

# **Guidelines for Completion of Footing Drain Disconnections**

## **City of Ann Arbor - Developer Offset-Mitigation Program**

Updated November 30, 2005

### **Purpose**

The purpose of this document is to establish a written policy for all aspects of the City of Ann Arbor program to offset development sewage flows through sanitary flow removal (*offset-mitigation*). This document will be accessible for City of Ann Arbor staff, developers, contractors, and others involved with offset-mitigation activities.

### **Introduction**

The City of Ann Arbor Offset-Mitigation Program was established to aid in protecting the health and safety of our community and environment by not allowing new development to exacerbate sewage collection system capacity issues or “MDEQ permitted” overflows of partially treated sewage by our treatment plant to the Huron River.

In structures built prior to 1981, footing drains were most often connected directly to the sanitary sewer system. Studies have shown that footing drain flows during rain events are the major cause of system capacity concerns and increase collection system flows by as much as 10-20 times the normal dry weather flow. In several instances, the sewer system has exceeded its capacity, causing basement backups in some neighborhoods. It was determined that even homes with no current basement backup problems were significant contributors to the basement backup problem for neighboring homes. The City decided on a solution, as required by an Administrative Consent Order (ACO) with the Michigan Department of Environmental Quality (MDEQ), to implement a comprehensive citywide footing drain disconnection (FDD) program in order to reduce the amount of rainwater flowing into the sanitary sewer system.

Beyond the implementation of the FDD program, the ACO also requires that the City of Ann Arbor demonstrate on a project-by-project basis, offset-mitigation for *new development* in a manner consistent with MDEQ guidelines to effect a net reduction in flow to the sanitary collection system. Before receiving a Certificate of Occupancy for a new development, a developer may be required by state ACO directives and city policy to remove existing I/I (Infiltration/Inflow) flow from the city sanitary system to offset the estimated sanitary sewage flow for the proposed development. The goal of the program is to offset sewage flow added to the sanitary sewer system by new development and to gradually gain back lost system capacity through application of a 20% System Recovery Factor as part of the requirement.

Ann Arbor City Council approved a resolution on August 18, 2003, creating a set of requirements for new developments so that the ACO policies are met. These requirements are summarized below:

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**I. Applicable Developments**

All property developments, within the City of Ann Arbor, requiring Site Plan submissions or application for a Part 41 Permit from the MDEQ, are required to offset-mitigate estimated sewage flows from the new development. In addition:

- County, public schools, colleges, universities and other government facilities on properties located within the City of Ann Arbor must offset-mitigate estimated sewage flows for new development.
- Properties requiring site plan submissions must also disconnect on-site footing drains from the sanitary sewer.
- Properties annexing into the city must disconnect on-site footing drains from the sanitary sewer.

Where a township contributes flow and where adequate transport capacity, within the city, has not been purchased or constructed, the townships must agree to institute policy equivalent to the city policy for offset-mitigation of new sanitary sewer flow. If the mitigation takes place within the City of Ann Arbor, city FDD program staff will verify the disconnection, but will not provide compliance tracking. The township will be responsible for coordinating a compliance tracking and reporting procedure, that is equivalent to the guidelines in Section IV of this document, and that will provide the City of Ann Arbor with assurance that the disconnections were completed in accordance with the ACO requirements. Additionally, the township is responsible for communicating with the MDEQ regarding all requirements and verification activities for their developments and the associated mitigations.

New sanitary sewer system connections for parcels currently using on-site sewage disposal systems shall be exempt from offset-mitigation requirements. New sanitary system connections for flow additions less than the equivalent flow from a duplex residential unit (average daily flow less than 700 GPD) and not requiring a Part 41 Permit application shall be exempt from offset-mitigation requirements. If subsequent flow additions for the same site result in cumulative flows over 700 GPD being added to the system after August 18, 2003, the offset-mitigation requirements must be met for all of the additional flow added after August 18, 2003.

**II. Disconnect Requirements and Calculation**

The number of disconnections required for any particular mitigation is calculated based on a city document titled SANITARY FLOW OFFSET MITIGATION FOR DEVELOPMENT. The City of Ann Arbor uses the procedures in this document to determine consistent and reasonable values for the sanitary flow added to the sanitary system based on the scope of proposed development and for the estimated “clean water” removal from the sanitary by reducing storm and ground water I/I sources.

The information in this document, for a single residential footing drain connection, includes:

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- Design dry weather flow rate of 350 GPD/unit
- Peaking factor of 4
- 20% recovery factor
- 4 GPM/home peak wet weather footing drain flow

Please see this entire document (attached) for additional details on determining the number of footing drain disconnections required. The peaking factor, recovery factor, and estimated peak footing drain flows are all constants. The design dry weather flow rate will vary based on the type and size of the development.

In order to obtain mitigation credits by any method other than footing drain disconnections, the detailed method for sanitary flow removal must be proposed to the FDD project manager, approved by the City of Ann Arbor, and ultimately accepted by the MDEQ. This includes situations where an existing non-residential property is altered such that the flow to the sanitary sewer system is reduced or eliminated. In this case, a developer may be able to obtain credits based on the design flow rates of the existing configuration compared to the altered configuration. These credits could then be used:

- For a new development on the same site
- For development at another site
- In trade with another developer or contractor

All mitigation credits, whether obtained through FDD or through other means, must be used to offset development within two years, unless a longer time limit has been approved by the FDD project manager.

### **III. Available Disconnection Locations**

In some areas of the Ann Arbor sanitary sewer system, capacity problems may be observed during peak flow conditions. These “problem areas” have been identified through the 1995 Trunk Sewer Study and the 2001 SSO Study Report. Because of these problems areas, offset mitigation for new developments must be completed in designated areas of the city. The location requirements are based on having the entire sanitary sewer system divided into three main districts. These districts are shown on the attached map and are labeled as North, South, and West. The mitigation requirement will be based on a percentage location distribution rule as follows:

*For developments within any of the three districts, 80% of the mitigation credits must be obtained from disconnections located within the same district as the development. 20% of the mitigation credits may be obtained from anywhere in the City of Ann Arbor.*

Developments connecting to the Ann Arbor sanitary sewer system from outside of the City of Ann Arbor limits must also follow the 80% / 20% distribution rule for their sewer district, but may choose to mitigate either within the city or in their township. Developments within the city must be mitigated within the city limits.

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In some cases, if the city has completed disconnections in the areas where mitigation is required, there may be opportunities for trading these disconnections between districts. The developer can then receive credit for a home in the correct district, while the city will receive credit for a disconnection to reduce Ann Arbor Wastewater Treatment Plant (WWTP) flows. The following guidelines will regulate the tracking of these trades:

- FDD district trades will only be allowed for developments that are located within the City of Ann Arbor.
- Homes for FDD district trades may not be available in all sewer districts. If homes are available, the City can only provide up to 20% of the completed homes in a single district for trades.
- FDD district trades must be approved in advance by the FDD project manager. The developer should contact the FDD project manager to explain the location of the development, and he/she will determine if FDD homes are available in the correct sewer district, and will approve a set number of trades to be allowed. The number of trades allowed will not necessarily equal the total number of required mitigations for a developer.
- Once approved, the developer must complete all of their district trades within 12 months, after which any untraded homes will be available again to all developers on a first-come, first-serve basis.

Additional consideration will be given to properties that are classified as Priority 1 for the City of Ann Arbor FDD Program. These properties are considered at risk for basement backups and are scheduled to be included in the FDD program by 2006. To avoid confusion and/or conflict between the FDD program and developer offset-mitigation activities, **a Priority 1 or 2 home cannot be completed for offset-mitigation credit if the home is scheduled to be part of the FDD program in the next 6 months.**

Future scheduling of both priority 1 and 2 homes will be tracked based on work zones already identified throughout the city. Each work zone consists of 30-60 homes, generally completed within a 2-3 month time period. To meet the 6-month requirement, homes in the current work zone and the next two sequential work zones are not eligible to be used for mitigation credit.

Once included in the FDD program, a priority 1 or 2 home will not be eligible for mitigation credit again, unless their incentive funding from the city has expired. In some cases, a property initially identified as Priority 1 or 2 will not meet the FDD program requirements and will be made available for developer offset mitigation.

The two most common examples are (1) homes that were built after 1981 and (2) homes that do not complete the footing drain disconnection within the required timeline. In both cases, since the properties are not eligible for FDD program funding, they may be completed for offset mitigation credit. For priority 1 properties, installation of check valves on lower level sanitary features should be included. The

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current work zone and a listing of homes that are ineligible for development offset-mitigation can be obtained from the FDD program construction manager. Any exceptions must be approved by the FDD project manager.

The remaining properties in the City of Ann Arbor are classified as Priority 2 and are not considered at risk for basement back-ups. Developers may complete footing drain disconnections for any of these properties that are not included in any of the next two sequential work zones. New curb drain is not scheduled for installation in many of these areas until future years, but may be installed in advance by the City's curb drain contractor (at the developer's expense) if requested. See section VI for additional explanation of curb drain discharge locations. Check valves will not be required for these properties unless required by City of Ann Arbor building code.

Please contact the FDD Program Construction Manager to obtain a current listing of FDD Program homes and priority classifications, as described above.

#### **IV. Work Specifications and Verification**

The detailed specifications for typical single-family residential buildings used by the City of Ann Arbor FDD program are available from the Construction Manager (CM). These specifications should be used for developer mitigation when working in single family residential structures. All work with floor tiles must be done in conformance with the Asbestos tile removal regulations available from the City.

A **footing drain disconnection** is defined as identifying all direct connections between a footing drain and the sanitary drain piping of a property, removing the connection(s), and directing the footing drain flows to an approved stormwater discharge location.

The FDD credit applicant is responsible for taking care of the following items to verify the disconnection for a single family residential FDD credit:

- Arrange an on-site inspection with the CM after the disconnection has been made and restoration is nearly complete. The contractor in charge of the work must be present to answer questions
- Provide photos of the pre-existing condition of the property and intermediate photos confirming a disconnection was made
- Provide closed building permits for plumbing and electrical work
- Provide discharge permits (county drain or right-of-way) as needed
- Complete photo or video as-built documentation of any installed curb drain
- Notify the CM of any other relevant information
- Provide design documents and calculations for building other than typical single-family residential buildings (see Section V, below)

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Any exceptions to the verification items above need to be approved by the FDD Project Manager.

**V. Multi-Unit and Commercial Disconnections**

The purpose of this section is to establish a standard policy for determining the number of credits granted for FDDs completed at multi-unit and commercial structures. It also presents the requirements for the discharge system needed at these locations, which can vary significantly in size and configuration from single-family structure. Generally, these structures include apartment complexes, duplexes, townhouses, commercial and industrial buildings.

**Equivalent Disconnection Credits**

Compared to a typical single-family residence, multi-unit residential or commercial structures have widely varying footprints and will have correspondingly different contributions of footing drain flows during wet weather conditions. This section establishes a policy for calculating the disconnection credits for these non-single-family structures if FDD work is performed for these locations.

A typical single-family residence in Ann Arbor contains 1,200 square feet of footprint area, most often with a standard basement depth of 5' to 8'. These structures have been found to generate an average of 4 gallons per minute (gpm) from monitoring data within the City during peak wet weather conditions.

After reviewing the mechanism for generation of flows into footing drains, it has been determined that the number of credits provided for non-single-family structures will be based on both the footprint area and basement depth of the structure compared to the typical single-family residence. For each building, the number of credits will be calculated as follows:

$$\text{Credits} = (\text{Building Footprint Area}) / (1200 \text{ sq ft}) * (\text{Depth Factor})$$

The average depth of the basement for a structure will be used to determine the depth factor, where the depth factor is 1 for a standard full-height basement. For structures with multiple basement levels, a location-specific policy will be created by the City. The following table describes the basement depth factor for structures with single basement levels:

<b><u>Basement Depth Range</u></b> (Measured from highest finish grade outside of the building to the basement floor)	<b><u>Depth Factor</u></b>
< 2'	0.25
2' - 5'	0.5
>5'	1.0

The number of credits calculated above must then be rounded to the nearest whole number. Note that this formula cannot be applied to any single-family structures.

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Multiple credits can only be obtained for non-single-family residential structures that have documented connections of footing drains and/or roof drains to the sanitary sewer system.

The FDD credit applicant is responsible for providing "Preconstruction Multi-Unit FDD Calculations" to the City FDD Project Manager as a proposal prior to starting the disconnection work. The City will then respond to the proposal and confirm or deny the request for multiple FDD credits.

### **Direct Surface Connections to Foundation Drain**

If there are direct surface connections to the foundation drainage system, these must be removed. These include area drains, stairwell drains, roof downspout discharges, and similar connections. An inspection report must be provided as part of each FDD credit application of all surface drainage around each structure. This surface drainage report must include:

- Drainage Sketch – Provide a sketch of the surface drainage in relation to the structure(s), including the area of drainage toward the structure. Sketch shall be to scale with approximate dimensions provided.
- Surface Connection Identification – Identify on the drainage sketch and provide photographs of all surface drainage inlets such as area drains, stairwell drains, roof downspouts, and similar connections.
- Removal Verification – Verification of the removal of all surface drainage connections shall be provided in the form of clearly identified photographs of the modification. In the case of stairwell drains, disconnection is recommended, but not required. If stairwell drains are not disconnected, surface flow must be directed away from the stairwell with a minimum 6" curb around the stairwell.
- Flow removal credit for 25%, 50% or a maximum of 75% of the flow removed from eliminating these illicit connections to the sanitary can be granted by the FDD Project Manager based on applying the 20% Recovery Factor and the cost percentage of the average FDD cost for removing 4 gpm from a single family dwelling.

### **Discharge System Design**

Because non-single-family residential structures will likely produce more footing drain flow than a typical single-family residence, the standard FDD sump and sump pump specifications developed by the City of Ann Arbor may not provide sufficient capacity. In some cases, a larger sump, a larger pump, or even a multiple pump system may be required to handle the larger flows that would be anticipated.

If possible a gravity discharge line from the footing drains to a catch basin, nearby curb drain, creek, or other approved discharge location would be the preferred. If a gravity drain is not feasible, the following guidelines are provided to aid the developer's engineer to estimate the required capacity for the FDD sump system:

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Sump Pump Capacity

All footing drainage systems are different and have varied conditions that they must accommodate. The sizing of the gravity drainage or sump system must take into account these varied conditions. The entity preparing the FDD credit application for the purposes of Development Mitigation must certify that the installed system takes into account these site conditions. Evidence of this assessment of site conditions must be provided as part of the FDD credit application in the form of calculations and site condition assessment. These calculations must be signed by a Professional Engineer.

At a minimum, the peak pumping of the sump pump(s) or flow capacity of the gravity discharge must be consistent with the following formula:

$$Q_{\text{peak}} = \text{Perimeter}_{\text{unit}} * 0.25 \text{ gpm/ft}$$

Where:

$Q_{\text{peak}}$  - Minimum peak flow (gpm) capacity of the installed sump pump(s)

$\text{Perimeter}_{\text{unit}}$  - Perimeter (ft) of the structure foundation drain leading to the discharge sump

An example of the calculation of the pump capacity for each unit, and the determination of the FDD credit is included in Appendix A.

Sump Location

Sumps may be located internally or externally, and must be installed according to all applicable codes. External sumps require safety features to prevent entrapment of repair personnel, children or pets.

Sump Volume

With the installed sump pump capacity calculated by the applicant, the sump system in which the sump pump(s) is located shall be sized to allow the installation of at least two sump pumps at the same elevation, even if only one is installed. In addition, the sump system shall be sized so that at the design capacity of the sump pump(s) and using the design levels of the controlling float switches, the operation of the sump pump (s) does not cycle in excess of the recommended number of starts per hour at the peak projected flow rate. Providing a sump volume that causes starting more frequently than pump manufacturer recommendations is not acceptable.

It is acceptable to utilize multiple sumps to provide the required sump volume as long as the sumps are capable of housing the correct number of pumps, and are hydraulically connected such that the sumps maintain the same level during all pumping operations.

Sump Cover

The sump(s) shall be equipped with a bolt down cover that has all penetrations in the cover adequately sealed around each discharge connection and electrical connection.

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Interconnections to Sanitary System

All connections between the foundation footing drainage system and the sanitary plumbing and sewer system for a building where FDD is being performed must be disconnected as part of the FDD process. Documentation of the nature and location of all of these interconnections must be provided as part of the FDD credit application as well as verification that the disconnection was performed for all of these interconnections. This documentation must include photographs of the disconnection work.

Pump Discharge Line

The pump pressure discharge line shall be of a size recommended by the manufacturer of the sump pump.

Gravity Discharge Line

The gravity discharge line must be a minimum of 4" PVC if installed using an open cut method or 2" PVC or HDPE if installed using a boring method. The slope of this discharge line shall be a minimum of 1" per 10' of length, and the required flow capacity must be provided in an open channel flow mode of operation. There is not a maximum slope requirement. Minimum cover requirements are 24" for 2" discharge pipe, 18" for 4" and larger pipe.

At the discharge from each structure into the discharge line, there must be an air gap to separate the in-structure pump discharge piping from the gravity discharge line. In addition, a cleanout must be provided at each entry point into the gravity discharge line.

After installation, the gravity discharge line shall be inspected for negatively sloped areas to verify proper installation. The FDD credit applicant shall provide verification using one of the following methods:

Open Cut Review – After the open cut has been performed and the pipe placed, the FDD credit applicant must demonstrate the proper cover and slope with photographs and field notes.

- CCTV Inspection – At the option of the FDD credit application, the completed gravity discharge line can be inspected from the upper end to the discharge point by CCTV to demonstrate positive slope. The necessary documentation is a written report as well as a continuous CCTV inspection video tape or DVD disc of the discharge line. This inspection video tape or DVD disc must include documentation of the addition of water (at least 1 volume of the discharge line) after the insertion of the CCTV camera. The addition of water must appear on the inspection video tape or DVD disc followed by the inspection of the entire length of the discharge line.

The gravity discharge line shall be constructed to only accept the flow from footing drains. No area drains or other surface drainage sources shall be connected to this discharge line.

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Inspection cleanouts shall be installed at every upstream point in this discharge line, and at all changes in direction that exceed 30 degrees, and at maximum distances of 300'. All cleanouts must include magnetic Locators. In addition, the curb drain system must include tracing wire along the entire length of the discharge line.

Gravity Discharge Line Capacity

The gravity discharge line provided must be adequately sized to accommodate the discharge from all installable pumps upstream from each segment of line. Each segment of this discharge line must be sized to flow by gravity with the maximum installable capacity of all the discharges operating simultaneously. This calculation must be performed by a professional engineer. Calculations to support this capacity must be provided in the FDD credit application. An example of this calculation is provided in Appendix A.

Pump Redundancy

If an installed sump serves 2 or more FDD equivalents, then a redundant sump pump system shall be installed. If a redundant sump pump system is installed, each of the installed pumps shall be of equal size, and the operation of the sump pumps shall be alternated to equalize pump wear. If there is a failure of either of the pumps, then the failure must be alarmed with an internal visual and audible alarm system as well as an external visual alarm system. The AC powered alarm shall sound if there is a failure of either pump, or if both pumps are operational and the water level continues to rise.

Electrical Power

The electrical power provided for the sump pump system shall be on an independent circuit that includes a single electrical box. This electrical circuit must have a rating of a minimum of 20 A. This circuit can be used for powering a backup sump pump as well as the primary sump pump(s). If the pumping system requires electrical power in excess of 20A, then a properly sized circuit shall be provided to power all installed sump pumps. If alarming is provided, then an independent circuit shall be provided for the alarming.

Summary

The FDD credit applicant is responsible for taking care of the following items to receive credit for the disconnection for multi-unit structures:

- Preconstruction Multi-Unit FDD Calculations – Calculation of the proposed site credit, with City approval required prior to construction
- Discharge System Design Calculations (Example in Appendix A, to be included as part of the FDD Credit Application)
- Surface Drainage Report – Part of FDD Credit Application
- Arrange an on-site inspection with the CM after the disconnection has been made and restoration is nearly complete.

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- Provide photos of the pre-existing condition of the property and photos confirming a disconnection was made
- Provide closed building permits for plumbing and electrical work
- Provide discharge permits (county drain or right-of-way) as needed
- Complete video verification and as-built documentation of any installed curb drain or discharge line.
- Notify the CM of any other relevant information
- Provide any additional design documents and calculations for structures

Any exceptions to the verification items above need to be approved by the FDD Project Manager.

## **VI. Discharge Locations**

For properties that have an on-site storm water discharge location for connection (including curb inlets, manholes, storm drains, etc.), or one fronting the property in a public right-of-way or easement, the contractor should tap into this structure with the sump pump discharge line (or approved surface discharge to open channel storm drain). In many cases, a storm water discharge location is unavailable. For the FDD program, the City of Ann Arbor employs a curb drain contractor, who installs a shallow drainage network of HDPE pipe to service the properties scheduled for disconnection. The City of Ann Arbor will install curb drain when requested for developer mitigation using our existing curb drain contract based on the following conditions:

- A. The developer pays for the curb drain based on our current construction and CM services costs per foot for installed curb drain across the entire frontage for properties where the property owners have agreed to have the FDD development mitigation work performed. Curb drain costs must be paid to the city before curb drain will be installed or before FDD mitigation credit will be given for certificates of occupancy for curb drain previously installed by the city.
- B. Property frontages that must be crossed to install curb drain between an FDD development mitigation property and a connection to a curb inlet structure will be funded 50% by the developer. If these property owners later decide to participate in the developer mitigation the additional 50% must also be reimbursed to the city by the developer for performing FDD work at these properties.
- C. If it makes good construction/economic sense to extend the curb drain beyond properties initially participating in the developer mitigation (item A.) then the city will pay for the cost of installing curb drain across the frontages of properties up to the point the curb drain section terminates (cleanout). If developers later convince these property owners to participate in their FDD

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development mitigation efforts the entire cost must be reimbursed to the city for actual footage of curb drain installed across the properties prior to receiving FDD mitigation credit for certificates of occupancy.

- D. The development mitigation areas are not deemed FDD program areas until specifically designated by FDD project staff and property owners not participating in development mitigation will not be required to perform FDD work in accordance with the program guidelines until such time as this area is designated for FDD program work.
- E. If a property owner decides to perform the footing drain disconnection (without participation of a developer) in advance of the "development mitigation" area being designated as a "program" area, the property owner may do so and will be reimbursed by the city in the next city budget cycle (up to 18 months). Credit for FDD development mitigation will not be granted to developers for these footing drain disconnected properties. Property owners will be reimbursed by the city and curb drain paid for by the city for these homes.

The steps that a developer should take to request this curb drain are as follows:

Contact the CM by letter or email with a list of properties to be disconnected and a proposed curb drain layout. The CM will visit the site(s) and evaluate the proposed layout to ensure the above requirements are met, and that the installation is feasible for the curb drain contractor. Before construction, the final layout and estimated costs will be reviewed with the contractor and/or developer. After payment to the city, the CM will then forward the request to the curb drain contractor and will arrange for the work to be completed on a date such that the FDD schedule is not negatively impacted. The anticipated completion date will depend on the progress of the curb drain contractor on FDD work, and on their ability to mobilize effectively to the new area. When construction is complete, the CM will document the condition and as-built measurements of the pipe.

Curb drain may also be installed by a contractor not affiliated with the FDD program, but any layouts for this work must be approved in advance by the FDD project manager and construction manager to ensure that no interference with future FDD program curb drain installation will occur. In addition, any curb drain installed must meet the requirements of the City of Ann Arbor building department and all necessary permits must be obtained. As-built drawings including pipe offset and depth measurements must be included and pipe slope verification via televising must be performed and submitted to the FDD construction manager.

As an alternative to installing curb drain, the developer/contractor may choose to manage the sump pump discharges on the property. Some options include the installation of an acceptable infiltration system, a surface discharge, or a sump garden designed to handle these flows. For this to be approved for a credit, the contractor must show the CM that a design was created that will effectively manage the water

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on-site, without causing any nuisance flows for the property owner, neighboring properties, or the city right-of-way/easement. The City of Ann Arbor Building Department must also approve any on-site sump flow management.

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**VII. Contact Information**

The following individuals are currently involved with the implementation of the developer mitigation program:

<u>Name</u>	<u>Organization</u>	<u>Role</u>	<u>Phone</u>	<u>Fax</u>	<u>Email</u>
Anne Warrow	City of Ann Arbor	Project Manager		(734) 994-1744	<a href="mailto:AWarrow@ci.ann-arbor.mi.us">AWarrow@ci.ann-arbor.mi.us</a>
Jay Zawacki	CDM	Construction Manager	(734) 213-5444	(734) 213-5775	<a href="mailto:ZawackiJR@cdm.com">ZawackiJR@cdm.com</a>
Oskar Nordstrom	CDM	Construction Manager	(734) 213-5444	(734) 213-5775	<a href="mailto:NordstromOE@cdm.com">NordstromOE@cdm.com</a>
John Calvert	City of Ann Arbor	Plumbing Inspector	(734) 994-2674		

Appendix A - Sample Calculations

**Appendix A - Developer Mitigation - Sample Calculations**

**Recommended Pumping System Equipment**

Professional Engineer: John Doe Signature: \_\_\_\_\_  
 License Number: Mi 601099999 Date: 10/13/2005

Type	Building Configuration				Perim Method				Selected Sump	Panel	FD Depth					
	Unit	Length (ft)	Width (ft)	Area (ft <sup>2</sup> )	FDD Equivalent	Perimeter (ft)	Peak Pumping Rate (gpm/ft)	0.25				Model	Mfr	Number	Rate	
Bldg 1	XXXX	180	20	3,600	3.0	400	100	100	N98	Zoeller	Duplex	122	10-1039	30" x 36" deep	30"	
Bldg 2	XXXX	200	20	4,000	3.3	440	110	110	N98	Zoeller	Duplex	122	10-1039	30" x 36" deep	30"	
Bldg 3	XXXX	80	20	1,600	1.3	200	50	50	M98	Zoeller	Simplex	61	N/A	30" x 36" deep	30"	
Bldg 4	XXXX	100	20	2,000	1.7	240	60	60	M98	Zoeller	Simplex	61	N/A	30" x 36" deep	30"	
<b>Total:</b>												<b>11,200</b>				

**FDD Area Equivalents: 9.3**  
**FDD Depth Factor: 1.0**  
**Total FDD Equivalents: 9.3**

**Notes**

- 1 - Duplex pumps require control panel and four floats to allow two pump and alarm operation
- 2 - Simplex pumps are not alarmed
- 3 - Basements are full-depth for all buildings

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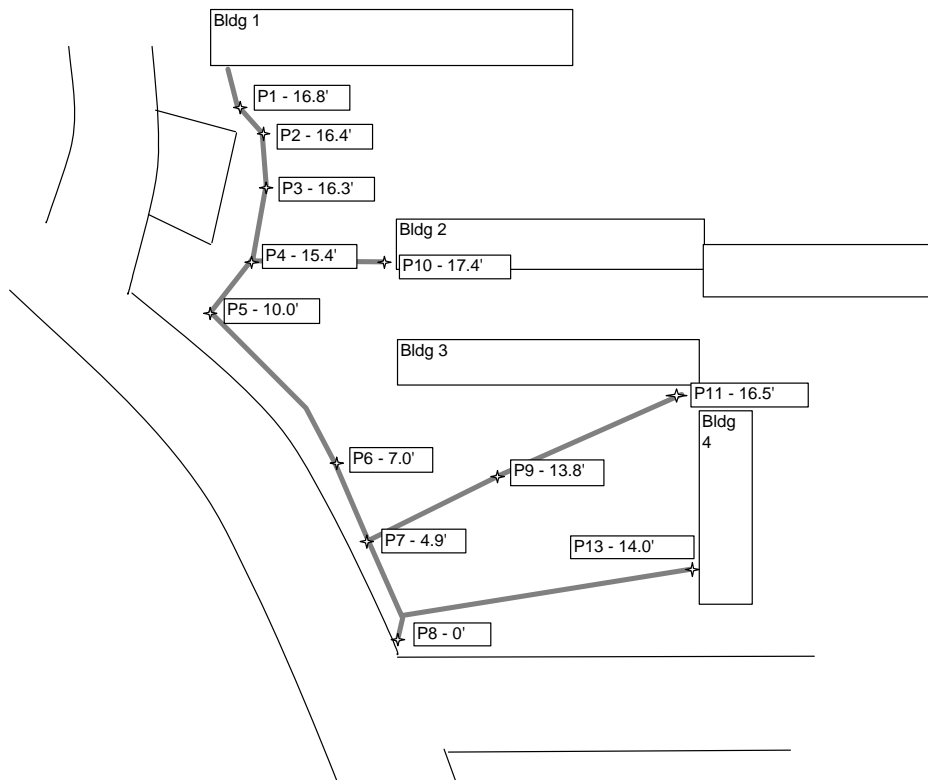
## Appendix A - Developer Mitigation - Sample Calculations

### Discharge Line Calculations

Professional Engineer: John Doe  
License Number: Mi 601099999

Signature: \_\_\_\_\_  
Date: 10/13/2005

Survey Point	Ground (ft)	Invert (ft)	Depth (ft)	Length (ft)	Selected		Maximum Pipe Capacity (gpm)	Peak Upstream Q (gpm)	Pipe Size
					Slope (ft/ft)	Diameter (in)			
0	16.8	14.3	2.5						
1	16.8	14.1	2.8	15	0.0167	4	130	122	OK
2	16.4	13.9	2.6	12	0.0167	4	130	122	OK
3	16.3	13.4	2.9	25	0.0167	4	130	122	OK
4	15.4	12.8	2.6	36	0.0167	4	130	122	OK
5	10.0	7.2	2.8	34	0.1667	4	412	244	OK
6	7.0	4.3	2.7	69	0.0417	6	607	244	OK
7	4.9	2.7	2.2	39	0.0417	6	607	244	OK
8	0.0	-2.4	2.4	68	0.0750	6	815	305	OK
10	17.4	14.9	2.5						
4	15.4	12.8	2.6	25	0.0833	4	291	122	OK
11	16.5	13.7	2.8	70	0.0750	4	276		OK
9	13.8	11.2	2.6	60	0.0417	4	206	61	OK
7	4.9	2.7	2.2	29	0.2917	4	545	61	OK
13	14.0	11.5	2.5						
8	0.0	-2.4	2.4	88	0.1583	4	402	61	OK
<b>Subtotal (4")</b>				<b>394</b>					
<b>Subtotal (6")</b>				<b>176</b>	n = 0.011 (PVC)				
<b>Total</b>				<b>570</b>					



## **SANITARY FLOW OFFSET MITIGATION FOR DEVELOPMENT**

The Offset Mitigation Program was established to aid in protecting the health and safety of our community and environment by not allowing new development to exacerbate sewage collection system capacity issues or “MDEQ permitted” overflows of partially treated sewage by our treatment plant to the Huron River. The goal of the program is to offset sewage flow added to the sanitary sewer system by new development and to gradually gain back lost system capacity through applying a 20% System Recovery Factor as part of the requirement. Studies have shown that footing drain flows during rain events are the root cause of system capacity concerns and increase collection system flows by as much as 10-20 times the normal dry weather flow. Removing these footing drain flows has been the key method selected by developers to meet offset mitigation requirements.

### **Calculation Examples:**

#### **Site 1: 48-Appartment Units (each apartment is 900 sf ~ then from Table A Design Flow = 275gpd/unit)**

48 units x 275 GPD/unit = 13200 GPD  
Peak flow = 13200 GPD x 4 (peaking factor) x 1.2 (System Recovery Factor)=  
63360 GPD (63360 GPD x 1day/24hours x 1hour/60minutes = 44 GPM peak flow)

Using 4 GPM/home footing drain flow (Value based on sump pump flow monitoring)

Footing Drains to Disconnect = 44 GPM/4 GPM per footing drain = 11 FDD: This development would be required to disconnect eleven footing drains from the sanitary sewer system.

#### **Site 2: Office Building (non-medical) 60,000 sf gross area ~ then from Table A Design Flow = 0.06 gpd/sf gr floor area**

Proposed development has 60,000 sf x .06 gpd/sf = 3600 GPD  
Peak flow = 3600 GPD x 4 (peaking factor) x 1.2 (System Recovery Factor)=  
17280 GPD (17280 GPD x 1day/24hours x 1hour/60minutes = 12 GPM peak flow)

Using 4 GPM/home footing drain flow (Value based on sump pump flow monitoring)

Footing Drains to Disconnect = 12 GPM/4 GPM per footing drain = 3 FDD: This development would be required to disconnect three footing drains from the sanitary sewer system.

TABLE A

TYPE OF FACILITY OR USE	DESIGN DRY WEATHER FLOW RATE
Single Family Residence	350 gpd
Two Family Residence	700 gpd
Apartment to a single family unit (up to 400 sq. ft)	200 gpd
Motels with kitchenettes, apartments, condos, mobile homes, trailers, co-ops, etc. up to 600 sq. ft. of gross floor area	200 gpd/unit
Motels with kitchenettes, apartments, condos, mobile homes, trailers, co-ops, etc. up to 601 – 1200 sq. ft. of gross floor area	275 gpd/unit
Motels with kitchenettes, apartments, condos, mobile homes, trailers, co-ops, etc. greater than 1200 sq. ft. of gross floor area	350 gpd/unit
Motel unit less than 400 sq. ft	100 gpd/unit
Motel unit greater than 400 sq. ft.	150 gpd/unit
Hospital (without laundry)	150 gpd/bed
Hospital	300 gpd/bed
University housing, rooming house, institutions	75 gpd/capita
Cafeteria (integral to an office or industrial building)	2.50 gpd/capita
Non-Medical Office space	0.06 gpd/sf gr. floor area
General Industrial Space	0.04 gpd/sf gr. floor area
Medical Arts (doctor, dentist, urgent care)	0.10 gpd/sf gr. floor area
Auditorium/Theater	5 gpd/seat
Bowling alley, tennis court	100 gpd/crt - alley + food
Nursing Home	150 gpd/bed
Church	1.50 gpd/capita
Restaurant (16 seat minimum or any size with dishwasher)	30 gpd/seat
Restaurant (fast food)	20 gpd/seat
Wet Store - Food processing	0.15 gpd/sf gr. floor area
Wet Store no food (barbershop, beauty salon, etc.)	0.10 gpd/sf gr. floor area
Dry Store (no process water discharge)	0.03 gpd/sf gr. floor area
Catering Hall	7.50 gpd/capita
Market	0.05 gpd/sf gr. floor area
Bar, Tavern, Disco	15 gpd/occupant + food
Bath House	5 gpd/occ. + 5gpd/shower
Swimming Pool	20 gpd/capita
Service Stations	300 gpd/double hose pump
Shopping Centers	0.02 gpd/sf gr. sales area
Warehouse	0.02 gpd/sf gr. area
Laundry	425 gpd/laundry machine
Schools, nursery and elementary	10 gpd/student
Schools, high and middle	20 gpd/student
Summer Camps	160 gpd/bed
Spa, Country Club	0.30 gpd.sf. gr. floor area
Industrial Facility, Large Research Facility	"Determined by Authority of
Others (car wash, etc.)	Water Utilities Director"

\* **Values in Table A (above) are from or derived from the following sources:**

Michigan Guidelines for Subsurface Sewage Disposal, 1977

Schedule of Unit Assignment Factors, 1988, Oakland County Public Works (Michigan)

Basis of Design, Scio Township (Michigan)

Sewer Design, 1992, Los Angeles Bureau of Engineering

Equivalent Residential Unit Determination, University of Central Florida

Standard Handbook of Environmental Engineering, 1989, Robert Corbitt

A MINIMUM OF 80% OF ALL FDD'S MUST BE WITHIN THE SAME MITIGATION DISTRICT AS THE DEVELOPMENT IS LOCATED AND A MAXIMUM OF 20% OF FDD'S MAY BE FROM OUTSIDE THE MITIGATION DISTRICT WHERE THE DEVELOPMENT IS LOCATED

North Mitigation District - North Campus, Northside, Northside Interceptor and Traverer Creek

**NORTH MITIGATION DISTRICT**

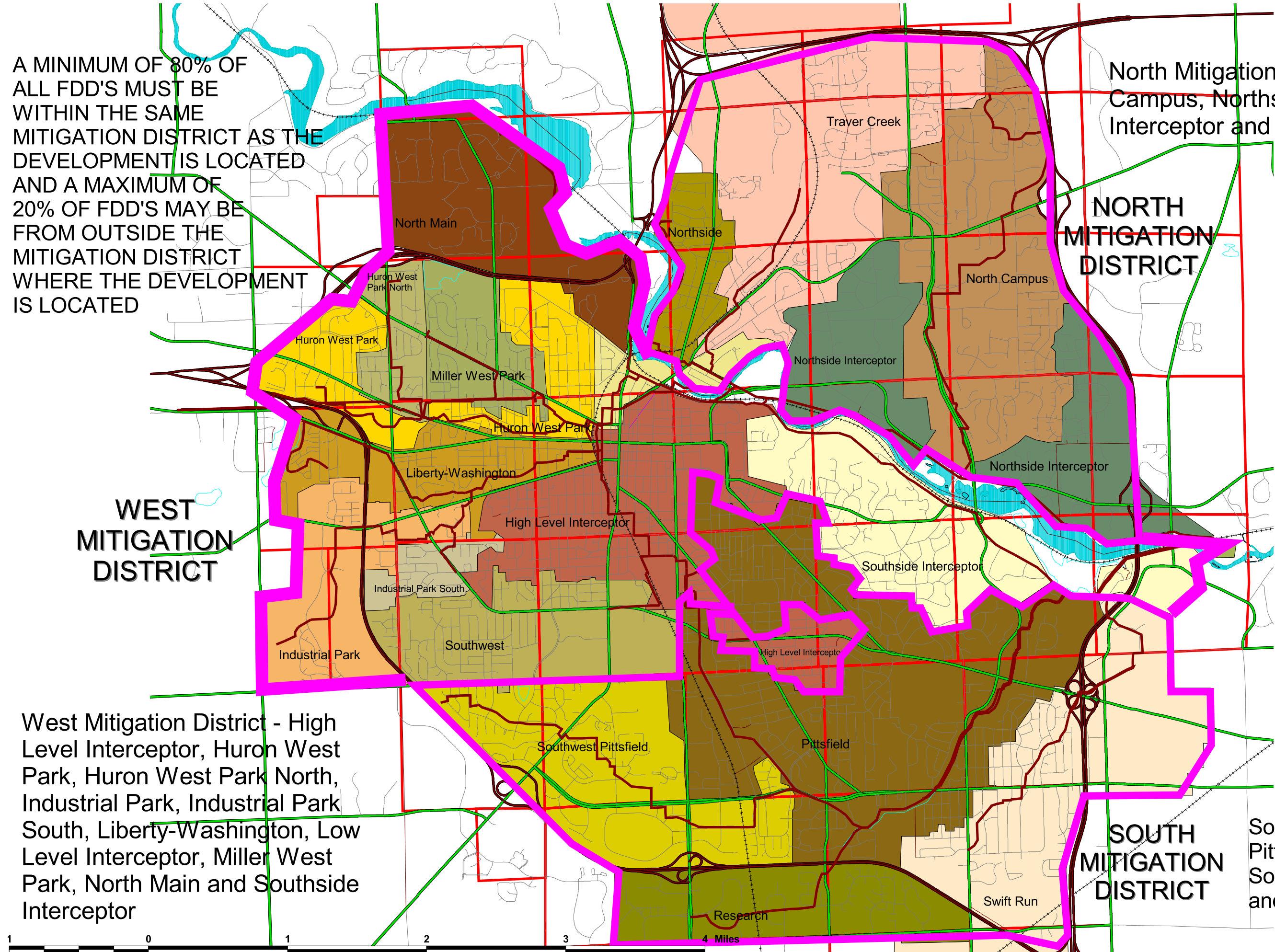
**City of Ann Arbor**  
Development Offset Mitigation Zones by Sanitary Sewer District

**WEST MITIGATION DISTRICT**

West Mitigation District - High Level Interceptor, Huron West Park, Huron West Park North, Industrial Park, Industrial Park South, Liberty-Washington, Low Level Interceptor, Miller West Park, North Main and Southside Interceptor

**SOUTH MITIGATION DISTRICT**

South Mitigation District - Pittsfield, Research Park, Southwest Pittsfield and Swift Run



- LEGEND**
- Sanitary trunk (pipes).shp
  - Geocoded Streets Database
  - Interstates
  - Major Roads
  - Minor Roads
  - AA Geographic Database
  - Railroads
  - Shoreline
  - Misc
  - Section Boundaries
  - Huron River
  - Sanitary-districts.shp
  - High Level Interceptor
  - Huron West Park
  - Huron West Park North
  - Industrial Park
  - Industrial Park South
  - Liberty-Washington
  - Low Level Interceptor
  - Miller West Park
  - North Campus
  - North Main
  - Northside
  - Northside Interceptor
  - Pittsfield
  - Research
  - Southside Interceptor
  - Southwest
  - Southwest Pittsfield
  - Swift Run
  - Traverer Creek
  - WWTP

