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Cost-Effective Private Property I&I Reduction

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1. ABSTRACT

The focus of the paper is to show the step-by-step progression of a private property I&I (PPII) reduction program in the City of Wauwatosa, WI. The acting Director of Public Works (DPW) for Wauwatosa decided on an investigative approach to determine locations of leaks and the most cost-effective means of eliminating infiltration. The project included soaker hose rain event simulation, lateral lining and chemical grouting.

Firstly, the project included private sewer lateral CCTV investigations, storm sewer dye flooding and flow monitoring to determine baseline flows and lateral leak locations. While televising, and after each phase of the project, soaker-hose rain event simulations were used to create conditions similar to a 3"/hour rain event.

Subsequently, laterals were lined utilizing the LMK "T-liner" system from the main to the right-of-way (ROW). Using the soaker-hose process and dye water flooding, the flows were re-evaluated to quantify the reduction of infiltration (a 70% reduction was achieved). The third phase of the project included lining the remainder of the laterals within close proximity of foundations.

The cost to line the laterals (30' on average) from the sewer main to the ROW was approximately \$5,300 and approximately \$7,100 for the 60' long liner (Excluding testing) (Brown & Caldwell, 2013). These costs take into consideration varied lengths and include approximately \$800 to install a Vac-A-Tee prior to lining. The vast majority of residential sewer laterals in the City of Wauwatosa do not have lateral clean-outs, and an upstream access point was necessary for the lining process. While successfully eliminating the majority of I&I when lining from the main to the ROW, the process was considered to be cost-prohibitive on a large-scale basis. Using the results of the project to optimize reduction on a more cost-effective basis, Wauwatosa decided to utilize chemical grouting to target infiltration at the lateral connection and the first five feet of the lateral. While still in the early stages, from visual inspections alone, chemical grouting is showing an estimated 25% reduction in the private property I&I with an average cost of \$469.49 per lateral. From a cost benefit perspective, the City of Wauwatosa considers the grouting project a huge success.

2. INTRODUCTION

The impetus behind this project came from the development of the 2010 – 2020 Milwaukee Metropolitan Sewerage District's (MMSD) Private Property Inflow & Infiltration (PPII) Reduction Program. The stated purpose of the MMSD program is "to incentivize the municipalities served by the District to partner in the effort to address private property I&I sources". Its 2010 Capital Budget established a project (M03044, I&I Reduction on Private Property, Phase II) to serve as a funding mechanism to municipalities for I&I reduction efforts on private property. As of the adoption of the 2011 Capital Budget, the project provides \$8 million the first year, with subsequent annual budgets projected to provide a total of \$59 million from 2011-2021. Additionally, \$2 million of funds provided for Best Management Practices (BMP) work in the municipalities may be transferred to the PPII program subject to District review. With \$1 million approved in the 2010 Capital Budget, total program funding is projected to be \$62 million (MMSD 2013).

The focus of the case study is to show the step by step progression of a private property I&I reduction pilot program. For the purposes of this case study, the pilot project area of discussion is on Eagle St. between 76th St. and 80th St., in the City of Wauwatosa, WI (See figure 1). At the time, the acting Director of Public Works, and now City Engineer, decided to take an investigative rehabilitation approach. The goal was to determine the locations of the lateral leaks and the most cost-effective means of eliminating a significant percentage of the infiltration. One of the driving forces behind the investigative approach was the MMSD requirement of using the majority of the funds for actual I&I reduction. With this in mind, the funding guidelines required 80% of the monies to be utilized for rehabilitation and only 20% for investigation. (MMSD 2013)

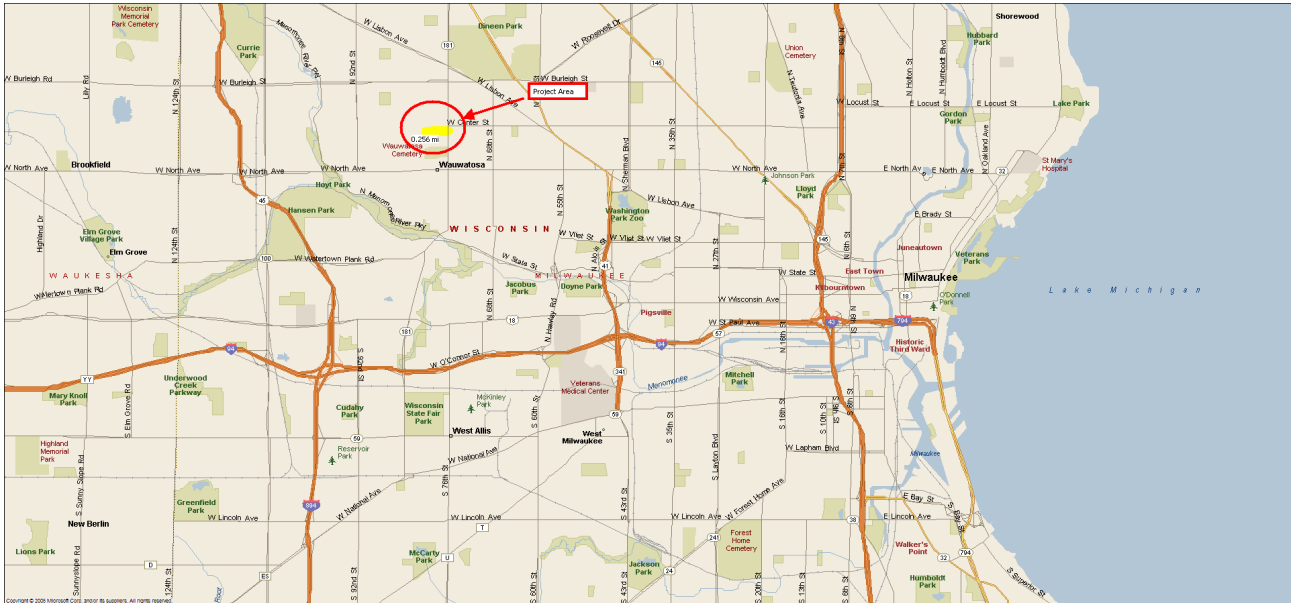


Figure 1. Eagle St. between 76th St. and 80th St., in the City of Wauwatosa, WI.

3. PROJECT BREAKDOWN

The funding guidelines were seen by some of the MMSD member communities as a challenge to developing a successful PPII reduction program. The communities had very little information documenting infiltration in private property sewers, and they were not exactly sure where to begin. Because of this, the City of Wauwatosa approached a targeted sewer basin with known levels of high infiltration. They incorporated lateral CCTV inspections, that would have been incidental to the chosen rehabilitation methods, combined with simulated rain events (Soaker-hose testing (see figure 2 & 4) and storm sewer dye flooding (see figure 3 & 5) to create repeatable conditions that minimized data collection timeframes (flow monitoring). The area studied was near the upstream end of the basin allowing for a fairly accurate measurement of flow changes throughout the various stages of the project, and included 44 private sewer laterals (Brown and Caldwell 2013).



Figure 2. Soaker Hose rain simulation



Figure 3. Storm Sewer dye flooding

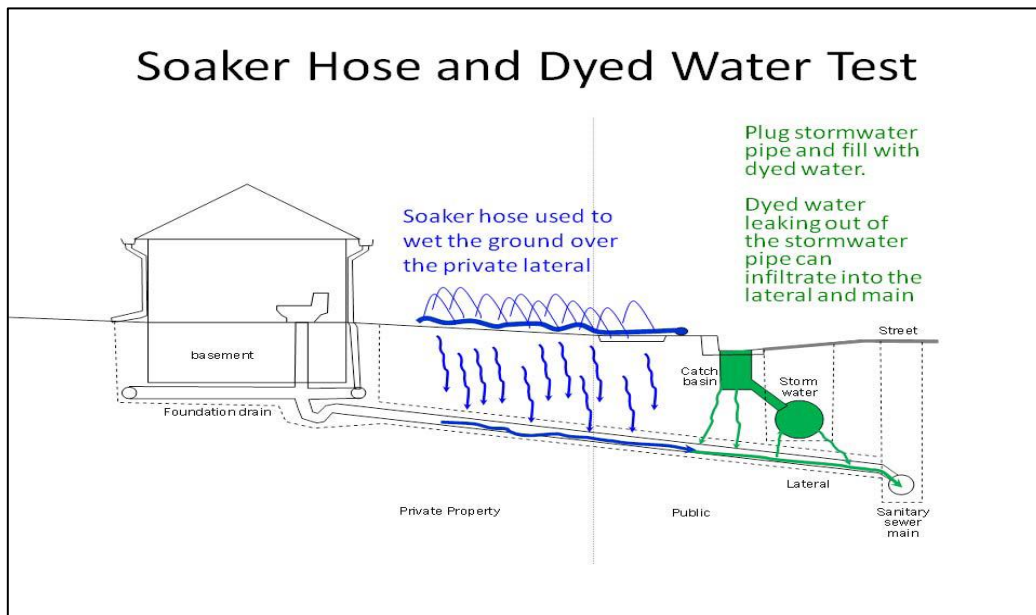


Figure 4. Soaker Hose and Dye Water Test diagram (Brown and Caldwell 2013)

Round 0-Pre-Rehabilitation

This stage of the project included storm sewer dye flooding results from 2011 (See figure 5, 6 & 7), and private sewer lateral CCTV investigations in conjunction with soaker-hose testing and flow monitoring with the use of a V-notch weir flow meter. These methods were used to establish baseline flows and lateral leak locations. While televising, and after each rehabilitation round of the project, soaker-hose rain event simulations and storm sewer dye flooding were used to reproduce conditions similar to that of a 3” per hour rain event (Brown and Caldwell 2013)



Figure 5. 2011 dye flooding project area – Eagle St. (Between 76th St. & 80th St.), Wauwatosa, WI (Brown and Caldwell 2013)



Figure 6. Sewer main & lateral pre dye flooding

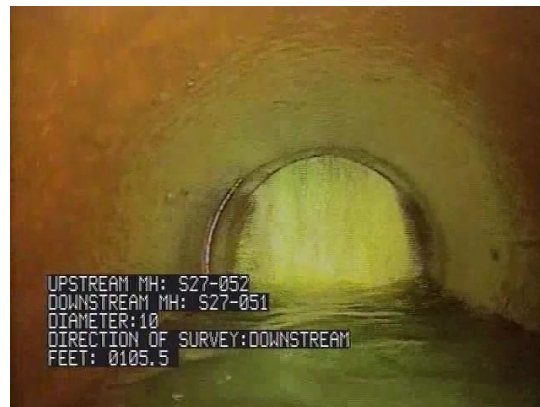


Figure 7. Sewer main & lateral during dye flooding

Round A

During Round A of the project, portions of the laterals were lined from the previously-lined sewer main to the ROW (approximately 30’) utilizing the LMK “T-liner” system. Once lined, the soaker-hose and storm sewer dye flooding processes were again utilized to quantify the reduction in infiltration.

Round B

Round B of the project included lining selected laterals from the ROW to within close proximity of the foundation. The chosen laterals were selected based on subjective leakage rate estimates from the dye water testing that was performed in 2011 (See figure 5). Those laterals that had an estimated leakage rate of 5 gallons

per minute (gpm) or more were placed into the targeted laterals category (Brown and Caldwell 2013). Again, lining was followed by another round of soaker-hose and storm sewer dye flooding.

Round C

The third and final round of the project included lining the remainder of the laterals from the ROW to within close proximity of the foundation. Again, lining was followed by soaker-hose and storm sewer dye flooding. The average pre-rehabilitation lateral I&I rates were in the range of three to four gpm. After all phases of rehabilitation were completed, the PPII rates were reduced to approximately one gpm, for an overall reduction of 75%. Of the 75% total reduction, 70-75% of the infiltration reduction took place from lining the lateral within the ROW (See figure 8).

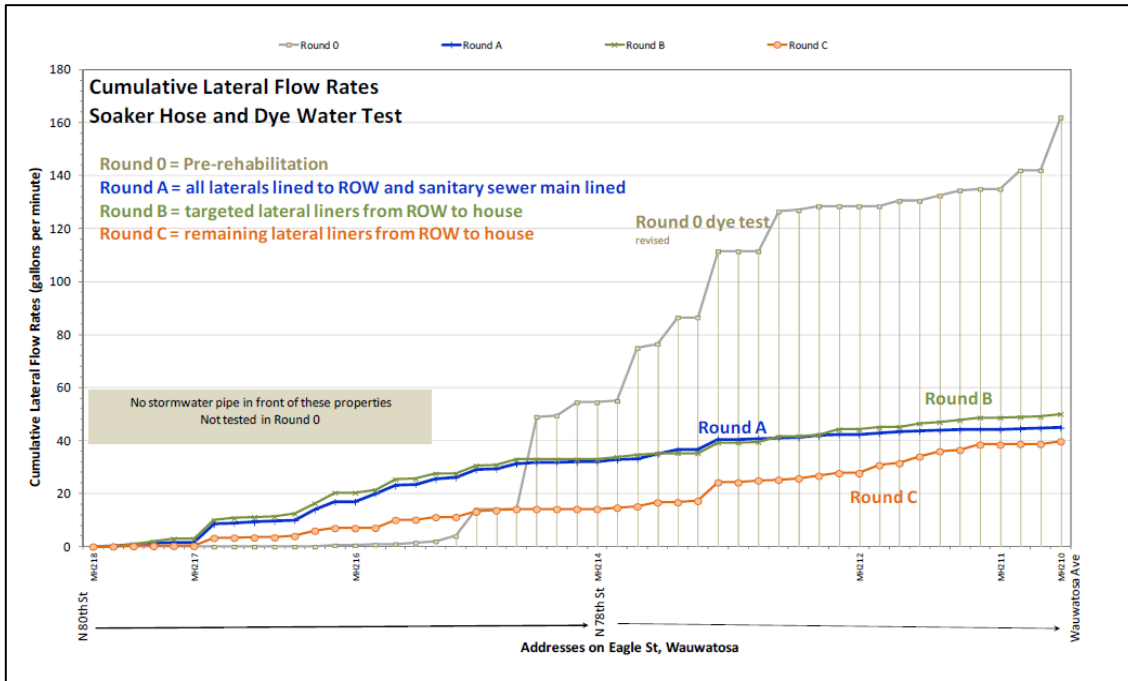


Figure 8. Eagle St., Soaker Hose & Dye Flooding, Cumulative Lateral Flows

5. COST PER LATERAL: LINING

From the onset, it was understood that the reasonably small scope of the PPII pilot project would generate lateral lining prices that would be higher when compared to a project with a larger scope. However, although it was anticipated that some efficiencies could be obtained, the costs were still expected to be significant. Future costs with a larger project were estimated to be \$4,700.00 to line the lateral just to the property line (approximately 30 feet) and \$6,000 to line the lateral to the house (Approximately 60 feet) (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.

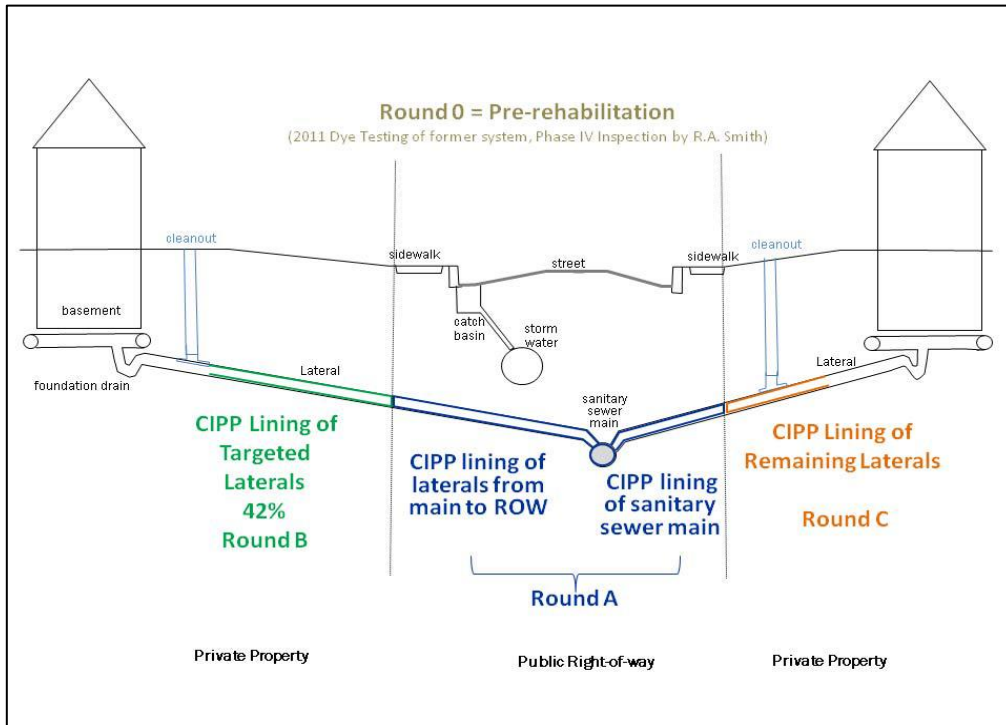


Figure 9. Eagle St. Project Implementation

6. LATERAL GROUTING

With the knowledge that the majority of the infiltration was stopped by sealing the lateral in the ROW (approximately 30'), the City looked at other technologies with a proven track record of infiltration reduction. Not surprisingly, the City decided to move forward with chemical grouting projects that targeted infiltration at the lateral connections, and within only the first five feet of the service lateral. After discussing the project with grouting contractors, the five foot length was chosen because of the availability of equipment, and the likelihood of success in cleaning and grouting a high percentage of laterals in the project area (See Figure 9). Chemical grouting is a low cost/high reward, non-structural solution to I&I problems.

A recent project phase in the City of Wauwatosa was completed in 2014 and targeted 931 laterals in the WA4002 sanitary sewer basin (See Figure 10). The project included the removal of 83 protruding laterals, the removal of roots from within the first ten (10) feet in 56 laterals, and CCTV connection verification in 78 laterals. At the conclusion of the project, 77 of the protruding laterals were removed, 79 laterals required root cutting, and 74 laterals were successfully televised. A combination of hardened deposits, tuberculation, and structural defects prevented cleaning and grouting in 74 of the 931 laterals. The laterals that were unable to be grouted were simply removed from the project and may be addressed at a later date. The preferred material was specified as an Acrylamide grout, with Avanti International's AV-100 or equal being specified. AV-100 is an ultra-low viscosity chemically reactive gel that can permeate anywhere water can travel. Once cured, it creates an effective long-lasting water barrier.

problems with public dollars. With that said, after comparing the cost of lateral lining (approximately 30' to the ROW) to chemical grouting of the lateral connections and the first five feet of the and lateral, for the sole purpose of infiltration reduction, it is easy to understand why the City of Wauwatosa views chemical grouting as a financially sustainable means of eliminating a sizable portion of their overall infiltration volume. Although future phases of the grouting project are still to come, at this stage, chemical grouting of laterals and lateral connections for PPII reduction is considered a major success by the City of Wauwatosa.

REFERENCES

Brown and Caldwell- Job: 141420.308.007 (January 2013) - Milwaukee Metropolitan Sewerage District Private Property Infiltration and Inflow Reduction Program - Wauwatosa Technical Assistance Report.

MMSD Private Property Infiltration and Inflow Reduction Program Information (December 2013) - Guidelines and Procedures.

Contract 13-78 Sanitary Lateral Chemical Grouting-City of Wauwatosa (2013 Bid Tab)

Contract 13-78 Sanitary Lateral Chemical Grouting-City of Wauwatosa-Project billing statement (Visu-Sewer, Inc. August 2014)