Detroit Water and Sewerage Department

# Wastewater Master Plan

DWSD Project No. CS-1314

# Review of Footing Drain Disconnection Projects

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Author: CDM

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# Review of Footing Drain Disconnection Projects

## 1. Introduction

Many communities have used traditional engineering based approaches that include providing additional relief sewer capacity and constructing equalization storage to reduce basement flooding problems to address wet weather problems. Besides these traditional approaches, other methods such as disconnection of footing drain connections from the sanitary sewer system have been employed. These alternative approaches have the potential of addressing the root cause of the basement flooding problems that are caused by excessive flows from basement foundation drains.

## 2. Community Reviews

The following peer reviews were performed through contacts with the engineers directly involved in this project. In some cases, the information is from design engineers involved in the work, but in most cases the success of the programs were based on comments from the utility staff who observed the results of the various programs. Since the utility staffers were directly impacted by the success or failure of the different methods chosen to correct the problems, they were often those with the best information on this important element of the review.

A brief description of each of the communities contacted is provided below. More detailed descriptions are included in the tables that follow. Figures 1 and 2 at the end of this document show examples of footing drain disconnection.

1. West Lafayette, Indiana – A basement flooding problem was corrected through footing drain disconnections made in individual private homes using a reimbursement incentive program that involved local plumbing contractors. The overall program was found to be successful in controlling the basement flooding.

2. City of Auburn Hills, Michigan – To address problems of basement flooding and inadequate contract capacity, the City of Auburn Hills has recently undertaken a full-scale footing drain disconnection program. This project includes work in individual homes to change the plumbing and direct the footing drain flow to a new shallow drainage system located along the curb

3. City of Ann Arbor, Michigan – The City of Ann Arbor has recently performed a comprehensive evaluation of the areas in the City that have the most extensive basement flooding problems. The work included pilot installation of footing drain disconnections to direct these flows away from the sanitary collection system and to the storm drainage system.

The City is now proceeding with implementing the footing drain disconnection program on a City-wide basis to over 20,000 homes.

4. Canton Township, Michigan – Using utility staff, Canton Township has installed more than 2,500 sump pumps to address chronic basement flooding and sanitary sewer overflow (SSO) issues. Since the initial installation of these pumps, basement flooding has been alleviated and flow to the sanitary sewer collection system has been reduced. However, there are still about 10,000 homes remaining in the Township that need sump pumps. As a result, SSO issues still have yet to be resolved.

5. Riverview, Michigan – The City of Riverview undertook a complete reconstruction and rehabilitation of their collection system because of its deteriorated condition. Prior to this final solution, a pilot footing drain removal program was found to be unacceptable because of social issues.

# 3. Conclusions

From a review of the available footing drain disconnection efforts; the following conclusions or lessons learned can be formed:

1. Feasibility – Footing drain disconnection on private property can be accomplished cost effectively. It has also been shown to effectively reduce the I/I into the sanitary collection system.
2. Cost – The estimated construction cost per home is on the order of $5,000. The costs of the management of the construction process have not been developed and are specific to the type of contracting method to be used.
3. Public Education – Key to all the successful programs is an active public education process. This starts with homeowner workshops and individual meetings as needed to discuss the process and to provide good information on what is expected.
4. Coordination – Active coordination of the program is needed. This ensures that there are minimal requirements of the homeowners for coordinating this work.
5. Flexibility – Since each home is different and the discharge lines must work with existing utilities, the footing drain process must have the flexibility to adjust to these conditions during the construction process. If this is not done, issues are likely to develop with homeowners.

| Element | Description |
|---|---|
| **Community:** | West Lafayette, Indiana |
| **Demographics:** | Population: 30,000 fulltime plus 35,000 at Purdue University<br>Households: 12,000<br>Customers: 15,000 |
| **Project Area:** | Fully developed area of about 670 homes |
| **Project Issue:** | Basement backup problems caused by excessive inflow/ infiltration. |
| **Findings:** | Inflow/infiltration from basement footing drains were causing basement flooding issues. Different alternatives were evaluated as part of a comprehensive program to correct this problem and resolve the risk of basement flooding. |
| **Recommendations:** | Based on flow projections from footing drains, it was recommended that all basement footing drains in the study area should be disconnected. This disconnection would reduce the risk of basement flooding to acceptable levels and also reduce the operational costs associated with treating this additional wastewater flow. |
| **Implementation:** | The City already had an ordinance in place that does not allow the connection of basement footing drains into the sanitary sewer system. To eliminate the footing drains for homes that were connected, the City decided to reimburse homeowners for the disconnection expense if they undertook the disconnection voluntarily after formal notice of noncompliance. Use of this program limited the City's liability for any of the construction activities on private property.<br>The City worked with local contractors to develop the program. Each resident signed an agreement with the City, which described the terms of the reimbursements, and it released the City from liability that might result from the work. The results of the program were found to be successful because of the reduced risk of basement flooding. Disconnection costs averaged $3,500/building and ranged from $11,678 for construction under a porch to $75 to reroute an existing sump pump. Costs of curbside sewers to convey the discharges from the new sump pumps to an available storm catch basin added about $1,500 per disconnection. |
| **Emergency Response:** | The City had a response that focused on protecting the public by pumping excess sanitary to the storm sewers when it rained using portable pumps. Utility Director stopped this practice. |
| **Flow Information:** | During the footing drain disconnection work, the sump pump discharges were directed to the lawn and curb areas. This gave the residents the opportunity to observe the amount of flow that was directed away from the sanitary sewers. The volume and peak rates of flow were not measured from these discharges. |
| **Sources:** | Bob Molzahn – Camp Dresser & McKee |

| Element | Description |
|---|---|
| **Community:** | Auburn Hills, Michigan |
| **Demographics:** | Population: 20,400<br>Households: 8,400 |
| **Project Area:** | A single residential neighborhood on the south side of the community that discharges to the Evergreen Farmington district of Oakland County. This neighborhood contains about 350 residences. |
| **Project Issue:** | There has been a history of sanitary sewer surcharging and basement backup problems in some neighborhoods within the community. To address this in one neighborhood where there is a significant basement backup problems and also a limitation of the discharge from the district. |
| **Findings:** | While the community understands that there is a significant wet weather issue, the City has not focused on determining the source of the problems through flow monitoring or modeling. City and consultant staff visited the footing disconnection project in West Lafayette, Indiana and concluded that footing drain disconnection had all the attributes needed to deal with their basement flooding and capacity issues. |
| **Recommendations:** | The recommendation was to proceed with the footing drain disconnection program in the neighborhood with the most basement backup issues. |
| **Implementation:** | The City has been working for about 6 months to disconnect homes in the first neighborhood. They have disconnected 150 homes to date. The program is using three plumbing teams to make the disconnections in individual homes. A specialized directional drilling firm is constructing the curb drains to accept the flows from the sump pumps being installed in each home. The connections from each home are also made using boring methods. The drilling and boring methods are used to minimize the impacts on the surface features including concrete and landscaping. The City has had a high degree of success in reducing damage to private property.<br>The City has an employee managing and coordinating the field efforts. This coordinator meets with individual homeowners, maps out the disconnection strategy, coordinates with the plumbing contractors, and makes decisions in the field.<br>It has been determined that the best method for construction of the curb drain system is to locate and uncover the utilities first, determine their elevations, and then develop the plan for installation of the curb drain system. This flexibility has reduced the need to move utilities and has ensured that these utilities are not damaged during the construction project.<br>The City is paying the cost of the construction program. The construction costs have been averaging about $5,000 per home. This includes all of the cost inside and outside of the home. The City is also providing the drilling contractor with the use of a Vactor truck to expose utilities and reduce the impacts on private properties. |
| **Emergency Response:** | Not known |
| **Flow Information:** | The City is performing a coordinated footing drain and curb drain installation program. There has not been flow monitoring to date to quantify the discharges from the installed sump pumps. Monitoring of the sanitary sewers in the areas in the disconnected footing drains is being planned. |
| **Sources:** | City of Auburn Hills |

| Element | Description |
|---|---|
| **Community:** | Ann Arbor, Michigan |
| **Demographics:** | Population: 114,600<br>Households: 45,000 |
| **Project Area:** | Five study areas that have significant basement flooding problems were selected to evaluate different solutions. These areas compose about 5% of the area of the City and about 50% of the basement flooding complaints. The SSO Advisory Task force, composed of homeowners from the study areas, City of Ann Arbor Utilities staff, and independent specialists, guided the work on the project. |
| **Project Issue:** | There has been a history of sanitary sewer surcharging and basement backup problems in some neighborhoods within the community. Past mitigation efforts have not been completely successful. The homeowners that have experienced the problems are calling for a complete solution that does not merely move the problem downstream. There has been a belief that the City has not been responsive to past problems. |
| **Findings:** | Each of the five study areas has detailed investigations into the condition of the collection system, flow monitoring, and model preparation. In addition, flow monitoring of individual house lead flows during storms was performed. The project also performed footing drain disconnections in 11 homes in the five study areas. Other overland flow mitigation was also undertaken.<br>The study estimated that residential footing drains account for between 70% and 90% of the total flows entering the sanitary sewers. The results also showed that the system responds very quickly to storms and that surcharging of the sanitary sewer routinely takes place in the areas studied.<br>The pilot footing drain disconnection work confirmed that the work could be performed on private property to the satisfaction of the homeowners. It also showed that a public education program is needed to make sure that the process is understood and to ensure that the homeowners know the benefits that will result from implementation of the effort. The pilot footing drain disconnection program cost approximately $3,500 per home for work inside the home. The cost for the construction of the sump pump discharge outside the home is estimated to be about $1,500 per home. This results in a total construction cost of approximately $5,000 per home for the footing drain efforts. |
| **Recommendations:** | The recommendations from the SSO Advisory Task force was that the footing drain disconnection program should be undertaken for all homes with connected footing drains. This will ultimately result in about 20,000 homes being disconnected. It is recommended that the Utility pay the cost of the disconnection work, which would ultimately be funded by user fees. It was further recommended that the footing drain disconnection program first be implemented for the homes that had flooded or had the potential for flooding in the five study areas. The next priority was the remaining homes that had historical basement flooding problems. The third priority included the remaining homes in the five study areas followed by the rest of the City. |
| **Implementation:** | The plan for implementation includes prequalifying contractors for both the plumbing efforts in the homes and the construction of the sump pump discharge systems. The plan is to have the construction process managed by a City of Ann Arbor employee with support from a construction manager. This process will work through the different priority areas. Once the sump pump drainage system is complete, the homeowner has 90 days to select a contractor to complete the work. If the homeowner refuses to have a disconnection, funding for the disconnection work will not be provided, and the homeowner is assessed a monthly storm discharge fee. |
| **Emergency Response:** | City has standard response documents and instructions. They have developed claim forms to apply for reimbursement for damages suffered. |
| **Flow Information:** | As part of an SSO investigation for the City of Ann Arbor, almost 20 different residential discharges were monitored under wet weather |

| Element | Description |
|---|---|
| | conditions in September 2000. The monitoring was performed during a period of steady rainfall several hours after heavy rainfall had fallen. During this portion of the storm, the flows generated by monitored homes remained fairly constant, but with significant variability from home to home. The footing drain flows measured ranged between 0 and 3 gpm, with an average of 1.4 gpm. From the available information, it was estimated in these areas that between 70% and 90% of the flow monitored at a downstream flow meter was the result of footing drain sources.<br>This flow and rainfall information was used to estimate the magnitude of flows expected during significant storms that had historically caused surcharging of the sewers. This work established that on average, the peak footing drain flow during large wet weather events would be expected to range between 4 and 7 gpm.<br>For comparison, an analysis performed in the 1960s was also reviewed. This evaluation used flood testing of the area around an Ann Arbor home and showed that footing drain flows could easily exceed 5 gpm. This analysis also demonstrated that the discharge from this flooding of the area around the home, used to simulate discharges from the rooftop, began almost immediately.<br>After the pilot footing drain disconnections were completed, the frequency of operation of the sump pumps was found to vary significantly from home to home. The homeowners reported that the footing drains may discharge as high as 8 to 12 gpm based on operating frequency and nominal pumping capacities. *Note that these pumping rates were based on homeowner observations of operating times and not based on verifiable measurements.* |
| **Sources:** | Pete Perala – City of Ann Arbor<br>Mark TenBroek – Camp Dresser & McKee |

| Element | Description |
|---|---|
| **Community:** | Canton, Michigan |
| **Demographics:** | Population: 73,000<br>Households: 26,800<br>Customers: 12,000 |
| **Project Area:** | Entire City of Canton composed of 26,800 households that include about 12,000 customers. |
| **Project Issue:** | Flows generated within the community exceeded the available capacity of their discharge contract with Wayne County during wet weather periods. The City wanted to identify and remove sources of I/I that were also causing basement flooding in some areas. |
| **Findings:** | Houses in Canton include large developments with very similar construction methods. In most homes, this included foundation footing drains that are connected to the sanitary house lead inside the basement wall. A cleanout with a deep trap that is accessible from the basement floor was present in most houses. |
| **Recommendations:** | The community determined that footing drain flows must be removed to allow the township to operate within its contractual limits with Wayne County, its provider of treatment services. Because most of the homes were installed using the same standards, it was recommended that the footing drain flows generated under wet weather be removed by installing a special sump pump that fits into the footing drain cleanout. |
| **Implementation:** | Of the approximately 12,000 homes in Canton Township, 2,500 have been retrofitted to date as described above because they were at risk of basement flooding and volunteered for the modifications. The Township is continuing to install the systems and hopes to convert all the homes with footing drain connections at some point.<br>To perform the upgrades, a special sump pump is placed into the footing drain cleanout. The pump is located inside the 4" cleanout and trap and the motor extends above the floor. In most cases, no sump is required and no concrete needed to be broken. A special plug is installed in the connection between the footing drain cleanout and the sanitary sewer. This plug allows small amounts of footing drain flow to discharge by gravity into the sanitary collection system in dry weather. When large footing drain flows are generated in wet weather, the hole prevents most of the flow to pass into the collection system. The sump pumps discharges most flow out of the house and onto the lawn area. A small flap valve is installed on this hole to prevent sanitary wastewater from entering the footing drain system. A flood guard backflow protector is installed in each floor drain in the basement to prevent flooding.<br>The costs of installing the sump pumps have been borne by the Township. Township personnel perform the installations, except for the electrical work, which is done by an outside contractor. The costs for the complete installation are approximately $500/home. One problem with the installations is that about 5% of the sump pumps have failed at one time or another after installation. This is because the pumps only run under wet weather conditions and can be inactive for months at a time. Since the homeowner has the responsibility for performing monthly maintenance on the units that include oiling the unit and starting it once per month, these failures are most often attributable to failure of the homeowner to perform this work. |
| **Emergency Response:** | Unknown |
| **Flow Information:** | The sump pump discharges have not been monitored as part of this program. In addition, this installation continues to allow a small amount of the footing drain flows to discharge to the sanitary sewer at all times. This minimizes the nuisance discharges during winter periods. |
| **Sources:** | Tom Casari – City of Canton Township, Michigan |

| Element | Description |
|---|---|
| **Community:** | Riverview, Michigan |
| **Demographics:** | Population: 13,000<br>Households: 5,000<br>Customers: 3,500 |
| **Project Area:** | The entire City of Riverview is composed of 5,000 households with 3,500 customer connections. The area that included a pilot footing drain removal program contained 60 homes. |
| **Project Issue:** | As part of a system-wide wet weather evaluation for the collection system that the City of Riverview discharges to, the flows from the City were evaluated. The wet weather response was compared to the available contract capacity that the City has in the collection and treatment system by virtue of existing contracts. |
| **Findings:** | The existing contracts for the downstream collection and treatment system were not sufficient to accept the dry weather flows from the City of Riverview. Wet weather flows from the community largely exceeded the available capacity of the conveyance and treatment system. |
| **Recommendations:** | The engineer recommended that the only method to achieve compliance with the available contract capacity was to remove all connected footing drain sources in the City. To determine the feasibility of doing this, a 60-home area was piloted for complete removal. |
| **Implementation:** | In the pilot area that was selected, all of the footing drain connections on the homes were disconnected by excavating to the connection between the footing drain and sanitary sewer connection that was made just outside of the foundation wall. The existing footing drain was left in place and connected to the existing sanitary sewer. This sanitary sewer was converted to a part of the stormwater drainage system. New house leads were installed and were connected to new sanitary sewers that were installed on either side of the street. Costs for the work included construction of a new stormwater and sanitary pumping station to handle these flows. The cost of this program was $5,700/home (1994 costs).<br>The pilot program showed that the construction activities on private property were a significant hurdle to citywide implementation. Further work was not performed because of these implementation issues. In its place, an extensive program of sewer lining and sewer replacement was performed and an increase in the City capacity was negotiated with Wayne County. The costs of this program were $12 million for construction and $20 million for capacity improvement, for a total cost per house of $9,000 (1994 costs). |
| **Emergency Response:** | A contact number was established at City Hall for residents to call regarding basement flooding problems. A task force was established through the City Manager and Department of Public Works. |
| **Flow Information:** | Flow monitoring information was not compiled for the flows that were removed. |
| **Sources:** | Tim Hennessey – Hennessey Engineers |

# Figures

Figure 1 is a schematic of a typical sump installed with the footing drain disconnected from the sanitary sewer line. Footing drain flows empty to the sump where a primary and backup pump discharge flows out to a drainage field or storm sewer. Figure 2 is a picture showing what a typical installation looks like. In this case, the backup pump is powered by water pressure in the event of a power outage.

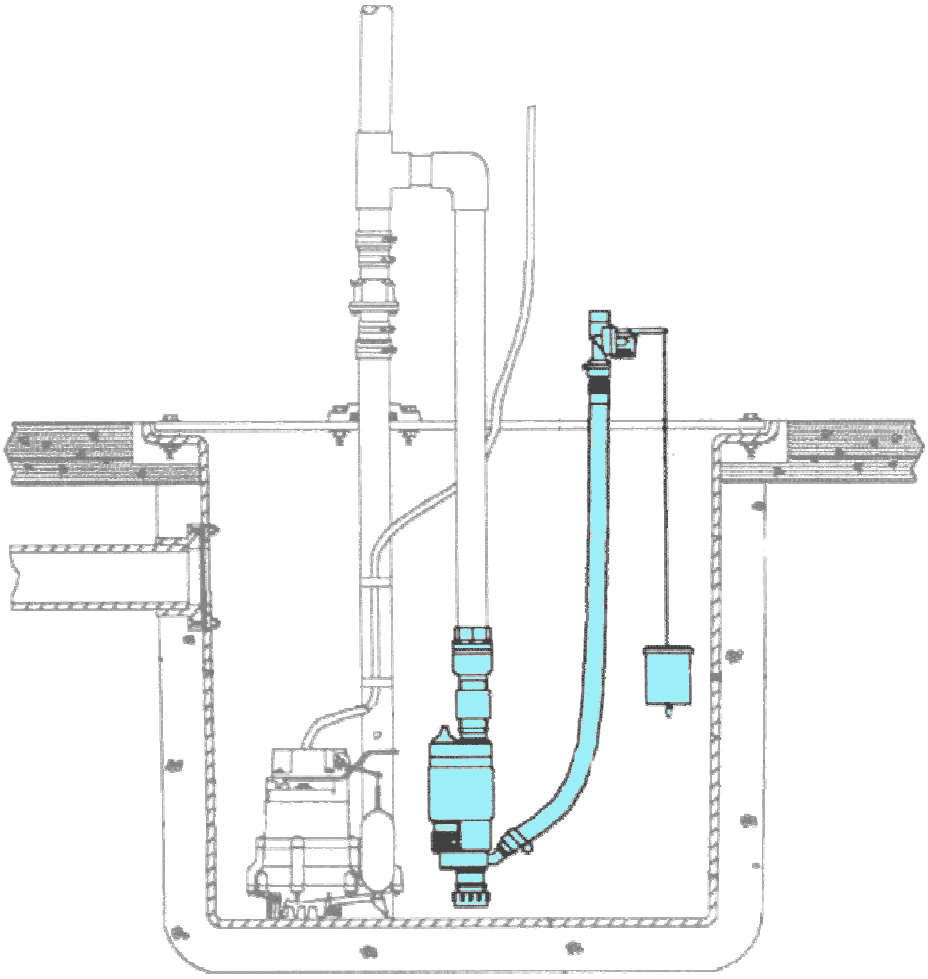

**Figure 1 –Sump Pump Installation Schematic**



**Figure 2 –Sump Pump Installation with Water Pressure Powered Backup Pump**