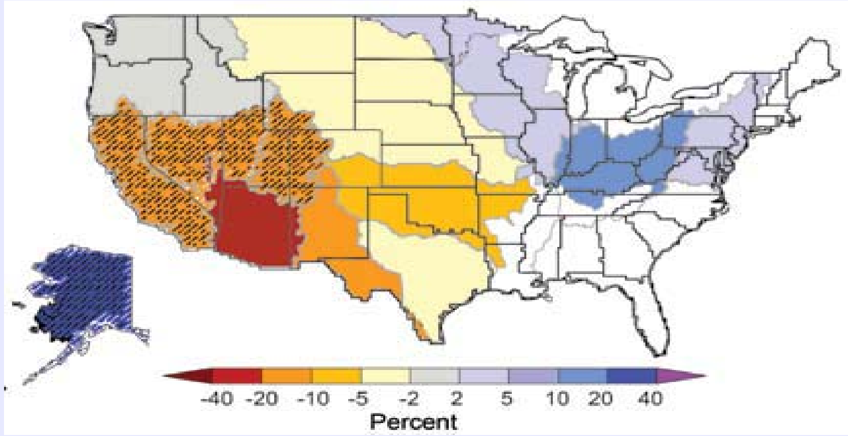
North American Drought: A Paleo Perspective
http://www.ncdc.noaa.gov/paleo/drought/drght_data.html

And what will the future bring?

- More uncertainty!
  - changes in precipitation patterns and intensity
  - changes in the incidence of drought
  - increasing evaporation
  - increasing water temperatures
  - changes in soil moisture and runoff



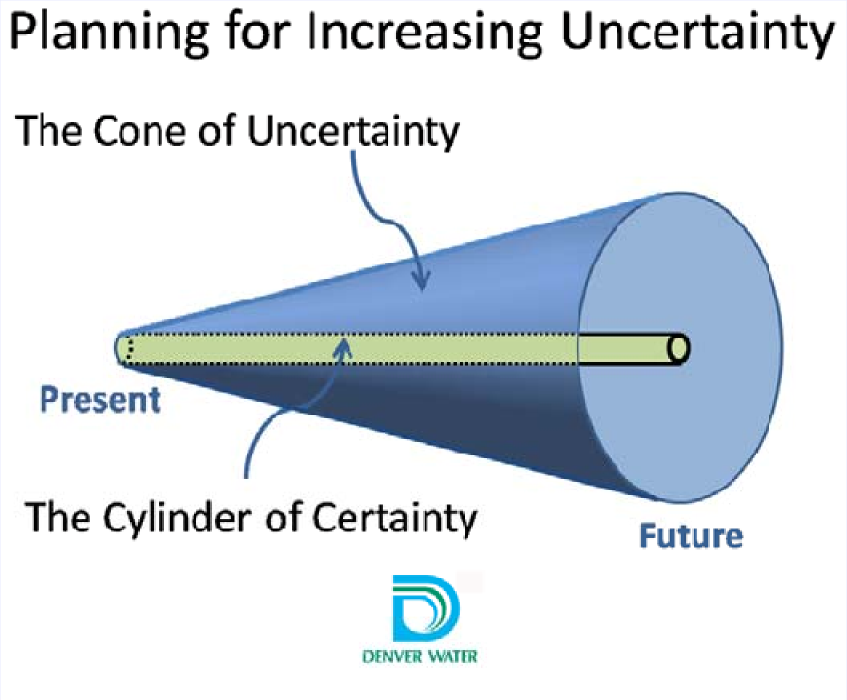
Simulated Changes in Annual Runoff Pattern
Green River, Colorado River watershed



Projected changes in median runoff for 2041-2060, relative to a 1901-1970 Baseline, Results based on emissions in between the lower and higher scenarios

Stationarity is Out

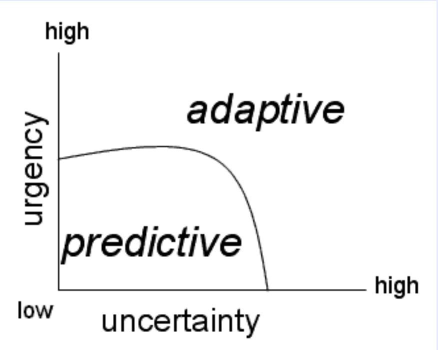
- Relying on the past to predict the future is no longer the best strategy
- Climate models are not yet reliable enough to predict impacts at scale needed to influence water infrastructure/management decisions
- What to do?!



The Solution? Build Resiliency!

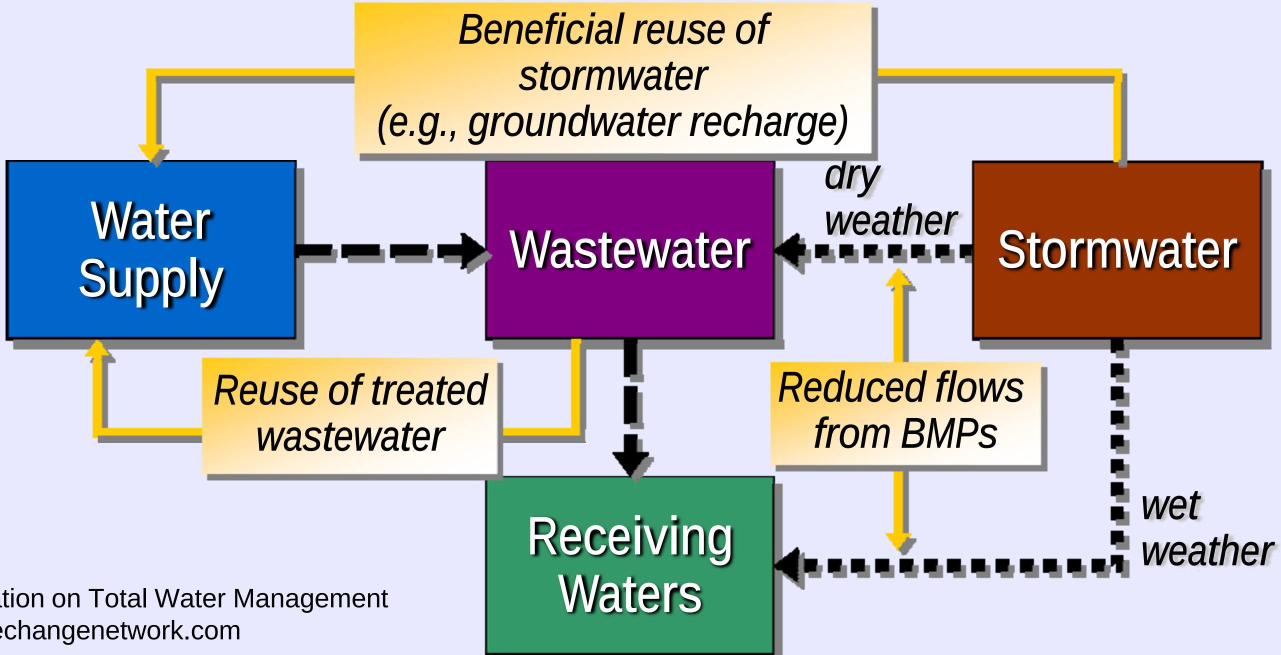
There are several strategies to consider

- Protect what you have
  - Protect existing resources from contamination
- Use water efficiently
  - Supply side – water loss control programs
  - Demand side – WaterSense, rate-setting
- Diversify your portfolio
  - Mix up supplies (surface water, ground water, reclaimed water, desalination, conjunctive use management)
- Plan for many outcomes
  - Robust/scenario planning - WUCA
- Use adaptive management approaches
  - Climate Ready Water Utilities



Infrastructure for the 21st century

- Rethinking how we manage our water infrastructure
  - Matching water quality to its use
  - A cradle to cradle approach to water management
  - New treatment technology that is effective at removing multiple contaminants and affordable



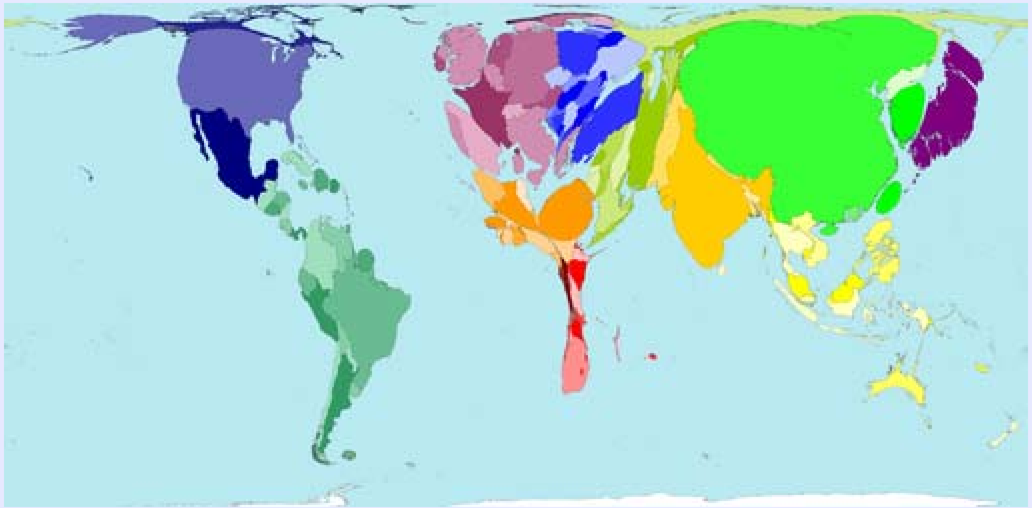
Graphic from presentation on Total Water Management
http://www.cdmclimatechangenetwork.com

Sustainable Communities

Our goal is to foster sustainable communities – which need to have

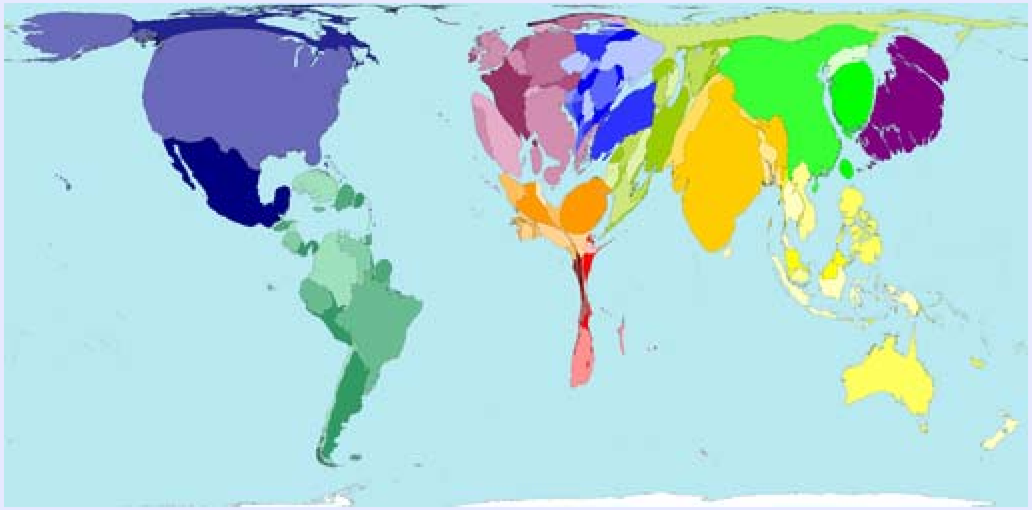
- Healthy drinking water
  - With assurance that disadvantaged members of the community share the benefits
- A ready supply of water
  - Challenges in determining where limited resources may be best allocated – and remembering need for ecological flows
- An informed and engaged public
  - People still do not understand the value of water and their role in ensuring availability and quality
  - Communicating risks about contaminants remains a challenge

And the rest of the world?



Access

Territory size shows the proportion of all households with tap water supplies that are found there.



Domestic water use

Territory size shows the proportion of all water used for domestic purposes that was used there.

Graphics from http://www.worldmapper.org

What we need from the research community

- Health science– a better understanding of risks
- Technology – new approaches to treatment
- Social science– how to communicate risks and influence behavior change
- Climate science – better information/models on potential impacts
- Engineering – infrastructure solutions for the 21st century

We need you to train the next generation of practitioners who understand the accomplishments of the past,
the challenges of the present, and
are ready to come up with solutions for the future!

Questions?