

# Overview of Drinking Water Quality Management

**Dr. Audrey LEVINE<sup>1</sup>**

**National Program Director for Drinking Water, USEPA**

**Dr. James A. GOODRICH<sup>2</sup>**

**Water Supply and Water Resources Division Director, USEPA**

## 1. Introduction

The provision and management of drinking water is based upon the multi-barrier concept; that is, (1) selecting the best available source and protecting it from contamination, (2) using water treatment to control contaminants, and (3) preventing water quality deterioration in the distribution systems. An added component is now the prevention, detection, and decontamination of deliberate attacks on drinking water infrastructure. Although such practices have resulted in the virtual elimination of traditional waterborne threats such as cholera and typhoid, public health concerns remain.

## 2. Problem Overview

The continued occurrence of waterborne disease outbreaks demonstrate that the safety of drinking water can still be threatened by pathogenic microorganisms if treatment is inadequate or the distribution system is compromised. New concerns have also been raised about emerging pollutants of concern with natural (arsenic) and man-made (endocrine disrupting chemicals) substances. The disinfection process itself leads to the formation of a number of potentially toxic organic and inorganic chemical by-products. Human subpopulations such as infants, children, pregnant women, and those with weakened immune systems are also of concern.

## 3. Program Description

The Safe Drinking Water Act (SDWA) requires EPA to set national drinking water standards to ensure the safety of water consumed by the millions of people who consume water from public water systems. The SDWA regulatory requirements require research on disinfection by-products, the Arsenic Rule, the Groundwater Rule, the Long Term 2 Enhanced Surface Water Treatment Rule, as well as future unregulated waterborne pathogens and chemicals on the Contaminant Candidate List (CCL). Source water protection, as well as maintaining the quality of drinking water in distribution systems is also priorities of the SDWA. Research is also associated with a subset of the contaminants subject to the Six-Year Review where regulations can be modified based upon new information. The most recent change was

---

<sup>1</sup> 1200 Pennsylvania Avenue, Washington, D.C. 20004 e-mail:Levine.Audrey@epa.gov

<sup>2</sup> 26 W. Martin Luther King Drive, Cincinnati, Ohio 45268 e-mail:Goodrich.james@epa.gov

the reduction of the Arsenic MCL from 50 ug/L to 10/ug/L which involves nearly 4,000 small systems. The EPA Office of Research & Development (ORD) has established an integrated, multidisciplinary research program that is closely linked to Office of Water's regulatory activities. The ORD program also works closely with the EPA Regions helping to implement the regulations. Recently, the Drinking Water Multi-Year plan has undergone revisions that will carry the research program through the next several years. A major change in the plan is the increased emphasis on aging infrastructure and source water protection. This also includes research on maintaining water quality in the distribution system and real-time monitoring. Another aspect of the new plan is the web-based Treatability Data Base that will be a repository on control of contaminants in drinking water. It will be interactive and portions of it will be available in 2007. There will ultimately be hundreds of contaminants.

The Drinking Water Research Program also includes efforts from other national laboratories and centers: The National Exposure Research Laboratory (NERL), the National Health and Environmental Effects Research Laboratory, the National Center for Environmental Assessment, the National Center for Environmental Research, the National Center for Computational Toxicology, and the National Homeland Security Research Center.

## Overview of Drinking Water Quality Management



**4<sup>th</sup> Japan – U.S.  
Government Conference  
on Drinking Water Quality  
Management and  
Wastewater Control**



Bankoku Shiryokan, Okinawa - January 22-25, 2007  
Dr. Audrey Levine & Dr. James A. Goodrich  
USEPA Office of Research & Development

## Sustainable Water Resources

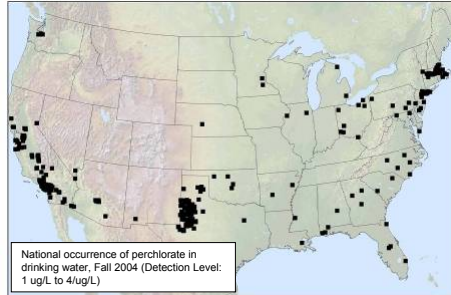
### **Challenges**

- Population growth
- Urbanization
- Water scarcity
- Climate change



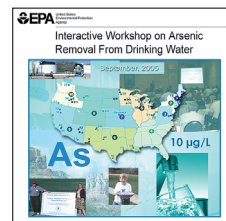
# Drinking Water Challenges

- More stringent regulations
- Emerging contaminants
- Water security
- Aging infrastructure
- Coordinating regulations



3

# Ongoing Drinking Water Research



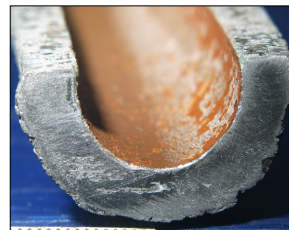
Arsenic compliance training and demonstration program



Simulated drinking water distribution system



Microbial disinfection



Lead control research

4

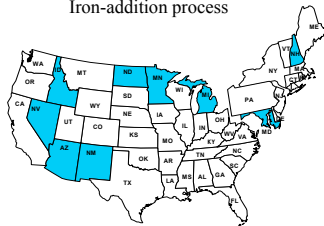
# Arsenic Removal Demonstration Program

- \$20 million targeted to a two year program (\$20M EPA; \$12M Congress)
- Small systems, full-scale, long-term (1 year) evaluation studies
- Focused on commercially-ready technologies or engineering approaches
- Three phases with the third beginning in 2006

## Round 1: 12 Sites / 9 States

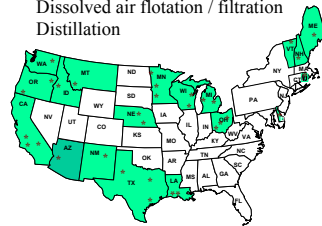
Iron media

- Iron-based media
- Anion exchange
- Modified activated alumina
- Iron-removal system
- Iron-addition process



## Round 2: 28 Sites / 18 States

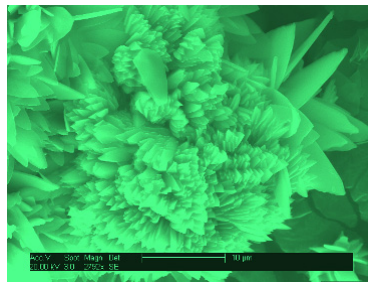
- Oxidation / filtration
- Iron Coagulation / filtration
- Reverse osmosis
- Anion exchange
- Process modification
- Dissolved air flotation / filtration
- Distillation



5

# Emerging Research Areas

- Perchlorate
- EDCs
- Cyanobacteria toxins
- Nanotechnology



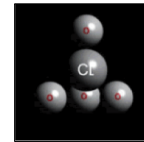
Nanoflowers synthesized using vitamin B<sub>1</sub>

6

# Perchlorate Research

## 1) EPA Funded a series of projects through AwwaRF

- Ion Exchange
- Biological treatment
- Membranes
- Tailored GAC
- Electrochemical



## 2) New research

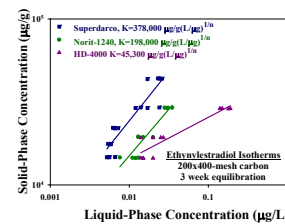
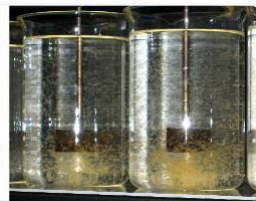
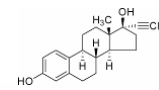
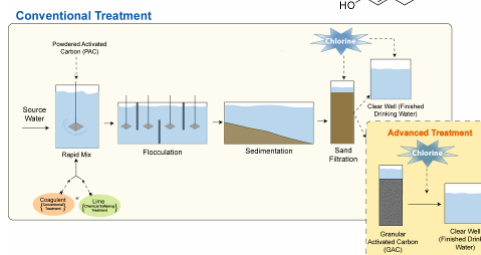
- Small-system cost modeling for perchlorate
- Ion exchange brine treatment with biological systems
- Adsorbents for multiple contaminants: arsenic & perchlorate
- Biological treatment of EDR concentrate streams with wastewater augmentation
- Biotreatment of perchlorate – post treatment needs
- Effect of nitrate competition on ion exchange treatment of perchlorate



7

# EDC Treatment Research

- Bench-scale conventional, PAC, GAC, and oxidation research for estrogens, androgens, and progesterone



8

# Cyanobacteria Research

*Microcystis aeruginosa*  
bloom



9

# Cyanobacteria Research



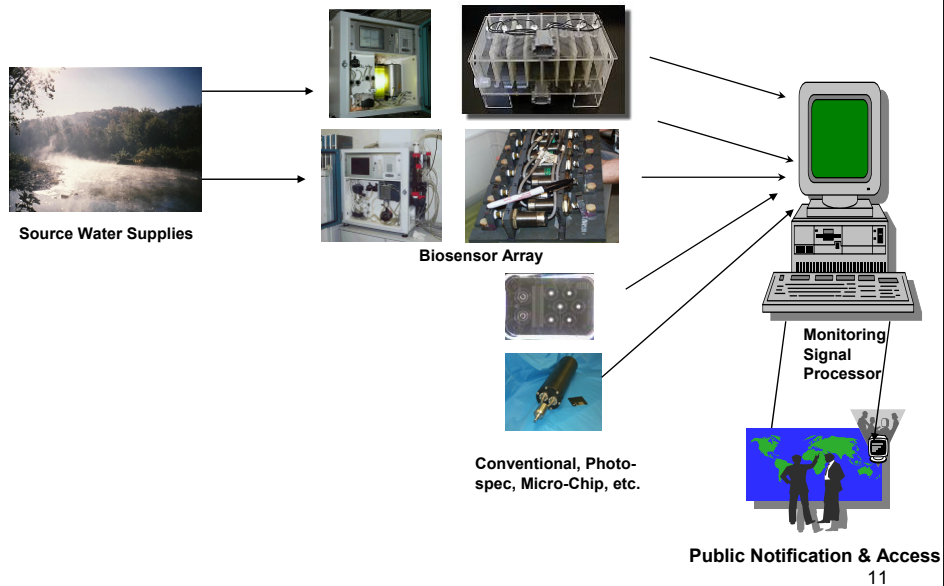
EPA Mini-pilot Plant



Filter Gallery

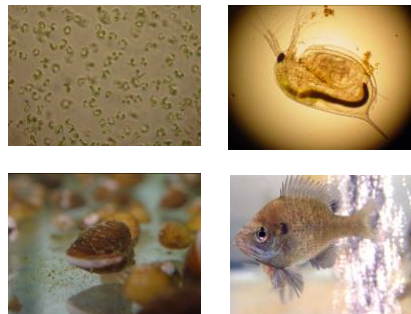
10

## Water Security: Early Warning & Monitoring



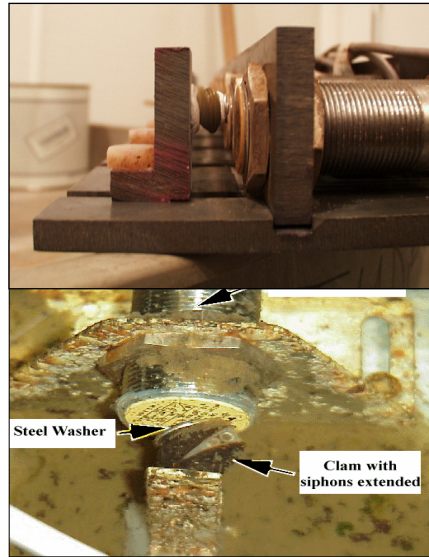
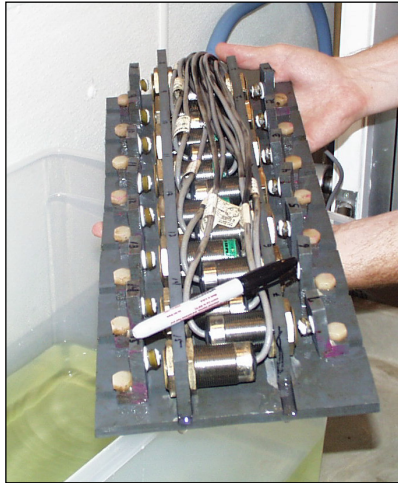
## Toxicity Monitor Research

- “Canary in the coal mine”
- Only an organism in its own environment can integrate all factors that contribute to stress





## Clam Monitor - Biosentinel



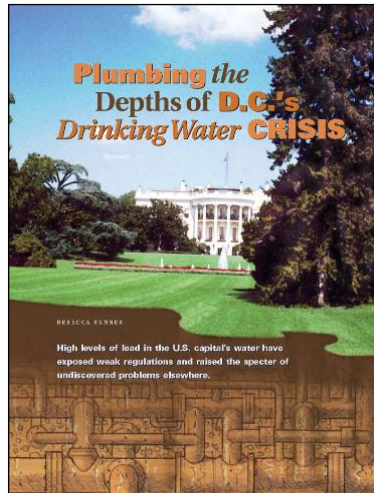
13

## Coordinating Regulations

- Simultaneous compliance for drinking water regulation
- Complementing CWA with the SDWA

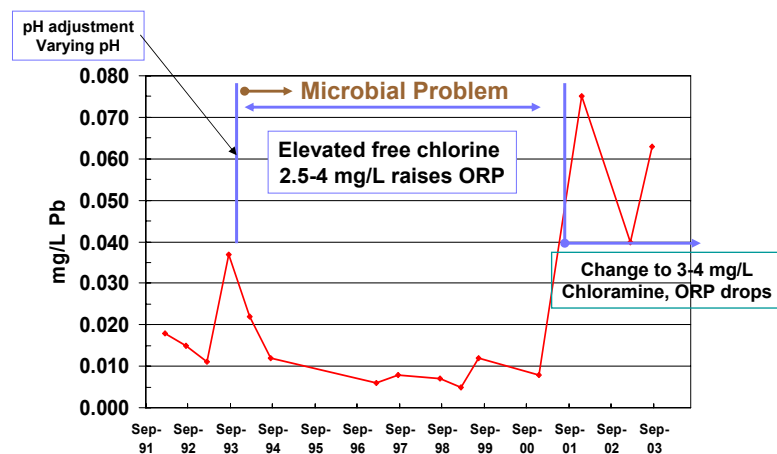
14

# Lead Corrosion in Distribution Systems



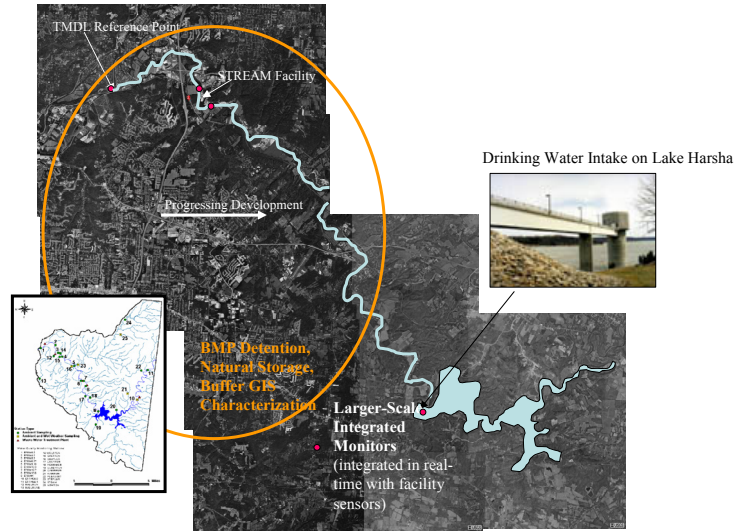
15

## Holistic View of Drinking Water Treatment



16

# Watershed Management



# Stormwater BMPs



Retention pond



Porous pavement



Swale used for roadway drainage



Detention pond



Constructed wetland



Rain garden



Bioinfiltration in traffic island

## EPA Swales Research Facility



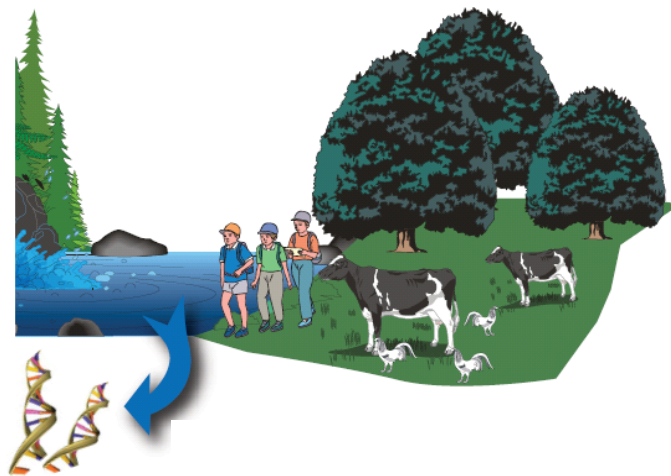
EPA  
Performance of  
Stormwater Retention  
Ponds and Constructed  
Wetlands in Reducing  
Microbial  
Concentrations



19

## EPA's Source Tracking Research

Match microbe  
from a polluted  
site and an  
animal source  
to suggest the  
origin of fecal  
pollution



20

## ***EPA's Source Tracking Research***

- Development of animal-specific molecular assays
- TMDL preparation
- Evaluation of Best Management Practices



21

## ***Activity of Microbes in Water Distribution Systems***

**Problem:** Traditional culture-based methods significantly underestimate density/diversity

**Goal:** DNA-based and RNA-based clone libraries to characterize non-culturable microbial communities and active populations in water distribution systems.

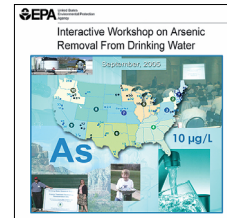


22

## Outreach

- Presentations, publications, multimedia
- EPA workshops
- Brochures, posters, etc.
- Collaborations
- Website:

<http://www.epa.gov/ORD/NRMRL/wswrd/>



23

## Key Products for Water Utilities



24

# Treatability Database

## Project

- Repository of referenced information on control of contaminants in drinking water
- Interactive database on EPA website in 2007

## Contaminants

- Regulated
- Unregulated

## Long-Term Commitment

- Expanding to hundreds of contaminants
- Updated over time

## Impact

- Potentially the largest single compilation of referenced drinking water treatment data in one place



25

# Research to Protect the Environment



[www.epa.gov/ORD/NRMRL/](http://www.epa.gov/ORD/NRMRL/)  
[Goodrich.James@epa.gov](mailto:Goodrich.James@epa.gov)

