GIS to the Rescue

After being plagued for years by chronic sewerage surcharges and basement backups, Columbus, OH, needed to provide relief to the residents of the Livingston-James neighborhood. To determine the most cost-effective way to solve the persistent problems in this southern part of the city, CDM (www.cdm.com) is working closely with the Department of Public Utilities' Division of Sewerage and Drainage (DOSD) on a detailed study of the wastewater and stormwater infrastructure in the 13-square mile area.

The Livingston-James sewer analysis combines interior sewer images, video, rainfall, and sewer flow data, and analytical tools—such as PC-SWMM (stormwater management model) software—into a sewer modeling and a comprehensive GIS. This integration of tools is providing the team with I/I solutions to support DOSD long after the assessment is finished.

The project includes the assessment of more than 800,000 ft of sewer pipes, ranging in diameter from four to 66 in., using digital CCTV cameras. The integration of multiple tools and technologies throughout the course of this initiative is quickly becoming a model for other communities across the nation addressing their flooding challenges.

Since this $7.1-million investigation began in March 2005, a multi-pronged approach has guided the city in addressing common, yet serious, operating concerns, like sewer-intruding tree roots and collapsed pipes. "This project represents our most comprehensive effort in our long program to find I/I, quantify it, and recommend mitigation measures," commented Tim Fallara, DOSD project manager.

Digitally Enhancing Traditional Tools

Led by Ted Burgess, CDM vice president, the Livingston-James sewer system I/I remediation project requires efficient management and interpretation of the large amount of data that is now being gathered. "The creative use of ArcView GIS (ESRI, www.esri.com), Microsoft Access (Microsoft Corporation, www.Microsoft.com), and Visual Studio.NET (Microsoft Corporation) has made it possible for us to develop an efficient system and user interface to manage, access, and interpret the vast library of digital data," said Burgess.

Although the filming of sewer interiors has been common practice for nearly three decades, the industry is just now harnessing digital footage to present to clients in a useable manner. Previously, if public works employees were interested in accessing CCTV footage, they would need to fast forward through hours of tape to view the shots of interest. Now, hundreds of hours of video footage can be stored and indexed on a single desktop computer.

"The use of digital data is the most unique aspect of this project," said John Schroeder, CDM project engineer, explaining that DOSD officials will be able to point and click on any part of the Livingston-James sewer map to call up the video, photos, and pipe condition information. "We are using this digital data to locate and summarize the problems within the sewer system so that we can also efficiently develop recommendations for these problems."

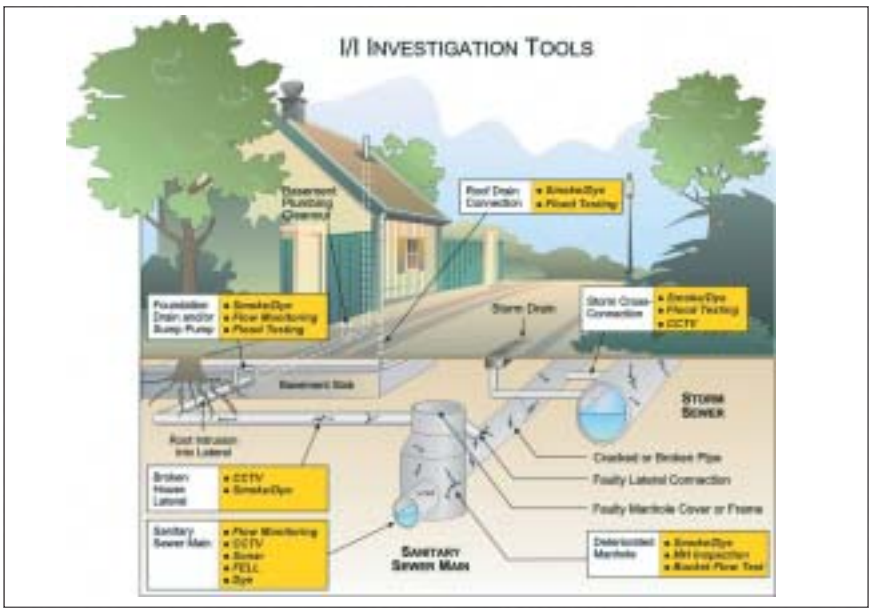
Despite the sophistication of such technology, each tool is user-friendly, so DOSD officials can access data quickly and apply the results of the study expeditiously. For example, a DOSD employee will be able to summarize the pipes within the area that have significant infiltration, roots, grease, deposits, cracks, or collapses, and quickly create a table or map to display them. By the time the project is complete, DOSD officials will be armed with sufficient information to help solve many of the area's infiltration, structural, and maintenance challenges. This data will provide a solid benchmark for future comparisons.

Proactive Repairs

If the city becomes aware of a chronic problem spot, officials can use CCTVs to record that spot every other year. In the past, a problem traditionally had to present itself before it could be resolved. This usually meant that a resident had to complain before DOSD was aware that a problem existed.

"Now, the city has the information it needs to correct deficiencies before they become problems for their customers," explained Tom Jedlinsky, CDM client officer.

The cleaning and CCTV inspection



portion of the study is already facilitating sewer system corrections. Several major heavy debris locations have been identified and removed, enabling the sewers to convey the maximum amount of wastewater possible. Several pipe collapses were also identified and CDM immediately notified DOSD with exact locations so the city could quickly initiate a point repair.

During the assessment, an alarming condition was discovered inside the sewer under Alum Creek. Throughout the 40 years that the line has been in service, hydrogen sulfide gas released by the flowing wastewater had attacked the concrete, exposing the inner reinforcing steel. A major failure of this section of pipe could have catastrophic consequences, diverting stream flow from Alum Creek into the sanitary sewer system. However, the proactive nature of the city's new system allows such a condition to be remedied before any negative effects.

The Residents' Role

Once the study is complete, DOSD's highly trained and skilled modelers will continue to operate the Livingston-James sewer model, integrate it into the city's current system-wide model, and keep it updated to ensure its central role in sound sewer system operation for years to come.

Along with developing this powerful tool for the city, CDM engineers have educated residents in the neighborhood about their role in ensuring the proper performance of the area's sewers. Schroeder said he was surprised at the amount of kitchen grease found in many of the sewers, something many residents said they didn't realize was such a problem.

"As users learn how to take care of the sewers, a significant number of the problems can be eliminated," Schroeder explained. With similar resident education along with the incorporation of CCTV footage, PC-SWMM, and GIS technology, communities like Livingston-James now have a means to predict and prevent potential sewer system emergencies. GE

The preceding is based on a presentation that originally appeared in CDM News *(Vol. 40, No. 1), April 2006.*

Build a Better Business Case to Fund Infrastructure Rehabilitation

By Wayne Miles, P.E., and Joe Ridge

The national funding gap between water and sewer infrastructure needs and spending is approximately $26 billion per year, according to a Water Infrastructure Network report published in 2000. For most communities, the wastewater collection system is the most valuable public asset, although it is often given a lower priority than other capital projects, especially during tight fiscal years. The average public utility rehabilitates less than 0.5 percent of its sewer system annually, which results in a system replacement period of more than 200 years. Because most pipe materials have a design life of 50 to 100 years, however, the average age and condition of our underground infrastructure are getting worse, not better.

To reverse this trend, utility managers must build and present a business case to show that funding infrastructure rehabilitation is a sound and necessary financial decision that will benefit customers and, ultimately, save money.

In many cases, funding levels and priorities for infrastructure rehabilitation have been based on rules of thumb, operator knowledge, and "seat-of-the-pants" understanding of system needs. While these are often reasonable approaches to short-term decision-making, they typically fail in the long term because:

- Proposed budgets based on rules of thumb cannot withstand high-level scrutiny during budget-cutting times.
- Staff turnover results in a lost knowledge base to support decisions.
- Undocumented assumptions cannot be tested and confirmed to demonstrate beneficial results and improve the decision-making process in the future.

To present a business case for infrastructure rehabilitation, functional objectives must be defined and a financial analysis conducted to demonstrate the savings that rehabilitation achieves within each of these functions. For example, a typical rehabilitation program would include three primary objectives:

- Restoring capacity or keeping assets functioning at their full, original capacity. Examples include removing sediment or debris and reducing infiltration and inflow.
- Repairing structural damage and failures in the system due to wear, corrosion, age, and/or construction-related damage. These repairs reduce the risk of system failures that could interrupt service, inconvenience the community, and increase costs as compared to scheduled maintenance and repairs.
- Reducing maintenance needs by repairing portions of the system subject to repeated maintenance problems. Examples in a wastewater collection system are the repair of root intrusion, offset joints, pipe sags, improper service connections, and other system deficiencies that typically lead to recurring problems for system operators.

By defining these functional objectives, utility managers are able to develop specific criteria and priorities and measure the success of the objective. Further, financial analyses will demonstrate returns on infrastructure investments. These calculations provide a mechanism to defend proposed funding levels and present the business case for increasing maintenance, repair, and replacement investments. An analysis approach, coupled with condition assessment information needed to support these objectives, improves and documents infrastructure priorities for decision makers. Lastly, and possibly most importantly, the resulting benefits from investments in a maintenance, repair, and replacement program must be quantified and documented. Documentation is essential to defending the need for funding on an annual, recurring basis so the long-term success of the program is realized.

Mr. Miles is a vice president who leads CDM's infrastructure rehabilitation services group. Mr. Ridge is a vice president and economist with more than 20 years of experience in evaluating utility financial matters.