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American Society of Civil Engineers Michigan Section

DRINKING WATER SYSTEMS

GRADE D

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OVERVIEW

The State of Michigan is a unique position of being surrounded by the Great Lakes, an abundant supply of fresh water. Yet the State faces crucial funding challenges both in treating and distributing clean drinking water to continue to meet the level of service demands of its residents.

BACKGROUND

Some 75% of the population of the State of Michigan, approximately 7.5 million people, gets its drinking water from the State's 1,420 community water systems (CWS). Both ground water and surface water provide the raw water for these CWS. The surface water systems are generally larger and supply more residents with drinking water.

Approximately 20% of the State's CWS (292 of 1,420) use surface water from the Great Lakes and a few inland rivers to provide drinking water to nearly 80% of the CWS-served population. The rest of the CWS (1,128 of 1,420) supply the remaining 20% of the CWS-served population using ground water.

The centralized nature of the State's water supply network is heightened by the fact that less than a quarter of the surface-water CWS (63 of 292) operate their own water-treatment plants. The remaining surface-water CWS purchase their water from these water-treatment facilities. The large systems in Detroit, Grand Rapids, and Saginaw supply the majority of them.

About half of the State's CWS (730 of 1,420) are owned and operated by municipalities (cities, townships and villages). The remaining half are either privately-owned systems that serve manufactured housing communities, apartment complexes, nursing homes and condominium associations, or State-owned systems that serve prisons, universities, and the like.

The following categories were assessed and assigned grades for the circumstances found:

CURRENT CONDITIONS

Water Source and Treatment Systems

Nearly 40% of CWS have some degree of water treatment. Some of these are vast and complex treatment systems, with complete water filtration processes which use coagulation, sedimentation, filtration and chlorination. Many also consist of membrane filtration systems for treating lake water, lime systems for softening groundwater, and iron-removal plants with oxidation and filtration to remove color, odor and arsenic. However, the majority of the treatment systems use methods as simple as deploying one or more positive displacement pumps to feed liquid sodium hypochlorite or a polyphosphate into the discharge pipe of a well. The majority of the complex water treatment facilities require significant financial investment on a periodic basis to rehabilitate, replace or upgrade the equipment needed to maintain water quality.

All but six of the 63 CWS with treatment plants get their water from the Great Lakes or connecting channels. These systems have access to abundant supply and can easily meet the needs of the residents they serve so long as they keep ahead of the demand by constructing and maintaining the required facilities.

The remaining six CWS with treatment plants get their water from inland rivers and are more likely to face capacity limits. With increasingly stringent treatment regulations and limited capacity, these inland-river systems have begun to develop groundwater systems to supplement or even replace their surface water systems.

Only a few areas of Michigan have groundwater resources that are limited in capacity, availability or by poor quality. The vast majority of the CWS in the state that rely upon groundwater are able to locate and install new wells as needed. Like surface-water treatment facilities, the source-related infrastructure for ground water wells, well houses, intake cribs, intake lines, shore wells, pumps and motors, etc. require significant financial investment to periodically rehabilitate or replace this equipment to maintain adequate source capacity.

Michigan has more public water systems than most states that were impacted by the revised arsenic standard of 0.010 micrograms per liter. This revised standard became effective in 2006. Because impacted systems are all small ground water systems serving fewer than 3,300, the statewide costs may not seem significant, but the need compared to other states is high, as is the cost borne by the limited number of customers in each system.

While most CWS have operation and maintenance budgets, the challenge they face is ensuring revenues generate adequate funds to cover the cost of maintaining and eventually replacing the equipment necessary to provide finished tap water at a consistent high quality. Too often, the equipment must reach a critical stage of deterioration, even approaching outright failure, before the infrastructure need is addressed. Fortunately, given the immediate impact of dissatisfied customers or potential public health jeopardy created by poor quality or inadequate capacity, CWS are more often likely to assign the resources necessary to address problems and restore their source and treatment facilities.

DISTRIBUTION SYSTEMS

Transmission and distribution mains account for most of the state drinking water infrastructure. A significant portion of the states primary distribution system is nearing 100 years old. CWS are facing a significant challenge to maintain the vast network of aging, underground infrastructure. Within the city of Detroit alone, approximately 80% of its distribution piping was installed prior to 1940, which is not unusual for CWS in Michigan. Booster pumping stations and storage tanks that are part of the distribution delivery system are more likely to be maintained and eventually replaced when necessary because like treatment systems, their deterioration is apparent and their failure results in more dramatic impacts on customers.

While water treatment systems are more stable because they are difficult to ignore, much of the delivery system including piping, valves and hydrants are reaching the end of their anticipated design life and routine replacement has been postponed for too long. Out of site and out of mind…until the road is closed and flooded out, toilets cannot be flushed, food cannot be cooked, dishes cannot be washed, or a shower cannot be taken. Water main breaks, low pressures and isolation failure commonly drive distribution system rehabilitation priorities. System disruptions continue to become more frequent as the distribution system ages. The workforce has adapted to effectively implement new technologies and materials for water distribution system repair. Tooling and emerging market forces continue to drive the distribution system rehabilitation by means of low impact trenchless construction technologies to minimize open cut excavation and social disruption.

The age of the majority of the state's distribution system is the primary contributor to normal decay and failure. In many cases, pipe life has far exceeded useful service life. Much of the older water systems consist of undersized mains constructed of materials such as unlined cast iron pipe. Minor fluctuations in system flows or pressure may cause red water complaints and even result in pipe failure. All CWS should have routine flushing and valve maintenance programs; however many are hesitant due to the time and cost. However, other factors are present within the distribution

system. Chemical additives and natural minerals in distribution systems are in a steady flux to minimize adverse delivery affects such as lead and copper leaching and taste and odor complaints. While this practice is the generally accepted cost effective and quality conscious distribution system management, signs of build up in the mains as solids particulate are suspended to the interior of the pipe is becoming increasingly more prevalent.

Under the Stage 2 Disinfection Byproducts Rule, all CWS that disinfect are required to provide increased trihalomethane (THHM) and haloacetic acid (HAA5) monitoring due to the potential byproducts of chlorine reactions within the pipe system. Corrosion, scale, solid suspension on the interior sidewall of pipe, in addition to the age and condition of the system will require diligent rehabilitation investment to maintain system integrity.

The majority of distribution system piping installed today is lined ductile iron, often with a polyethylene wrap which has proven to be effective in corrosive soils, and is expected to exceed the life of the existing sand cast system. Also, the use of plastics in distribution systems including high density polyethylene (HDPE) and poly vinyl chloride (PVC) have been gaining momentum due to their widely accepted use for potable water transmission, suitability for trenchless construction installations, and the non metal/ferrous components. The life of these plastic systems is also expected to exceed the life of the existing sand cast materials in the original system.

While better materials and advanced technology is available to replace the aging distribution system, resources remain scarce when compared with the magnitude of the rehabilitation task at hand. Too often, distribution system replacement costs are underfunded and the first item to be slashed when budget problems arise.

Overall, distribution system maintenance is reactionary in much of the older systems. Since the majority of the antiquated system will require removal and replacement beyond the CWS funding resources for systematic upgrade, a reactionary rehabilitation program is inevitable and must be funded accordingly.

FUNDING NEEDS/OPTIONS

CWS face a significant shortfall in capital funds to maintain the aging infrastructure. Along with the cost to maintain treatment operations, the need to replace antiquated infrastructure including pumps, piping, hydrants, valves and storage reservoirs looms. All of these components of the majority of the CWS are reaching the end of their design life. A significant portion of the state's primary distribution system is nearing 100 years old. CWS have recognized this daunting task and the major systems have invested resources in master planning, needs assessments, and project plan development. The continued implementation of GIS mapping has allowed the larger CWS to quantify and prioritize the preservation of a vast network of underground infrastructure. Furthermore state regulatory required reliability assessments and sanitary surveys serve as a tool for regular system oversight and checkup.

The most comprehensive analysis performed on the state of Michigan's drinking water systems is the EPA Drinking Water Needs Survey. The Safe Drinking Water Act requires that the EPA conduct an assessment of the national public water system capital improvement needs every four years. The purpose of the survey is to document the 20-year capital investment needs of public water systems eligible to receive Drinking Water State Revolving Fund (DWSRF) monies. The needs survey is designed to compile the 20-year drinking water system needs that meet EPA criteria for project funding. These surveys were performed in 1995, 1999, 2003, and most recently in 2007. In every survey so far, the transmission and distribution system needs were found to be largely underfunded The results from the 2007

survey are scheduled to be completed by the EPA and MDEQ in February 2009, and were not available at the time of this research. It can be reported however that the 1999 study estmated $6 billion in fiscal needs in Michigan and the 2003 study showed a remarkable increase to $11 Billion Dollars in needs. The 2007 survey is anticipated to post an even larger total, climbing at a rate beyond the monies available to meet the needs.

It must be emphasized that the EPA needs survey funding represent only the projects which fit the EPA established criteria of need. One major deficiency in this process is the limitation on identifying funding for distribution system rehabilitation in excess of 0.05% of the total system. This number is based on matching the state's largest City's planned 20-year CIP expenditure apportioned against its true critical system needs. Therefore, a significant shortfall exists in this process to meet the true needs of the distribution systems statewide, by backing into only what it can afford to levy.

CONCLUSIONS

The State of Michigan's larger water systems have improved or updated their raw water and treatment systems to an adequate level to keep the systems operating. There are instances when the rehabilitation of critical unit processes such as filters are delayed for cost reasons. Other items that have delayed maintenance and/or rehabilitation are the plant piping and pumping systems maintenance demands. Some raw water source systems have recently been shown to be inadequate either to handle adverse environmental conditions (i.e. freezing of intake lines) or regulations (i.e. inadequate back-up source). Generally, source and treatment system components have been better maintained because they are more visible assets whose operation is often critical to providing satisfactory customer service, both from a quality and quantity standpoint. In addition, DEQ oversight often focuses on inspection and evaluation of wells, pumps and treatment facilities, and the majority of MDEQ regulations require that treatment facilities be properly operated and maintained in order to stay in compliance, which has not been the case with distribution system components, particularly piping.

Deficiencies with the source and treatment systems are addressed due to immediate impact of dissatisfied customers or potential public health jeopardy created by poor quality or inadequate capacity. However, CWS are more often likely to assign the resources necessary to address problems and restore their source and treatment facilities rather than invest in the rehabilitation of aging infrastructure and distribution systems. Planning and Capital investment for rehabilitation of aging infrastructure must be secured and is critical to ensure sustainable drinking water distribution systems.

Much of the State's underground infrastructure has been ignored in an effort to delay system capital expenses. If water mains are depreciated over 100 years (longer than usual) a water system should be replacing at least 1% of its system every year. This is rarely if ever done. In reality, large portions of systems were constructed during growth eras and therefore the system replacement is not spread out equally. This will result in large portions of distribution systems failing at or near the same time. The problem seems to be underfunding. The use of asset management systems can help,and we recommend they aggressively pursued. There has been a history of delaying capital investment in an effort to artificially keep rates low. This is critical to the rehabilitation and replacement of distribution system components.

RECOMMENDATIONS

Many but not all water utilities have done some level of Master Planning. However, the ability of the utility to follow through on the resulting recommendations appears to be the more critical and missed step. It appears essential that CWS, especially the large systems with

multiple consecutive customer communities, have to be prepared to implement the critical utility rehabilitation planning initiative and make those processes as transparent as possible, and be able to reasonably and equitably justify to each of those communities all of the improvements and how they should be funded. Integrating a true asset management program into the annual budgeting process may ensure adequate planning.

CWSS must prepare to finance rehabilitation of their respective distribution systems with user based fees and legal utility management controls to properly plan for inevitable continued system deterioration. This will require local and regional efforts to establish the funds and resources. The overall state and federal sources available will not suffice for anticipated system maintenance. Only a relatively small number of WSS are applying for the DWRF Funds available, purportedly due to the cost match requirement. WSS leaders must be educated to bring the fiscal needs of the drinking water production, treatment and distribution systems to the forefront of the local politicians, leaders, law makers, financial analysts, and budget committees.

SOURCES

1. The Safe Drinking Water Act
2. EPA Drinking Water Needs Survey
3. Drinking Water State Revolving Fund (DWSRF)
4. MDEQ Water Quality Bureau