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System Planning for Water Utilities

Introduction

The water sector is one of the most capital intensive utilities in the United States, more so than other regulated utilities such as electric, gas, and telecommunications. Capital investment and upgrades will continue to be needed well into the future to replace deteriorating infrastructure, address new and more stringent regulatory requirements, and adjust to shifts and growth in population.

One of the major challenges facing the water and wastewater industry in the United States is the age of its infrastructure. Much of the vast network of aging treatment plants, pumping stations, storage facilities, and nearly 700,000 miles of main and collection pipe is in need of replacement or repair. The U.S. Environmental Protection Agency (EPA) estimates that the cost of investment to simply keep the system operating as it does today for the next 20 years will cost over \$650 billion, and the American Society of Civil Engineers estimates that \$1 trillion is needed over that same time frame.

The more a utility plans ahead, the more likely it will be able to meet these challenges. American Water utilizes a well-established capital planning process that is integrated with its asset management program to prepare for the future.

Comprehensive Planning Studies

American Water's engineering and operations team examines every facility and the associated water availability to develop capital plans. These plans help chart a course for how much investment is needed to meet future infrastructure needs as well as a 15-year outlook that incorporates estimates of population growth, urbanization rates, and other factors.

The company conducts a Comprehensive Planning Study (CPS) program to develop a master plan for each water and wastewater system. The plans recommend capital improvements that are necessary in order for its subsidiaries to continue to provide safe, adequate and reliable service to its customers. American Water invests annually in its CPS program, which is primarily conducted by in-house engineering staff. Through the studies, the company analyzes system capacity needs, asset condition and reliability, performance factors such as regulatory compliance, water quality and efficiency. System needs are identified, and project costs, alternatives and risks are assessed. By conducting comprehensive studies of water and wastewater assets, companies can have a clear and objective view of needs and potential capital project solutions.

Planners utilize many tools during this work, including hydraulic models, GIS (geographic information systems), system operating data and asset management software. The CPS process also provides an excellent opportunity for both internal and external stakeholder engagement. Internally, subject matter experts from various disciplines are brought to the table, including engineering, operations, water quality, rates, communications and customer service, to identify issues and potential solutions for the systems under study which allows for a fully inclusive and collaborative process. Externally, the CPS process offers the opportunity to engage local planning commissions, regulatory agencies, fire departments, and community/environmental groups on issues impacting or impacted by the water system.

Planning Criteria

The criterion that American Water uses to evaluate its water and wastewater assets is based on accepted engineering standards and practices. This common set of sound, defensible engineering guidelines assures adequate capacity and an appropriate level of reliability of facilities to meet customer service needs and ensure environmental protection. Highlights of the criteria are shown below.

Assets in each system are evaluated for capacity, condition, performance and efficiency factors. Recommendations are then developed to ensure the company can continue to provide a reliable and high quality water supply into the future.

Customer and Demand Projections

Water is essential for the life of a community, its residents and its businesses. Water use projections are developed for every system and provide the basis for evaluating future system capacity needs. Projections of the total number of customers and their associated demands for each customer classification (i.e. residential, commercial, industrial, etc.) are developed for the water system over a fifteen year planning horizon. Similar projections are made for wastewater systems.

The projections are developed based upon review of population trends, historic customer and usage data, and local planning commission forecasts. The effects of water conservation and other factors influencing declining usage are also considered.

Water Sources

Rivers, lakes, streams, reservoirs, wells, seawater and reuse water are the various types of water sources in use across American Water. These supplies are routinely evaluated for their quantity and quality. Intake structures, pumps and motors, dams and other assets are examined for their capacity, condition, performance and efficiency of operation. When needed, upgrades to these facilities are planned, designed and implemented. Capacity levels are chosen to reliably meet the projected system demand, even in the event of failure/malfunction of one unit of mechanical equipment. The quality of the source water and the watershed are also regularly monitored.

Water Treatment Facilities

Drinking water treatment plants are evaluated for their ability to produce high quality water that meets or surpasses federal and state water quality standards at all times. Treatment facilities are also examined for their capacity to meet current and future water demands. Individual components are examined for condition, performance and efficiency under varying operating conditions. Data on treatment chemicals, process units, and power consumption is used in these analyses.

Pumping, Water Distribution and Storage

Water is delivered from the treatment plants to customers through distribution piping grids. The systems are designed to provide reliable water service that meets flow and pressure requirements under peak demand and fire flow conditions. Pipelines, storage tanks, booster pump stations and pressure reducing stations are all analyzed for capacity, condition, performance and efficiency. Water quality, fire flow delivery and local pressure limitations are also considered in the analysis of distribution system pipelines, where applicable.

Interconnections and Regionalization

Interconnections between systems can enhance each system's resiliency in the event of an emergency. Regionalization can also provide economies of scale, avoid duplication of facilities, and provide more effective service to customers. For example, water systems within a specific geographic area can regionalize to benefit from shared sources of supply, treatment facilities or distribution system facilities. Opportunities for interconnections and regionalization are evaluated to determine if a consolidated solution to water supply problems in a particular area is feasible.

Resiliency

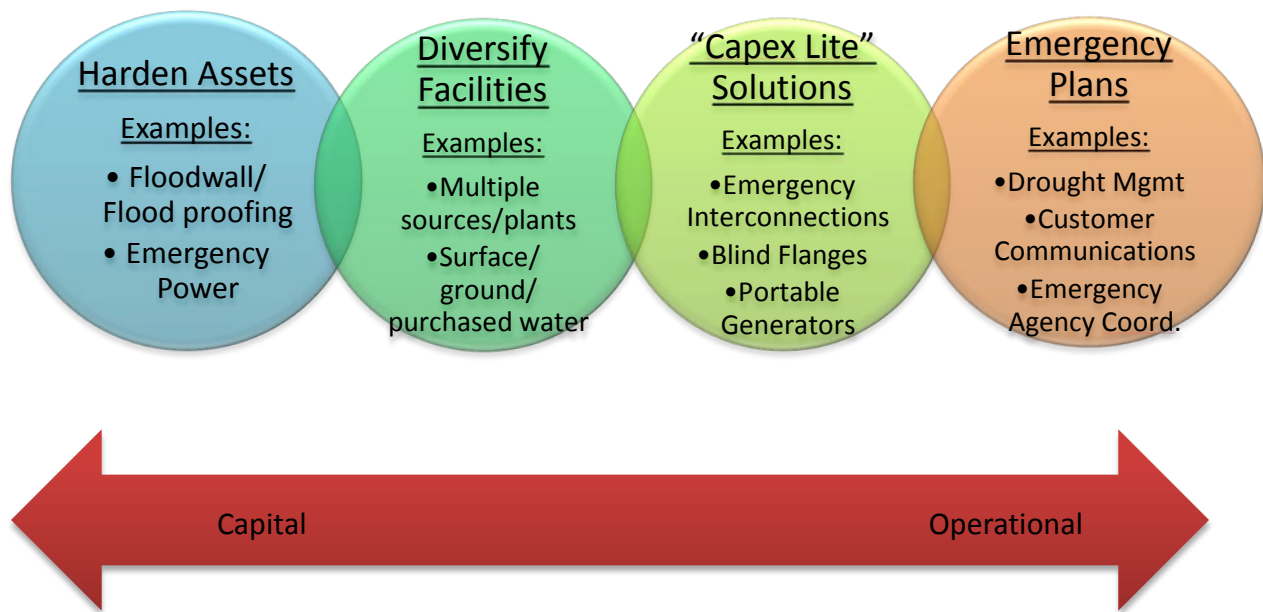
System resiliency is also considered during the CPS process. This evaluation includes examining how resilient the system is in the face of extreme weather events, natural hazards and malevolent threats. American Water also maintains business continuity and emergency response plans to increase

preparedness to address “all hazard” scenarios including climate variations and extreme weather events. The CPS process also has the added benefit of providing a strong foundation for communicating with state utility regulators and local government officials about the need for enhanced resiliency in light of these hazards.

The ability to provide continuous service during a power outage is an example of how planning efforts can lead to enhanced reliability. Evaluations include several factors such as the nature of the electrical service (i.e., service from one vs. two substations), the presence of any floating storage within a pressure zone, standby electrical generating capacity, and the availability of pumps which can be driven by diesel fuel or natural gas.

The CPS studies have proven to be a valuable tool for assessing investments needed to make system upgrades and meet customer demands now and in the future. American Water emphasizes, however, the conclusions from its risk assessment models and planning studies do not always result in a decision to build additional infrastructure. Often, an operational solution or well-scoped emergency plan could be a more cost effective solution to a particular scenario. In many cases, a combination of solutions, ranging from capital to operational, provide the best resiliency against extreme events (see Figure 1).

FIGURE 1



Thus, consideration is given to other factors in determining the need for upgrades, such as equipment age, condition and historic performance, opportunities to improve efficiency through better technologies, and ability to meet future regulations and growth projections. It is often a combination of these primary drivers that triggers infrastructure upgrades.

Innovation

American Water continues to enhance its capital planning process through adopting innovative best practices. For example, the company created an enterprise GIS group for administration of centralized tasks. Subsidiaries have converted from a CAD system to using a GIS to manage its infrastructure. In addition to GIS desktop analysis and web mapping services, the company launched a Mobile GIS application specifically designed to increase operational efficiency and improve field worker productivity. GIS was put to the test when Hurricane Sandy hit the northeast U.S. The company used GIS in New Jersey for cleanup efforts to help identify customer premises that were destroyed by the storm, allowing them to deactivate those accounts on its records and notify customers of its actions. Not only did the company provide an enhanced service to customers, but they significantly reduced calls to the Customer Service Center.

Consideration of National, State and Local Trends

In developing system plans, planning engineers review national, state and local trends that can affect future water and wastewater services. Nationally, there has been a strong trend toward increased and tougher environmental regulations. Examples include: increased protection of water sources; more stringent water quality regulations of finished water; additional regulation of treatment plant residuals; increased frequency of required water quality monitoring; increased water and energy conservation requirements; and more extensive environmental laws affecting new construction and source development. Typically these new regulations are passed down from the federal to the state level to be incorporated as state laws. Often, states have passed additional legislation that address issues specific to their individual circumstances, and can be more stringent than federal laws.

Conclusion

American Water's well established capital planning process creates the road map for sustainable water and wastewater services for each of its systems. The engineers that deliver these plans use many state-of-the-art tools to gather data and analyze system operation, and make recommendations to prepare each system for the future. These studies are core to the company's asset management process and capital investment program. This work identifies solutions and prioritizes projects for implementation so that customer expectations will continue to be met in the decades to come.

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