IMPLEMENTING A COST EFFECTIVE INFLOW AND INFILTRATION PROGRAM AND THE BENEFITS ON WATERSHED MANAGEMENT

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Abstract. This paper considers an approach to inflow and infiltration (I/I) correction, as currently adopted by Gwinnett County. Through a project implemented in the Jack's Creek area of Gwinnett County, the paper examines the costs of an I/I program focused on correcting manhole defects and its corresponding impact on the reduction in inflow. The benefits of this more pragmatic approach are compared to the more comprehensive methods involving CCTV, dye testing and smoke testing.

INTRODUCTION

In the Metropolitan North Georgia region, many jurisdictions have already commenced with implementing programs to address the much anticipated federal Capacity Management, Operations and Maintenance (CMOM) regulations. The legislation is targeted at reducing the impact of sanitary sewer overflows from aging sanitary sewer systems, which ultimately improves the watershed water quality. For example, several jurisdictions are already preparing detailed maps showing the existing sanitary sewer systems, developing sewer master plans, and conducting condition assessments of existing sewer systems. One of the key benefits of developing these CMOM-type programs is to reduce the impact of inflow and infiltration (I/I) on the sanitary sewer system, which not only reduces the risk of watershed pollution but can also potentially extend the permitted capacity of the wastewater reclamation facility. As the costs of developing new advanced wastewater treatment systems are highly significant ($10-12 per gallon), I/I correction in sewer systems can beneficially delay major investment in treatment plant expansions.

Many different approaches have been taken to reduce inflow and infiltration (I/I). There are several well documented methods to identify defects with sewer systems such as closed circuit television, smoke testing and dye testing. However, such inspection services can require significant resources and extensive sewer systems can take months to inspect and analyze. Another approach, which is the focus of this paper is to first concentrate on reducing the potential sources of inflow due to manholes and then correct these problems. In older systems, inflow at manholes due to seep holes in manhole covers, loose fitting rims and covers, the use of brick manholes with many open joints in manhole rings, etc. is common and can generate large volumes of stormwater inflow.

A typical manhole inspection program would comprise opening of all manholes in the system and recording the defects, which potentially give rise to inflow. Two-person manhole inspection crews can inspect typically 20-40 manholes per day. In conjunction with the inspections, the reports can be recorded in a database, which can be used to generate work orders. A County can then execute the work orders or use a contractor to rehabilitate the manhole defects. The County can finally determine the impact of the manhole measures on inflow and infiltration, usually by monitoring the flow at the wastewater treatment facility or at a sanitary sewage pumping station.

In this paper, a case study is presented in which the costs and return on investment for I/I programs adopting manhole inspection and repairs is considered.

In the event that the manhole inspection and repair program is not fully effective in reducing I/I impacts, other measures such as smoke testing, dye testing and finally CCTV inspection can be employed in terms of the respective order of priority. This phased approach can reduce the I/I correction costs to the County. This paper also considers the comparative costs and return on investment of more comprehensive I/I programs.

BACKGROUND AND RELATED WORK

Gwinnett County Department of Public Utilities (GCDPU) authorized MACTEC Engineering and Consulting, Inc. (MACTEC) in April 2004 to inspect manholes in the Jack's Creek pump station sewer

collection area. The project objective was to identify manholes in the study area that contribute to inflow and/or infiltration as well as prepare work orders for repair of the defect. The manholes inspected were all the manholes on the gravity sewer system connecting to Jack's Creek Pump Station. Excluded were sewers that are pumped to the Jack's Creek gravity collection area by pump stations. The Jack's Creek sanitary sewer pump station had experienced significant increases in flow rate after rain events. The pump station, having an average dry weather flow of approximately 712,000 gallons per day, pumped an estimated 1,918,000 gallons during the 24 hour period from January 24 to January 25, 2004 after a ¾-inch rainfall event. As a first step to reduce this significant I/I problem, GCDPU decided to inspect all manholes in the gravity sewer system connecting to Jack's Creek Pump Station. A total of 1,123 manholes were inspected in an area with sanitary sewers consisting of a range of sewer sizes up to 24-inches in diameter. The age of the sewers ranged from recently constructed to sewers constructed over 40 years ago.

Manhole inspections were generally conducted from May 11, 2004 to June 29, 2004. A few manhole inspections were conducted in the months of August and September due to access issues which were resolved by GCDPU. Following the completion of manhole inspections, MACTEC entered the inspection reports into an Access™ database. The database was then used to generate work orders for manhole rehabilitation and repairs. Work orders were generated where the need to correct potential sources of inflow was identified.

MACTEC submitted reports to GCDPU detailing the inspections performed, inspection reports and work orders to perform the sewer manhole repairs. GCDPU reviewed the work orders and then either arranged for a Contractor or GCDPU maintenance teams to perform the repairs or manhole rehabilitation.

EXPERIMENTAL DESIGN

In conventional I/I programs, there is frequently a more comprehensive approach to determine the extent of the I/I problem and then devise strategies to reduce the I/I. For example, many County governments carry out video (CCTV) inspection of sewer lines to find potential problems, such as root intrusion, cracked sewer pipes and other potential sources of I/I. This is in addition to manhole inspections, and techniques such as smoke testing and dye testing to locate sources of I/I, such as illicit stormwater connections. Although this approach is very thorough, it can be time consuming and costly to conduct a full program, by comparison with a program which addresses manhole inspection only.

The hypothesis put forward in this case study is that the majority of I/I for a significant sewer network can be attributed to its sewer manholes, rather than I/I associated with sanitary sewer piping and joints. In order to test this hypothesis, this case study was used to look at the reduction in I/I after inspecting and correcting defects in some 1100 manholes in the Jack's Creek area in Gwinnett County. The costs of performing the study and conducting repairs were recorded and compared with the reduction in I/I in order to determine the return on investment, i.e. the unit cost of the program per I/I gallon reduced. This was then compared with the return on investment of more comprehensive programs.

METHODS

After completion of the manhole inspection program in the Jack's Creek watershed area, GCDPU arranged for repairs to be performed of all manhole defects listed in the work orders as being potential sources of I/I. The total costs of the manhole inspections and repairs were carefully documented. After completion of the work, GCDPU made a determination of the I/I following a number of rainfall events.

The data obtained from the program was used to determine the unit costs per manhole for inspection and repairs. The reduction in I/I was used to determine a unit cost in terms of the costs of inspection and repairs per gallon of I/I reduced or saved.

CONCLUSIONS

The results of the inspection of 1123 sewer manholes showed that there were 716 defects which can arise to potential I/I flow. The most common sewer manhole defects were:

- Cover bolts missing (252 or 22.4% of manholes had this defect)
- Covers with improper seal fitting (108 or 9.6% of manholes had this defect)
- Cover frames not properly sealed (71 or 6.3% of frames had this defect)
- Barrel wall-manhole joint not sealed (71 or 6.3% of manholes had this defect)
- Connecting pipe at bottom poorly sealed (67 or 6% of manholes had this defect)
- Barrel wall-lift hole not grouted (36 or 3.2% of manholes had this defect)
- 111 various minor defects were found

The above defects were addressed by a series of work orders. The costs of the sewer inspection and repairs will be presented at the conference in April.

The results of the impact of the I/I reduction after repairs were performed were not available during preparation of this paper but will be presented at the conference in April 2005. This was due to there not being a significant stormwater event since the manhole repairs have been completed.

The author should shortly receive the remaining information from GCDPU in order to complete the Conclusions, Discussion and Recommendations Sections of this paper.

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