

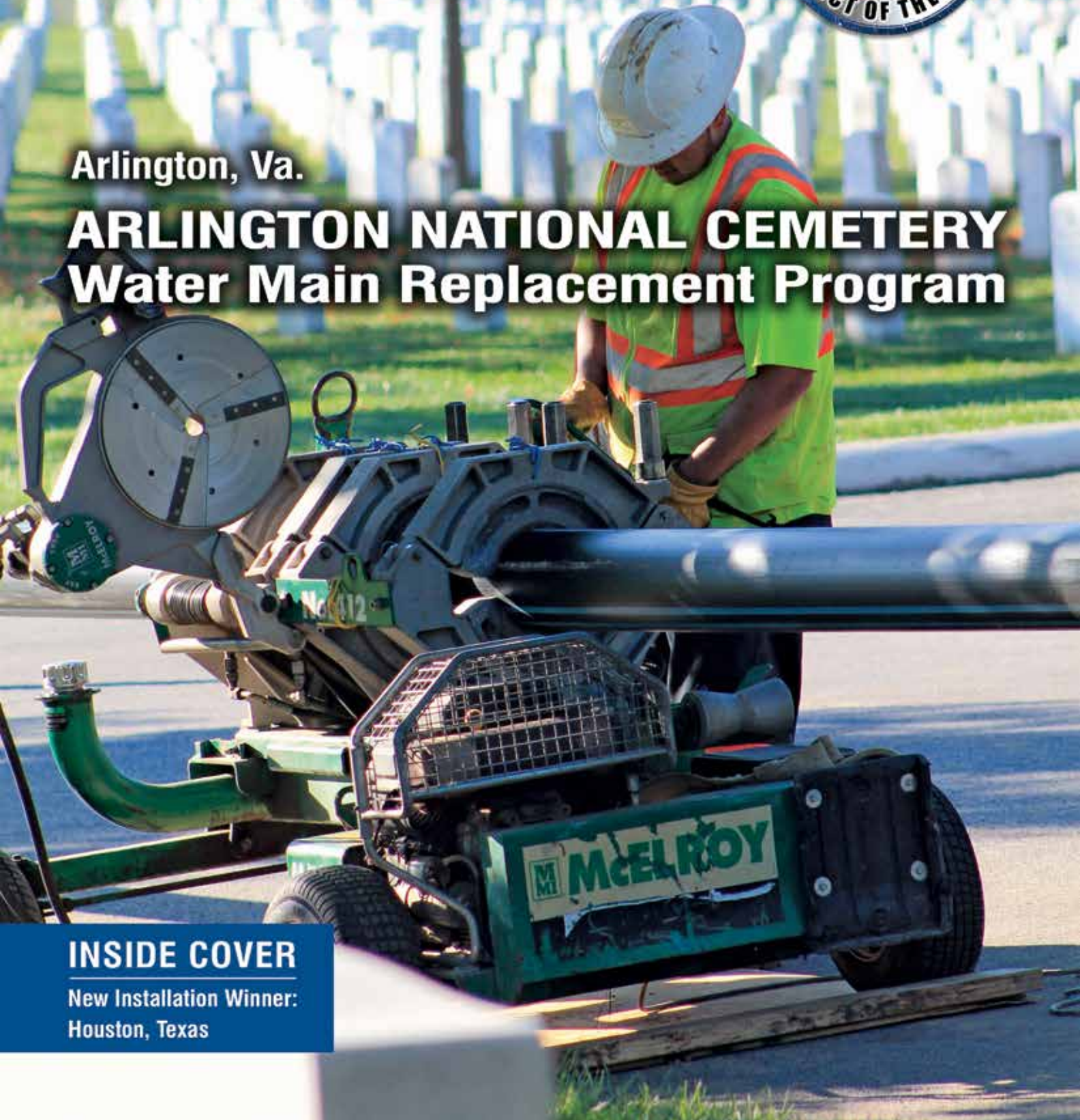
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LISTENING FOR BLOCKAGES – Santa Barbara Incorporates Acoustics to Prioritize Sewer Maintenance

By Alex Churchill

The City of Santa Barbara Calif., sits between the pristine Pacific coastline and the Santa Ynez Mountains in Southern California and is often called the “American Riviera.”



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As a popular tourist destination with a population of approximately 90,000 people, the City places a high value on the flawless performance of its basic services. This includes maintaining the 256 miles of gravity-fed sewer lines within its boundaries — of which 90 percent is 6- or 8-in. pipe.

The Santa Barbara collection system is almost wholly gravity-fed with only seven lift stations and two miles of force main. More than 80 percent of the network is vitreous clay with the remaining 20 percent composed of PVC, ductile iron and other materials. The majority of the system was constructed in an age when 6-in. pipe was acceptable and, hence, approximately 50 percent of the network is composed of 6-in. lines. At an average asset age of 52 years, the pipes have begun showing their age and the need for a well thought-out maintenance program.

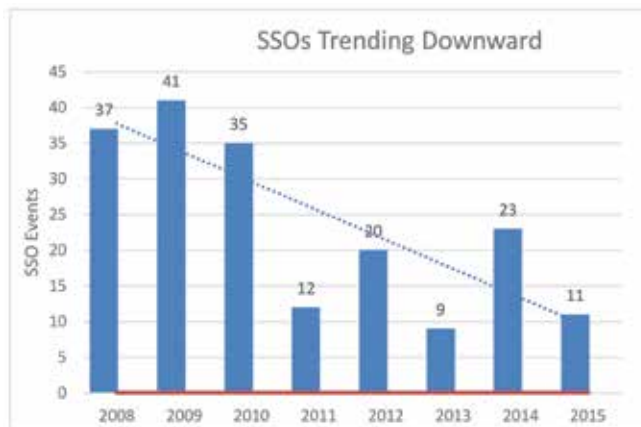
Maintaining this network is a dedicated team of 16 employees led by wastewater system manager Chris Toth. They clean more than 200 miles of pipe per year using two Vactor 2100 combination trucks, supplemented by two Vactor 850 Jet Rodder trucks. The same field crews perform CCTV inspections with an RST camera van and jointly conduct SL-RAT acoustic inspections and manhole inspection activities. Additionally, their group also has responsibility for the City's fats, oils and grease (FOG) reduction and food service grease trap inspection programs.

To compound the daily challenge of maintaining these aging assets with a small crew, Santa Barbara has seen the effects of drought and water conservation on the utility budget. Water use has declined by approximately 25 percent in the past two years. Consequently this reduction in volume has resulted in significant reductions in wastewater revenues.

AGGRESSIVE CLEANING PROGRAM NEEDED BETTER TARGETING

Santa Barbara has a goal of cleaning every pipe at least once every five years. All pipes are placed on a cleaning cycle ranging between one month and 60 months. This aggressive cleaning schedule has led to a 25 percent increase in cleaned miles between 2012 and 2014 and a consequent reduction SSO events (see Chart A). Fortunately for the community, Santa Barbara's SSO

Chart A: An aggressive cleaning schedule has led to a reduction in SSO events.



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events have historically led to small discharge volumes — for example, all 23 events in 2014 totaled only 4,000 gals of sewage spills.

With a focus on continuing to reduce SSO events, the Santa Barbara team began by analyzing where the problems occurred. The team found that most SSOs came from 6-in. pipes with root intrusions and that the vast majority of these occurred in the 2,000 lines on the 60-month cycle.

Armed with this information, multiple options were evaluated including increasing CCTV activity, increasing cleaning or evaluating the Sewer Line Rapid Assessment Tool (SL-RAT), a relatively new technology that provides a fast, low-cost screening of blockage condition using acoustics.

Based on cost, speed, simplicity, and mobility an initial SL-RAT was purchased in mid-2014 after a brief field trial. Liking what it saw, the City has since purchased three more.

THE SL-RAT SECRET

The SL-RAT's active acoustic inspection technology quickly provides pipe blockage condition information to prioritize the allocation of more expensive cleaning and maintenance resources. The SL-RAT combines two components — a transmitter and a receiver. An operator places the transmitter in an open manhole and sends a loud sequence of tones through the airspace above the flow within the pipe. The receiver is placed in an adjacent manhole and listens for degradation in tones it hears. The resulting data is analyzed in real-time on the device using a sophisticated pattern matching algorithm.

The technology exploits the fact that sound and water flow similarly through the free space within a pipe. Hence, if a known sound signal transmitted through a pipe segment is degraded, the SL-RAT analyzes the result in less than three minutes and provides a simple assessment of blockage within the pipe on a scale of zero to 10. A score of zero indicates a significant pipe anomaly that should be prioritized and investigated quickly. A score of 10 indicates the pipe sounds as clean as a known clear reference pipe. Most customers group the SL-RAT scores into "Red Light" for 0 to 3, "Yellow Light" for 4 to 6, or "Green Light" for 7 to 10.

The SL-RAT inspection requires no prior preparation of the pipe other than opening the cover sufficiently to insert the speaker and microphone elements just below the plane of the manhole. The SL-RAT works in almost all small diameter (6 to 12 in.) gravity-fed pipe and manhole geometries, as well as with all types of pipe material.

It is not uncommon to inspect more than 10,000 ft in a day with a two-person crew. The raw results of each inspection are immediately available to the field operator and the inspection data can be uploaded to a cloud-based application called the Sewer Line Data OrGanizer (SL-DOG), for sharing, editing and visualization in Google Earth or enterprise GIS platforms.

MAINTENANCE STRATEGY CHANGE REQUIRED

Employing the SL-RAT technology has changed Santa Barbara's operating strategy for collection system maintenance. The City has gone from looking at each pipe with a high-resolution CCTV inspection on a multi-year inspection schedule



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to a blend of less CCTV and more frequent but lower resolution inspection using the SL-RAT.

“We wanted to clean or inspect more. Prior CCTV work has helped us find structural defects and generate a rehabilitation backlog,” Toth says. “The SL-RAT allows us to inspect much more pipe now and find blockage conditions before they create an SSO.”

Toth indicates it took Santa Barbara approximately one year of working with its initial SL-RAT to develop the new strategy and achieve the cultural change and buy-in required. At this point, City staff have developed “a lot of confidence in the SL-RAT data,” according to Toth. This confidence has allowed the team to fully embrace the technology and integrate it into their existing management processes. For example, acoustic inspection has been integrated with an existing manhole inspection program and the SL-RAT data set available from the Sewer Line Data OrGanizer is used to verify and communicate issues across the team.

RESULTS SO FAR

The Santa Barbara field crews have acoustically inspected more than 2,000 lines totaling approximately one third of the Santa Barbara system since the program began — focused on primarily on 6-in. lines on the 60-month cleaning cycle. The results of those efforts are shown in Chart B. It is interesting to note that 55 percent of the pipes inspected are in the “Good” 7 to 10 range of scores, where City staff have found a high likelihood the pipe is in good shape, and only 23 percent fall into the “Poor” 0 to 3 category where Toth states “We see a lot of protruding laterals, roots, and other issues.”

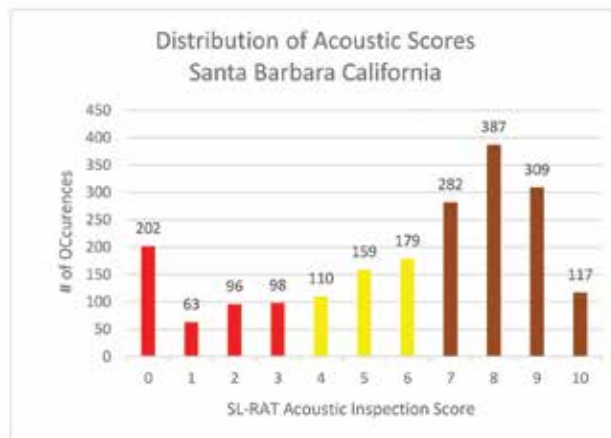
WHAT'S NEXT

The Santa Barbara team has developed a contractor program to supplement their internal staffing and acoustically inspect an additional 80 miles per year.

As the program expands, the City anticipates scanning all pipes acoustically on a regular basis, not just the 60 month lines, and using the blockage assessment data to better target their cleaning efforts while saving money and further improving SSO performance.

Alex Churchill is chief operating officer at InfoSense Inc.

Chart B: A score of zero indicates a significant pipe anomaly and a score of 10 indicates the pipe sounds as clean as a known clear reference pipe.



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