

# Aging Water Infrastructure: Update on ORD's Research Plan

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*Daniel J. Murray, Jr., P.E.*  
*Senior Environmental Engineer*





## Presentation Overview

- Program Links to Sustainable Infrastructure Initiative
- Aging Water Infrastructure Research Program Goal
- Aging Water Infrastructure Research Program Implementation
  - Focus areas for research
  - Programs and projects
  - FY07-09 project timelines
  - Technology verification activities
  - Outreach products

## **Aging Water Infrastructure Research Program: Links to the Sustainable Infrastructure Initiative**

### **Four Pillars:**

- better management
- water efficiency
- full cost pricing
- watershed approach

### **Cross Cutting Themes:**

- innovation
- partnerships
- technology
- research

- Top Priority for Administrator Steve Johnson in 2007

## Aging Water Infrastructure Research Program Goal

To conduct research and demonstrations and develop technical guidance to transfer *innovative* technologies and approaches for:  
More cost-effective operation, maintenance, repair and replacement of aging and failing drinking water and wastewater systems and  
Development and application of advanced designs and management approaches for drinking water and wastewater systems.



## Aging Water Infrastructure Research Focus Areas

- Inspection and Condition Assessment
- System Rehabilitation (Repair to Replacement)
- Advanced Design and Management Concepts
- Wastewater and Water Reuse Treatment Technologies

## Aging Water Infrastructure Program & Project Types

- “State of the Technology” Assessments
  - Internal camera inspection technologies
  - Rehabilitation of house laterals
  - Sewer liner retrospective
- Innovative Technology Demonstration Programs
  - Emerging inspection and monitoring approaches
  - New repair, renewal and replacement materials and techniques
- Applied Research and Field Application
  - Integrated system management and decision support
  - System failure analysis, modeling and forecasting
- Basic Research and Bench/Pilot Scale Testing
  - Advanced hydraulics for sanitary sewers
  - New sewer designs and system configurations

## Condition Assessment of Collection Systems

Research Area/Project	Est. Start	Est. Finish	2007	2008	2009
<b>Initiate State-of-the-Technology Review</b>	09/07	03/08	■		
Convene Technology Forum	01/08	05/08		■	
Technology Forum Synthesis Report	05/08	07/08		■	
<b>State-of-the-Technology Capsule Reports</b>	03/08	09/12			
CCTV Internal Camera Inspection	03/08	09/08		■	
Advanced Integrity Monitoring	03/08	12/08		■	
Post Construct. Analysis of Pipe Failures	09/08	10/10		■	■
Guidance for CS Failure Investigation	09/09	10/11			■
Asset Management Guidance	09/08	10/12		■	■
<b>Controlled - Condition Testing</b>	09/08	10/12		■	■
<b>Pre-Demonstration Studies</b>					
Protocols/Metrics for Demonstration	01/08	01/09		■	
Site Selection Criteria for Demonstration	01/08	01/09		■	
QAPP for Field Demonstration	09/08	07/09		■	
<b>Field Demonstrations</b>					
Select Utilities for Demonstrations	01/08	10/09		■	
Conduct Verifications	09/08	12/12		■	■
Conduct Field Demonstrations	09/08	12/12		■	■

## Condition Assessment of Drinking Water Mains

Research Area/Project	Est. Start	Est. Finish	2007	2008	2009
<b>State-of-the-Technology Review</b>	09/07	08/09			
Value of Condition Assessment Report	09/07	08/08			
Research Review & Assessment	09/07	09/11			
Predictability Index Article/Studies	09/07	09/11			
Condition/Decay Curves Report	09/07	02/09			
<b>Improve Access to Existing Data</b>					
Condition Assessment Database	09/08	09/12			
Accessibility Standards:In-line Inspection	09/08	03/10			
<b>Failure Mechanisms</b>					
Plastic pipe	10/08	03/10			
CI/AC/Polywrapped DI	10/10	03/12			
Failure Documentation Guidelines	10/08	03/10			
<b>Controlled - Condition Testing (DS)</b>	05/08	09/12			
<b>Pre-Demonstration Studies</b>	09/07	09/08			
Report on Site Selection Criteria	09/07	09/08			
Protocols/Metrics for Field Demonstrations	09/07	09/08			
<b>Field Demonstrations</b>	05/08	09/12			

## Rehabilitation of Wastewater Collection and Water Distribution Systems

Research Area/Project	Est. Start	Est. Finish	2007	2008	2009
<b>Initiate State-of-the-Technology Review</b>	09/07	03/08	■		
Convene Technology Forum	01/08	05/08		■	
Technology Forum Synthesis Report	05/08	11/08		■	
<b>State of Technology Capsule Report</b>					
Service Laterals/Lines	12/07	12/08		■	
Liners	12/07	01/09		■	
Manholes	01/08	02/09		■	
Force Mains	02/08	03/09		■	
Siphons	03/08	04/09		■	
Sewer Overflow Regulators	04/08	05/09		■	
Pumping Stations/Wet Wells	05/08	06/09		■	
Rehab vs Replace Decision Support	10/08	02/10			■
New Materials Evaluation	10/08	09/12			■
<b>Controlled - Condition Testing</b>	10/07	09/12	■		
<b>Pre-Demonstration Studies</b>					
Inspection/QA	08/08	08/09		■	
Protocols/Metrics for Demonstration	03/08	11/09		■	
Site Selection Criteria	03/08	01/10		■	
<b>Field Demonstrations</b>					
Select Utilities for Demonstration	06/09	09/09			■
Conduct Verifications	10/08	12/12		■	
Conduct Field Demonstration	10/09	12/12			■



## Technology Verification Activities

- Grouts
  - ETV stakeholder-based protocol completed; several vendors interested
- Coatings
  - ETV stakeholder-based protocol almost complete; vendor has applied and test plan is being completed
- Liners
  - As with above categories; stakeholders prioritized several years ago. Decision on protocol development pending.

## Addressing the Challenge Through INNOVATION



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**Aging Water Infrastructure Research Program**  
Addressing the Challenge Through Innovation

**Condition Assessment of Collection Systems**

*"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."*

George Gray, Ph.D.  
Assistant Administrator for  
Research and Development  
United States Environmental  
Protection Agency

EPA has begun a new research program intended to generate the science and engineering that will address our aging water infrastructure. The program, entitled "Innovation and Research for Water Infrastructure for the 21st Century," calls for research relating to system rehabilitation, advanced concepts, and condition assessment. To assess the condition of a 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.

**Current Issues**

There are several concerns related to condition assessment of collection systems. Since the Clean Water Act was passed in 1972, sewer system condition assessment has focused on the reduction of:

- Infiltration – ground water that enters a sewer system through pipe leaks
- Inflow – water that flows into a sewer system through improper connections, such as downspouts, sump pumps, and manhole covers

Excessive infiltration and inflow must be conveyed and treated, too much of this infiltration and inflow in a sewer system can cause backups and system overflows, and peak-flow treatment at wastewater treatment plants becomes challenging. Deterioration of a wastewater collection system can result in infiltration of ground water and the export of recharge water from watersheds. This situation, when combined with the impervious surfaces found in urban and suburban areas, reduces flows in streams, which can adversely affect aquatic ecosystems and reduce water availability. A universal challenge for wastewater utilities is corrosion of the collection

infrastructure. Special and corrosion resistant concrete surfaces, no reinforcement rebar issue, it's important that the pipe corrosion could happen, and it (i.e. rehabilitation, or replacement).

**State of the Technology**  
Comprehending the focus condition assessment likelihood and cause infrastructure detect. The current state of the art of inspection assessment in the field examine the internal gravity sewer using a usually closed circuit Most utilities employ was the result from to make an overall as section of sewer. The combined with other to determine mature rehabilitation priority Inspection technology sonar, laser, ultrasound (technologies not try to sewer system new emerging with concern in digital, modular, a technologies.



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**Aging Water Infrastructure Research Program**  
Addressing the Challenge Through Innovation

**Advanced Concepts**

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Research on advanced concepts will evaluate and demonstrate the application of innovative infrastructure design, management procedures, and operational approaches. Advanced concepts go beyond simple asset management. The infusion of these advanced concepts into established wastewater collection systems is especially challenging.

**Current Issues**

There are several issues related to the adoption of advanced concepts:

- Existing collection systems, many of which were designed and constructed when performance expectations and technical knowledge were less advanced, must now perform to today's standards.
- Broad goals, such as sustainability, are not being achieved by current design practices.
- Proper transport of solids in sewers is still not well understood; the transport of solids can cause clog, overflows, and surcharges.
- There are limited performance data, which leads to engineering conservatism.
- It is difficult to retrofit old systems using new design technology.

**State of the Technology**

Collection system technology in the U.S. represents a combination of separate sanitary sewers, combined and separate storm sewers, and associated components (such as manholes and pump stations). In some cases, sections of our collection system infrastructure are over 100 years old. But as our urban fringe expands with increased development, new collection systems are being added.

For the most part, current practices are not modeled from those applied 50 years ago. However, older systems were designed and cost performance expectations and technical knowledge were less advanced, now being challenged to regulations and the need increasing populations.

As our collection system managers and system design lock to advanced concept for new and expanding a retrofitting our existing infrastructure.

Successfully blending the concepts with an existing collection system is challenging. Innovative concepts can existing systems through opportunities, but complete in-place system is critical systems expand with new opportunities for the app advanced concepts grow maximizing the benefits infrastructure. Low-impact water reuse, source water and watershed management



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**Aging Water Infrastructure Research Program**  
Addressing the Challenge Through Innovation

**Rehabilitation of Wastewater Collection Systems**

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System rehabilitation is the application of infrastructure repair, renewal, and replacement technologies in order to restate functionality of a 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.

**Current Issues**

Rehabilitation includes a range of approaches that return the system to near-original condition and performance. For example, repair techniques are used within the existing sewer is structurally sound. But when the existing sewer is severely deteriorated or collapsed, or when its flow capacity should be increased, the system is usually replaced. Current rehabilitation methods address unmet structural conditions. There are many causes for wastewater collection system deterioration and failure:

- Poor design and installation
- Inadequate or improper bedding material
- Chemical attack
- Traffic loadings
- Soil movements
- Root intrusion
- Compromised joint integrity
- Subsequent construction damage
- Ground water fluctuation
- Inadequate maintenance

Deposition of material and sewer blockages that occur because of flat grades along with high ambient temperatures and poor ventilation can lead to the development of sulfuric acid and resulting crown corrosion. This reduces the structural integrity of concrete and its reinforcing steel.

In addition, inadequate inspections and quality assurance, and poor workmanship during sewer installation, can result in long-term problems. Other issues include:

- Pipe defects can cause blockages that lead to dry-weather sewer overflow and backups into buildings.
- Water that flows into sewer pipes through defects (e.g., holes, cracks, and failed pipe joints) can weaken the critical soil-pipe structure.
- Fine soil particles carried into the sewer can eventually reduce soil support and cause pipe deformation or subsidence.
- Exfiltration of water from the sewer into the surrounding soil can weaken support provided by the soil.
- Soil movement due to traffic can exceed design assumptions and result in soil support problems.

**State of the Technology**

Collection system rehabilitation includes many repair and replacement options, each of which could return the system to acceptable levels of performance. Options include repairing the pipeline using common methods, such as chemical and cement grouting, to address ground water movement, washouts, soil settlements, collapse, and soil voids.

## Questions?

- 513-569-7522
- [murray.dan@epa.gov](mailto:murray.dan@epa.gov)

