WHITE PAPER

AMERICAN WATER

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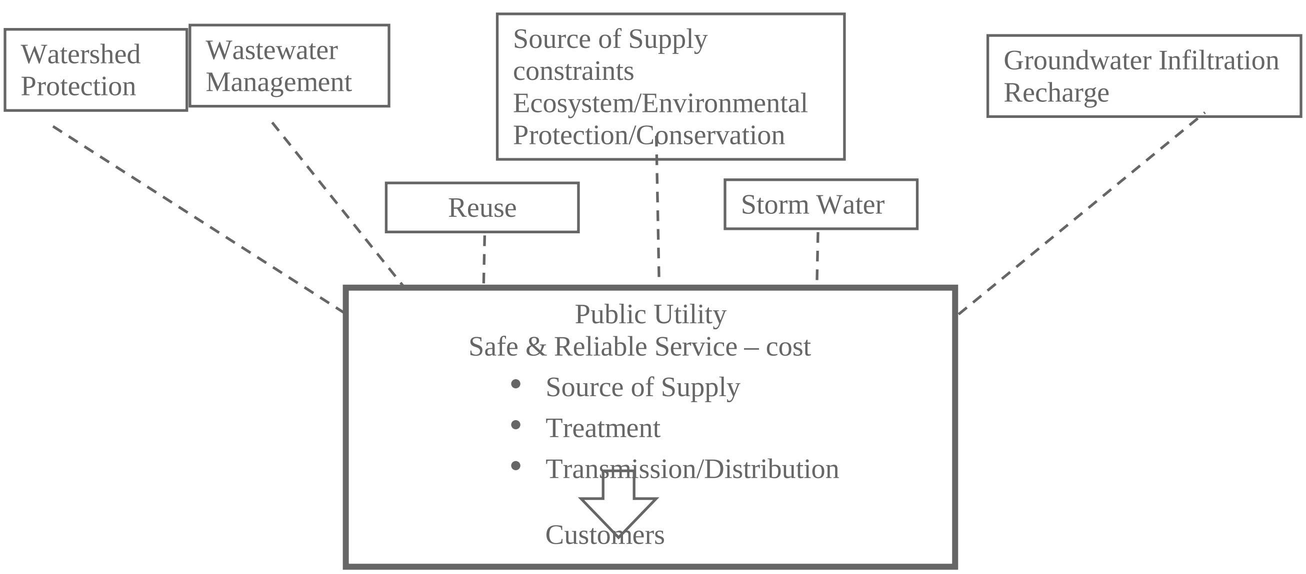
Integrated Water Resource Management

Introduction

The challenges of infrastructure replacement and compliance with water quality requirements under the Safe Drinking Water and Clean Water Acts are increasing. For the water and wastewater industries, the United States Environmental Protection Agency (EPA) estimates the costs of meeting these challenges could approach $1 trillion over 20 years,[1] putting upward pressure on rates for the foreseeable future. It is incumbent upon utilities and their regulators to identify and implement, as appropriate, best practices to facilitate capital attraction, economies of scale and efficient operations if these challenges are to be met in a cost-effective manner. This paper discusses one of the innovative solutions designed to achieve these goals, Integrated Water Resource Management (IWRM).

Explaining IWRM

IWRM is the management of the whole hydrologic cycle to achieve a coherent set of water resource policies and uses that balances all reasonable social, environmental, and economic needs in a sustainable way. Providing safe, reliable and cost-effective service increasingly means a more holistic approach to water resource management. The better all the elements are managed, the better the impact on safety, reliability and cost (Figure 1.1).



[1] U.S. Environmental Protection Agency's 2007 Drinking Water Infrastructure Needs Survey and Assessment, presented March 2009.

FIGURE 1.1

Many factors outside of the traditional regulated framework or Public Utilities Commission (PUC) jurisdiction can directly impact the cost and reliability of service to regulated customers. For water service providers it can mean long-term planning incorporating concepts of reuse, watershed protection, wastewater management, groundwater infiltration and recharge, among others. For PUCs it can mean pursuing statutory and regulatory policies that promote greater interaction and coordination among state agencies that directly impact the quality, cost and sustainability of water resources, such as public health and environmental agencies.

The more effectively all these impacts can be managed, the more efficient and cost-effective provision of regulated water service is likely to become. Innovative solutions should include using integrated water resource planning concepts in source of supply and treatment decisions, and in leveraging all the resources and capabilities of service providers to meet the challenges of the future.

Water utilities can lead the way by developing policies and practices that promote the preservation and restoration of water resources and by fostering strategic partnerships to collaboratively use integrated water resource planning and management as a tool to examine assumptions concerning supply, demand and alternative methods of meeting unmet future demand and social, economic and environmental challenges.[2]

IWRM Principles

- Recognize that fresh water is a finite but renewable and vulnerable resource, essential to sustain life, development and the environment
- Manage water resources based on watersheds and needs of relevant stakeholders
- Preserve water sources and use water wisely
- Allocate water equitably based on input from all relevant stakeholders

Need for IWRM

Nobody would argue with the need for IWRM. Water is required for human consumption, industry, agriculture and to sustain essential ecosystem services. Demand is increasing at an alarming rate with agriculture ever thirstier. In many basins, water resources are already in short supply relative to this demand and integrated management of land and water resources is required to try to ensure all sectors are satisfied equitably.[3]

Fragmentation and Regulations

There are approximately 52,000 water systems in the U.S. today serving more than 250 million American residents. That is about one system for every 4,700 people. In addition, over 90 percent of these systems serve fewer than 10,000 people, which the USEPA defines as a "small" system and many of these systems are simply not financially or technologically viable to meet current, let alone future, infrastructure and quality requirements. Similarly, there are approximately 16,000 wastewater systems providing service.

The severe fragmentation of the U.S. water industry poses serious challenges to meeting the great and growing water needs of Americans, not only with regard to the number of systems and ownership structure, but also in terms of regulation, jurisdiction, planning and policy development and many other areas. Literally, tens of thousands of state and federal statutes, regulations, political subdivisions and agencies impact to some extent the development, use and sustainability

2 A Report of the Aspen Institute's Dialogue on Sustainable Water Infrastructure in the U.S.: "Sustainable Water Systems: Step One - Redefining the Nation's Infrastructure Challenge".

3 Jenkins, Alan & Ferrier, Robert. WaterWorld. "Water, climate change and tough choices." May 2009.

of water supplies. Statutory goals and policies can be, and often are, inconsistent and contradictory. Stakeholder interests are as diverse and divergent as one might expect, given the fact that access to water resources is essential to virtually every significant aspect of human activity and interest. From human consumption, to habitat and ecosystem protection, to recreational, agricultural and industrial uses, and numerous other areas, stakeholders have legitimate interests in the development and use of these resources.[4]

In addition, the source of supply, treatment and distribution chain, as well as the cost to end use customers, is directly affected by other water resource-related issues, such as watershed protection and management, reuse, wastewater treatment, storm water control and disposal, and competing uses – such as for agriculture, habitat and ecosystem protection, human consumption and recreation. Each of these areas is often affected by oversight from numerous different government entities and the competing interests of many stakeholders, and which usually operate with little cohesion or consistent policy. Unlike the energy and telecommunications industries, there is no national, integrated transmission network in the water industry, nor is there a national economic regulatory authority, such as the Federal Communications Commission for the telecommunications industry or the Federal Energy Regulatory Commission for the energy industry. This obviously makes development of a coherent and integrated water policy more difficult.

Global Climate Change

Climate change is greatly affecting weather patterns and the world's ecosystem and, in particular, posing serious challenges to the world's water supply. Causing poor water quality and scarcity and putting significant stress on our water infrastructure, climate change is having a profound effect on how communities can reliably access clean water.

For U.S. water providers, addressing the impact of climate change will require: finding solutions to maintain adequate levels of water supply to communities; ensuring high standards of water quality in the face of droughts or increased flooding; and balancing the need for infrastructure improvements while keeping this vital resource as affordable as possible.

Climate change generally refers to changes in average temperature, precipitation, and weather intensity. Climate experts agree that the main cause of global warming is the increasing levels of greenhouse gases in the atmosphere. While a certain level of greenhouse gases are essential to maintaining the temperature of the earth,[5] higher levels raise the earth's temperature causing climate change. Given these challenges, it is essential to identify practical solutions today to help mitigate the impact of climate change on our future water supply.

Water/Energy

We all consume a great deal of water and electricity every day simply by living our busy lives. While many Americans know the importance of saving both energy and water, few know the direct connection between the two. Water and energy are intimately interrelated - using water more efficiently conserves energy and ultimately, decreases carbon emissions. Unfortunately, many people generally continue to waste water and ignore this link.

As cities continue to grow, particularly in regions already experiencing water scarcity,[6] the linkages between water and energy use are becoming more important. A growing community needs more power, which requires additional water.

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4 NAWC Water Policy Forum: Consolidation White Paper

5 Karl, Thomas R.; Kevin E. Trenberth (2003). "Modern Global Climate Change". Science 302 (5651): 1719-1723. doi:10.1126/science.1090228.

6 The American Water White Paper: "Challenges in the Water Industry: Meeting Demand in the West" highlights scarcity challenges in Western United States.

Electricity plays a critical role in producing, treating and delivering the clean water we use in our homes every day. For example, about 4 percent of the electricity consumed in the U.S. is used for collecting, treating and moving water and wastewater.[7] Pumping accounts for the biggest energy use with 85-99 percent of water treatment plant electric consumption goes to pumping. Given this interrelationship between water and energy, one of the best ways to save energy across the country and in our own homes is to use water more efficiently.[8]

The recently released Report on Freshwater Supply from the Government Office of Accountability states that according to state water managers, experts, and literature GAO reviewed, freshwater shortages are expected to continue into the future. In particular, 40 of 50 state water managers expected shortages in some portion of their states under average conditions in the next 10 years. Given this fact, water conservation—using water efficiently and avoiding waste—is fundamental to ensuring water availability in the future and lessening the effects of a limited water supply. Since very little of our water is used for drinking, there is significant room to find more efficient ways to manage our water use and reduce energy.

Greenhouse Gases & Water Supply Implications

An important step in addressing the challenges of climate change is identifying ways to limit greenhouse gas emissions and educate people about these measures. American Water was the first water or wastewater utility to join the Environmental Protection Agency's Climate Leaders program. As such, the company recently submitted its Climate Leaders Partner Goal Proposal to lower its greenhouse gas emissions per the volume of water it produces by 16% from 2007 levels by the year 2017.

Although other measures will be undertaken to address this goal, it will primarily be achieved by improving the energy efficiency of the water pumping process, which accounts for approximately 90% of the company's greenhouse gas emissions. By replacing or refurbishing older large pumps, studies have shown pump efficiency can improve by as much as 20 percent.

Other Industry Challenges

Capital Intensive

No utility sector is more capital intensive than the water industry. This means that $3.48 of capital is needed to produce $1 of operating revenue – higher than any other utility industry and most other businesses of any nature. The EPA estimates a total 20-year capital improvement need of $334.8 billion.[9] But with water-related services twice as capital-intensive as electricity and three times as capital intensive as gas, many communities simply cannot afford to upgrade their systems, many of which are decades to a century old.

Water Quantity

The quantity of water is as much of a concern as is its quality. A recent GAO survey of state water managers indicated that, even under normal or non-drought water conditions, 36 states anticipate water shortages in localities, regions, or statewide within the next 10 years. Under drought conditions 46 states expect shortages over the next decade. Increasing population and declining groundwater levels indicate that the freshwater supply is reaching its limits in some locations while freshwater demand is increasing. The building of new, large reservoir projects has tapered off, and existing storage is threatened by age and sedimentation.[10]

7 Environmental Protection Agency's WaterSense publication. "Benefits of Water Efficiency."

8 Environmental Protection Agency's WaterSense publication. "Saving Water Saves Energy: Make the Drop-to-Watts Connection."

9 U.S. Environmental Protection Agency's 2007 Drinking Water Infrastructure Needs Survey and Assessment, presented March 2009.

10 Mehan, Tracy. WaterWorld. "Imperative of Integrated Water Resources Management."

Of all the water on the planet, only 3 percent is freshwater and only one hundredth of one percent (0.01%) of the planet's freshwater is considered easily accessible to humans.[11] The amount of water available per person from the hydrologic cycle (evaporation and rain) is estimated to fall by 73 percent between 1950 and 2050.[12]

Quality in Rivers and Streams
Despite many accomplishments, the quality of almost 40 percent of our rivers, streams and lakes still does not support their designated uses. The challenges we face today are from diffuse (nonpoint) sources of pollution such as urban storm water, sanitary sewer overflows, agricultural runoff and atmospheric deposition.[13]

Technology
The Safe Drinking Water Act is increasing technological expertise necessary to effectively comply with new monitoring and treatment techniques and contributing to non viability of small systems. R&D is necessary to develop more efficient and cost-effective ways to treat water and comply with tightening regulations.

IWRM at Work

IWRM focuses on meeting the needs of the present without compromising the ability of future generations to meet their own needs. The goal is to allocate water equitably based on input from all relevant stakeholders.

American Water's large size and technological expertise make it an ideal partner in leveraging the IWRM process. By practicing IWRM, American Water and its partners have been able to preserve water sources and use water wisely while considering the needs of the public and relevant stakeholders.

Piasa Creek – Alton, Ill.
Watershed Project
The Piasa Creek Watershed Project represents a ten-year commitment to reduce sedimentation in the watershed by using silt basins, dry dams, stream stabilization, land acquisition and other watershed protection techniques. American Water is helping to reduce erosion of the Piasa Creek watershed, which helps make the mighty Mississippi River a little less muddy.

The 16 million gallons per day water treatment facility replaces a 100 year old facility susceptible to flooding. The old plant had site specific exemption as part of National Pollutant Discharge Elimination System (NPDES) for direct discharge of residual solids and backwash water to Mississippi. However, the Illinois EPA determined that existing site specific exemption and NPDES did not apply to the new plant. Working with local officials, community groups and state environmental agencies, a solution was reached that allowed the new plant to discharge into the Mississippi, but achieved far greater benefits than the conventional approach to disposing of residuals. The solution reduces sediment in the watershed two times (6,700 tons per year) the discharge of the new treatment plant. The investment in the river bank erosion has shown to be more environmentally beneficial and less costly than building waste treatment facilities.

The Solaire - New York, NY
Wastewater Treatment System
In a city where the population is growing rapidly toward nine million people, there is only so much water to go around. So when the Solaire luxury high-rise building was planned for an already

11 Young People's Trust for the Environment, 2003.

12 Worldwatch Institute, 1999.

13 United States Environmental Protection Agency, Office of Water, 2001.

dense area like Battery Park City in lower Manhattan, a solution based on water recycling was seen as a strategic way to ensure the most efficient use by its tenants. American Water took on the task of finding a “green” solution for the Solaire project. They managed the design and building of a wastewater recycling facility that allows the Solaire to treat 25,000 gallons of wastewater per day. The treated water is reused for flushing toilets in the 293-unit apartment building, filling the cooling tower and irrigating rooftop gardens. The Solaire is so efficient that is uses 35 percent less overall energy consumption and 67 percent less energy at peak demand than systems in typical buildings of similar size.

Keeping with the “green” goal, the facility contains 19 percent recycled construction materials. The rainwater collection system irrigates 10,000 square feet of rooftop gardens. The Solaire received a Gold LEED (Leadership in Energy & Environmental Development) rating and a Green rating from the Green Building Council. The treatment plant uses an industry-leading filtration technology to separate waste from the water, providing a high-quality effluent. The recycling plant process includes further treatment with hollow fiber micro-filtration membranes, treatment with ultraviolet light to kill bacteria, and both oxygen-based and non-oxygen-based treatment to remove nitrogen to comply with New York’s direct reuse standards.

Gillette Stadium - Foxborough, Mass.
Wastewater Treatment System
Game days at the home of the NFL’s New England Patriots created a tremendous strain on the water supply and wastewater disposal capacity of Foxborough, a city of 16,000 people about 30 miles south of Boston. The challenge for American Water was to create an environmentally friendly system to produce high-quality reuse water for the stadium’s nearly 69,000 fans during peak halftime flush periods – without creating additional demands on the community’s existing systems.

American Water managed the design and construction of a wastewater treatment system for Gillette Stadium. The system returns high-quality treated wastewater both to the stadium and the Foxborough economic development area. The recycled water is used for flushing toilets, facilities cooling and other purposes.

The system is an all-inclusive wastewater treatment and recycling facility. Advanced, industry-leading filtration technology is used to provide the main treatment to the wastewater. Membranes effectively remove particles and bacteria in the effluent before the water is further disinfected by passing through ultraviolet light. The system can currently handle 250,000 gallons of wastewater per day with the ability to expand it to 1.3 million gallons per day.

Fillmore Water Recycling Plant - Fillmore, Calif.
Wastewater Treatment Plant
Harnessing the most advanced treatment technologies available to help make a difference for the environment, American Water designed, built and now operates this state-of-the-art wastewater treatment plant that recycles 100 percent of the water it treats. The $42.5 million facility was built to replace an existing, outdated facility that no longer met modern environmental standards. Now, instead of water being discharged into the Santa Clara River as the old facility did, cleaner treated water suitable for irrigation is used on school grounds, in parks and green areas throughout the city of Fillmore.

The plant was designed and built for maximum energy efficiency, and includes many features that allow for “greener” operation. Flow is minimized during peak hours when energy use and cost are highest. During off peak hours, a greater volume of wastewater is cycled back into the plant and treated. The DBO project helped Fillmore save $10 million by working through a single contract and establishing a guaranteed cost.

Community Engagement

Established in 2005, American Water's Environmental Grant Program offers funds for innovative, community-based environmental projects that improve, restore or protect the watersheds, surface water and/or groundwater supplies in our local communities.

Surface water (rivers, lakes and streams) is the source of 60 percent of our nation's drinking water, with the remainder supplied by groundwater sources. Our rivers and groundwater support public health and economic development, and also help to sustain the environment and wildlife. For example, our wetlands provide a valuable habitat for wildlife, naturally cleanse and filter water, and help reduce flooding. Every individual and community has the ability to positively impact our source water and watersheds, and opportunities exist to improve, restore and protect these valuable natural resources. American Water's Environmental Grant Program will help to improve the sustainability of our water resources.

Participating states award grants of up to $10,000 to support diverse types of environmental sustainability activities such as watershed cleanups, reforestation efforts, biodiversity projects, streamside buffer restoration projects and hazardous waste collection efforts.

Conclusion

IWRM needs a holistic long-term approach. This must be supported by all stakeholders, including government and investor-owned service providers, federal and state environmental regulators, state economic regulators, regional planning agencies, river basin commissions, non government community and environmental organizations and consumers. In conclusion, we need a new IWRM perspective that:

- Embraces concepts of sustainability
- Facilitates economies of scale
- Promotes R&D, knowledge sharing and best practices
- Encourages innovative, cost-effective solutions to current and future challenges

These solutions will enable cities to move rapidly towards an IWRM approach. It is imperative that water managers practice IWRM today.