Deflect Defects

Sanitary sewer evaluation studies spot problems and provide solutions.

By Chris Stamborski

Sanitary sewer system failures and basement backups lead to unanticipated and costly repairs, inconvenience to the community, and intervention by regulatory agencies. Water departments and utilities can avoid these headaches by planning and budgeting for monitoring, maintenance, and inspection, yet many utilities neglect system deficiencies until the damage is done. A cost-saving, proactive approach is to conduct a comprehensive sanitary sewer evaluation study (SSES), or at minimum a limited version of such a study (LSSES).

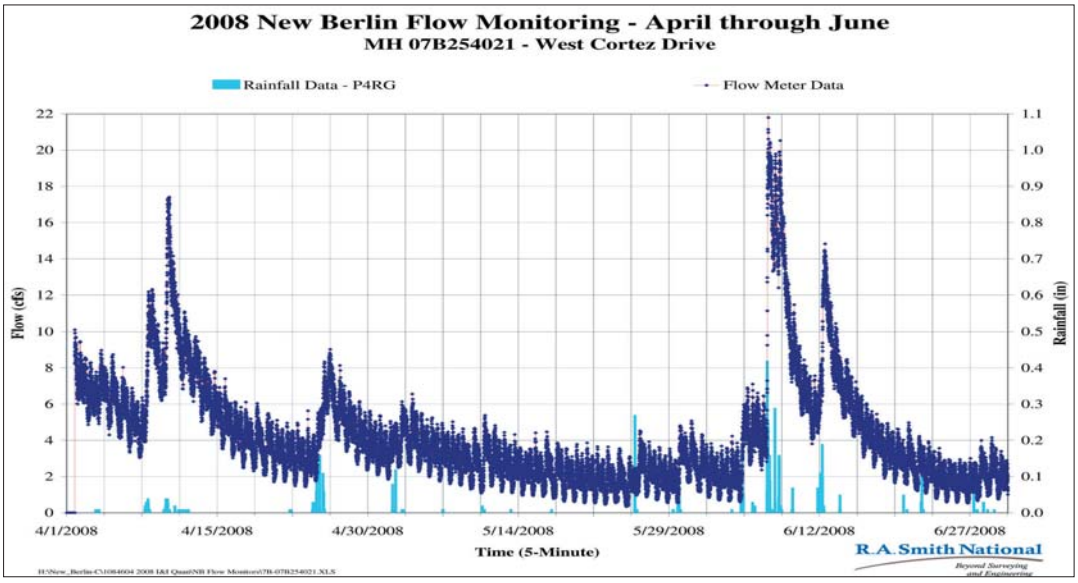
An SSES is a formal program of investigation work encompassing dye water flooding, manhole and structure inspection, smoke testing, closed circuit television (CCTV), and flow monitoring. Many municipalities already perform some of these functions, but an SSES provides a structured examination of the entire system and generates a cost-effective rehabilitation plan to reduce infiltration and inflow (I/I), satisfy regulatory requirements, and reduce the need for expensive water treatment in prioritized areas.

A comprehensive SSES is advisable if the sanitary sewer basin has never been analyzed. Depending on the basin size, an SSES will take about six months to one year to complete, as each survey step should be performed during the recommended time period for maximum effectiveness.

A follow-up LSSES will help to gauge the effectiveness of the rehabilitation work resulting from the SSES. An LSSES should also be performed when a utility notices system changes related to flow, backups, or bypasses. Usually performed within a smaller area of a sanitary sewer basin, an LSSES may be limited in the overall area analyzed or in the specific investigation tasks selected.

"An LSSES helped us by providing recommendations for doing preventive maintenance on our sewer system," said Rick Johnson, utility manager of the New Berlin (WI) Water & Wastewater Division. "By rehabilitating our sanitary sewer through re-lining, we will save time and money in the long term. Most of all, rehabilitating allowed us to perform repairs while avoiding costly restoration charges."

Some utilities, such as New Berlin, have the ability to perform many inspection tasks with in-house resources. Others need to outsource a portion or all of these services. Once a format is developed, future investigative work can be performed in-house to reduce costs. In either case, the utility should establish a set of standards to conduct each investigation consistently so valid comparisons can be made between different sets of collected data. The data sets can be correlated by using asset management software.



A flow monitoring and rain graph prepared by R.A. Smith National for the New Berlin, WI, provides valuable data in determining the existing sources of infiltration and inflow and evaluating the system's overall performance.

Analysis of the data gathered using the following investigation methods creates a snapshot of system performance and prioritizes problem areas.

CCTV Inspection. Televising reveals and records defects that can then be rated for severity and potential

Manhole inspection can reveal defects that may be a major source of infiltration and inflow in a utility's collection system.

to impede the hydraulic performance of a sanitary sewer system. Typical defects are pipe joint leaks, mineral deposits, pipe cracks, and sags between pipe lengths. More severe problems, such as a broken or collapsed pipe, need to be addressed quickly.

Utilities that do not own CCTV equipment should consider contracting out the work, as this investigation technique provides a first-hand look at the performance of any segment of the system. CCTV inspection should be performed at least every seven to ten years, but specific conditions may require more frequent televising.

The National Association of Sewer Service Companies (NASSCO, www.nassco.org) Pipeline Assessment and Certification Program provides a coding standard for televised inspections. By applying consistent methods, standardized coding enables a comparative analysis of each area of the system to establish maintenance and rehabilitation priorities.

The CCTV information can be delivered in a hard copy report format supplemented by VHS, CD, or DVD video formats. CD and DVD enable digital storage of the data using asset management software such as GIS. Prior CCTV work performed as part of general system maintenance can also be used as part of an SSES or LSSES to help track system changes over a longer period of time.

Manhole Inspection. Deteriorated manholes are a major, often overlooked source of I/I. Manhole, or structure, inspection can accurately inventory these assets and confirm the structural condition of each site. Inspections are typically performed by two-worker field crews recording surveyed data on hard-copy or digital records. Digital records can be incorporated into asset management software. Use of a standardized coding system such as NASSCO's Manhole Assessment and Certification Program is recommended.

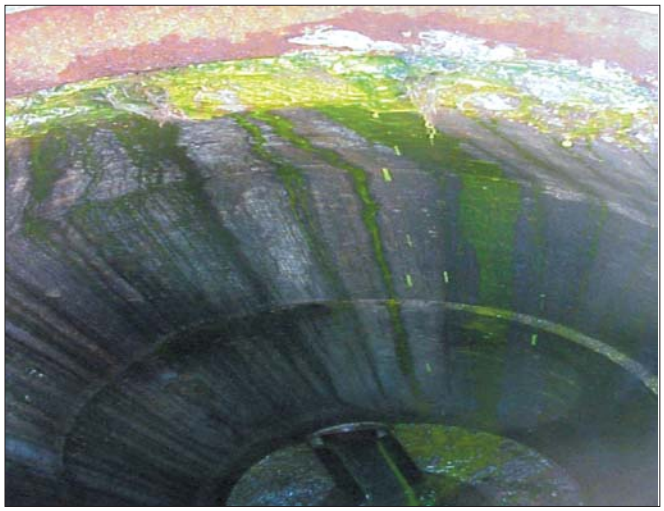
Manhole defects are readily apparent upon visual inspection and may include the following: holes in manhole covers, poor fit between the manhole cover and rim, cracks and holes in the pavement around the manhole rim, cracks or misalignment between bricks in the manhole, loss or absence of mortar between the bricks or rings of the chimney, cracks in manhole walls or joints between sections, and non-water-tight seals around connecting pipes. Manhole inspection should be part of a rotating maintenance program to revisit each site at least every seven to ten years.

Flow Monitoring. Flow monitors measure and quantify sewage flows to evaluate overall system performance. The amount of groundwater and rainwater entering the sewer system can be quantified by comparing the difference in the sewage flows during dry and wet weather conditions. Flow and rain data can be correlated to determine the percent of rainfall that entered the pipe—or rainfall derived I/I—and the overall sewer performance.

Different technologies are available, but most flow monitors measure the velocity and depth of the flow at various time intervals using either contact or non-contact methods. Newer technologies deliver collected flow monitoring data directly to office computers, avoiding the cost of visiting the site to collect data.

Typically collected for at least six months, the data can be used to develop statistics for base flow, average day flow, maximum day flow, and maximum hour flow, indicating how the sewer performs during wet weather events. The time period is important because monitoring the system during wet and dry months is necessary to understand the impact I/I has on the system.

Utilities that choose to perform continuous flow monitoring can purchase the equipment and train staff to install, collect, and maintain flow meters. Crew members must be certified for confined space entry. Continuous monitoring provides the flexibility to investigate different areas with little down time, gauge the effectiveness of rehabilitation work in SSES-identified areas, and track system changes that could lead to future investigations. Utilities that do not intend to perform continuous flow monitoring outside of the SSES program can either rent the equipment or



Dye water flooding consists of forcing non-toxic bright colored dye into manholes to assist in locating defects.

outsource the work.

Smoke Testing. In addition to observing defects, smoke testing identifies illegal connections to the sanitary sewer system on private property. Unlike CCTV or manhole inspections, smoke testing will reveal potential I/I sources that cannot otherwise be seen. Typically performed as a part of a survey rather than a routinely scheduled inspection task, smoke testing is usually outsourced.

Non-toxic smoke is forced through a sealed-off sewer segment, creating smoke plumes where defects exist. The location of the smoke plume will help determine if the defect is causing infiltration and if it is a result of an illegal connection such as a downspout or sump pump. Smoke testing should be performed during seasonally dry weather, as rain events or high groundwater can prevent smoke from seeping through defects.

Defects that can be identified by smoke testing include cracked or broken pipes, open joints, holes or poorly fitting manhole covers, and lateral cleanouts with cracked or missing covers. Typical illegal connections found by smoke testing include footing drains, sump pumps, down spouts, and storm sewer or yard inlets. Defective plumbing systems, or dry traps, may allow smoke into properties, but that does not necessarily mean there is a defect at that location. Properly installed plumbing will prevent smoke from entering the house by redirecting it out the plumbing vents.

Smoke plumes are most commonly noted using measurements from stationary landmarks, addresses, and photographs. A crew of two or three tracks the sources of smoke emissions during the testing. The workers photograph smoking areas and identify them in a report that can be used to locate the source again in the future. The results of the smoke testing can be entered into asset management software for future use.

Dye Water Flooding. Often performed in conjunction with structure or CCTV inspection, dye water flooding can confirm potential I/I sources identified by other investigation methods. Dye water flooding also can reveal a previously invisible defect by showing system performance under the stresses of water pressure. Dye water flooding helps quantify specific defects during an evaluation.

The procedure consists of forcing non-toxic, brightly colored dye into specific defects. The path of the dye is observed and defects are located and documented. Examples of defects include manholes with evidence of I/I, mainline defects, cross-connections, and roof drains.

Scheduling Inspection Tasks. With a few exceptions, the SSES investigation tasks may be completed in any sequence or concurrently. Specific features such as age, construction material, operation, and suspected illegal service connections may change the order of the investigations performed, but following are a few key points to remember when preparing the SSES schedule.

- CCTV and manhole inspection are best performed during seasonally high groundwater, or the wet weather season. This allows the inspector to witness I/I defects in an active stage, providing the best recommendation for repair or rehabilitation.
- Smoke testing should be performed during seasonally dry weather, as rain events or high groundwater can prevent smoke from seeping through defects. Dry weather allows the smoke to emit from sources such as rain gutters, downspouts, and the ground.
- Flow monitoring is typically the longest process, as continuous monitoring during all periods is necessary for an accurate picture of system performance. GE

Mr. Stamborski, P.E., is a project engineer for the Municipal Services Division, R.A. Smith National (www.rasmithnational.com).

Bypassing a Pump Station that Normally Handles 39 MGD

In July 2009, Jackson, MI, began experiencing problems with a 54-in. concrete sewer force main at its Savannah Street water and waste treatment plant. This problematic force main served a vital pump station that pumped several gravity flow lines. The pump station pumped the flow from these lines through this 54-in. force main, a distance of 1,100 ft to the plant.

The city personnel needed to re-route the flow of sewage to inspect the 54-in. force main pipe. Thus the city installed six 12-in. Thompson (www.thompsonpump.com) dry-prime, solids-handling centrifugal sewer bypass pumps that they owned. Having these pumps in inventory quickly paid off. They were able to divert the flow from the pump station to a sewage lagoon, install the pumps at this lagoon, and pump through 700 ft of 12-in. HDPE pipe to the plant. The lagoon served as a reservoir to hold the sewer flow until the diesel pumps became operational. All doing so while using Thompson's Enviroprime® system to prevent sewage spills.

Once in place and running, the six 12-in. pumps could keep up with the normal flows of the 54-in. force main, which are around 27,500 gpm (39 mgd). However, in the event of a large rain, a major spill could occur. To prevent spillage during a large rain, Thompson representative Jim Templeton installed an 18JSC, an 18-in. solids handling dry-prime compressor-assisted Enviroprime pump, which could produce an additional 8,500 gpm (12 mgd). With this added capacity the system could handle flow in a rain event and also pump down the surcharge in the lagoon.

The force main was successfully rehabilitated.