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**SEWER**  
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# Saving Cities

Private contractor takes on persistent municipal problems

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COVER PHOTO: Carlos Chavez of H&R Plumbing in El Sobrante, California, injects grout through the wall of a manhole to repair leaks. The company specializes in manhole rehabilitation and other I&I reduction work for municipal customers. (Photography by Collin Chappelle)



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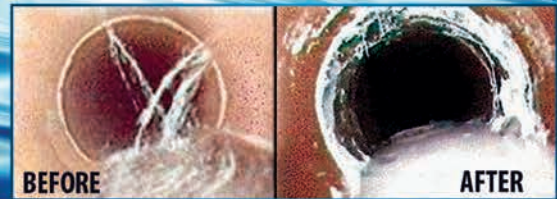
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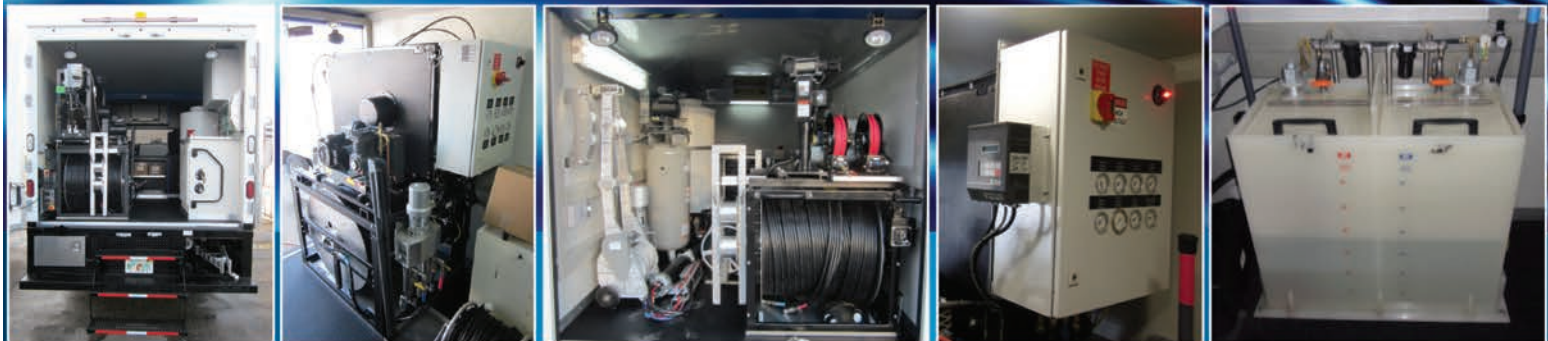
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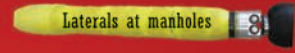
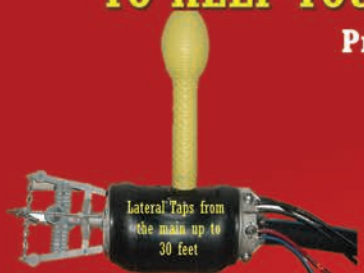
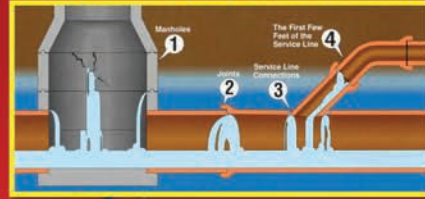
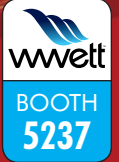
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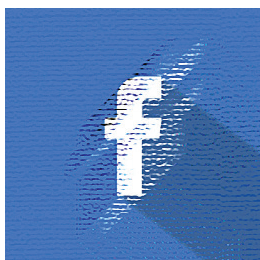
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# BALANCING BOTH SIDES OF THE EQUATION

Accurate rainfall data is just as important as flow data when measuring rainfall-dependent infiltration and inflow

By Patrick Stevens, P.E., and Peter Frick

**W**hat have you accomplished with the money? Project managers tasked with establishing wastewater system capital improvement programs after rainfall-dependent infiltration and inflow studies will inevitably have to answer that question.

Projects that fail to provide clear conclusions experience many of the same stumbling blocks. Rainfall measurement is critical to any RDII study or project, and while it is necessary for the successful evaluation of sewer system performance, it is often overlooked.

Rainfall issues are at the top of the list because inadequate rainfall data is the most common stumbling block to proper measurement of RDII. People often think of an RDII study primarily as a flowmetering effort. The collection of rainfall data can be an afterthought.

It is not uncommon for a utility's scope of work to describe in great detail the type of flowmetering technology, field services, and level of data processing that's expected, while only specifying a few rain gauges or relying solely on existing sources of rain data from the airport or water treatment plant. Yet in the relationship between rainfall and RDII, rainfall data is mathematically just as important as flow data.

## THE RIGHT RATIO

Some people use rules of thumb for rain gauge placement based on the number of flowmeters used (e.g., one rain gauge for every 10 or so flowmeters). This approach can result in an adequate number of rain gauges in small areas, but in large sewer sheds, it won't be enough.

Small studies often end up using only a single rain gauge, but rain gauges should be treated the same way we treat pumps in pump station designs. We always assume one will fail, so at least two are deployed. Similarly, a flow study should never have less than two rain gauges. Agencies new to RDII measurement seem to be unaware of how primitive tipping-bucket rain gauges are and how easily they become plugged. An uptime of 80 percent for a permanently installed rain gauge network is a high value.

Rain gauge density is another issue that's often overlooked. Many agencies view rain gauges as nothing more than an expense that needs to be minimized. In March 2011, participants in an RDII webinar were asked about the importance of accurate flow and rain measurement in quantifying RDII. Over half the respondents believed that rainfall data from any nearby facility was adequate.

Recommendations for the density of rain gauges for urban hydrology vary considerably. There is a tenfold difference in the recommendations for rain gauge density in the three published references below:

- *Existing Sewer Evaluation and Rehabilitation*, Third Edition, by the Water Environment Federation and American Society of Civil Engineers recommends one rain gauge for every 5 to 10 square miles with a minimum of two gauges even for smaller projects.
- *Code of Practice for the Hydraulic Modeling of Sewer Systems*, Version 3.001, by the Wastewater Planning Users Group recommends the following:
  - Flat Terrain: 1 + 1 per 1.5 square miles.
  - Average: 1 + 1 per 0.8 square miles.
  - Mountainous: 1 + 1 per 0.4 square miles.

- *A Guide to Short Term Flow Surveys of Sewer Systems* by the Water Research Centre provides the same recommendations as the above resource from the Wastewater Planning Users Group.

Radar rainfall service providers can deliver rainfall information at a 1-square-kilometer resolution and generally want to see a network of calibrating rain gauges at a density of one gauge per 10 to 20 square miles.

With such a wide range of recommendations, it can be difficult to determine the right density for a flowmetering project. The selection depends on whether you ever expect to answer the initial question: What have you accomplished with the money? Remember that in the rain-to-flow relationship, rainfall is the independent — and most important — variable, and RDII is the dependent variable.

**Small studies often end up using only a single rain gauge, but rain gauges should be treated the same way we treat pumps in pump station designs. We always assume one will fail, so at least two are deployed.**

## READ THE WEATHER

The importance of a dense rain gauge network is obvious when studying rainfall patterns as measured (estimated) by Next-Generation Radar, or NEXRAD, which can be found on the National Weather Service website. One of the NEXRAD products shows the estimated storm total rainfall and the last hour's accumulated rainfall.

Storms don't deposit rain evenly, which is clear when you look at thin bands of yellow within a larger green footprint. A large storm delivering only a 1/2 inch of rain per hour could produce 1.2 inches over small areas within the larger storm.

Imagine that an agency is conducting an RDII study or calibrating a model in a sewer shed in this rainfall footprint. Depending on the rain gauge density, the measured rainfall could have been 0.5 or 1.2 inches for the hour. This can make a huge difference in model calibration or RDII measurement.

For RDII measurement in large areas, the rain gauges should be laid out in a grid so that a storm with a narrow footprint can't sneak through undetected. For small areas, the placement of a rain gauge in each sewer shed may be acceptable, but make sure the gauges are no farther than 2 miles apart.

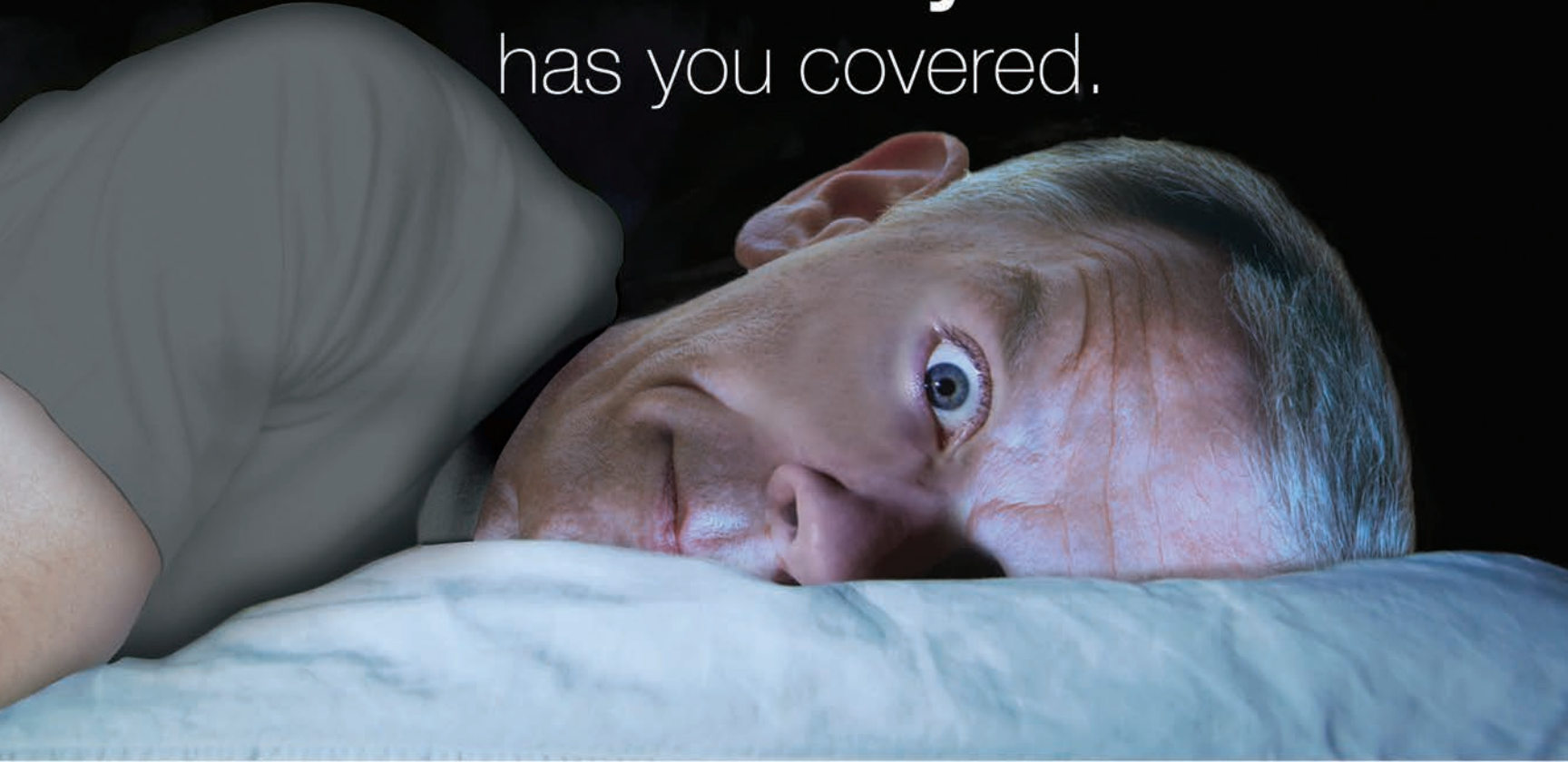
Rainfall can be calculated for each sewer shed through distribution algorithms. Common algorithms include closest rain gauge, Thiessen polygon, inverse distance, and inverse distance squared.

And remember, rain gauges are low-cost line items. Don't let a lack of rainfall measurement limit the effectiveness in properly locating sources of RDII or demonstrating the RDII reduction of your rehabilitation project. **I&I**



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H&R Plumbing laborers (from left) David Rodriguez, Jesus Uriarte and foreman Rafael Escobar connect a Graco 190 pump to a bucket of Avanti 202 polyurethane injection resin to be used in sealing a leaking manhole.



# Saving Cities

## Private contractor focuses on providing affordable solutions to a persistent municipal problem

STORY Jared Raney | PHOTOS Collin Chappelle

**S**mall-business contractors like H&R Plumbing have become the unexpected saviors of West Coast municipalities over the past year.

After the historic five-year drought — from which most of the area has only recently begun to recover — a new challenge has arisen.

Water system operators who had forgotten the impacts of a storm surge were violently reminded. “In the last year, it rained enough to make up for what we missed in the last five,” says Horacio Franco, owner of H&R Plumbing. “After (municipalities) saw what we do and what we can accomplish ... they really rely on us taking care of those situations for them.”

One of H&R Plumbing’s biggest customers, the city of Napa, California, is a perfect example. During one of the first big rain events after the drought, Franco was called in by Napa to assess a manhole.

“Napa called me to fix a manhole. When I was walking close to the manhole, I could hear water just gushing,” Franco says. “I thought it was a pump discharging into the manhole. When we opened the manhole, I found out that it was just the I&I into the manhole.”

It had at least two large leaks, contributing 2-inch-diameter flows, that were completely unchecked. Franco and his team fixed the leaks and rehabbed the entire manhole in one day. “I was pleased, and they were more than pleased,” Franco says. “It was one of the more challenging manholes that we’ve had. I had no doubt that we were going to fix it; I didn’t know how much time and materials it would take to fix it, but we got it done.”

Upon successful completion of that job, H&R Plumbing became a go-to contractor for Napa. “After we did that manhole, they gave us another six manholes — same category — and after that, it has been progressive work,” Franco says.





**“To stop a leak in a manhole, lift station, wet well, or holding tank, first we have to identify the source and location; we have to identify where the leak is coming into the system. Once we have identified all that, we look for the best approach and the best way to seal the leak.”**

Horacio Franco

In fact, they were recently contracted on two bid projects, totaling between 250 and 300 manholes and over \$300,000 in revenue. One of those projects is in progress; the other is awaiting permits.

Overall, Franco estimates they have completed close to 500 manholes for Napa between various projects. “They’ve been giving us a contract every year to fix five or 10 manholes, meaning fixing the I&I and rehabbing,” Franco says.

Another lucrative \$300,000 contract came to them from Rohnert Park, a city that is embarking on I&I work in addition to a brand-new trunk sewer — a project featured on page 16 of this issue.

#### **DEVELOPING A STRATEGY**

H&R Plumbing uses products from Avanti International, Madewell Products, and Source One Environmental (mainly Seal-Guard) in their I&I efforts. Some of the seals and grouts are applied

by hand, such as Avanti International’s Oakum, a fibrous jute material that is packed into leaks and then sealed in.

“To stop a leak in a manhole, lift station, wet well, or holding tank, first we have to identify the source and location; we have to identify where the leak is coming into the system,” Franco says. “Once we have identified all that, we look for the best approach and the best way to seal the leak.”

Case in point: A new fiberglass lift station had a 3/4-inch opening at the inlet all the way around the 6-inch pipe. They used Avanti International’s AV-219 Fibrotite Oakum and AV-202 Multigrout, a multipurpose blended polyurethane resin.

“We saturated the Oakum in AV-202 and packed it tight into the opening. We forced it into the opening using a flat metal or a flat screwdriver — just to push it into the cavity and hold it tight to cure and seal the opening — stopping the I&I almost instantly,” Franco says.

The other main component of Franco’s work is injection grouting.

“There are some instances where we find I&I coming from a crack where the best way to seal is injecting grout behind the walls,” Franco says. “We use a Milwaukee drill to penetrate for easy injection of chemical grout behind the walls.”

They use a 3/8-inch concrete bit to penetrate the wall near the I&I and then use a Graco 190 pump to inject AV-202 or SealGuard until the leak ceases. Then Oakum is packed into the interior side of the crack to prevent grout from squeezing out.

Hydraulic cement from Madewell Products is more efficient for brick-construct manholes or severe leaks — it is a fast-setting mortar that will cure even underwater.

After the leaks are taken care of, H&R Plumbing rehabs the whole manhole, lift station, wet well, etc. with Madewell Products ML-72 sprayable microsilica restoration mortar and a 100 percent-solids epoxy coating. A Madewell Products mortar mixer on a 20-foot trailer preps the materials, and a power washer is used to prep the surfaces. Air com-

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**H&R PLUMBING**  
El Sobrante, California

**SPECIALTY:**

Inflow and infiltration solutions, underground rehabilitation

**NOTEWORTHY PROJECT:**

Rehabbing approximately 500 manholes for the city of Napa

pressors power the hydraulic equipment, and a spincaster applies the linings and coatings.

All told, Franco says the process can increase the life of a manhole up to 50 years, I&I-free.

In addition to the variety of grouting and sealing products, H&R Plumbing also has an impressive list of auxiliary equipment:

- An Aries Industries CCTV truck.
- Two Vactor combination trucks.
- A grout truck built by Aries Industries.
- Logiball packers.
- PipeTech Software inspection software.

**EVOLVING OVER TIME**

As the name suggests, H&R Plumbing hasn’t always been involved in underground rehabilitation. What started as a straightforward plumbing operation slowly evolved to fill a gap in service for their customers.

“When I was doing CCTV work, there were a lot of leaks and there was a need to stop those leaks,” Franco says. “I saw the necessity of learning about these products so we can seal those leaks and service my customers.”

Though he never got around to changing the name, Franco estimates plumbing contributes only 15 percent of the company’s workload. The rest is all underground rehabilitation — not only manholes, but also general concrete restoration, chemical grouting, and spot repairs.

“Everything underground in the collections system,” Franco says. “It’s something that we enjoy doing every day and something where we find a big satisfaction in fixing this problem.”

The crew at H&R Plumbing includes (from left) laborers Jesus Uriarte and Carlos Chavez, owner Horacio Franco, foreman Rafael Escobar and laborer David Rodriguez.





“They were surprised that there were not two laterals coming in; it was just the I&I coming into the manhole. We sealed them and then we rehabbed the manhole. And that manhole is still strong and sealed, and they’re happy.”

Horacio Franco

ABOVE: H&R Plumbing, based in El Sobrante, California, specializes in manhole rehabilitation and other I&I reduction work for municipal customers. RIGHT: Carlos Chavez prepares for a confined-space entry in a residential neighborhood of Hercules to inspect and repair a leaking manhole.

Discovery of I&I rehabilitation came at the WWETT Show nearly a decade ago. He got started with manhole rehab, and after finding success in the niche service, expanded over the years to all things I&I.

“I saw the need for stopping leaks, and I started learning about it. I started researching new products and effective ways to fix the situation,” Franco says.

Franco has continued that learning by completing all the NASSCO certifications — ITCP, PACP, MACP and LACP — and by becoming certified by Madewell Products in the use of their products.

**PROVING THE BENEFITS**

I&I work entails a lot of cost-benefit analysis for municipalities, and Franco is more than happy to do everything in his power to aid in the decision-making process.

“We like to do demos so customers will know the benefit of our service in I&I repair,” Franco says.

In one instance, city supervisors believed a manhole had two laterals coming into it due to the amount of discharge, but after a demo, Franco proved that it was in fact a one-lateral manhole with an extreme amount of I&I.





**“[We repair] everything underground in the collections system. It’s something that we enjoy doing every day and something where we find a big satisfaction in fixing this problem.”**

Horacio Franco

in the city of Hercules, which was experiencing I&I problems.

H&R Plumbing assessed conditions in the Hercules manholes during a storm, even going as far as creating a map and assessment report. “I believe it was really a benefit for them and for us,” Franco says. “It was something that we did without being asked to do it and without asking for compensation.”

The company doesn’t just deal with aging infrastructure. Franco says he’s open to tackling new projects and happy to do whatever he can to serve customers. “These types of projects are something that we find a pleasure and joy to work on, and we are always looking for more.” **I&I**

Horacio Franco’s office staff at H&R plumbing includes (from left) estimator Janet Rodriguez, bookkeeper Elena Crotte and secretary Leticia Mendoza.

“I said there was a huge leak, so we sealed it using Avanti products,” Franco says. “They were surprised that there were not two laterals coming in; it was just the I&I coming into the manhole. We sealed them and then we rehabbed the manhole. And that manhole is still strong and sealed, and they’re happy.”

Franco has even been known to embark on unprompted, pro bono system assessments, as was the case

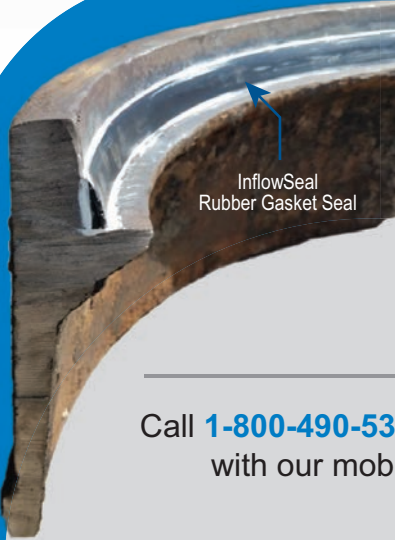
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— Ed Norton, *The Honeymooners*

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The crew connects a precast base with fiberglass insert and coupled new pipe stubs to an existing sewer main in Rohnert Park, California. The connection to the existing main at left is an intentional overflow connection, with primary flow moving from the right to the top of the photo.

## SEALED FROM THE START

Rohnert Park sewer expansion project uses precast manhole bases for watertight construction

By Jared Raney

Years of problems with inflow and infiltration in its sewer collections system inspired Rohnert Park, California, to adopt new standards when it came to designing and constructing a trunk sewer expansion.

Specifically, they rethought the way they were building up manholes. Previous projects had used standard cast-in-place processes, but now, they wanted to invest in I&I-inhibiting construction technology: monolithic base inserts.

“You can’t do too much better in our industry to prevent I&I from getting into your system than to use monolithic pieces,” says Matt Winkelman, project manager with GHD, the consulting firm on the project.

For this project, Rohnert Park used PREDL Systems North America precast base inserts. The dual-containment system consists of fiberglass-reinforced polymer (FRP) bonded to an HDPE transition strip, which mechanically locks to the surface of both the FRP base liner and the HDPE wall liner. Integral compression gasket fittings connect the sewer pipes to the manhole base. All these elements seal the manhole as one cohesive unit, virtually eliminating infiltration and H<sub>2</sub>S corrosion, saving space and providing construction efficiency.

**“You can’t do too much better in our industry to prevent I&I from getting into your system than to use monolithic pieces.”**

Matt Winkelman

The manhole base insert is prebuilt at PREDL’s ISO 9001-certified facility, and shipped to a concrete precaster — in this case, NCPA-certified Jensen Precast — who can simply precast then ship the completed base to site instead of building a system from the ground up on site.

“The advantage is in having more assurance of the quality before it’s shipped to the site, and once the manhole base is received at the site, it really does cause more efficiency in construction,” Winkelman says.

Monolithic manhole bases weren’t originally part of the city’s design for the new trunk system, but after a fortuitous call from PREDL, the design team and contractor decided it fit the bill.



“There were a number of community factors and potential public impacts that were also to be considered ... and I’d say having the manholes designed as they were, especially with the fiberglass-reinforced base inserts, helped speed construction along. It kept things efficient,” Winkelman says. “Everyone was eager to see the benefits come to life.”

## A NEW LEAF

The project stemmed from a collections system analysis in the early 2000s. It showed a number of hydraulic deficiencies, I&I included, that necessitated infrastructure growth. Rohnert Park began planning for the new trunk sewer using traditional construction methods.

“I&I was prevalent enough that it had to be part of the solution ... to convey those peak flows from I&I and to accommodate for growth,” Winkelman says. “Not wanting this new infrastructure, these new assets, to eventually turn into the same concerns that they have with their older infrastructure. The city wanted a longer design life for the new trunk sewer, including their manholes, and they wanted the manholes and pipelines to be as watertight as they could reasonably get them.

“This being a client of ours that has set a very high standard for quality of construction materials ... in keeping I&I out of their critical assets and this being a new trunk sewer — a big investment — they were very firm on that point.”

Because of these factors, when PREDL called at a critical moment as the design team was reanalyzing manhole parameters for the project, the city decided to go with the fiberglass base insert — despite a slight increase in upfront cost.

“With the PREDL system, we’re able to get a smaller manhole with a larger-diameter pipe, so you have a smaller footprint and the cost savings of using a smaller barrel section,” says Warren Naumann, supervising maintenance worker for sewer and stormwater in Rohnert Park. “The cost (of the insert) was negligible, and the end product was much nicer than the product specified at that time.”

The city was so happy with the inserts that they decided to sole-source the product for the remaining phase 3, which was completed in 2016.

## ULTIMATE PREVENTION

A monolithic system is a seamless, one-piece design. PREDL’s manhole base insert is FRP bonded to HDPE, built out at PREDL’s facility. That insert is sent to a pre-caster, where concrete is poured around the prebuilt shape to fill out the form.

In typical manhole construction, the bench would be built up separately from the pipe and connections and all the pieces combined on site using coatings or CIP liners to mimic the one-piece concept.

“It took some of the guesswork out, and it took some of the effort out of the field and put the quality control into the shop,” Winkelman says. “That’s a unique aspect of these monolithic systems — the ability to create a shape that’s monolithic, that can be quality controlled in a shop, reviewed through shop drawings, and then brought out to the field and be ready to go.”

The project used bell and spigot connections, but Winkelman says the base inserts can be designed to pretty much any shape to fit the system.

Construction on phase 3 concluded in 2016, and a year later, the city has only good things to say.

“The whole process went very well,” Naumann says. “A couple of the engineers/contractors who I’ve talked to say it’s the best system they’ve ever seen.” **I&I**



The Rohnert Park sewer expansion project called for open-cut construction, with the use of monolithic base inserts in the manholes.



The manholes are designed to have a continuous liner from the base up through the top. Spark testing is used to identify any holes in the liner that require repair.



A small-diameter drop connection in the manhole, where the fiberglass base insert was designed to convey flow from the drop to the main channel.

# ST. LOUIS GETS TO THE SOURCE

Monitoring, modeling and budgeting help Metropolitan Sewer District reduce the flow

By Jim Force



**H**ow do you budget for inflow and infiltration? Not an easy question to answer because I&I is linked to so many other issues, including precipitation, flooding, customer connections, and age and condition of sewer lines.

Ultimately, utilities need to consider separating combined sewers, stemming the flow at the source, or expanding sewer and treatment systems to handle increased flows. However, each of those costs money, requires detailed planning, and can take years to complete.

Although the Metropolitan St. Louis (Missouri) Sewer District is larger than most at 525 square miles and with more than 9,000 miles of pipe in its collections system, its current program to combat I&I and prevent overflows features several best management practices.

Rich Unverferth, director of engineering, recently outlined how the Metropolitan St. Louis Sewer District is tightening up its system.

**I&I: How did you develop your plan to address I&I issues?**

**Unverferth:** System characterization, monitoring and modeling formed the basis for our entire capital program to meet our consent decree. We performed smoke testing and dye testing. We used flowmeters and rainfall gauges to see how our system responded to wet-weather events, and we transmitted the data back into models for our sewer system.

At the same time, we were cleaning our system extensively, using CCTV to identify the sources of I&I. We used the data to develop future operations and maintenance activity within our asset management program.

**I&I: What did the monitoring and modeling reveal about I&I?**

**Unverferth:** Within the city, sewers are combined; and outside the city, they are separated. However, in the fringe areas in between, we discovered a lot of cross connections, downspouts and yard drains getting into the sanitary-only sewer system. We spend a lot of time disconnecting downspouts and drains and using CIPP to line sewer mains and lateral lines.

**“We spend a lot of time disconnecting downspouts and drains and using CIPP to line sewer mains and lateral lines.”**

Rich Unverferth

Frank Coleman, Gregg Hall and Dan Kateman (from left) of the Metropolitan St. Louis Sewer District lower a sectional liner from Infrastructure Repair Systems into a sewer line to make a point repair.



CLOCKWISE, FROM TOP LEFT: Frank Coleman lowers a camera into a sewer for a prelining inspection in Ballwin, Missouri; workers position a piece of the new Maline Creek Storage Facility, a project aimed at reducing wet weather overflows; a tunnel boring machine is lowered into a 30-foot shaft on the Upper Maline Trunk Sanitary Relief project. The project will provide wet weather storage capacity to reduce overflows.

**I&I: What about the bottom line? What is your budget, and how has the program affected rates?**

**Unverferth:** The total cost of our capital project as outlined in 2012 is \$4.7 billion. On average, we're now spending close to \$60 million per year on I&I, and 99.99 percent comes from ratepayers.

We take the \$4.7 billion and divide it into four-year buckets. Every four years, we meet with our rate commission and lay out our program. Then, they decide how to fund the projects — whether through rates or bond issues. We monitor our rates, which are in line with other large metro

Smoke testing doesn't always reveal everything. When we inspected homes, we found other connections. We would walk around the house, identifying potential connections from downspouts and drains from patios and driveways. Then, we'd validate it with a dye test, try to estimate the amount of water getting into the system, and plug that information back into the model. We'd notify the homeowner and offer to pay for the disconnection as part of an Metropolitan St. Louis Sewer District project — give them the option to disconnect on their own at the district's expense — or if they were not interested, we would let them know that it would still be required later on, but they might have to pay for it themselves.

**I&I: How did customers react to this program?**

**Unverferth:** This approach — one-on-one communications — really marked a change in our customer relationships. We're still putting resources in place to support that. We have a universe of 104,000 connections, and we're getting good participation. We'll probably inspect 110,000 to 130,000 homes and ultimately disconnect a quarter of those. We want to stop all cross connections at some point and get that flow off the system.

districts. Rates are currently around \$50 to \$60 per month. It's a very public process, and we don't shy away one bit from discussing the budget with ratepayers.

We also maintain a special Infrastructure Repair Fund to address roots or collapsed lines. We set aside about \$5 million each year for that.

**I&I: What are some of the lessons you've learned through this process?**

**Unverferth:** One of several things we've learned is that lining the main-line sewer will not prevent all stormwater from entering the system. Water tends to travel alongside the rehabilitated sewer line and enter the line at a connection point. We've used CIPP top-hat sleeves to prevent that.

The other lesson is that cleaning, inspecting and smoke testing to identify sources of I&I might not catch everything. **I&I**



# Shelter From the Storm

**Sweet Home uses modeling and inspection data to target inflow and infiltration sources and reduce excess treatment demand**

STORY Dan Heim | PHOTOS Peter Krupp

**W**hen it rained in Sweet Home, Oregon, flow to the local treatment plant could reach 22 times dry-weather flow.

Sweet Home is nestled in central Willamette Valley, about 100 miles south of Portland, near the foothills of the Cascade Range. The utility serves around 3,200 customers with an 8.5-square-mile service area, 64 miles of pipe, and 1,020 manholes. And they get plenty of rain — some 45 inches per year on average.

I&I was a huge problem for the aging collections system, often overwhelming the treatment plant during peak wet-weather events, but the utility has reduced I&I significantly with smart planning and coordinated rehabilitation efforts.

“We knew we had a real problem with I&I, so starting in 2001, we embarked on a four-phase plan to solve that problem,” says Dominic Valloni, former engineering technician, who is now a crew chief for the Streets and Parks Department.

The city formulated a plan to solve their wastewater issues with input from the collections crew and engineering department, and guided by Rob Lee, P.E., an engineer with Murraysmith who was with Brown and Caldwell at the time. Lee says that led to a long-term program to assist with the city’s efforts to mitigate I&I.

## **GETTING STARTED**

Phase 1 of their plan involved flow monitoring, smoke testing and video inspection of the pipes. The city also asked Brown and Caldwell to build a hydrologic model of their system so they could predict problems and focus their resources. The result was a multiphase I&I abatement program. Flow monitoring after each phase drove analysis and helped fine-tune the program.

High groundwater levels and natural springs in the area exacerbated I&I problems, especially in winter, and made trenching or excavation difficult at best. There are also many trees in the Sweet Home environs, and root intrusion further contributed to I&I.



Crew chief Doug Latham (left) and maintenance worker Dean LeBret help bring a coworker aboveground after performing maintenance in the sewer line.

**“We knew we had a real problem with I&I, so starting in 2001, we embarked on a four-phase plan to solve that problem.”**

Dominic Valloni



Engineer Rob Lee (left) and Sweet Home Streets and Parks Department crew chief Dominic Valloni review sewer plans during phase 4 of the city's I&I project.

**UTILITY:**  
SWEET HOME, OREGON

**PROJECT:**  
Four-phase I&I abatement program

**RESULT:**  
Approximately 5 mgd reduction in wet-weather flow

**COST:**  
\$17 million

Finally, their aging collections system had pipes dating back to 1938, composed mostly of concrete. That pipe was rapidly deteriorating, and much of it had already reached the end of its service life.

Two additional phases of design and construction occurred. At the start of the most recent phase 4 project, flow to the treatment plant at times reached 15 mgd over what it could handle.

By the end of the phase 4 project in 2012, projected peak flows had been reduced to a few million gallons over the plant's 7 mgd treatment capacity. While the continued deterioration of aging pipes has created new sources of I&I, the utility has made great strides in tightening up its system.

**EARLY PHASES**

Phases 1 and 2 of the city's program began in the early 2000s. Smoke testing revealed a number of cross connections between storm sewers and private roof drains. These were disconnected early on by in-house staff.

Rehabilitation used a number of technologies including open-cut replacement, cured-in-place pipe and pipe bursting. Additionally, the type of work



Valloni (left) and crew chief Doug Latham lower a CUES camera into a manhole at the start of an inspection.

varied by sewer basin. In some basins, only mainline sewers were rehabilitated. In others, mainlines and laterals to the property line were rehabilitated, while in others, private-side laterals were addressed.

At this point, Brown and Caldwell conducted another round of flow monitoring and modeling. This allowed the city to determine which methodology was most effective and how much of the collections system required attention.

Modeling results were conclusive: addressing only sewer mains and manholes would result in a 10 percent decrease in I&I during peak weather events, while addressing manholes, sewer mains, and laterals to property lines would yield a 30 percent decrease. If private laterals were included, a 60 to 80 percent reduction in peak I&I was expected.

"The success of the city's program was their willingness to address the private-side laterals," Lee says. "Without that commitment, reduction in I&I would have been much less — and several times more expensive — to get the same results."

These predictions convinced the city to move forward by rehabilitating mains, manholes and laterals as far as possible. Given the limited number of rehabilitation contractors, the city followed Brown and Caldwell's recommendation to allow various rehabilitation techniques to be bid against each other. Pipe bursting was bid against CIPP, and various manhole products were tested in numerous phases. The result was greater competition and lower bid prices, with contract documents emphasizing quality.

**MAKING PROGRESS**

During the first three phases of work, Sweet Home experimented with the gamut of products for manholes from various manufacturers: polyurea, several spray-on products, fiber-reinforced cementitious compounds, and CIPP manhole liners. By phase 4 they had settled on an epoxy product manufactured by Epoxytec.

The city uses PVC for open-cut replacement of mains and laterals, but pipe bursting with HDPE is their preferred method for rehabilitation. "We found that if you can burst a pipe with HDPE, it is the best way to go," Valloni says.

Sweet Home wrapped up phase 4 of its I&I plan in 2013. With that, they had already gotten most of the low-hanging fruit.

Lee says the city has been monitoring flows during all phases of their program to see what really works, including an extensive round of hydrological modeling after completion of phase 4 to determine whether it would be better to throw resources at treatment plant capacity upgrades or collections system upgrades. “We really need to look at the balance there to get the most bang for our buck,” he says.

While originally a four-phase plan, phase 5 is now imminent and is expected to focus on improvements to the treatment plant: increasing size and capacity with probable technology upgrades for increased efficiency. The city has put phase 5 out to bid with engineering firms, and though it is the final phase of this specific project, it’s not the end of I&I for Sweet Home.

“They’ll continue looking for other I&I sources. That means continuing camera inspections and staying involved with controlling inflow sources,” Lee says. “We’ve done some rain gardens and green streets improvements, but the focus continues to be the deteriorating collections system.”



Dale Jarvis from subcontractor K&R Plumbing installs a new Epoxytec manhole liner.

PHOTOS COURTESY OF DOMINIC VALLONI

**“The success of the city’s program was their willingness to address the private-side laterals. Without that commitment, reduction in I&I would have been much less — and several times more expensive — to get the same results.”** Rob Lee, P.E.

### LESSONS LEARNED

Significant I&I reductions are proof of the value of Sweet Home’s approach to system improvement.

Lee says the city has already done the bulk of the necessary work and should be proud of the progress to date. The phase 5 treatment capacity

upgrades and continued annual focus on the collections system should put Sweet Home in total compliance with permits.

“They have been creative in obtaining funds for this effort, and the City Council has been extremely supportive,” Lee says. “They realize this is a process. ... You can’t do it all in one fell swoop.

“And the city is funding this work the right way. Instead of slapping customers with a 40 percent rate increase in one shot, gradual and consistent rate increases compatible with future planning went a long way toward preventing customer backlash.”

Valloni notes that the city has spent close to \$17 million through all their I&I reduction projects, which is a huge amount of money for a city its size. “Much of our funding has come through DEQ and a few federal grants. The rest of it is just good planning and overall support from the city. We need to maintain the mentality that we’re not done, and the city has supported us in that respect.”

“One final thing I’d like to emphasize is the importance of knowing your system, whether by monitoring, modeling or inspection,” Valloni concludes. “Utilizing that information when planning projects has been critical to our success.” **I&I**



K&R Plumbing employees Brandon Moore (left) and Steve Roberts guide 8-inch HDPE pipe into a pipe bursting machine.

PHOTOS COURTESY OF DOMINIC VALLONI

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The Toms River installation crew prepares a Quick-Lock repair sleeve for installation in a sewer main.

# EVERY LITTLE BIT COUNTS

## Repair sleeves tighten up Toms River system without excavation or confined-space work

By Angus Stocking

The Toms River (New Jersey) Municipal Utilities Authority saved \$1 million in treatment costs in 2016 thanks to an aggressive program to reduce inflow and infiltration.

Toms River, a township in New Jersey (population 91,000), has consistently been ranked as one of the safest places to live in the entire U.S., and that attention to the basic needs of its citizens extends to sewer infrastructure.

Toms River is now at the point where most of the obvious, easily fixed sources of I&I have been addressed, and the authority is looking for ways to make further reductions.

“Every little bit counts when it comes to infiltration,” says Rich Sistad, Toms River Municipal Utilities Authority rehabilitation foreman. “I’ve been keeping a folder for several years, filled with known leaks that were too expensive to get to because they would require digging and trenching in busy areas. We’ve tried different spot repair methods in the past, like short sections of CIPP, but most of them were a hassle to install and didn’t work well. But this year, things are different — we finally have a solution that is quick and easy to install, and we’ve been able to repair up to seven leaks in a single day. It’s really making a difference.”

### SMALL INVESTMENT

In early 2017, the Toms River Municipal Utilities Authority became the first public works agency in its region to use the Quick-Lock (Pipeline Renewal Technologies) point repair solution. Quick-Lock is a stainless steel sleeve



**“The rep came with all the equipment needed. We bought one of the sleeves, and he installed it into a section of clear PVC pipe while we watched — it was impressive.”**

Rich Sistad

that is positioned in pipelines on a packer (a wheeled pneumatic bladder) pushed by any inspection crawler and then expanded with the packer so that it locks into place and permanently seals isolated leaks.

Sistad first heard of the solution at a trade show and arranged for a demonstration. “I thought it was interesting and promising, so we decided to take a look,” he explains. “The rep came with all the equipment needed. We bought one of the sleeves, and he installed it into a section of clear PVC pipe while we watched — it was impressive.”

After the demonstration, Sistad made a small investment in the necessary installation equipment: two packers, one suited for 6- to 8-inch lines and the other for 10- to 16-inch lines, as well as a dozen of the sleeves for immediate use. He’s since installed several dozen, orders 20 to 30 at a time in various sizes, and keeps them in stock for rapid deployment.

### EASY INSTALLATION

The Toms River Municipal Utilities Authority uses a four-man crew for Quick-Lock installation, usually accompanied by a two-man jetting truck crew. “Installation is a simple process, but you do have to get the pipes clean before installation,” Sistad explains. “Because it’s a rigid sleeve, any rocks or gravel in the pipe can prevent sealing.” In addition to jetting, pipes are usually inspected with CCTV before insertion.

Pipes needing repair are identified using the authority’s extensive CCTV archive and records Sistad has kept. “We have an aggressive TV program, and our engineer watches a lot of the video and makes recommendations,”



A crawler pushes the packer loaded with a repair sleeve into a sewer main for repair.





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he explains. "And also, we have a backlog of known issues that I've been keeping track of, and now, we can finally get to them — it's a good feeling."

All Quick-Lock installations are inspected immediately after insertion, and Sistad has yet to observe any failures. Most are focused on classic spot or point repairs — isolated leaks caused by roots, aging pipeline or, especially, construction damage.

"A lot of the holes we see were probably caused by digging or backhoe work during construction, and sometimes when people break things, they don't tell anyone," Sistad says. "Years later, when we notice it, the area is built up with utilities everywhere, and digging up the pipe is expensive and time-consuming."

On occasion, though, the stainless steel sleeves are used to repair leaks that are scheduled for end-to-end CIPP rehabilitation because the Toms River Municipal Utilities Authority engineer believes they are effective at stopping gushing infiltration, which can otherwise cause CIPP installation to fail. It helps that the repair sleeves are low profile when installed and don't impede CIPP work or significantly impact the pipe's carrying capacity.

### BETTER THAN DIGGING

Quick-Lock sleeves come in several sizes and two basic styles — with a single beveled end or with both ends beveled. The twin-beveled sleeves are used for most spot repairs where line breaks are relatively isolated and small, as in construction-caused punctures. The unbeveled sleeves can be butted together in chains to rehabilitate longer sections of pipe. "We have a few infiltration sources that are the result of longitudinal cracks," Sistad explains. "We just ordered some of the single-beveled sleeves for these repairs and will be installing them in the next couple of weeks."

"It's so much better than digging: faster, easier, and safer," he adds. "We don't have to have our guys working around backhoes, don't have to disrupt traffic or get near utilities, and our confined-space entry is greatly reduced."



A crew member monitors air pressure to the packer while installing a Quick-Lock repair sleeve.

Basically, there's just no comparison to digging up pipe. We can just pop these in, and they work."

Quick-Lock is a relatively new trenchless repair solution, and Toms River is one of the first agencies in New Jersey to commit to a self-install program. They're not entirely alone — Franklin Township Sewerage Authority in eastern New Jersey has been self-installing Quick-Lock sleeves since 2016. But Sistad is comfortable with the investment in innovation.

"We're the leaders around here, I guess. And that's fine because we like to be self-sufficient. I see us continuing with this program without a doubt. After all, I still have 50 to 60 known leaks in my folder." **I&I**

**PIPES** By Craig Mandli

## LINER SYSTEM EMPLOYED IN BRICK MANHOLE RESTORATION

**PROBLEM:**

A brick manhole in Florida had almost a complete loss of mortar and was in need of restoration due to corrosion from hydrogen sulfide.

**SOLUTION:**

Carylon (Bio-Nomic Services) contacted **Primeline Products**, an authorized distributor of **CLADLINER products**, to complete the project. To begin, the crew ensured that all leaks and water flow had ceased and then proceeded to prep the manhole. CLADLINER was spray-applied and back-troweled over. To address extreme deterioration of the bottom portion of the manhole, CLADRESTORE was applied as a resurfacer.

The industrial-grade, early high-strength, high-density cementitious mortar is an excellent rebuilding/restoration mortar that's suitable for aggressive environments. It has 250 times the chemical resistance of calcium aluminate and the simplicity of a cementitious liner with the performance of a high-build epoxy liner. It can be effectively used as a resurfacer and liner in a single, simple application and can be used in wet, humid conditions.

**Result:** A final topcoat of CLADLINER was applied, the structure was closed, and the material cured to deliver a long service cycle protecting against inflow and infiltration and the hydrogen sulfide environment for years to come. It allowed the city to repair rather than replace this brick manhole, saving time and money.

877-708-2523; [www.cladliner.com](http://www.cladliner.com)



## RESERVOIR PRESENTS CHALLENGES TO PIPE REPAIR PROJECT

**PROBLEM:**

Tomhannock Reservoir in New York is over 5 miles long and holds 12.3 billion gallons when full. Parts of the reservoir's earth-filled dam date back to 1900, and being the only water source for the nearby city of Troy, draining the reservoir for repairs is nearly impossible.

In early 2013, the dam's bottom outlet was failing. The 310-foot-by-60-inch riveted steel pipe was leaking and threatening collapse. Without access from the reservoir side, all work would have to be done from the diffuser chamber — a small space about 4.5 feet wide, 5 feet high and 12 feet long.

**SOLUTION:**

Staging constraints led Ryan Arold, vice president of trenchless at Arold Construction, to recommend **CentriPipe** from **AP/M Permaform** — a centrifugally cast concrete pipe technology that repairs failing pipe by inserting a spincaster into a pipe to spray thin layers of high-strength cementitious grout onto the pipe interior. Arold Construction set up the spincaster's withdrawal winch in the diffusion chamber and ran in power, air, and concrete hoses from outside the dam and through the 30-inch diffusion pipes. Substantial scaffolding was built to provide safe access to the outlets 10 feet above the ground. Dewatering was accomplished by slowing leaks with hydraulic cement repairs and installing a sandbag and poly sheet cofferdam to hold back water for about five hours.

**Result:** The design called for a 1-inch application of PL-8000, the high-strength grout manufactured by AP/M Permaform. However, a little over 1 1/2 inches was applied in a total of five passes to cover the thick bolt heads completely and ensure a long-lasting, watertight, structurally sound rehabilitated pipe.

800-662-6465; [www.permaform.net](http://www.permaform.net)

## CUSTOM CURB INLET RISERS SAVE TIME ON MILL AND OVERLAY

### PROBLEM:

Rowe Construction was contracted to perform a mill and overlay of a 3-mile stretch of U.S. Highway 51 near Bloomington, Illinois.

“The curb and gutter area was a little different,” says Ben Donovan, superintendent with Rowe Construction. “The Illinois Department of Transportation wanted a slope, from 2.5 inches at the edge of pavement down to 1 inch in the flow line of the gutter pan. And there were 42 grated curb inlets in this 3-mile stretch.”

### SOLUTION:

An **American Highway Products** representative met with Donovan, and together, they figured out a way to customize the catch basin risers. **Risers** were installed just prior to new paving, and they took one man 10 to 15 minutes per inlet to install. “Most of that time was spent on grate removal,” Donovan says. “Some had been in place for years and were really stuck.”

**Result:** The project was completed in October 2016. When the risers were evaluated later in winter, all were performing well with no failures. “We were able to pave right around them,” Donovan says. “It all worked out really well, and IDOT was happy, too. We’ll certainly be using them again.”

888-272-2397; [www.ahp1.com](http://www.ahp1.com)



## EPOXY COATING USED ON BADLY DETERIORATED MANHOLES

### PROBLEM:

A project in the city of Coquille, Oregon, required the rehabilitation of 15 badly deteriorated 48-inch manholes located in a flood plain that is largely swampland. Most locations were inaccessible for the delivery and utilization of spray equipment.

### SOLUTION:

**Neopoxy International** is the manufacturer of high-strength, corrosion-resistant sprayable and hand-applied NPR-5300 series **epoxy resins**, specifically designed for manhole coatings. Per Neopoxy International’s recommendation, Michels used 3-gallon One-Step KITS of trowelable epoxy resin NPR-5305. The kits are easy to use since both parts of the epoxy system are preloaded in the same container. They don’t require spray equipment, rather just an electric drill with a paint blade and a spatula. Using the specified 250-mil thickness, Michels hand-applied the epoxy to around 80 percent of the work area. The remaining area was sprayed with NPR-5304, another Neopoxy International epoxy product, to a thickness of 250 mils.

**Result:** The epoxy resin was successfully applied by the crew of three on the deteriorated manholes.

510-782-1290; [www.neopoxy.us](http://www.neopoxy.us)



## CHEMICAL GROUT SYSTEM PUTS A STOP TO ACTIVE LEAKS

### PROBLEM:

A municipality in Texas was in need of a cost-effective way to stop problematic high-volume active leaks in their collections system manholes. In-house crews had the capability to do the work with a chemical grout injection system but needed a system that would provide consistent results.

### SOLUTION:

The crew decided to try **Seal-Tite**, a two-component, fast-acting chemical **grout system** from **Parson Environmental Products**. The team was so impressed, they bought the product in bulk, along with two pneumatic application guns for a solution every time they find a leak.

**Result:** The municipality has a 100 percent success rate stopping active leaks. They continue to stock the product in bulk for quick fixes to a problem that used to cause them a lot of headaches.

800-356-9023; [www.parsonenvironmental.com](http://www.parsonenvironmental.com)

(continued)

PIPES

## DEEP, CENTURY-OLD COMBINED SEWER PIPE REPAIRED WITH MINOR SURFACE DISRUPTION

**PROBLEM:**

The Milwaukee Metropolitan Sewerage District needed a circa-1906 combined sewer overflow pipe cleaned and its concrete repaired to stop groundwater infiltration and to prepare the pipe for use as a diversion overflow tank. With walls varying between 6 and 12 inches thick, it's located 30 to 35 feet below the surface of the busy Hawley Road bridge on Milwaukee's far south side. Near an outfall to the Menomonee River, the pipe is in the flood plain and had developed cracks every 45 to 50 feet from uneven settling of surrounding organic soils. Approximately 120 feet of it contained severe enough damage to require five different types of concrete and epoxy crack repair. The city was looking for a structural solution that would provide 50-year service life from the liner, using trenchless techniques.

**SOLUTION:**

Through constant client communication and the ability to work from original as-built drawings, Spectrum Contracting completed the project from Jan. 21 through May 20, 2016. Spectrum Contracting applied 900-plus mils of **Sprayroq SprayWall** with quick curing time, allowing crews to move fast and the pipeline to be almost immediately returned to service after final site cleanup.

**Result:** Spectrum Contracting achieved the desired inflow and infiltration elimination and extended service life; and they completed the project on time and on budget, despite a myriad of significant safety, environmental, traffic and schedule challenges.  
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## STORMWATER MANAGEMENT TEAM USES TECHNOLOGY TO REMAIN NPDES COMPLIANT

**PROBLEM:**

In July 2015, Department of Public Works Stormwater division in Alpharetta, Georgia, had been awarded a \$29,100 federal Environmental Protection Agency grant to be used for field inspections of 130 miles of stormwater pipeline (7,486 pipes) and 8,344 storm structures and for identifying potentially hazardous conditions. However, the city's decade-old pipeline inspection equipment and software was out-of-date.

The city needed a rugged, steerable camera and transporter with the power and mobility to move around and over obstacles in the pipe. Its software had to provide digital video upload capability so reports including important details could be integrated into the ArcGIS stormwater structure and conveyance database, allowing operators to accurately add information — including PACP attributes — about pipes being inspected.

**SOLUTION:**

After bids and demonstrations, Alpharetta chose a new **pipeline inspection system** from **Trio Vision Technologies**, including the **Cobra Technologies V9** pan-and-tilt zoom camera, a Model 806 steerable crawler, a cable reel and 1,000-foot cable, and Cobra's Asset DMS software.

**Result:** The city remained NPDES compliant, and the thorough inspection and maintenance program has allowed the department to stay out ahead of maintenance needs, including identifying opportunities to use trenchless technologies to avoid opencutting.

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# ELIMINATING ILLEGAL FLOW

## Minnesota city tackles inflow with an innovative sump pump inspection project

By MaryBeth Matzek

Illegal sump pump connections in New Ulm, Minnesota, are a thing of the past.

For the past three summers, the city took on an ambitious project to inspect every residence in the city for illegal connections. Although New Ulm has an ordinance against illegal sump pump hookups to the wastewater system, enforcing the rule has been a big challenge.

Dan O'Connor, the city's wastewater treatment supervisor, solved that challenge by hiring temporary summer workers to go out and check every city residence for illegal connections.

"We were thinking, let's go out there and do this. Let's check for illegal hookups," he says. "It was a city ordinance but never enforced."

The checks revealed about 3 percent of the city's homes had their sump pumps discharging into the sanitary sewer. They were given 60 days to correct the problem and have the home rechecked.

A big rain event in 2013 brought the issue of illegal connections to the forefront after some residents had flooded basements because the system backed up. Pipes were not able to handle the extra stormwater coming from illegal connections, O'Connor says.

"All municipalities deal with I&I issues. We addressed infiltration by carefully inspecting our infrastructure," he says. "After that, it was onto inflow: looking at both sump pumps in residences and eventually roof leaders downtown."

Checking residences for illegal connections, however, is very labor intensive, and O'Connor says the city couldn't afford to pull people off their regular jobs. Three summers ago, the city decided to hire summer help to go out and check every home in the city. O'Connor says the project was modeled after one used by the city of Mankato about 10 years ago.

This summer, the temporary workers finished their checks of the city's homes. They worked 10 a.m. to 7 p.m. — a nontraditional shift in order to catch more residents at home.



New Ulm summer workers Elizabeth Miller and George Smith inspect a home for signs of an illegal sump pump hookup.

**"All municipalities deal with I&I issues. We addressed infiltration by carefully inspecting our infrastructure. After that, it was onto inflow, looking at both sump pumps in residences and eventually roof leaders downtown."**

Dan O'Connor

"Using temporary help is a good way to tackle a big project like this," O'Connor says, adding that two or three college students were hired each summer along with a retiree to work on the project.

Training the temporary inspectors was not too difficult, he adds. The department used videos to show what legal and illegal sump pump connections look like.

Inspecting all the homes in a city of 13,000 can be overwhelming, so

O'Connor came up with a plan that divided the city into 28 zones. The temporary workers went to a select area of homes on a certain day and checked if people were home. If they were, the inspector would ask to come in to check the sump pump or set up a time to come back. If no one was home, a door tag was left instructing homeowners to call and set up an appointment.

"It's similar to the system we use when new water meters are put in," O'Connor says. "You catch some people at home, and others you need to go back to later."

The tag instructs the homeowner to call within 15 days to set up an appointment. If homeowners fail to have the inspection done, a \$50 wastewater surcharge is added to their monthly utility bill. Only a handful of homeowners refused the inspection.



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Homeowners also had the option of hiring a plumber to do the check if they did not want a city worker in their home.

"When people heard about the inspections, many were proactive and got any problems fixed," O'Connor says.

An intensive public relations campaign about illegal sump pump connections and the problems they cause for homeowners and the city's infrastructure was key to making the program a success, O'Connor says.

"We marketed this project as we're trying to protect you and your neighbors by looking for illegal connections that can put a greater strain on the system. Many people don't even realize that what they have is not up to code." **I&I**



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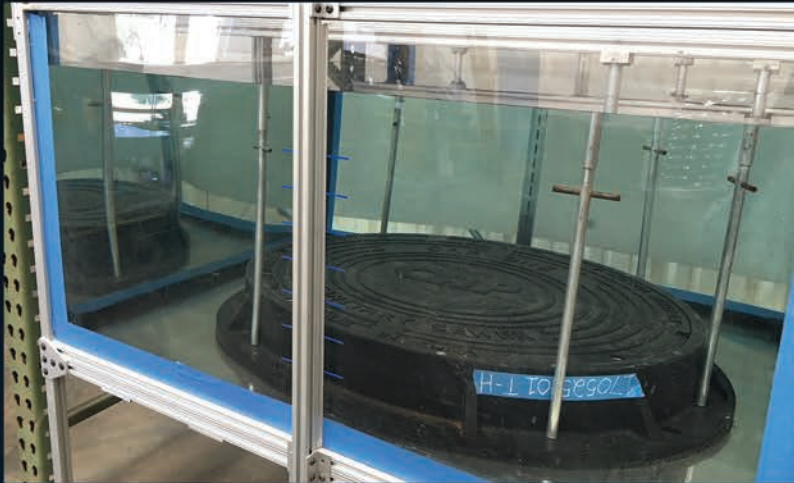
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