EPA

www.epa.gov

AGING WATER INFRASTRUCTURE RESEARCH

SCIENCE AND ENGINEERING FOR A SUSTAINABLE FUTURE

Addressing the Challenge Through SCIENCE and INNOVATION

Office of Research and Development
National Risk Management Research Laboratory

AGING WATER INFRASTRUCTURE RESEARCH
SCIENCE AND ENGINEERING FOR A SUSTAINABLE FUTURE

"An issue we face is deferred maintenance in our [water] infrastructure, which in too many communities is over-worked and under-budgeted. Our system is deeply stressed, our financial and our natural resources are limited and our needs are not negotiable."

"In protecting America's waters today, we have a responsibility to continue the work that began 40 years ago, and begin new work that will change the course of the next 40 years and beyond. This is what we have been doing since taking office, and what we plan on continuing to do in the months and years ahead."

Statement of Lisa P. Jackson
Administrator
U. S. Environmental Protection Agency
October 15, 2010

A National Problem

The U.S. population is increasing and shifting geographically. Communities across the country are facing challenges in making costly upgrades and repairs to their aging water infrastructure, which includes drinking water and wastewater conveyance systems and related treatment facilities. This requires investment for new infrastructure in growth areas and also strands existing infrastructure in areas of decreasing population. Despite this need, investment in research and development has declined and current practices and techniques may not be sufficient to address emerging issues and potentially stronger regulatory requirements.

EPA has issued its Clean Water and Drinking Water Infrastructure Sustainability Policy as part of its efforts to promote sustainable infrastructure within the water sector. Making water infrastructure last longer, while increasing its cost-effectiveness and sustainability, is essential to protecting human health and the environment, and maintaining safe drinking water and clean water bodies. This new policy is part of EPA's priority to protect America's waters.

Drinking Water Distribution Systems

- There are an estimated 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.
  - Breaks at a large utility 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).

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.
- There are an estimated 5,500 annual illnesses due to exposures to contaminated recreational waters.
- 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.

Innovative Research

The Funding Gap

To gain a better understanding of the challenges facing the nation's drinking water and wastewater utilities, in September 2002, EPA's Office of Water (OW) published "The Clean Water and Drinking Water Infrastructure Gap Analysis" (EPA-816-R-02-020), also known as the "Gap Analysis" report. The report identified several issues that raised concern as to the ability of utilities to keep up with their infrastructure needs in the future. In the report, EPA estimated that if spending for capital investment and operations and maintenance remained at current levels, the potential gap in funding for the years 2000 through 2019 would be approximately $270 billion for wastewater infrastructure and $263 billion for drinking water infrastructure.

Understanding the need for research in this area, EPA's Office of Research and Development (ORD) initiated research projects addressing aging water infrastructure (AWI). ORD's AWI research supports OW's larger Sustainable Infrastructure (SI) Initiative. The SI Initiative is guiding our efforts in changing how the nation views, values, manages, and invests in its water infrastructure, and AWI research is supporting these efforts with innovative science. Both efforts are bringing together drinking water and wastewater entities, including 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 are addressed.

A Sustainable Water Infrastructure Tomorrow Means Fundamental Change Today

To face our nation's aging water infrastructure (AWI) challenges, EPA's Office of Research and Development (ORD) has set a goal to generate the science and engineering needed to improve and evaluate promising innovative technologies and techniques that will reduce the cost and improve the effectiveness of operation, maintenance, and replacement of 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, cost-effective, and reliable water infrastructure.

Research Areas

ORD has identified critical research needs related to the AWI in our communities. Scientists and engineers work with collaborators and stakeholders to conduct technology research, development, and demonstration projects to fill the identified research gaps. Projects fall into four main research areas:

Condition Assessment In order to assess the condition of drinking water distribution and wastewater collection systems, 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 infrastructure assets. This area also includes failure analysis to determine the causes of infrastructure failures and to develop ways to prevent future breakdowns.

System Rehabilitation Because it is not economically feasible to completely replace all of our nation's AWI with new infrastructure, the application of repair, renewal, and replacement technologies is crucial 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 Innovation is key to a sustainable water infrastructure for future generations. The application and infusion of innovative infrastructure designs, management procedures, and operational approaches into an established system is especially challenging. Advanced concepts go beyond asset management to include maximizing the benefits from low-impact development, including green infrastructure, water reuse, source water protection, and watershed management.

Innovative Solutions

Treatment Technologies for Wastewater and Water Reuse There is a growing demand for safe and reliable reclaimed wastewater and stormwater along with dynamic requirements for improved water quality. For example, wet-weather flows at wastewater treatment plants must be managed more effectively in order to reduce pathogen content. 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 reuse of reclaimed wastewater and stormwater is rapidly increasing. There is accelerated demand for wastewater treatment technologies to be more energy efficient and to produce smaller volumes of residuals.

Research Projects

EPA's ability to find solutions to environmental problems and to communicate the results depends on a talented and dedicated workforce with diverse expertise and perspectives. ORD researchers lead and collaborate in a wide range of water infrastructure research projects, including technology demonstrations; state-of-the-technology assessments; applied research; field applications; basic research; and bench-scale, pilot-scale, and controlled-condition testing. The combined projects have a broad scope to address all components of our water infrastructure:

- 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
- Designing systems with low-impact development components, including green infrastructure, to manage wet-weather flows
- 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
- Reducing high-risk water main and force main breaks

Outputs and Activities

Research results and outputs will assist drinking water and wastewater entities to more effectively implement comprehensive asset management, provide reliable service to their customers, and meet their Clean Water Act and Safe Drinking Water Act requirements. In addition, the research results will assist EPA's program and regional offices, states, territories, and tribes in meeting their programmatic requirements.

Completed and expected outputs and activities include reports, workshops, site- and full-scale demonstrations, models and tools, journal articles, and others. ORD has produced technical reports on condition assessment, rehabilitation, and advanced system designs, as well as design guidance on nutrient control at wastewater treatment plants. Information can be found on EPA's AWI research website.

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.

Resources

EPA's Aging Water Infrastructure Research
http://www.epa.gov/awi/

EPA's Sustainable Infrastructure Initiative
http://water.epa.gov/infrastructure/sustain/

Water Infrastructure Gap
http://water.epa.gov/infrastructure/sustain/infrastructuregap.cfm

Our drinking water and wastewater systems are aging, with some system components exceeding more than 100 years in age.

www.epa.gov

AGING WATER INFRASTRUCTURE RESEARCH

SCIENCE AND ENGINEERING FOR A SUSTAINABLE FUTURE

EPA/600/F-11/010 | July 2011
(This document is a revision of EPA/600/F-07/015)

The Door Is Open for Collaboration

EPA's AWI research presents opportunities for utilities, technology developers, vendors, researchers, academia, water associations (trade and professional), and other agencies and organizations to collaborate. The success of this research 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:

Daniel J. Murray, Jr., P.E.
Coordinator
513-569-7522 • murray.dan@epa.gov

Michelle L. Latham
Technical Communications
513-569-7601 • latham.michelle@epa.gov

U.S. Environmental Protection Agency
Office of Research and Development
National Risk Management Research Laboratory
Water Supply and Water Resources Division
MS 689
Cincinnati, Ohio 45268

www.epa.gov/awi

United States Environmental Protection Agency

PRESORTED STANDARD
POSTAGE & FEES PAID
EPA
PERMIT NO. G-35

Office of Research and Development
National Risk Management Research Laboratory
Cincinnati, OH 45268

Official Business
Penalty for Private Use
$300