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AGING WATER INFRASTRUCTURE
RESEARCH PROGRAM

Addressing the Challenge Through INNOVATION

Office of Research and Development
National Risk Management Research Laboratory

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"Our nation's extensive water infrastructure has the capacity to treat, store, and transport trillions of gallons of water and wastewater per day through millions of miles of pipelines. However, as our infrastructure deteriorates, there are increasing concerns about the ability of this infrastructure to keep up with our future needs.

As part of our effort to address these concerns . . . ORD initiated a new water infrastructure research program. This program will generate the science and engineering needed to evaluate promising, innovative technologies to repair existing and provide new water infrastructure, and that improve effectiveness at reduced cost."

Statement of George Gray, Ph.D.
Assistant Administrator
Office of Research and Development (ORD)
United States Environmental Protection Agency
March 14, 2007

Drinking Water Distribution Systems

- There are 240,000 water main breaks per year in the United States.
- The number of breaks increases substantially near the end of the system's service life.
  - Large utility breaks in the Midwest increased from 250 per year to 2,200 per year during a 19-year period.
  - In 2003, Baltimore, Maryland, reported 1,190 water main breaks—that's more than three per day.
- A 2005 British study correlated self-reported diarrhea with low water-pressure events (including water main breaks).
- The U.S. Geological Survey estimates that water lost from water distribution systems is 1.7 trillion gallons per year at a national cost of $2.6 billion per year.

Wastewater Collection Systems

- There are up to 75,000 sanitary sewer overflows per year in the United States, resulting in the discharge of 3–10 billion gallons of untreated wastewater.
- Up to 3,700 illnesses annually are due to exposure to recreational water contaminated by sanitary sewer overflows.
- In 1989, sanitary sewer overflows in Cabool, Missouri, contaminated drinking water distribution lines, causing 243 cases of diarrhea and 4 deaths.
- In 1993, direct contact with a discharge of untreated sewage in Ocoee, Florida, resulted in 39 cases of hepatitis A.

The Aging Water Infrastructure (AWI) research program is part of EPA's larger effort called the Sustainable Water Infrastructure (SI) initiative. The SI initiative brings together drinking water and wastewater utility managers; trade associations; local watershed protection organizations; and federal, state, and local officials to ensure that all components of our nation's water infrastructure—drinking water treatment plants, drinking water distribution lines, sewer lines, and storage facilities—meet future needs.

The AWI research program supports the four priority areas of the SI initiative's strategy:

- Better management – Moving beyond compliance to sustainability and improved performance
- Full-cost pricing – Helping utilities to recognize the full cost of providing service over the long term
- Water efficiency – Promoting water efficiency in the residential and commercial sectors
- The watershed approach – Integrating watershed management principles and tools into utility planning and management practices

The Gap Analysis

A driving force behind the SI initiative and the AWI research program is the "Clean Water and Drinking Water Infrastructure Gap Analysis." In this report, EPA estimated that if operation, maintenance, and capital investment remain at current levels, the potential funding shortage for drinking water and wastewater infrastructure could exceed $500 billion by 2020. This funding gap could narrow with the application of innovative technologies and management practices.

Top Priority

A sustainable water infrastructure is among the top four priorities of EPA Administrator Stephen L. Johnson for these reasons:

- Our drinking water and wastewater systems are aging. Some components are more than 100 years old.
- The U.S. population is increasing and shifting geographically. This requires investment in new infrastructure for growth areas.
- Current treatment may not be sufficient to address emerging issues and changing regulatory requirements.

The Research Program

The AWI research program has identified the critical research needs related to our aging drinking water and wastewater infrastructure. EPA will work with collaborators and stakeholders to conduct technology research, development, and demonstration projects to fill the identified research gaps. Research projects will fall into four main areas:

Condition Assessment To assess the condition of a drinking water distribution or wastewater collection system, data and information are gathered through observation, direct inspection, investigation, and indirect monitoring and reporting. An analysis of the data and information helps determine the structural, operational, and performance status of capital infrastructure assets. Condition assessment also includes failure analysis to determine the causes of infrastructure failures and to develop ways to prevent future breakdowns. Condition assessment enhances the ability of utilities to make technically sound judgments regarding asset management.

System Rehabilitation System rehabilitation is the application of infrastructure repair, renewal, and replacement technologies in order to reinstate functionality in a drinking water or wastewater system or subsystem. The proper

balance of the repair, renewal, and replacement depends on the condition assessment, the life-cycle costs of various rehabilitation options, and the related risk reductions.

Advanced Concepts Developing advanced concepts relates to the application of innovative infrastructure designs, management procedures, and operational approaches. The infusion of these advanced concepts into an established system is especially challenging; for example, the innovative concept could be a retrofit solution, but compatibility with the in-place system is critical. Advanced concepts go beyond asset management to include maximizing the benefits from low-impact development, water reuse, source water protection, and watershed management.

Innovative Treatment Technologies for Wastewater and Water Reuse These technologies address the dynamic requirements for improved water quality and the growing demand for safe and reliable reclaimed wastewater and storm water. For example, wet-weather flows at water treatment plants must be managed more effectively in order to reduce pathogen content. And there are new challenges relating to the capability of pharmaceuticals and personal care products to interfere with, and even inhibit, the wastewater treatment process. Controlling nitrogen and phosphorous is a growing priority, especially in the basins that drain into the Mississippi River, the Great Lakes, and the Chesapeake Bay. In Florida, California, and the arid Southwest, the use of reclaimed wastewater and storm water is rapidly increasing. There is accelerated demand for wastewater treatment technologies to be more energy efficient and to produce smaller volumes of residuals.

Projects under the AWI research program include technology demonstrations; state-of-the-technology assessments; applied research; field applications; basic research; and bench-scale, pilot-scale, and controlled-condition testing. The projects will focus on:

- Optimizing repair, rehabilitation, and replacement
- Extending the service life of installed drinking water and wastewater system components
- Reducing system failures and their adverse effects on public health and the environment
- Reducing sewer overflows and backups
- Evaluating the performance and cost of innovative technologies and approaches
- Investigating advanced system design and management concepts

- Detecting, locating, and characterizing leaks in drinking water distribution and wastewater collection systems
- Designing systems with a green infrastructure and low-impact development components to attenuate wastewater flows
- Reducing high-risk water main and force main breaks

A Sustainable Water Infrastructure Tomorrow Means Fundamental Change Today

The AWI research program is bringing about that change. Using the program's technical strength and unbiased information, EPA is helping reduce the cost and improve the effectiveness of our aging—and failing—drinking water and wastewater treatment and conveyance systems. Existing technologies need to be applied in unconventional ways. Emerging technologies and innovative thinking will be at the forefront of creating a powerful, secure, and reliable water infrastructure.

Outcomes

Near-term outcomes will be technology reports on condition assessment (inspection technologies), rehabilitation (service laterals, liners), and advanced system designs. In the long term, guidance documents will be developed on asset management, real-time monitoring, new materials, verification and demonstration of innovative technologies, and sustainable management and design approaches.

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The Door Is Open for Collaboration

EPA, whose primary role is that of advocate for a sustainable water infrastructure, is only one partner in this effort. The AWI research program presents opportunities for utilities, vendors, researchers, academics, water associations (trade and professional), and other agencies and organizations to collaborate. In fact, the success of the program depends on stakeholder involvement, sharing information and tools, and working together toward the long-term stewardship of our water infrastructure.

EPA INVITES YOU TO PARTICIPATE BY CONTACTING:

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