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Supplement to:
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WATER

Bringing It All Together

Sewer district builds reputation solving tough system problems

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A BETTER FIX:
Rehab in the remote north

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CASE STUDIES Page 26



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Ohio's Northwestern Water & Sewer District builds its reputation on solving tough system problems.

By Peter Kenter

COVER PHOTO: David Cromley, a sanitary engineering aid at Northwestern Water & Sewer District in Wood County, Ohio, looks over a recently completed 2.2-million-gallon sanitary sewer equalization basin designed to store excess wet weather flow. (Photo by Amy Voigt)



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State mandates mean more work for contractors who specialize in residential work.

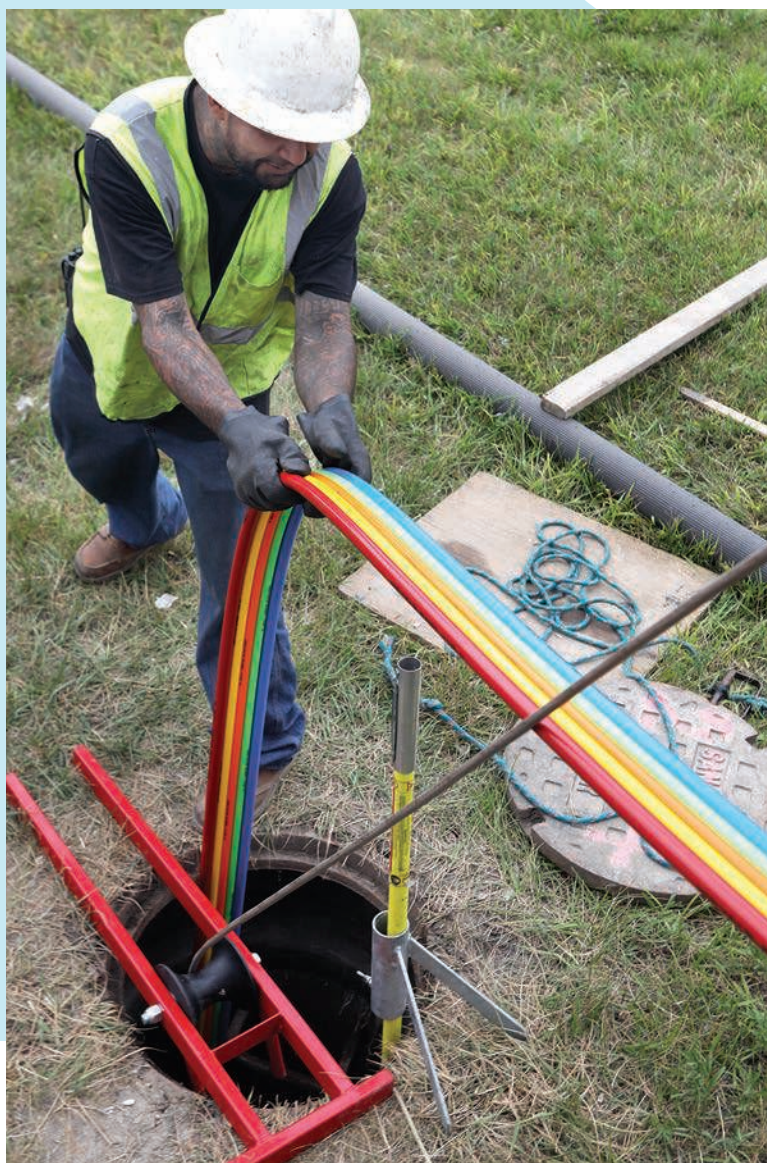
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Winter 2019

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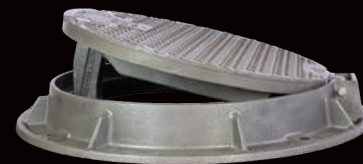


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Published four times yearly by COLE Publishing, Inc.
1720 Maple Lake Dam Rd., PO Box 220, Three Lakes, WI 54562

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Mon.-Fri., 7:30 a.m.-5 p.m. CST

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SUBSCRIPTIONS: I&I™ is included quarterly (Jan., April, July, Oct.) along with a one-year (12 issues/monthly) subscription to Municipal Sewer & Water™ (MSW). MSW and I&I are free for qualified subscribers in the United States, Canada and Mexico. A qualified subscriber is any individual or company in the United States, Canada and Mexico that maintains, manages, designs or installs municipal or commercial sewer, water and storm infrastructures. To qualify, visit www.mswmag.com or call 800-257-7222.

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ADVERTISING RATES: Call Jim Koshuta at 800-994-7990 or email jim.koshuta@colepublishing.com. Publisher reserves the right to reject advertising which it considers misleading, unfair or incompatible with the character of the publication.

EDITORIAL CORRESPONDENCE: Address to Editor, I&I, P.O. Box 220, Three Lakes, WI, 54562 or email editor@iandimag.com.

REPRINTS AND BACK ISSUES: Visit iandimag.com for options and pricing. To order reprints, call Jeff Lane at 800-257-7222 (715-546-3346) or email jeff.lane@colepublishing.com. To order back issues, call Nicole at 800-257-7222 (715-546-3346) or email nicole.labeau@colepublishing.com.

CIRCULATION: 9,577 copies, four times yearly.

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Bringing It All Together

Ohio's Northwestern Water & Sewer District builds its reputation on solving tough system problems

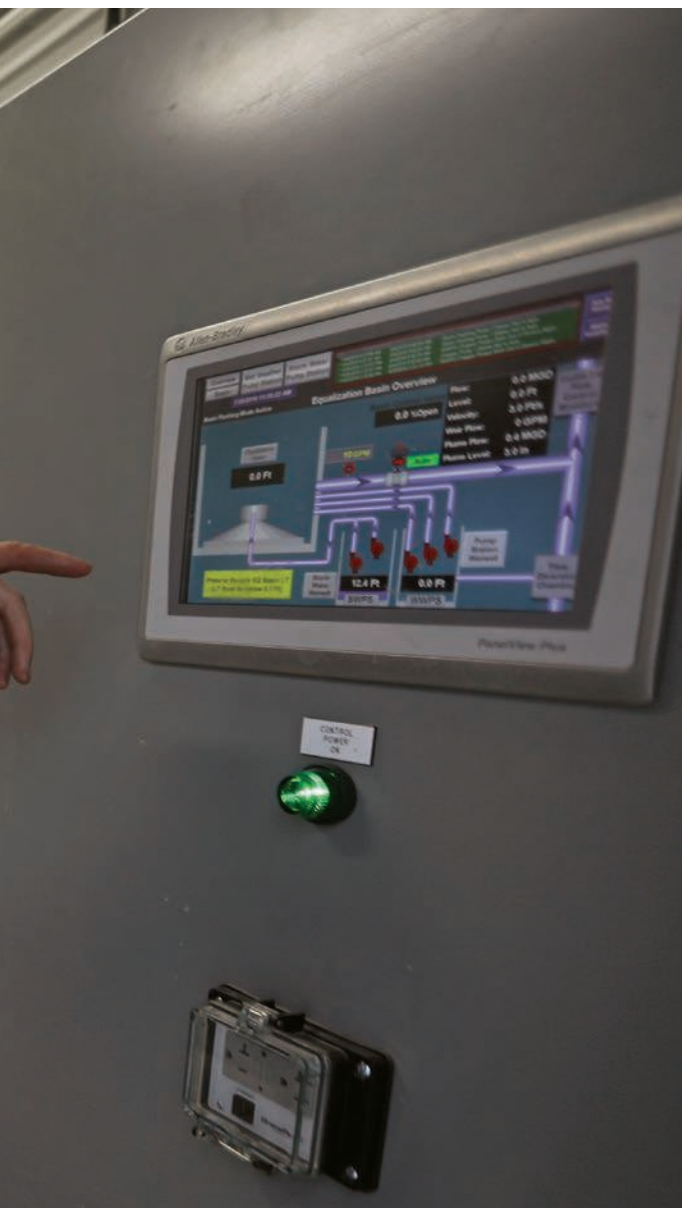
STORY Peter Kenter | PHOTOS Amy Voigt



“The beauty of being a sewer and water district is that we don’t have to worry about decisions made at election time. We charge people what it costs to run the system.”

Tom Stalter

David Cromley, sanitary engineering aid III at Northwestern Water & Sewer District, in the control room of the sanitary sewer equalization basin that he helped to complete in 2017. The basin holds 2.2 million gallons.



Ohio's Northwestern Water & Sewer District was established in 1994 to unite the utilities of five municipalities and 14 townships in Wood County, Ohio. The district has grown since then to include 13 municipalities and 20 townships — in large part due to its reputation as a problem-solver, helping newly incorporated members solve problems such as inflow and infiltration and working to normalize costs across the service area.

The district serves just under 20,000 accounts with sewer and water service primarily in Wood County, just south of Toledo.

"The five municipalities that first joined did not have their own sewer or water services," says Tom Stalter, district engineer. "They joined on hopes that we would supply those services. Other municipalities didn't find it cost-effective to operate their systems, so they asked us to take ownership of their systems and bring them up to speed. Like so many small systems across the country, many of these systems are aging, in poor condition, or have state EPA findings and orders against them. In some cases, the EPA will hold off from issuing an order if we're on the case. They see us as an organization that can solve problems."

Today, the district's service map extends to parts of all the county's 19 townships, excluding centers such as Bowling Green and Perrysburg, which operate independent systems. In Northwood, Tontogany, Portage, Walbridge, and several other communities, the district owns the utility systems, although the communities are not officially district members. The town of Luckey owns its system but contracts operation to the district. The member town of McComb lies in Hancock County to the south, while the district's responsibilities for the town of Risingsun straddle the border to a municipal area located in Sandusky County.

DIVERSE SYSTEM

The sewer system comprises 355 miles of sewer pipe over more than 581 square miles. Managing the diverse utility systems and ensuring they meet specifications is a delicate balancing act.



NORTHWESTERN WATER & SEWER DISTRICT Bowling Green, Ohio

YEAR ESTABLISHED: 1994
RESIDENTS SERVED: 19,800

SERVICE AREA:
581 square miles

DEPARTMENT STAFF:
74 (10 engineering; 50 operations;
14 administration, finance, customer service)

ANNUAL BUDGET:
\$26 million capital

WEBSITE:
www.nwwsd.org

“We have to make good business decisions while serving the public,” Stalter says. “The beauty of being a sewer and water

district is that we don’t have to worry about decisions made at election time. We charge people what it costs to run the system.”

In some cases, new district members are already experiencing system problems such as I&I that require significant capital infusions to remedy.

“We can’t always equalize rates immediately,” Stalter says. “We have to decide how much of the cost of improving the system will have to be borne by the customers served by those utilities. Often, we can reduce costs through grant funding by the Ohio EPA and the U.S. Department of Agriculture. They’re very supportive of what we do when we take on the operation of these challenged systems.”

A case in point is the village of McComb, a community of 1,700 where the cost of expensive wastewater and water treatment plant upgrades was too high for the town to take on by itself.

“We received enough grant and loan money to reduce their costs by about half,” Stalter says. “McComb residents paid 23 percent of the project costs while the entire system picked up 20 percent. When we take over a system, we try to make sure that the residents pay their fair share, but we also want

A CUES grouting system is used to repair and grout a sewer line in Perrysburg Township. From left are Joe Kelly, Eric Ewersen and Anthony Velez, contractors for Northwestern Water & Sewer District, and David Cromley.

to make sure the cost of that share is as low as possible. Our goal is that, down the road, they’ll be paying similar rates to every customer in the system.”

The district sewer system includes a series of 12 wastewater plants. Some wastewater treatment services are contracted from the adjacent cities of Toledo, Bowling Green, Oregon and Fostoria. Wastewater is conveyed by more than 70 pump stations. The condition of the pipe network runs from “poor” to “great” with overall condition gradually improving. Pipe diameters range from 2 inches for grinder systems up to 60 inches, and materials range from clay, concrete, and steel to PVC.

COST-EFFICIENT COMPLIANCE

“For some of the small communities that were under orders, we built new sewer systems, sewer extensions, oxidation ditches, and lagoons,” Stalter says. “We do whatever is required to bring them into compliance in the most cost-effective way.”

In-house crews handle routine repairs, while contractors handle larger jobs and capital improvement projects. The capital budget has averaged \$25 million dollars per year over the last several years.

A coordinated campaign against I&I was accelerated in 2012 when the district was negotiating new contracts with Toledo to provide wastewater services.

“Toledo was under orders from the U.S. EPA and we were required, as part of the terms of our contract renewal, to demonstrate that we were

(continued)

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The Northwestern Water & Sewer District's coordinated campaign against I&I accelerated in 2012 with a robust inspection program.

making efforts to limit wet-weather flow,” Stalter says. “At that point, we really ramped up our efforts against the I&I problem.”

The district used consultants and in-house staff to conduct a blitz of camera inspections, smoke testing and flowmeter analysis to identify the areas with the worst problems. Initial testing focused on the older, urbanized northern end of the system.

UNIQUE SOLUTIONS

“We discovered wide-ranging problems and addressed the worst with remediation and new construction,” Stalter says. “We responded with unique solutions for each community. For example, we used pipe bursting in the town of Walbridge, where shallow sewer lines ran beneath buildings on forgotten easements, followed by manhole rehabilitation.”

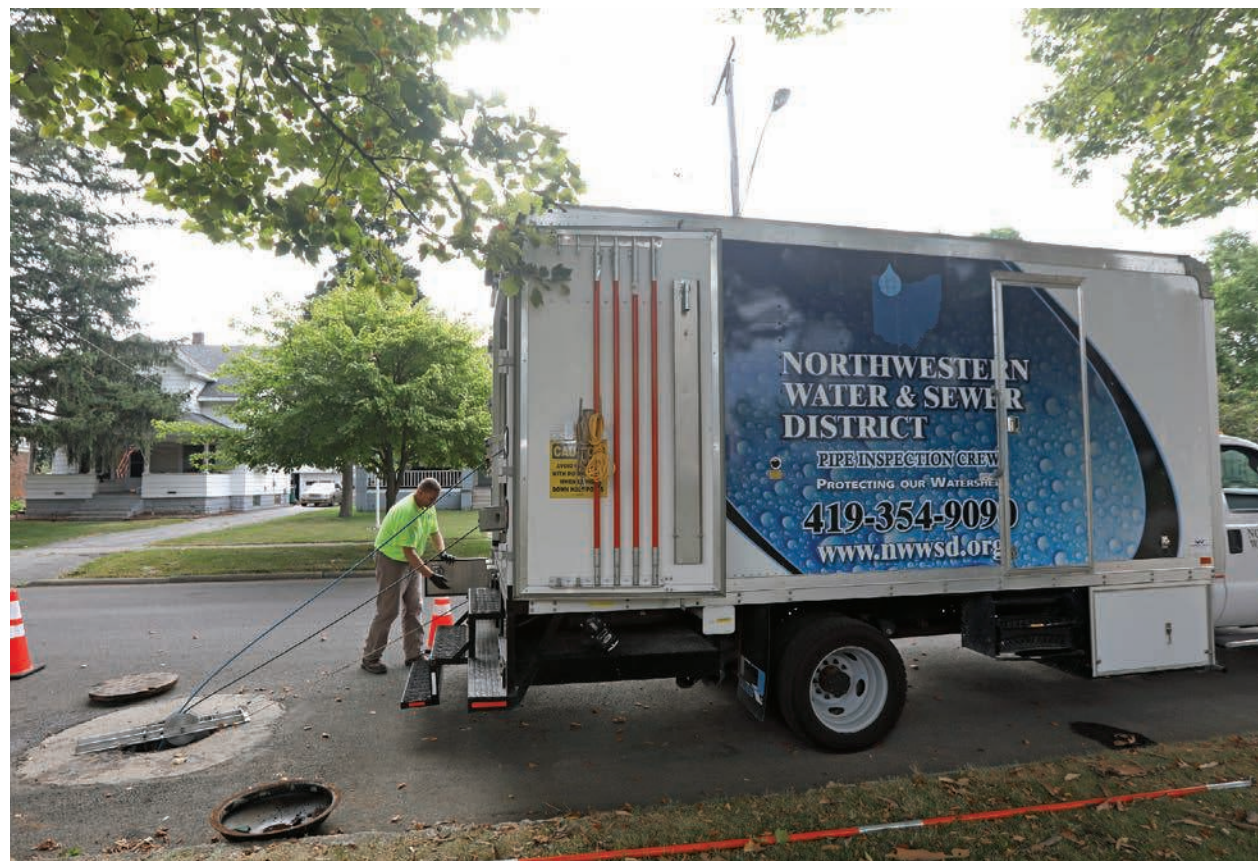
The district has also relied more on sewer grouting, which was used extensively in the village of Millbury to restore clay and concrete pipe integrity.

The study also discovered that leaking laterals on private property were a significant overall contributor to I&I. In the city of Northwood, the district implemented a remediation program for sewer laterals, helping to finance lateral remediation beyond the property line onto private property.

“We met with some success on that,” Stalter says. “We’re now in the process of rolling out a broader program.”

The district has also embarked on an intensive campaign to televise every foot of the system — including all sewer laterals — over 10 to 15 years. The district purchased an inspection truck outfitted with a CUES camera and LAMP II Lateral Launcher in early 2017.

Camera operator Jason Bomeli uses a CUES camera and LAMP II Lateral Launcher to inspect an 8-inch concrete pipe in a residential neighborhood in Rossford, Ohio.



“For some of the small communities that were under orders, we built new sewer systems, sewer extensions, oxidation ditches, and lagoons. We do whatever is required to bring them into compliance in the most cost-effective way.”

Tom Stalter

(continued)

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Anthony Velez pulls the grouting lines from the truck and guides them down a manhole during a rehabilitation project.

“We responded with unique solutions for each community. For example, we used pipe bursting in the town of Walbridge, where shallow sewer lines ran beneath buildings on forgotten easements, followed by manhole rehabilitation.” Tom Stalter

“Oregon was on a compliance schedule that required it to upgrade its plant but also required satellite systems to reduce wet-weather flow,” Stalter says. “As part of our wastewater contract negotiations with Oregon, we agreed to build the equalization tank to store our excess wet-weather flow. When the sewer starts to surcharge, the excess pumps into the tank. Once the storm is over, the tank begins to bleed the surcharge back into the system.”

The wastewater contract allows the district to convey 5 million gallons to Oregon’s wastewater treatment plant each day. A hydraulically controlled flow-level regulator automatically “pinches” itself down as flows approach the maximum cutoff.

The district is currently earmarking \$1.5 to \$2 million per year in capital improvements, targeting dollars for maximum effect on reducing overall I&I. However, Stalter notes that the battle is a long-term engagement that doesn’t always deliver immediate results.

“We know we’ve improved the system when we’ve remediated a pipe

or completed new construction,” Stalter says. “But stormwater has a way of finding the next-best entry point into the system. However, we know we’re doing the right things and expect to see solid data on peak flows over five to 10 years down the road. We happen to be good at what we’re doing, and we have the right staff to fix the problem.” **I&I**

“We have a dedicated crew of two working on that project every day,” Stalter says. “They’re supervised by a third crew member who collects, organizes and analyzes data.”

The district owns two Vactor 2100 combo trucks. One serves multiple needs, including assisting construction crews. The other divides its time between scheduled cleaning and clearing the way for the camera crew.

I&I SOLUTION

The district’s biggest I&I project to date has been the construction of a 2-million-gallon flow equalization tank. The construction cost of \$5.4 million was funded through a Water Pollution Control Loan Fund through the Ohio EPA. Serving Northwood, Millbury, and parts of Lake Township, the concrete tank was completed in July 2017 and now ties into a trunk main conveying wastewater for processing in the city of Oregon’s regional wastewater treatment plant.

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“There are instances in this area with underground springs. When you camera through the terra cotta, there are little streams of water just coming through the joints. It happens more often than not, actually.”

Josh Shelton

Denny Kelley of Shelton Plumbing uses a RIDGID SeeSnake camera to inspect a residential lateral line in Lower Burrell, Pennsylvania. The city requires all homes have inspections of connections to the city sewer before a sale in an effort to eliminate stormwater from entering the system.



Private-Side Mitigation

State mandates mean more work for contractors who specialize in residential work

STORY Jared Raney | **PHOTOS** James Robinson

For many, inflow and infiltration mitigation is a hassle, but it has been a gift for Shelton Plumbing in New Kensington, Pennsylvania.

Josh Shelton, CEO and president, has increased revenue from \$500,000 in 2015 to \$1.2 million in 2017, mostly thanks to relining work in relation to state I&I mitigation mandates.

As I&I mitigation becomes a greater focus among municipalities, many cities have turned an eye toward the private side as part of their programs. This has brought a huge wave of potential job opportunities for contractors like Shelton.

“The amount of opportunities that people have in the plumbing industry with relining, and dealing with the I&I, I mean it’s just unbelievable how much work is out there,” Shelton says. “Nobody can even find enough manpower to do the work.”

BOON AND BURDEN

In the early 2000s, Pennsylvania adopted statewide rules to reduce I&I in the coming decades. In more recent years, local municipalities have started pushing their programs to reach those state goals.

For Shelton’s area, this entails several practical applications, such as requiring an inspection before any name transfer or sale on a private home and requiring full replacement on illegal systems, even when repairs are possible.

In the greater Pittsburgh area, many homes date back to a time when downspouts and storm-water collections systems were allowed to tie straight into the sanitary sewer line. Another

problem with a prevalence of older homes is the terra-cotta pipe that was frequently used.

"There are instances in this area with underground springs. When you camera through the terra cotta, there are little streams of water just coming through the joints," Shelton says. "It happens more often than not, actually."

French drains are common as well, and systems with these elements must be replaced, lest the contractor and homeowner face severe penalties.

THE COMPANY

Looking at the history of Shelton Plumbing is a bit like following the up-and-down path of a roller coaster. At one time, the company had up to 20 employees, but founder John Shelton didn't enjoy the dynamics of a larger company and scaled down to only himself.

Shelton's son, Josh Shelton, joined the company in 2005 and a new growth mentality took hold.

"We wanted to grow," Josh Shelton says. "I wanted to

grow this business and just keep up with the times."

In early 2016, Shelton began researching relining as an additional service the company could offer. With Pennsylvania imposing mandates on municipalities to reduce I&I and limit the amount of water ending up in treatment plants, he saw an opportunity.

"I found it fascinating and wanted to get into it," Shelton says.

Today, the company has nine employees, three focused on relining. The customer base is primarily residential with a small amount of commercial.

BRANCHING OUT

While I&I is a municipal problem, private laterals are a major contributing factor.

"Our cities are handling the systems, but when it comes to an individual wanting to sell their home, excavation to replace or repair is very challenging as well as expensive," Shelton says. "Relining saves time, liability and money. This is a way to solve the problem by sealing a system and stopping root infiltration as well. It can do some amazing things."

The company was in the relining business by June 2016. Today, it is a major part of the business and its growth trajectory.

"We're getting to the point where it's probably about 50-50. Service and repairs are still a big part of our business, but this year we separated into another department for sewer services," Shelton says. "Almost 90 percent of what we do in the sewer department is dealing with I&I and real-estate sales — relining every single day almost."

The team at Shelton Plumbing includes, from left, Jake Graff, Denny Kelley, CEO and President Josh Shelton, company founder John Shelton, Sarah Kimmel, Aaron Dray and Caleb Graff.

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Josh Shelton

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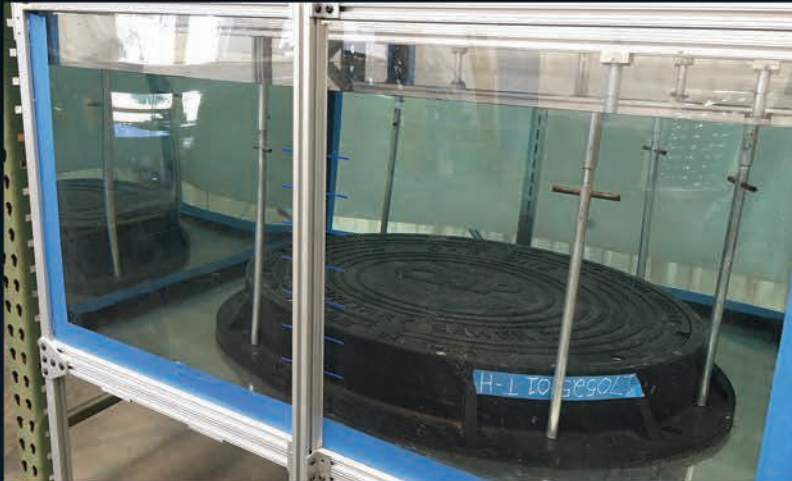


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Caleb Graff assists Denny Kelley (right) locating a residential sewer connection during an inspection for the City of Lower Burrell.



A sketched map of a home in Lower Burrell will guide a CCTV inspection and dye test of all interior drains and where they connect to the city sewer.

ABUNDANCE OF OPPORTUNITY

Shelton Plumbing mostly works as a direct-hire for Realtors and homeowners, with about 5 to 10 percent of its business subcontracted. The company's long-standing reputation as a trustworthy plumbing operation gave it a running start into relining work. Previous relationships with real-estate companies and agents, and existing customers, make up a significant portion of the workload.

"We have a lot of customers that we would maintain their drainlines for years. We do a ton of drain cleaning, so we make sure to let them know up

"This year we separated into another department for sewer services. Almost 90 percent of what we do in the sewer department is dealing with I&I and real-estate sales — relining every single day almost."

Josh Shelton

front that there are roots in here, and if you're planning on selling your house in the coming years, you're going to have to fix the line," Shelton says.

Another great lead generator has been real-estate inspections, which are required in the area.

"This specific test requires a full camera inspection of the interior building drain and the exterior sewer lateral to the main sewer," Shelton says. "You're looking for severe separations in terra-cotta joints, cracks, broken pipes — obviously any type of active water flowing, root infiltration, etc.

"We'll do the testing, and then we'll usually provide an estimate right away to do the repairs. You don't get every job, but the majority of them that you do the testing on, you end up getting the job to do the relining."

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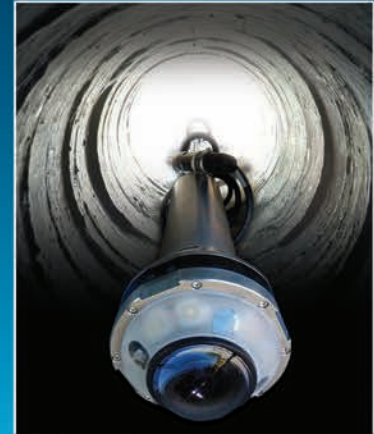
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Shelton uses RIDGID cameras for inspection and a Spartan Tool trailer jetter to clean the line before relining. Using an inversion-process lining machine, Shelton is a dedicated Perma-Liner Industries customer and says he will not buy materials from anyone else.

SKY'S THE LIMIT

It can be tough when big government hands down mandates that require locals to spend a lot of money, but it does provide opportunities for the industry, and with technology, contractors can ease the burden for citizens.

"We wanted to take care of our customers. We knew that there had to be a way to reduce the cost for our customers," Shelton says.

Relining can cost a third of traditional excavation and replacement, according to Shelton, which is a blessing for homeowners suddenly faced with a failing system. Providing trenchless rehabilitation earns plumbers goodwill from customers, in addition to steady work.

"Sooner or later, everybody's going to have to come up to compliance," Shelton says. "There's a handful of companies that are doing lining now, and most of us are booked for months and can barely keep up." **I&I**

Josh (left) and John Shelton



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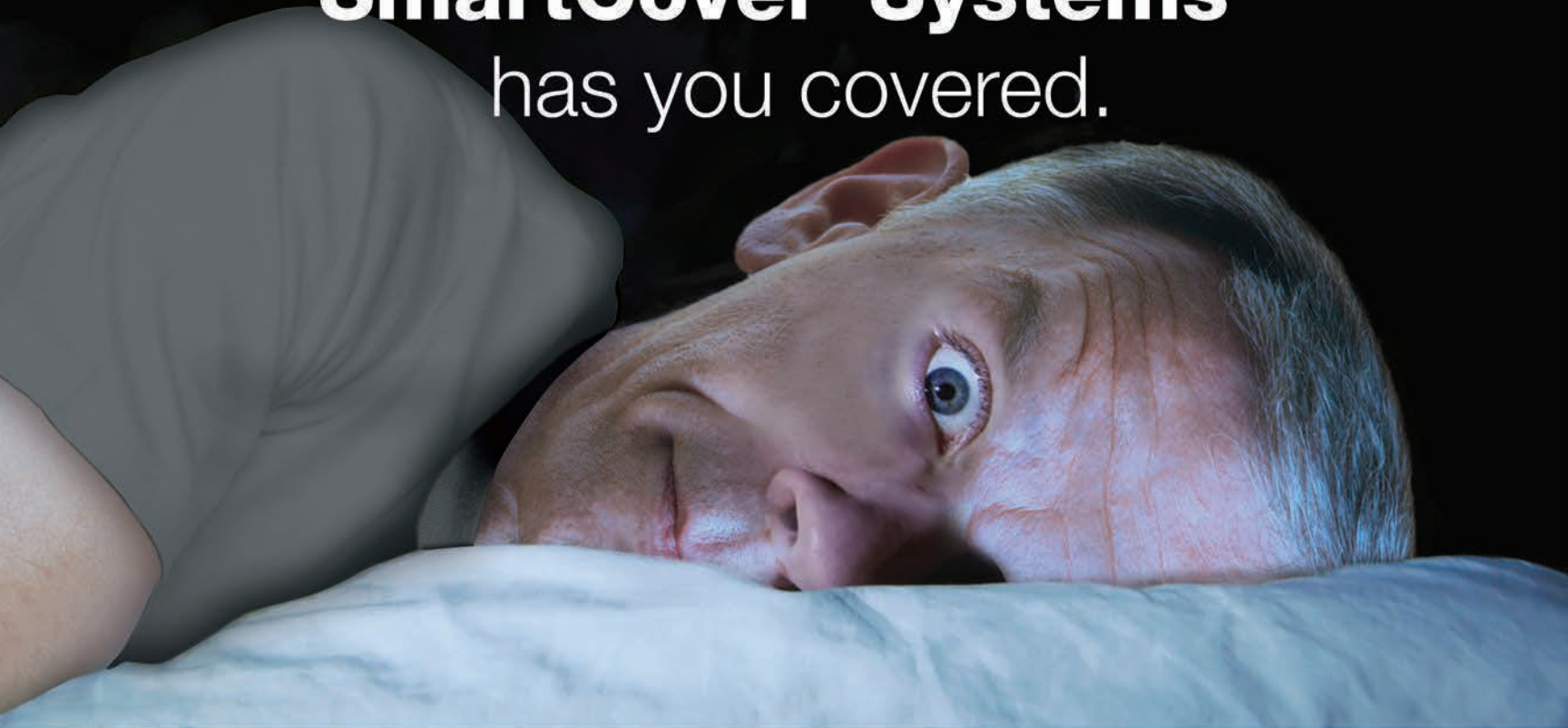
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REHAB IN THE REMOTE NORTH

Innovative manhole rehabilitation technique reduces inflow and infiltration and proves value in extreme conditions

By Angus W. Stocking

Carmacks is a remote village in the Yukon with a population of just 503. Infrastructure is relatively undeveloped, and repairs and rehabilitation present special challenges.

“Basically, the sewer system is the only infrastructure — even water is trucked in,” says Darrell Peters, project facilitator at Yukon Engineering Services.

As part of a review funded by the government of Yukon, Peters identified six manhole barrels that were leaking badly and overwhelming the community’s small wastewater treatment plant. “The system is near a big river, and main sewer lines are actually in the water table,” Peters says. “The manhole barrels were just part of the project, but they were a main source of infiltration — I could see water pouring in like a garden hose, and I had to dewater just to get a good look at the situation.”

At the time, Peters installed plugs to temporarily fix poorly installed seals and cracked barrels. For a permanent solution, he decided to try the Permacast system, developed by AP/M Permaform and installed by Edmonton-based Osco Mudjacking & Shotcreting. “I thought it could work here at a relatively low cost and would be a good choice given the remoteness of the location,” he says. “The nearest source of supplies is Whitehorse, about 200 km away.”

COMBINED SOLUTIONS

The Permacast process Osco employs is based on a bidirectional spin-caster, which is lowered into the manhole from above and withdrawn vertically, so crews are usually able to avoid confined-space entry. The bidirectional feature is important in this regard; since the spray nozzle spins both clockwise and counterclockwise, there are typically no concrete shadows caused by uneven bricks or other protrusions. This eliminates handwork. The result is, essentially, a smooth, watertight, completely structural new manhole that tightly adheres to and stabilizes the existing manhole.

Permacast can be used to repair brick, concrete or even steel manholes. The material used is MS-10,000 — an ultrahigh-strength mortar based on ordinary Portland cement and fortified with microsilica and other densifying agents. Graded quartz sands and fibers are added to improve cohesion and flexural strength. The properties of MS-10,000 are much different than Portland cement, with twice the compressive strength.

“We set up over the manhole, lowered in the spin-caster, and withdrew it while spraying on MS-10,000. Sewer flow was not affected at all,” Peters says. Just a few passes were required to build up an inch of thickness. The



The Permacast system uses a bidirectional spin-caster that is lowered into the manhole and withdrawn vertically, so crews are usually able to avoid confined-space entry. The bidirectional motion eliminates concrete shadows caused by uneven bricks or other protrusions.

“The manhole barrels were just part of the project, but they were a main source of infiltration — I could see water pouring in like a garden hose, and I had to dewater just to get a good look at the situation.”

Darrell Peters

process casts a new, joint-free pipe within the original manhole, and manhole diameter is not significantly reduced.

For added protection, ConShield — a concrete additive that inhibits microbial activity — was incorporated into the MS-10,000. Concrete treated with ConShield has been used for decades to prevent microbiologically induced corrosion. Poorly understood when many manholes were originally built and installed, microbiologically induced corrosion is now known to be a prime cause of concrete deterioration in wastewater systems. The organic waste, combined with increased temperatures, long retention times, turbulence and anaerobic conditions create hydrogen sulfide gas. This in turn creates a proliferation of *Thiobacillus*, a bacterium that feeds on the sulfur within the gas



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A view of one of the manholes in Carmacks before (left) and after rehabilitation.



and then excretes sulfuric acid. And sulfuric acid, of course, attacks the concrete matrix and decomposes it into a crumbly white mass consisting primarily of gypsum.

ConShield — a water-stabilized silica salt — is a liquid added during the mixing phase that bonds molecularly with cement particles, forming a physical barrier to production of *Thiobacillus*. It is nontoxic to humans and animals, but it permanently inhibits single-celled organisms like *Thiobacillus*. "Using ConShield is a very good idea in any sanitary sewer, where organic

material and turbulence lead to microbial damage," says Don Moroz, Osco owner. "It's a best practice, and we recommend it to greatly extend the life span of concrete sewer structures."

SUCCESSFUL OUTCOME

For Osco, the main challenge was weather; at the time of rehabilitation, nighttime temperatures were 5 degrees F, with daytime temperatures climbing all the way up to 41 degrees F. Aerotech Herman Nelson Int. heaters were brought on site and connected to 12-inch hoses that brought manhole barrels up to workable temperatures. Osco also had to contend with insulated frost lids, a unique feature of Yukon manholes used to prevent sewer freezing in winter.

Aside from those challenges, rehabilitation was routine. All six barrels, approximately 10 feet deep, were repaired in just two days on site.

Peters considers the project a success and says he is likely to use Permacast again. And given the extreme challenges successfully met by this project, it's likely that the system will be used routinely throughout Canada, just as it is in the United States. **I&I**



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By Craig Mandli



CRAWLER CAMERA HELPS STORMWATER UTILITY INCREASE PRODUCTIVITY

PROBLEM:

The Roanoke River, which meanders through residential and industrial neighborhoods in Roanoke, Virginia, serves as one of the main water sources for the city. To protect the water quality for years to come, the city formed the Roanoke Stormwater Utility. To achieve their goals, the utility needed a reliable, efficient inspection system.

SOLUTION:

Envirosight's ROVER X inspection platform provided the efficiency the utility needed to assess its system for defects — and find any infiltration and exfiltration that came with that damage. The compact system can be transported in built-out inspection trucks or vans, on the back of a pickup truck, or out of an all-terrain vehicle. The crawler is also agile and maneuverable, with a short wheelbase and zero-degree turning radius that makes it easy to overcome any obstacle. The system has the power to tackle long runs. With 1,000 feet of lightweight, buoyant cable, it can crawl upstream or down, tackling offsets and inclines with ease.

Result: The utility improved from inspecting 17,000 feet of pipe in one year to inspecting more than 100,000 feet of pipe in five months. This increase in inspection capacity dramatically improved its ability to identify line defects. Additionally, the team discovered nearly 200 miles of storm line that had been forgotten and neglected. The city now understands its collections system and can identify sources of stormwater pollution and infiltration and continue working toward its water-quality goals.

866-936-8476; www.envirosight.com

MECHANICAL POINT REPAIR SLEEVE USED IN SEWER PREVENTIVE MAINTENANCE PROGRAM

PROBLEM:

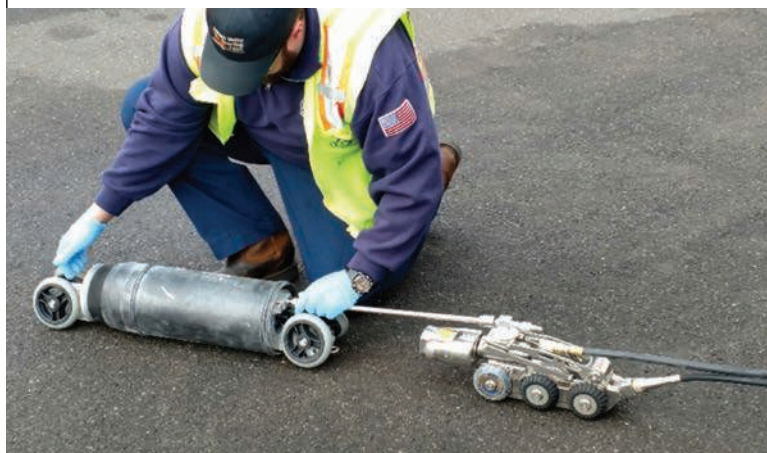
The preventive maintenance program for the Franklin Township Sewerage Authority in New Jersey prioritized identifying and addressing defects to reduce I&I. But the repair process had become a bottleneck: Staff engineers spent too much time planning how to tackle each defect, and the contractor bidding process was slow. In the meantime, groundwater infiltration would continue to fill the pipe. The authority needed an option that was easier and more efficient.

SOLUTION:

Quick-Lock point repair sleeves from **Pipeline Renewal Technologies** provide infiltration abatement and structural repair, and they can be installed by just two people in under 30 minutes. Made of a heavy-gauge 316L stainless steel cuff and an EPDM rubber gasket, a sleeve can restore strength and stop infiltration immediately. Users position and prepare the sleeve with a standard inspection crawler, and the device is then expanded pneumatically to seal out infiltration. With no contaminating resins or prolonged cure time, this mechanical solution requires neither wet-outs nor bypass pumping. And, it can be installed directly over “gushers” to eliminate high-volume sources of I&I.

Result: With the addition of Quick-Lock to their repair options, the authority is now able to identify a defect, determine if it is a candidate for Quick-Lock, and make the repair immediately. After just two months of utilizing Quick-Lock on an as-needed basis, the authority had installed seven sleeves and was saving over \$6,500 per month, in addition to the savings from reduced I&I.

866-936-8476; www.pipelinert.com



LINING PRODUCTS PROVIDE A SOLUTION FOR LEAKING MANHOLES

PROBLEM:

A New York sewage authority determined a substantial amount of groundwater was entering their collections system through their manholes, placing stresses on the system and additional cost to treat I&I.

SOLUTION:

A contractor from New Hartford, New York, was brought in to find a solution. Working with the **Sauereisen** representative, a **rehabilitation system** was recommended to restore the manholes, prevent further degradation, and stop the infiltration. The manholes were cleaned to remove old coatings and loose mortar, then active leaks were sealed with InstaPlug No. F-88 (hydraulic cement). Next the manholes received a 1/4-inch cementitious lining of RestoKrete F-121 Substrate Resurfacer before applying a topcoat of SewerGard at 125 mils for corrosion resistance from chemicals common in wastewater environments. The chimney sections were coated with elastomeric F-88 ChimneySeal, a flexible, fiber-reinforced urethane material that bonds well to substrates typically encountered in manholes. Surface preparation and application is done by hand with the F-88 and applied in a single layer at 1/4 inch.

Result: I&I was practically eliminated.
412-963-0303; www.sauereisen.com



LINER USED TO REHABILITATE MANHOLE DETERIORATION FROM HYDROGEN SULFIDE

PROBLEM:

A 4-by-6-foot precast concrete manhole in Key Largo, Florida, was in need of relining due to deterioration of the existing coating and concrete from hydrogen sulfide exposure. The manhole was located on a city street where traffic needed to be redirected, so quick turnaround time was important.



SOLUTION:

Maxx Environmental was contracted for the job. The surface preparation included hydroblasting to remove the loose coating and concrete. The contractor then mixed **CLADLINER** according to the manufacturer's instructions, and the product was poured into a cement hopper and sprayed into the manhole. It was then back-troweled to produce a smooth finish.

Result: The manhole rehab was completed in less than three hours from start to finish. The manhole was not only rehabilitated, but also is now protected from hydrogen sulfide.
877-708-2523; www.cladliner.com

GROUT SYSTEM STOPS HIGH-VOLUME MANHOLE LEAK

PROBLEM:

During a routine sewer line inspection on Tupper Street in the town of Milton, Ontario, cameras found a manhole leaking a substantial amount of groundwater into the sanitary system. After identifying the leak, Peter Knight-Chevalier, president of Rain Drain Restoration, was called to evaluate the manhole and propose a solution for the infiltration issues.

SOLUTION:

PARSON SEAL-TITE, part of the manhole rehabilitation product line from **Parson Environmental Products**, was chosen because of its ability to stop leaks up to 50 gpm. The moisture-insensitive, two-component, fast-reacting hydrophobic polyurethane grout is designed to stop high-volume active leaks in manholes, pump stations, and other wastewater structures. It is packaged in a dual cartridge with a static mixer and is injected at or near the source of the leak, using a manual dual-component caulk gun. The product cures to a dense, rigid mass in approximately 30 seconds and contains no solvents, CFCs, or HFCs.

Result: The grout was able to stop the high-volume leak in less than 4 minutes, resulting in a significant reduction of groundwater in the town's sanitary sewer system.
800-356-9023; www.parsonenvironmental.com



(continued)

MANHOLE BARRIER PREVENTS MANHOLES FROM LEAKING

PROBLEM:

Several years ago, the city of Rochester, Minnesota, began an extensive rehab program. Each spring they would concentrate on different areas of their community to rehab manholes. During heavy rains, the city's treatment plants were pushed to capacity levels, making the need to reduce the extra water entering through leaking manholes even greater. Also, as the manholes deteriorated, the need to rehabilitate them became even more important.

SOLUTION:

The city chose to install the **I & I Barrier** from **Strike Products**. Sealant provided with each barrier is placed on top of the cone section and followed by installation of the barrier. Either concrete or plastic grade rings are then put in place, with the first ring placed on the flange of the barrier dry. This allows water to leak out into the ground table. There is also a lip on the barrier, which keeps the barrier in place and water out. The remaining rings are then stacked and either concreted or glued in place to the proper height where the casting will sit. Contractors like the quick installation and are able to cut the barrier to fit inside the casting.

Result: With the installation of the I & I Barrier, there is less water entering the sanitary system, which saves the city money and also extends the life of the treatment facility.

800-262-4129; www.strikeool.com



MANHOLE ENCAPSULATION SYSTEM HELPS ELIMINATE COMBINED SEWER OVERFLOWS

PROBLEM:

In the rural area of Honesdale Borough, Pennsylvania, locals like to spend their time enjoying activities such as fishing, rafting and biking. As bicyclists pedaled around town, it became harder for them to overlook the increasing cracking of the pavement above their manhole structures. The challenge was several combined sewer overflows. The structures were receiving excessive inflow and infiltration, resulting in hydraulic overload conditions that needed to be addressed.

SOLUTION:

The Central Wayne Regional Authority enlisted the assistance of Entech Engineering, which recommended the use of **WrapidSeal Manhole Encapsulation System** from **CCI Pipeline Systems**. "Entech has been using WrapidSeal on projects for over 12 years simply because it works," says Bryon Killian, P.E., LO. "Starting in this industry 16 years ago, I personally conducted thousands of manhole inspections and found the manhole riser rings and joint sections were almost always the primary cause of infiltration. In addition to helping prevent I&I, we also use WrapidSeal to ensure pavement life by preventing fines being washed away with infiltration, causing pavement cracking around manhole structures."

Result: Once these structures were repaired and protected with WrapidSeal, the amount of I&I causing the hydraulic overload conditions during wet weather was significantly reduced, accounting for the elimination of 13 CSOs over the last decade.

800-867-2772; www.ccipipe.com



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CHIMNEY SEALS EFFECTIVELY STOP MANHOLE I&I

PROBLEM:

During the construction of a new subdivision near Louisville, Kentucky, the specification on new manholes stated that all had to be vacuum tested after construction. Upon passing the vacuum test, an internal mechanical chimney seal had to be installed to prevent future I&I into the sewer system, thus preventing costly treatment of unnecessary water.

SOLUTION:

The project was awarded to Tru Test and included the installation of more than 50 internal manhole seals. Dave Conrad of Tru Test had used **Trelleborg Pipe Seals' DrainFlexRib Manhole Chimney Seals** for several years. The solution consists of an EPDM seal, which has a rib design that allows vertical and lateral movement, while still ensuring a watertight seal. The Waveband technology creates a more effective seal by concentrating the compressive force of the expansion band, effectively capturing the rubber between the band and the concrete. According to Conrad, the chimney seals were installed before the contractor had finished the final asphalt road surfacing. After completion of the road grading, Tru Test went back to check the installation. This was less than two weeks after the manholes had passed the initial vacuum test.

Result: What Tru Test found was that the top retaining band of the DrainFlexRib seal was already performing. It held back water that had leaked through the failed mastic and concrete grouting that the manhole contractor had used to help pass the vacuum test. Without the installation of the chimney seals, the manholes would already be leaking two weeks after construction. Instead, an immediate impact on I&I was achieved.

800-626-2180; www.trelleborg.com/pipe-seals



(continued)

MANHOLE RESURFACING UTILIZED IN SENSITIVE ENVIRONMENTAL AREA

PROBLEM:

The Moraine Park Campground, the only year-round campground in the Rocky Mountain National Park, was experiencing severe infiltration issues in its sanitary system, especially during the spring snowmelt. The system consists of 2,346 lineal feet of 6-inch gravity pipe and 11 manholes in an environmentally sensitive area 8,160 feet above sea level. Park officials knew the system needed to be repaired but were worried that the rehab process could lead to significant park closures.



SOLUTION:

The National Park Service tabbed Advanced Solutions Group for the job. Given the time-sensitivity around the project and the extreme conditions the system has to withstand, Advanced Solutions Group employed Fold In Place PVC for the sewer lines and **SpectraShield Liner Systems** for the manhole rehab. SpectraShield Liner Systems' trenchless rehab proved ideal since it can be used to resurface a typical manhole in less than an hour.

Result: Due to the fast and easy application, the campground's manhole rehab was completed in two days and is guaranteed infiltration-free for 10 years.

800-284-2030; www.spectrashield.com

GEOPOLYMER LINING A FIT FOR MANHOLES IN DRY CONDITIONS



PROBLEM:

The town of Cheektowaga, New York, began rehabilitating its manholes by trying out an assortment of products in extremely dry conditions. The township found that ordinary Portland cement liners and calcium aluminate cement liners were prematurely cracking only hours after installing the lining.

SOLUTION:

Milliken Infrastructure Solutions reached out to the township's design engineer and suggested using **GeoSpray geopolymer**, which is less sensitive to cracking in dry manhole conditions. Compared to Portland cement linings, GeoSpray geopolymer has about double the compressive strength (8,000 psi) and about triple the flexural strength (1,500 psi). This added strength, coupled with its resistance to sulfuric acid corrosion often found in sanitary sewer systems, gives the geopolymer mortar a 70- to 100-year life cycle. "GeoSpray geopolymer mortar has a noticeable product consistency and quality that my crew and I appreciated during the project," says Dennis Sullivan, vice president and general manager of the installation contractor, National Water Main Cleaning.

Result: GeoSpray mortar went on quickly and easily and did not crack. The township was pleased with the pilot application and specified GeoSpray mortar on a 5,000 vertical linear foot manhole 2018 project. "This product's user-friendly application characteristics lead to efficiency in the field," Sullivan says. "These characteristics make it a preferred product on certain future projects."

864-503-2020; www.milliken.com

RISER SYSTEM KEEPS MANHOLE CASTINGS AND LIDS IN PLACE

PROBLEM:

Twenty-nine manhole riser installations were placed in the roadways of Cumming, Georgia. Due to the installations degrading quickly during normal, everyday traffic, the manhole casting/lids were moving and getting displaced, which not only compromised ride quality, but also resulted in inflow and debris falling into the sewer collections system.

SOLUTION:

James Waite Inc. was called in to assess the situation, and the decision was made to remove the grade rings from the 29 manholes and replace them using the **Whirlygig Manhole Riser System**. Once in place, the riser/collar forms were trimmed to finished height, during which the slope of the roadway is automatically reconciled. After pouring the concrete collar, the result is a monolithic structure impervious to corrosive elements.

Result: Traffic flow across a planar surface was safely restored in short order, and a smooth ride was ensured over the lifetime of the installation.

800-307-4263; www.wgig.us



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PROBLEM:

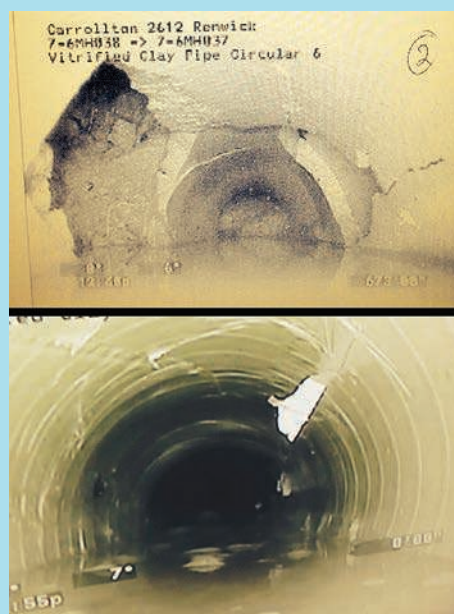
A 6-inch vitrified clay pipeline in Carrollton, Texas, had significant damage, causing heavy I&I. The pipeline was buried 10 feet deep in an alleyway and through a resident's driveway. Open-cut replacement would cost between \$10,000 and \$12,000, require at least three days of labor, and the alley would need to be closed during the repair. In addition to the expense to the city, it would be an inconvenience to the homeowner and neighborhood.

SOLUTION:

Hoping to avoid an expensive and time-consuming excavation, the city turned to **Source One Environmental** to provide a **trenchless pipe rehabilitation** solution. Rehabilitating the pipeline with a CIPP method would restore the pipeline's structural integrity and improve the overall performance, at a fraction of the cost and time. The company installed the PipePatch point repair system 10 feet deep to cure the broken 6-inch pipeline.

Result: PipePatch eliminated the need for digging by creating a pipe within a pipe with minimal change to the original diameter, improving the overall flow capacity. The repair was significantly less expensive than the original estimate and took less than three hours to complete. Not only was the residential area virtually undisturbed, the rehabilitation added decades of additional service life to the pipeline, ensuring that the residents would not encounter this again.

877-450-3701; www.s1eonline.com **I&I**



IT'S ALL ABOUT DEPTH

Successful flow measurement studies are dependent on accurate depth readings

By Patrick Stevens and Matthew Brown

In the inflow and infiltration business, depth is the key to flow measurement success.

It is important to recall that no open-channel flowmeter on the face of the earth measures flow. They all measure depth and velocity and then calculate a rate of flow. In the last issue, we discussed the importance of reviewing meter data in a scattergraph format to understand the hydraulic condition in a sewer, and in this article, we will examine how the scattergraph can be used to evaluate the accuracy of the depth measurement.

The open-channel flowmeters on the market today deploy at least seven velocity technologies including Acoustic Doppler, Gated Acoustic Doppler, Laser Doppler and Time-of-Travel. But there are only two technologies commonly used to measure depth: pressure transducers and ultrasonic sensors. The vast majority of open-channel flowmeters in use in the country today are equipped with pressure transducers, primarily because they are less expensive and are a bit easier to install. In the open-channel flowmeter business today, much of the marketing is based on patented velocity technologies used in the meter and little mention is made of the mostly unpatented depth technologies.

CATCH THE DRIFT

There is a wide range of costs in available pressure transducers, but the types typically deployed in open-channel meters share the common characteristic of sensor “drift.” Pressure sensor drift refers to the tendency for the sensor’s reading to gradually change from its true depth. The ultrasonic sensor is based on a precise clock measuring the return time of an acoustic echo, and its readings tend to have a narrower band of precision and do not drift. Figure 1 is an example of depth measurements in an 8-inch sewer and with both ultrasonic and pressure sensor readings.

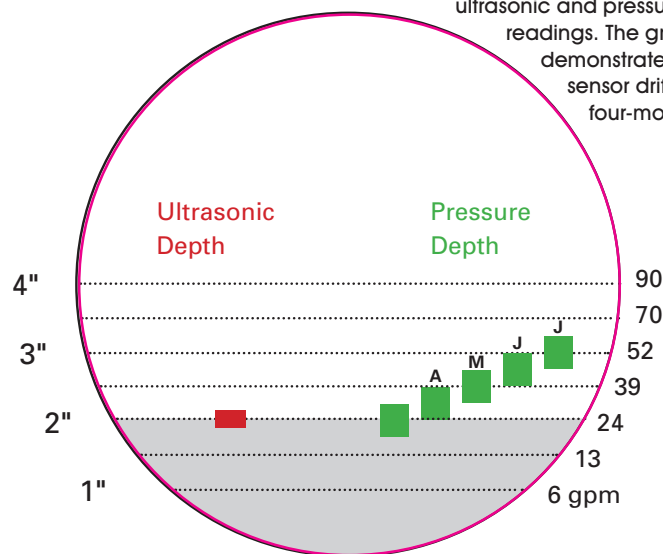
In general, an ultrasonic sensor has greater precision than a pressure sensor, and the difference is displayed in the heights of the red and green bars in Figure 1, which shows 2 inches of water in the 8-inch pipe with the pipe marked in 1/2-inch increments. The flow rate in gallons per minute is shown on the right side of the depth markings. If sensors are installed in the month of March, both would properly measure 2 inches of flow at 24 gpm. During the following 4 months, the pressure sensor drifted by 1/4 inch per month. Drift at such a small rate will likely go unnoticed by the operator, but after 4 months of operation, the meter will be reporting 2 inches of depth (24 gpm) as 3 inches of depth (52 gpm). That is an error of 117 percent.

VIVID DATA

Pressure sensor drift is hard to spot when it occurs in a single meter, but it becomes vivid when meter subtractions are set up to calculate I&I. When one meter flows into the next, I&I is determined by subtraction of the two meters. There are three separate conditions in which the upstream flow is higher (bad), higher than the upstream (good), and equal to the upstream (not good). The last installment in this series discussed the importance of depth-velocity scattergraphs as a key performance indicator in evaluating flow data, and that is the tool to use to diagnose this problem.

If all the data on the scattergraph lines up on the pipe curve, the meter

FIGURE 1. An example of depth measurements in an 8-inch sewer with both ultrasonic and pressure sensor readings. The green bars demonstrate pressure sensor drift over a four-month period.



is working correctly. If there is depth drift, it will show up as a vertical shift in the pattern along the depth axis.

The example in Figure 2 is of a nearly 9-month data set in which the relationship between the two meters changed several times as highlighted by the color bands along the hydrograph. The downstream meter on the left experienced a small amount of drift, but is generally acceptable. The upstream meter experienced a maximum of 3 inches of drift and is responsible for most of the flow imbalance problem.

Reviewing the scattergraph of all flowmetering should be the “do-not-pass-go” step. This means that no flow data should be considered ready to use until the data have been viewed in the depth-velocity scattergraph. This is a critical quality assurance/quality control step that should not be skipped.

CHECK THE VOLUME

A comment that is commonly heard among casual flow data users is “close enough is good enough.” This implies that one does not need to take the time and make the effort to collect accurate or even valid flow data. But as we have seen, a relatively small amount of pressure sensor drift can result in dramatically wrong conclusions. In the next installment in this series, we will discuss a second KPI in the I&I business and that is the Q vs. i plot. Q is I&I volume, and i is the rainfall.

The Q vs. i plot is simply the comparison of rainfall on the bottom axis and the I&I volume on the side axis. For data collected in the same season (e.g., winter or summer), these data points should be linear in nature. The slope of the linear regression is an indicator of I&I severity; the steeper the line, the more severe the I&I.

Figure 3 is the Q vs. i plot of a small 1-inch pressure sensor drift. The rainfall-dependent I&I volume from the sewershed between these two meters is determined by subtraction. A review of the Q vs. i plot displayed in Figure 3 shows that the relationship is far from the expected linear relationship. The regression line splits the difference between the data points from the two largest storms, but think of the danger if the study captured only one of

Example of Pressure Sensor Drift in Meter Subtraction

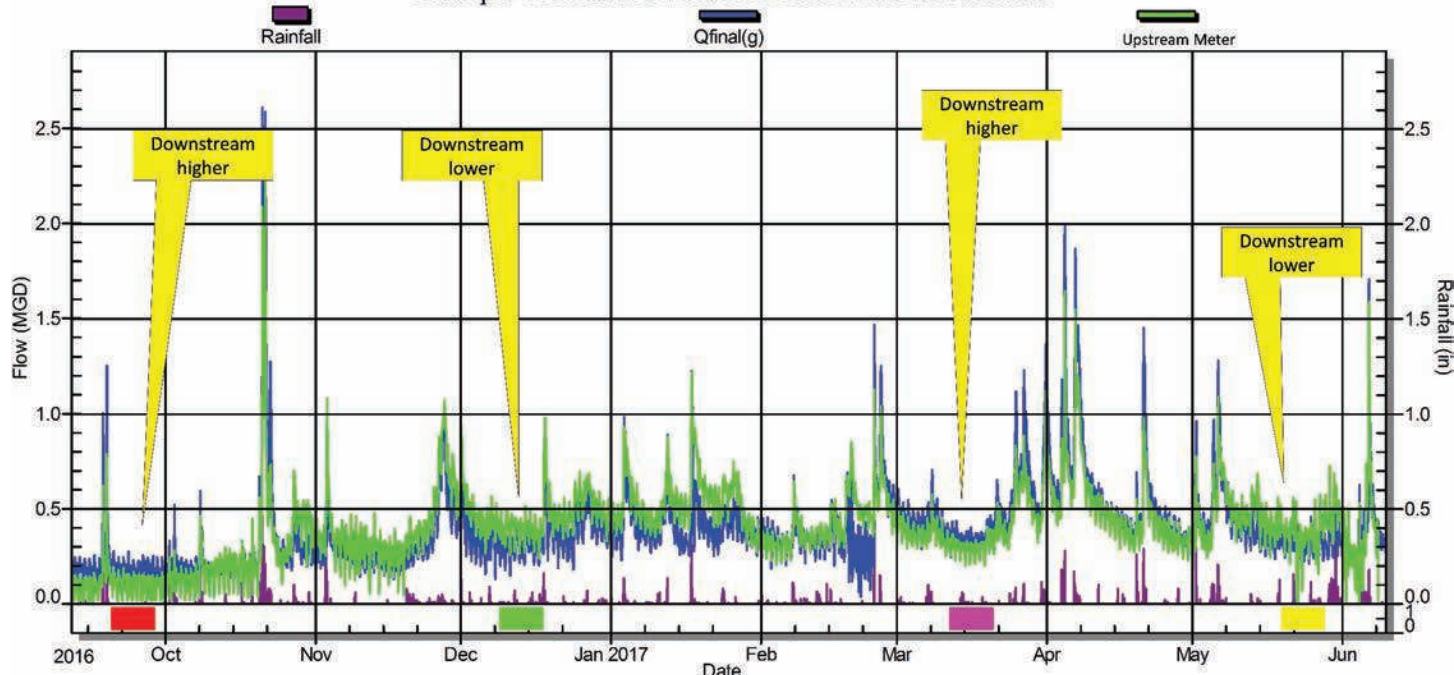


FIGURE 2. A hydrograph charting a nearly 9-month data set in which the relationship between the two meters changed several times as highlighted by the color bands.

the two largest storms. The sewer agency could have concluded that this sewershed had little I&I (low slope) if only the March 29 storm was captured or have extremely severe I&I (high slope) if only the March 22 storm was captured. This could have caused the agency to overlook a bad sewershed or spend money trying to rehabilitate a sewershed that was adequate.

As old-timers in the I&I business (Patrick Stevens is the old-timer), we have learned how to tell the past experiences of a sewer agency by the language in their procurement documents for flowmetering services. If they have been burned by pressure sensor drift in the past, they will specify that the provider must visit the site weekly or biweekly to conduct manual depth measurements. Any difference between the meter depth measurement and the manual measurement must be corrected by adjusting the meter. This has been the only way to spot and control pressure sensor drift.

RULES OF THUMB

The old-timers have seen flow data from well over a thousand I&I projects and have developed three rules of thumb about open-channel flowmeters:

Rule 1 - All pressure sensors drift at some time in their life, and the user cannot predict when it occurs or by how much it will drift.

Rule 2 - When a data set comes from an agency that is not aware of pressure sensor drift and has not tried to control it, much of the data is not usable. The data fall into the 30-40-30 rule of thumb.

30 - Percentage of data with accuracy of 20 percent or better and are useful
40 - Percentage of data with accuracy between 20 and 50 percent and is marginally useful

30 - Percentage of data with accuracy worse than 50 percent and is generally not useful.

Rule 3 - Once a flow data set with pressure sensor drift has been collected, there is no going back to try to correct/recover data.

With the advent of wireless data collection and deployment of ultrasonic

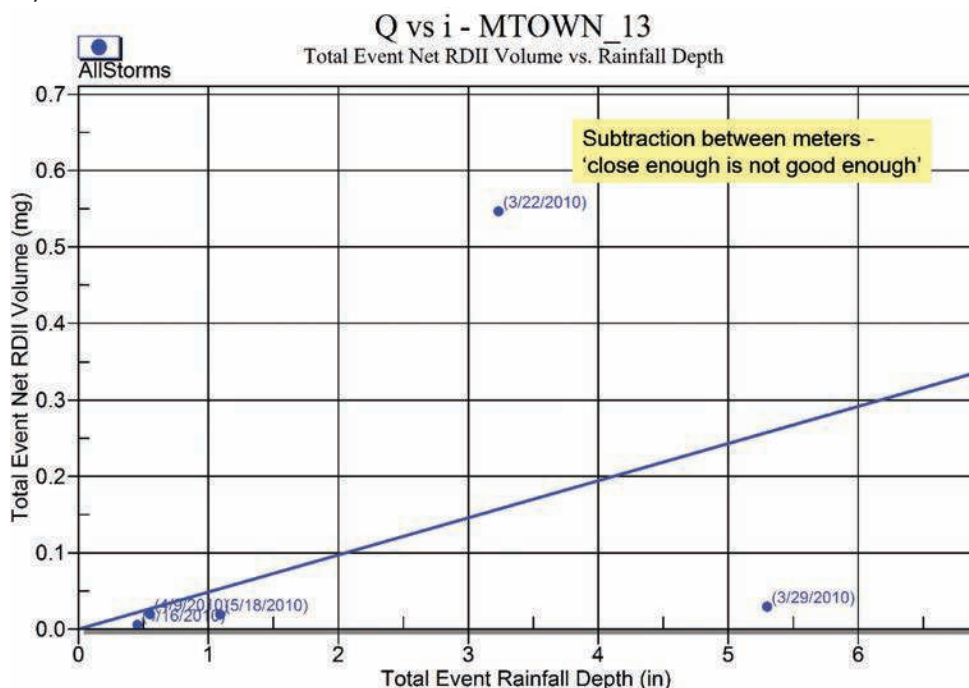


FIGURE 3. A Q vs. i plot of a small 1-inch pressure sensor drift. The rainfall-dependent I&I volume from the sewershed between these two meters is determined by subtraction.

depth sensors, drift does not occur and the analyst can spot any discrepancy in meter performance on almost a daily basis by the use of scattergraphs. Many sewer agencies today will specify that flowmeters deploy both depth sensor technologies: ultrasonic depth during open-channel condition and pressure sensors for when the sewer surcharges.

It is important to recognize that the accuracy of a flow rate calculation is influenced by the depth measurement much more than by the velocity measurement. The velocity sensors on the market tend to deliver similar results that may differ by 10 or perhaps 20 percent. So that is the maximum flow rate error that can be generated by the velocity sensor. But as we have seen in this article, flow rate error that can be generated by the depth sensor can be 100 to 200 percent, especially in shallow flow. **I&I**

FIRE AND RAIN

California utility mitigates a disaster and minimizes system damage after wildfires

By Jared Raney



After a wildfire burned through 36,800 acres of California's Sonoma and Napa counties last October, the city of Santa Rosa's water department had to locate and cap sewer laterals in an area at risk for system intrusion by remnants of the fire.

Every municipality's goal is ultimately to protect its residents — but losing 5 percent of your housing stock to wildfire can make that difficult. The resulting inflow to the wastewater system after such a catastrophe presents other challenges.

A wildfire burned through 36,800 acres of California's Sonoma and Napa counties last October, and the city of Santa Rosa found itself picking up the pieces of 3,000 structures that had been obliterated.

While debris removal and other emergency services were still underway, the city's water department had its own task — capping sewer laterals in an area at risk for system intrusion by remnants of the fire.

"The majority of the homes were completely destroyed — down to the foundations — and that left the sewer pipes exposed at the surface of the foundation, underneath the debris," says Jillian Tilles, associate civil engineer with Santa Rosa and manager of the sewer capping project. "There was a lot of concern that the exposed pipe would be vulnerable to inflow and infiltration, allowing the debris and ash to enter into our system."

When ash combines with water, it can calcify in a system, hardening into a blockage and potentially restricting or stopping flow. As a preventive measure against future system repair and line replacement, it was decided to cap sewer laterals. Two neighborhoods in particular in Santa Rosa were deemed high-risk due to topography and the fact that two lift stations servicing the area had been destroyed.

A contract for 88 obliterated homes in the Fountaingrove and Coffey Park neighborhoods opened up to bids in early February, and notice to proceed was issued later that month. Though the initial contract estimated a six-week project, it only took about three.

"There was a lot of concern that the exposed pipe would be vulnerable to inflow and infiltration, allowing the debris and ash to enter into our system."

Jillian Tilles

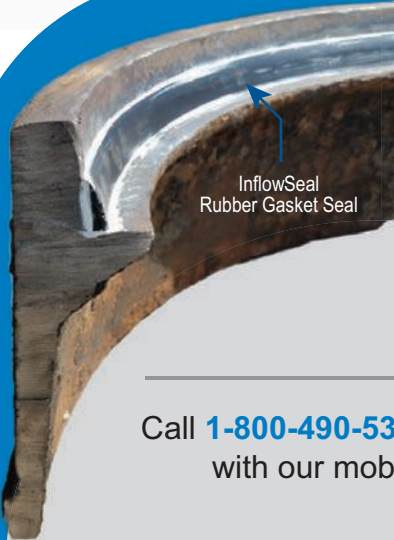
TOUGH TERRAIN

"The topography and the damaged lift stations are the reason that the city chose to address this specific area. There were concerns about the debris causing overflows in the neighborhoods served by the destroyed lift stations," Tilles says.

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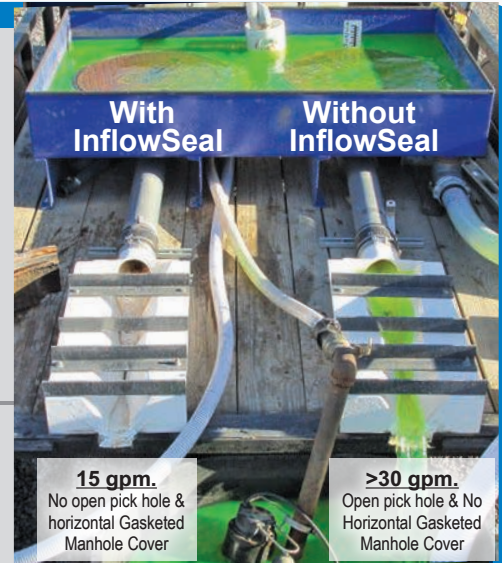
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Many laterals were capped during the initial debris removal, but others were not. The city inspected all the properties and lines that hadn't been addressed were capped at the foundation.



An area of mixed topography, the Fountaingrove and Coffey Park neighborhoods have many houses built into steep slopes, making them vulnerable to I&I. Because of the unusual terrain, the whole area is served by nine lift stations. Most of them sustained some damage in the wildfires, with two being completely destroyed.

Many laterals had already been capped during the initial debris removal, but the city still needed confirmation on each property in the predetermined zone.

“We would go onto the property and verify whether or not the sewer lateral was plugged by the contractors that did the debris removal,” Tilles says.
(continued)

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Many properties were also capped at the sidewalk. If a lateral had to be dug at the property side of the sidewalk, a two-way clean-out was installed and the pipe was brought up to within 2 feet of the surface.

“If we did not find proper evidence that it was capped, we located the sewer laterals to the best of our ability at the foundation in order to cap it at the foundation. If we were not able to locate it at the foundation, we capped it at the back of the sidewalk.”

Video was used to identify the open laterals, but workers ran into some issues.

“We anticipated being able to video a little bit more than we actually were able to,” Tilles says. “We were hoping to find a clean-out and run a video up to the foundation and identify a location at the foundation, but most of the clean-outs were one-way clean-outs, and we weren’t able to get any video equipment in there.”

As a result, many properties were capped at the sidewalk. If they had to dig up the sewer lateral at the property side of the sidewalk, they exposed it, installed a two-way clean-out, and brought the pipe up to within 2 feet of the surface.

“Our intention for bringing it up to the surface was so that as people begin to rebuild their homes, it was more accessible and easier to find,” says Lori Urbanek, deputy director of capital projects engineering for Santa Rosa.

Of the 88 homes listed in the contract, the city only ended up needing to cap 38 laterals after verifying that the other 50 had been capped during initial debris removal. **I&I**





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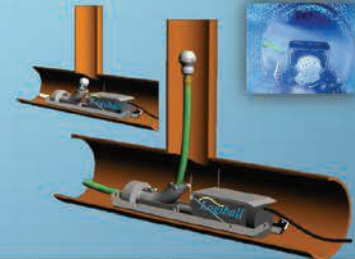
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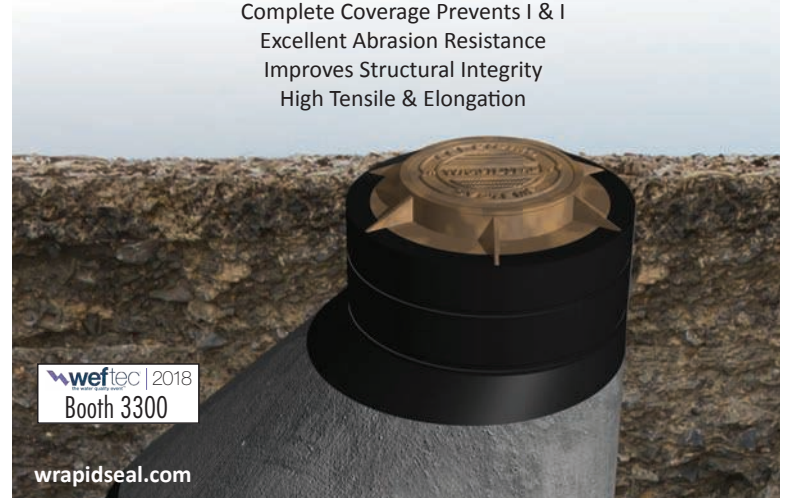
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