THE Water Research FOUNDATION

# Asset Management

## THE CHALLENGE

High-quality water service depends on having the infrastructure to meet the requirements of customers, utilities, and regulators. Because water services are asset intensive, utilities are constantly working to maintain these pipes, pumps, tanks, and systems, while also controlling costs and reducing risks. With deteriorating infrastructure, limited budgets, restricted flexibility in rates, and increasing expectations, utilities are on a continual quest for the most appropriate practices to meet these competing demands.

Asset management is a way of thinking—of seeing the infrastructure world from an asset-centered perspective as opposed to operations centered, and it depends on the entire organization. It allows utilities to direct limited resources to where they are most needed, and it is the basis for both short- and long-term investment planning and rate setting—as well as for building public support for these decisions. Customers need to understand and acknowledge that these investments play a critical role in their community.

To effectively manage water infrastructure, utilities must answer the question: Is it the right work and the right investment at the right time and for the right reason? The more utilities understand about their assets—the demand, the condition and remaining useful life, the risk and consequence of failure, the feasible renewal options (repair, refurbish, replace), and the cost of these options—the higher the confidence there is in investment decisions.

## THE RESEARCH

WRF has provided the water sector with more than 300 asset management projects that have resulted in leading practices, tools, and knowledge. This research is based on a One Water approach to asset management, looking at a unified collection of water systems that have traditionally been divided along service lines—including wastewater, drinking water, recycled water, and stormwater. In 2002, WRF hosted a workshop that brought together international experts to identify the research and tools the industry needs to thrive—and set the course for a more comprehensive asset management research program going forward.

Although maintaining and rehabilitating water system assets has been an element of WRF's research for over 50 years, in 2006 WRF responded to the industry's call for more guidance and launched the Strategic Asset Management (SAM) Program. The program developed products to support planning, acquiring, operating, maintaining, rehabilitating, and building water infrastructure to


**20%** Improved system/ organizational performance that delivers enhanced service

**80%** Improved focus of existing budgets and long-term cost reduction

Source: WRF Project 03-CTS-14/4013

maximize performance while minimizing life-cycle costs at an acceptable level of risk.

Because asset management has far-reaching implications—with estimates to renew and replace infrastructure totaling more than $300 billion over the coming decades—WRF works strategically with other organizations to ensure the best possible solutions. Beginning in 2010, as part of EPA's Aging Water Infrastructure Research Program, WRF received $6.5M in funding to evaluate new technologies and techniques to help utilities cope with aging and failing sewer lines, water mains, and other components. The collaboration resulted in more than 20 projects including the groundbreaking WATERiD knowledge base—an information center where utilities can share information on pipeline condition assessment and renewal technologies, techniques, and practices. Additionally, WRF staff have served on AWWA's Asset Management and Condition Assessment Committees, both of which drive innovation in these areas for the entire water sector.

**Strategic Asset Management**

Asset management is a collection of processes and practices, and the right combination can make the difference between consistent, reliable water service and system failures. WRF has been leading the way in cutting-edge tools to help utilities make strategic decisions about what to do and when to do it.

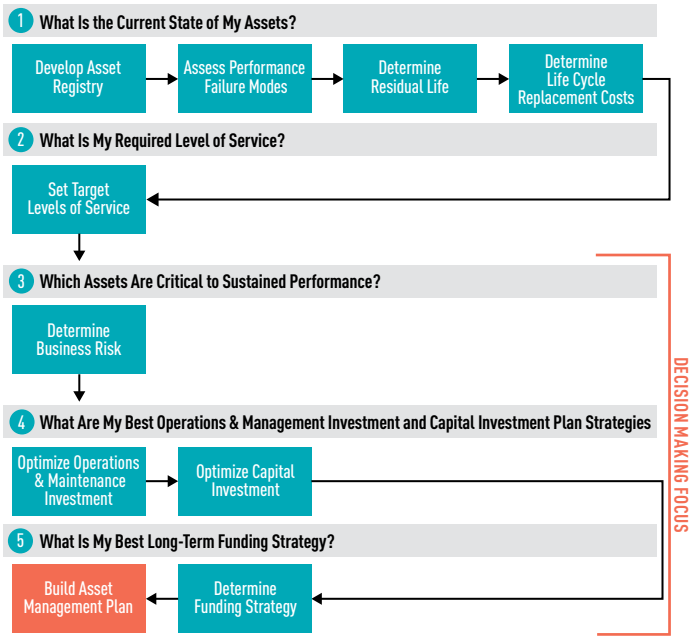
WRF's research in this area is centered around five core questions and 10 key steps to effective asset management (see figure). This framework allows practitioners of all levels to design their asset management program around a set of practices with a level of sophistication tailored to their needs. These practices are intended to assist in the systematic development of rationalized business cases for every dollar invested in a utility—from capital and administration to operations and maintenance—making every dollar work as hard as possible.

Outputs from this research are incorporated into an online portal, the Sustainable Infrastructure Management Program Learning Environment, also known as SIMPLE. This site is a hub for asset management resources, offering nearly 20 tools in all. SIMPLE was originally released in 2009 and has grown with evolving industry needs to include intuitive, user-friendly practice guidelines, templates, and decision support tools that simplify the development of effective, enterprise-wide asset management.

**Condition Assessment**

Before utilities can forecast and prioritize maintenance needs—or the likelihood of failure—they must be able to assess the condition of their assets. This process can be complex, especially when it comes to underground assets that are not easily accessible. Because of the extra time, effort, and expense involved with these assessments, utilities have not always been quick to adopt these processes.

## 5 CORE QUESTIONS AND 10 STEPS TO EFFECTIVE ASSET MANAGEMENT




## KEY STRATEGIC ASSET MANAGEMENT PRODUCTS

**SIMPLE: Sustainable Infrastructure Management Program Learning Environment (03-CTS-14/4013):**
**An online knowledge base with more than 16,000 pages of best practices and processes from around the world, offering state-of-the-art asset management strategies, tactics, tools, and resources that correspond with each of the 10 steps of asset management.**

**Practitioners Guide to Economic Decision Making in Asset Management (SAM1R06b1/1725, b2/26):**
**A two-volume guide containing approaches to economic decision making related to asset management and guidance on the use of core economic principles at each stage of asset management development.**

WRF research is making the process easier, helping utilities understand the benefits and shortcomings of various piping materials, providing some of the first comprehensive reviews of everything from traditional cast iron pipes to newer materials like high-density polyethylene and structurally enhanced PVC. This includes research on pipe deterioration that began in the 1980s, which sheds light on the little-understood physical processes involved in corrosion, as well as better ways to monitor its effects.

While options for condition assessment have been available for some time, obstacles such as lack of understanding technologies or potential benefits, have delayed adoption. WRF has taken important steps to help the water sector accept these tools and put them to use, including the 2007 release of *Condition Assessment Strategies and Protocols for Water and Wastewater Utility Assets* (03-CTS-20CO/1111). The nearly 500-page guide outlines a step-by-step approach for developing a condition assessment program, including a framework for selecting assessment tools and techniques.

To further advance the science in this area, WRF launched a five-year research effort with UKWIR and several Australian utilities and universities. *Advanced Condition Assessment and Failure Prediction Technologies for Optimal Management of Water Supply Pipes* (4326) conducted trials of commercially available condition assessment technologies to see how well they performed in the real world, and how they could be advanced. The researchers aimed to measure the physical state of pipes more accurately, beginning with cast iron water mains, which led to the development of a predictive model for pipe corrosion based on a leak-before-break concept. The results make important connections between the timing of an initial fracture and an eventual burst, substantially improving failure prediction techniques, and saving the industry roughly $1 billion a year.

**Natural Assets**

"Built" assets, like pipes, are not the only assets utilities need to consider. Natural assets—including forested watersheds, aquifer systems, wetlands, and other natural features—provide highly valuable services to water utilities, including contributions to source water quality, moderating runoff and floods, and groundwater recharge. The loss or degradation of these natural assets can reduce the levels of service provided, increase costs, and pose significant additional risks for a utility.

Like the built assets upon which a utility depends, natural assets require systematic attention and management to ensure that they deliver the types of services that the utility relies on. However, there are several challenges to managing natural assets, which often are owned, managed, and/or accessed by entities other than the utility. Published in 2020, *Asset Management Framework for Forested and Natural Assets* (4727) provides a framework, and associated practical guidance, for how utility professionals can

## SOLUTIONS IN THE FIELD: Tacoma Water

**A critical problem for water utilities today is how to determine which assets might be most vulnerable to deterioration and therefore the best candidates for rehabilitation, renewal, or replacement—this makes condition assessment even more critical. In 2019, WRF published *Integrating Master Planning and Condition Assessment: A Road Map for Utilities* (4656), which developed tools utilities can use to determine the monetary benefits of using condition assessment on their transmission mains.**

**Tacoma Water, one of the participating utilities on this project, found direct benefit from using these tools. They used the tools to assess the condition of Pipeline No. 1 (P1), a critical gravity pipeline in their system. The tool provided a benefit cost analysis of different levels of condition assessment: low-, medium-, and high-resolution. The tool helped Tacoma Water determine that a medium-resolution condition assessment was cost-effective for P1. Medium-resolution condition assessment results in data that allows a utility to either find a near-failure impairment and repair the main prior to the main failing; or, provide sufficient overall information on the condition of the pipe to validate a replacement decision.**

## SOLUTIONS IN THE FIELD: City of Gresham, Oregon

**In 2008, the city of Gresham wanted to improve the management of their assets across all sectors, which required a better understanding of future rehabilitation and replacement schedules and long-term projected costs. The city turned to WRF for assistance, and using an independent peer-review approach, they began to evaluate their ongoing asset management programs and create a roadmap for an integrated program.**

**WRF's Strategic Asset Management Gap Analysis Tool (SAM GAP) guided this process. The tool allows utilities to rapidly measure their performance against data from over 170 of the world's best asset management practitioners. Using the gap analysis results as a starting point, the team zeroed in on the key process steps (based on WRF's 10-step process) that would have the most impact on their program. They decided to concentrate on the first six steps over a two-year period, including steps such as determining residual lives for each asset. Based on the results, the city's Water Services Division communicated the long-term benefits of asset management to city council, and showed how using only short-term considerations impeded the ability to make better long-term management decisions for the city and its infrastructure. The approach helped foster cross-departmental cooperation, as well as a better overall understanding of the value of asset management.**

apply the principles and tools of advanced asset management practices to the natural systems that are critical to meeting a utility's mission and strategic objectives. Several leading utilities have established asset management practices for both built and natural systems, and other utilities have begun the process of applying asset management practices to their natural assets. While the report focuses on drinking water utilities, the same principles and practices may also be applied to natural assets supporting clean water, water reuse, and stormwater agencies.

**Evaluating New Technologies**

Water utilities recognize the importance of properly managing their infrastructure investments to achieve higher system reliability and service level at lower costs. As new technologies emerge, application issues, cost-benefits, reliability, maintenance, durability, and performance need to be evaluated to develop fit-for-purpose solutions and minimize application risks. Therefore, there is a need to compile and critically review this information to provide guidance to the water sector on asset condition assessment technology implementation and operation.

Published in 2020, *Innovative Technologies to Effectively Manage Deteriorating Infrastructure* (4717) identified and mapped emerging technologies that can provide more effective solutions for inspecting, monitoring, and overall management of deteriorating water conveyance systems.

## WHAT'S NEXT?

Although considerable progress has been made in asset management research, fundamental challenges remain, such as changing requirements and the ability to use data in new ways to enhance decision making. Along with research to address the recent shift toward data-driven asset management, additional work is required to determine the remaining useful lives of assets, risk management, maintenance, service levels and costs, communications, and data management. WRF continues to invest in these key areas, with two projects currently underway: *Managing Prestressed Concrete Cylinder Pipe to Extend Asset Life* (5069) and *Application of Finite Element Analysis in the Design of Large-Diameter Buried Pressure Pipes – Special Cases* (5109).