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DISPUTING THE MYTH OF INFLOW AND INFILTRATION REMOVAL EFFICIENCY

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ABSTRACT: December 2003, the City of Naperville was placed on the Money Magazine's "Best Places to Live" list. Naperville earned top honors in the magazine's annual list among cities with populations of more than 100,000.

1. INTRODUCTION

Many factors were discussed to provide us with this prestigious honor. One area not mentioned was our undertaking of a massive upgrade to our collection system. Currently we are in the middle of a six-year program of eliminating extraneous flows from our collection system. One of the primary culprits has been residential connections. Public discussions in Naperville initiated a Trenchless Lateral Rehabilitation Program of 2,400 laterals in the older sections of the City.

This paper will discuss the trenchless rehabilitation methods used on the cities collection system as well as the public relation issues. The city's program accomplished inflow and infiltration, root blockage reduction, and restored the integrity of the collection system in a "focus area" with the goal in mind to extend the service life for another one hundred years. We disputed the myth of rehabilitating the mainline and manholes alone will reduce enough of the inflow and infiltration to eliminate Sanitary Sewer Overflows. This myth is widely accepted throughout most of our Nations Communities, probably due to the public relations and efficiencies of lateral lining. In order to obtain the best and longest lasting results, the focus area must include: renewal of the mainline sewer, the service laterals, manhole structures, and backup prevention devices as a whole. Because water migrates and does not know to stop at the property line, the Utility lined the services 18' onto private property (leaving another 18' to the home). An opportunity of sharing this approach and related data helping prevent another community from experiencing our early nightmares is our primary goal in presenting this paper.

In 2004, the City of Naperville had a population of 142,000 with 2,492,160 million feet of sanitary sewer main, 2,851,200' of service lines, 19 lift stations, 11,500 sanitary manholes, and one treatment plant. On October 13, 2001, the city experienced a 4.5" rainfall over a 12-hour period, covering our already saturated grounds. There were approximately 200 reported sanitary sewer backups predominately in nine subdivisions of the city. Before the flooding of 2001, the city had already identified the lateral as a

major contributor of infiltration and was actively renewing laterals using pipe-bursting technology. In addition to pipe bursting the laterals, the city was lining mainlines and rehabilitating manholes, yet still encountered the serious flood occurrence of 2001. Naperville's City Council subsequently directed the Water Distribution and Collection staff to construct an aggressive plan to prevent future sanitary sewer backups. Identifying the need for a detailed plan was only the first step in the process.

The more critical part was determining what repair methods would be used in each of the focus areas. To compound the complexity of the problem, each area had to be evaluated independently to compensate for a wide range of needs within a limited budget while protecting customers from future backups before the rehabilitation was completed.

What was the proactive response by the Utility Department to accomplish this difficult task?

The Utility Department spent almost a year of intense dedication of in-house staff to address the following:

- A) Televising sanitary mains and service lines
- B) Visually inventory manholes
- C) Perform building surveys
- D) Acquire information, and specifics from homeowners from the October 2001 flooding and any previous backups
- E) Investigate current rehab techniques available on sanitary sewer service lines and manholes. The Utility had already been contracting out Cured in Place Pipelining on main lines.
- F) Design a six-year rehabilitation plan of sanitary service lines, sanitary sewer mains, manholes, lift stations, and interceptors. The plan identified the quantities and cost of each renewal process in the focus areas.

The biggest challenge was going to be the rehabilitation of the sanitary sewer service lines. The Utility realized from their past experience and on going Operation and Maintenance and rehabilitation work, that most inflow and infiltration reduction would be accomplished by renewal of the sanitary service lines. Evaluative bidding was an essential part of our program to ensure the city would receive the best process from the most qualified contractor at the best price. Additionally, the presentation will illustrate how the Utility worked side-by-side with the chosen lateral lining contractor Performance Pipelining Inc. of Ottawa, IL. This was and continues to be a true city/contractor partnership that achieved significant inflow and infiltration reduction efficiency.

There was a joint venture between the City and the Contractor where both parties evaluated the specific tasks required to accomplish the directives. The project required an aggressive construction schedule while maintaining high quality rehabilitation results. This project was and continues to be accomplished with little or no disruption to the homeowners at a considerable cost savings over conventional methods of repair. The joint venture resulted in specific duties to be performed by the city and by the contractor.

2. CURRENT TRENCHLESS LATERAL PROGRAM

- The city identified and selected 2,400 laterals to be rehabilitated using a cured in-place lining system over a six-year period.
- A contract was awarded for the first phase, which included 1,200 laterals to be completed in a three-year period for an average cost of \$3,500 and per lateral with average length of 51' per lateral. This price structure was a result of previous working relationships and the joint venture between the city and the contractor through a common goal. Both the city and the contractor worked side-by-side together for a successful project, which was and is being accomplished through mutual cooperation. The contractor backed the materials and workmanship for a ten-year period.
- All lateral linings were installed from the mainline up into the lateral line of distances up to 160' with zero trenching.

- The lining system utilized a one-piece main and lateral cured-in-place lateral lining. The mainline portion being of a cylindrical shape, extending over a 16" long section in the main pipe. The lining was installed remotely from within the mainline pipe as the lateral portion is inverted by air pressure. The lining terminates just before the cleanout, which was installed by city crews.
- The contractor's daily installation rate was a critical factor in meeting the city's aggressive plan. This led to the contractor working in sub-zero temperatures where some days the production rate was one. The contractor utilized a proprietary steam curing technique allowing the daily installation rate to increase to as many as ten laterals rehabilitated in one day.
- The city and the contractor both understood the need for inflow and infiltration, root blockage reduction, and restoring the integrity of the lateral pipe while extending the service life for one-hundred years (which is greater than the original life expectancy of the lateral pipe). The chosen lateral lining method was T-Liner® by LMK Enterprises, Inc, a patented technique for rehabilitating a portion of the main and the lateral through a one-piece cured in-place lining.

3. CITY RESPONSIBILITIES

- The City inspected 1,500 laterals by using a mainline/lateral camera, specifically designed to inspect the mainline as well as the lateral lines with all access being from mainline alone. The sanitary service lines were located by means of an internal sonde, (which is part of the camera inspection unit) to pinpoint the cleanout install location.
- The City installed the cleanouts by using a trenchless cleanout method that utilized vacuum excavation. This in-house installation method costs the city \$719.77 per cleanout. Water Distribution and Collection has installed 900 cleanouts since April 2003, at a total savings of more than \$432,000. This savings would not have been possible if not for the use of vacuum excavation techniques and using a patented process called VAC-A-TEE® in which a cleanout is installed without entering the excavation "hole". The primary advantage of vacuum excavation is the greatly reduced need for backfill materials; spoil disposal, and surface restoration. In fact, the cost of a service lateral cleanout installation using a traditional backhoe excavation is nearly \$1,395.97 in comparison to \$719.77 by vacuum excavation. Equally important is the increased customer satisfaction associated with vacuum excavation, which leaves virtually no visible landscape damage. The typical vacuum-excavated installation creates a two-foot diameter hole that is backfilled with sand and covered with the original sod that is removed and set aside at the beginning of the job.
- The city contracted out the cleaning and rehabilitation of the mainline pipes by lining.
- The city also had to verify service cuts were open 100% so as not to hinder the insertion of lateral linings.
- The city identified active and non-active laterals.
- The city was responsible for customer awareness and satisfaction.

4. CONTRACTORS RESPONSIBILITIES:

- Traffic control
- Flow control
- Permits
- Flushing and stringing the mainline
- Lateral root removal: cleaned, measured, and verifying the lateral was prepared and ready for lining.
- Installed the cured in-place lateral lining
- The contractor was responsible for customer awareness and satisfaction.

5. REHABILITATION OUTCOME:

- In 2002, the focus area delivered average daily flows of 800,000 gallons of wastewater and in 2004 the same focus area delivered an average daily flow of 400,000 gallons of wastewater. The basis of this paper is the overall results for effectively eliminating sanitary sewer backups in a relatively short period of time.
- Manholes, lateral service lines and mainlines have been rehabilitated to serve an additional 50-100 years of life.
- Naperville's program for assisting home owners and protecting against sanitary sewer backups included but was not limited to:
 - A) The City of Naperville 60/40 program offers a cost shared program where the city will pay 60% and the resident pays 40% for "internal" backup prevention devices (i.e. modified overhead sewers or check valves). The City of Naperville has spent a total of \$210,000 since 1981, protecting homeowners from sanitary sewer backups with the 60/40 program. This very cost effective program protects those few people while allowing personnel to work in the higher priority areas.
 - B) The cities program includes the installation of backup prevention stations on the mainline.
 - C) Customer Awareness to the public was an integral part of the city's program and its success.
 - a) Internally to all city workers and city council
 - b) To the public as a whole
 - c) To specific homeowners where the rehabilitation is occurring
- Activity Based Costing (ABC) mythology was used in determining "all related costs" of in-house labor and work. ABC also seeks to identify and account for all costs associated with any given activity. This includes sick leave, vacations, heating of buildings, general overheads, clerical, supervisor time, etc. When a contractor gives you a price, most of this (except for the city's inspections, supervisors, clerical time) is in their price and the cities need to do the same to evaluate outsourcing or hiring more people in-house.

6. POINTS CITIES SHOULD CONSIDER FOR THEIR LINING PROJECTS

- Choose materials for mainline rehabilitation that will be compatible to the materials used for lateral linings.
- Choose a lateral lining system that will provide a verifiable non-leaking connection between the mainline and the lateral lines.
- Ensure the mainline lining contractor has opened each service connection 100%. The city does not need to pay for service openings two times.
- Be sure to identify active versus non-active lateral connections, eliminating a potential source of infiltration if a non-active service is opened.
- Choose a tight fitting, smooth bore mainlining so as not to hinder future lateral lining techniques. This is accomplished by specifying and performing a mandrel test of the mainline pipe prior to rehabilitation of the mainline, if possible. If, the mainline was previously rehabilitated, do not attempt to install lateral linings from the mainline until a mandrel test has been performed ensuring that a proper diameter exists.
- Use evaluative bidding as an essential part of your program to ensure that the city receives the best process from the most qualified contractor and at the best price. Criteria to consider:
 - A. Overall effectiveness and suitability of the product/process in eliminating inflow and infiltration and enhancing structural integrity.
 - B. Overall effectiveness of the installation process in minimizing landscape/pavement damage, disruption of residential life, and incidental cost borne by the city.
 - C. Length, scope, and effectiveness of warranty.
 - D. Manufacturer and installer qualifications and references.

- Data Collection/Information Management. In establishing a detailed rehab plan there is an abundance of information, on going work and a need-to-know where the program is at, at all times. Work orders, spreadsheets, and color-coded maps/indexes are essential. At a glance you can view where you are at in regards to your plan. A subdivision map 24"x24" with lot lines and addresses shown was used in conjunction with color coding in relation to the index below:

849 SINGLE FAMILY RESIDENCES

- No City Sewer Service
- Plumber To Locate
- No Repair Now
- Cast Or PVC Service
- Other Repairs
- Need To Locate
- Located Need To Install Cleanout
- Cleanout Ready For Lining
- Given To LMK For Lining
- LMK Lined Repair Complete