HAZEN AND SAWYER Horizons
Engineering Excellence in Meeting Environmental Challenges
Winter 2004

Challenges and Solutions in the "Replacement Era"

Water, wastewater, and storm drainage utility owners and managers are increasingly bombarded with new terms and acronyms: gap analysis, replacement era, CMOM, SSOs, CSOs, GASB 34, asset management, CMMS, trenchless technologies, CIPP, PACP, etc. While it may seem overwhelming, for the most part, these terms are simply new phrases for concepts and methods that have been around for some time. The recent explosion in the use of these terms is likely the result of a growing realization that our nation's infrastructure is in dire need of refurbishment.

This issue of *Horizons* focuses on the renewal of water and sewer infrastructure assets. We explore a number of new terms and what they can mean for our clients. Our intent is to offer some helpful hints and other practical information, based on our long history of helping utilities meet their pipeline rehabilitation needs, with an emphasis on recent developments in this field, particularly the use of trenchless technologies. To illustrate how we've applied some of the concepts and advice offered, several recent project examples are highlighted throughout the issue. For more detailed descriptions, please visit our Website, where several related articles are posted under "News": www.hazenandsawyer.com.

There is a growing realization that our nation's infrastructure is in dire need of refurbishment.

Also in this issue, we introduce some new members of the growing H&S team. These additions substantially expand our capabilities in these markets, so that we can better serve our clients in the coming "replacement era."

Inside

When (and When Not) to Use Trenchless Methods

An experienced carpenter knows that there is a proper tool for every task. The same may be said of engineers who specialize in pipeline renewal and construction, especially with respect to the selection of trenchless methods. An engineer with hands-on experience in the field with the use of trenchless technologies can quickly assess which trenchless (and conventional) technologies may apply to a particular project challenge. Often, it may be more important to know when a trenchless method is not applicable. As an example, consider the case

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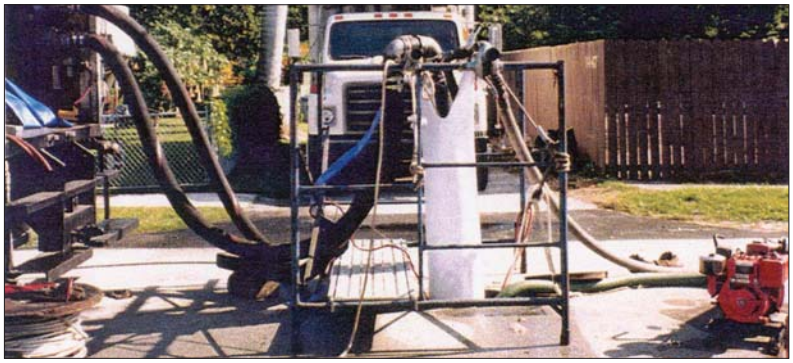
Trenchless technology was creatively applied for the City of Miami. H&S was part of a design/build team that constructed a 2,400' 16"-diameter high-density polyethylene force main 80' below Biscayne Bay, using horizontal directional drilling. This technology prevented disturbance to sea grass and benthic communities.

Slip lining was among the repair methods employed in an aggressive I/I reduction program for the Miami-Dade Water and Sewer Department.

Trenchless Methods *Continued*

of an existing sewer main that is partially deteriorated, as well as hydraulically undersized. Conventional open-cut and pipe-bursting methods are the logical options. In comparing these two options, the engineer must consider such factors as the number of significant sags in the pipeline, surface congestion, geotechnical conditions, and the presence of groundwater. Sags that are more than a third of a pipe's diameter must be repaired before the pipe can be burst, or the polyethylene pipe commonly used in bursting will sag back into the cavity left by the old pipe. If there are many such critical sags, the total cost of the point repairs could make pipe bursting more costly than open-cut. An engineer experienced in trenchless technologies can determine the feasibility of each process very early on in the design process, saving the owner time and significant expense.



The Miami-Dade I/I reduction program also included installation of cured-in-place pipe liners.

Real-World Examples

The Biscayne Bay crossing by horizontal directional drilling (HDD) is a good example of a technically challenging project for which the benefits of a trenchless approach outweighed the potential risks. In contrast, as part of a recent water main replacement job, Hazen and Sawyer evaluated the use of the same technology for crossing underneath a major intersection. For the latter job, extensive excavation would still have been needed to reinstate valves and branch connections within the intersection, following completion of HDD. Therefore, a conventional open-cut approach was deemed a surer and more cost-effective means of completing the work, with a similar level of traffic disruption.

Moreover, the so-called "conventional" open-cut method sometimes takes less conventional forms, based on the specific demands and constraints of a job. For example, for an emergency repair to a collapsed sewer main in Pembroke Pines, FL, the hydraulic excavator capable of performing such a deep repair could not access a rear-yard easement due to close spacing between residences. Instead, high-powered vacuum excavation equipment was utilized, as shown in the photo to the left.

While called "conventional," open-cut construction sometimes takes an unconventional twist, such as the use of high-powered vacuum excavation equipment to enable work in close proximity to houses.

What is Asset Management?

As part of a 3,000-mile sewer assessment program, H&S is providing classroom training for the Philadelphia Water Department—an important element in an overall asset management program, which will allow the Department to take full control of the program by September 2004.

The term "asset management" is increasingly being heard around the offices of utility owners and managers. Simply stated, asset management is the application of good business practices that enable utilities to provide a desired level of service for the minimum long-term cost. Most, if not all, utilities currently implement many elements of a complete asset management program; they just may not refer to these tasks collectively as "asset management." The recommendations in the GASB Statement 34 and the upcoming SSO Rule, especially the CMOM (Capacity, Management, Operation, and Maintenance) provisions, will require utilities to coordinate these activities in a more deliberate and comprehensive manner. However, with a little common sense and forethought, this should not place an undue financial burden on a well-run utility.

Maximizing Hydraulic Capacity of Lined Sewers

Cured-in-place liners may offer better hydraulic capacity than slip lining.

Utility managers often express concern that lining an old sewer pipe will reduce its hydraulic capacity by decreasing the pipe diameter. The typical response from liner manufacturers is that the minor loss in pipe diameter is more than compensated by a significant improvement in the frictional coefficient of the lined pipe. In most cases, where the pipe liner thickness is a relatively small fraction of the total host pipe diameter, liner manufacturers note that the lined pipe will have a higher capacity than the old deteriorated pipe. While this is generally a true statement, it does not fully address the pipe rehabilitation issue.

The issue at hand is not a comparison of the newly lined pipe versus the old pipe. Instead, a utility manager should ask, "What is the best available renewal option?" Most liner options (such as slip-lining, cured-in-place lining, etc.) will provide a similar smooth interior, at least initially. The primary differences between liners are: 1) how long they maintain their improved friction characteristics; and 2) the amount of interior diameter lost to the liner. The hydraulic capacity of the lined pipe depends on both criteria.

For instance, slip lining takes up considerably more of the host pipe's interior diameter than cured-in-place lining, thus permanently losing more pipe capacity. Recent projects for which both methods were included in the bid have indicated that cured-in-place systems can be cost-competitive with slip lining, while affording greater hydraulic benefits. Therefore, to maintain the highest value of the pipeline asset, a forward-thinking owner should consider slip lining only as the last resort.

A Promising Technology for Water Main Lining

New rapid-setting polymer lining systems can provide same-day service on water main repairs.

Since its introduction in the 1920s, cement mortar lining (CML) has been the primary method for rehabilitating water mains. However, things may be about to change.

Rapid-setting polymeric lining systems, developed in the United Kingdom for water main renewal, are beginning to move into the North American market, and have received NSF approval. The attraction of these new lining systems is their rapid set time. Dry to the touch in only three minutes, the lined main can be returned to service in under three hours, as opposed to 16 to 24 hours for CML and standard epoxies. Using the new systems, a qualified contractor should be able to remove a main from service in the morning, clean and prepare the main, line it, inspect it, disinfect it, and put it back in service—all in the same day! This may allow water utilities to eliminate the costly and time-consuming installation of temporary service piping. Instead, they may only need to issue a "boil water" notice until laboratory results are in.

Of course, the use of these new lining systems will require regulatory approval. However, pilot programs in several states have proven the validity of the concept. If successful, water utilities can get a better and longer-lived product for about the same price as CML.

Selecting Modeling Tools for Long-Term Value

Software options must be evaluated based on long-term planning, design, and management criteria.

Although delayed, the long-expected SSO Rule will eventually be promulgated. In fact, some states are already implementing versions of the Rule. A key component of this Rule will be its CMOM (Capacity, Management, Operation, and Maintenance) provisions. "Capacity" refers to the requirement that sewerage utilities develop programs to assure that all system components have adequate capacity for future growth in the service area. A vital part of this task is the selection of a sewer modeling program.

To realize the maximum benefit from this effort, a utility should invest in modeling software that not only helps meet its immediate capacity assurance goals, but also provides long-term value as a planning, design, and management tool. There are a number of software packages to choose from. The strengths and weaknesses of each must be evaluated before selecting a package that meets the utility's planning and design needs, is within their capabilities, and interfaces well with other applications, especially GIS. As an example, H&S recently evaluated sewer modeling software options for the Town of Cary, NC. The table to the left presents the comparison matrix for the final four leading contenders. Software "C" was selected due to its dependability, ready GIS interface, and cost. It is important to note that cost was the last parameter evaluated, and one given the least weight in this analysis; long-term dependability and usefulness were considered far more important than short-term cost savings.

Dynamic Sewer Model Comparison Matrix

Feature	A	B	C	D
Dynamic Model	✗	✗	✗	✗
Extended Time Simulation	✗	✗	✗	✗
Loop & Branched Network	✗	✗	✗	✗
Quantify SSO Spills	✗	✗	✗	✗
Model Surcharges and Reverse Flows	✗	✗	✗	✗
Model Pump Stations and Siphons	✗	✗	✗	✗
User-Friendly	✗	✗	✗	✗
Original Windows-Based	✗	✗	✗	✗
GIS-Ready		✗	✗	✗
Stable Work Engine			✗	✗
Self-Validity Diagnostic			✗	✗
Real-Time Control	✗	✗	✗	✗
Manipulation of Raw Data	✗	✗	✗	✗
Software Support			✗	✗
Current Price	$20,000	$10,000	$25,000	$45,000

When Claims Sound Too Good to Be True

As with any new market, industry has rushed to fill the need for new materials and systems for the renewal of water and sewer pipes. Many of these systems are quite good. But inevitably, there are a few "bad apples" out there.

Utility managers are busy people and may not have enough time or experienced personnel available to check on the credentials of these new systems. As a result, some of these questionable systems may get "into the barrel." To avoid this, utility managers should insist that each manufacturer provide sound references and full documentation of any claims for their products. References must be current and should be contacted, to confirm product performance. Documentation must be provided by a reputable and independent testing lab. Most importantly, the laboratory should verify the claims for product strength and reliability after it is in place (i.e., the final product). If at all possible, utility personnel should prequalify those contractors and manufacturers whom they know and trust. When a new product comes on the market, however, utilities should rely on the experience and technical resources of consultants in the field to protect them from the "bad apples."

Ensuring the Quality of Sewer Liners

Water and sewer utilities have a range of options to choose from when contemplating infrastructure rehabilitation methods, and may find it difficult sifting through all the claims for material performance and strengths. (See sidebar at left.) Owners need to review competitive bids for their work, but how do they know that each proposed product provides equivalent quality and service life for the bid price offered?

In particular, fold-and-form liners (as shown above) may exhibit different material characteristics among competing products.

The answer is to determine the performance characteristics of each material and to provide a common design basis for its use. This is best done during the design stage, so that the performance characteristics of each product can be considered and incorporated into the specifications. For instance, the stiffness of the material (measured by the modulus of elasticity) can vary from 140,000 psi for polyethylene products to 400,000 psi for some PVC alloys. With proper design, all of these systems give good performance. The designer must include proper design parameters in the specifications, so that each product offered in the bid will provide equivalent service. That way, the bidders fully understand the required level of quality, and the owner is ensured of receiving an equivalent product, no matter which bidder wins the contract.

Viewpoint: By Ethan Heijn

TOUGH ECONOMIC TIMES UNDERSCORE BENEFITS OF TRENCHLESS APPROACHES TO ASSET PRESERVATION

The effect of economic slowdowns on public utilities may lag the broader economy. However, as with past recessions, our clients are facing increased funding pressures. While this can be challenging for utilities and their consultants, a positive by-product of such tight fiscal conditions may be the strong incentive to reevaluate how budgets are expended and what technical and operational approaches help maximize investments. In the long term, especially for buried water, wastewater, and stormwater infrastructure, we have found that overall costs are reduced through a regular program of condition assessment and repair.

. . . over the next 20 years, there will be a $50 billion/year gap between funded work and needed work for capital investments in water and wastewater plants and piping systems.

While there's been much recent discussion about "asset management" in the context of such federal initiatives as CMOM and GASB 34, the central tenets of these regulations involve practices that many well-operated utilities have understood and employed for years. In essence, it's about good planning—having procedures in place and knowing the condition of infrastructure, so that problems are avoided or resolved before reaching a crisis. And, while even the best-run utilities cannot avoid the occasional emergency expense, planned spending is always cheaper than unplanned spending in the long run.

Apart from regulatory incentives and long-term cost-effectiveness, there are other important reasons why now is a good time to invest in a regular program of condition assessment and repair. Benefits apply to water, wastewater, and stormwater systems alike.

Technological Advances

Trenchless technology products, processes, and contractors have become cheaper, faster, and more reliable, making preventive maintenance easier. Meaningful rehabilitation work can now be accomplished without major impacts to roads, traffic, businesses, neighborhoods, and other utilities, which such endeavors traditionally entailed. Also, since the design life of trenchless processes, such as structural lining and pipe bursting, may exceed 50 years, they may appropriately be viewed as long-term solutions that essentially amount to infrastructure replacement. Information management tools, such as GIS and relational databases, can be employed in support of such efforts to create a level of order, efficiency, and documentation that was impossible in the days of paper files.

Increased Efficiency

The ancillary benefits of preventive maintenance can deliver real cost savings to a utility. Reducing unaccounted-for-water loss, through a water audit and leak detection survey followed by repair and replacement of pipelines and meters, may allow a utility to obtain revenue for more of what it produces, resulting in an income-generating project. On the wastewater side, infiltration/inflow removal can significantly reduce the costs of collection, pumping, treatment, and disposal, as well as potential overflows. Apart from the desirability of avoiding SSOs and the accompanying costs of cleanup, repair, and possible enforcement action, reducing such extraneous flows also increases service reliability and system capacity, benefiting current and future customers. In the case of stormwater systems, condition assessment, along with cleaning and rehabilitation, can restore hydraulic capacity and correct defects that could otherwise lead to more costly repairs or even traffic hazards, such as pavement settlement and sinkholes.

The Funding Gap

Utilities are beginning to grapple with the funding gap estimated by the USEPA, Water Infrastructure Network (WIN), and others. WIN (a coalition of local elected officials, utilities, state environmental and health administrators, engineers, and environmentalists) projects that, over the next 20 years, there will be a $50 billion/year gap between funded work and needed work for capital investments in water and wastewater plants and piping systems. In response, many utilities have undergone self-examination, concluding that the assessment accurately reflects their own local realities. In such cases, the proactive application of trenchless repair approaches helps maximize the significant financial investment that accompanies asset preservation programs.

The Bottom Line

Planned, regular condition assessment and preventive maintenance, making full use of advances in trenchless rehabilitation methods, is the cost-effective solution that best advances the long-term public service mission of water and wastewater utilities.

Hazen and Sawyer Happenings

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Greensboro Office Broadens Modeling Capabilities

We've opened a branch office in Greensboro, NC, staffed by three new additions to the firm with extensive hydraulic modeling experience. Jeffrey Cruickshank, P.E., Ricardo Espinosa, and Kevin Widderich are all former employees of Pitometer Associates in Greensboro. Sharing a common specialty in water distribution modeling, all three have conducted work for most of the major municipalities in North Carolina, and for other Mid-Atlantic clients, and are among the region's most highly acclaimed water distribution modelers. They've joined our corporate hydraulic modeling group under the direction of Michael Wang, P.E., Vice President in our Raleigh office. Cruickshank also serves as our Greensboro office manager.

DC-Area Practice Adds Baltimore Office

The success of our Fairfax, VA, office, which recently marked its 10th anniversary, has triggered the birth of another area office. We've opened an office in Baltimore, MD, under the direction of Bruce Pierstorff, P.E., Vice President, who also continues to head the Fairfax office. Pierstorff is being assisted by Grantley Pyke, who has transferred from Fairfax to Baltimore.

Additional Pipeline Experts

In recent months, our firm's pipeline design and rehabilitation capabilities have been enhanced with the addition of the following specialists to our staff:

Henry "Kelly" Derr, who joined our Raleigh, NC, office as a Senior Associate. He is leading the Mid-Atlantic region's sewer/water line rehabilitation efforts, with an emphasis on trenchless technologies. Derr has over 30 years of experience and is a nationally recognized expert in trenchless rehabilitation.

Cecilia "Cece" Nguyen, who joined our Fairfax, VA, office as an Associate. During the past 24 years, Ms. Nguyen has conducted over 50 I/I-SSES programs, as well as many sewer and water infrastructure condition assessments, facilities plans, and computer modeling projects nationwide. Her emphasis is on the computerization of field investigation work/data, priority ranking schemes, and the rehabilitation selection process.

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