AN UPDATE ON LOUISVILLE MSD’s BASEMENT BACKFLOW PREVENTION PROGRAM – 10 YEARS AND 6,700 INSTALLATIONS LATER

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ABSTRACT

Louisville and Jefferson County Metropolitan Sewer District (MSD) is responsible for stormwater and wastewater service for the Louisville, Kentucky metropolitan area. A long-standing problem for MSD has been basement flooding due to sewers that are surcharged from wet weather.

A non-traditional program was developed by MSD as a means to address this problem in a cost effective and timely manner. The Plumbing Modification Program began in 1993 as part of the combined sewer overflow program. The program pays for the installation of plumbing modifications inside of customers’ homes to protect against basement flooding due to wet weather surcharged sewers. Initially established for the combined sewer area only, the program has grown to include the entire combined and sanitary sewer service area. The program has been extremely successful. To date approximately 6,700 installations have been completed with a total construction cost of over $10.5 million.

KEY WORDS

Basement flooding, combined sewer, wet weather surcharged sewer, private property

INTRODUCTION

The Louisville and Jefferson County Metropolitan Sewer District (MSD) was created by Chapter 76 of the Kentucky Revised Statutes in 1946 as a public entity managed by a board of eight. MSD has approximately 600 employees and has complete control of the sanitary sewer, combined sewer and stormwater drainage systems within the majority of Louisville Metropolitan area, which now comprises all of Jefferson County, Kentucky. Refer to Figure 1 for a map of MSD service area.
Due to the recent merger of the City of Louisville and the Jefferson County governments, MSD now works more closely than ever before with the new Louisville Metro government. The Louisville Metro Mayor appoints, with the approval of the Louisville Metro Council, the members to MSD's governing Board. MSD's sanitary sewer and drainage services areas lie within the County which, with a population of 700,300 (2004).

**Figure 1 – Louisville, KY Metropolitan Sewer District Service Area**

The Backflow Prevention Device Installation Program, which has recently been renamed the Plumbing Modification Program is an on-going voluntary program managed by MSD that installs devices inside of customer homes to protect from basement flooding due to wet weather surcharged sewers. The Plumbing Modification Program has been ongoing for thirteen years and as of May 1, 2006, over 6,700 backflow devices have been installed, with a total construction cost of over $10.5 million.

**BACKGROUND**

During the initial development stages of MSD's combined sewer overflow (CSO) Program, MSD recognized that a significant problem within the combined sewer system was basement flooding of customers’ homes during heavy rains. This was because the majority of Louisville homes have gravity basement service and the combined sewer system become surcharged during heavy rains resulting in the basement becoming relief a point for the sewage. This problem was quickly identified as a very high priority for the CSO Program due to the potential health risks of human contact with sewage as well the customer service issue of residents having to deal with property damage associated with the sewer backup. Figure 2 is a presentation of how wet weather surcharged sewers can cause basement flooding.
Although the problem of basement flooding had existing for quite sometime, the impetus of a focused program to deal with basement flooding began in 1992 because of a significant rain event. On Saturday, August 8, 1992, heavy rainstorms dumped nearly six inches of rain in three hours on parts of Louisville. The old combined sanitary and storm sewer system was overwhelmed. Water flooded basements, gushed up through manholes, flooded streets and yards, and even flooded the first floors of houses in one southern Louisville neighborhood.

Engineering evaluations were performed to identify various options to address the basement-flooding problem. The range of options included significant capital projects to enlarge the conveyance and collections system to handle the extreme flows, construction of CSO wet weather storage basins; or the installation of individual devices on a specific customers plumbing to stop the water from entering the home. The option to build capital projects to enlarge the conveyance and collection system and the option to build large storage basins were dismissed as potential solutions to the basement flooding problem. Although likely a key component of the CSO Program, these projects would take many years to design and construct leaving the customers’ basement flooding problem unresolved for many years.

While uncharted territory and full of potential risks, MSD decided to pursue the option of installation of individual plumbing devices on the customer’s property. This decision was made because the homes could be protected quickly and at a more cost-effective manner.

**Figure 2 – Schematic of Surcharged Sewer Causing Basement Flooding**

**POTENTIAL PROGRAM RISKS**

Prior to implementation of a Plumbing Modification Program, MSD identified several risks associated with the installation of devices on customers’ private property. These identified risks included:

- The potential liability associated with performing construction work inside of customer homes;
- The impact to MSDs budget for the overall cost of the Plumbing Modification Program;
- The legal aspect and concerns as a result of spending public dollars on private property improvements;
- Educating customers on the proper operation and maintenance of the devices installed;
Avoiding the need for confined space entry to maintain devices; and,
• Concern regarding on-going maintenance commitments due to customers not taking ownership of the installed devices. No entity can afford to be forever responsible for operation and maintenance of modifications on private property.

Each of these associated and potential risks was discussed among the project team. They were accepted a reasonable risks and were identified to be addressed as part of the implementation steps of the Program.

IMPLEMENTING THE PROGRAM

The Plumbing Modification Program officially began in early 1993 as part of the Combined Sewer Overflow (CSO) Program. The CSO Program engineering team began by developing detailed options for installing devices inside of the customer basements. The initial decision was to install a flap or check valve and a ball valve within the basement floor and in line with the floor drain or basement plumbing prior to connecting to the house main plumbing line. The recommendation to protecting the basement plumbing only, was made to allow a customer to use the plumbing fixtures on the first and second floor if and while the flap valve was closed. A ball valve was installed in series with the check valve as a backup to the flap valve. The customer could manually shut the ball valve if the check valve failed. In addition, the customer could shut the ball valve as a precaution if they were away from their homes for extended period during periods of heavy rain.

Once the scheme of valves was established, laboratory type tests were conducted on the actual brand and model of devices that were available. A testing apparatus was setup in the parking lot of one of the local engineering firms to test the device ability to hold various heads of water and hold the water for extended periods. These tests resulted in selection of a flap valve that had the best overall performance.

Once the device layout, model and type were selected, planning for “roll-out” of the Plumbing Modification Program began. Initially, there was concern that the program would take time to become accepted. Not only was the Plumbing Modification Program new, but MSD did not have the complete trust of all customers after the 1992 flooding. In addition, MSD wanted to make sure they had the resources and time to respond if the demand for the Plumbing Modification Program was high. To deal with these issues, designated areas within the combined sewer area were selected so that time could be spent notifying customers and educating customers about the program. The designated areas were those that had experienced chronic problems with basement backups.

The next step was to develop a process for offering the Plumbing Modification Program. Letters were mailed, door-hangers were distributed, and meetings were held with local politicians to get the word out. An extensive effort was made to communicate with the customer about the Plumbing Modification Program.
PUBLIC EDUCATION AND PLUMBER TRAINING

In addition to an extensive effort to communicate details of the Plumbing Modification Program to customers, MSD also developed a separate component to educate the plumbers. Although the device installations were straightforward modifications to existing household plumbing, MSD took the initiative to review the details of the program with plumbers. This was done to assure that the bids for the installations were competitive, i.e., did not include large contingencies, and so that enough plumbers were available and educated for the upcoming work. The training sessions were held at convenient hours such as weekends and evenings. Also, presentations were made at the union and non-union plumber group meetings.

ACTUAL STEPS OF THE INITIAL PROGRAM

In detail, the steps for the initial Plumbing Modification Program were setup as follows:
1. MSD designated specific areas based upon basement backup complaints logged into the MSD complaint monitoring database.
2. MSD mailed letters to the customer in these predetermined areas offering the program and asking them to call MSD if they were interested. Within the letter, a post card was included which the customer returned requesting to be part of the Plumbing Modification Program.
3. MSD would enter the customer information (address, contact information etc.) into a database, identifying them as participants in the Plumbing Modification Program.
4. Packets of information were then mailed to the customer. Information in the packet included: a summary of the process, specifications for installations to be given to the plumber; a listing of licensed plumbers who attended training; contact information of MSD employees that were available to answer questions.
5. Customer would solicit 3 bids from licensed plumbers. Typically, customers would use those plumbers that were on the list of those trained. These bids were mailed to MSD.
6. MSD would review the bids submitted. Unless there appeared to be unusual circumstances, the bids were reviewed without a visit to the customer’s home.
7. An approval letter was sent to the customer approving the type of installation and the approved amount for the work. The letter did not contain language approving the plumber to be used but simply re-stated a licensed plumber was required.
8. The homeowner contacted the plumber to schedule the work.
9. The plumber would obtain the appropriate permits and perform the work.
10. The plumber would contact the plumbing inspector and MSD for an inspection of the work.
11. Once both inspections were complete, a check made out to both the customer and the plumber was sent. As MSD had not contracted with the plumber, MSD did not make payment directly to the plumber.

PLUMBING CODE CHANGE

As stated previously, MSDs service area contains a significant number of homes that have gravity sewer service to the basement. This situation creates the possibility for basement
flood when the sewers serving the areas are surcharged due to wet weather. So as not to continue to construct new homes that would need retrofitting of Plumbing Modification Program devices, in the late 1990s, MSD worked with local building code officials and State Plumbing code officials to revise plumbing code. The new plumbing code requires that homes with basement elevations below the elevation of the nearest manhole must have an ejector pump installed, pumping the household waste into the sewer so as not creating the opportunity for basement flooding.

FLOOD OF 1997

During the period from Friday, February 28 until Sunday, March 2, 1997, the Louisville metropolitan area experienced its worst flooding since 1964. Over 12 inches of rain fell on Louisville, Jefferson County and much of the Ohio River Basin. The result was the sixth worst Ohio River flood on record and inland flash flooding. An estimated 50,000 structures in Louisville and Jefferson County were damaged by surface flooding or basement flooding from overloaded sewer lines. In all, Louisville and Jefferson County suffered more than $85 million in public and private property losses. This flood was a milestone for the Plumbing Modification Program. As a result of this flood event, the Plumbing Modification Program was opened to MSD customers throughout Jefferson County.

DETAILS OF THE EXISTING PROGRAM

From 1993 until today, the Plumbing Modification Program has undergone many changes. Several steps within the process have been revised to incorporate the lessons learned along the way.

Types of Plumbing Devices Installed

The types of devices installed for Plumbing Modification Program has expanded to include three types of installations. Figure 3 shows the distribution of the various types of devices installed. The Plumbing Modification Program has evolved away from valves to pumps. This was done because of the higher maintenance needs of the valves and the low factor of safety associated with the valves. Basically, if a valve is not properly used or not properly maintained, there exists a probability that the device will fail and create an opportunity for basement flooding to occur. On the other hand, if a pump is not properly used or not properly maintained, it may not function properly but it will not create an opportunity for basement flooding to occur. This is because the elevation of the discharge piping of the pump is higher than the elevation of the wet weather surcharged sewer.
Valve Installations

As stated above, the Plumbing Modification Program has evolved away from the installation of valves. There are some valves still being installed but not as many as during the initial stage of the Plumbing Modification Program. A schematic of a valve installation is shown in figure 4.

Figure 4 – Schematic and Picture of Valve Installation

There have been a significant number of sump pumps installed. Again, there was a progression away from valves to pumps. Sump pumps have been used because the majority of the fixtures requiring protection from backup have been floor drains. Floor drains typically receive flow from groundwater drains and from air conditioning condensation lines. In Kentucky it is legal to plumb a floor drain to a sump pump and discharge on the ground outside of the home. A schematic of a sump pump installation is shown in figure 5.
Figure 5 – Schematic and Picture of Sump Pump Installation

Ejector Pump Installation

As with the increase in number of sump pumps installed, there has been an increase of ejector pumps installed. Ejector pumps are installed to serve basements that have toilet, shower or other sanitary type fixtures. The total number of ejector pump installations has been moderate due to the number of customer homes that have bathroom facilities in their basements.

Figure 6 – Schematic and Picture of Ejector Installation

Cost of Installations

The cost per installation for the initial devices installed was much higher than today. The reason for this decrease in cost is the plumbers understanding and familiarity with the Plumbing Modification Program. No technical or programmatic change has occurred. Initial cost ran in the range of $5,000 per installation. Today’s average cost of installation within the program for ejectors is approximately $2,800.00; for a valve the approximate cost per installation is $2,100 and for sumps pumps the approximate cost per installation is $1,600. Although not documented, it is estimated that the administrative costs for the program per installation is $200.
Revisions to the Process

Over the years, several lessons learned have been incorporated into the process. Some key changes that have been made include:

- The Plumbing Modification Program has taken the direction away from installation of valves to pumps.
- The number of bids required for the customer to submit to MSD has been reduced from three to two. The purpose of the multiple bids was to insure competitiveness but many customers were having problems getting plumbers to respond with written estimates. The result of this change was evaluated and MSD found no increase in cost on average for installations.
- The Plumbing Modification Program has always been a voluntary program. Customers are not required to participate. It has evolved from a program that was by invitation only (designated areas) to a program that was open to the entire service area and now back to a program that is by invitation only. The current criterion for being invited into the program is based upon the established history of an area for having basement flooding problems.

Location and Distribution of Installation

A map showing the locations of the devices installed is shown in Figure 7. Initially the program was rolled out to designated areas within the combined sewer area. The areas identified were selected based upon basement flooding complained. As the program developed, and because it progressed at a pace less than expected, MSD opened it up to the entire combined sewer area. Until 1997, the areas identified were based upon the documented basement flooding complaints.

Figure 7 – Location Map of Installations
SUMMARY AND CONCLUSIONS

Since its inception in 1993, the Plumbing Modification Program has been an extremely successful initiative for MSD. To date approximately 6,700 installations have been completed inside of customer homes. The Program had an increase of installations immediately after the floods that occurred in 1997. Figure 8, shows the number of installations per year.

Figure 8 – Graph of Installations per Year

The Plumbing Modification Program has reduced the potential for human contact with diluted sewage; and has reduced property damage caused by basement flooding. The basement flooding issue, that previously overwhelmed MSDs’ legal department, customer service department and maintenance department, is now very manageable. The Plumbing Modification Program provided a solution using non-traditional means to a problem that may have taken over 25 years to resolve utilizing tradition means. To date, no unusual problems have occurred within the Program. There have been issues but nothing that has caused regret. The basic principle that the Program has operated under has been “keep is simple”. Things will go wrong and you can not prevent them but you can prepare for them.