



## Strategic, Cost-Effective I&I Reduction in Wisconsin

1 By Angus W. Stocking, L.S. on December 1, 2015 Grouting, Rehabilitation

Our consultants developed an excellent model, and a good analysis of options,” says Wauwatosa, Wis., city engineer Bill Wehrley. “And... the cost estimates ranged from \$34 million to \$80 million.

That’s basically decades of our sewer budget — so we started looking at shorter -term solutions to provide relief to our residents, while we planned long term.”

The good news is, Wauwatosa’s short term solution — chemical grouting of sewer lateral connections to reduce I&I — has worked out so well that long-term efforts may not be needed at all. Strategic chemical grouting, based on innovative testing methods and a pilot project, is likely to save Wauwatosa tens of millions of dollars.

Wauwatosa was responding to the Milwaukee Metropolitan Sewerage District’s (MMSD) Private Property Inflow & Infiltration (PPII) Reduction Program, aimed at reducing I&I from private property in the MMSD’s 28-member communities. In Wauwatosa, one metered sewer district (MSD) produced most of the excess I&I load, which wasn’t a surprise to Wehrley. “There’s about 4,000 homes in this MSD, and 3,200 of them are in Wauwatosa,” he says. “It’s an old area, clay tile laterals, and, during extreme rain events, we know that some residents have sewage backing up in basements. So, quite aside from the District’s program, we knew we had to do something.”

But, aside from the emphasis on private property and relatively modest incentive funds, exactly what to do wasn’t specified by the program. For Wauwatosa, it made sense to investigate and to that end, the City hired consultants Brown and Caldwell (BC) to create a hydraulic model and master plan to address basement backups and for I&I reduction in the MSD.

Ten flow meters were already installed in the MSD and had been in place in July 2010 during two major rain events. “In a way, those rain events were lucky for us,” Wehrley explains. “They caused problems, of course, but they gave us very good baseline data for calibration.”

Using that data and 55 years worth of rain event records, BC created a useful model and came up with the startling mitigation figures mentioned above.

## Looking For Plan B

In search of cost-effective mitigation, Wauwatosa launched a series of cured-in-place pipe (CIPP) lining projects, together with smoke testing, dye flooding, soaker hose testing and CCTV inspection. The dye flooding technique turned out to be a key innovation by Wauwatosa's engineering staff.

"At first we tried using soaker hoses over laterals to simulate a rain event," Wehrley explains. "That worked, but it was slow — it would take hours before we started seeing inflow on the video feed. So we tried flooding the storm sewer instead."

And by flooding, Wehrley means just that — the sewer was plugged downstream of the pilot project area and filled until the entire sewer and associated basins were full to the brim with water dyed bright green. "With this technique, we could see within minutes that laterals underneath the storm sewer were leaking quite a bit, even though they looked fine during dry video inspections," he says.

Wehrley credits consultants R.A. Smith National with excellent implementation of the dye flood testing. "Our staff put together the specifications of what we wanted, and they worked with subcontractors to do the actual plugging and filling. And then they were able to use video information expertly, to tell us where the leaks were and to quantify the amount of infiltration we were dealing with."

## Pilot Project

The pilot project focused on one neighborhood in the MSD, about 77 houses, and was performed in three rounds, with dye water flooding, soaker hose testing and CCTV inspection during and after, and flow meter testing to measure results.

In Round A, laterals were lined with CIPP from the (previously lined) main sanitary sewer to the right of way, about 30 ft.

In Round B, selected laterals were lined from the right of way to just shy of home foundations — laterals were judged to have a leakage rate of 5 gpm or more, based on video of previous flood testing.

In Round C, laterals remaining in the pilot project area (leakage rates of less than 5 gpm) were also lined from the right of way to just shy of home foundations.

Full flow reduction data from the pilot projects is available in Cost-Effective Private Property I&I Reduction (Paper MA-T1-02), a report presented at the North American Society for Trenchless Technology's (NASTT) 2015 No-Dig Show. Wehrley and his engineering staff drew two important conclusions from the pilot project:

- Of the 75 percent total I&I reduction achieved in the pilot area, 70 to 75 percent was due to lining the lateral within the right of way. So, lining worked.
- But, lining was expensive. "Future costs with a larger project were estimated to be \$4,700 to line the lateral just to the property line (approximately 30 ft) and \$6,000 to line the lateral to the house (Approximately 60 ft) (Brown and Caldwell 2013). After reviewing the results of the pilot project and comparing costs, the City of Wauwatosa came to the conclusion that lining the laterals for the sole purpose of infiltration reduction might not be financially sustainable and another solution needed to be found." (Paper MA-T1-02)

Wauwatosa engineers decided to make the most of the fact that significant reduction occurred when lining within the right of way. Given this — and the well-known status of lateral connections as sources of I&I — it made sense to try chemical grouting of the lateral connection and 5 ft past the connection. So a new pilot project was performed — 388 laterals were sealed with acrylamide grout, by contractor Visu-Sewer Inc. A mainline lateral packer was used to extend grout sealing 5 ft up the laterals, and a push packer was used to seal approximately 30 ft of the laterals that terminated in manholes. Results were unequivocally successful. “Based on flow testing, we saw about a 27 percent reduction in the model based on the five-year wastewater recurrence interval,” Wehrley says. And just as important, “In the first CIPP pilot project, we lined 77 houses on one street at a cost of \$414,000. In the grouting pilot project, we sealed 388 lateral connections for \$145,000,” he says.

Based on just these projects, that meant grouting could address 14 times more houses than CIPP, for the same amount of money. Later work refined the figures, but Wehrley confirms that, per house, grouting costs work out to less than a tenth of CIPP costs. “One change we made, after this project, was to grout 10 ft up the lateral rather than 5 ft,” he says. “We learned from contractors that the extra cost was minimal, and we get more value — we’ve done more than a thousand homes now this way.”

Based on data from the pilot projects, Wauwatosa went ahead with several chemical grouting projects that sealed laterals of Wauwatosa residences in the problematic MSD. By June 2014, when a major rain event occurred, about half of the residences had been treated, along with some work on mainlines. “The amount of rain we experienced in June [2014] was similar to the events in July 2010, so we had a good measure of performance,” Wehrley says. “In 2010, we saw 2 ft of surcharge and flooding basements. In 2014, the sanitary sewer was only half full, and we had no complaints from residents.”

BC also did testing and analysis and found that peak flows during rain events were cut from 30 cfs to 25 cfs. That brought Wauwatosa very near compliance, with only half the homes treated — sweet success indeed.

## Not For Every City

Wehrley is quick to point out that conditions in Wauwatosa are uniquely suited for this approach. “Every system is different. Here, we have clay tile laterals running under a storm sewer with mortar joints, and the storm sewer was just 5 ft away from connections. Grouting the lateral connection and 5 — later 10— ft up the connection was very effective for us. But in a newer system with different characteristics, results would have been different.”

Wehrley also emphasizes the importance of chemical grouting contracts. Wauwatosa followed specifications published by the Infiltration Control Grouting Association (ICGA), which pay contractors for every gallon they pump. “I think some prejudice against grouting goes back to the 1980s,” Wehrley says. “At that time, contractors were paid by the joint and it actually cost them money to pump more grout, even when it was needed. In our contracts, we created motivation to pump until refusal, so that leaks and voids are completely filled.”

Since the grouted connections will stay moist, and are well below the area’s frost line, Wehrley expects the repairs to last decades. And so far, continuing flow meter testing confirms that. The City plans to continue with grouting until all homes in the target MSD have been treated and then evaluate results.

“We want to completely end all basement backups, and we’ll need more data to be sure we’ve accomplished that,” Wehrley explains. “But the bottom line is, we’re paying about \$500 per house when grouting, and lining would cost about \$5,000 per house. And, we’re already near compliance, and have improved the situation for our residents. So grouting has been a success for us — we’ve saved millions.”

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