WATER SYSTEM INFRASTRUCTURE
A VIEW OF WHERE WE ARE, WHERE WE COULD GO AND HOW WE CAN GET THERE

This is the first of several essays that are aimed at focusing attention on water and sewer infrastructure systems. In this essay, the current state of city and regional systems are examined; the current state of the industry will be examined next, investigating some of the tools, resources and technologies that are available, today. Beyond that, the final essay in this series will look at the needs emerging from the developing world as well as the shifting demands that will drive decisions affecting the upkeep and expansion of existing water infrastructure.

When those of us who live in developed nations turn on the tap or flush the toilet, most of us are not thinking of what it takes to deliver us that glass of clean water or treat our sewage. The infrastructure that is in place for pumping, purifying, transport and waste treatment is what allows those mundane, daily activities to occur without a second thought. These water and sewer networks are a patchwork-quilt of local and regional systems that have been pieced together in order to meet the needs of the populations that they support. In some cases, components have been in place for hundreds of years; this is especially true in the case of networks that serve large urban centers. In fact, fully 1/3 of London's water pipes are over 150 years old , and while there may be some truth to the adage 'they don't build them like they used to', the stark reality is that water and sewer systems do deteriorate over long periods of time and constant use.

Populations grow and new industries bring new needs. The infrastructure to support these new needs must be put in place; new roads and power systems must be constructed, and installed as needed. Water and sewer systems cannot simply 'expand capacity' as needed, though. Because of this, water system mangers and engineers must plan for the future in design and construction, anticipating future needs. Critical questions that city and regional managers must ask themselves include:

- What is the state of the existing water and sewer systems?
- What is the yearly cost to maintain these systems?
- What population were these systems designed to serve?
- Are these systems meeting the current demands that are placed upon them?
- What is the best approach to addressing any immediate issues or shortfalls?
- What are likely to be the demands placed in these systems 25 years in the future? 50 years? 100 years?
- How far into the future will the systems continue to support the population?
- How can those future needs be most effectively addressed?
- Are there new ideas or new technologies that should be pursued?
- How can these repairs, upgrades and improvements be financed?

In examining the water and sewer systems in the United States, the first point of interest is the distributed and independent nature of these networks. The US Congressional Budget Office (CBO) found that over 53,000 independent systems are in place to serve an estimated 264 million people. While that may seem like a huge number of water

systems, it should be noted that just 7 percent of these community systems serve 10,000 people or more . While local control and regulation is, in many cases, desirable, in this case it unfortunately leads to situations where some local communities struggle to deal with the costs associated with addressing necessary upkeep and maintenance of these systems, much less improved water quality. For example, the US Environmental Protection Agency's (EPA) data on the costs of monitoring and treatment to comply with the Safe Drinking Water Act standards that came into force as of September, 1994, suggest that the average cost per household was on the order of $4 per year in systems serving more than 500,000 people, but $300 per year for systems serving no more than 100 people .

The need to maintain the existing drinking water supply systems is clearly evidenced by the tragedies that unfold when those systems fail. As an example, in 1993 contamination of the Milwaukee water supply by cryptosporidium caused 400,000 cases of gastrointestinal illness and an estimated 50 to 100 deaths. Less catastrophic failures demonstrate the widespread nature of the problems. According to EPA's data, 880 publicly owned treatment works receive flows from "combined sewer systems" which commingle storm water with household and industrial wastewater and frequently overload during heavy rain or snowmelt. Such overflows are estimated to discharge 1.2 trillion gallons of storm water and untreated sewage every year.

Even "sanitary" systems with separate sewers for wastewater can overflow or leak because of pipe blockages, pump failures, inadequate maintenance, or excessive demands. According to a draft EPA report, overflows from sanitary sewers alone result in a million illnesses each year . Even historic Boston Harbor was used for nearly 300 years as the disposal site for regional sewage until a court-ordered cleanup and treatment plan changed that in 1998. While Boston appears to have successfully upgraded its sewer treatment and disposal system, there are still many coastal communities in the US, Canada, Europe and elsewhere that practice raw sewage disposal in the world's oceans. This is a practice that generates almost universal repulsion when it is exposed to the public light, and mostly continues because of public ignorance that it occurs.

Furthermore, many urban and rural drinking water systems lose 20 percent or more of the water they produce through leaks in their pipe networks; London offers a prime example of this. Water leakage in London's Thames Water system runs at the equivalent of 300 Olympic-sized swimming pools a day. In part, such problems are the result of normal aging of water infrastructure worldwide. The generally accepted rule of thumb is that a sewer pipe lasts 50 years and a 1998 US survey of 42 municipal sewer systems found that existing pipes averaged 33 years old, suggesting that many are, or soon will be, in need of replacement.

These facts are not presented in order to alarm or point fingers; instead they are offered as the starting point for discussions. The fact is that today more people have access to clean water than ever before in human history and that is a great accomplishment, of which everyone should be proud. That should not, however, preclude constructive assessments of problems that affect the health and well being of people in communities everywhere.

Quite the opposite, knowing how much has been accomplished and the effort that has gone into putting the infrastructure in place should be motivation to maintain and continually improve the drinking water and sewage treatment systems that serve the world.