ADDENDUM No. 2

RFP No. 937
Sanitary and Stormwater Systems Asset Management Plan

Due: February 2, 2016 at 2:00 P.M. (local time)

The following adjustments shall be made to the Request for Proposal for Sanitary and Stormwater Systems Asset Management Plan RFP No. 937 on which proposals will be received on/or before February 2, 2016 at 2:00 P.M. (local time).

The information contained herein shall take precedence over the original documents and all previous addenda (if any), and is appended thereto. **This Addendum includes 280 page(s).**

Offeror is to acknowledge receipt of this Addendum No. 2, including all attachments in its Proposal by so indicating in the proposal that the addendum has been received. Proposals submitted without acknowledgement of receipt of this addendum will be considered nonconforming.

The following forms provided within the RFP Document must be included in submitted proposal:

- **City of Ann Arbor Non-Discrimination Ordinance Declaration of Compliance**
- **City of Ann Arbor Living Wage Ordinance Declaration of Compliance**
- **Vendor Conflict of Interest Disclosure Form**

Proposals that fail to provide these completed forms listed above upon proposal opening will be deemed non-responsive and will not be considered for award.

I. QUESTIONS AND ANSWERS

The following Questions have been received by the City. Responses are being provided in accordance with the terms of the RFP. Respondents are directed to take note in its review of the documents of the following questions and City responses as they affect work or details in other areas not specifically referenced here.

Q1: Regarding RFP Proposal Format Section B. Proposed Work Plan requirement for a separate work plan for each system.

We expect the narratives describing our approach will be 90% in common with each system. Can we provide a single descriptive section, highlighting where differences exist between the stormwater and sanitary approaches? The work plan would still have two sections detailing resources by task, staff hours per task and schedule for each system, separately.

A1: No, please provide separate work plans for each system.

Q2: Is the defect coding and scoring of the 6,700 CCTV inspections collected in a standard database format?

A2: Yes, please understand the database is not to be trusted as an accurate source of pipe condition. The coding does not adhere to PACP standards.

Q3: Are these 6,700 pipe segments geo-referenced or tied to an AssetID that is tied to your GIS?

A3: Yes.

Q4: Is it possible to get a sample segment of your CCTV?

A4: Yes - please see attached PipeLogix sample report. Due to file size, digital video is available upon request to tbaughman@a2gov.org.

Q5: Can you please provide us with access to the City's 2007 Stormwater Study?

A5: Please see attached PDF.

Q6: Also, at the pre-proposal meeting there was mention of a criticality assessment that was performed for the City's water system. Would it be possible for us to view that document to get an idea of the level of detail the City would like included in the assessment?

A6: Yes - please see attached Technical Memorandum 3 (Please note - for security purposes, some pages have been redacted).

Q7: Also, for clarification, is the $100k price for software purchase intended to include software implementation as well, or would that be a separate consideration?

A7: $100K is for purchase only. Implementation is a separate consideration in your proposal.

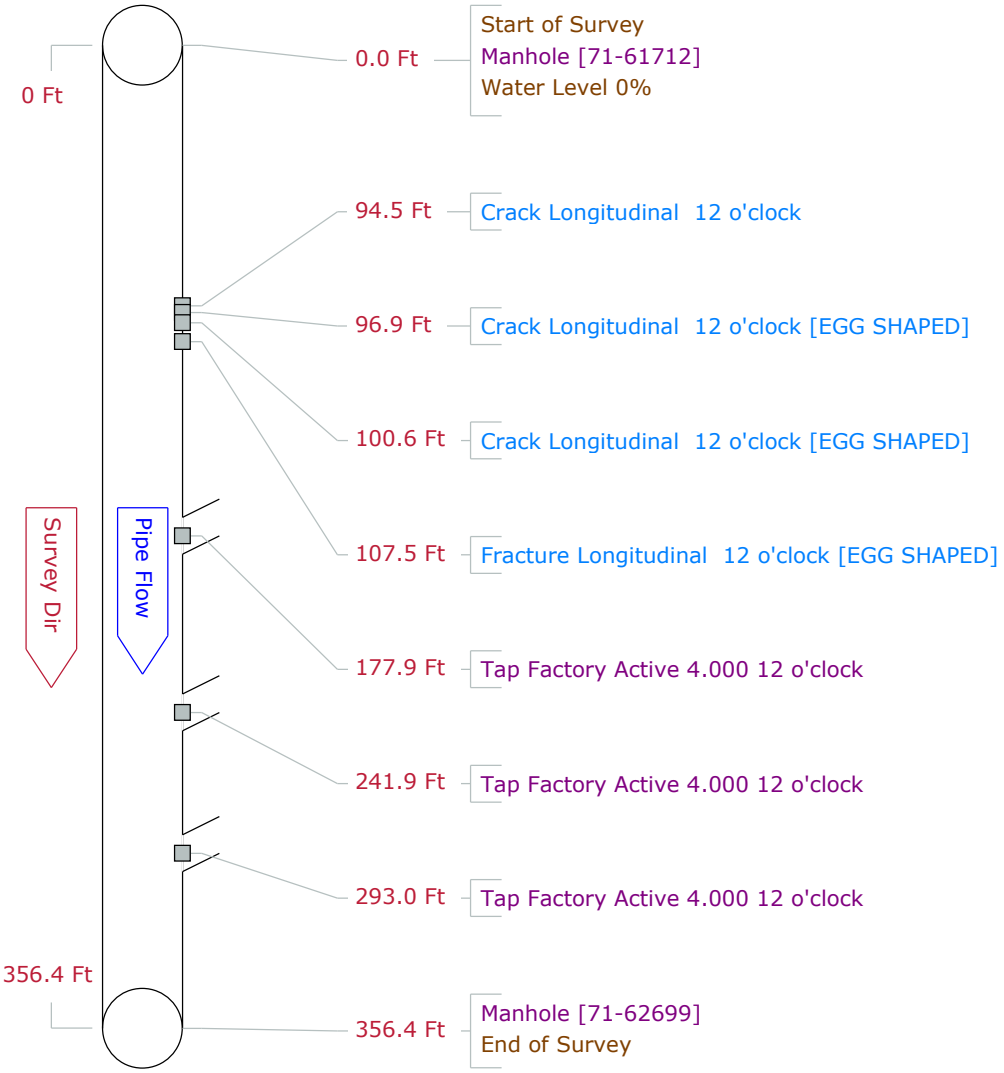
Q8: The RFP mentions the current Green Infrastructure Asset Management Plan project. Can you provide preliminary findings or the scope for this project?

A8: No - nothing is available at this time.

Respondents are responsible for any conclusions that they may draw from the information contained in the Addendum

Pipe Graphic Report of PSR 71-61712 B **for** City of Ann Arbor

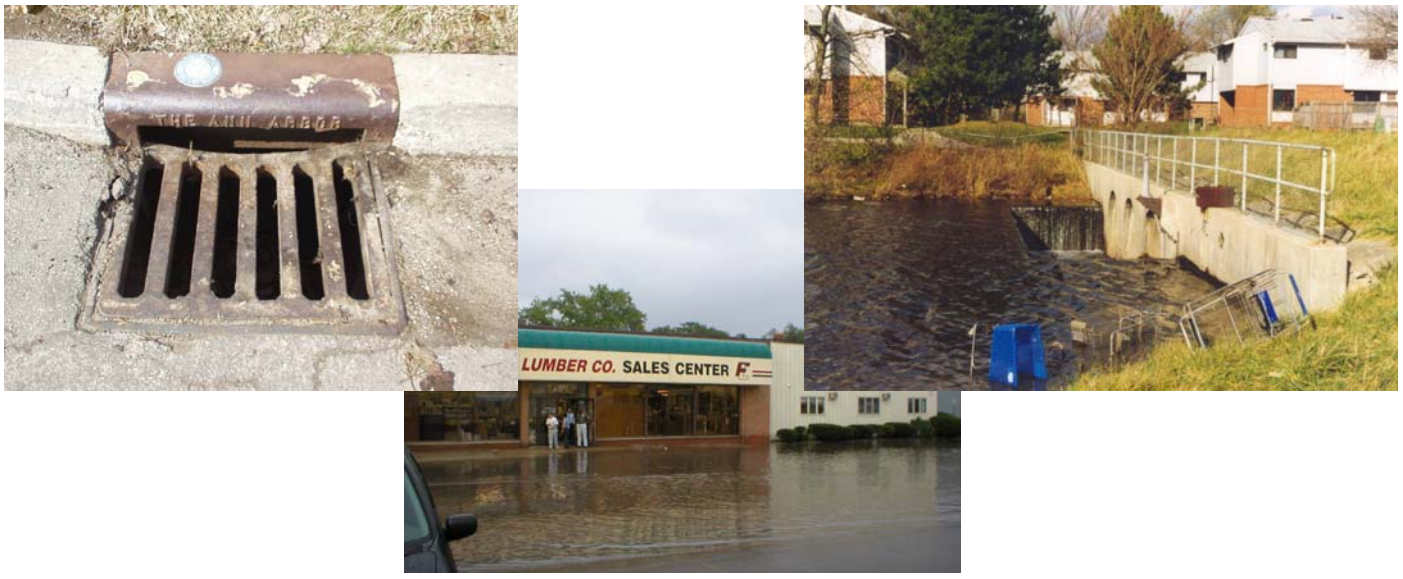
Setup 2291	**Surveyor** TRAVIS	**Certificate #** 000000	**System Owner** CITY OF ANN ARBOR		
Drainage	**Survey Customer**				
P/O #	**Date** 2013/04/30	**Time** 7:03	**Street** TOWNER RD		
City ANN ARBOR	**Further location details**				
Start 71-61712	**Rim to invert**	**Grade to invert**	**Rim to grade**	**Ft**	
Finish 71-62699	**Rim to invert**	**Grade to invert**	**Rim to grade**	**Ft**	
Use Sanitary	**Direction** Downstream	**Flow control**	**Media No**		
Shape Circular	**Height** 10	**Width** ins	**Preclean** Z	**Year Cleaned**	
Material Clay Tile	**Joint length** Ft	**Total length** 356.4 Ft	**Length Surveyed** 356.40		
Lining	**Year laid**	**Year rehabilitated**	**Weather** Dry		
Purpose Not Known	**Cat**				
Additional info			Structural O&M Constructional		
Location			Miscellaneous Hydraulic		
Project 2012			**Work Order**		
Northing	**Easting**	**Elevation**			
Coordinate System		**GPS Accuracy**			



PipeLogix Inc.
Phone: 866-299-3150
Fax: 760-406-6023

City of Ann Arbor

Stormwater Utility Update



September 2008

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Section 1
Project Objectives and Approach

1.1 Purpose

The City of Ann Arbor has used a stormwater utility to fund maintenance and enhancements of existing stormwater facilities since the early 1980s. This utility employed a rather simple billing formula that groups residential users into a single fixed rate category and evaluates the commercial and industrial customers based on their impervious and pervious area. This structure served its purpose, but it was determined that the utility needed to be updated to better meet these three criteria:

- The fees must serve a regulatory purpose (rather than a revenue-raising purpose)
- The fees must be proportionate to the necessary cost of service
- Property owners must be able to refuse or limit their use of the service.

1.2 Approach

To meet these three criteria, it was first necessary to perform a comprehensive cost of service evaluation to identify the necessary capital, operational and administrative needs of the City's stormwater program; define specific services that the City will provide to meet these needs; and establish appropriate criteria and policies that describe feasible alternative levels of service. The outcome of this cost of service evaluation was a five-year financial plan for alternative service levels that were considered by elected officials and the stormwater task force to define affordability criteria. **Section 2** contains a discussion of the City's stormwater revenue requirements for these different level of service options.

Project Mission: Improve the existing stormwater utility to address emerging City stormwater needs while meeting rate design requirements

After establishing the level of service options, the cost of service evaluation established a rational linkage between the cost of various stormwater services and the customer base making use of these services. A previous review of Ann Arbor's stormwater utility indicated that a multi-tiered residential rate structure should be used to better match the production of stormwater for properties to the fees that are charged for these services. This project reviewed the use of this proposed structure and other viable rate structure alternatives, as well as the methodology used to assess charges to commercial and industrial customers within the stormwater utility. **Section 3** describes the development of the revised stormwater rate structure for Ann Arbor.

A key element of the project was the development of a methodology for fairly and accurately categorizing the different residential parcels within the city into the final rate structure tiers based on their contribution of stormwater to the conveyance

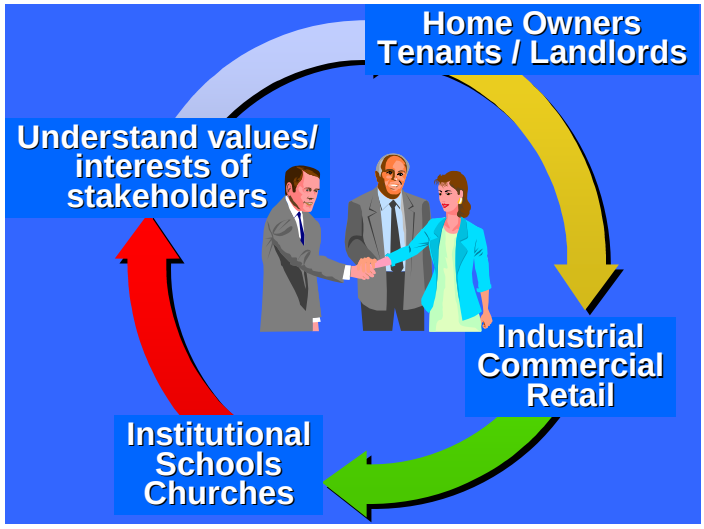
system. The approach made use of advanced remote sensing technology to assist with establishing the imperviousness on a parcel basis and provides a mechanism for periodically updating and validating the collected information for all parcels within the city. **Section 4** describes the development of impervious area data and the structure of the billing database and data management system needed to support the recommended rate structure.

Section 5 of this report describes a range of revenue scenarios for achieving the level of service goals of the City established in Section 2. Based on this evaluation, the project recommended rates for the various customer categories and quantified the impact of these rates on a range of typical and unique property owners. Key features of this utility are provision for credits for property owners that take steps, or have intrinsic reasons, why their parcel contributes differently based on "green" technology that has been employed, measures that retain stormwater on the property, or stormwater management infrastructure or services that otherwise must be provided by the City. This section also addresses how the stormwater generated within publicly owned road rights-of-way and similar areas within the City are calculated, and establishes credits for those areas where stormwater infrastructure is located or that otherwise facilitate stormwater management activities.

Finally, **Appendix A** includes the ordinances, policies, regulations, and procedures necessary to support the City's stormwater utility and its services. Included in this appendix are the specific legal description of the rate methodology, the rates and charges established for FY 2007/08, procedures for applying for credits and adjustments, and specific billing procedures and practices. In addition, an adjustment process was established so that customers can have a review of their specific situation and adjustments could be made if necessary. In addition, the utility provided an enforcement process to address those customers that apply for these variances, and do not follow through on the implementing or maintaining these measures.

1.3 Public Engagement

The public engagement element of the project was the most critical component for implementation of the stormwater utility. This element included the development of a stakeholder's task force. The objective was to initiate and carry out a consensus-building process for support of the stormwater user charge concept. First, CDM prepared a Public Engagement plan to facilitate implementation of



Public engagement activities involved a consensus-building process for support of the stormwater user charge concept.

Table 1-1. Ann Arbor Stormwater Citizens Advisory Committee Members

Stakeholder Organization	Participant
MDEQ	Rachel Matthews
WCDC	Janis Bobrin
U of M	Rich Robben Kevin Donovan
A2 Public Schools	Randy Trent Tim Gruszcynski
Pfizer	Steve Kapeller, P.E Michael Lemon (backup)
Downtown Development Authority	Susan Pollay
Chamber of Commerce	Brandt Coltis Doug McClure
Apartment Associations	Tom Ewing Jay Holland
Interfaith Council	Chuck Warpehoski
Huron River Watershed Council	Ric Lawson Laura Rubin
Environmental Commission	Rita Curuso Malama Chock
Citizens	Mike Appel John Kaczor Todd Pascoe

the stormwater financing system and satisfy public education and involvement requirements of MDEQ's stormwater permitting program. **Appendix B** includes a copy of the Public Engagement Plan.

The plan included guidance for forming and facilitating the Stormwater Citizen Advisory Task Force (SCATF); including committee membership, operating rules, key issues, meeting agenda and meeting materials. **Table 1-1** lists the members of the SCATF. The goals of the seven SCATF meetings was to educate members about the City's stormwater needs, seek input on the "affordable" level of service to meet those needs, support a financing mechanism that fairly distributes the cost of the program through the community, and allow SCATF members to brief the Mayor and City Council on their work and recommendations. The Public Engagement plan also identified the targets, objectives, and content of proposed meetings, and outreach materials, and included available examples of news articles, notices, brochures, public service announcements and video productions that have been used by other cities and counties during implementation of stormwater utilities.

1.4 Critical Study Objectives

CDM conducted a one-day project kickoff workshop to define goals and objectives for the cost of service study and explore the issues generated by the participants, which included staff from Systems Planning, Customer Service, Information Technology, and Legal, as well as representatives from the University of Michigan, Washtenaw County Drain Commissioner, Michigan Department of Environmental Quality, and the Huron River Watershed Council. This workshop was directed toward:

- Establishing the goals and objectives for the cost of service study.
- Identifying existing data resources to support the study.
- Discussing the level of service necessary to address the stormwater management needs of Ann Arbor.

- Delineating existing stormwater management program services and associated costs.
- Identifying existing City capabilities and key staff.
- Establishing the role of remote sensing and geographic information system (GIS) within the stormwater program.
- Establishing the role of City staff and others in the public education/information program.

Project objectives developed during the Project Kickoff Workshop were reviewed and revised during the first meeting of the Stormwater Citizen's Advisory Task Force. Based on these discussions, the following critical objectives were established for this study:

- Establish legal requirements for a fair, equitable rate structure
- Establish an acceptable level of service for stormwater management activities
- Establish responsibilities of City, property owners with regard to stormwater management
- Promote voluntary activities to control stormwater
- Control administrative burden
- Create a verifiable rate and credit structure
- Address Chapter 4 drainage district properties
- Provide "recognition" for "Green" practices

Section 2
Revenue Requirements and Level of Service Options

2.1 Introduction

A fair, equitable stormwater fee system must be based on the affordable revenue requirements for meeting public stormwater management objectives. This section assesses the needs of the City's stormwater program and, based on these needs, develops level of service objectives around which alternative rate structures and service fee levels can be developed.

2.2 Existing Stormwater Program Evaluation

An effective stormwater management program must address a wide range of issues. This section presents a "needs assessment" for the City's stormwater program, examining the readiness of the City to address the critical objectives identified for this project in Section 1.4, addressing the following major functional stormwater service areas:

- ***Administrative Services:*** Examine the roles of the various City areas and units in current stormwater management. Provide the City with recommendations on how to best provide for the oversight and coordination of the stormwater management activities conducted by the various City areas / units, in order to satisfy critical community concerns and Michigan Department of Environmental Quality (MDEQ) Phase II Stormwater Permit requirements.

Elements of an Effective Stormwater Management Program

- ***Public Engagement:*** Evaluate existing public education and engagement activities and recommend areas for enhancement.

- ***Regulation and Enforcement:*** Evaluate and enforce existing ordinances and regulations that control construction site runoff, post-construction runoff, floodplain management, and illicit discharges to the City's stormwater drainage system. Identify deficiencies in existing ordinance(s), programs and practices and provide recommendations on how to best address areas that require improvement, with specific examples where possible.

- ***Operations and Maintenance:*** Examine existing stormwater system maintenance practices and make recommendations for enhancements needed to meet program objectives.

- ***System Planning.*** Assess the stormwater management needs in the City, including existing stormwater problems and potential capital improvements requiring stormwater funding over a five- to ten-year period.

- ***Capital Improvements.*** Design and build new and substantial enhancements to the storm water infrastructure.

- ***Organization and Finance***: Define operating budget requirements and capital project needs based upon reported stormwater problems within the City and an assessment of personnel and equipment needs.

2.2.1 Existing Drainage System

Ann Arbor's stormwater drainage system captures, conveys, and stores flow generated by runoff. The drainage system consists of several components, including open channels, creeks, swales, ditches, pipes, detention ponds, manholes, catch basins, inlets, treatment devices, and curb drains. Drainage systems require proper maintenance to function properly and to prevent stormwater-related problems both upstream and/or downstream.

Ann Arbor is comprised of parts of eight watersheds: Allen, Fleming, Honey, Huron, Mallets, Millers, Swift Run and Traver Creeks. The stormwater conveyance systems in each system are generally contiguous segments of underground facilities and open channels. The watersheds are shown in **Figure 2-1.**

To better prioritize stormwater management needs, Ann Arbor's stormwater drainage system was divided into two systems: primary and secondary systems. Ann Arbor's primary drainage system is classified as the components of the system that drain areas approximately one square mile or larger (e.g. Allen Creek, Mallets Creek, Miller Creek). Ann Arbor's secondary drainage system includes all remaining drainage system components, and is intended to address areas where benefits are limited in scope to a local street, block, or neighborhood.

Various types of stormwater facilities serve each watershed. The City is one of several owners of these facilities. **Figures 2-2, 2-3, 2-4,** and **Table 2-1** define the approximate location, quantity, and ownership of storm drainage infrastructure within the City.

The quantities noted in Table 2-1 were based primarily on the information contained in the City's geographic information system (GIS), where the data has been georeferenced and accurate estimates of lengths can be made. There are areas where the GIS data is not comprehensive, and for those areas the GIS data was used as guidance and assumptions were made about the quantity of infrastructure. The following statements characterize the City's drainage system:

- Approximately 9 percent of the drainage system lies within the primary system, with the remaining 91 percent in the secondary system.

Figure 2-1: Major Watersheds in Ann Arbor

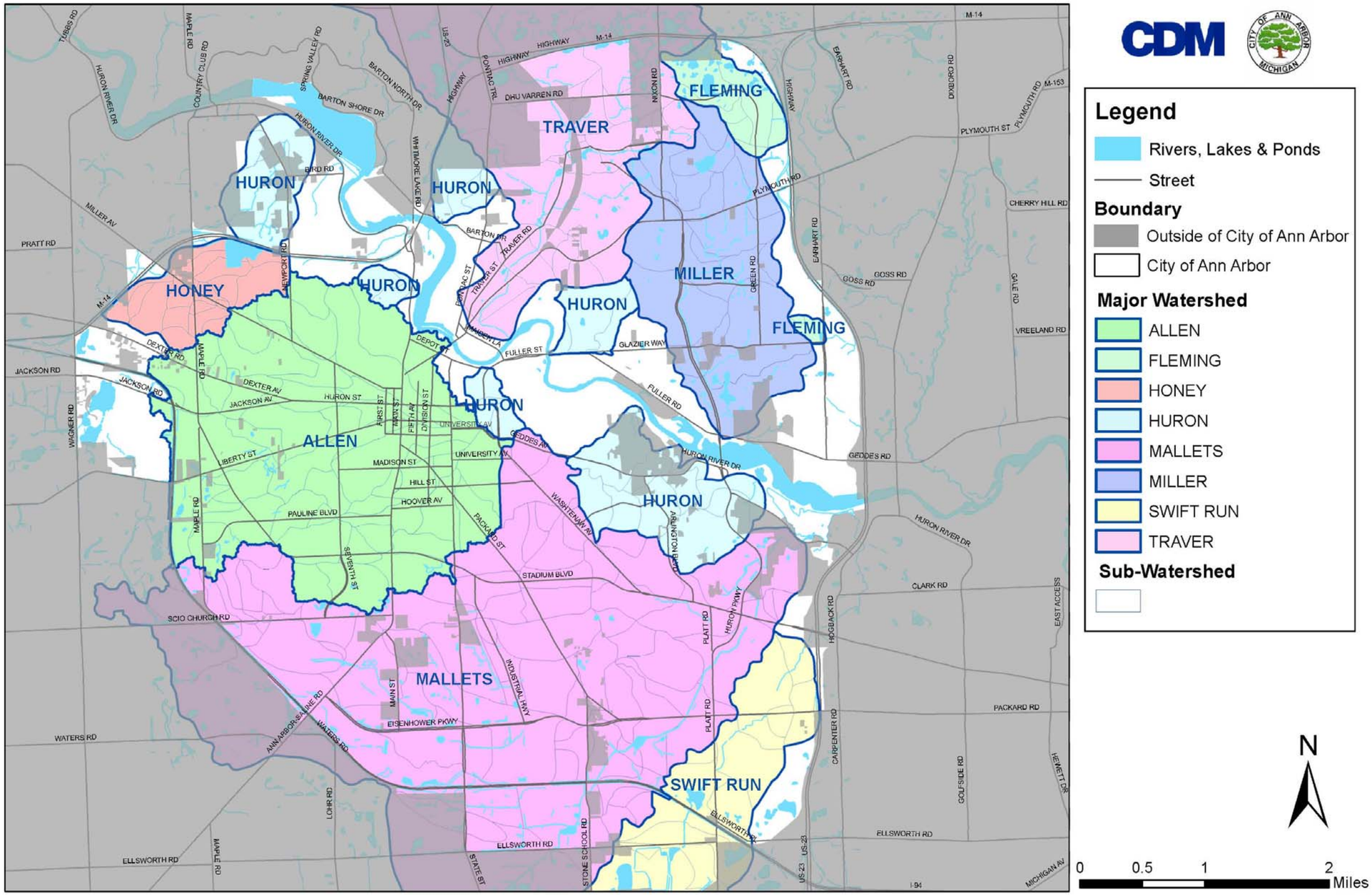


Figure 2-2: Storm Drainage Infrastructure in Ann Arbor

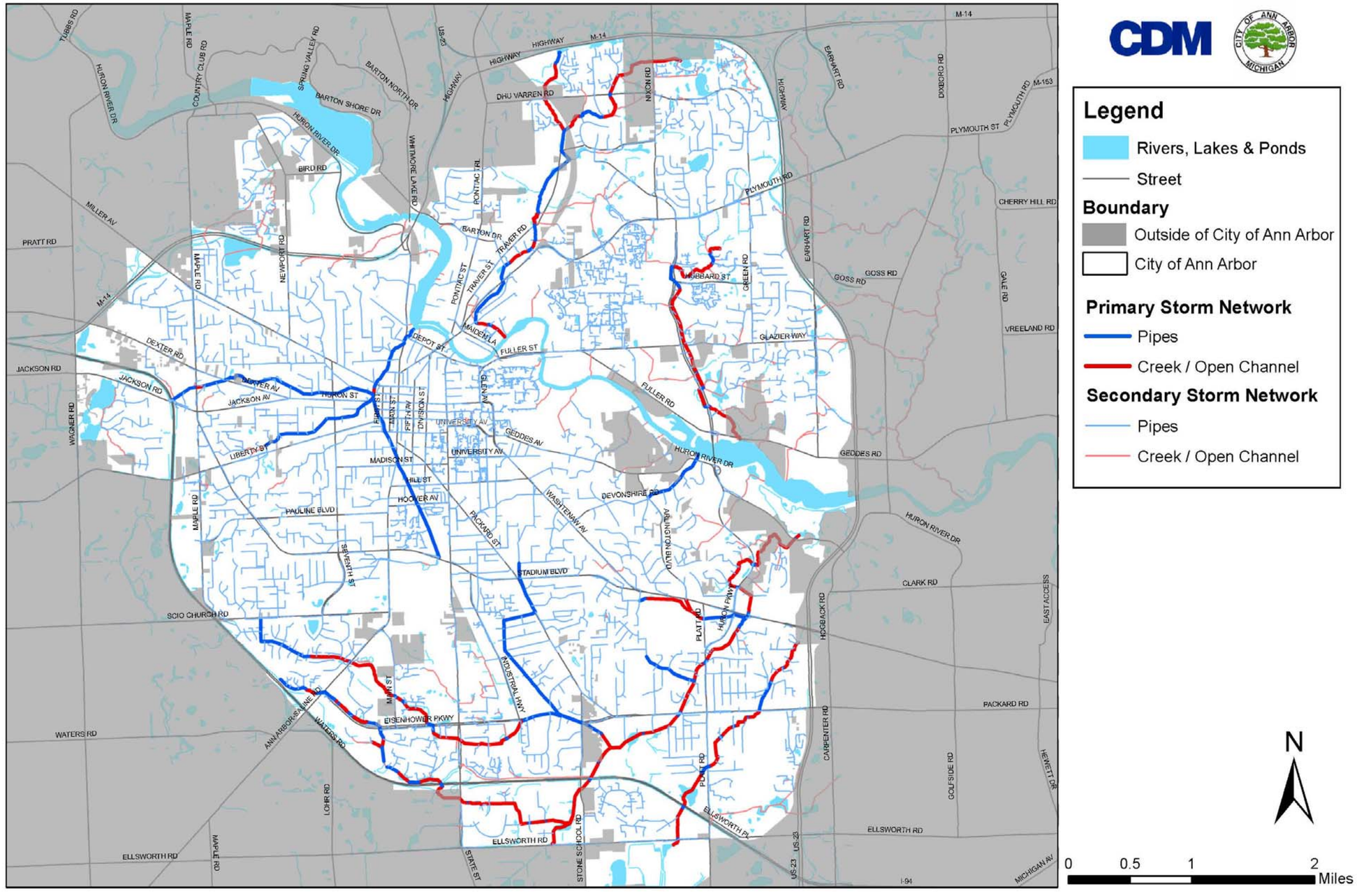


Figure 2-3: Stormwater Detention Facilities in Ann Arbor

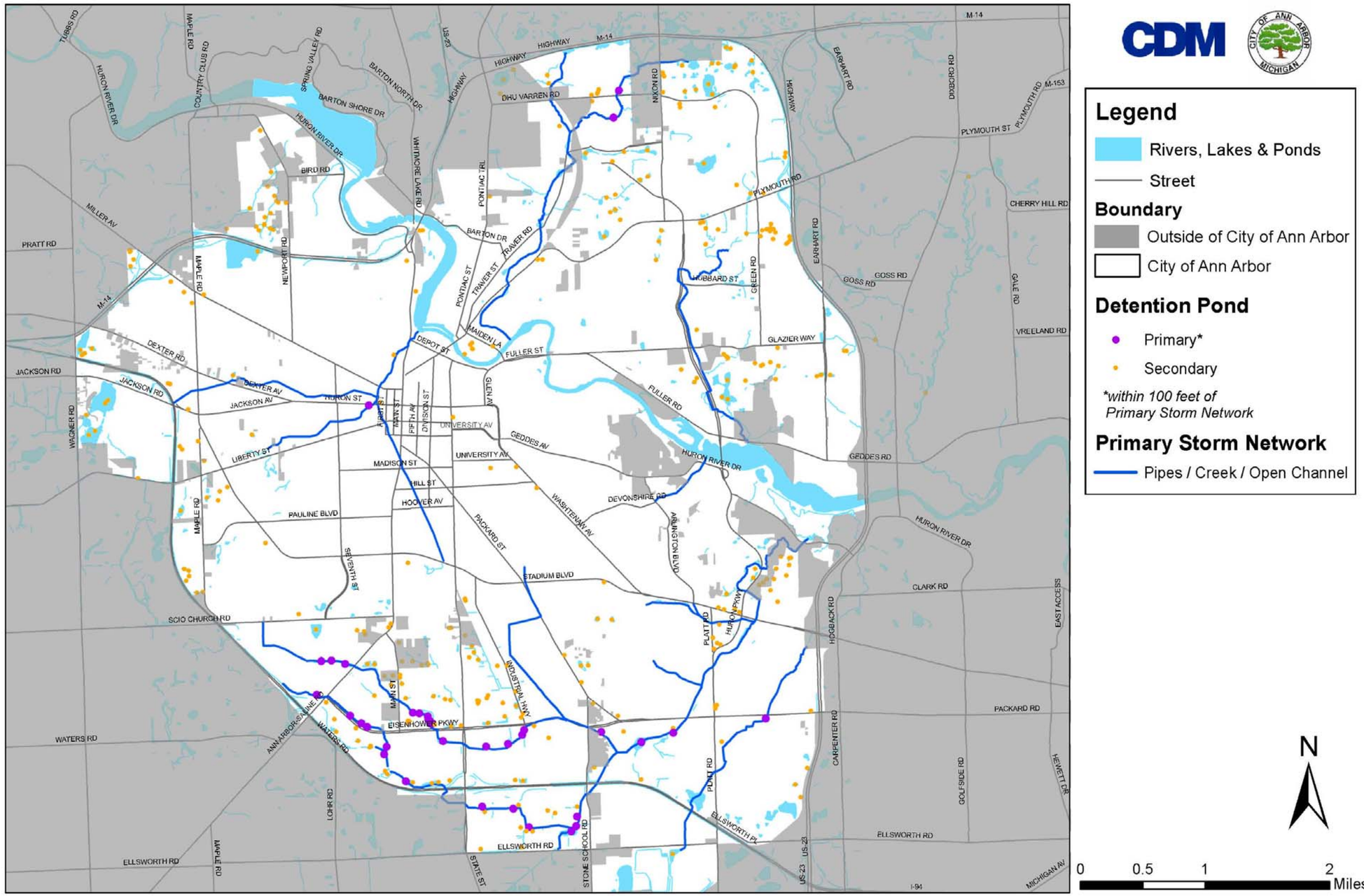


Figure 2-4: Ownership of Facilities in Ann Arbor

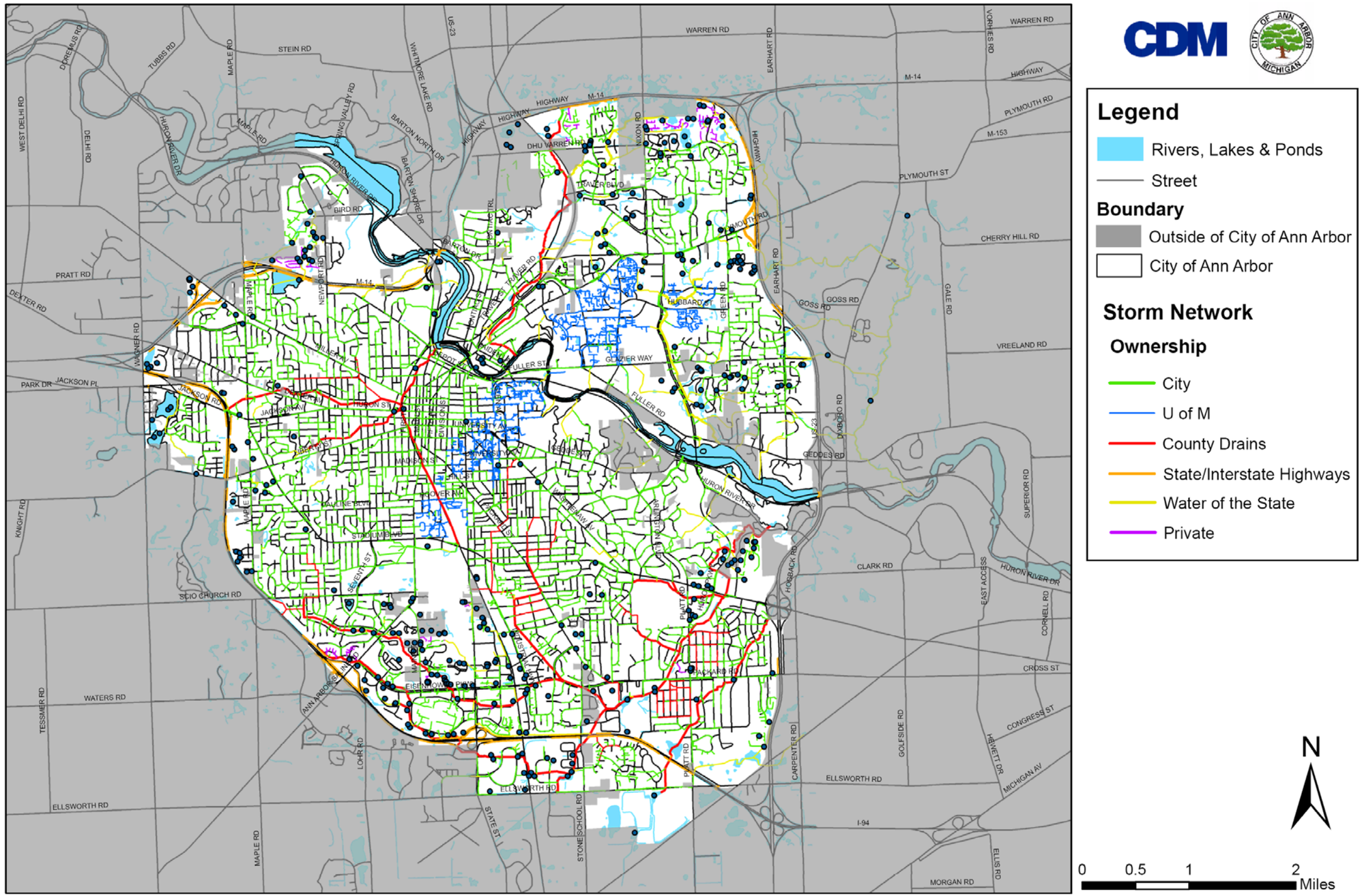


Table 2-1
City of Ann Arbor
Stormwater Utility Project
Estimated Inventory of Existing Stormwater Facilities

Type of System	System Element	Units	City	County Drains (1)	State/ Interstate Highways (2)	Water of the State (3)	U of M (4)	Private	Total
Primary	Creeks / Open Channels	miles	0	11.6		3.1	0	0	15
	Stream Crossings	units	0	49.0		9.0	2	2	62
	Pipes	miles	1.3	12.1		0	0	0	13
	Outfalls (5)	units	9	53		0	6	1	69
	Manholes (6)	units	53	295		0			348
	Surface Detention Locations (ponds, wetlands) (7)	units	2	28		5	0	1	36
Secondary	Creek / Open Channels	miles	0	0	23	28	0	0	51
	Stream Crossings	units	4	0		79	3	7	93
	Swales / Ditches (8)	miles	4.3	0	6	0	0	0.1	10
	Pipes	miles	211.8	10.5			42.5	5.1	270
	Outfalls (5)	units	213	0			31	33	277
	Manholes (6)	units	7000	286			2216	301	9802
	Catch Basins / Inlets	units	11000	683			1644	721	14047
	Treatment Devices	units	5						5
	Surface Detention Locations (ponds, wetlands) (7)	units	0	42			22	242	306
	Underground Detention Locations	units					1		1
	Curb & Gutter Roadway Conveyance	miles	3	24	0	0	0	0	27
	Roadway Curb and Gutters	miles	783						783
	Curb Drain for Sump Discharges (226 runs)	miles	9						9
	Sump Pumps (9)	units						653	653

(1) Surface detention locations located on / within 100 feet of County Drains
(2) Hydrologic features within 100 feet of section of I-94, M-14 inside City's Boundary. Assume 20% being Swale / Ditches, 80% being Creek / Open Channels.
(3) Open Channel which are not County Drains
(4) Surface detention locations based on a U of M RFP
(5) Based on Storm Coverage developed on Citywide Model and GIS project
(6) Field-Located
(7) Within 100 feet of Primary Storm Network
(8) Assume 2% of City / Private Road does not have Storm Pipes
(9) Based on Footing Drain Disconnection Project as of May 2006

- By length, approximately 46 percent of the primary and 90 percent of the secondary drainage systems consist of underground pipes. Most of these pipes lie within roadway right-of-way (City, County, and MDOT roadways) and provides drainage for both the road and adjoining properties.

- Approximately 2 percent of the City's streets have no underground facilities to convey and capture stormwater flow. Stormwater flows above ground in these streets to the lowest ground elevation for these portions of the City and can result in flooding, erosion, damage of infrastructure, etc.

- Open and culverted streams form the majority of the primary system drainage. More than 75 percent of these primary drains are under the jurisdiction of the Washtenaw County Drain Commissioner (WCDC), who performs maintenance on Chapter 4 and 20 drainage districts within the City. Improvements may also be made if a petition is filed. Some streams collect drainage from many properties, but do not lie in a public right-of-way or easement.

- The University of Michigan (U of M) owns and operates 22 detention facilities, as well as much of their own stormwater infrastructure within the City.

- The City estimates that over 350 sites include detention basins on private property and operation and maintenance of these basins is the responsibility of the respective property owners. Many of these sites have multiple detention basins.

2.2.2 Existing Stormwater Management Responsibilities

The City of Ann Arbor's existing stormwater management program can be organized into seven functional service categories:

- Administrative Services
- Public Engagement
- Regulation and Enforcement
- Operation and Maintenance
- System Planning
- Capital Improvements
- Organization and Finance

Appendix C summarizes existing functional stormwater management services, the service provider, and estimated Fiscal Year (FY) 2005/06 costs. This section describes each of these seven functional service categories, defines each current, and presents opportunities for enhancements needed to successfully fulfill program objectives.

2.2.2.1 Administrative Services

Existing Services

Administrative services include a percentage of the Public Services budget for overall program management, reporting to the Mayor and City Council, and coordination with the WCDC and major stakeholders (e.g., U of M). Administrative services also include a portion of the Public Services Customer Service budget to issue bills, collect funds, and field ratepayer inquiries and service requests. Additionally administrative services functional category captures the municipal service charge, covering an equitable share of City administrative services (legal, human resources, overall City administration, etc.).

Current Budget

The administrative services related to stormwater management are provided by the Administration and Systems Planning Units of the Public Services Area. These units perform most of the administrative, public engagement, regulatory and enforcement, and organizational and financial services described in this memorandum. Expenditures are not currently itemized according to these four functional service

areas. **Table 2-2** presents the estimated annual cost of administrative services for stormwater related issues. These costs were estimated through discussions with staff.

Opportunities for Enhancement
The City currently provides adequate administration of its stormwater management program for the existing level of service provided. The following enhancement opportunities should be examined:

- Clearly define activities to be included in the administrative services budget.
- Improve accounting of stormwater administrative services in order to appropriately fund these services from stormwater fee revenues.
- Examine roles and improve coordination between City Areas, maximizing City resources (e.g., with Parks and Recreation Unit on drainage improvements and with the Forestry program in the Field Operations Unit.)
- Minimize additional administration under expanded level of service options.

Table 2-2
Administrative Services
Annual Summary of Existing Stormwater Related Costs

Administrative Service Provided	Estimated Expenditures in FY 2005/06	Unit Providing Service
Administration		
Program Administration	$197,000	Administration (Labor, Benefits, Direct Costs, and Municipal Service Charge)
MS4 Permit Administration	$ 12,000	System Planning
Customer Service Request Management	$209,000	Transfer from Customer Service
Interjurisdictional Coordination	$ 32,000	Adminstration (services provided by WCDC), System Planning
Total Expenditures	**$450,000**	

2.2.2.2 Public Engagement

Existing Services
Stormwater related public engagement and educational programs are primarily conducted by the Administration, Systems Planning, and Water Treatment Units of the Public Services Area. Their efforts are supplemented by the Park and Recreation Unit of the Community Services Area, the City Communications Office, the Huron River Watershed Council (HRWC), and the WCDC. Methods the City currently uses to communicate with the public about stormwater issues include:

- Direct mail through the HRWC tip cards, calendars, and point-of-sale coupons
- "Water Matters" mailing with the water utility bills
- "Waste Watchers" (City Solid Waste Unit education program) information

- Advertising
- Labeling on the stormwater drains

Other public education and involvement activities in which the City is involved, or that the City uses to involve the public in stormwater management include:

- A pre-design meeting is held at the start of each road project
- Participation in Millers and Allen Creeks watershed groups, and Mallet's Creek Advisory Committee
- Participate in Middle Huron Initiative
- Extensive public involvement through projects done by WCDC, including the RiverSafe Homes and Community Partners for Clean Streams programs
- Participation in WCDC Citizen Advisory Committee
- Coordination of public education materials through the WCDC (City has a jurisdictional stormwater permit)
- Development of some informational materials for schools related to source water, which are transferable to stormwater
- Natural Areas Preservation staff involvement
- Efforts by the Canoe Livery
- "State of the Environment" report
- Systems Planning provides staff support to the Environmental Commission (a citizen group that advises council)
- Parks Advisory Commission in regards to greenbelt
- U of M has its own educational brochures, videos, vendor education materials, etc.
- Water resources education programs conducted by the Leslie Science Center
- Source water protection and public education programs sponsored by the Water Treatment Unit.

Current Budget
A number of stormwater public engagement activities are not separately accounted for by the City. Currently, the City budgets $100,000 annually to contract for MS4 permit-related public education activities. The City also pays $11,400 in annual dues directly to the HRWC, with System Planning staff investing a minimum of 22 hours

per month ($24,000 annually) in support of watershed, environmental and "resource user" groups. Programs performed by Public Services Administration ($5,000), the Water Treatment Unit ($75,000), and the Community Services Area ($20,000) have not historically been charged to the stormwater fund.

Opportunities for Enhancement
The City's public engagement activities are relatively mature and only a modest $50,000 increase in the level of effort is envisioned unless mandated under a new National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (MS4) permit. The following enhancement opportunities should be examined:

- The City anticipates that the time required to provide public education and to coordinate with watershed groups should increase about 50% ($12,000) in the future, supported by a proper allocation and accounting for staff time.
- New public outreach activities are anticipated to support compliance with emerging total maximum daily loads (TMDLs).
- The City should consider charging a portion of public engagement services provided by City Areas other than Public Services to the stormwater fund.
- The City should explore ways to enhance the current relationship with other organizations involved with stormwater services (e.g., U of M, WCDC, HRWC, Systems Planning, Parks Advisory, Leslie Science Center, and others).
- Public engagement activities are anticipated to create a "stewardship" ethic and to support the "green" credit system for voluntary actions by property owners to implement stormwater management activities (e.g., implementing on-site stormwater retention practices, participating in a recognition program like "Community Partners for Clean Streams" and RiverSafe Homes.)

2.2.2.3 Regulation and Enforcement

Existing Services
The City of Ann Arbor and other agencies have extensive local regulations and enforcement activities related to stormwater, which include:

- Best Management Practices for Storm Water: A Developers' Guide for Ann Arbor
- Rules, ordinances and policies through which the City of Ann Arbor regulates its stormwater system:
    - Chapter 33 of the City Code – Stormwater System
    - Chapter 57 of the City Code – Natural Features Protection

  - Chapter 59 of the City Code – Off Street Parking
  - Chapter 60 of the City Code – Wetlands Preservation
  - Chapter 62 of the City Code – Landscape and Screening
  - Chapter 63 of the City Code – Stormwater Management and Soil Erosion and Sedimentation Control
  - Standard Specifications of the Public Services Area – Storm Sewer Design, approved December, 1992
  - Mallett's Creek City Council Resolution
  - Selected chapters of the Michigan Drain Code

- Rules, ordinances and policies of other organizations that regulate or impact the stormwater system:
  - Rules of the Washtenaw County Drain Commissioner (note that these Rules are currently being rewritten).
  - Michigan Building and Residential Codes
  - MDEQ Permit required activities

- NPDES Permits for the following facilities:
  - Industrial Storm Water General Permit for Airport, expires April 1, 2009
  - Industrial Storm Water General Permit for Ann Arbor Maintenance Garage, 721 N. Main, expires April 1, 2009 City of Arbor MS4 Storm Water Permit, expired October 1, 2006. Expect to close Permit upon removal of salt operations in 2008.
  - City of Ann Arbor MS4 Permit for the WWTP, expires October 1, 2008 (includes Industrial Stormwater Permit requirements)

- City of Ann Arbor Stormwater Management Program, dated October 1, 2002 (as required by MS4 Permit), including:
  - Public Education Plan

- Illicit Discharge Elimination Program
- Post Construction Storm Water Management Plan for New Development and Redevelopment
- Construction Stormwater Runoff Control
- Stormwater Pollution Prevention/Good Housekeeping
- Best Management Practices and Measurable Goals

Several City units have responsibility for regulation and enforcement:

- ***System Planning Unit:*** floodplain management and monitoring compliance with the City's MS4 stormwater permit.
- ***Field Operations Unit:*** Miss Dig-required utility locates. Miss Dig has one full time staff person with approximately 20% of their time devoted to locating storm sewers, catch basins, inlets and leads. Also illicit discharge elimination program (IDEP), TV inspection and followup (illicit discharge detection), and spill response.
- ***WCDC:*** IDEP program contracted through WCDC.
- ***Community Services Area, Planning and Development Unit:*** Compliance inspection, site plan reviews for erosion and sediment control and post-construction stormwater controls, coordinating plan reviews with WCDC, and spill response.
- ***Safety Services Area:*** Spill response.

Current Budget
In FY 2005/06, the City estimated that the Systems Planning Unit provided approximately $75,000 of services for site plan reviews. In addition, the Community Services Area in coordination with the WCDC provided $143,000 in site plan reviews and erosion and sedimentation control inspections. The City estimated that $24,000 (20% of the Miss Dig services budget of $120,000) is related to locating storm system components. Fees paid by developers only recovered about $56,000 of the costs charged to the stormwater utility in FY 2005/06.

Estimated FY 2005/06 expenditures for illicit discharge detection and elimination were approximately $109,000. This was an increase over previous years expenditures, as activities had been limited to Closed Circuit Television (CCTV) inspections in response to contracted dry weather field screening at outfalls. Additional expenses can be expected as grants diminish and/or more comprehensive investigations are needed. Stormwater-related regulatory services performed by the Safety Services

Area (spill response services), the Field Operations Unit (natural area preservation regulation).

Opportunities for Enhancement
The City has enacted and currently enforces numerous regulations associated with stormwater quantity and quality management. The following enhancement opportunities should be examined:

- New regulatory programs may be needed in association with emerging TMDLs.
- Increased installation of structural and "green" stormwater best management practices (BMPs) as part of development projects and/or by existing property owners may need the support of regulatory reviews and site inspections with regard to proper design and appropriate maintenance.
- Grant funding for illicit discharge detection and elimination enforcement can not be assured, and additional staff and funding may be needed for this program.
- Pre-construction permit reviews for new public stormwater facilities are recommended to improve compliance and minimize development review delays.
- Enhance existing regulations with regard to illegal dumping, landscaping, and floodplain management.
- Develop and implement formal written policies and procedures for spill response, publicly-owned land in the floodplain, and enforcement actions.

2.2.2.4 Operation and Maintenance

Existing Services
A robust maintenance program is essential for the protection of water quality and proper function of the stormwater system. For example sedimentation, a recurring natural event, requires consistent maintenance for a properly functioning stormwater conveyance system. Typically, stormwater contains fine grained material mobilized during stormwater overland flow that will settle at locations where the stormwater flow velocity decreases. Over time, the sediments begin to accumulate at these decreased velocity locations, reducing the conveyance and storage capacity of the system, causing flooding. A proper maintenance program removes the accumulated sediment from within the stormwater conveyance system (catch basins, pipes, drainage ditches, detention ponds, open channels, etc.) to maintain the systems full flow capacity, decreasing the risk of flooding upstream.

The Field Operations Unit (FOU) is responsible for the infrastructure operation and maintenance program within the City of Ann Arbor, including streets, stormwater, water distribution, and wastewater conveyance. CDM assessed the City's existing operation and maintenance program through interviews with City staff and review of financial statements and budgets. Currently the FSU completes work orders

scheduled for that day. The major roles for the FSU Unit in stormwater management include:

- ***Administration*** covers overall supervision of the FSU, including tracking customer service requests, issuing work orders, and providing staff supervision.

- ***Street sweeping*** is performed three times per year (once in the spring, and twice in the fall after the leaves are down) with one of the two fall sweepings paid specifically by stormwater. Stormwater also pays whenever the vacuum trucks go out, which is done throughout the year.

- ***Leaf removal.*** Street sweeping is the only storm water related cost of leaf removal. All other leaf removal costs are covered by the Solid Waste Unit.

- ***Storm sewer inspection and cleaning.*** CCTV inspections of storm sewers are conducted at a rate of 5,000 feet/month. Storm sewers are cleaned by either jetting (using high pressure water) or rodding (using mechanical means to remove material), with jetting as the primary cleaning method. Rodding is performed periodically where CCTV inspections indicate tree root or other intrusions that are not able to be removed by jetting. The current cleaning program has all the storm sewers jetted once every six years. The quantity of debris removed is tracked and provided to System Planning for reporting to MDEQ.

- ***Catch basin inspection, cleaning, and repair.*** Maintenance is generally limited to selected catch basins at low points and those for which a clogged inlet work order has been generated. Quantity of material removed is logged and provided to System Planning for reporting to MDEQ.

- ***Open channel maintenance*** is performed on major creeks, including County drains. FOU staff walk these open channels once per year to clear the channels of downed trees and debris. Repair needs are identified. Some problems identified are referred to the Washtenaw County Drain Commissioner (WCDC), who also does some of their own maintenance. There may be more opportunities for collaboration with the WCDC.

- ***Mosquito control*** is provided to address the potential for West Nile Virus. In 2005, $100,000 was spent ($60,000 for materials and equipment and $40,000 for temporary employees) in mosquito control efforts.

- ***Maintain stormwater treatment devices.*** There are eight swirl type treatment devices in the City (3 near Stadium, 2 on Liberty, 2 near Packard and 1 on Bens Street). These treatment systems require need cleaning to remove accumulated material annually.

- ***Stormwater Management at Maintenance Yards.*** The City has three maintenance yards, with most stormwater-related work performed in the yard located at 2000 S. Industrial. Two maintenance yard sumps are periodically cleaned by the City,

with the third being maintained by a private contractor as it contains oil and grease. These three yards are currently being decommissioned, with all operations moved to the new Wheeler Service Center at 4251 Stone School Road.

- ***WCDC*** performs and/or oversees maintenance on Chapter 4 and 20 drainage districts within the City.

- ***County Road drainage*** is maintained by the Washtenaw County Road Commission, with City support.

Table 2-3 summarizes our understanding of the existing operation and maintenance level of effort on Ann Arbor's stormwater system. Inspecting and cleaning services within a maintenance program are "preventative maintenance" which is performed to improve the overall function of the stormwater conveyance system. Benefits obtained through preventative maintenance include optimizing the hydraulic conveyance and capacity of each of the individual components and identifying and resolving minor problems before they escalate into major problems. Referring to Table 2-3, preventative maintenance or repair services are currently performed on the existing stormwater facilities but there are opportunities for improvement.

Table 2-3
City of Ann Arbor
Stormwater Utility Project
Existing Operation and Maintenance Program

System	Component	Current Work Performed
Primary	Creeks / Open Channels	All major creeks are walked annually for inspection, clearing debris, and identifying repair needs.
	Associated Culverts	Inspected as part of creek walks.
	Pipes	TV inspect 5,000 ft of primary and secondary storm sewer per month. All storm sewers are jetted every 6 years. Storm sewer lining is contracted out.
	Outfalls	Some outfalls assumed to be inspected as part of creek walks.
	Manholes	Repair/replace manholes - sometimes as part of road projects. Condition is also assessed via TV'ing of sewers.
	Surface Detention Locations (ponds, wetlands)	Limited inspections being done.
Secondary	Creeks / Open Channels	Limited inspections being done.
	Associated Culverts	Limited inspections being done.
	Swales / Ditches	Limited inspections being done.
	Associated Culverts	Limited inspections being done.
	Pipes	TV inspect 5,000 ft of primary and secondary storm sewer per month. All storm sewers are jetted every 6 years. Storm sewer lining is contracted out.
	Outfalls	Some outfalls assumed to be inspected as part of creek walks.
	Manholes	Repair/replace manholes - sometimes as part of road projects. Condition is also assessed via TV'ing of sewers.
	Catch Basins / Inlets	Apply control for West Nile; frequently clean known low points to remove debris and prevent clogging; also cleaned in response to customer complaints.
	Treatment Devices	Remove accumulated materials once every 5 years.
	Surface Detention Locations (ponds, wetlands)	Limited inspections being done.
	Underground Detention Locations	N/A
	Curb & Gutter Roadway Conveyance	All streets are sweeped 2-3 times per year - one is charged to SW utility.
	Curb Drain for Sump Discharges	Limited inspections being done.
	Sump Pumps with lines to Curb Drain	N/A
	Sumps for Facility Yard Drainage	Cleaned once every 2-3 years.

Current Budget
Estimated expenditures for stormwater management activities conducted by the Field Operations Unit in FY 2005/06 are $696,000 (excluding capital outlays, depreciation, and interest, which are addressed under capital improvements). Also, approximately $109,000 expended on illicit discharge elimination is considered as a regulatory enforcement functional activity. Costs are tracked and allocated to the stormwater budget in the following manner, based on information provided by Field Operations and Public Services Administration staff:

- ***Equipment Costs*** – The FOU maintains a list of which equipment was purchased from each fund, including the stormwater fund (0069). Estimated stormwater-related 2005/06 expenditures was approximately $47,000 for maintenance of "revolving equipment" and $60,000 for trucks and other "rolling stock", for a total cost of $107,000.

- ***General Expenses*** – FOU costs not specifically allocated to another category are applied to a general category. This general category is allocated based on 40% for water supply, 40% for sanitary sewer, and 20% for storm sewer.

- ***Street Sweeping*** – No street sweeping expenditures were charged to stormwater budget during FY 2005/06. Beginning in FY 2006/07, $125,000 has been budgeted for stormwater-related street sweeping. This was anticipated to cover the costs of, one of three annual street sweeping events (one of the two Fall sweepings).

- ***Administration*** – Approximately $63,000 to administer stormwater elements of the Field Operations Unit. Expenditures varied substantially from FY 2003/04 to FY 2005/06.

- ***Center*** – Expenditures of $25,000 during FY 2005/06 cover storm water related worked done in 2000 S. Industrial yard.

- ***Merchandising & Jobbing*** – The $12,000 estimated expenditures for stormwater merchandising and jobbing is largely covered by the individual property owners receiving the service.

- ***Rodding*** – Approximately $8,000 was expended for stormwater-related services during FY 2005/06.

- ***TV*** – Approximately $58,000 was expended during FY 2005/06 for TV inspections of storm sewers, performed at rate of 5,000 feet/month.

- ***Catch Basins*** – Approximately $146,000 was expended during FY 2005/06 for catch basin (CB) cleaning and debris removal.

- ***Ditch*** – The stormwater expenditures of approximately $62,000 during FY 2005/06 cover the open channel maintenance described earlier in this memorandum. This expense is expected to increase to nearly $600,000 as the city

is taking over maintenance of more County Roads which do not have enclosed drainage systems.

- ***Jetting –*** The stormwater expenditures of approximately $132,000 during FY 2005/06 are for ongoing preventative maintenance which covers all storm sewers within a 6 year cycle.

- ***Spill Response -*** Currently budgeted with Safety Services. None is budgeted in Public Services.

Opportunities for Enhancement
The City practices operation and maintenance procedures that address significant stormwater quantity and quality issues. The following enhancement opportunities should be examined:

- It is expected that the number of stormwater treatment devices will increase as the City plans their addition when doing major road rebuilding projects, and that the maintenance frequency of these devices should increase with time.

- Preventative operation and maintenance is desired for the secondary system to determine if the benefits of extending this program to the secondary level will have a cost effective benefit for the system as a whole.

- Installation of detention basins at existing city facilities when new facilities are constructed. In addition, maintenance strategies for private detention facilities should be evaluated.

- Implement on a pilot scale the plan for increasing street sweeping in order to help control phosphorus and silt loading to watercourses. Expand from pilot scale as results warrant.

- The City's three existing maintenance facilities will be closed by 2008 and the new facility in Pittsfield Township will have a decant center for handling non-stormwater runoff. The capital cost of the decant center is $600,000, with the center expected to receive 10 to 11 truckloads per week. If the estimated disposal cost of the collected solids is $20 / cy, then the expected annual operating cost would be approximately $2,000 per week, or $100,000 annually. Stormwater services are projected to provide about 45 percent of the center activity, thus a budget of $45,000 should be established for decant activities.

- Design and implement leaf removal to minimize phosphorus and debris loading in stormwater systems, and to reduce catch basin plugging and accompanying localized flooding.

2.2.2.5 System Planning

Existing Services

Several agencies have conducted planning studies regarding Ann Arbor's stormwater system, including the Systems Planning Unit of the City's Public Services Area, the WCDC, MDEQ, and the HRWC. The following planning studies have affected and/or are expected to influence stormwater management in the City:

- The City's 1997 Stormwater Master Plan evaluated the hydraulic capacity of the City's drainage systems with a 36-inch diameter or larger, identified problem areas, and recommended capital improvements and/or regulatory approaches to resolve these problems. This Plan concluded that significant flooding problems occur within the Allen and Mallets Creek watersheds during the 10-year design storm, with much less severe flooding projected in the other six City watersheds. With the evolution of Federal stormwater regulations, control of water quality is as important, if not more important, than water quantity control. Water quality is most cost effectively controlled at or near the source of the runoff water. Thus the strategy of downstream or regional water quantity control (i.e., build larger pipes) does not integrate with current water quality control strategy.

Flood Mitigation Objectives

1. Utilize up to date mapping and technology
2. Increase community knowledge about floodplains
3. Integrate floodplain management into City planning and zoning
4. Limit flood impacts through regulations and development standards
5. Identify properties for corrective actions
6. Protect City infrastructure within floodplains
7. Practice good response / preparedness

- The City has an ongoing project to update the City's GIS database of stormwater infrastructure and develop a hydrologic/hydraulic model of the storm drainage system.

- The City's 2008 – 2013 Capital Improvements Plan recommends $11.8 million in projects and studies over the next 5 years, with the proposed GIS implementation and planning studies discussed later in this section. Proposed design and construction projects will be described in the Capital Project Section of this memorandum.

- The City's 2003 Natural Features Master Plan contains numerous stormwater related recommendations, including reductions in impervious surfaces and enhanced stormwater retention technologies. Natural feature protection regulations pertinent to the plan were discussed under the Regulatory and Enforcement section of this technical memorandum.

- The City prepared a draft Flood Mitigation Plan in March 2006 that establishes flood mitigation objectives (see box at left). This plan identifies previous watershed plan elements that are consistent with these objectives, recommends additional watershed planning according to these objectives, and identifies enhanced regulatory approaches in the Allen Creek watershed.

- Middle Huron Watershed Management Plan (the A2/Ypsi plan) includes Allen and Mallets Creeks and Ford Lake and is due for update by the WCDC, with no definite date for completion established. This plan focuses on actions to control phosphorus in the middle Huron River and to control algal blooms.

- Millers Creek Watershed Management Plan and Mallets Creek Restoration Plan have been completed by the WCDC and selected recommendations are included in the Ann Arbor CIP.

- U of M has prepared a Storm Water Plan for their facilities, however this plan has not been provided for review to date.

- The City updated their NPDES Stormwater Management Program description in 2002 in association with revised NPDES Permit Number MI0022217 issued November 2004. The program defines specific permit compliance activities, a schedule, and a set of measurable goals to achieve permit compliance. NPDES Program elements, which include public education, illicit discharge elimination, construction stormwater runoff control, and stormwater pollution prevention/ good housekeeping measures, align with the functional service categories described in this technical memorandum, and are described in each category.

- MDEQ has prepared four TMDL studies of water bodies in or near Ann Arbor:

    - TMDL for Escherichia Coli in Geddes Pond, August 2001

    - TMDL for Phosphorus in Ford and Belleville Lakes (September, 2004)

    - TMDL for Biota for Mallets Creek (August 2004)

    - TMDL for Biota for Swift Run Creek (November, 2004)

  MDEQ seeks to reduce phosphorus loading by 50% and TSS to 80 ppm in the Mallets Creek watershed. Recommended actions in the other three TMDLs are much less specific. MDEQ's Draft 2006 Sections 303(d) and 305(b) Integrated Report contains a schedule for planned TMDLs in other watersheds.

- The City currently operates three rain gages throughout the City as well as one stream gage on Malletts Creek.

- Planning for future TMDL's.

Current Budget

The estimated expenditures of the Systems Planning Unit for stormwater services during FY 2005/06 were approximately $224,000, but these expenses are expected to increase to approximately $526,000 in FY 2006/07. Approximately $69,000 of these funds were expended on the systems planning functions described in this section,

with remaining funds expended on certain public engagement and regulatory and enforcement services described in previous sections.

Opportunities for Enhancement
The various system planning initiatives described in this section are expected to continue. The following enhancement opportunities should be examined:

- Ann Arbor is evaluating an asset management system to help better program system maintenance, renewal, and improvement initiatives.
- The City seeks to upgrade and expand its rain and stream gage network with new equipment, including upgrades to cellular modems. The plan currently includes an additional rain gage at City Hall, which will bring the total number of city-wide rain gauges to four.
- Standard procedures and protocols are needed, prioritizing between floodplain mitigation and stormwater management practices with competing goals.
- GIS inventory of stormwater system – calibrated model of entire system.
- Develop and implement a plan assessing existing areas of environmental contamination, their impacts on existing stormwater quality, and the impact their remediation or lack there of would have on stormwater improvements.
- Integrate floodplain with City greenspace planning (e.g., greenways in floodplains) and establish priorities for property acquisition.

2.2.2.6 Capital Improvements

Existing Services
Recommended capital improvement projects (CIP) for the City were identified in the 1997 City of Ann Arbor Stormwater Master Plan. **Table 2-4** presents the City's current list of approximately $11.8 million in stormwater capital improvements, including the costs of "partial projects" where the project benefits activities other than stormwater. This list contains the project name, description, type of work, and present value costs. About $4.2 million of the $11.8 million dollars is identified for rehabilitation of the existing system infrastructure, with the Miller and Malletts Creek restoration projects being $1.5 million of the $4.8 million dollars. There are also several planning studies identified which will develop a scope of work for future improvements that are not yet budgeted.

Many of the CIP recommended in the 1997 Master Plan have not been initiated due to lack of funding for stormwater-related projects and/or the City's concerns about the cost-effectiveness to implement these recommendations. Portions of the CIP budget are for studies to obtain more accurate GIS information about the size and location of the drainage infrastructure, to build a hydrologic/hydraulic model of the system, and to support additional studies/re-studies of some of the more severe drainage problems in the City.

Table 2-4
Stormwater Projects 2008-2013 CIP
City of Ann Arbor

Project Name	Type of Drainage System	Fiscal year	Cost
Rehabilitation of System Components			
Ferry St / Westover Ave / Jackson Rd Drainage through alternative "green" methods	Secondary	2007/08	$475,000
Harvard Drain in Nichols Arboretum	Secondary	2007/08	$150,000
Huron Parkway Median Bio-Swales	Secondary	2007/10	$645,000
Wayne St. Drainage Improvements	Secondary	2007/08	$115,000
Foxcroft (Hunting Valley No. 2) Storm Outlet / Pond Re-establishment	Secondary	2008/09	$135,000
Awixa Outlet Stormwater Repair	Secondary	2009/10	$375,000
Malletts Creek In-System Storage Structures	Primary	2007/11	$1,273,000
Miller Creek Bank Stabilization - Hubbard to Glazier	Primary	2007/08	$250,000
SUBTOTAL			**$4,168,000**
Replacement of System Components			
West Stadium Storm Sewer Replacement -- Pauline to South Main	Primary	2007/08	$1,200,000
Marlborough Storm Sewer Replacement	Secondary	2007/08	$150,000
North Main St. / Railroad Storm Sewer Outlet Replacement	Secondary	2007/08	$165,000
Oakwood / Edgewood Stormwater Repair / Replacement	Secondary	2008/09	$200,000
State St. and Newport Rd. Culvert Crossings	Primary	2007/08	$250,000
Residential Streets Stormwater Pipe Repairs (Phase II)	Secondary	2009/10	$650,000
SUBTOTAL			**$2,615,000**
New Facility Construction			
Demonstration Rain Gardens	Secondary	2008/12	$50,000
South State Street Storm Sewer Outlet (N of I-94)	Secondary	2009/10	$200,000
SUBTOTAL			**$250,000**
Data and Model Development			
Storm Asset ID, GIS Conversion & Model	Primary	2007/11	$3,264,000
SUBTOTAL			**$3,264,000**
Planning Studies			
Allen Creek Improvements Re-study	Primary	2010/11	$200,000
Millers Creek Drainage District Creation	Primary	2012/13	$1,000,000
Evergreen Subdivision Stormwater (Phase II)	Secondary	2011/12	$100,000
Eberwhite Woods Drain Study	Secondary	2011/12	$200,000
SUBTOTAL			**$1,500,000**
TOTAL			**$11,797,000**

The City also maintains a list of planned improvements identified through a variety of processes: staff knowledge, results of routine inspections, customer complaints, and regulatory compliance. Budgeting for these projects occurs in several different service areas of the City, although most are in the Systems Planning Unit budget. Other stormwater-related projects may be budgeted in other service areas if they are part of another project. For example, the Water Treatment Plant "Recycle Streams and Storm Water Improvements" project is budgeted under the Water Treatment Services Unit.

In addition to projects included in the CIP budget, the City must undertake unplanned capital outlays to address reconstruction of open channels, storm sewers, and manholes that develop structural problems beyond routine repairs provided by the Field Operations unit.

Current Budget
The City's FY 2005/06 budget for stormwater–related improvements is tabulated in the following line items of the City's budget:

- ***Capital Outlay*** –Approximately $850,000 was expended by Field Operations Unit in FY 2005/06 for storm sewer replacement projects. Small projects are managed by FOU and large projects are managed by the Project Management Unit (PMU), but both are included in the FOU budget. Several large projects are planned for FY 2006/07 but may get pushed into the next fiscal year. Storm sewer lining is contracted out, but is not included here. This budget includes repairs and new inlet leads under road re-surfacing projects.

- ***Capital Outlay/Manhole*** – Approximately $254,000 was expended by the Field Operations Unit for manhole reconstruction during FY 2005/06. This also includes manhole reconstruction for road replacement projects.

- ***County P&I*** – Principal and Interest for County drain projects was approximately $184,000 in FY 2005/06, charged to the Public Service Administration budget.

- ***Bonded P&I*** – Principal and Interest for the Depot St. outlet project was approximately $155,000 in FY 2005/06, charged to the Public Service Administration budget.

- ***Fund Depreciation*** – Depreciation of stormwater fund assets amounted to approximately $52,000 in FY 2005/06, charged to the Public Service Administration budget.

- ***Replacement Mainline Storm Sewers*** – Approximately $1.1 million replacement mainline storm sewers with specific road projects occurred during FY 2005/06. This included $433,000 for the Easy Street Alternative Design project. Capital expenditures are budgeted as $505,000 annually but may be higher and lower depending in part on road funding sources.

Opportunities for Enhancement
The City does not have adequate funding to support all of its known and unknown capital improvements, including flooding problems identified in the 1997 Master Plan where an adequate solution does not yet exist and emerging stormwater permit conditions and TMDLs that might require the City to implement capital projects to achieve mandated load reductions. In addition, the City should evaluate initiating a program to establish a stream corridor protection zone on each stream.

2.2.2.7 Organization and Finance

Existing Services
Stormwater services included in this functional service area include operating the stormwater billing system, financial planning, maintaining financial records, and preparing/tracking budgets. These services are provided by both Public Services Administration staff and the System Planning Unit.

The City of Ann Arbor has used a stormwater utility to fund construction of stormwater projects and maintenance of stormwater facilities since the early 1980s. This current utility employs a rather simple billing formula that groups residential users into a fixed rate category and evaluates the commercial and industrial customers based on their impervious area. While the basic existing rate structure meets the intent of charges proportional to use, one of the purposes of this cost of service and rate study is to determine if there is a more equitable method of establishing charges and providing a methodology for credits.

Current Budget
The City does not explicity track stormwater organizational and financial services. The following expenditures have been estimated through discussions with City staff:

- ***Financial Planning, Rate Projections, and Rate Structure***: The City estimates 0.4 FTEs are dedicated to this activity for this study, at an estimated cost of approximately $34,000.

- ***Maintenance of Non-Residential Billing Records:*** Before the new rate methodology, the City estimates 0.5 FTEs are dedicated to this activity, at an estimated cost of approximately $37,000.

Opportunities for Enhancement
This project is re-evaluating the City's stormwater rate structure, with a goal of developing an equitable, sustainable system that meets legal requirements. In addition, a more detailed accounting and cost tracking system may be needed to see that cost fundable from the stormwater rate are properly tracked.

2.2.3 Summary of Existing Stormwater Program Costs

The annual existing stormwater management program funding, as summarized in **Table 2-5**, is approximately $3.7 million, with additional expenditures of slightly more than $200,000. Improving the level of service for the existing stormwater management program would add certain benefits, but additional costs are associated.

Table 2-5
Estimated Expenditures for Existing Stormwater Management Program

Expenses by Functional Service Area	FY 2005/2006 Charges to Stormwater Budget	Stormwater Services by Other Units	Total FY 2006/2007 Stormwater Expenditures
Funding Provided by Service Fees			
o Administrative Services	$450,000	$0	$450,000
o Public Engagement	$135,000	$100,000	$235,000
o Regulations and Enforcement	$327,000	$30,000	$357,000
o Operation and Maintenance	$696,000	$90,000	$786,000
o System Planning	$69,000	$0	$69,000
o Capital Improvements	$1,980,000	$0	$1,980,000
o Organization and Finance	$71,000	$0	$71,000
Total	**$3,728,000**	**$220,000**	**$3,948,000**

2.3 Level of Service Options

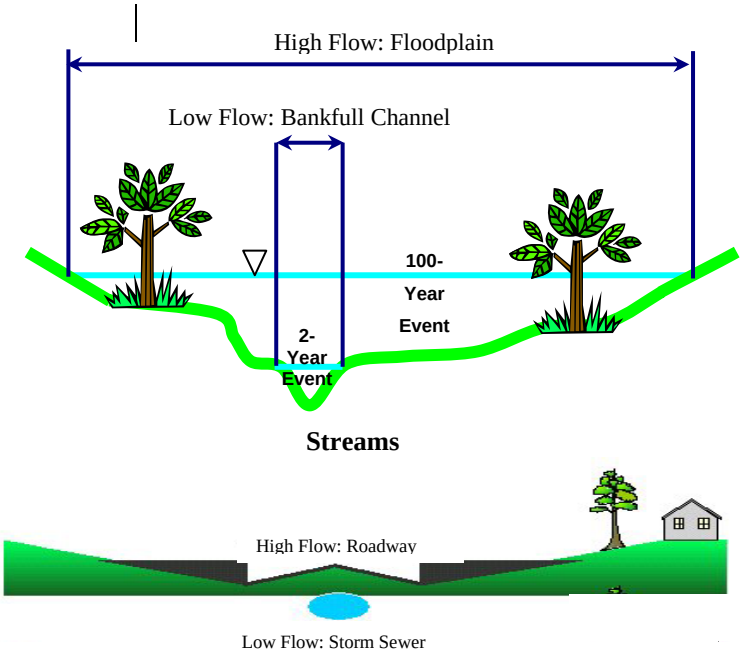
This section summarizes the development of level of service options for Ann Arbor's stormwater management program. A recommended level of service option was developed with the assistance of the City's Stormwater Citizen's Advisory Task Force (SCATF).

2.3.1 Level of Service Considerations

The level of service of Ann Arbor's stormwater management program describes the types of services provided by the City, the frequency at which these services are delivered, and the criteria used to determine when, where, and how to deliver each service. Policy goals, performance objectives, design criteria, and other techniques are used to define what the City plans to accomplish through its level of service. This section presents several key considerations used in defining a cost-effective level of service for the City's stormwater management program.

2.3.1.1 Frequency and Severity of Flooding

Flooding is a natural phenomenon accommodated within natural drainage systems. During rainfall events of small to moderate size, storm water runoff is contained within the banks, or the ***bankfull channel***, of streams. Typically, the bankfull conditions are exceeded about once every 2 years. During larger, less frequent storms, runoff overflows the channel banks into the surrounding ***floodplain***. Flooding causes problems when:



Both natural streams and urban drainage systems need a low-flow and high-flow component to accommodate flooding.

- Impervious surfaces are placed within the watershed draining into the stream, increasing runoff, stream flow, out-of-bank flooding, and floodplain size.
- Buildings, roads, infrastructure, or other human activities encroach into the floodplain.

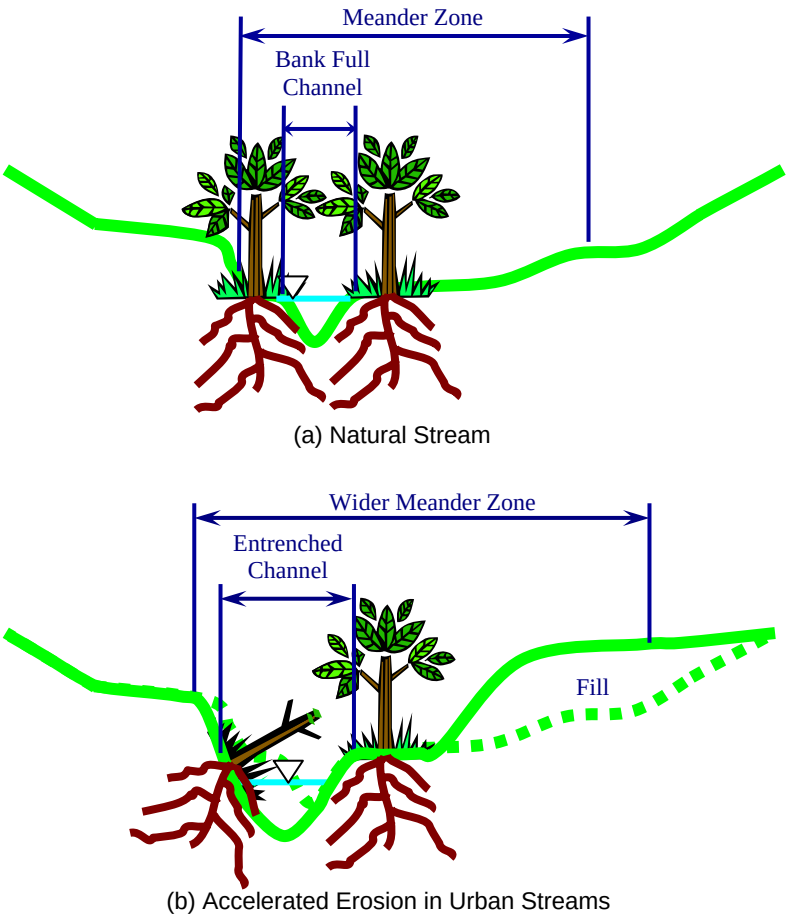
As areas develop, portions of the natural drainage system are often replaced with underground storm sewers sized to collect and convey runoff from small to moderate storms. Modern, properly designed developments use streets or swales to convey runoff from larger, less frequent storms to the open channel drainage system. Building or extended street flooding may occur if an appropriate surface drainage system is not provided.

Effective drainage system design depends upon how frequently the capacity of the "low-flow" system should be exceeded, and how severe the impact of flooding would be within the "high-flow" system. Frequency is usually expressed as a recurrence interval. An example of a recurrence interval is the 100-year design storm event, defined as a storm with a one percent probability of occurrence in any given year. Severity is quantified through hydraulic modeling to determine specific characteristics such as flood depth, length of roadway flooding, number of roadways that become impassable (e.g., greater than 8 in. in depth), number of structures where flooding reaches the foundation, and depth of flooding at structures.

2.3.1.2 Extent and Severity of Stream Erosion

All streams erode. Stream erosion is part of a natural geomorphic process that balances tractive forces and sediment transport within the stream system. The figure below illustrates two significant geomorphic features that characterize many streams:

- A ***bank full channel*** that flows full at a recurrence interval of 1.5 to 2 years



Comparison of Natural and Urban Stream Erosion

- A ***meander zone*** where the main channel naturally migrates, usually in a sinusoidal pattern, to maintain a stable stream length and slope

Stream erosion may accelerate within urban areas as flows increase or streams are straightened or constrained. Figure (b) illustrates how streams respond to these changes:

- The channel becomes ***entrenched*** due to the force of the increased flows, causing the stream to erode first down (downcutting) and then out as the streambank destabilizes.

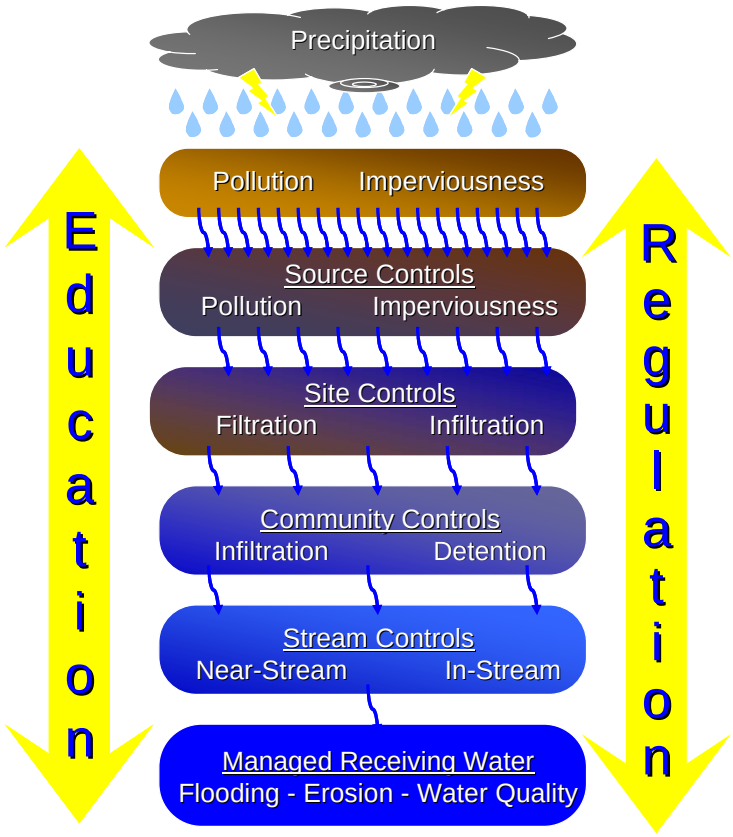
- The channel attempts to establish a ***wider meander zone,*** becoming longer and milder to reduce the increased velocity and return to a more stable condition. Often, development encroaches into the meander zone, reducing the ability of the stream to naturally adjust to its new flow regime.

Under these conditions, significant structural bank stabilization may be needed to prevent damage to property, structures, and natural habitat.

2.3.1.3 Stormwater Pollution Control

Stormwater is considered to be the leading cause of stream impairment in many urban streams, rivers, and other waterbodies. This impairment is often the result of two factors:

- Constituents from many of the materials and activities within urban watersheds enter stormwater and are rapidly conveyed to receiving waters before natural assimilative mechanisms can decompose them.



Multi-Level Strategy for Storm Water Management Programs

- The rapid conveyance of stormwater, particularly during small, frequent storm events, elevates flows and velocities within streams and rivers, damaging habitat and further reducing natural assimilative mechanisms.

Constituents are present, and velocities are elevated during large and small storm events. An appropriate level of service for stormwater pollution control involves a multi-level strategy recognizing that small storm events (those events generating less than one inch of precipitation) occur frequently and contribute more than 90 percent of the runoff during a typical year. Consequently, appropriate management of small storm events results in control of most stormwater impacts. Appropriate management techniques include source control (i.e., reducing pollutant sources exposed to precipitation and impervious areas that increase stormwater runoff), extended detention and conveyance (i.e., capturing and slowly releasing small storm runoff over 24 to 48 hours to allow pollutants to settle/biodegrade and to slow runoff velocities), and habitat preservation / renewal (i.e., enhancing the biological function of streams and their riparian zones to assimilate pollutants that reach them).

2.3.2 Level of Service Objectives

Defining the stormwater revenue requirements involves defining and analyzing various level of service options based on several factors:

- Technical feasibility and reliability based on current technology.
- Acceptability to the public and compliance with regulatory agency guidelines.
- A reasonable degree of public protection for the public funds expended.
- Consistency with known environmental goals.
- Financial feasibility.

The Stormwater Citizens Advisory Task Force (SCATF) was asked to recommend level of service objectives for City stormwater management programs. A

questionnaire was used to assist with establishing consensus around preferred objectives. The completed questionnaire representing committee consensus is found in **Appendix D**. Level of service objectives were established for the following nine types of issues:

- Flooding of dwelling, business, industrial, and institutional structures
- Flooding of private property
- Flooding of roadways
- Preservation of floodplains and stream buffer and wetland areas
- Stream bank erosion control and stream restoration
- Repair / renewal of deteriorated infrastructure (maintenance)
- Removal of sediment, debris and excessive vegetation
- Mosquito control
- Control of pollution in stormwater discharges

Addressing flooding of structures, repair of deteriorated infrastructure, and control of pollution in stormwater discharges were considered to be the most important issues for the SCATF members. In developing level of service objectives related to these issues, SCATF members suggested applying the following guiding principles to the City's stormwater management program:

- ***Protect public health, safety, and welfare.*** The extent, frequency, and duration of flooding are all important factors. Extensive, frequent flooding typically becomes an issue when it prevents long term access or causes property damage. Erosion caused by the flooding is an important factor, as this causes long term damage to property that must be addressed.
- ***Protect ecological health.*** The quality of the streams and water bodies in Ann Arbor was a significant issue to many community representatives. This includes a design to include a healthy and diverse habitat to the extent there are not physical constraints in the existing system. In addition, there is the design to improve and create this habitat where feasible as it would improve the overall quality of the downstream water systems, including the Huron River.
- ***Conduct comprehensive planning to determine priorities.*** Comprehensive planning is needed to set priorities, assign resources, and recognize where upstream new development is changing the floodplain. City responsibilities for addressing structural flooding must be made on a case-by-case basis through

sound planning based upon the causes and severity of flooding and the flood control requirements.

- ***Offer incentives to guide desired behaviors.*** Credits and incentives should be used to guide and reward behaviors that minimize negative effects on the stormwater system and water quality (e.g., encourage storage on private property).

- ***Encourage shared responsibility.*** Every class of stormwater user should be treated equitably in terms of the protection and services that are provided, and the required property owner responsibilities for stormwater management. Owners in the floodplain share in the responsibility to prevent flooding issues.

- ***Educate stormwater system users.*** There needs to be broad education on how stormwater management is accomplished.

- ***Provide an understandable, equitable rate structure***. The rate structure must be simple rather than complex, and while it may include credits for "green" behaviors, the intent is not to create a complex enforcement mechanism. In terms of the rate classes, these should be clearly tied to the use of the stormwater system, and any reductions should be caused by efforts taken by the property owners to mitigate those impacts.

2.3.3 Emerging Needs and Opportunities

This section describes emerging trends in stormwater management that are expected to influence the City's level of service.

2.3.3.1 Ann Arbor Stormwater Management Needs Assessment

Section 2.2 provides an evaluation of the City's existing stormwater program, identifying several areas where enhancements are needed and/or where programs related to stormwater that are conducted by other Areas and Units should receive stronger support from stormwater:

- ***Administrative Services:*** Provide additional coordination, support, and shared responsibilities to the Washtenaw County Drainage Commissioner.

- ***Public Engagement:*** Increase education to enhance public understanding and participation in City stormwater management program, provide additional support to watershed groups, and improve coordination and funding of educational efforts related to stormwater by other Areas / Units.

- ***Regulation and Enforcement:*** Implement and enforce Flood Mitigation Plan, assure funding of illicit discharge detection and elimination program, and enhance / support natural resource planning / implementation.

- ***Operations and Maintenance:*** Evaluate street sweeping programs in light of TMDL recommendations, enhance mosquito control program.

- ***System Planning:*** Develop stormwater GIS and system model, apply to prepare enhanced watershed plans and identify additional capital improvement and system renewal needs.

- ***Capital Improvements:*** Implement City FY 2008 to 2013 CIP

- ***Operation and Finance:*** More closely align budget tracking with functional service areas to prepare for annual reporting.

2.3.3.2 Watershed Evaluations and Opportunities

The City, the Washtenaw County Drain Commissioner, and Michigan DEQ have all evaluated various stormwater management issues affecting the watersheds within Ann Arbor. These evaluations include the City's 1997 Stormwater Master Plan and 2006 Flood Mitigation Plan, the Malletts Creek Restoration and Millers Creek Watershed Plans, and various MDEQ TMDL studies. These studies indicated that the various streams and their watersheds within Ann Arbor have differing drainage systems, drainage needs, and options for improvement. In order to adequately control flooding, erosion and water quality problems, some of the watersheds will require a high amount of difficult and expensive improvements. Therefore, the nature of these improvements will be critical:

- Can the level of performance objectives be best achieved by capital improvement programs or by private property initiatives or a combination of both?

- What barriers exist to implementing desired capital improvements that may make their cost prohibitive in some cases?

- What is an affordable funding level for capital improvements?

- What is the individual commitment and level of compliance necessary to assure the effectiveness of stormwater management measures provided by private property owners (e.g., rain barrels, rain gardens)?

- Are there opportunities to control storm water runoff through hydrologic controls, such as improving the tree canopy and/or using decentralized controls that enhance infiltration and evapotranspiration of precipitation?

- What assessment activities are still needed in order to be able to fully identify needs and improvement possibilities?

Currently, the City does not have adequate funding to support all of its known capital improvements, and the cost of additional anticipated requirements for improvements are unknown. Therefore, the additional funding and the equitable distribution of funds necessary to achieve these goals must be taken into account when evaluating potential solutions to meet desired level of service goals.

There are two basic categories of improvement recommended in the prepared plans:

- Floodplain management and non-structural controls (e.g., relocate structures out of floodplains, use floodproofing or berms to limit damage caused by flooding, conduct pollution prevention programs) and

- Storm drainage system improvements (e.g., structural improvements and/or maintenance to lower flood water elevations, slow erosive velocities, and remove pollutants from runoff).

The watershed planning conducted to date, as well as future watershed planning activities, should address the following issues within the level of service goals established in this memorandum:

Routine Operation and Maintenance
- Site visits and evaluations (annual and after major rain events)
- Silt removal (varies)
- Stream / culvert cleaning (annual)
- Grass channel grubbing / mowing
- Storm sewer CCTV and jetting (six-year cycle)

Remedial Operation and Maintenance
- Channel bank improvements
- Silt removal after major storms
- Channel and culvert cleaning after major storms
- Monitor structural rehabilitation
- Storm sewer cleaning after major storms

Capital Improvements to the Drainage System
- Channel lining
- Pilot-channel improvements
- Detention/retention storage
- Culvert and bridge modification
- Culvert and bridge replacement
- Channel reshaping / realignment
- Storm sewer modification
- Storm sewer replacement

Flood Plain Planning and Regulations
- Planning process
- Flood preparedness planning
  - Zoning changes
  - Land acquisition
  - Enforce floodplain regulation
  - Enforce storm water runoff regulations

Physical improvements
- Erosion and sediment control
- Flood proofing (wet and dry)
- Minor flood walls and berms
- Elevating buildings
- Relocating/removing buildings

Table 2-6 is a summary of the potential improvements that have been identified in previous studies for each watershed. Each potential improvement within each watershed is discussed in the following paragraphs.

Table 2-6: Comparison of Watershed Problems and Potential Improvements

Findings of Watershed Planning	Allen Creek	Fleming Creek	Honey Creek	Huron*	Malletts Creek	Millers Creek	Swift Run	Traver Creek
Flooding Severity	Repetitive	Limited	Limited	Limited	Limited	No	Limited	Limited
Potential Improvements Recommended by 1997 Stormwater Master Plan								
Modify/replace conveyance system	Yes – High cost	No	No	Yes	No	Partial	Yes	No
Add detention storage	Yes – High cost	No	Yes	Potential	No	No	No	Yes
Combination of detention & conveyance replacement	Yes – High cost	Yes	No	No	Yes	No	No	No
Land acquisition	Accept Lower LOS	No	No	No	No	No	No	No
Flood proof properties	Accept Lower LOS	No	No	No	No	No	No	No
Limited improvements	Accept Lower LOS	No	No	No	No	No	No	No
Zoning and floodplain restrictions	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Enforcement	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Estimated Capital Cost (1997 Master Plan)	$41.0M	$3.5M	$1.9M	$4.1M	$38.6M	$5.2M	$2.7M	$0.6M
TMDL Studies								
Status	Not Req'd	Not Req'd	2007 & 2009	Complete	Complete	Not Req'd	Complete	Not Req'd
Constituents	--	--	Biota, Pathogens	Phosphorus Pathogens	Biota	--	Biota	--
Controls	--	--	--	--	Riparian protection, flow & sediment control	--	Riparian protection, flow & sediment control	--
Implement Controls on Private Property	Yes	Unknown	Unknown	Unknown	Yes	Unknown	Unknown	Unknown

* Huron River recommendations may affect other tributary watersheds

Allen Creek

Allen Creek has a history of flooding problems. Significant portions of the main channel of Allen Creek and its major tributaries have been enclosed, eliminating or greatly diminishing floodplain storage. As a result, projected capital improvement needs are significantly greater in this watershed than within watersheds where the channel has not been enclosed and the floodplains are largely intact. Implementation of capital improvements is further complicated by the fact that much of the watershed is in an historic district. The 1997 Stormwater Master Plan identified the following alternatives for handling the stormwater flows:

1. Modify/replace the existing stormwater conveyance system
2. Provide detention storage
3. Use a combination of the above
4. Acquire properties that are prone to flooding
5. Flood proof properties
6. Provide improvements that meet a lower standard (lower flood event)
7. Implement private property actions

The first three options are extremely expensive. Alternatives 4 through 6 do not meet existing City design standards to provide for protection from a 10 year flood. However, these alternatives may provide some benefits and at lower costs. The Allen Creek total estimated cost for improvements for Alternative 3 (Combination of Detention Storage and Conveyance Replacement) was $41M. The effectiveness of private property actions (e.g., rain barrels, rain gardens, etc.) is unknown and needs to be evaluated.

Fleming Creek

This system experiences only minor flooding. Concerns over future development may create problems in the system. Therefore, the 1997 Stormwater Master Plan considered the following improvements:

1. Upgrade the existing conveyance system
2. Provide detention (consider a regional facility?)
3. Use a combination of the above.
4. Implement private property actions

The 1997 Stormwater Master Plan recommended detention to reduce flow and partial replacement of the conveyance system. The combination of approaches was estimated

at a cost of $3.5 M. Private property practices may be employed to help reduce this cost but their effectiveness is currently unknown.

Honey Creek
While limited flooding issues have been identified along Honey Creek, TMDL's are scheduled to address biota degradation (in 2007) and pathogen pollution (in 2009). Improvements are anticipated in the future, however, to address additional runoff from development projects, when much of the watershed will convert from agricultural to urban land use. Site specific detention facilities are currently envisioned in the Plan for this scenario. The 1997 Stormwater Master Plan recommended the cost of needed capital improvements at $1.9M. Private property practices may be employed to help reduce this cost but their effectiveness is currently unknown.

Huron River, including Geddes Pond, Ford Lake, and Belleville Lake
The portions of the Huron River watershed within Ann Arbor, but outside the watershed of the various Huron River tributaries consist predominantly of five areas drained by conveyance systems with a diameter of 36 inch and larger. While the Huron River does experience some flooding, this flooding is only slightly affected by the discharges within the City of Ann Arbor. To address localized flooding and to plan for future land use changes, the 1997 Stormwater Master Plan recommended some drainage system improvements. The options identified are to modify/replace the conveyance system; provide detention storage or a combination of both. A previous study recommended replacement of the system at a cost of $4.1M. Private property practices may be employed to help reduce this cost but their effectiveness is currently unknown.

TMDLs have been prepared for three impoundments along the Huron River – Geddes Pond (for pathogens), Ford Lake (for phosphorus), and Belleville Lake (for phosphorus). These TMDLs affect direct discharges to the Huron River as well as stormwater runoff within the watersheds of the various Huron River tributaries. Management measures suggested for TMDL compliance include catch basin cleaning, illicit discharge detection and elimination, public education, and structural controls for new development. City programs that address these TMDL limits should generally apply Citywide, potentially affecting the City's current policy to not charge stormwater fees to properties that directly discharge to the Huron River.

Malletts Creek
This is the largest creekshed within Ann Arbor. Flooding occurs at numerous locations throughout its drainage area. Future development is expected to exacerbate these problems. The 1997 Stormwater Master Plan evaluated the following alternatives:

1. Modify/replace conveyance system

2. Provide detention

3. Combination of the above

4. Acquire land in the most flood prone areas

5. Flood proof properties Implement private property actions

6. Develop improvements for a smaller storm event

7. Implement private property actions

To address the situation and comply with city standards, a combination of detention and modification/replacement of the system are recommended. Detention is possible in the upstream reaches, but would require land acquisition. Replacement is not financially feasible. The 1997 Stormwater Master Plan estimated the cost to completely address flooding issues in the Malletts Creek watershed at $38.6M. The effectiveness of private property actions is unknown and needs to be evaluated.

A TMDL has been prepared to address biota impairment and excessive sedimentation along Malletts Creek. This impairment is attributed to unstable flow regimes, bank erosion, sedimentation, and stormwater pollution. Management practices to address this impairment include upgrades to the riparian zone, detention and other BMPs to control sediment and reduce velocities, and stormwater control and impervious area reductions for new development. Construction is nearing completion on a regional detention facility in Mary Doyle Park, which was designed to provide regional sediment and velocity control.

Miller Creek
Flooding in this watershed occurs primarily in the upper reaches. The drainage system is unique in that the middle portion consists of very large open channels while the lower portion is a small, confined channel. The 1997 Stormwater Master Plan identified the following alternatives to address flooding in the watershed:

1. Modify/replace conveyance system

2. Provide detention

3. Combination of the above

4. Zoning and flood plain restrictions and enforcement

5. Implement private property actions

The configuration of this system lends itself to zoning and flood plain restrictions and enforcement as being effective options. In addition some channel widening might be required to help address the increased flows. The cost of these improvements was estimated in the 1997 Stormwater Master Plan at $5.2 M. The effectiveness of private property actions is unknown.

Swift Run
This watershed experiences only minimal flooding in the middle reaches. This flooding can be addressed by the addition of detention facilities, according to the 1997 Stormwater Master Plan at an estimated cost of $2.7 M. It should be noted that much of the watershed is currently residential with open areas. Infill development pressures have been changing this character and are increasing flooding issues as the land use is changing. Private property practices may help reduce this cost but their effectiveness is currently unknown.

A TMDL has been prepared to address biota impairment and excessive sedimentation along Swift Run. This impairment is attributed to unstable flow regimes, bank erosion, sedimentation, and stormwater pollution. Management practices to address this impairment include upgrades to the riparian zone, detention and other BMPs to control sediment and reduce velocities, and stormwater control and impervious area reductions for new development.

Traver Creek
Some flooding occurs in the lower reaches of the watershed. Future development pressure is expected to create problems. The following alternatives were identified:

1. Modify/replace the conveyance system

2. Provide detention

3. Combination of the above

4. Zoning and flood plain restrictions and enforcement

5. Both adding detention

6. Implement private property actions

Both adding detention and the development/enforcements of ordinances have been recommended. The prior cost estimate was $0.625M. The effectiveness of private property actions is unknown.

2.3.3.3 Deteriorating Infrastructure

All drainage infrastructure is subject to wear, tear, and structural deterioration as it ages. Engineers establish an expected service life of various types of structures based upon the materials used and the conditions encountered. Less expensive materials typically have a shorter expected service life than more expensive and durable materials, and system design usually involves an evaluation of the true "lifecycle" cost of infrastructure that accounts for its periodic maintenance and eventual replacement. It is reasonable to anticipate, therefore, that each component of the drainage system will require replacement or renewal at some point to address anticipated deterioration. Older portions of the drainage infrastructure may require replacement or renewal sooner than those more recently installed, but all drainage

infrastructure will eventually require replacement or renewal. As a result, it is reasonable to expect all stormwater rate payers to fund system replacement and renewal costs, even if the infrastructure directly serving their property is not expected to require renewal until many years in the future.

Anticipated costs of system replacement and renewal can be projected by examining the replacement value of the drainage system and its expected life. **Table 2-7** presents replacement and renewal costs for the Ann Arbor drainage system, presented in this manner. This table summarizes the estimated quantities of drainage infrastructure within the City, which includes all City-owned drainage infrastructure as well as County drains and Waters of the State where the City currently participates in system maintenance. Unit replacement costs are typical values for average sized drainage infrastructure within each category. Costs for stabilizing streambanks, restoring stream habitat (assumed to be required for 10 percent of the streams within the City), and for major sediment removal for detention facilities are also included. The expected life of this infrastructure is based on typical engineering economic assumptions for materials and construction conditions commonly encountered in Ann Arbor. Costs are presented in 2006 dollars.

Table 2-7 estimates the replacement cost of the entire drainage system within Ann Arbor at nearly $600 million. Based upon the expected life of this infrastructure from an engineering standpoint, the City's estimated annual renewal budget should be approximately $8.3 million, far exceeding the City's existing stormwater budget and traditional capital improvements budget. As the actual life of drainage infrastructure often exceeds its expected life, it would be reasonable to budget a lesser amount for system renewal, while gathering more specific information on system conditions and fine-tuning life expectancy assumptions.

2.3.3.4 NPDES MS4 Stormwater Permit Renewal

The City's current NPDES permit for stormwater discharges from its municipal separate storm sewer system (MS4) expired in 2006. To date, the MDEQ has been satisfied with the City's level of compliance. The MDEQ has stated, however, that they envisioned that the next round of stormwater permits would include more performance-based requirements rather than specific programmatic requirements. It is also envisioned that TMDL objectives will be reflected in permit requirements.

Table 2-7
City of Ann Arbor
Estimated System Replacement Value and Average Annual Renewal Needs

Component	Estimated Units[1]		Average Unit Replacement Cost	Estimated Replacement Cost	Expected Life (years)	Estimated Annual Renewal Cost
Primary Drainage System						
- Creeks / Open Channels	77,616	feet	$30 per foot[2]	$2,328,000	25	$93,000
- Stream Crossings	58	units	$250,000 each	$14,500,000	50	$290,000
- Pipes	70,734	feet	$1,500 per foot	$106,101,000	80	$1,326,000
- Outfalls (5)	62	units	$50,000 each	$3,100,000	80	$39,000
- Manholes (6)	348	units	Included in pipe cost	N/A	N/A	N/A
- Surface Detention Locations (ponds, wetlands) (7)	35	units	$1,000,000 each	$35,000,000	100	$350,000
Secondary Drainage System						
- Creek / Open Channels	147,840	feet	$30 per foot	$4,435,000	25	$177,000
- Stream Crossings	83	units	$50,000 each	$4,150,000	50	$83,000
- Swales / Ditches (8)	22,822	feet	$10 per foot	$228,000	25	$9,000
- Pipes	1,173,551	feet	$250 per foot	$293,388,000	80	$3,667,000
- Outfalls (5)	213	units	$10,000 each	$2,130,000	80	$27,000
- Manholes (6)	9,629	units	Included in pipe cost	N/A	N/A	N/A
- Catch Basins / Inlets (9)	20,635	units	$5,000 each	$103,177,000	50	$2,064,000
- Treatment Devices	5	units	$250,000 each	$1,250,000	25	$50,000
- Surface Detention Locations (ponds, wetlands) (7)	42	units	$250,000 each	$10,500,000	100	$105,000
- Underground Detention Locations	-	units	$500,000 each	$0	50	$0
- Curb & Gutter Roadway Conveyance	141,468	feet	Included in road cost	N/A	N/A	N/A
- Roadway Curb and Gutters	4,134,311	feet	Included in road cost	N/A	N/A	N/A
- Curb Drain for Sump Discharges (226 runs)	47,520	feet	$25 per foot	$1,188,000	50	$24,000
- Sump Pumps (10)	-	units	$3,000 each	$0	20	$0
				$581,475,000		**$8,304,000**

[1] Total of City-owned infrastructure, County drains, and Waters of the State

[2] Assumes 10 percent of streams require natural bank stabilization at an average cost of $300 per foot

(5) Based on Storm Coverage developed on Citywide Model and GIS project

(6) Based on Storm Coverage developed on Citywide Model and GIS project - and scaled up to match City's manholes estimate of 11,500

(7) Within 100 feet of Primary Storm Network

(8) Assume 2% of City / Private Road does not have Storm Pipes

(9) Total number of Inlet scaled from manholes - assume 2 inlet per manholes

(10) Based on Footing Drain Disconnection Project as of May 2006

These changes have several implications for the City's stormwater management program:

- New and / or refined management practices may need to be added to the City's program to address MDEQ's (as yet unstated) performance standards.
- More direct relationships may need to be established between the management practices and the pollutants of concern identified in the TMDL studies (e.g., pathogens, nutrients, elevated / unstable flow regimes).
- Enhanced monitoring and tracking of management practices, including flow monitoring, water quality sampling, and habitat assessments, are envisioned to evaluate achievement of performance standards.

2.3.4 Evaluation of Level of Service Options

Table 2-8 describes four alternative levels of service that were developed to assist the City and the SCATF in understanding the cost implications of various drainage system objectives. Each alternative Level of Service is defined by the degree to which each type stormwater service is provided, with the shaded areas indicating the existing level of service provided by the City:

- ***System Planning –*** Four level of service options are examined for system planning: comprehensive, routine planning of the entire system utilizing extensive surveillance, monitoring, and modeling (Level A), focused planning in priority areas to address known drainage and water quality issues (Level B), planning only in response to an observed drainage and/or water quality problem (Level C), and no planning (Level D). Existing system planning services nearly achieve service level C.
- ***Operation and Maintenance –*** Four level of service options are examined for the City's operation and maintenance program: a fully preventive, on-going maintenance program that anticipates needs (Level A), a program that routinely inspects the entire drainage system while only addressing existing observed problems (Level B), a program that only investigates and follows-up on reported stormwater problems (Level C), and a program that only investigates and

Table 2-8.
Level of Service Options for Ann Arbor Stormwater Management Program

Level of Service	System Planning	Capital Improvements	Operations and Maintenance	Enforcement, Public Engagement, & Finance
A	Comprehensive Planning	Total Renewal (20-year CIP)	Fully Preventive / 100% Routine	Proactive
B	Priority Planning	Partial Renewal (50-year CIP)	Inspection-based	Inspection-based
C	Reactionary Planning	Current CIP (100-year CIP)	Only complaint-based response	Only complaint-based response
D	No Planning	Emergency Repairs (No CIP)	Less than full response	Less than full response

responds to critical stormwater issues (Level D). Currently, the City performs operation and maintenance at a service level between C and D.

- ***Capital Improvements –*** Four level of service options are examined for capital improvements: a full system renewal option with annual investments equal to the full projected system renewal costs (Level A), a partial system renewal option, including a 25-year implementation schedule for capital improvements to all known problems (Level B), a low system renewal option, including a 50-year implementation schedule for cost-effective solutions to all known problems (Level C), and an emergency repair only option, including a 100-year implementation schedule for cost-effective solutions to all known problems (Level D). Currently, the City provides capital improvements at a service level slightly higher than D.

- ***Enforcement, Public Engagement, and Finance –*** Four level of service options are examined for the City's regulatory enforcement, public engagement, administrative, and organization / finance services: A proactive program that routinely performs inspections City-wide and actively engages the public (Level A), a program that inspects within areas where stormwater problems are most likely and provides education for priority issues (Level B), a program that conducts education, investigation and enforcement actions only in response to complaints (Level C), and a program that only investigates and responds to critical stormwater issues (Level D). Currently, the City performs enforcement, public engagement, and financial activities at a service level between B and C.

These regulations require the City to conduct a stormwater management program that provides stormwater pollution control in six major program areas:

- Public education about sources of stormwater pollution.
- Public involvement in stormwater pollution prevention initiatives.
- Identification and elimination of illicit changes to the stormwater system.
- Stormwater pollution controls to be implemented in areas of new development.
- Stormwater pollution and erosion sedimentation controls for construction sites.
- Municipal operation and maintenance practices that reduce stormwater pollution.

The *Bolt vs. Lansing* ruling has implications for the current funding structure and evaluation of level of service alternatives. The ruling from this court case finds that a connection between level of service and customer fees must be established. When evaluating the alternatives identified, the ability to develop an equitable, sustainable system that meets these legal requirements will be necessary. Task 2-C examines the cost of each service level and applies applicable legal tests to define appropriate funding mechanisms.

CDM reviewed the findings of various planning studies and gathered information from City staff on existing services and perceived service needs to compare the benefits between the existing level of service and the alternative levels of service for each category. Level of service alternative D was not evaluated, as the City's current level of service exceeds this level. The following sections describe the cost of service under level of service options A, B, and C in more detail.

2.3.4.1 Level of Service Options for System Planning

The City recognizes that planning is fundamental to sound stormwater management, and is actively pursuing the necessary information and tools to support enhanced, watershed-based planning in the future. A stormwater GIS and system modeling project began in FY 2006/2007 (Level of Service C). The Allen Creek watershed study is budgeted in the City's current CIP, and will refine the City's understanding of the existing level of service provided by the stormwater system in this watershed and allow the development of a strategy of coordinated capital projects and private property requirements to achieve desired level of service goals in this watershed.

Under Level of Service B and A, similar watershed planning studies are envisioned in the remaining watersheds. These plans will define specific capital improvements and timelines for implementing these improvements. These capital needs are expected to be consistent with, but more refined than the capital needs current projected by studies conducted to date. Therefore, the City's existing understanding of planning requirements and capital needs will be used to establish the anticipated cost of service for this rate study, which will be re-evaluated as planning proceeds.

2.3.4.2 Level of Service Options for Operations and Maintenance

Operation and maintenance requirements under each level of service option were determined by first establishing production measures (**Table 2-9)** for typical operation and maintenance activities, such as the maintenance practice, the crew size and experience level needed to conduct each practice, the amount of time required by a crew to maintain a single unit of infrastructure, and equipment and material requirements. Next, each level of service option is defined as the percent of the drainage system addressed annually by each operation and maintenance activity. Inspection and cleaning activities are included in the projected operations and maintenance budget, while repairs (Capital Outlays under the Field Operations Area budget) are included under capital improvements in this section. Four level of service options for operations and maintenance were evaluated:

- The ***existing level of service*** for operations and maintenance is presented in **Table 2-10.** This level of service represents actual City expenditures during FY 2005/2006. The table indicates that the City conducted a routine inspection of most major stormwater infrastructure; cleaned approximately 30 percent of the streams, 60 percent of the culverts, 17 percent of the storm drains, and 10 percent of the storm drain inlets; and repaired approximately 4 percent of the manholes and 1 percent of the storm sewers. Approximately $0.7 million was expended for operation and maintenance during FY 2005/2006.

Table 2-9
City of Ann Arbor
Stormwater Utility Project
Production Rates Used to Determine Level of Service Options

Component	Estimated Units		Equipment & Materials (Percentage of Labor)	Inspections				Cleaning				Repair			
				Method	Units per day	Labor Requirement		Method	Units per day	Labor Requirement		Method	Units per day	Labor Requirement	
						Workers	Supervisors			Workers	Supervisors			Workers	Supervisors
Systemwide Administration						$235	$323			$235	$323			$235	$323
- Customer Service															
- Center															
Primary Drainage System															
- Creeks / Open Channels	77,616	feet	35%	Stream Walk	10,560	3	0.0626	Remove Debris,Sed	1,000	3	0.0626	Stabilization	75	4	0.25
- Stream Crossings	58	units	35%	Stream Walk	10	3	0.125	Remove Debris,Sed	1	3	0.125	Spot Repair	1		
- Pipes	70,734	feet	35%	CCTV	850	3	0.0626	Remove Debris,Sed	100	3	0.0626	Spot Repair	50	4	0.125
- Outfalls (5)	62	units	35%	Stream Walk	5	2	0.083	Remove Debris,Sed	4	4	0.125	Spot Repair	1	5	0.125
- Manholes (6)	348	units	35%	Part of Pipe	8	2	0.0626	Part of Pipe	4	3	0.0626	Spot Repair	2	3	0.0626
- Surface Detention Locations (ponds, wetlands) (7)	35	units	35%	Visual	5	1	0.0626	Remove Debris,Sed	1	5	0.3125	Stabilization	0.25	5	0.3125
Secondary Drainage System															
- Creek / Open Channels	147,840	feet	35%	Stream Walk	10,560	3	0.0626	Remove Debris,Sed	1,000	3	0.0626	Stabilization	75	4	0.25
- Stream Crossings	83	units	35%	Stream Walk	10	3	0.125	Remove Debris,Sed	1	3	0.125	Spot Repair	1		
- Swales / Ditches (8)	22,822	feet	35%	Drive By	26,400	1	0.0626	Grading	1,000	3	0.0626	N/A	75	4	0.25
- Pipes	1,173,551	feet	35%	CCTV	850	3	0.0626	Jetting, Rodding	850	2	0.0626	Spot Repair	50	4	0.125
- Outfalls (5)	213	units	35%	Stream Walk	5	1	0.0626	Remove Debris,Sed	4	4	0.125	Spot Repair	1	4	0.125
- Manholes (6)	9,629	units	35%	Part of Pipe	8	2	0.0626	Part of Pipe	4	4	0.125	Spot Repair	2	4	0.125
- Catch Basins / Inlets (9)	20,635	units	35%	Drive By	100	1	0.0626	Vactor, Mosq. Cntl	16	3	0.0626	Spot Repair	4	3	0.0626
- Treatment Devices	5	units	35%	Visual	2	1	0.0626	Vactor	1	4	0.125	Spot Repair	0.2	5	0.3125
- Surface Detention Locations (ponds, wetlands) (7)	42	units	35%	Visual	5	2	0.083	Remove Debris,Sed	1	5	0.3125	Stabilization	0.25	5	0.3125
- Underground Detention Locations	-	units	35%	Visual	1	1	0.0626	Vactor	1	4	0.125	Spot Repair	0.5	5	0.3125
- Curb & Gutter Roadway Conveyance	141,468	feet	35%	Drive By	10,560	1	0.0626	Sweeping	1,000	3	0.0626	Spot Repair	100	4	0.125
- Roadway Curb and Gutters	4,134,311	feet	286%	Drive By	10,560	1	0.0626	Sweeping	52,800	1	0.0626	Spot Repair	100	4	0.125
- Curb Drain for Sump Discharges (226 runs)	47,520	feet	35%	CCTV, Jetting	650	3	0.0626	Rodding	650	3	0.0626	Spot Repair	50	4	0.125
- Sump Pumps (10)	-	units	35%	Visual	8	1	0.0626	N/A	4	2	0.0626	Mech. Repair	2	2	0.0626

Assumptions:

- Maintenance Supervisor Annual Salary $ 55,000
- Maintenance Worker Annual Salary $ 40,000
- Benefits & Overhead 35%
- Annual Holidays and Leave 30 days

Table 2-10
City of Ann Arbor
Stormwater Utility Project
Existing (FY 2005/2006) Operation and Maintenance Expenditures

Component	Estimated Units		Inspections				Cleaning				Total Operation & Maintenance
			Method	Percent of System per year	Units per year	Estimated Annual Cost	Method	Percent of System per year	Units per year	Estimated Annual Cost	
Systemwide Administration											
- Customer Service											$5,000
- Center											$26,000
Primary Drainage System											
- Creeks / Open Channels	77,616	feet	Stream Walk	60%	46,570	$4,000	Remove Debris,Sed	30%	23,285	$23,000	$27,000
- Stream Crossings	58	units	Stream Walk	60%	35	$3,000	Remove Debris,Sed	60%	35	$35,000	$38,000
- Pipes	70,734	feet	CCTV	17%	11,789	$14,000	Remove Debris,Sed	5%	3,537	$35,000	$49,000
- Outfalls (5)	62	units	Stream Walk	100%	62	$8,000	Remove Debris,Sed	0%	0	$0	$8,000
- Manholes (6)	348	units	Part of Pipe	0%	0	$0	Part of Pipe	0%	0	$0	$0
- Surface Detention Locations (ponds, wetlands) (7)	35	units	Visual	0%	0	$0	Remove Debris,Sed	0%	0	$0	$0
Secondary Drainage System											
- Creek / Open Channels	147,840	feet	Stream Walk	60%	88,704	$8,000	Remove Debris,Sed	30%	44,352	$43,000	$51,000
- Stream Crossings	83	units	Stream Walk	60%	50	$5,000	Remove Debris,Sed	60%	50	$50,000	$55,000
- Swales / Ditches (8)	22,822	feet	Drive By	0%	0	$0	Grading	0%	0	$0	$0
- Pipes	1,173,551	feet	CCTV	5%	58,678	$68,000	Jetting, Rodding	17%	199,504	$155,000	$223,000
- Outfalls (5)	213	units	Stream Walk	100%	213	$15,000	Remove Debris,Sed	0%	0	$0	$15,000
- Manholes (6)	9,629	units	Part of Pipe	0%	0	$0	Part of Pipe	0%	0	$0	$0
- Catch Basins / Inlets (9)	20,635	units	Drive By	100%	20,635	$71,000	Vactor, Mosq. Cntl	10%	2,064	$126,000	$197,000
- Treatment Devices	5	units	Visual	100%	5	$1,000	Vactor	20%	1	$1,000	$2,000
- Surface Detention Locations (ponds, wetlands) (7)	42	units	Visual	0%	0	$0	Remove Debris,Sed	0%	0	$0	$0
- Underground Detention Locations	-	units	Visual	0%	0	$0	Vactor	0%	0	$0	$0
- Curb & Gutter Roadway Conveyance	141,468	feet	Drive By	0%	0	$0	Sweeping	0%	0	$0	$0
- Roadway Curb and Gutters	4,134,311	feet	Drive By	0%	0	$0	Sweeping	0%	0	$0	$0
- Curb Drain for Sump Discharges (226 runs)	47,520	feet	CCTV, Jetting	0%	0	$0	Rodding	0%	0	$0	$0
- Sump Pumps (10)	-	units	Visual	0%	0	$0	N/A	0%	0	$0	$0
						$197,000				**$468,000**	**$696,000**

- ***Level of Service C*** for operations and maintenance is presented in **Table 2-11**. Under this level of service, the City would increase the system cleaning expenditures from $0.5 million to $0.8 million, with funding level increases targeted at annual stream and culvert cleaning. In addition, the City will pay for two of the three Citywide street sweeping events using stormwater funds. An additional $0.4 million is also budgeted for manhole, storm sewer, and stream erosion repairs. Approximately $1.2 million is budgeted for operation and maintenance during FY 2006/2007.

- ***Level of Service B*** for operations and maintenance is presented in **Table 2-12.** Under this level of service, the City would increase the system cleaning expenditures from $0.5 million to $2.1 million, with funding level increases targeted at annual cleaning of streams, culverts, outfalls, and public detention facilities, and doubling the cleaning frequency of storm drain inlets to once every 5 years on average. In addition, the City would conduct monthly street sweeping using stormwater funds. An additional $1.0 million is also budgeted for manhole, storm sewer, and stream erosion repairs. Approximately $2.6 million would be budgeted for operation and maintenance during FY 2006/2007.

Level of Service A for operations and maintenance is presented in **Table 2-13.** Under this level of service, the City would increase the system cleaning expenditures from $0.5 million to $7.0 million, with funding level increases targeted at annual cleaning of streams, culverts, outfalls, public detention facilities, storm drain inlets, and treatment devices. In addition, the City would conduct weekly street sweeping using stormwater funds. An additional $1.2 million is also budgeted for manhole, storm sewer, and stream erosion repairs.

Approximately $7.5 million would be budgeted for operation and maintenance during FY 2006/2007.

2.3.4.3 Level of Service Options for Capital Improvements

Numerous stormwater-related capital improvement projects are needed within the City of Ann Arbor. The cost to implement all identified capital improvements is over $100 million. Capital improvements are divided into two categories under this evaluation:

- ***Minor Capital Improvements*** consist of system repairs and minor upgrades generally performed by Field Operations Unit crews and currently tracked as "Capital Outlays". **Table 2-14** lists the estimated frequency of repair and estimated annual repair costs under each level of service option.**

- ***Major Capital Improvements*** generally consist of significant projects that commonly require a complete design, bid, and award process. Major capital improvements consist of the the City's 2008-2013 Capital Improvements Program (Table 2-4) and similar projects that may emerge under a comprehensive replacement and renewal program (Table 2-7).

Table 2-11
City of Ann Arbor
Stormwater Utility Project
Level of Service C: Operation and Maintenance Budget

Component	Estimated Units		Inspections				Cleaning				Total Operation & Maintenance
			Method	Percent of System per year	Units per year	Estimated Annual Cost	Method	Percent of System per year	Units per year	Estimated Annual Cost	
Systemwide Administration											
- Customer Service											$5,000
- Center											$26,000
Primary Drainage System											
- Creeks / Open Channels	77,616	feet	Stream Walk	100%	77,616	$7,000	Remove Debris,Sed	100%	77,616	$76,000	$83,000
- Stream Crossings	58	units	Stream Walk	100%	58	$6,000	Remove Debris,Sed	100%	58	$58,000	$64,000
- Pipes	70,734	feet	CCTV	17%	11,789	$14,000	Remove Debris,Sed	5%	3,537	$35,000	$49,000
- Outfalls (5)	62	units	Stream Walk	100%	62	$8,000	Remove Debris,Sed	0%	0	$0	$8,000
- Manholes (6)	348	units	Part of Pipe	0%	0	$0	Part of Pipe	0%	0	$0	$0
- Surface Detention Locations (ponds, wetlands) (7)	35	units	Visual	0%	0	$0	Remove Debris,Sed	0%	0	$0	$0
Secondary Drainage System											
- Creek / Open Channels	147,840	feet	Stream Walk	100%	147,840	$14,000	Remove Debris,Sed	100%	147,840	$145,000	$159,000
- Stream Crossings	83	units	Stream Walk	100%	83	$8,000	Remove Debris,Sed	100%	83	$83,000	$91,000
- Swales / Ditches (8)	22,822	feet	Drive By	100%	22,822	$0	Grading	100%	22,822	$22,000	$22,000
- Pipes	1,173,551	feet	CCTV	17%	195,592	$225,000	Jetting, Rodding	17%	199,504	$155,000	$380,000
- Outfalls (5)	213	units	Stream Walk	100%	213	$15,000	Remove Debris,Sed	0%	0	$0	$15,000
- Manholes (6)	9,629	units	Part of Pipe	0%	0	$0	Part of Pipe	0%	0	$0	$0
- Catch Basins / Inlets (9)	20,635	units	Drive By	100%	20,635	$71,000	Vactor, Mosq. Cntl	10%	2,064	$126,000	$197,000
- Treatment Devices	15	units	Visual	100%	15	$3,000	Vactor	20%	3	$4,000	$7,000
- Surface Detention Locations (ponds, wetlands) (7)	42	units	Visual	0%	0	$0	Remove Debris,Sed	0%	0	$0	$0
- Underground Detention Locations	-	units	Visual	0%	0	$0	Vactor	0%	0	$0	$0
- Curb & Gutter Roadway Conveyance	141,468	feet	Drive By	0%	0	$0	Sweeping	0%	0	$0	$0
- Roadway Curb and Gutters	4,134,311	feet	Drive By	0%	0	$0	Sweeping	400%	16,537,243	$140,000	$140,000
- Curb Drain for Sump Discharges (226 runs)	47,520	feet	CCTV, Jetting	0%	0	$0	Rodding	0%	0	$0	$0
- Sump Pumps (10)	-	units	Visual	0%	0	$0	N/A	0%	0	$0	$0
						$371,000				**$844,000**	**$1,246,000**

Table 2-12
City of Ann Arbor
Stormwater Utility Project
Level of Service B: Operation and Maintenance Budget

Component	Estimated Units		Inspections				Cleaning				Total Operation & Maintenance
			Method	Percent of System per year	Units per year	Estimated Annual Cost	Method	Percent of System per year	Units per year	Estimated Annual Cost	
Systemwide Administration											
- Customer Service											$5,000
- Center											$26,000
Primary Drainage System											
- Creeks / Open Channels	77,616	feet	Stream Walk	100%	77,616	$7,000	Remove Debris,Sed	100%	77,616	$76,000	$83,000
- Stream Crossings	58	units	Stream Walk	100%	58	$6,000	Remove Debris,Sed	100%	58	$58,000	$64,000
- Pipes	70,734	feet	CCTV	17%	11,789	$14,000	Remove Debris,Sed	5%	3,537	$35,000	$49,000
- Outfalls (5)	62	units	Stream Walk	100%	62	$8,000	Remove Debris,Sed	100%	62	$20,000	$28,000
- Manholes (6)	348	units	Part of Pipe	0%	0	$0	Part of Pipe	0%	0	$0	$0
- Surface Detention Locations (ponds, wetlands) (7)	35	units	Visual	100%	35	$2,000	Remove Debris,Sed	100%	35	$120,000	$122,000
Secondary Drainage System											
- Creek / Open Channels	147,840	feet	Stream Walk	100%	147,840	$14,000	Remove Debris,Sed	100%	147,840	$145,000	$159,000
- Stream Crossings	83	units	Stream Walk	100%	83	$8,000	Remove Debris,Sed	100%	83	$83,000	$91,000
- Swales / Ditches (8)	22,822	feet	Drive By	100%	22,822	$0	Grading	100%	22,822	$22,000	$22,000
- Pipes	1,173,551	feet	CCTV	17%	195,592	$225,000	Jetting, Rodding	17%	199,504	$155,000	$380,000
- Outfalls (5)	213	units	Stream Walk	100%	213	$15,000	Remove Debris,Sed	0%	0	$0	$15,000
- Manholes (6)	9,629	units	Part of Pipe	0%	0	$0	Part of Pipe	0%	0	$0	$0
- Catch Basins / Inlets (9)	20,635	units	Drive By	100%	20,635	$71,000	Vactor, Mosq. Cntl	20%	4,127	$252,000	$323,000
- Treatment Devices	105	units	Visual	100%	105	$18,000	Vactor	20%	21	$28,000	$46,000
- Surface Detention Locations (ponds, wetlands) (7)	42	units	Visual	100%	42	$6,000	Remove Debris,Sed	100%	42	$145,000	$151,000
- Underground Detention Locations	-	units	Visual	100%	0	$0	Vactor	100%	0	$0	$0
- Curb & Gutter Roadway Conveyance	141,468	feet	Drive By	100%	141,468	$5,000	Sweeping	50%	70,734	$69,000	$74,000
- Roadway Curb and Gutters	4,134,311	feet	Drive By	0%	0	$0	Sweeping	1200%	49,611,728	$925,000	$925,000
- Curb Drain for Sump Discharges (226 runs)	47,520	feet	CCTV, Jetting	17%	8,078	$12,000	Rodding	4%	1,901	$3,000	$15,000
- Sump Pumps (10)	-	units	Visual	20%	0	$0	N/A	10%	0	$0	$0
						$411,000				**$2,136,000**	**$2,578,000**

Table 2-13
City of Ann Arbor
Stormwater Utility Project
Level of Service A: Operation and Maintenance Budget

Component	Estimated Units		Inspections				Cleaning				Total Operation & Maintenance
			Method	Percent of System per year	Units per year	Estimated Annual Cost	Method	Percent of System per year	Units per year	Estimated Annual Cost	
Systemwide Administration											
- Customer Service											$5,000
- Center											$26,000
Primary Drainage System											
- Creeks / Open Channels	77,616	feet	Stream Walk	100%	77,616	$7,000	Remove Debris,Sed	100%	77,616	$76,000	$83,000
- Stream Crossings	58	units	Stream Walk	100%	58	$6,000	Remove Debris,Sed	100%	58	$58,000	$64,000
- Pipes	70,734	feet	CCTV	17%	11,789	$14,000	Remove Debris,Sed	20%	14,147	$138,000	$152,000
- Outfalls (5)	62	units	Stream Walk	100%	62	$8,000	Remove Debris,Sed	100%	62	$20,000	$28,000
- Manholes (6)	348	units	Part of Pipe	0%	0	$0	Part of Pipe	0%	0	$0	$0
- Surface Detention Locations (ponds, wetlands) (7)	35	units	Visual	100%	35	$2,000	Remove Debris,Sed	100%	35	$120,000	$122,000
Secondary Drainage System											
- Creek / Open Channels	147,840	feet	Stream Walk	100%	147,840	$14,000	Remove Debris,Sed	100%	147,840	$145,000	$159,000
- Stream Crossings	83	units	Stream Walk	100%	83	$8,000	Remove Debris,Sed	100%	83	$83,000	$91,000
- Swales / Ditches (8)	22,822	feet	Drive By	100%	22,822	$0	Grading	100%	22,822	$22,000	$22,000
- Pipes	1,173,551	feet	CCTV	17%	195,592	$225,000	Jetting, Rodding	20%	234,710	$183,000	$408,000
- Outfalls (5)	213	units	Stream Walk	100%	213	$15,000	Remove Debris,Sed	0%	0	$0	$15,000
- Manholes (6)	9,629	units	Part of Pipe	0%	0	$0	Part of Pipe	0%	0	$0	$0
- Catch Basins / Inlets (9)	20,635	units	Drive By	100%	20,635	$71,000	Vactor, Mosq. Cntl	100%	20,635	$1,262,000	$1,333,000
- Treatment Devices	500	units	Visual	100%	500	$86,000	Vactor	100%	500	$661,000	$747,000
- Surface Detention Locations (ponds, wetlands) (7)	42	units	Visual	100%	42	$6,000	Remove Debris,Sed	100%	42	$145,000	$151,000
- Underground Detention Locations	-	units	Visual	100%	0	$0	Vactor	100%	0	$0	$0
- Curb & Gutter Roadway Conveyance	141,468	feet	Drive By	100%	141,468	$5,000	Sweeping	50%	70,734	$69,000	$74,000
- Roadway Curb and Gutters	4,134,311	feet	Drive By	0%	0	$0	Sweeping	5200%	214,984,155	$4,008,000	$4,008,000
- Curb Drain for Sump Discharges (226 runs)	47,520	feet	CCTV, Jetting	17%	8,078	$12,000	Rodding	4%	1,901	$3,000	$15,000
- Sump Pumps (10)	-	units	Visual	20%	0	$0	N/A	10%	0	$0	$0
						$479,000				**$6,993,000**	**$7,503,000**

Table 2-14
City of Ann Arbor
Stormwater Utility Project
Projected Capital Outlays (Minor Capital Improvements) under Level of Service Scenarios

Component	Estimated Units		Method	Existing Level of Service			Level of Service C			Level of Service B			Level of Service A		
				Percent of System per year	Units per year	Estimated Annual Cost	Percent of System per year	Units per year	Estimated Annual Cost	Percent of System per year	Units per year	Estimated Annual Cost	Percent of System per year	Units per year	Estimated Annual Cost
Primary Drainage System															
- Creeks / Open Channels	77,616	feet	Stabilization	10%	7,762	$142,000	25%	19,404	$356,000	25%	19,404	$356,000	25%	19,404	$356,000
- Stream Crossings	58	units	Spot Repair	0%	0	$0	0%	0	$0	2%	1	$0	2%	1	$0
- Pipes	70,734	feet	Spot Repair	0%	0	$0	3%	2,122	$56,000	3%	2,122	$56,000	3%	2,122	$56,000
- Outfalls (5)	62	units	Spot Repair	0%	0	$0	40%	25	$41,000	40%	25	$41,000	40%	25	$41,000
- Manholes (6)	348	units	Spot Repair	4%	14	$7,000	3%	10	$5,000	3%	10	$5,000	3%	10	$5,000
- Surface Detention Locations (ponds, wetlands) (7)	35	units	Stabilization	0%	0	$0	0%	0	$0	5%	2	$12,000	5%	2	$12,000
Secondary Drainage System															
- Creek / Open Channels	147,840	feet	Stabilization	5%	7,392	$136,000	5%	7,392	$136,000	5%	7,392	$136,000	5%	7,392	$136,000
- Stream Crossings	83	units	Spot Repair	0%	0	$0	0%	0	$0	2%	2	$0	2%	2	$0
- Swales / Ditches (8)	22,822	feet	N/A	0%	0	$0	0%	0	$0	2%	456	$8,000	2%	456	$8,000
- Pipes	1,173,551	feet	Spot Repair	1.0%	11,736	$310,000	1%	11,736	$310,000	2%	23,471	$621,000	2%	23,471	$621,000
- Outfalls (5)	213	units	Spot Repair	0%	0	$0	40%	85	$113,000	40%	85	$113,000	40%	85	$113,000
- Manholes (6)	9,629	units	Spot Repair	4%	385	$255,000	4%	385	$255,000	4%	385	$255,000	4%	385	$255,000
- Catch Basins / Inlets (9)	20,635	units	Spot Repair	0%	0	$0	0%	0	$0	2%	413	$101,000	2%	413	$101,000
- Treatment Devices*	5	units	Spot Repair	0%	0	$0	0%	0	$0	5%	5	$45,000	5%	25	$215,000
- Surface Detention Locations (ponds, wetlands) (7)	42	units	Stabilization	0%	0	$0	0%	0	$0	5%	2	$14,000	5%	2	$14,000
- Underground Detention Locations	-	units	Spot Repair	0%	0	$0	0%	0	$0	5%	0	$0	5%	0	$0
- Curb & Gutter Roadway Conveyance	141,468	feet	Spot Repair	0%	0	$0	0%	0	$0	2%	2,829	$37,000	2%	2,829	$37,000
- Roadway Curb and Gutters	4,134,311	feet	Spot Repair	0%	0	$0	0%	0	$0	0%	0	$0	0%	0	$0
- Curb Drain for Sump Discharges (226 runs)	47,520	feet	Spot Repair	0%	0	$0	0%	0	$0	2%	950	$25,000	2%	950	$25,000
- Sump Pumps (10)	-	units	Mech. Repair	0%	0	$0	0%	0	$0	5%	0	$0	5%	0	$0
						$850,000			**$1,272,000**			**$1,825,000**			**$1,995,000**

Assumptions:

- Maintenance Supervisor Annual Salary	$	55,000
- Maintenance Worker Annual Salary	$	40,000
- Benefits & Overhead		35%
- Annual Holidays and Leave		30 days
- Treatment Units under LOS B		105
- Treatment Units under LOS A		500

Table 2-15 itemizes projected capital improvements under each level of service option. Each option is premised on a capital improvement program able to achieve a certain level of the $8.3 million annual system replacement and renewal needs projected in Table 2-7. Under the existing level of service (FY 2005/2006), the City performs $850,000 in capital outlays through its Field Operations Unit, and is in the process of completing capital projects begun in previous fiscal years, maintaining an existing debt service of $430,000.

Approximately 25 percent of the City's estimated system renewal needs are addressed under this level of service. Level of service C increases the annual CIP budget to approximately $2.6 million, in year 2006 dollars. Under this level of service, about 100 years are needed to complete all anticipated capital improvements. Approximately 40 percent of the City's estimated system renewal needs are addressed under this level of service (including capital outlays under the operation and maintenance program). Level of service B increases the annual CIP budget to approximately $3.8 million, in year 2006 dollars, decreasing the length of time to complete all anticipated capital improvements to about 50 years.

Approximately half of the City's estimated system renewal needs are addressed under this level of service (including capital outlays under the operation and maintenance program). Level of service A increases the annual CIP budget to over $7 million, in year 2006 dollars, addressing all known capital needs in 20 years and achieving over 90 percent of the total projected system renewal needs of the City.

Table 2-15
City of Ann Arbor
Stormwater Utility Project
Estimated Capital Improvement Expenditures under Each Level of Service Option

Capital Improvement Program Component	Estimated Cost	Level of Service Alternative			
		Existing (2005/2006) Level of Service	LOS C: 2007/2008 Budgeted Services	LOS B: Prioritized Services Based on Routine System Inspections	LOS A: Full Preventative Maintenance
CIP Implementation Period:		*None*	*100*	*50*	*20*
Existing Debt Service		$430,000	$430,000	$430,000	$430,000
2008 / 2013 CIP -- System Planning	$1,500,000	$69,000	$922,500	$1,010,000	$1,510,000
2008 / 2013 CIP -- Primary System	$2,093,000	$500,000	$348,833	$348,833	$348,833
2008 / 2013 CIP -- Secondary System	$2,615,000	$200,000	$435,833	$435,833	$435,833
1997 Stormwater Master Plan Capital Needs	$97,600,000		$0	$281,493	$2,895,733
Subtotal	$103,808,000	$1,199,000	$2,137,167	$2,506,160	$5,620,400
Existing Capital Outlays, Field Operations		$850,000	$1,272,000	$1,825,000	$1,995,000
Total		$2,049,000	$3,409,167	$4,331,160	$7,615,400
Percent of System Renewal Needs		25%	41%	52%	92%

Estimated Annual System Renewal Needs $8,304,000

2.3.4.4 Level of Service Options for Enforcement, Public Engagement, and Finance.

Administration services can be organized into three primary components: Overall Administration, Billing, and Public Relations. The City's existing stormwater program addresses most overall administration services, including keeping financial records, preparing and monitoring budgets, and providing development review services. Billing services are necessary to properly ensure billing statements are sent to users and payment is received. Level of service B and A included funding for more routine updates to the stormwater billing system database.

Public relations are also needed to answer any questions the community may have regarding the stormwater utility. In addition, the permit regulations require the City to actively engage in public education and public involvement. The City of Ann Arbor currently meets all existing public engagement requirements. Under Level of Service C, the City plans to offer stormwater funding to other units conducting public education and involvement activities related to stormwater. Under level of service B and A, the City seeks additional funding to more actively engage the public in implementing stormwater management practices on their own property. These initiatives, coupled with a commensurate level of regulatory enforcement and "green" credits under the stormwater service fees, are expected to reduce future City capital and operational expenditures to address stormwater quantity and quality issues.

2.3.5 Recommended Level of Service

Figure 2-5 graphically depicts the estimated cost of service in year 2007 dollars of each level of service alternative. **Table 2-16** provides additional detail about the cost of service under level of service alternatives A, B, and C. Level of service alternative D was not evaluated, as the City's current level of service exceeds this level and MDEQ requires service level C as a minimum for permit compliance. The estimated annual cost for the City's existing level of service is approximately $3.5 million. Overall, this

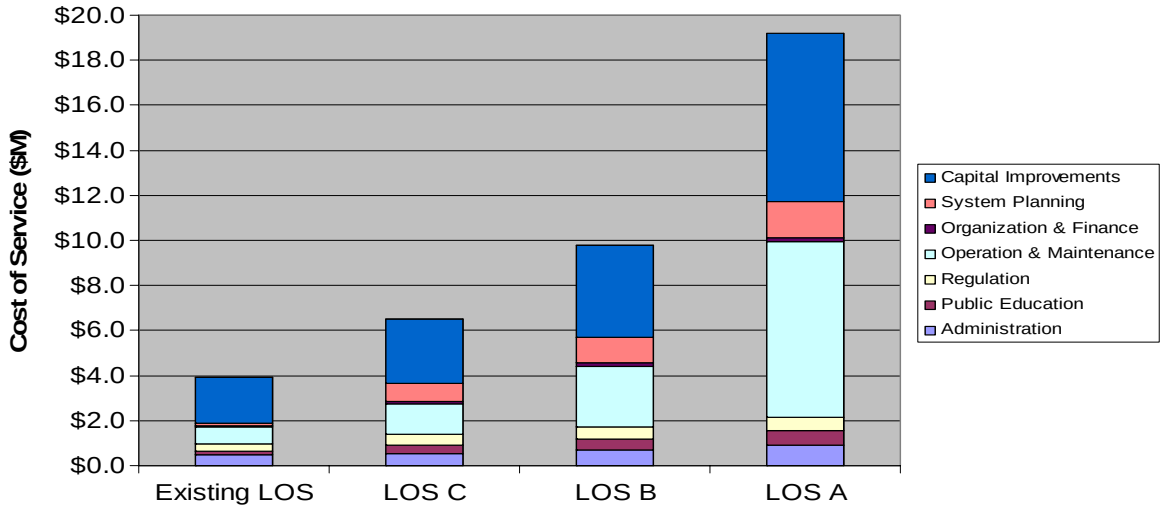


Figure 2-5. Cost of Service Summary Under Existing and Alternative Future Level of Service Options

scenario provides inadequate funding for Public Education, Operations and Maintenance services and Capital Improvement Projects.

Level of Service C includes additional funding for billing services, public relations, Operations and Maintenance and the CIP budget. The overall annual cost for level of service C is approximately $5.6 million. Overall, this option provides partial attainment of level of service goals expressed by the City's SCATF. Approximately 100 years are required to address all anticipated capital improvements under this level of service, but it achieves a level of service commensurate with communities similar to Ann Arbor that have implemented stormwater utilities.

Level of Service B provides further increases in funding for Public Education, Operations and Maintenance and the CIP budget. The overall annual cost for this level of service ranges between approximately $7.6 million and $10.2 million, depending on the method of financing capital improvements. Overall, this option provides full attainment of level of service goals expressed by the City's SCATF. Preventive maintenance and repair services are adequate for both primary and secondary system components. The CIP budget reduces the time to implement anticipated capital improvements to 50years.

Level of Service A increases capital and operational expenditures to levels equal to anticipated system renewal costs. The overall annual cost for this level of service ranges between approximately $9.8 million and $15.4 million, depending on the method of financing capital improvements. Overall, this option provides full attainment of level of service goals expressed by the City's SCATF. Preventive maintenance and repair services are adequate for both primary and secondary system components. The CIP budget reduces the time to implement anticipated capital improvements to 20 years.

Based on a review of the SCATF goals and input, and City goals, it is recommended that the City establish Level of Service B as the level of service goal for the City's stormwater program, with a long-term approach to phase into this level of service at an affordable rate. It is also recommended that there be a "mid-course" review to determine whether this level of service approach is appropriate. The move towards a Level of Service B should provide adequate resources to address the most critical stormwater needs, satisfy federal regulations, and conduct planning studies and efficiency evaluations needed to clearly define funding requirements for remaining stormwater needs.

Table 2-16
City of Ann Arbor
Stormwater Utility Project
Estimated Revenue Requirements under Each Level of Service Option

Program Component	Existing (2005/2006) Level of Service	LOS C: 2007/2008 Budgeted Services	LOS B: Prioritized Services Based on Routine System Inspections	LOS A: Full Preventative Maintenance
Operational Fund Expenditures				
Administrative Services	**$ 450,000**	**$ 495,000**	**$ 656,000**	**$ 861,000**
- Program Administration	$ 197,000	$ 242,000	$ 400,000	$ 600,000
- MS4 Permit Administration	$ 12,000	$ 12,000	$ 15,000	$ 20,000
- Customer Service Request Management	$ 209,000	$ 209,000	$ 209,000	$ 209,000
- Interjurisdictional Coordination	$ 32,000	$ 32,000	$ 32,000	$ 32,000
Public Engagement	**$ 135,000**	**$ 300,000**	**$ 400,000**	**$ 535,000**
- Contract Services	$ 100,000	$ 100,000	$ 100,000	$ 100,000
- Support for Watershed Groups	$ 35,000	$ 35,000	$ 50,000	$ 85,000
- New Education and Outreach Activities	$ -	$ 15,000	$ 100,000	$ 200,000
- Stormwater Funding of Other Departments	$ -	$ 150,000	$ 150,000	$ 150,000
Regulation and Enforcement	**$ 327,000**	**$ 473,000**	**$ 507,000**	**$ 547,000**
- Illicit Discharge Elimination	$ 109,000	$ 139,000	$ 160,000	$ 200,000
- Development Reviews	$ 218,000	$ 294,000	$ 300,000	$ 300,000
- Facility Inspections	$ -	$ 40,000	$ 47,000	$ 47,000
Operation and Maintenenace	**$ 696,000**	**$ 1,244,000**	**$ 2,591,000**	**$ 7,531,000**
o Systemwide Administration	***$ 31,000***	***$ 29,000***	***$ 44,000***	***$ 59,000***
- Customer Service	$ 5,000	$ 20,000	$ 35,000	$ 50,000
- Maintenance Center	$ 26,000	$ 9,000	$ 9,000	$ 9,000
o Primary Drainage System	***$ 122,000***	***$ 204,000***	***$ 346,000***	***$ 449,000***
- Creeks / Open Channels	$ 27,000	$ 83,000	$ 83,000	$ 83,000
- Stream Crossings	$ 38,000	$ 64,000	$ 64,000	$ 64,000
- Pipes	$ 49,000	$ 49,000	$ 49,000	$ 152,000
- Outfalls (5)	$ 8,000	$ 8,000	$ 28,000	$ 28,000
- Manholes (6)	$ -	$ -	$ -	$ -
- Surface Detention Locations (ponds, wetlands) (7)	$ -	$ -	$ 122,000	$ 122,000
o Secondary Drainage System	***$ 543,000***	***$ 1,011,000***	***$ 2,201,000***	***$ 7,023,000***
- Creek / Open Channels	$ 51,000	$ 159,000	$ 159,000	$ 159,000
- Stream Crossings	$ 55,000	$ 91,000	$ 91,000	$ 91,000
- Swales / Ditches (8)	$ -	$ 22,000	$ 22,000	$ 22,000
- Pipes	$ 223,000	$ 380,000	$ 380,000	$ 408,000
- Outfalls (5)	$ 15,000	$ 15,000	$ 15,000	$ 15,000
- Manholes (6)	$ -	$ -	$ -	$ -
- Catch Basins / Inlets (9)	$ 197,000	$ 197,000	$ 323,000	$ 1,333,000
- Treatment Devices	$ 2,000	$ 7,000	$ 46,000	$ 747,000
- Surface Detention Locations (ponds, wetlands) (7)	$ -	$ -	$ 151,000	$ 151,000
- Underground Detention Locations	$ -	$ -	$ -	$ -
- Curb & Gutter Roadway Conveyance	$ -	$ -	$ 74,000	$ 74,000
- Roadway Curb and Gutters	$ -	$ 140,000	$ 925,000	$ 4,008,000
- Curb Drain for Sump Discharges (226 runs)	$ -	$ -	$ 15,000	$ 15,000
- Sump Pumps (10)	$ -	$ -	$ -	$ -
Organization and Finance	**$ 71,000**	**$ 150,000**	**$ 150,000**	**$ 150,000**
Capital Fund Expenditures				
System Planning	**69,000**	**$ 922,500**	**$ 1,010,000**	**$ 1,510,000**
- Capital Planning and Asset Management	69,000	185,000	185,000	185,000
- GIS/Model Development (5-year implementation)	-	487,500	325,000	325,000
- System Evaluation -- Primary System Planning	-	200,000	400,000	800,000
- System Evaluation -- Secondary System Planning	-	50,000	100,000	200,000
Minor Capital Improvements (Capital Outlays)	**$ 850,000**	**$ 1,272,000**	**$ 1,825,000**	**$ 1,995,000**
Major Capital Improvements	**$ 1,130,000**	**$ 1,354,000**	**$ 2,021,000**	**$ 5,035,000**
o Funded by Transfers from Operational Fund	700,000	$ 910,000	$ 1,591,000	$ 4,605,000
- 2008/13 CIP Project: Primary Drainage System	500,000	$ 418,250	$ 418,250	$ 418,250
- 2008/13 CIP Project: Secondary Drainage System	$ 200,000	$ 491,250	$ 491,250	$ 491,250
- Other Capital Improvements for System Renewal	$ -	$ -	$ 281,493	$ 2,895,733
- Other Capital Improvements for Water Quality Control	***$ -***	***$ -***	$ 400,000	$ 800,000
o Estimated Debt Service at Interest Rate of 5%	**$ 430,000**	***$ 444,000***	***$ 430,000***	***$ 430,000***
- Existing Debt Service of $ 430,000				
- 2008/13 CIP Project: Primary Drainage System	-	$ -	$ -	$ -
- 2008/13 CIP Project: Secondary Drainage System	-	$ 162,500	$ -	$ -
- Other Capital Improvements for System Renewal	$ -	$ -	$ -	$ -
- Other Capital Improvements for Water Quality Control	$ -	$ -	$ -	$ -
Total Annual Costs	**$ 3,728,000**	**$ 6,210,500**	**$ 9,160,000**	**$ 18,164,000**

Section 3
Stormwater Rate Structure Development

3.1 Introduction

This section describes the process used to develop the revised rate structure for Ann Arbor's stormwater utility. First, various funding options were evaluated related to their ability to finance portions of Ann Arbor's stormwater program under the level of service options presented in Section 2. Options evaluated included the stormwater utility, bonded indebtedness, assessments, tap fees, connection charges, and disconnection charges. In exploring funding options, the following factors were considered for each of these options and their applicability for the City's program:

- Met the necessary legal requirements
- Fairness and equity
- Funding sufficiency
- Stability
- Understandability by the users (public, engineers, developers)
- Administrative simplicity
- Program maintenance
- Cost effectiveness (revenue generated compared with effort to implement and administer)

The section concludes with an evaluation of the various types of rate structures considered for a service charge to the various users of Ann Arbor's stormwater system. The rate methodology identifies the basis for determining the runoff potential and the stormwater service charge for each property. The rate structure determines how an actual billing system is configured, typically through developing user classes with similar runoff generation rates.

3.2 Evaluation of Funding Options

The options available to fund the City of Ann Arbor stormwater management program are varied and could be used individually or in combinations. This evaluation is presented in three sections. Section 3.2.1 describes the range of options commonly used to fund various elements of a stormwater program. Section 3.2.2 compares the various options, highlighting which options are most suited to funding which program elements. Finally, Section 3.2.3 recommends the specific funding options for implementation by the City of Ann Arbor.

3.2.1 Options

Currently, the stormwater management activities of the City of Ann Arbor are funded in a number of ways. Most funding is generated by a stormwater fee charged to each property based on its runoff characteristics. Other fees, assessments, and charges are applied to specific program elements. This section describes each existing funding option of the City, other funding options available to the City, and the advantages/disadvantages of each.

3.2.1.1 Stormwater Utility User Charge System

Ann Arbor has been using revenues from a stormwater utility user charge system to fund stormwater management programs since the 1980's. However, the City is re-evaluating its stormwater utility rate structure and the services funded by the stormwater utility in light of the *Bolt vs. Lansing* ruling, which established three eligibility tests for user charge systems:

- Does the charge serve a *regulatory,* rather than revenue-producing, purpose?
- Is the charge *proportionate* to the necessary costs of the service?
- Is the user able to *refuse or limit use* of the commodity or service?

The stormwater utility concept has achieved growing popularity in the United States since the mid 1970's. Since the concept was established, over 400 entities have adopted ordinances and taken steps to implement the stormwater utility concept. The user charge assigned to the rate payer is an equitable share of the cost of the stormwater management program based on the rate payer's relative contribution to the stormwater that must be managed. This share is determined by the amount of runoff attributed to the property -- the greater the runoff, the greater the contribution to the system needed to manage this stormwater. The relative amount of runoff is estimated by the amount of impervious area on the parcel. This allows for the equitable and fair distribution of the stormwater management program costs.

Enabling legislation and municipal practice have allowed the stormwater utility user charge system to be used for all six aspects of a stormwater management program: administration; regulation and enforcement; operation and maintenance; organization and finance; system planning; and capital improvements. The income is also commonly used to pay the debt service for a stormwater capital improvement program. A stormwater utility user charge is typically viewed as a more equitable funding mechanism than reliance on General Fund revenue and special districts, since charges assessed to each parcel of land are based upon usage of the drainage system rather than property value or other factor.

Because commercial properties typically contain more impervious area than single-family residential properties, they also generate much more runoff and stormwater pollution per square foot and are consequently charged a proportionately greater amount by the stormwater utility. A principal advantage associated with a city

stormwater utility is that tax-exempt properties (federal, state, school and other tax-exempt buildings and installations) are assessed a user-charge that reflects their relative stormwater contribution to the City's drainage system. For example, each tax-exempt parcel is charged a stormwater utility charge that is proportional to the stormwater discharge from the site. The method is identical to that used by other public utilities: a tax-exempt property is charged based upon usage (i.e., power consumption, water consumption).

Advantages of a stormwater utility user charge system include:

- Dedicated funding for the City's stormwater management program;
- At present, the primary funding source for the City's stormwater program;
- An equitable user charge based on runoff contribution rather than the property value;
- A mechanism to charge tax-exempt parcels for municipal stormwater management services proportional to the parcel's impact on the system; and
- A stable funding source for all stormwater activities.

Disadvantages of a stormwater utility program include:

- A need for parcel-by-parcel evaluation of impervious area coverages and other measures taken by the customer to control the quantity and quality of stormwater leaving the property;
- A need to demonstrate that the services provided to each customer by the stormwater utility are equivalent to the rates paid by each customer.

3.2.1.2 General Fund

The General Fund comprises many revenue sources including: property tax, income tax, state and federal revenue sharing, municipal state aid, franchise fees, fines/penalties, etc. The General Fund can be considered as a "bank" into which revenues are placed and from which many municipal services are funded. When considering the General Fund's capacity to effectively support the City's stormwater management program, the discussion must focus upon the competition for funds as well as the fairness and equity of this option.

Currently, some stormwater-related City services are provided by units outside the Public Services Area and funded through the General Fund. Such services include certain public education programs, leaf collection, and equitable shares of the spill control, "Miss Dig", and natural areas preservation programs.

When evaluated in this manner, the General Fund has several disadvantages:

- First, when the fairness and equity of this revenue source are addressed, there is no relationship between the amount of property tax paid for a parcel based on the value of the property and the parcel's contribution to stormwater runoff (either the quantity of runoff or water quality). These combinations make General Fund support difficult to substantiate as a total equitable or effective funding source for a stormwater management program.

- Second, the funding demands for public safety (police and fire) decrease the General Fund's ability to support significant increases for the stormwater management program. The priorities for other "essential services" often leave little available funding for a comprehensive stormwater management program.

Funding the stormwater management program through the General Fund with property taxes and income taxes does offer some advantages:

- The funds are a primary existing source of revenue;

- The billing system is established;

- There are minimal implementation and administration costs; and

- An individual's cost (bill) is tax deductible.

3.2.1.3 Special Assessment Districts

Income from a special assessment district is dedicated to that district. The area that is designated as special, for whatever reason, would pay an additional fee. The justification for such charges is that many capital improvements enhance the value of land that directly benefits, thereby providing a benefit to property owners. Administrative costs can be included as part of the special assessment.

The City has used special assessments to fund construction of storm drainage improvements in areas where such systems were not built when the land was developed. For example, if a new underground storm drainage system were constructed along a street where none currently exits, then the properties along that street would receive a one-time benefit from the extension of the City's stormwater system to their property. Under a special assessment, those properties would be designated as a special assessment district and an additional charge would be assigned to the residents of that special assessment district.

Michigan's Drain Code allows establishment of special assessment districts for drainage area-wide capital improvements and operational expenses. Ann Arbor's policy is that drainage area-wide drainage improvements provide city-wide benefits, thus their cost should be shared by all rate payers.

Advantages of this funding option are as follows:

- Districts can provide additional funding to their portion of the city with greater stormwater needs, where it would not be equitable to distribute these costs throughout the City;

- May be used for areas requiring storm sewers where none were constructed with the initial development.

Disadvantages of this funding option are as follows:

- Revenues generated can only be spent within the district in which they are collected; and

- Allocation of the benefits (or costs) of the improvement to each property can be a lengthy and cumbersome exercise that must be done for each assessment district.

3.2.1.4 Homeowners Association

The homeowners association concept is similar to the special assessment district in that a relatively small area would receive an additional charge for specific facilities directly benefiting members of the association. The charges are designed to meet the specific needs and desires of each association, and may be used to fund the operation and maintenance of privately-owned drainage features that are not utilized throughout the City (e.g., detention basins). This method is generally available only for residential parcels and cannot be used to finance an entire stormwater management program. Additionally, because the level of service and the assessment will vary among associations, inconsistencies in protection and inequities of assessment can result.

3.2.1.5 Fees/Licenses/Permits

Funding from this source is generally limited to cover the cost of providing a specific service such as permit review, enforcement, and the inspection of construction sites. Both the City and the Drain Commissioner levy fees for services such as plan reviews and site inspections. The City's *Connection Permit Charge* includes an equitable fee for tapping into the storm sewer. This charge does not cover the cost for permit reviews, before or during construction, or for a "capital buy-in charge." Since these income sources are established to cover the costs for select services that are provided to certain parties, they are difficult to dedicate toward the other aspects of the stormwater management program (i.e., administration, operation/maintenance, and capital improvements).

3.2.1.6 Penalties and Fines

Similar to permit fees, revenues from penalties and fines are limited. Such income can be placed in the General Fund; however, it may be more reasonable to use the fines to correct the violation and improve enforcement. This type of income should be used in conjunction with the other stormwater funding to finance the complete program.

3.2.1.7 Bonds

Governments normally use general obligation, revenue, or special assessment bonds to pay for large capital improvement programs. Payments for general obligation bonds are normally from the General Fund (i.e., ad valorem tax or income tax). Most often, the revenues from a special assessment district or stormwater utility are used to meet the debt service payment for revenue bonds. The principal advantage of selling bonds is that a large-scale capital improvement program can be initiated when the facilities are needed rather than when the funds are accumulated. The disadvantage is the interest charges associated with the long-term debt incurred by the entity.

3.2.1.8 Pay-As-You-Go Sinking Fund

This type of stormwater funding is most commonly used as an adjunct to revenue bond financing. A fund is formed similar to a separate account and receives revenues from numerous sources (i.e., ad valorem taxes or stormwater utility income). The fund accumulates revenue until sufficient money is available for an identified project. Then the total project amount is removed from the fund and the growth stage starts over. No money is borrowed so it is "pay-as-you-go" and, since funds are periodically deposited (sunk) into the account; it is referred to as a sinking fund.

3.2.1.9 Developer Contributions

As a condition for approval for development, the City requires the developer of a subdivision or large parcel to construct stormwater management facilities and dedicate storm sewers to the local government upon completion. In addition, developers are required to donate drainage easements or other types of partial rights to the local government for stormwater purposes. The local government would be responsible for the operation/maintenance. Thus, the developer would be responsible for funding the capital program, while the local government would be responsible for funding the operation/maintenance. Most storm drains in the City are constructed and financed in this manner, but detention facilities are typically retained in private ownership. The advantage of this type of funding mechanism is the transfer of the capital burden away from the local government. The disadvantages are that it is entirely possible to find that the stormwater facility transferred to the local government may not have been properly designed, or that its discharge may aggravate downstream flooding problems.

3.2.1.10 Fee-In-Lieu-Of

An option to requiring developers to construct stormwater management facilities is to require them to pay an initial "front-end" charge for the capital improvements needed to serve their development. The charge would be representative of the development's contribution to a future regional facility in the watershed.

Although this option is currently in code (Chapter 63, Section 5:654(3)), it has only been used once since implemented. This is primarily because the cost of purchasing a portion of a future regional facility on another site is typically higher than handling

stormwater management on site. This approach also goes counter to the emphasis of stormwater management at the source that has gained favor in recent years.

3.2.1.11 Developer Incentives

Incentives could be offered to induce developers to use proper stormwater management planning techniques. For example, such incentives could include waiving maximum allowable residential densities if land is dedicated to the City for stormwater purposes. This method would still require the construction of the stormwater facility by the City; however, the land costs for the stormwater management facility would be reduced. The two major disadvantages of this method are: (1) it may be in direct conflict with the goals and objectives of the land use element of the City's Comprehensive Plan; and (2) it may increase the magnitude of nonpoint source pollution problems due to the higher intensity level of development.

3.2.1.12 Improvement Charges

Most often, when a stormwater management facility is constructed to deal with a problem near a community, the property within the community will increase in value. For example, if a drainage system is installed along a street where no stormwater management system had existed before, then the control of flooding increases the value of property next to the road. The capital costs for such improvement could therefore be apportioned to the property owner. The advantage is that the benefactors of the stormwater management system would fund the program. The disadvantage is that the increased property value is difficult to estimate and this amount may be less than the construction cost, thus limiting revenue recovered.

3.2.1.13 Grants

Grants may be available from various federal, state, and private entities to fund aspects of the stormwater program. Grants are often small, highly competitive, and may not be available every year, limiting their use for many routine stormwater management activities. Available grants help supplement other funding sources and achieve program elements that would be difficult to achieve otherwise. The City has periodically received grants to conduct its illicit discharge detection and elimination program.

3.2.1.14 Merchandising, Jobbing, and Intra-Governmental Sales

The City provides services requested and paid by property owners, services that are the property owner’s responsibility such as cleaning a private storm drain. *Merchandising and jobbing* charges cover the time and material costs for these services, which are billed directly to the property owner. Intra-governmental sales occur when the Public Utilities department provides services to another department (e.g., charges collected by the Building Department for erosion and sediment control reviews and inspections provided by Public Utilities staff.

3.2.1.15 Investment Income

This category includes interest earned on stormwater utility funds that are invested in anticipation of collecting revenue for a major project.

3.2.2 Comparison of Options

Based on the discussion in the previous section, the various funding options can be compared and evaluated for use in the City of Ann Arbor. **Table 3-1** lists each option and the stormwater management functions, which can be addressed by the option.

Table 3-1
Funding Options
Stormwater Management Activities

Funding Option	Stormwater Management Administration and Design	Capital Improvement Program	Operation and Maintenance	Water Quality Monitoring
Stormwater Utility	X	X	X	X
General Fund	X	X	X	X
Special Taxing District		X	X	
Homeowners Association		X	X	
Fees/Permits	X			
Penalties/Fines	X			X
Bonds		X	X	
Pay-as-you-go Sinking Fund		X		X
Developer Contributions		X		
Fee-in-Lieu-of		X		
Developer Incentives		X		
Betterment Charges		X		
Grants		X		

Special assessment districts and homeowners associations can be used to finance maintenance and capital improvements. The disadvantages are: (1) the districts are typically applied to only a watershed or other portion of the City; (2) the district may not be capable of generating the required revenue; (3) revenues generated can be spent only in the jurisdiction where collected and may not necessarily be where the funds are most needed; and (4) charges are based on property value and not on impact to, or use of, the stormwater management system.

A revenue bond is a financing tool that provides a large source of funds for construction, which would take other financing options several years to accumulate. The major disadvantage is the long-term commitment of annual revenues to pay for the debt service. A pay-as-you-go sinking fund often prolongs the time to complete a project. Subdivision exactions, fees-in-lieu-of, developer incentives, and improvement charges are all one-time payments for constructing new stormwater facilities. These funding mechanisms cannot be used to correct existing drainage

problems and cannot be used to provide continued maintenance of the facilities. Permits and fines are intended to cover only the cost of administration and enforcement and are not sufficient to fund either capital improvements or operation/maintenance programs.

A review of the benefits and deficiencies of each funding option indicates that the General Fund and a stormwater utility are the only two funding sources capable of addressing a stormwater management program on a citywide basis. The major distinction between the two options is the method of allocating the costs for stormwater management. The General Fund is composed of revenues generated from ad valorem tax based on property value and income tax, neither of which correlates with the runoff contribution of the property or with the benefits received from the stormwater management system. Competition from other municipal programs for General Fund revenues often results in less than adequate funding for a stormwater management program.

With stormwater utility, costs are allocated based on the quantity and quality of the stormwater that is generated by each property. The correlation between the amount of impervious area and the quality and quantity of stormwater runoff is used to equitably allocate stormwater management costs. Therefore, the stormwater utility is the most equitable means of allocating stormwater management costs.

3.2.3 Preliminary Funding Recommendations

The previous analyses identify the general fund and the stormwater utility as the most complete funding mechanisms to support stormwater management activities. In concert with the Stormwater Citizens Advisory Task Force final recommendations, CDM proposes the following funding concepts be evaluated:

- The stormwater utility charge will serve as the base funding mechanism for stormwater services provided to all property owners.
- Improvement charge funding may be used in areas where the development did not originally have separate storm sewer service, or through the drain commissioner for watershed-based capital improvements.
- Developers should continue to be responsible for constructing storm drainage facilities for development projects, according to City criteria. Alternatives for funding the operation and maintenance of private storm drainage facilities may be evaluated in the future, including the potential for public ownership and operation of these facilities.
- Miscellaneous fees/permits, penalties/fines, and developer incentives will be evaluated to determine their equitability and ability to cover program costs.
- Bond funding of major capital improvements will be compared with "pay as you go" and/or sinking fund financing approaches.

- Following master planning, other development sensitive charges (i.e., fee-in-lieu-of) may be adopted, but are dependent upon watershed specific data.

- Utility funds should be used to leverage pursuit of available grant funds.

The cost allocation methodology presented in Section 3.3.1 evaluates which existing and potential future costs of stormwater management are appropriate to fund from each of these funding mechanism, using a combination of public acceptability and legal defensibility, as defined by the three legal tests established by *Bolt v. Lansing*.

3.3 Rate Structure Alternatives

The City of Ann Arbor is investigating potential modifications to its stormwater service charge structure. Potential modifications are contemplated to improve the equitability of the rate structure by accommodating new data regarding its customers; establishing revised customer classes resulting from that data, and incorporating additional flexibility into the charge structure. The revised rate structure will allocate an equitable share of the costs for the City's stormwater management program to all properties within the City Of Ann Arbor.

Stormwater service charges typically base cost allocations on the stormwater runoff characteristics of each land parcel since the level of service provided by the City of Ann Arbor should be proportional to the amount of runoff from each land parcel. This section defines key considerations for allocating costs to individual ratepayers, identifies alternative rate structures based on each parcel's contribution of runoff, defines an appropriate cost allocation method to the various components of the rate structure, and selects a rate structure appropriate for the City of Ann Arbor.

3.3.1 Cost Allocation Evaluation

The most fundamental requirement of any funding system is equity - assuring that the benefits received are consistent with a fair share of cost. In the case of a stormwater service charge, the primary benefits are measured in terms of enhanced flood control and water quality throughout the area served by the agency. Inevitably, additional direct benefits are received by some individuals as a result of enhanced water quality and increased property values, but the primary purpose of a stormwater management program is to provide community-wide control and management of stormwater.

Section 2 evaluated the City's existing stormwater management program and defined various levels of service options, demonstrating that the level of effort involved with most stormwater services provided by the City is directly related to the runoff generated by the various properties tributary to the City's stormwater drainage system. This is because the size and extent of the drainage system (and consequently the cost of building, operating, and renewing this system) are directly related to its ability to collect, store, and convey the runoff generated by each property within the City. **Table 3-2** lists each of the functional service areas of the City's existing stormwater program, indicating the principal beneficiaries of each with an "X". The

next three columns of Table 3-2 describe how each service relates to three primary considerations for determining an equitable method of funding based on the unique characteristics and needs of beneficiaries:

- ***Overall function of program component***. Each program component eligible for funding through a utility rate-based system must have a clearly-defined function, with collected revenues directly related to the costs associated with providing this function. Table 3-2 indicates that most of the functional stormwater services are directed at public health, safety, and welfare, as well as compliance with state and federal laws. Costs of these services generally relate to the storm drainage system needed to properly control runoff from each property within the City.
- ***Service Beneficiaries***. The functional services should directly benefit those paying for these services, with rates paid proportional to the benefits received. Most functional services, particularly those related to the operation, maintenance and capital improvement of the existing drainage system, are directly related to the quantity and quality of runoff contributed by individual properties. In other words, each property "benefits" from a drainage system able to collect, convey, and otherwise manage the runoff from each property in a manner that protects public health, safety, and welfare and complies with regional, state, and federal regulations. Other services benefit existing property owners, but not necessarily based on the runoff contribution from their property. For example, the cost of educational programs is more closely related to the number of customers /people educated rather than the runoff from their property.
- ***Ability to control service***. Utilities and their rates are commonly predicated on the ability of individual users to control the service they provide. As most stormwater services are related to the runoff contribution of each property, users can control the service they receive by controlling the quantity and/or quality of the runoff leaving their property. This can be done through either "structural" controls (e.g., rain gardens, rain barrels, or other controls that reduce the volume and/or rate of runoff) or "non-structural" controls (e.g., providing education and training, conducting source controls in addition to those required by City regulations). In addition, system users can receive credits if they provide services that otherwise would be provided by the City (e.g., a property owner owns and / or operates a drainage facility that controls runoff from upstream properties).

The right column of Table 3-2 uses these considerations to define the basis for a user charge that accounts for these three key considerations. Since the majority of the services provided by the City are related to the runoff contributed to the system, an equitable charge would be one based on a measurement of runoff. Therefore, the evaluation of appropriate rate structures should evaluate the advantages and disadvantages of various methods for defining the relative amount of runoff from each property. Other portions of the charge (e.g., public engagement, utility billing) are more directly related to the number of customers, so rate structures related to a "per customer" formula should be considered for financing these services.

Table 3-2. City of Ann Arbor Stormwater Utility -- Cost Allocation Matrix

Program Component	Systemwide Service	Local Service	Service for Existing Development	Service for New Development	Services for Area with Detention	Services for Areas Without Detention	Service to Maintain Current Design Standards	Upgrade to Meet Current Design Standards	Watershed-specific Service	Services for Residential Areas	Services for Non-Residential Areas	Overall Function of Program Component	Service Beneficiaries	Ability to Control Service	Basis for User Fee
Administrative Services															
- Program Administration	X		X	X	X	X	X	X			X	X	Directs services at public health, saftey, and welfare; compliance with County, State, and Federal regulations	Primarily oversees services related to quantity, quality of runoff.	Administrative costs reduced as less runoff is contributed by properity	Cost per runoff contributed
- MS4 Permit Administration	X		X	X	X	X	X	X			X	X				
- Customer Service Request Management	X		X	X	X	X	X	X			X	X				
- Interjurisdictional Coordination	X		X	X	X	X	X	X	X	X	X	X				
Public Engagement															
- Contract Services	X		X	X	X	X	X	X			X	X	Required under State, Federal permit; promotes protection of public health, safety, and welfare	Public engagement related to number, type of property	Can offer credits / incentives to rate payers who conduct public engagement activities	Cost per Customer
- Support for Watershed Groups	X		X	X	X	X	X	X	X	X	X	X				
- New Education and Outreach Activities	X		X	X	X	X	X	X			X	X				
- Stormwater Funding of Other Departments	X		X	X	X	X	X	X			X	X				
Regulation and Enforcement															
- Illicit Discharge Elimination	X		X		X	X		X			X	X	Required under State, Federal permit; promotes protection of public health, safety, and welfare	System surveillance related to outfall number, sizes; illicit discharge elimination is not	On-site runoff controls can reduce servcie	Surveillance: Stormwater Service Fee Elimination: Cost to Offender
- Development Reviews	X			X	X			X			X	X		Development services not propotionale to user fee	Development is voluntary	Time & material cost to developer
Operation and Maintenenace															
o Systemwide Administration												Supports services directed at public health, safety, welfare, and permit complinance	Supports services related to quantity, quality of runoff.	Administrative costs reduced as less runoff is contributed by properity	Cost per runoff contibuted
- Customer Service	X		X		X	X	X				X	X				
- Maintenance Center	X		X		X	X	X				X	X				
o Primary Drainage System												Maintenance of primary drainage system necessary for solution to local drainage problems	Necessary system capacity proportionate to quantity, quality of runoff contributed	Users can limit service by contributing less runoff	Cost per runoff contibuted
- Creeks / Open Channels	X		X		X	X	X				X	X				
- Stream Crossings	X		X		X	X	X				X	X				
- Pipes	X		X		X	X	X				X	X				
- Outfalls (5)	X		X		X	X	X				X	X				
- Manholes (6)	X		X		X	X	X				X	X				
- Surface Detention Locations (ponds, wetlands) (7)	X		X		X		X				X	X				
o Secondary Drainage System												A well-maintained drainage system protects public health, safety, and welfare; is required to meet State and Federal regulations	Type and amount of secondary system maintenance may vary within City based on type of infrastructure	Users can limit service by contributing less runoff	Cost per runoff contributed, fee may vary by area based on services provided
- Creek / Open Channels		X	X		X	X	X				X	X				
- Stream Crossings		X	X		X	X	X				X	X				
- Swales / Ditches (8)		X	X		X	X	X				X	X				
- Pipes		X	X		X	X	X				X	X				
- Outfalls (5)		X	X		X	X	X				X	X				
- Manholes (6)		X	X		X	X	X				X	X				
- Catch Basins / Inlets (9)		X	X		X	X	X				X	X				
- Treatment Devices		X	X		X	X	X				X	X				
- Surface Detention Locations (ponds, wetlands) (7)		X	X		X		X				X	X				
- Underground Detention Locations		X	X		X		X				X	X				
- Curb & Gutter Roadway Conveyance		X	X		X	X	X				X	X				
- Roadway Curb and Gutters		X	X		X	X	X				X	X				
- Curb Drain for Sump Discharges (226 runs)		X	X		X	X	X				X	X				
- Sump Pumps (10)		X	X		X	X	X				X	X				
Organization and Finance	X	X	X	X	X	X	X	X	X	X	X	X	Supports services directed at public health, safety, welfare, and permit complinance	Billing proportionate to number of accounts; organization & finance supports services based on quantity, quaity of runoff	Organization & finance costs reduced as less runoff is contributed by property	Billing per account number, organiation & finance based on runoff contributed
Capital Fund Expenditures															
System Planning												System Planning: builds understanding of and develops solutions to public health, safety, and welfare threats, and regulatory compliance needs . Capital Improvements to Existing Systems: Provide public health, safety, welfare, and regulatory compliance . New Capital Improvements: improvements to primary system benefits all properties; improvements to secondary systems benefit local properties;	All system planning and capital improvements are proportionate to the quantity and quality of runoff draining through the affected system; system renewal requirements indicate that every drainage system will require capital improvement eventually, thus each property should pay an equivalent fee	Users can limit service by contributing less runoff	Cost per runoff contributed, distributed to all users through service fee or as an assessment to benefiting properties for new infrastructure
- Capital Planning and Asset Management	X	X	X	X	X	X	X	X	X	X	X				
- GIS/Model Development (5-year implementation)	X	X	X	X	X	X	X	X	X	X	X				
- System Evaluation -- Secondary System Planning	X	X	X	X	X	X	X	X	X	X	X				
Minor Capital Improvements (Capital Outlays)		X	X		X	X	X	X		X	X				
Major Capital Improvements	X	X	X	X	X	X		X	X						
o Funded by Transfers from Operational Fund															
- 2008/13 CIP Project: Primary Drainage System	X		X		X	X		X		X	X				
- 2008/13 CIP Project: Secondary Drainage System		X	X		X	X		X		X	X				
- Other Capital Improvements for System Renewal	X	X	X		X	X		X		X	X				
- Other Capital Improvements for Water Quality Control	X	X	X	X	X	X		X	X						
o Funded through Bond Revenue															
- 2008/13 CIP Project: Primary Drainage System	X		X		X	X		X		X	X				
- 2008/13 CIP Project: Secondary Drainage System		X	X		X	X		X		X	X				
- Other Capital Improvements for System Renewal	X	X	X		X	X		X		X	X				
- Other Capital Improvements for Water Quality Control	X	X	X	X	X	X		X	X						

Finally, the cost of remaining services (e.g., many regulatory services) can vary significantly by customer regardless of runoff generation, and may be appropriately charged based on the actual cost of providing these services. **Figure 3-1** illustrates how the cost of existing City stormwater functions breaks down into each of these three categories.

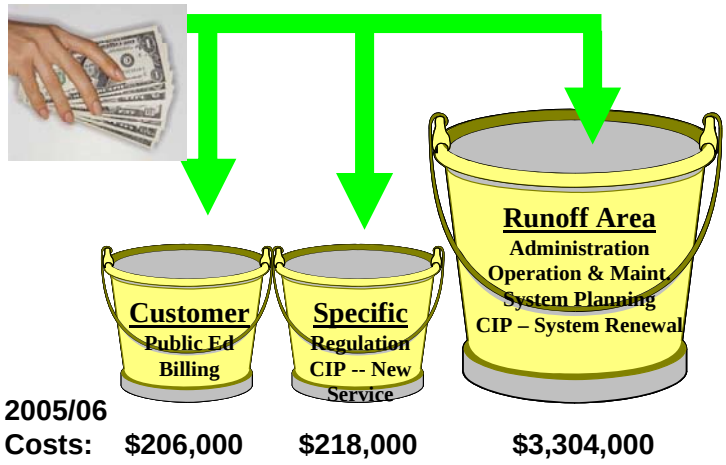


Figure 3-1. Allocation of Costs for Existing Stormwater Services

3.3.2 Ann Arbor's Existing Rate Structure

3.3.2.1 Overview of Existing Rate Structure

Chapter 33 of the Ann Arbor Municipal Code, adopted January 19, 1993 and amended subsequently, defines the existing rate structure for the City of Ann Arbor. The current rate structure involves flat rate charges, charges based on land area, charges for non-stormwater uses, and discounts:

Flat Rate Charges for Single-Family and Two-Family Dwellings

- Not served by a stormwater retention facility: $22.75 per quarter
- Served by a stormwater retention facility: $19.35 per quarter

Land Area-Based Charges

- For remaining real property, $243.95 per quarter per acre multiplied by the following factors:
  - 0.20 for pervious area
  - 0.95 for impervious area without adequate retention
  - 0.30 for impervious area with adequate retention
- No charge for public recreational lands, public streets, and lands discharging directly to the Huron River

Non-Stormwater Use of the Stormwater System

- Permitted non-stormwater discharges, not pre-treated:
  - During precipitation events: $0.47 per 1,000 gallons
  - No discharges during precipitation events: $0.14 per 1,000 gallons
- Permitted non-stormwater discharges, pre-treated: $0.94 per 1,000 gallons (100,000 gallon minimum)
- Non-permitted Non-stormwater discharges: $9.42 per 1,000 gallons

Discounts

- 10 percent for on-time payment

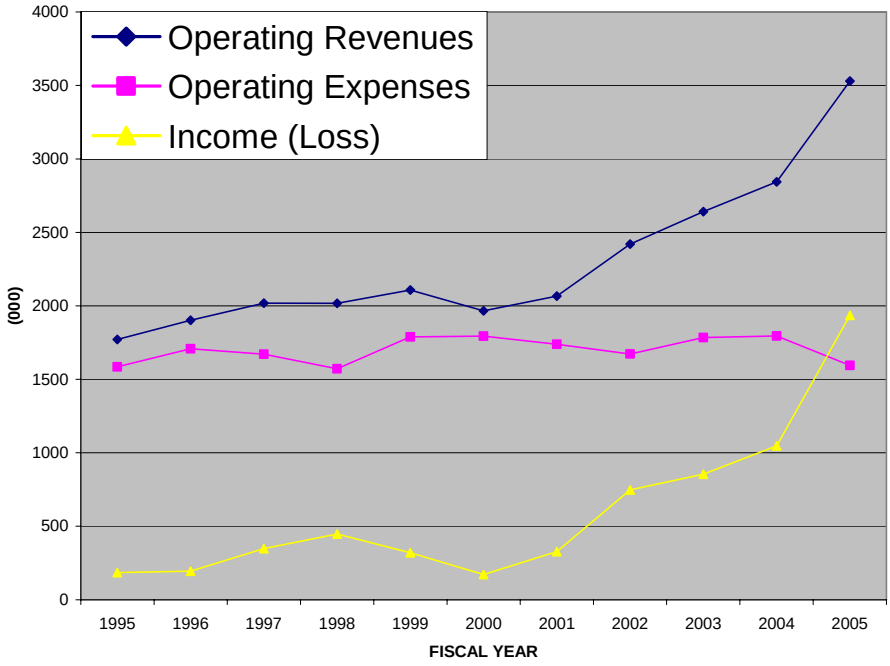


Figure 3-2. Financial History of Ann Arbor's Stormwater Utility

3.3.2.2 Assessment of Existing Rate Structure

The City of Ann Arbor was a stormwater utility pioneer – its stormwater charge structure was one of the first adopted across the county and has served the City well for several years. The original structure featured industry standard approaches to allocate the costs of stormwater service to, and recover from, both residential and non residential customers in the City. The fundamental concepts embodied in the existing rate structure are still sound – however the availability of additional, more precise data regarding individual customers' contribution to and use of the stormwater system may encourage modifications to that structure. An assessment of the relative advantages and disadvantages of the existing structure can be summarized as:

Advantages

- Overall equity - costs are recovered from estimated runoff volume
- Simplicity in application – all costs allocated on runoff volume; residential customers are treated uniformly

Disadvantages

- Specific equity - May not reflect the latest data available
- Oversimplification – Similarly, uniformity in residential class may not result in the most equitable allocation of costs to these customers. Also, some costs may be more appropriately allocated on a basis other than runoff volume
- Inflexibility – The rate structure may not adequately address customers ability to control their use of the system

Figure 3-2 illustrates the City's stormwater utility revenues (called stormwater *sales)* and expenditures since 1995, indicating that revenue may exist to provide additional services. In Fiscal Year 2003, the City started to budget to allow funding of capital preservation projects out of current rates, which requires accumulating fund balance large enough to sustain the projected capital projects. The City's current strategy is to increase rates approximately 11 percent annually to raise funds for capital projects.

3.3.3 Alternative Rate Structures

Equity is most commonly achieved by basing the stormwater service charge on the quantity and quality of stormwater generated by each parcel of land, independent of the location of actual benefits. Several factors influence the quantity and quality of stormwater, including the size, soil type, topography, impervious area, and the development intensity. This section describes the following stormwater rate structures commonly employed by municipalities that are based largely on the relative amount of runoff from each property:

- Flat Charge
  - All Properties
  - All Single-Family Residential Properties
- Runoff Coefficient / Intensity of Development Factor
- Tiered Flat Charge
- Level-of-Service / Geography Base
- Impervious Area Measurements
  - Non-Single-Family Residential Properties
  - All Properties
- Combinations of Rate Structures

The accuracy of the impervious area / runoff generation estimate increases from flat charge systems to systems based on impervious area, improving the equity of the resulting service charge. This improved accuracy is achieved, however, through an increased level of effort to develop and maintain the stormwater utility billing database. An appropriate rate structure balances these two conflicting concerns.

3.3.3.1 Flat Charge

A flat charge bills one or more classes of customers that same amount for the services provided. For example, Ann Arbor and many other stormwater utilities charge every residential customer a "per dwelling unit" charge. Alternatively, a flat charge could be charged for a particular type of service performed by the utility (e.g., "per plan review", "per inspection performed", etc). A flat charge has been proven to be an equitable rate structure when the characteristics within each "class" of customers charged are relatively uniform (e.g., the runoff associated with each residential dwelling unit is largely the same). A flat charge rate structure has the following advantages and disadvantages:

Advantages

- Overall equity - costs are recovered from estimated runoff volume
- Simplicity in application – all costs allocated on runoff volume; residential customers are treated uniformly

Disadvantages

- Specific equity - May not reflect the latest data available. Non-residential user classifications are rarely uniform in runoff generation.
- Over-simplification – Uniformity within a land use class may not result in the most equitable allocation of costs to these customers, particularly non-residential land uses. Also, some costs may be more appropriately allocated on a basis other than runoff volume.
- Inflexibility – The rate structure may not adequately address customer's ability to control their use of the system.

3.3.3.2 Runoff Coefficient / Intensity of Development Factor

This rate structure utilizes recognized hydrologic methods to approximate the amount of runoff contributed by different classifications of properties. This system seeks to allocate costs based on runoff contributions from individual properties with less parcel-specific information. Under this system, parcels are divided into sub-classifications with similar runoff characteristics, and the size of each parcel is multiplied by a set "factor" for each sub-classification that approximates the runoff from that parcel. The biggest challenge for this rate structure is to define subcategories with similar runoff potential, particularly for large parcels where a relatively small difference between the actual runoff and the runoff calculated with a "factor" could result in a significant miss-estimation of the charge to that parcel. A rate structure based on a runoff coefficient or intensity of development factor has the following advantages and disadvantages:

Advantages

- Overall equity - costs are recovered from estimated runoff volume. Volume estimates are somewhat more accurate that those under a fixed rate system.
- Simplicity in application – all costs allocated on runoff volume, with literature-defined runoff factors applied uniformly across a land use category.

Disadvantages

- Specific equity - may not reflect the latest data available. Non-residential user classifications are rarely uniform in runoff generation.
- Over-simplification – uniformity within a land use class may not result in the most equitable allocation of costs to these customers. Also, some costs may be more appropriately allocated on a basis other than runoff volume.
- Inflexibility – The rate structure may not adequately address customers' ability to control their use of the system.

3.3.3.3 Tiered Flat Charge

A tiered flat charge system recognizes differences within one or more classes of users, establishing subclasses with similar characteristics that are billed a flat charge within that class. For example, a tiered flat charge would divide residential customers into sub-classifications (e.g., sub-classifications of single family residential, duplexes, multifamily, etc.) and develop an equitable flat charge for each sub-class. A tiered

charge seeks to maintain the relative simplicity of a flat charge system, while improving system equity by recognizing differences in characteristics. The largest challenge of a tiered system is obtaining and managing the data necessary to differentiate between user subclasses. A tiered flat charge rate structure has the following advantages and disadvantages:

Advantages

- Overall equity - costs are recovered from estimated runoff volume. Volume estimates are more accurate than the flat charge or runoff coefficient methods.
- Simplicity in application – all costs allocated on runoff volume. Need to define appropriate runoff factors for each land use category.

Disadvantages

- Specific equity - may not reflect the latest data available. Non-residential user classifications are rarely uniform in runoff generation.
- Over-simplification – non-residential land uses are difficult to categorize into tiers with uniform runoff generation rates. Also, some costs may be more appropriately allocated on a basis other than runoff volume.
- Inflexibility – The rate structure may not adequately address customer's ability to control their use of the system.

3.3.3.4 Level of Service / Geography Base

Most stormwater utilities charge the same rates throughout their service area. Such a system is equitable if the utility provides the same level of service throughout its service area. In some cases, however, service needs may differ dramatically in different parts of the service area, due to differences in the characteristics of the drainage system and/or the service expectations of some customers. For example, utilities comprised of both urban and rural areas may be served by different types of drainage systems, or may be subject to different regulatory conditions. As such, sub-districts may be formed with different charges within these sub-districts based upon the actual services provided. These charges are most commonly related to the runoff contributed by each property, but may also be related directly to the cost of the service provided. For example, a utility could chose to charge different "per impervious area" charges in different portions of its service area, depending on the actual services provided within each area. Alternatively, charges not related to runoff may be billed at the cost of the service provided (e.g., a time and materials charge for plan reviews, site inspections, etc). A rate structure with different charges based on different level of service expectations has the following advantages and disadvantages:

Advantages

- Overall equity - costs are recovered from estimated runoff volume and/or cost of service provided, and allocated based upon significant differences in the level of service delivered.

- Flexibility – The rate structure provides clear parameters indicating methods for ratepayers to control their use of the system.
- Specific equity – rates are established based on the latest data available about both runoff generation and estimated cost of service.

Disadvantages

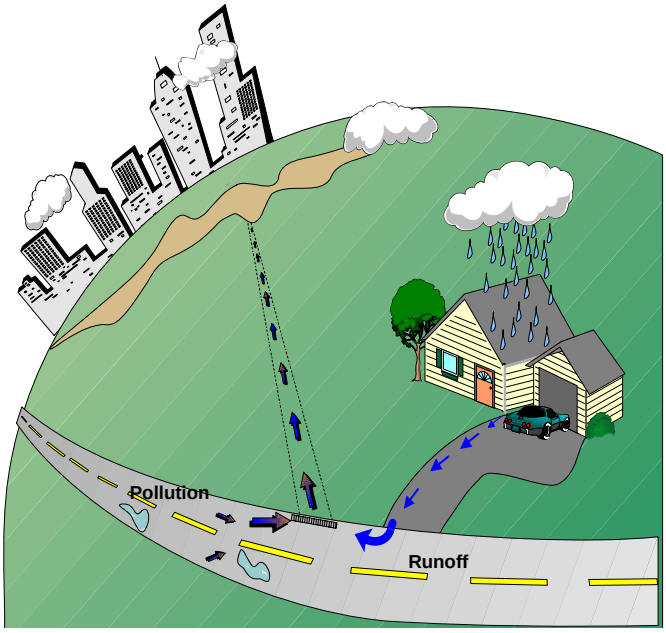


Figure 3-3. A rate structure based on impervious area directly relates property characteristics to the quantity and quality of stormwater runoff.

- Over-simplification - some costs may be more appropriately allocated on a basis other than runoff volume.
- Complexity - must associate charges paid with the services provided within different "subdistricts".

3.3.3.5 Impervious Area Measurement

Analysis of rainfall events used in stormwater management planning and design has shown that the amount of impervious area is the most important parameter affecting the quantity and quality of runoff **(Figure 3-3)**. Since this value is easily quantified, rate policies developed for stormwater management funding should have a primary focus on the amount of impervious area to determine the procedure for allocating costs to agency customers. Impervious area of a parcel refers to surfaces, which have been covered with material (including structures) that are highly resistant to the infiltration of water. For example, rooftops, pavements, and building footprints are impervious surfaces. Many stormwater utilities use the amount of impervious surface as the basis for a stormwater charge, while other also includes consideration of runoff from the pervious areas within each parcel. A rate structure based on impervious area measurements has the following advantages and disadvantages:

Advantages

- Overall equity - costs are recovered from estimated runoff volume. Volume estimates based on impervious area measurements of individual properties are largely accurate.
- Specific equity - clearly distinguishes runoff contribution of individual properties, improving education of individual property owners on the rate basis. Reflects the latest data available.
- Flexibility – The rate structure provides clear parameters indicating methods for ratepayers to control their use of the system.

Disadvantages

- Over-simplification - some costs may be more appropriately allocated on a basis other than runoff volume.
- Complexity – requires measurement and updating of the impervious area of individual properties

3.3.3.6 Combinations of Rate Structure

The previous discussion indicates that each rate structure has clear advantages and disadvantages, depending on the service provided and the circumstances of the rate payer. Combining rate structures within a single utility funding system allows the utility to take best advantage of all viable rate structures in order to maximize equity while minimizing administrative costs. Combined rate structures provide the following advantages and disadvantages:

Advantages

- Overall equity - costs are recovered from estimated runoff volume and/or cost of service provided, and allocated based upon significant differences in the level of service delivered.
- Specific equity - clearly distinguishes runoff contribution of individual properties, improving education of individual property owners on the rate basis. Reflects the latest data available.
- Flexibility – The rate structure provides clear parameters indicating methods for ratepayers to control their use of the system.

Disadvantages

- Complexity - must associate charges paid with the services provided within different "sub-districts" and user categories. Requires more data to properly define and allocate charges.

3.3.4 Alternative Rate Structures for Further Evaluation

Based on the goals of the City, the assessment of the existing rate structure, the relative benefits of alternatives described above, and the property characteristics described later herein, the following alternative structures were identified for further evaluation. *Actually, the "alternatives" only apply to the manner in which residential customers will be charged, as illustrated below.*

The alternative rate structures selected for further evaluation maintain the same overarching concept as the existing structure – most costs should be recovered from customers based on the estimated amount of stormwater they contribute to the system. However as described in Section 3.3.3, the selected alternatives are more complex than the existing structure to address the more complex cost structure of the utility, the availability of additional data, and the desire to allow flexibility to individual customers where merited. The alternative rate structure has three primary components:

- A ***customer*** charge that is uniform for all properties served by the utility. This charge is designed to recover costs associated with customer billing and information and certain direct administrative costs that are not impacted by the amount of stormwater runoff.
- A ***stormwater discharge*** rate that is related to the relative contribution of stormwater to the system from individual customers. This charge is designed to recover all other system-wide costs of the stormwater utility.
- ***Special*** charges that are designed to recover the costs of individual projects and programs that provide service to specific customer classes, watersheds and/or geographic regions.

The cost recovery method that would be utilized for the various functional service areas was presented in Table 3-2.

In addition, the alternative rate structure contemplates two secondary components:

- ***Adjustments*** – to the individual impervious area computations for specific properties; and
- ***Credits*** – for services provided by individual customers that provide value added services to the stormwater management functions of the City.

Each of the components of the alternative rate structure is discussed below.

3.3.4.1 Customer Charges

The customer charge component is calculated by dividing the total revenue requirement associated with customer related services by the total bills issued during the year. This uniform unit cost will be applied in the calculation of the quarterly bill to all customers, irrespective of customer classification or size.

3.3.4.2 Stormwater Discharge Rates

The basis for the stormwater discharge rates will continue to be the overall area served by the stormwater utility. The "per acre" drainage charges will be computed by dividing the total revenue requirement associated with drainage charge elements by the total estimated impervious area within the City, less an allowance for anticipated adjustments and credits. This will result in a unit charge that is uniform for all customers of the system. Section 4 provides statistics on the imperviousness of various customer classifications and the methodology for determining the "per impervious acre" stormwater discharge rate.

Non-Residential Customers

The drainage charge component for non-residential customers will be calculated by applying the stormwater discharge rate to the estimated impervious area of each individual parcel.

Residential Customers
Several options exist for establishing the drainage charge component for residential customers. The alternative rate structure contemplates potential application of the four alternatives presented below.

Flat Rate. A flat rate for residential customers is similar to the existing structure. The uniform stormwater discharge rate is applied to the "average" residential impervious acreage to determine the flat rate charge for all residential customers.

- *Advantages*: Simplicity in application and understanding; uniformity with existing structure.
- *Disadvantages*: Over-simplistic, potentially leading to claims of inequity; does not fully reflect available data.

Parcel-Specific. A parcel-specific residential rate structure is similar to the non-residential rate structure. The stormwater discharge rate is applied to the specific impervious acreage for each individual residential property.

- *Advantages*: Fully embraces available data and represents most robust possible attempt to allocate stormwater contributions (and related costs) to individual users. If properly implemented results in most equitable allocation of costs.
- *Disadvantages*: Implementation challenges related to impervious data accuracy - relies on full faith in imperviousness calculations for individual residential properties; may create substantial administrative efforts to address individual customer inquiries/complaints.

Tiered Impervious Acreage. Impervious acreage is computed for each individual residential parcel. Customers are then categorized into tiers which reflect similar relative impervious acreage measurements. Tiered drainage charges are then calculated by applying the stormwater discharge rate to the average impervious acreage for each tier.

- *Advantages*: Represents good faith in application of available data to group customers into similar classifications to attempt to further refine flat rate approach more equitably. Relatively simple implementation and ease of individual customer inquiries, etc.
- *Disadvantages*: More equitable than the Flat Rate, but potentially still over-simplistic, depending on the data and how the tiers are developed. Possibly open to equity challenge, particularly for customers on the "edges" of various tiers.

3.3.4.3 Adjustments

The alternative rate structure contemplates that adjustments to the calculated runoff potential of a parcel will available. This adjustment process will be facilitated through a website that allows customers to view the impervious areas on their properties, and provide feedback on these images to the City. Through this interface, customers will be able to demonstrate the following:

- The property is associated with an incorrect user class.
- The impervious area estimated for the property is incorrect.
- Gravel areas of the property that are not compacted should be considered as a pervious surface.
- The property owner has taken action to retain all runoff on-site and / or to remove impervious area.
- The runoff from the property does not discharge into the City's stormwater system, either directly or indirectly, either because it discharges directly to the Huron River or discharges outside the City limits to a drain that is not tributary to the City's system.

Appendix A contains regulations of the Public Services Area that define allowable adjustments in more detail.

3.3.4.5 Credits

The alternative rate structure also contemplates direct credits offered to individual customers that engage in activities that augment the City's efforts in administering, managing, and operating its stormwater control responsibilities. Such activities may include installation and proper maintenance of facilities that capture and control the discharge of stormwater (such as detention basins, bioretention facilities, grass swales and filter strips, stream corridor protection), facilities that control and/or convey upstream, off-site stormwater, education and engagement activities that supplement City-financed programs, and replacement of impervious area with a permeable material, and/or enclosure / containment of pollutant sources exposed to rainfall.

Appendix A contains regulations of the Public Services Area that define the credits allowed by the City.

Section 4
Billing Database Development

4.1 Introduction

The rate methodology recommended in Section 3 must be supported with a billing database containing impervious area data and other property-specific information. This section first evaluates the City's existing customer billing data and data management systems, and provides the conceptual design of an automated procedure for impervious data and billing updates, consisting of the following items:

- A procedure to create, update, and append the imperviousness database file.
- Automated file and information maintenance procedures for the stormwater utility charge information in the City's computer system.
- A procedure for billing the stormwater utility charge, including protocol to interface the imperviousness database with the City's billing system.
- A procedure for updating the City's imperviousness database with new property information and/or for credits or adjustments granted by the City.
- General staff and resource needs to maintain the imperviousness database.

The recommended automated procedures for updating the imperviousness data build upon information from building permits, utility billing system data, new aerial imagery, and other available data sources. The City is incorporating recommended procedures into routine file maintenance procedures.

To support database development, new aerial photography and orthoimagery was obtained for the City. This orthoimagery was used to develop a GIS coverage that represents the imperviousness throughout the City. This coverage was intersected with the parcel database to allow residential parcels to be categorized, for measurement of impervious area on each non-residential property, and for subsequent rate assessment. This same process was applied to non-tax parcels such as the street right of way.

4.2 Utility Billing System Analysis

The City's existing Utility Billing system has been reviewed to understand how it is currently used to generate and bill stormwater fees. The purpose of this section is to document what has been learned and to identify areas that need further refinement in order to support the proposed rate structure.

The requirements for using the City's existing utility billing system to bill for the revised stormwater utility charge to every property in the City has been established. This was done by revising the stormwater service charge on existing utility bills and

creating "stormwater only" accounts for properties not currently included in the billing system.

After reviewing this information, the logistics of revising the stormwater utility charge within the City's existing billing system and database and updating the database as necessary was determined. Based on this review, the administrative procedures for developing the stormwater billing account database were outlined and recommendations were developed for the collection, updating and file maintenance requirements of the system, including the following topics:

- Updates and changes that may be necessary to modify the database and billing system to incorporate the stormwater utility charge information.
- Procedures for file and information maintenance.
- Data transfer procedures.
- Modifications to the billing format.
- Procedures for updating the billing file database.
- Potential issues that need to be resolved for implementation.
- An estimated cost associated with using the existing system and updating it as necessary.

The results of this evaluation are presented in terms of general requirements for billing system software and staffing to support the stormwater utility charge.

4.2.1 Utility Billing System Overview

The City's current utility billing system is implemented through Cogsdale Corporation's Customer Service Management software (CSM). CSM was developed using Microsoft's Business Solutions – Great Plains e-business management system. Data resides in a Microsoft SQL Server database.

Stormwater is billed quarterly with a billing cycle of 88 to 93 days. Bills are normally sent to tenants unless no tenant is on file, in which case the owner is billed. For utility billing, any multi-family building with more than 4 dwelling units is considered a commercial property. At multi-family locations with multiple accounts, stormwater bills usually go to the master account. A typical strip mall would normally receive one bill per parcel, even when there are multiple water meters on the parcel. Properties with no water or sewer service are also billed for stormwater. There are approximately 150 to 200 accounts outside the City which receive water and sanitary bills, but no stormwater bills.

Based on the current stormwater ordinance, single–family and two-family dwellings are charged a flat fee per dwelling per quarter unless adequate stormwater retention

is provided, in which case the per-dwelling charge is reduced. All other properties are charged a per acre rate multiplied by 0.20 for pervious area, and either 0.95 for impervious area without adequate detention or 0.30 for impervious area with adequate detention. A 10% reduction is allowed for all bills paid in full before the due date.

4.2.2 Required Utility Database Updates and Changes

A conference call was held with a representative of Cogsdale Corporation to discuss any issues that may arise from integrating the new stormwater rate structure into the existing utility database based on the proposed tiered residential rate structure, coupled with a broader range of credits and adjustments. It was determined that the anticipated stormwater rate structure should be implementable within the current utility database without significant additional development effort on Cogsdale's part. Several options were discussed for implementation of the anticipated rate structure including an option involving unique rates for each tier and green credit combination as hypothetically illustrated below.

Tier 1 with no credits = 2.0

Tier 1 with one credit = 1.8

Tier 1 with two credits = 1.6

Tier 2 with no credits = 2.5

Tier 2 with one credit = 2.3

While this method is workable, it may prove cumbersome to maintain.

A more satisfactory solution was the calculation of rates using the 'Fixed Multiplier Components' section of the existing system. This would allow for a flat rate to be modified by up to three component factors similar to how rates for commercial properties are now calculated.

Once the rate structure was finalized, the stormwater rate calculation methodology was supplied to Cogsdale for their comment. Using the rate calculation methodology developed, Cogsdale prepared detailed requirement specifications that were then used to implement the methodology within the Cogsdale billing system.. This methodology is based on the following assumptions:

- Data should be imported to the appropriate tables by Location number (the uniquely generated Cogsdale location identifier).
- In addition to the fields required for the rate calculation, the Cogsdale system can store an unlimited number of user defined fields containing related information such as parcel number, lot size, and comments describing how the rate was determined.

- If for some unexpected reason changes would be required to the database, it is understood that these changes would be made by Cogsdale or City staff under the direction of Cogsdale.

- Testing of data import routines to the utility database and billing calculations prior to going live is a critical component of the implementation plan.

4.2.3 Procedures for File and Information Maintenance

An integral part of a successful implementation of the stormwater rate structure is the procedure necessary to maintain the system and keep it current after its initial setup. This includes among other things, the maintenance of tenant and owner information, synchronization of the Assessor's and Utility database, the updating of impervious/pervious areas and the maintenance of parcels with associated splits, joins, annexations, etc.

The City IT Strategy Plan addresses some of these issues including address maintenance, parcel maintenance workflow and the migration of the existing GIS system to a geodatabase. Starting with this plan, the interfaces with the Assessor's Office, GIS, Permitting and other pertinent areas were developed and effective information management procedures established.

4.2.4 Data Transfer Procedures

Data transfer procedures are dependant upon where and how the information related to stormwater billing is maintained. The City desired to maintain parcels in a geodatabase running in ArcSDE which would lend itself to transfer of the information to the utility database though the use of data transformation services (DTS).

4.2.5 Modifications to Billing Format

Current customer utility bills display a *Service Class* field along with an entry for *Stormwater* and its associated fee. Unless the City needs to supplement the existing stormwater information included with the bill, it is anticipated that the existing billing format will require no modification.

4.2.6 Potential Issues

The following items were identified as potential issues to resolve to enable a successful implementation of the stormwater rates structure.

4.2.6.1 Number of Dwelling Units

The City is responsible for providing the number of dwelling units within each multi-family residential parcel. Currently, there is no one up-to-date source of this data. The Assessor's database does not track number of dwelling units and, while the Utility database does include a field for dwelling unit numbers, the City acknowledges it is not up-to-date. Potential sources of dwelling unit numbers include the trash cart database (not complete for the entire city) and the City's permitting system which

requires further investigation. In light of this, the stormwater billing system is relying on the existing definitions within the Utility database.

4.2.6.2 Assessor and Utility Database Synchronization

No one-to-one match between the Assessor's and Utility databases existed at project inception. The Assessor's database is understood to have the best owner information while the Utility database contains the most up-to-date tenant information. Approximately 90% of the records between the databases were matched using tax parcel numbers. The other 10% required matching of addresses which was somewhat problematic in that the Assessor's database addresses are derived from property descriptions and do not necessarily follow postal addressing standards while the Utility database addresses do, for the most part, follow postal standards. The synchronization was completed over a two month period through an intensive effort by the Customer Service Center working with IT.

4.2.6.3 Parcel Acreage Calculations

Parcel acreages maintained in the Assessor's database are based on property descriptions and are considered the official parcel area. Pervious/impervious area determinations for use in the calculation of stormwater rates were derived from GIS. Parcel areas derived from GIS do not always agree with property description areas. While in most cases the discrepancies were minor, it was important to adequately resolve significant discrepancies when determining rates.

4.3 Parcel Evaluation

This section evaluates available property information, defines the relative runoff from different classifications of property, and evaluates the ability of the various rate structures to properly represent this information. It will include six subsections.

4.3.1 Sources of Information

4.3.1.1 City of Ann Arbor Property Records

A data file containing information describing parcels within City of Ann Arbor (Equalization and Billing databases) was obtained from the City in mid-2006. The assessor's information provides the majority of the detailed parcel data required to:

- Evaluate property characteristics and uses that may influence stormwater
- Identify a customer base, and
- Begin a customer database for the stormwater utility billing system.

A parcel refers to any contiguous property, lot(s), or land-tract under single ownership. Of significant relevance to this project, the assessor's information for the majority of developed property parcels includes an amount of area on a parcel that has been covered with structural improvements (i.e., buildings or pavement) that resist the infiltration of stormwater.

4.3.1.2 Parcel Maps

The most current GIS parcel layer (May 2006) was obtained from the City with each parcel identified with a unique parcel information number (PIN) constructed from the city, township, section, block and parcel identifiers. The parcel layer contained approximately 27,650 parcels of which 24,701 belonged to the City with the remainder belonging to other minor civil divisions. This parcel layer was used for analysis until an updated parcel layer was received in March of 2007.

A land use GIS layer which had been developed from the Ann Arbor Planning Department's comprehensive land use inventory conducted during the summer of 1998 and updated in the summer of 2000 was also obtained for use in assigning land use classifications to parcels.

All GIS layers were in the Michigan State Plane Coordinate System, NAD83, South Zone with a unit of international feet.

4.3.1.3 Aerial Photographs and Impervious Area Database

The City, in conjunction with the University of Michigan, obtained orthoimagery for the City during the spring of 2006. Both 6"pixel infrared and processed color imagery was acquired and all data was required to meet the ASPRS Accuracy Standards and National Map Accuracy Standards (NMAS) for 1" = 100' scale mapping. Imagery was to be obtained during leaf-off conditions. Due to weather constraints on the photography, some leaf growth was visible but did not appreciably affect the overall usefulness of the imagery. All flights were made at a sun angle of greater than 30 degrees to lessen the impact of shadows upon the imagery. Images were supplied as digital files in a TIF format.

Available Pilot Data Sets

A pilot study approach was used to evaluate the automated processes for calculating impervious/pervious area using the City's new orthophotography and existing City GIS feature layers, and to meet the needs of the Stormwater Rates Project. The purpose of the pilot was to:

- Verify the efficacy of the automated imperviousness calculation process.
- Refine costs for performing the work citywide.
- Identify any potential problems with the processing that may impact the project schedule or budget.

The pilot study area consisted of 4 tiles in section 20 of township 2 South, Range 6 East. The following data sets were made available for use in the pilot study:

- Existing City GIS data layers including parcel boundaries, building foot prints, roads, etc.

- Newly acquired CIR and "processed color" aerial imagery of the pilot study area

As indicated in the original proposal, imagery was re-sampled at a 1 foot resolution for processing.

Definition of Impervious Areas
For the purpose of this study, impervious area is defined as any of the following:

- Buildings/structures, garages, sheds, shelters, patios, decks
- Paved roads and major dirt/gravel roads
- Paved parking areas and major dirt/gravel parking areas
- Paved, dirt and gravel driveways
- Paved sidewalks and bike paths
- Ponds, lakes, rivers, streams
- Swimming pools

Benchmark Data Set
To develop a 'true' benchmark data set for use in evaluating the results of the automated impervious/pervious determination processes, selected impervious/pervious areas within the pilot area were manually inspected and digitization of the aerial imagery was performed in conjunction with field ground-truthing as necessary. The entire section 20 was not benchmarked in this way, but selected areas were completed so that there is adequate comparison in the different land use types present in this section.

Automation Process Deliverables
The following products were required from those participating in the pilot study:

- Excel or MS Access table containing the impervious/pervious area for each land parcel in the pilot study area by parcel ID.
- Map showing polygons representing impervious/pervious areas within the study area. Maps were submitted in ESRI shape file or personal geodatabase format.
- Complete written description of the methods and processes used in the determination of the impervious/pervious areas including software and hardware used.
- Cost to complete pilot
- Time required to complete pilot

- Estimated cost and time to complete impervious area determination City-wide.

Evaluation Criteria

Results from the automated processes were compared to the benchmark data set and evaluated for accuracy, completeness, time to complete, estimated cost and skill level required to process the data. Since the City wishes to update their impervious/pervious layer on a periodic basis, consideration was also given to how well the automation process lends itself to periodic updates in a cost effective manner.

Impervious Area Database Development

Upon completion of the pilot study, a technical memorandum detailing the evaluation of the automation processes using the evaluation criteria outlined above was produced. As a result of the pilot study, it was determined that a semi-automated approach was necessary to create an impervious layer that would meet the project needs. The process began with the mosaicing of the aerial imagery into tiles which were then loaded into ESRI's ArcMap software where training data for the impervious classes was taken and used to train the classification software, called Feature Analyst, to recognize the appropriate targets. After the first pass, the analyst corrected any misclassifications and submitted the data for a second pass evaluation. At this point, the impervious representations were available for editing. Prior to editing, however, water was extracted as a separate class, using supervised classification methodologies. The classification was then examined by a technician, and any errors were corrected prior to vector conversion.

The impervious layer was converted to a vector layer in ArcMap, using a smoothing option to minimize the number of vertices and the size of the file. The map was assessed for accuracy using a minimum of 150 points for impervious and pervious classes with a Minimum Mapping Unit of 100 square feet. Points were verified to make sure that the area being evaluated was homogenous to be considered in the accuracy assessment. Points were photo interpreted from the imagery; in cases where questions existed with respect to the labeling of points, these points were visited in the field.

Once the impervious classification met the desired specifications, it was intersected with the City's parcel layer and a summary table of surface type (impervious, pervious or water) by parcel was prepared. This information was used to develop sample statistics for residential parcels and as the basis for impervious area estimates for commercial parcels. Impervious areas for all commercial properties were developed with an automated process in an ArcGIS environment based on the parcel boundaries and orthophotography. Impervious areas for a statistical sample of residential parcels of various classes (i.e., single family detached, duplex, apartment, and condominiums) were also delineated using the parcel data and orthophotography.

Impervious Area Adjustments and Credits for Water Features
While water is considered to be impervious area, many water features either form part of the drainage system within the City or do not discharge into the City's drainage system. For this reason, water features were measured separately from other impervious areas to facilitate the adjustment and credit process, which is described in more detail in Section 5.2. In general, the rate calculation is adjusted by removing impervious area associated a water features that either (1) corresponds to a portion of the City's drainage system (e.g., a stream, open water course, or City-owned wet detention basin) or (2) does not discharge (up through and including the 100-year storm event) to the City's drainage system. For example, rate calculations area adjusted to remove impervious area associated with water within swimming pools, since water falling onto the pools is required to be discharged into the wastewater system and does not typically get discharged to stormwater. Water features may also be eligible for credits if the water feature controls on-site or off-site runoff to the City's drainage system.

Impervious Area Adjustments for University of Michigan
Due to the availability of a highly accurate building footprint GIS layer for buildings located on University of Michigan property and in an effort to use the best available information for determining impervious area, a modified approach was used for determining impervious area for UM parcels. All impervious area as determined above was classified into building, sidewalk, parking and other for UM parcels. Those areas classified as buildings were removed from the existing impervious layer and replaced with the UM building footprint areas to arrive at a total impervious area that is believed to more accurately reflect reality.

4.3.2 Parcel Evaluation

User fee programs typically consider the owner or user of a parcel as the beneficiary of stormwater management services. The parcel owner or user is, therefore, considered the program customer. Defining rate policies and developing rate policy models requires information regarding parcels within a program service area. For this study, parcel information was obtained from the City of Ann Arbor Assessor's Office and the City of Ann Arbor Geographic Information System.

A database of parcels within the City was created and used to establish parcel distribution by land use category, as shown in **Table 4-1**. Land use classifications were assigned by taking the centroid of each parcel and spatially joining them with the City's land use layer. A cross-check of the parcel land use assignation with data from the Equalization database was also done where possible. All parcels were then overlaid on the aerial imagery and examined on screen to check for proper assignment of single, two family and commercial land use designations. Based on the assembled database, twenty land uses were used to categorize all land parcels within the City. A total of approximately 24,521 parcels were identified within the City, with 21,804, or 89%, categorized as residential land use categories, 1,987, or 8% categorized non-residential, and 730, or 3%, categorized as vacant.

Table 4-1 City of Ann Arbor Land Use Analysis

Land Use Category	Number of Parcels	Percent of Total	Parcel Area		Impervious Area	
			Total (sq. ft.)	Percent of Total	Total (sq. ft.)	Percent of Total
Residential						
Single Family	19,202	78.3%	215,440,510	27.7%	63,362,175	20.1%
Two Family	1,286	5.2%	11,241,110	1.4%	4,863,411	1.5%
Total Residential	**20,488**	**83.6%**	**226,681,620**	**29.2%**	**68,225,586**	**21.7%**
Multiple Family Residential						
Multiple Family	1,137	4.6%	78,129,362	10.1%	35,866,133	11.4%
Group Housing	146	0.6%	3,227,446	0.4%	1,643,113	0.5%
Mobile Home Park	1	0.0%	194,450	0.0%	114,827	0.0%
Hotel / Motel / B&B	22	0.1%	3,740,272	0.5%	2,547,192	0.8%
Assisted Living	10	0.0%	3,719,352	0.5%	1,495,971	0.5%
Office	314	1.3%	25,617,423	3.3%	14,755,828	4.7%
Commercial	486	2.0%	21,403,927	2.8%	16,922,012	5.4%
Industrial	75	0.3%	14,212,691	1.8%	7,597,802	2.4%
Transportation	300	1.2%	30,072,560	3.9%	8,790,370	2.8%
Institutional						
Government	21	0.1%	1,696,813	0.2%	1,281,293	0.4%
Education	105	0.4%	47,686,983	6.1%	15,993,488	5.1%
Religious	78	0.3%	8,144,844	1.0%	2,964,391	0.9%
Other	50	0.2%	9,170,070	1.2%	2,079,457	0.7%
Recreation						
Indoor	4	0.0%	1,126,037	0.1%	641,178	0.2%
Outdoor	248	1.0%	102,469,023	13.2%	18,164,485	5.8%
Mixed Use	12	0.0%	8,031,081	1.0%	3,959,360	1.3%
Vacant	730	3.0%	38,624,937	5.0%	4,872,451	1.5%
Mixed Use	294	1.2%	11,162,433	1.4%	7,539,593	2.4%
Total Commercial	**4,033**	**16.4%**	**408,429,704**	**52.6%**	**147,228,944**	**46.8%**
Right of Way						
City			104,354,215	13.4%	81,505,334	25.9%
State			23,503,895	3.0%	9,695,805	3.1%
County			1,630,513	0.2%	968,286	0.3%
Rail			5,995,903	0.8%	2,891,201	0.9%
U of M			3,558,939	0.5%	1,744,579	0.6%
Private			2,958,226	0.4%	2,375,530	0.8%
Other			65,746	0.0%	41,404	0.0%
Total Right-of-Way			**142,067,437**	**18.3%**	**99,222,139**	**31.5%**
Total	**24,521**	**100.0%**	**777,178,761**	**100.0%**	**314,676,669**	**100.0%**

Once the parcel database was created, a statistical sampling of the single and two family residential land use categories identified in the City was developed. Each non-residential parcel was individually inspected for accuracy of impervious delineation and, where uncertainty existed, was field checked. The impervious area for each parcel was calculated using scaled measurements from aerial photographs.

4.3.2.1 Residential Parcel Analysis

In keeping with the City's existing stormwater billing convention, residential parcels were considered to be those parcels with land use designations of single or two family while all other parcels were considered commercial for stormwater billing purposes. Residential impervious area is an important parameter for developing the stormwater utility representing almost 84 percent of the parcels.

Table 4-2 shows parcel information for single and two family parcels identified in the parcel database. The database information identified 19,202 developed single family parcels and 1,286 two family parcels in the City. The sample average impervious area for single family parcels was estimated to be 3,300 square feet and 3,782 square feet for two family parcels. The total impervious area for single family parcels is 1,455 acres of impervious area. Similarly, the calculated total impervious area for two family parcels is 112 acres. The impervious area for single family residences and two-family residences is approximately 22 percent of the total impervious area within the City.

Table 4-2 City of Ann Arbor Residential Property Evaluation

Land Use Category	Parcels Number	Percent of Total	Average Impervious Area (sq. ft.)	Impervious Area (sq. ft.)	Percent of Total
Single Family	19,202	78.3%	3,300	63,362,175	20.1%
Two Family	1,286	5.2%	3,782	4,863,411	1.5%
Total	**20,488**	**83.5%**	**3,330**	**68,225,586**	**21.7%**

To assist the City and its Stormwater Citizens Advisory Task Force (SCATF) in evaluating rate policy options, single and two family detached unit properties were plotted as a scatter graph, shown in **Figure 4.1**. As this information was further analyzed and discussed, the plot indicated a significant absolute difference in total impervious areas between the "small house" and the "large house". When the percentages of parcels that contain a specific impervious area are evaluated, relationships can be developed to clarify the differences between "small" and "large". As in most user charge rate studies, a balance must be drawn between absolute values and values that reflect significant differences. When water, wastewater, and solid waste charges are evaluated to define "fairness", the typical standard is that no two adjoining residential classes should have ratios that are more than 2.0 – 2.5 to 1.0.

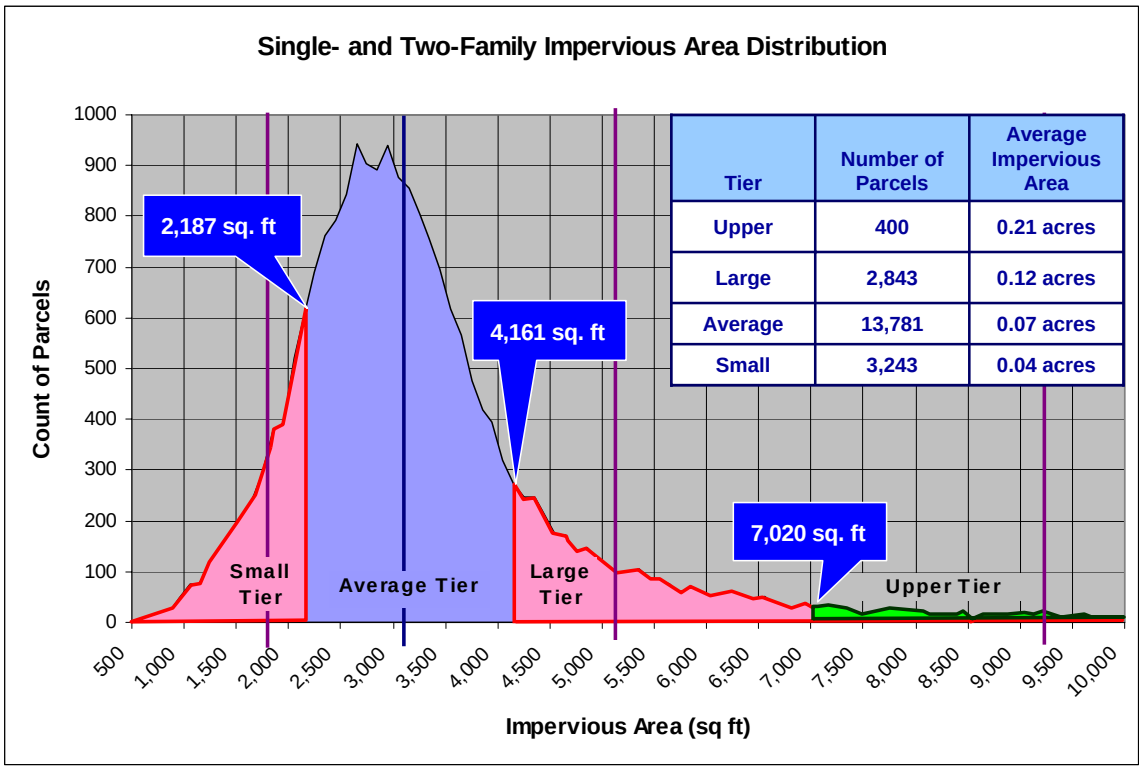


Figure 4-1. Distribution of Single and Two-Family Residential Property Impervious Area and Definition of User Fee Tier Classifications.

When this relationship is applied to a stormwater user fee, the comparisons are usually based upon the properties that contain the smallest impervious areas (i.e., those more than 1 standard deviation less than the mean or the 16 percent of the parcels with the least impervious area) and the largest impervious areas (i.e., those more than 1 standard deviation greater than the mean or the 16 percent of the parcels with the most impervious area). From the data collected for the City, 16 percent of the single family detached units contain less than 2,187 square feet impervious area and 16 percent contain greater than 4,161 impervious area; representing a ratio of 2.0 to 1.0 (4,161 divided by 2,187 = 1.9). This ratio is marginally less than the desired ratio for lumping all residential parcels into a single tier. However City staff and the Stormwater Citizens Advisory Task Force believed that the ratio was large enough to justify establishing a rate structure containing more than one "tier" of single-family residences was recommended to more equitably distribute costs among residential properties.

SCATF members also suggested that it would not be equitable to bill all properties within the large tier the same amount because the properties with the largest amount of impervious area within this tier contain significantly more impervious area than those in the remainder of the tier. For this reason, an upper tier was created, consisting of those properties with an impervious area greater than two standard deviations higher than the mean impervious area. This represents 2 percent of all properties, or approximately 400 properties.

4.3.2.2 Developed Commercial Properties

Developed commercial parcels contain all parcels other than those coded one and two family. This category consists of 4,033 parcels. The parcels are further divided into other residential, office, commercial, industrial, transportation, institutional, recreation, and mixed use based on the land use code found in the parcel database data.

Commercial property is typically an important customer class for a stormwater utility because they generate a large portion of utility revenue. In the City of Ann Arbor, this customer class makes up 16 percent of the total number of parcels, but contributes nearly 50 percent of the total impervious area within the City. Parcels in this group represent large developments and government and educational complexes with a total of 3,380 acres of impervious area estimated for these categories.

4.3.2.3 Rights-of-Way and Easements

Local, county and state rights-of-ways alone account for nearly 2,200 acres or approximately 30% of the total impervious area within the City. However, drainage facilities such as swales, storm sewers, and drainage ditches are usually located within road or drainage rights-of-way/easements. The interconnection of roadway and associated drainage facilities is significant. Roadway curbing and swale systems constitute a significant portion of the City's drainage system. In addition, they constitute a large part of the stormwater storage system. Therefore, stormwater management utilities typically consider all road rights-of-way and drainage facilities (federal, state, local) as components of the City's stormwater management infrastructure. These facilities are subject to a credit equivalent to the benefits provided by the drainage facilities within the public ROW. Section 5.2.2 provides the basis for credits to Ann Arbor's public ROW.

4.3.2.5 Summary of Parcel Analysis

The parcel analysis identified 24,521 individual parcels in the City. Single and two-family residential parcels make up 84 percent of the parcels and 22 percent of the impervious area, while commercial parcels make up 16 percent of the total parcels, but account for nearly 50 percent of the total impervious area of the City. The average commercial parcel contains over 10 times as much impervious area as an average residential property in the City.

4.3.2.6 Billing Database

To support the management of information required for parcel analysis and determination of billed impervious areas for input to the City's Cogsdale billing system, a billing database was developed in MS Access. Information contained in the database consists of:

umLocationID – unique billing account identifier

umLocClass – identifies parcel as a residential or commercial property; RES for residential, COM for commercial

umServiceType – type of service; STORM

umTariffID – identifies how impervious area is determined; directly measured or tier

umAssessorID – assessor parcel identification number

umLandParcelID – land parcel identification number

Landuse_code – land use classification code

Admin – identifies parcel as; PB – public, PV – private or UM – University of Michigan

Total_area – area of parcel in square feet as calculated in the parcel GIS layer

TIA – total impervious area in square feet as determined by GIS orthophotography impervious analysis

Split_type – for parcels whose impervious area is split between multiple billing accounts, indicates how the split is made; **proportional** with an equal impervious area assigned to each split account or **percent** where each account is assigned a percentage of the total impervious area

Split_num – number of accounts the impervious area is to be split between

Split_area – impervious area associated with each split in square feet

Credit – type of credit if applicable; direct drainage, detention or BMP

PBI – percent billable impervious area. Mutiplied by TIA to determine the amount of impervious area to be billed.

Comment –parcel specific comments

The billing database was developed by combining the GIS parcel analysis with the billing account information from the Cogsdale billing system. Credits were assigned as determined along with split information.

In order to prepare data for input to the Cogsdale system, a query was written to extract umLocationID, umLocClass, umServiceType, umTariffID, AssessorID, umLandParcelID, TIA, PBI and credit data. The extracted data was exported to Excel and sent to the City for import to Cogsdale.

Section 5
Revenue Scenarios and Rate Analysis

5.1 Introduction

The findings and work products summarized in the previous sections support a stormwater rate analysis for the City of Ann Arbor that evaluated a range of revenue scenarios. This analysis began with the projected revenue requirements described in Section 2, focusing on attaining the revenue requirements of Level of Service B, which is supported by the City's Stormwater Citizen's Advisory Tsk Force and City Public Services Area staff. Next, these estimated revenue requirements are allocated to individual customers according the rate structure recommended in Chapter 3, using the specific billing system data as described in Section 4.

This section, Section 5, evaluates strategies for phasing rate increases to achieve the desired LOS B, determines the value of the various credits and adjustments to these rates, and closes with a discussion of the impact of the proposed rates on a representative set of property owners within the City of Ann Arbor.

5.2 Estimated Adjustments and Credits

The City grants charge adjustments when customers identify incorrect information contained in the City's billing database or when some or all of the stormwater discharge from the property does not enter the City's stormwater system. Stormwater that does not enter the City's stormwater system may discharge directly to the Huron River, discharge across the City limit (and not re-enter the City), or be completely retained on-site.

Any customer may qualify for stormwater credits when they can demonstrate that their existing or proposed stormwater facilities and management practices provide the City with a cost savings that the City otherwise would incur as part of their efforts to manage stormwater. The reduction available for each type of credit was established by City Council in Chapter 29 of the Code, City of Ann Arbor, Michigan, with the actual credit reduction for a specific property determined by the Public Services Administrator according to regulations based on the characteristics of the actual facility or management practice employed by the customer.

This section describes the available credits and adjustments and provides the rationale for the specific credit amounts established in Chapter 29 of the Code. Credit amounts are based on average projected expenditures over the next five years, and should be revised periodically to reflect future projected costs.

5.2.1 Adjustments for Non-Contributing Areas

The billing database presented in Section 4 identifies properties or portions of properties that do not discharge to the City's storm drainage system. These properties may either discharge directly into the Huron River, discharge into an

adjoining political jurisdiction through drainage that does not flow back into the city, or are able to completely retain the runoff on-site.

A facility or area that completely retains runoff on-site must not discharge according to criteria in WCDC code (have no outlet), be completely watertight, and have at least 18 inches of freeboard. This adjustment is for unusual structures, such as swimming pools, hazardous material storage areas, quarries, certain wetlands and ponds with no direct or indirect connection or surface drainage pathway to the City's drainage system, etc. These non-contributing areas are charged a customer fee, but are not charged for stormwater discharges. Billing data described in Section 4 indicates that approximately 7.6 percent of the impervious area within Ann Arbor does not contribute to Ann Arbor's drainage system and is not charged for stormwater discharges.

5.2.2 Credits for Public Rights of Way

The stormwater utility (Utility) and the public right-of-way (ROW) (defined as the right-of-way for all City streets and other rights-of-way that provide stormwater conveyance and/or control integral and necessary to providing adequate service to the Utility customers, as determined by the Administrator) share a symbiotic existence. The public ROW receives stormwater drainage service from the Utility – just like any other entity that benefits from its existence. However, the public ROW also provides service to the Utility (and all of its other customers) by serving as a conduit for stormwater drainage and storage that augments the Utility's other assets – and that the Utility would have to construct independently but for the existence of the public ROW.

The question at hand is this: To what extent does the benefit provided to the Utility by the public ROW fairly compensate the Utility for the services it renders to the public ROW? Three potential outcomes could emerge from such an assessment:

- Some portion of the normal stormwater charge to the public ROW is waived through a credit mechanism to reflect the value of service provided by the public ROW,
- The value of public ROW service is sufficient to support transfer payments from the Utility to the public ROW (although such payments are not provided for within the City's Ordinances), or;
- The value of public ROW service and the normal stormwater charge to the public ROW are reasonably equivalent, in effect supporting a 100% credit for the public ROW.

This section projects long-term stormwater utility charges for runoff from impervious area within the public ROW based on the projected revenue requirements presented

in Section 5.3, presents alternative scenarios for estimating the value of the service provided by the public ROW, and supports definition of a credit for the public ROW.

5.2.2.1 Projected Stormwater Charge to Public Right of Way

The following procedure was used to determine the estimated stormwater utility charge for runoff from the 2,182 acres of impervious area within the public right of way under the various ROW easement scenarios. First, the stormwater utility charge for the public ROW between FY 2006/07 and FY 2040/41 has been estimated. The projected charge was based on the following City revenue requirements described in more detail in Section 5.3:

- Achieve Level of Service B by FY 2014/15, requiring 11 percent annual rate increases. Under this approach, annual costs and required revenues would increase from $3.7 million to $9.6 million

- Maintain Level of Service B thereafter, assuming a 2 percent annual inflation rate and additional revenue necessary to pay off bonds issued to fund capital improvements (assumes one bond issued every 5 years to fund 5 years of capital improvements). Under this approach, annual costs and required revenues would increase from $9.6 million in FY 2014/15 to $19.9 million in FY 2040/41.

- The estimated charge (without credits) to the public ROW was established. In general, the public ROW contains approximately one-third of the total 6,865 acres of impervious area within the City and (with no credits) would generate approximately 1/3 of the City's annual revenue requirement.

5.2.2.2 Value of Services Provided by Public ROW

One way to determine the value of the public ROW to the stormwater utility is based upon the equivalent value of a drainage easement that would need to be obtained if the drainage system were located outside the public right of way. This section describes five scenarios for defining this equivalent easement value:

- ***Scenario 1: Credit Based on Equivalent Easement for the Underground Drainage System at an Underground Easement Rate.*** Approximately 196 miles of storm drainage within the public right of way contains an underground storm sewer, which is designed to convey relatively small design storms (generally the 2-year to the 10-year storm). The estimated equivalent easement value for an underground drainage easement along these roadways is typically valued at 15 percent of the assessed value of the property. Assuming that the typical roadway width in Ann Arbor is 24 ft, this yields a cost of approximately $2.0 million using 2007 property values,. Scenario 1 is not a realistic representation of how the public ROW and the drainage system interact, and therefore provides an unrealistically low estimate of the value of service provided by the public ROW.

- ***Scenario 2: Credit Based on Equivalent Easement for Underground System at Surface Easement Rate.*** Scenario 2 is similar to Scenario 1, but also recognizes that the curbs along the roadway provide a surface conveyance system, since they are generally designed to convey the flow to the underground system without impeding traffic and to convey / store flows from storms exceeding the capacity of the underground drainage system between the curbs. The estimated equivalent easement value for a combined underground and surface drainage easement (typically valued at 40 percent of the assessed value of the property) is approximately $5.4 million at 2007 property values, assuming that the typical roadway width in Ann Arbor is 24 ft. Scenario 2 is also not a realistic representation of how the public ROW and the drainage system interact, and provides an unrealistically low estimate of the value of service provided by the public ROW.

- ***Scenario 3: Credit Based on Equivalent Easement for Roads with Underground and Surface Drainage Systems plus Remaining Roads with Surface Drainage Systems.*** The remaining 104 miles of roadway within the Public Right of Way have no underground drainage system, but are served by either the surface curb and gutter system or a roadside ditch system. The estimated equivalent easement value is the sum of the easement value for the underground drainage easement, from Scenario 1, and the surface drainage system along the remaining roadways, which are typically valued at 40 percent of the assessed value of the property. This assumption results in approximately $4.9 million at 2007 property values, assuming that the typical roadway width in Ann Arbor is 24 ft.

- ***Scenario 4: Credit based on Equivalent Easement for All Roads at Surface Easement Rate.*** Every roadway serves as a surface drainage system during extreme storm events exceeding the capacity of the underground storm sewer system. As such, Scenario 4 establishes the estimated equivalent easement value as the value of a surface drainage easement, typically valued at 40 percent of the assessed value of the property, along the entire 300 miles of roadways with drainage systems. The value of the equivalent easement under Scenario 4 is approximately $8.3 million at 2007 property values, assuming that the typical roadway width in Ann Arbor is 24 ft.

- ***Scenario 5: Credit based on Equivalent Easement of Varying Value.*** Scenario 5 recognizes that the value of the easement may vary depending on the degree that the drainage system infringes on other uses. Therefore, the following equivalent easement values were established:

    - Surface easement (valued at 40% of assessed value) along the gutter on each side of the road (4 ft total width) and/or the width of any roadside drainage ditch.

    - Underground easement (valued at 15% of assessed value) along the road where the underground storm sewer is located (4 ft total width).

- Mixed surface and underground easement (valued at 25% of assessed value) along the remaining width of the roadway where surface water may pond or be conveyed during the 100-year storm event.

To be conservative, the estimated value of the easement was calculated only for the 196 miles of roadway paralleled with underground storm sewer, curb, and gutter. Portions of the 104 miles of roadway not paralleled by underground storm sewer may be added to the estimated equivalent easement value in the future after better information about the drainage systems along these roadways is obtained. The value of the equivalent easement under Scenario 5 is approximately $ 4.1million at 2007 property values, assuming that the typical roadway width in Ann Arbor is 24 ft.

Generally, drainage easements vary depending on the size of the drainage system, consisting of the width of the drain and adequate area on either side of the drain to facilitate maintenance and potential future construction. This evaluation assumed that the typical underground drainage easement in the City is equivalent to the 24 feet, the assumed width of a typical roadway in Ann Arbor.

For calculating the present worth cost of the equivalent drainage easement, the City determined that the average assessed value of vacant land in Ann Arbor is $9.09, based on a review of 36 vacant properties, and multiplied this value by the easement width, drainage system length, and estimated percent of assessed value for easement purchase. The evaluation also utilized a rate of return of 6% and payments in perpetuity for calculating annual costs.

5.2.2.3 Evaluation of Public ROW Charges and Service Value

As the previous sections indicate, projecting stormwater utility rates and determining the value of the service provided by the public ROW is not a precise exercise – it depends on alternative assumptions regarding property values, construction costs, easement conditions, stormwater infrastructure sizes, utilization of the roadway for surface conveyance, and so forth. The previous section describes a variety of conditions that may reasonably exist for each of these elements. Therefore, a wide range of potential values exists for the services provided by the public ROW.

Figure 5-1 compares the estimated impervious area charge to the public ROW with the high and low estimate of equivalent easement costs (excluding unrealistically low estimates included in Scenarios 1 and 2) presented earlier in this memorandum. The annual "public ROW benefit value", expressed in terms of the annualized cost of an equivalent drainage easement, ranges from approximately $4.1 million to $8.3 million and is represented by the upper and lower boundaries in the figure. These lines illustrate the range of annual benefit provided to the Utility under the varying assumptions.

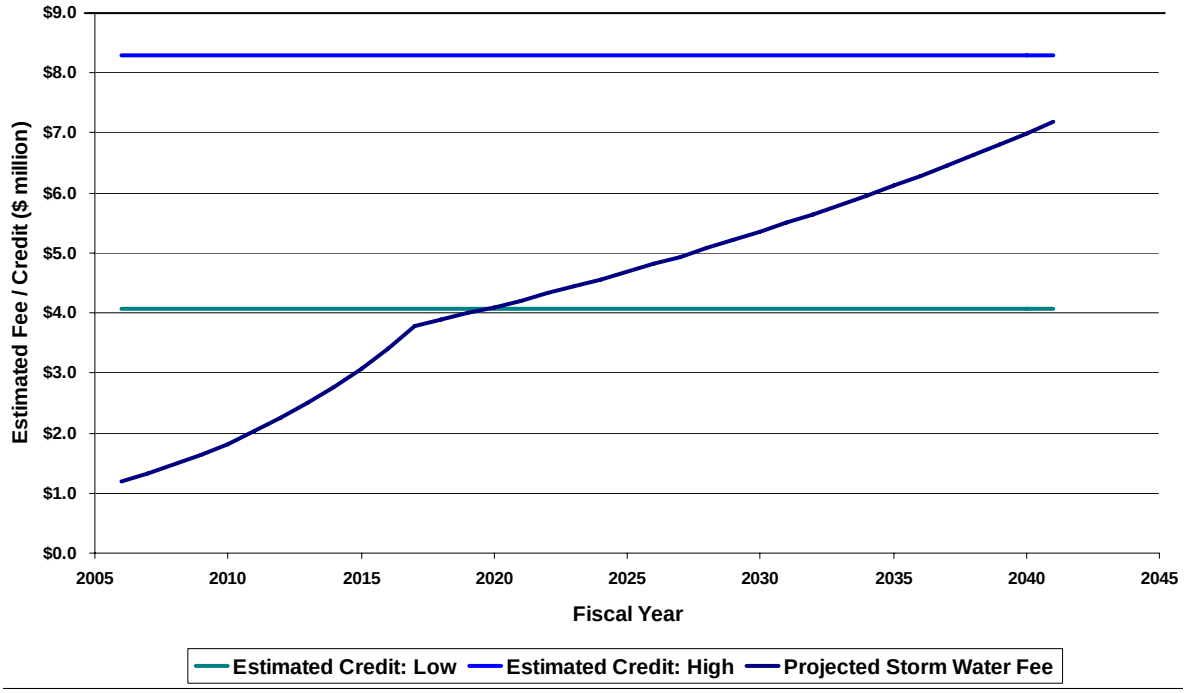


Figure 5-1. Comparison of Projected Stormwater Fee and Credits for Public Right-of-Way

To the extent that annual charges to the public ROW exceed this range, a partial credit to the public ROW is supported. At the other end of the spectrum, it could be argued that transfer payments from the Utility to the public ROW may be supported to the extent that annual charges to the public ROW are below this range. City ordinances do not provide for such transfer payments, however, limiting the value of the credit to 100 percent of the estimated stormwater utility charge is reasonable.

Finally, if the annual costs fall within the range, it can be concluded that the value provided by the public ROW and the costs of serving the public ROW are reasonably equivalent – and that the credit to the public ROW should be 100 percent. As illustrated in the chart, the projected charges to public right-of-way over the 35 year projection period fall below the range of estimated annual benefit value through approximately 2018 (when Level of Service B will be achieved), and is within the range for the remainder of the 35 year projection period. This supports a conclusion that the public ROW should receive a 100 percent credit to the stormwater utility charge.

5.2.2.4 Credits for Railroad ROW

A similar evaluation was conducted to determine the eligible credit for the 137.6 acres of railroad ROW within the City. Railroad ROW are eligible for a credit because they are paralleled by drainage swales that collect runoff from adjoining property and include culverts maintained by the railroad that convey off-site runoff through the ROW. The following evaluation was conducted according to the methodology used for public ROW to determine if Railroad ROW also should receive a 100 % credit:

Impervious Area Charge for Railroad ROW

- Impervious Area = 66.4 acres
- 2008 Fee @ $275.49/acre/quarter = $18,293 * 4 quarters = $73,172/year
- 2022 Fee @ $762.40/acre/quarter = $50,623 * 4 quarters = $202,492/year

Value of Services Provided by Railroad ROW

- Length of Railroad through Ann Arbor = 7.8 miles
- Estimated length of drainage within railroad ROW = 11.7 miles
- Average width of drainage feature plus access = 25 ft.
- Average property value in Ann Arbor = $9.09 / sq ft
- Value of surface easement = 40% property value
- Value of drainage along Railroad ROW = $6.7 M
- Annualized value of drainage along Railroad ROW = $337,000

Based on this evaluation, the value of drainage services provided within the railroad ROW exceeds the anticipated impervious area charge well beyond FY2022, and thus it would be appropriate to grant a 100% credit to the railroad ROW.

5.2.3 Residential Credits

Credit may be issued to a single-family or two-family residential property where the property owner has implemented one or more of the following stormwater facilities or management practices. This section describes the stormwater management practices qualifying for credits and presents the basis used for calculating each credit.

5.2.3.1 Credit for On-Site Stormwater Management Practices

The owner or authorized occupant of a single-family or two-family residence may receive a credit for physical stormwater management practices installed on their property. The revenue projections in Section 5.3 are based on an estimated 10 percent of the residential properties in the City participating in the on-site stormwater management credit program. Credit would be granted on both the stormwater discharge rate and to the customer charge:

- Stormwater discharge credits are set equal to the per typical single family residential cost of providing stormwater quality maintenance services (pipe cleaning and catch basin cleaning) times the reduction in stormwater discharges achieved by the practice during a stormwater quality event of 0.50 inches of precipitation, the current standard of the WCDC for stormwater quality management.

- Customer charge credits are proportionate to the public education benefits provided to the City by citizen involvement in such practices, set at 30 percent of the estimated per customer cost of public education.

The following types of practices are eligible to receive credits based upon a complete application to the City and subject to review and inspection by the Administrator.

Credit for Rain Barrels

To receive this credit, a property owner is required to install one or more rain barrels, each 35 gallons or larger, onto the downspouts from structures on the property, and to direct discharges from rain barrels between storm events either directly or indirectly to pervious areas of the property. The basis for this credit is that the property owner would install rain barrels with a total storage of 175 gallons. This is the volume necessary to store the runoff from approximately 600 sq. ft. of impervious area during a 0.50 inch precipitation event (the current standard of the WCDC for stormwater quality management), or approximately 20 percent of the total impervious area of a typical single family residential property with 3,049 sq. ft. of impervious area. A total of 175 gallons of storage can be achieved with 5-35 gallon rain barrels, or 3-60 gallon rain barrels. The credit is calculated as 20 percent of the per typical single family cost of pipe and catch basin cleaning, plus 30 percent of the per customer cost of public education programs.

Credit for Cisterns and Dry Wells

To receive this credit, a property owner is required to install one or more cisterns or dry wells able to capture a total stormwater volume of at least 500 gallons (or 66 cubic feet) and drain the captured volume into the soil in less than 24 hours. Facilities designed according to these criteria should accept runoff from at least 50 percent of the impervious area of a typical single family residential property with 3,049 sq. ft. of impervious area. In no event may the discharge from the facility cause an increase in the runoff to an adjoining property. The credit is calculated as 50 percent of the per typical single family cost of pipe and catch basin cleaning, plus 30 percent of the per customer cost of public education programs.

Credit for Rain Gardens

To receive this credit, a property owner is required to install one or more rain gardens at least 130 square feet in area, and at least 3 to 6 inches deep. The rain garden should be able to drain the captured volume into the soil in less than 24 hours. Facilities designed according to these criteria should accept runoff from at least 50 percent of the impervious area of a typical single family residential property with 3,049 sq. ft. of impervious area. In no event may the discharge from the facility cause an increase in the runoff to an adjoining property. The credit is calculated as 50 percent of the per typical single family cost of pipe and catch basin cleaning, plus 30 percent of the per customer cost of public education programs. Natural wetlands within a residential property may also be considered as rain gardens if they satisfy the above criteria.

5.2.3.2 Credits for Off-Site Stormwater Management Practices

Most properties within the City developed since 1978 are served by stormwater detention facilities built as a condition of development according to Section 63 of the City code. Design criteria for these facilities have evolved since then:

- ***1978***: Detention of the 100-year storm event for new impervious surfaces exceeding 15,000 square feet. Outlet rate is restricted to 0.2 cfs/acre (also referred to as the agricultural runoff rate for the 10 year storm event).

- ***1994:*** Washtenaw County Drain Commissioner adopts new design standards requiring control of the First Flush, Bankfull, and 100-year storm events. City staff requests voluntary compliance with WCDC design standards as developments are proposed.

- ***2000:*** WCDC revises design rules. These rules lowers outlet restriction rate to 0.15 cfs. City adopts new stormwater management requirements and also eliminates the "grandfather clause". Requires compliance with the rules of the WCDC.

- ***2002:*** City makes minor revisions to its stormwater management standards to provide an exception of minor projects that do not increase impervious area.

Generally, these facilities are owned and maintained by a homeowners association or similar organizations. The City maintains records of these facilities, their design criteria, and the properties served by these facilities. The City also periodically inspects these facilities to determine if they are properly maintained and operating as designed. Currently, 24 percent of the properties in the City are served by off-site stormwater management practices complying with Section 63 of the City code and would receive this credit.

Single-family and two-family residential properties that completely drain into one or more stormwater management facilities designed according to criteria in Chapter 63 of the Code, City of Ann Arbor in effect at the time the facility was constructed are eligible for a credit to their stormwater discharge rate. To receive this credit, the facility must be fully maintained according to criteria established by the Administrator. Stormwater discharge credits are set equal to the per typical single family residential cost times a factor based upon the design criteria of the facility establishing the amount of stormwater discharged into the City's stormwater system :

- The per typical single family residential cost of maintaining the primary drainage system and components of the secondary drainage system (i.e., open channels, stream crossings, and ditches), times a factor of 25%, which represents the relative reduction in O&M achieved through use of smaller infrastructure.

- The per typical single family residential cost of cleaning the secondary pipes, and catch basins, times a factor of 90%, representing the pollution control achieved by a Chapter 63 facility.

- The per typical single family residential cost of the City's major capital improvement budget, times a factor of 40%, which is the ratio of relative pipe costs with and without detention.

- The per typical single family residential cost of the City's minor capital improvement (capital outlay) budget, times a factor of 30%, which is the estimated reduction in stream erosion repair costs achieved with a Chapter 63 facility.

5.2.3.4 Credits for RiverSafe Home Participants

In 2007, the Washtenaw County Drain Commissioner initiated the RiverSafe Home program, which provides recognition to home owners or occupants who employ best stormwater management practices in the maintenance of their property. Information about this program and an on-line survey to determine if property owners are eligible can be found at the Drain Commissioner's web site:

http://www.ewashtenaw.org/government/drain_commissioner/dcRiverSafeHomes2

The City is supporting this program by providing customer credits as additional recognition to participating property owners and tenants who are in full compliance with the latest criteria of the RiverSafe Home program published by the Washtenaw County Drain Commissioner. Ann Arbor Stormwater Utility Customers must apply directly to the City for this credit by filling out the credit application. The City will periodically verify if the properties receiving this credit are in good standing with the WCDC's RiverSafe Home program. Customer charge credits are set at the estimated per customer cost of public education, which equals 45 percent (since the RiverSafe Home program addresses 5 of the 11 public education requirements of the City's NPDES stormwater discharge permit) times 67 percent (the fraction of the total public education budget supporting stormwater quality management), or a total factor of 30 percent. The revenue projections in Section 5.3 are based on an estimated 20 percent of the residential properties in the City participating in the RiverSafe Homes credit program.

5.2.4 Non-Residential Credits

A somewhat different set of credits is available to the other residential and the non-residential properties within the City. In general, property owners or eligible tenants must apply for these credits, and may be required to submit supporting documentation with their credit application to allow the Administrator to properly determine the value of the credit to be granted. Since the amount of impervious area within the non-residential properties in the City of Ann Arbor varies significantly, non-residential credits are established as a percent reduction (except for the school-based education credit) to the either the customer charge and/or the total charge for stormwater discharges from the property. In general, this percent reduction is calculated as the percentage of the City's total stormwater budget that is allocated to a certain service times a factor proportionate to the value of the creditable service at controlling the cost of service.

5.2.4.1 School-Based Education Credit

Schools, public or private, that perform public education and outreach practices in full compliance with an NPDES stormwater discharge permit issued by the Michigan

Department of Environmental Quality (MDEQ) may receive a credit for educating students and employees in the area of water quality awareness and protection. To be considered for this credit, the school must submit a copy of the NPDES permit, with the permit number, the latest stormwater management plan and annual report prepared under this permit, and the estimated number of residents of the City of Ann Arbor who received or participated in each educational practice.

The Administrator will review the application, and determine a credit amount based on the estimated cost-reduction in the City's public education programs provided by the school-based educational activities. Revenue projections in this section are based on an estimated $100,000 for school-based education credits

5.2.4.2 Credits for Stormwater Management Practices Required under Chapter 63

Most properties within the City developed since 1978 are served by stormwater detention facilities built as a condition of development. Design criteria for these facilities have evolved since then:

- ***1978***: Detention of the 100-year storm event for new impervious surfaces exceeding 15,000 square feet. Outlet rate restricted to 0.2 cfs/acre (also referred to as the agricultural runoff rate for the 10 year storm event)

- ***1994:*** Washtenaw County Drain Commissioner adopts new design standards requiring control of the First Flush, Bankfull, and 100-year storm events. City staff requests voluntary compliance with WCDC design standards as developments are proposed.

- ***2000:*** WCDC revises design rules. Lowers outlet restriction rate to 0.15 cfs. City adopts new stormwater management requirements and also eliminates the "grandfather clause". Requires compliance with the rules of the WCDC.

- ***2002:*** City makes minor revisions to its stormwater management standards to provide an exception of minor projects that do not increase impervious area.

The City maintains records of these facilities, their design criteria, and the properties served by these facilities. The City also periodically inspects these facilities to determine if they are properly maintained and operating as designed. Currently, 24 percent of the properties in the City are served by off-site stormwater management practices complying with Section 63 of the City code and would receive this credit.

Other residential or non-residential properties that completely drain into one or more stormwater management facilities designed according to criteria in Chapter 63 of the Code, City of Ann Arbor in effect at the time the facility was constructed are eligible for a credit to their stormwater discharge rate. To receive this credit, the facility must be fully maintained according to criteria established by the Administrator. Stormwater discharge credits are set equal to the percentage of the City's total

stormwater budget that is allocated to a certain service, times a factor based upon the design criteria of the facility establishing the amount of stormwater discharged into the City's stormwater system :

- The percentage of the City's total stormwater budget that is allocated to the cost of maintaining the primary drainage system and components of the secondary drainage system (i.e., open channels, stream crossings, and ditches) times a factor of 25%, representing the relative reduction in O&M achieved through use of smaller infrastructure.

- The percentage of the City's total stormwater budget that is allocated to the cost of cleaning the secondary pipes and catch basins, times a factor of 90%, representing the pollution control achieved by a Chapter 63 facility.

- The percentage of the City's total stormwater budget that is allocated to the cost of the City's major capital improvement budget, times a factor of 40%, which is the ratio of relative pipe costs with and without detention.

- The percentage of the City's total stormwater budget that is allocated to the cost of the City's minor capital improvement (capital outlay) budget, times a factor of 30%, which is the estimated reduction in stream erosion repair costs achieved with a Chapter 63 facility.

5.2.4.3 Stormwater Quality Control Structural BMP Credit

Stormwater quality control structures that do not fully satisfy the criteria of Chapter 63 of the Code, City of Ann Arbor may be eligible for a credit. In order to qualify for this credit, one or more facilities must be able to capture runoff from the first one-half inch of rain and at least 50 percent of the impervious area of the property. Captured runoff must be released to the City drainage system and/or into the soil in no less than 24 hours. The facility otherwise must be designed and maintained according to criteria in the Stormwater Design Standards, low impact design fact sheets available from the Washtenaw County Drain Commissioner, or generally accepted engineering practice.

The City will determine whether to provide this Credit based upon a complete application including necessary hydrologic data, water quality data, design specifications, and other pertinent data supplied by qualified, licensed professionals on behalf of property owners. Structural stormwater quality management facilities that are eligible for credits include, but are not limited to the following:

- Vegetated Swales and Filter Strips,
- Infiltration and Percolation Basins,
- Percolation Trenches,
- Buffer Strips and Swales,
- Porous Pavement,

- Extended (Dry) Detention Basins,
- Retention (Wet) Ponds,
- Constructed Wetlands
- Natural Wetlands satisfying the criteria for this credit
- Media Filtration, and
- Other Stormwater Treatment System.

Credits for on-site stormwater facilities shall be generally proportional to the benefit that such systems have on complementing or enhancing the water quality benefit to the City's stormwater management system. Property access, adequate and routine facility maintenance, and self-reporting must be provided by the property owner to the City to verify that the facility is providing its intended benefit.

Properly designed and maintained facilities that receive stormwater from off-site sources may be eligible for an additional credit, subject to Administrator review. In all cases, the facility must be designed to fully meet criteria in the Stormwater Design Standards based upon the total drainage area of the facility. Credit is granted to both the stormwater discharge rate and to the customer charge:

- Stormwater discharge credits are set equal to the percentage of the City's total stormwater budget that is allocated to the cost of providing stormwater quality maintenance services (pipe cleaning and catch basin cleaning) times a factor of 50%, which represents the reduction in stormwater discharges achieved by the practice during a stormwater quality event of 0.50 inches of precipitation (the current standard of the WCDC for stormwater quality management).

- Customer charge credits are proportionate to the public education benefits provided to the City by citizen involvement in such practices, set at 30 percent of the estimated per customer cost of public education.

The revenue projections in Section 5.3 are based on an estimated 10 percent of the non-residential properties in the City participating in the on-site stormwater management credit program.

5.2.4.4 Credits for Community Partners for Clean Streams Participants

The Washtenaw County Drain Commissioner administers the Community Partners for Clean Streams program, which provides recognition to businesses that employ best stormwater management practices in the maintenance of their property. Information about this program can be found at the Drain Commissioner's web site:

http://www.ewashtenaw.org/government/drain_commissioner/dc_cpcs.html

The City is supporting this program by providing customer credits as additional recognition to participating businesses that are in full compliance with the latest criteria of the Community Partners for Clean Streams program published by the Washtenaw County Drain Commissioner. Ann Arbor Stormwater Utility Customers

must apply directly to the City for this credit by filling out the credit application and attaching a copy of the letter of recognition provided by the Drain Commissioner.

Customer charge credits are set at the estimated per customer cost of public education, which equals 45 percent (since the Community Partners for Clean Streams program addresses 5 of the 11 public education requirements of the City's NPDES stormwater discharge permit) times 67 percent (the fraction of the total public education budget supporting stormwater quality management), or a total factor of 30 percent. The revenue projections in Section 5.3 are based on an estimated 20 percent of the non-residential properties in the City participating in the Community Partners for Clean Streams credit program.

5.3 Revenue Scenarios

Section 2 established the service goals of the City of Ann Arbor, based upon identified stormwater needs and the recommendation of the City's Stormwater Citizen's Advisory Task Force. The recommended level of service, termed Level of Service B, would significantly increase the services provided by the City's stormwater management program:

- Expand on proactive planning activities for periodic update of needs
- Expand maintenance of detention facilities
- Continue with enforcement work
- Expand water quality control activities, providing monthly street sweeping and a 5-year cycle for catch basin cleaning
- Increase CIP infrastructure renewal to 50-years to address known issues
- Dedicate budget for system renewal (50% of estimated need) and water quality control

While the City's Stormwater Citizens Advisory Task Force (SCATF) recommended that the City increase their service level to LOS B, they also recognized the need to phase implementation of these services to balance impacts to ratepayers. This section discusses the revenue scenarios examined to develop a reasonable projection of rate increases to reach LOS B within a reasonable time frame affordable to the community.

5.3.1 Methodology and Assumptions

The following methodology and assumptions were used to project revenue requirements as the City's stormwater program transitions from its existing level of service to the desired Level of Service B, and to define the estimated stormwater utility rates necessary to support these projected costs:

- The basis of the projected cost of service under each level of service option is presented in Table 2-16, with a cost in FY 2006/07 dollars.
- Spreadsheets were used to project the annual cost of each program component listed on Table 2-16 into the future. Assumptions about capital improvement costs and financing are presented in the next section.
- A 2 percent rate of inflation was assumed for projecting these costs into the future.
- Since Ann Arbor is nearly built out within its current municipal boundaries, and the City is embracing programs that seek to reduce the amount of impervious area, it was assumed that the total impervious area of the City would not change in the future.
- The City has a long-established policy of proving a 10 percent discount on its utility bills if paid on time. Based on historic billing data, it was assumed that 95 percent of the customers would pay on-time and receive this discount.

Other assumptions were made to accurately incorporate the impact of credits and adjustments on projected revenue:

- As stated in Section 5.2.1, the parcel evaluations summarized in Section 4 determined that approximately 7.6 percent of the impervious area in the City does not contribute to the City's storm drainage system.
- Based on the evaluation presented in Section 5.2.2, impervious areas within the right-of-way of City roads, MDOT roads and railroads would receive a 100 percent credit, thus the impervious area of these lands is not included in the revenue projections.
- Based on the methodology and assumptions summarized in Sections 5.2.3 and 5.2.4, the net impact on projected revenue from the various credits is 7.9 percent on the stormwater discharge rate and 6.9 percent on the customer charge.

5.3.2 Capital Project Financing

The City requires a wide variety of capital improvements. Some projects are sponsored entirely by the City. Other projects are conducted with other agencies (e.g., WCDC, MDOT) and sometimes supported with grant funding. Occasionally, projects are funded through assessments to individual property owners (e.g., first-time local drainage infrastructure) or all properties within a watershed (typically through WCDC assessments, which are generally paid by the City's stormwater utility funds). Two options are available for financing the City's share of these capital improvement costs:

- ***"Pay as you go" financing***, where project funding must be secured through available revenue streams in their entirely prior to initiating the project.

- ***Bond financing,*** where the City can sell bonds (typically revenue bonds supported by stormwater utility fund revenues) in advance of one or more projects to raise necessary funding, with bonds paid over a long term (typically 20 years).

Figure 5-2 illustrates the difference in projected average annual revenue requirement of the various level of service options (in FY 2006/2007 dollars) under each financing method. The figure indicates that average annual costs under bond funding options are approximately $1 million (10 percent) less under LOS B, and approximately $3 million (17 percent) less under LOS A. Repayment of bonds, however, requires additional revenues in future years. Since the City is envisioning a long-term capital improvement program able to address a significant portion of system replacement and renewal needs, bond financing is the preferred option to balance revenue needs and better phase in long-term revenue requirements. The following assumptions were used to support revenue projections under the bond financing option:

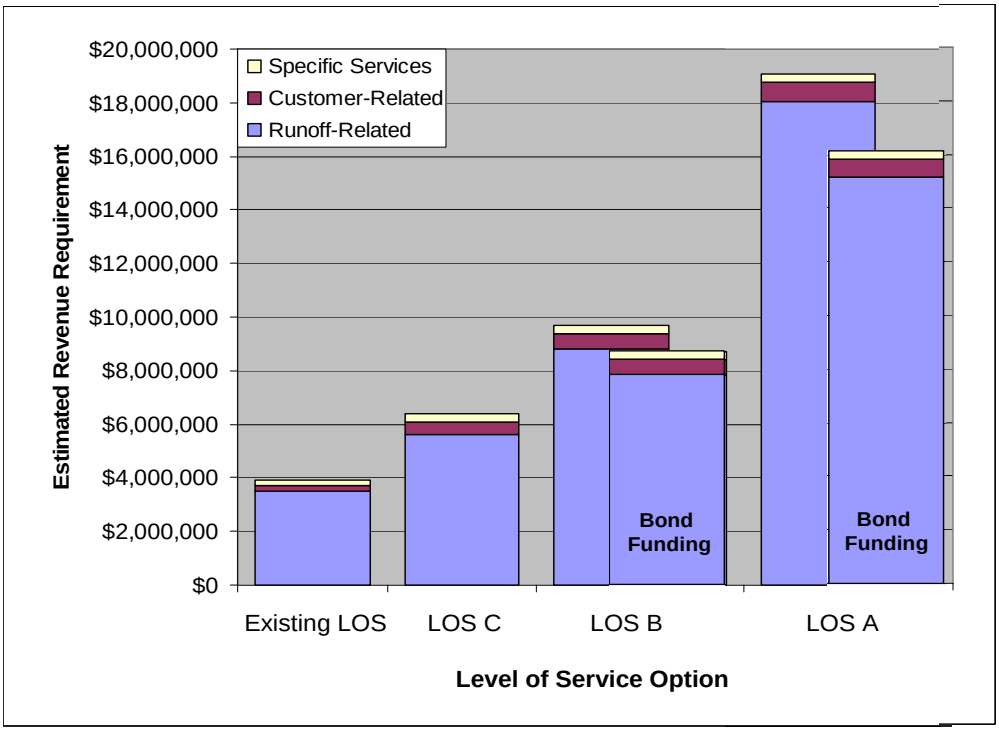


Figure 5-2. Average Annual Revenue Requirements (FY 2006/2007 dollars) under Bond Financing and "Pay as you Go" Financing Options

- Bond issued every 5 years to fund anticipated capital improvements
- 5 percent average interest rate on bonds
- 5 percent bond issuance expense
- 20 year average term on bonds

- $430,000 existing debt service
- 25 percent of outstanding bonds as a cash reserve

5.3.3 Existing Rates and Revenues

Section 3.3.2 summarized the City's existing rate structure and utility rates charged in FY 2006/2007:

- 1 and 2 Family Residential: $22.75 / quarter / residence
- Others: $243.95 / quarter / contributing acre
- Non-stormwater: $0.14 to $9.42 / quarter / 1000 gal.
- Erosion & Sediment Control: Time & Materials
- Reduction for on-time payment
- Credits recognize on-site stormwater management

In addition, the City utilizes the following additional revenue sources:

	FY 2005/2006 (Actual)
■ Connection Permit Charges (Tap Fees)	$29,000
■ Improvement Charges	$13,000
■ Merchandizing and Jobbing	$5,000
■ Intra-Governmental Sales	$110,000
■ Grading Permits	$56,000
■ Investment Income	$1,000
■ Miscellaneous	$3,000
Total	$217,000

Each of these revenue streams are for "specific" services that are not directly related to runoff area or customers, as shown previously in Figure 3-1. It is assumed that these additional revenues would be fixed at existing levels (plus inflation) for future revenue projections. In addition, approximately $137,000 of projected City services (largely development-related reviews and inspections) are currently funded under stormwater fees but are more appropriately categorized as fees for "specific" services under the recommended rate structure, raising the expected revenue for sources other than stormwater utility revenues to $354,000. Additional development-related services are expected to increase to $215,000 (in FY 2006/2007 dollars) under recommended level of service option B, raising the anticipated revenue requirements for "specific" services to $432,000.

If the existing rate structure was applied to the revised billing data described in Section 4, it is projected that annual revenues would equal nearly $4 million (not including revenues from "specific" services). The following rates would be necessary to generate the same revenue under the rate structure recommended in Section 3:

- Rates for ALL Residential and Non-Residential Properties:

  - $5.92 / quarter / customer PLUS

  - $251.44 / quarter / impervious acre

- Non-stormwater: $0.27 / quarter / 1000 gal.

- Reductions for on-time payment

- Credits recognize on-site stormwater management

These "revenue-neutral" rates were assumed as the starting point for the rate-increase implementation scenarios presented in the next section.

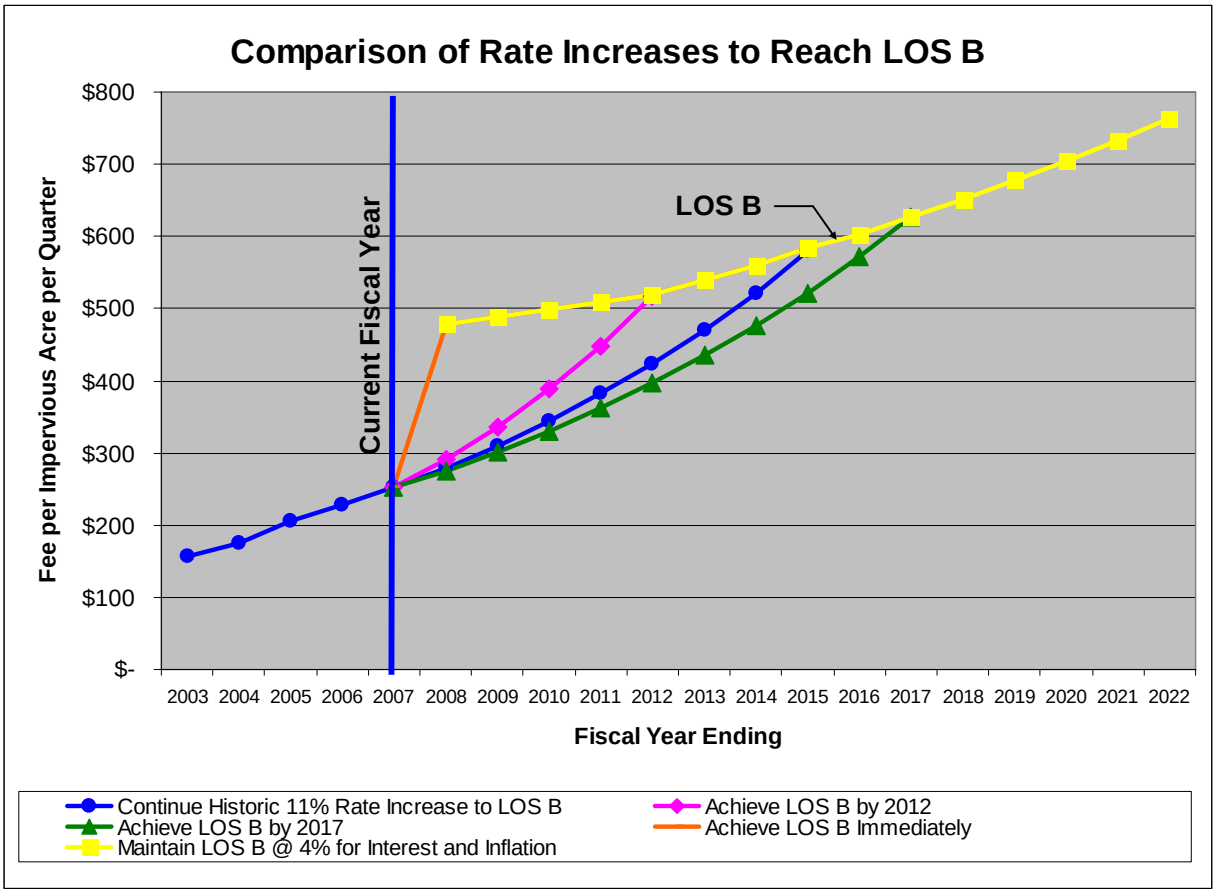
5.3.4 Implementation Scenarios

Several scenarios were evaluated to determine the most appropriate method of "ramping up" existing revenues to a revenue level sufficient to meet Level of Service B. **Figure 5-3** illustrates the projected fee per impervious acre per quarter under each of the evaluated scenarios. All scenarios presented assume that the City will employ bonds to finance capital improvement costs. This section describes each scenario and illustrates the projected rate increases under each scenario.

5.3.4.1 Scenario 1: Immediate Rate Increase to Level of Service B

One option available to the City is to raise rates immediately to a level able to generate revenues sufficient to support a Level of Service B program. Under this scenario, rates would increase from a "revenue-neutral" rate of $5.92 per customer per quarter plus $251.44 per impervious acre per quarter to a rate of $7.23 per customer per quarter plus $479 per impervious acre per quarter, an increase of 90.5 percent. After 2008, annual rate increases of approximately 4 percent would be needed to account for inflation and interest on bonds.

Figure 5-3 – Alternative Approaches to Reach LOS B



5.3.4.2 Scenario 2: Reach LOS B in 5 Years

The second option available to the City is to raise rates to a level that would generate revenues sufficient to support a Level of Service B program over a 5-year period. Under this scenario, rates would increase from a "revenue-neutral" rate of $5.92 per customer per quarter plus $251.44 per impervious acre per quarter to a rate in 2012 of $7.82 per customer per quarter plus $518.00 per impervious acre per quarter, an annual increase of 15.6 percent. After 2012, annual rate increases of approximately 4 percent would be needed to account for inflation and interest on bonds.

5.3.4.3 Scenario 3: Reach LOS C in 10 Years

A third option available to the City is to raise rates to a level able to generate revenues sufficient to support a Level of Service B program over a 10-year period. Under this scenario, rates would increase from a "revenue-neutral" rate of $5.92 per customer per quarter plus $251.44 per impervious acre per quarter to a rate in 2017 of $9.51 per customer per quarter plus $626.64 per impervious acre per quarter, an annual increase of 9.6 percent. After 2017, annual rate increases of approximately 4 percent would be needed to account for inflation and interest on bonds.

5.3.4.4 Scenario 4: Maintain Historic Rate Increase

The final option available to the City is to maintain the historic 11% rate increase that has occurred, on average, since 2003 until revenues sufficient to support a Level of Service B program are raised. Under this scenario, rates would increase from a "revenue-neutral" rate of $5.92 per customer per quarter plus $251.44 per impervious acre per quarter to a rate in 2015 of $8.80 per customer per quarter plus $579.36 per impervious acre per quarter. After 2015, annual rate increases of approximately 4 percent would be needed to account for inflation and interest on bonds.

5.3.5 Recommended Rates

Option 4 is recommended. This would maintain the historical rate increase and balances reaching Level of Service B in as short a time as possible without significant financial strain on rate payers. City council has supported equivalent rate increases over the past 4 years. These rate increases have been discussed in open council meetings and generated little discussion. Public Service Area staff believe that such rate increases can be sustained for the foreseeable future.

As with any financial evaluation, the City's revenue requirements for its stormwater management program, as well as the revenue expected to be generated by the various service fees should be evaluated annually, with a more thorough evaluation conducted every 3 to 5 years. Rates established at such a future time should be demonstrated to achieve a proper balance of supporting necessary stormwater management programs while addressing the overall economic health of the community.

5.4 Summary of Recommended Rates on Typical Properties

The recommended rate structure is expected to affect various properties within the City differently. **Table 5-1** illustrates the impact of projected rates on six typical properties within the City. The following conclusions can be drawn from this table:

- The proposed rate structure increases the quarterly stormwater fee to average residential dwellings by $0.77, or about 3 percent.
- Rates for residential properties in the small impervious area tier are reduced by about 30 percent, while rates for residential properties in the large impervious area tier will increase nearly 60 percent. Rates for the 400 residential properties in the "upper" tier will increase by nearly 160 percent.
- The proposed rate structure affects non-residential properties differently depending on the percent imperviousness of the property. Rates will increase somewhat for properties with relatively high percentages of impervious area, while they are somewhat lower for properties with lower impervious area percentages.

Table 5-1. Impact of Alternative Service Fees on Representative Properties in Ann Arbor

Classification	Service Fee		Single and Two-Family Residential				Commercial	Industrial	Institution
	Impervious Area ($/acre/quarter)	Customer ($/quarter)	Average	Small	High	Upper			
Address			3515 Charter	515 Spring	1241 Olivia	2203 Devonshire	2350 Washtenaw	505 Maple	3545 Packard
Parcel Size (sq ft)			10,883	6,945	7,925		48,203	105,788	80,882
Impervious Area (sq ft)			3,156	1,689	5,104	9,853	38,883	57,302	21,119
Impervious Area Billed			3,049	1,742	5,227	9,148	38,883	57,302	21,119
Estimated Fees in FY 2006/07									
- Current Rate Structure	$243.95	N/A	$22.75	$22.75	$22.75	$22.75	$217	$359	$179
- "Revenue Neutral" Fee	$251.45	$5.92	$23.52	$15.97	$36.09	$58.72	$230	$337	$128
Estimated Fees in FY 2007/08									
- Current Rate Structure	$248.83	N/A	$23.21	$23.21	$23.21	$23.21	$222	$366	$183
- "Revenue Neutral" Fee	$256.48	$6.03	$23.99	$16.29	$36.81	$59.89	$235	$343	$130
- 11% Annual Rate Increase	$279.10	$6.30	$25.84	$17.46	$39.79	$64.91	$255	$373	$142
Estimated Fees in FY 2011/12									
- Current Rate Structure	$269.34	N/A	$25.12	$25.12	$25.12	$25.12	$240	$397	$198
- "Revenue Neutral" Fee	$277.62	$6.53	$25.97	$17.64	$39.85	$64.83	$254	$372	$141
- 11% Annual Rate Increase	$424	$8.10	$37.76	$25.05	$58.94	$97.07	$386	$565	$213

Appendix A
Ordinances, Policies, Regulations, and Procedures

Chapter 29 WATER, SEWER AND STORMWATER RATES*

***Editor's note:** Ord. No. 18-07, § 1, adopted July 2, 2007, effective July 10, 2007, amended Ch. 29, in its entirety, to read as herein set out. Prior to inclusion of said ordinance, Ch. 29 was entitled, "water and sewer rates." See also the Code Comparative Table for a detailed analysis of inclusion.

2:61. Definitions.

Unless the context specifically indicates otherwise, the meanings of terms used in this chapter shall be as follows:

(1) *"Capital charge"* shall mean charges levied to customers of the wastewater system and which are used to pay principal, interest and administrative costs of retiring the debt incurred for construction and/or capital improvements to the wastewater system. The capital charge shall be in addition to the user charge (including surcharges).

(2) *"Person"* shall mean any individual, firm, association, public or private corporation or public agency or instrumentality.

(3) *"Premises"* shall mean each lot or parcel of land, building or premises having any connection to the water distribution system of the City, or the sanitary sewer system of the City, or the stormwater system of the City.

(4) *"Customer charge"* shall mean a monthly or quarterly base charge that recovers costs for billing, collection, customer service, and public involvement and public education activities.

(5) *"Residential 1 rate"* shall mean the rate applied to the domestic meter usage for residential customers where 4 or fewer dwelling units are served off of the same meter.

(6) *"Residential 2 rate"* shall mean the rate applied to the domestic meter usage for residential customers with both a domestic and a water only meter where 4 or fewer dwelling units are served off of the same meter.

(7) *"Impervious area"* means a surface area which is compacted or covered with material that is resistant to or impedes permeation by water, including but not limited to, most conventionally surfaced streets, roofs, sidewalks, patios, driveways, parking lots, and any other oiled, graveled, graded, or compacted surfaces.

(8) *"Property"* means any land within the boundary of the City of Ann Arbor, both publicly and privately owned, including public and private rights-of-way, but excluding the Huron River.

(9) *"Peaking factor"* shall mean a measure of the additional system capacity needed to deliver peak water volumes. The peaking factor is stated as the ratio of peak consumption to average consumption.

(10) *"Commercial 1 rate"* shall mean the rate applied to the domestic meter usage for commercial customers with a peaking factor of no greater than 5.0.

(11) *"Commercial 2 rate"* shall mean the rate applied to the domestic meter usage for commercial customers with a peaking factor of greater than 5.00 and no greater than 8.00.

(12) *"Commercial 3 rate"* shall mean the rate applied to the domestic meter usage for commercial customers with a peaking factor of greater than 8.00.

(13) Definitions listed in Chapters 27, 28, 33, and 63 shall also apply to this chapter.

(Ord. No. 18-07, § 1, 7-2-07; Ord. No. 08-20, § 1, 6-21-08)

2:62. Basis of charges.

Except for minimum charges that may be specified by ordinance, all water service shall be charged for on the basis of water consumed as determined by the meter installed in the premises of water or sewage disposal service customers by the City public services area. Except for minimum charges that may be specified by ordinance, all sanitary sewer service shall be charged for on the basis of water consumed, to the extent that such consumption reflects the return of water to the sanitary sewers as herein provided. Except for minimum charges that may be specified by ordinance, all stormwater service shall be charged for on the basis of the impervious area of every property within the City. No free water service, sanitary sewer service or stormwater service shall be furnished to any person.

Consumption data utilized for rate analysis shall reflect a 12-month period of water usage. This 12-month period shall be established by the Public Services Area Administrator or his/her designee. Classification into commercial tiers is based on the peaking factor of the building, regardless of the number of meters in the building and may be adjusted quarterly if the customer experiences a significant event. A significant event shall be 1 or more of the following: (1) a change in size of the connection, (2) a change in meter size, (3) a change in the number of meters or (4) other comparable change. A request for reclassification shall be made in writing to the office of the Public Services Area Administrator. Such reclassification shall apply prospectively from the date of the request. In the absence of a written request, the Public Services Area Administrator may, but is not required to, reclassify a property prospectively based on a significant event. Commercial customers without 12 months of representative consumption data shall be placed in the commercial tier best representing "like" customers with similar peaking factors.

(Ord. No. 18-07, § 1, 7-2-07; Ord. No. 08-20, § 1, 6-21-08)

2:63. Water rates.

(1) The commodity charges for water service shall be as follows. A unit shall constitute 100 cubic feet. The rates shown are per unit.

TABLE INSET:

	Residential 1	Residential 2	Water Only
1--7 units	$1.10	$1.10	$3.87
8--28 units	2.33	2.33	3.87
29--45 units	3.78	2.33	3.87
Over 45 units	5.24	2.33	3.87

TABLE INSET:

	Commercial 1	Commercial 2	Commercial 3
All Units	$2.43	$4.63	$7.94

Commercial Customer Charge per Quarter:

TABLE INSET:

5/8" meter	$12.90
3/4" meter	19.00
1" meter	30.30
1 1/2" meter	62.00
2" meter	97.00
3" meter	195.00
4" meter	308.00
6" meter	613.00
8" meter	1,225.00

Residential Customer Charge per Quarter:

TABLE INSET:

5/8" meter	$11.25
3/4" meter	16.55
1" meter	30.30
1 1/2" meter	62.00
2" meter	97.00
3" meter	195.00
4" meter	308.00
6" meter	613.00
8" meter	1,225.00

Fire Service Charge per Quarter:

TABLE INSET:

1" service	$37.00
1 1/2" service	37.00
2" service	37.00
3" service	37.00
4" service	73.00
6" service	73.00
8;inch service	73.00

(2) The rates to be charged for persons using water in violation of regulations issued under authority of City Code Section 2:31(2) shall be quadruple the rate provided under City Code Section 2:63(1). The rate shall be applied to all water supplied to the premises during the billing cycle at the time of the violation.

(Ord. No. 18-07, § 1, 7-2-07; Ord. No. 08-20, § 1, 6-21-08)

2:64. Sewer rates.

(1) Commodity charge for customers in Ann Arbor shall be $3.01 per 100 cubic feet of water flow of which $1.39 is a user charge for wastewater plant operation, maintenance and replacement, 48 cents is a user charge for field operation and maintenance of the sewer system, 11 cents is a user charge for system planning and administration and $1.03 is applied toward a portion of capital expenditures. Charges for sewer service provided to Ann Arbor Township, Pittsfield Township and Scio Township shall be as provided per the provisions of their respective wastewater treatment or sewer agreements with the City of Ann Arbor.

(2) Customer Charge per Quarter:

TABLE INSET:

5/8" meter	$10.57
3/4" meter	15.60
1" meter	26.50
1 1/2" meter	53.00
2" meter	84.50
3" meter	169.00
4" meter	265.00
6" meter	528.00
8" meter	1055.00

(Ord. No. 18-07, § 1, 7-2-07; Ord. No. 08-20, § 1, 6-21-08)

2:65. Residential Summer service billings.

The charges established in Section 2:64 shall be applicable to residential bills rendered in each month, January to June, inclusive, except as hereinafter provided. To eliminate water consumed but not disposed of in public sanitary sewers rendered in each month, July to December, inclusive, shall be based upon prior water consumption on the premises as follows:

TABLE INSET:

Bill Rendered:	Charges to be Same as Bill Rendered
July	April
August	May
September	June
October	April
November	May
December	June

Where premises are billed on a monthly basis, the bills due in May through October shall be the same as the bill rendered in April of the same year. Where sanitary sewer service or water service was not used by any premises during the month or quarter on which the charges for any subsequent month or quarter are to be based, this section shall not be applicable but the charges for such subsequent month or quarter shall be based on the rates established in section 2:64. Whenever, in the discretion of

the Public Services Area Administrator, application of the foregoing table would be inequitable because any customer consumes abnormal amounts of water during the winter months or consumes amounts of water of which an abnormal amount or proportion is returned to the public sanitary sewers during the summer months, the Director may bill such customer on the basis of water consumed during each month or quarterly period and apply the rates specified in Section 2:64. Any customer may, at his/her option, elect to be billed for sanitary sewer service on the basis of water actually consumed during each month or quarterly period. Both water service charges and sanitary sewer service charges shall, however, be billed on the same basis, either quarterly or monthly.

(Ord. No. 18-07, § 1, 7-2-07; Ord. No. 08-20, § 1, 6-21-08)

2:66. Private water supply.

Where any sanitary sewer service customer uses any private water supply, any portion of which reaches the public sanitary sewers, such private supply shall be metered at the customer's expense and the consumption therefrom shall be added to the consumption from the public water supply and the total shall be used to establish the sanitary sewer service charges, based on water consumed. The quarterly charge in such cases may be fixed by Council resolution. The Council may classify the users of sewer service according to the quantity of water used and charge such rates to the users in each class as it may deem reasonable. Failure to meter any water supply shall not release the customer from paying the sanitary sewer service charge thereon. In such case, the total water consumption shall be estimated by the public services area administrator and shall be conclusive.

(Ord. No. 18-07, § 1, 7-2-07)

2:67. Optional arrangement.

Any customer may elect to rearrange his water supply pipes and metering for the purpose of eliminating from the total water consumption, the water not disposed of to the public sanitary sewers, or he may elect to establish metering facilities registering the discharge from his premises to the public sanitary sewers. All such arrangements shall be subject to the prior approval of the Public Services Area Administrator and the expense thereof, including installation, maintenance and operation, shall be borne by the customer. While such an approved installation shall be in effect, the rates specified in Section 2:64 shall be applied only to the water passing through the meter for water to be returned to the public sanitary sewers or to the sewage actually discharged to the public sanitary sewers. No person shall divert any water metered as water not entering the public sanitary sewers, into the public sanitary sewers. Where any water metered as not entering the public sanitary sewers does enter the public sanitary sewers, the premises shall be billed at the regular sanitary sewer service rates for all water used during all billing periods in which the unlawful diversion of water occurred, if it can be determined, otherwise for a period to be determined in the discretion of the Public Services Area Administrator, but not to exceed 5 years.

(Ord. No. 18-07, § 1, 7-2-07)

2.68. Outside service.

The rates for water service to premises outside the City shall be specified in Chapter 27. The rates for sanitary sewer service to premises outside the City shall be as determined by the City Council and shall meet EPA guidelines for charges for operation, maintenance and replacement.

(Ord. No. 18-07, § 1, 7-2-07)

2:69. Stormwater rates.

(1) Except as provided in this section and Chapter 33, all property shall be subject to the stormwater utility charge.

(2) *Stormwater Discharge Rate.* Each property shall be billed at a quarterly stormwater discharge rate of $309.79 per acre multiplied by the representative impervious area of the property. The representative impervious area of the property shall be the measured impervious area, rounded to the nearest 0.01 acre, of the portion of the property discharging to the City's stormwater system, except for single-family and two-family residential properties and properties considered residential for storm and sewer. These properties have been grouped into the following categories based upon their measured impervious area:

TABLE INSET:

Single-Family and Two-Family Residential		
Measured Impervious Area	Representative Impervious Area	Quarterly Charge
Less than or equal to 2,187 square feet	0.04 acres	$12.39
Greater than 2,187 square feet to less than or equal to 4,175 square feet	0.07 acres	$21.69
Greater than 4,175 square feet to less than or equal to 7,110 square feet	0.12 acres	$37.17
Greater than 7,110 square feet	0.21 acres	$65.06

(3) *Customer Charge.* Each property shall be billed a customer charge of $6.77 per quarter.

(4) *Credits to Stormwater Discharge and Customer Charges.* The City shall offer the following credits per quarter to property owners fully satisfying pertinent criteria established in Chapter 33 and in regulations promulgated by the Administrator:

TABLE INSET:

Single-Family and Two-Family Residential	Reduce Total Charge by
Rain Barrels (One or more)	$1.79
Rain Gardens/Cisterns/Dry Wells	$2.80
RiverSafe Homes	$1.24
Chapter 63--Compliant Stormwater Control	$7.16

TABLE INSET:

Other Properties	Reduce Stormwater Discharge Rate by	Reduce Customer Charge by
Community Partners for Clean Streams	0.0%	17.3%
Chapter 63--Compliant Stormwater Control	29.5%	0.0%
Other Approved Stormwater Controls	6.4%	17.3%

(5) *Charges for permitted non-stormwater discharges.* The charges for non-stormwater

discharges to the stormwater system that are permitted by the Public Services Area Administrator according to Chapter 33, Section 2:217, shall be $0.30 per 1,000 gallons. If non-stormwater discharges to the stormwater system are controlled such that the discharges cease during periods of precipitation, then the above rate shall be multiplied by a factor of 0.3. For any month in which the user discharges into the stormwater system, there shall be a minimum bill for 100,000 gallons. Stormwater discharges exempt from discharge prohibitions under Section 2:216(3) are not subject to this charge.

(Ord. No. 18-07, § 1, 7-2-07; Ord. No. 08-20, § 1, 6-21-08, eff. 7-1-08)

2:70. Service to City.

The City shall pay the same water, sanitary sewer, and stormwater rates and charges for service to it as would be payable by a private customer for the same service. The City shall pay a charge of $8.00 per year per fire hydrant. All such charges for service and fire hydrants shall be payable quarterly from the current funds of the City, or from the proceeds of taxes which the City, within constitutional limits, is hereby authorized and required to levy in amounts sufficient for that purpose.

(Ord. No. 18-07, § 1, 7-2-07)

2:71. Billing.

Billing for water service, sanitary sewer service, and stormwater service shall be the responsibility of the public services area of the City, but the Council may, by resolution, transfer such responsibility to the City Treasurer. All water meters shall be read at least every third month and bills rendered thereafter. A discount of 10% will be allowed on all bills paid in full and in the City Treasurer's office or payment agencies on or before the due date shown on the bill.

(Ord. No. 18-07, § 1, 7-2-07)

2:72. Collection.

The public services area is hereby authorized to enforce the payment of charges for water service to any premises by discontinuing the water service to the premises and the payment of charges for sanitary sewer service and/or stormwater service to any premises may be enforced by discontinuing the water service, the sanitary sewer service or the stormwater service to the premises, or all 3, and a civil action may be instituted by the City against the customer. Where the water service to any premises is turned off to enforce the payment of water service charges, sanitary sewer charges, or stormwater charges, the water service shall not be reconnected until all delinquent charges have been paid, including any turn-on charges established by Council resolution.

The charges for water service, sanitary sewer service or stormwater charges, are hereby recognized to constitute a lien on the premises to which furnished; and the City Administrator shall annually, at the first meeting in April of the City Council, report to the Council, all unpaid charges for services furnished to any premises which, on the 31st day of March preceding, have remained unpaid for a period of 6 months. The City Council may thereupon, after due notice to the owners of the premises so served, assess the amount so found to be due as a tax against the premises, and the same shall be certified to the City Assessor who shall place the same on the next tax roll of the City. Charges so assessed shall be collected in the same manner as general City taxes. In cases where the City is properly notified in accordance with applicable statutory provisions, that a tenant is responsible for water, sanitary sewer, or stormwater service charges, no such service shall be commenced or continued to the premises until there has been deposited with the public services area, a sum sufficient to cover twice the average quarterly bill for such premises as estimated by the Public Services Area

Administrator, the deposit to be in no case less than $18.00.

A similar deposit may also be required by the administrator in cases where the person applying for services has a delinquent utility account owing or has had services shut off in the last 180 days because of non-payment at another location. Such deposits shall be applied against any delinquent water, sanitary sewer, or stormwater service charges. If the application thereof satisfies the delinquency, such service shall not be discontinued.

No deposit shall bear interest and the deposit, or any remaining balance thereof shall be returned to the customer making the same, when he or she shall discontinue receiving water, sanitary sewer, and stormwater service or, except as to tenants as to whom notice of responsibility for such charges has been filed with the City, when any 8 successive quarterly bills shall have been paid by that customer with no delinquency.

(Ord. No. 18-07, § 1, 7-2-07)

2:73. Revision of sewer rates; notification.

An annual audit shall be prepared. Based on said audit, rates for sewage services shall be reviewed annually and revised as necessary to meet system expenses and to insure that all user classes pay their proportionate share of operation, maintenance and equipment replacement cost. Each user shall be notified annually, in conjunction with a regular bill, of the rate and portion of charges attributable to wastewater operation, maintenance and replacement services.

(Ord. No. 18-07, § 1, 7-2-07)

Chapter 33 STORMWATER SYSTEM*

***Editor's note:** Ord. No. 62-92, § 1, adopted Jan. 19, 1993, amended Ch. 33, in its entirety, to read as herein set out. Former Ch. 33 pertained to similar subject matter. Subsequently, Ord. No. 17-07, § 1, adopted July 2, 2007, effective July 18, 2007, repealed Ch. 33, §§ 2:200--2:214. Section 2 of said Ord. No. 17-07 enacted provisions designated as a new Ch. 33, §§ 2:200--2:222, to read as herein set out. See also the Code Comparative Table.

Cross references: Soil erosion and sedimentation control, Ch. 63.

2:200. Title.

This chapter shall be known as the "Stormwater System Ordinance" of the City of Ann Arbor.

(Ord. No. 17-07, § 2, 7-2-07)

2:201. Purpose.

This Chapter establishes a stormwater utility for the purpose of conducting the city's stormwater management program to protect public health, safety, and welfare; provides for the proportional allocation to property owners of the necessary costs of the stormwater utility; permits the establishment and collection of just and equitable rates and charges to fund the stormwater utility; provides for credits, adjustments, exemptions and appeals; establishes regulations for the use of the stormwater system, and prescribes the powers and duties of certain municipal agencies, departments and officials.

(Ord. No. 17-07, § 2, 7-2-07)

2:202. Findings.

The City Council finds all of the following:

(1) The constitution and laws of the State of Michigan authorize local units of government to provide stormwater management services and systems that will contribute to the protection and preservation of the public health, safety and welfare, and to the protection of the state's natural resources.

(2) Property owners influence the quantity, character and quality of stormwater from their property in relation to the nature of the alterations made to property.

(3) Stormwater contributes to the diminution of water quality, adversely impacting the public health, safety and welfare, and endangering natural resources.

(4) Control of the quantity and quality of stormwater from developed and undeveloped property is essential to protect and improve the quality of surface waters and groundwaters, thereby protecting natural resources and public health, safety and welfare.

(5) The Federal Clean Water Act and rules and regulations promulgated thereunder place increased mandates on the city to develop, implement, conduct and make

available to its citizens and property owners stormwater management services which address water quality, velocity, and volume impacts of stormwater.

(6) Water quality is improved by stormwater management measures that control the quantity or quality, or both, of stormwater discharging directly or indirectly to receiving waters, that reduce the velocity of stormwater, or that divert stormwater from sanitary sewer systems.

(7) The city, having a responsibility to protect the public health, safety, and welfare, has a major role in ensuring appropriate water quality related to stormwater flow.

(8) Improper management of stormwater runoff causes erosion of lands, threatens businesses and residences and other facilities with water damage from flooding, adversely impact public health, safety, and welfare, and creates environmental damage to rivers, streams and other bodies of water in Michigan, including the Great Lakes.

(9) The public health, safety, and welfare is adversely affected by poor ambient water quality and flooding that results from inadequate management of both the quality and quantity of stormwater.

(10) It is appropriate for the city to establish user charges, fees, or rates to offset entirely or in part the cost of its stormwater management program.

(11) It is in the interest of protecting both the waters of the state from pollution and the public health, safety, and welfare for the city to fund stormwater management with a charge that allocates the costs of these services to property owners within the city based upon the extent to which each parcel of real property contributes to the need for stormwater management.

(Ord. No. 17-07, § 2, 7-2-07)

2:203. Definitions.

For the purposes of this chapter, the following words and phrases shall have the meanings described in this section:

(1) [*Reserved.*]

(2) *Administrator* is the public services area administrator or such other person as the city administrator may designate.

(3) *Customer charge* shall mean a monthly or quarterly base charge that recovers costs for billing, collection, customer service, and public involvement and public education activities.

(4) *Discharge permit* is as set forth in section 2:216 of this chapter.

(5) *Footing drain* is a pipe or conduit which is placed around the perimeter of a building foundation for the purpose of admitting ground water.

(6) *Impervious area* means a surface area which is compacted or covered with material that is resistant to or impedes permeation by water, including but not limited to, most conventionally surfaced streets, roofs, sidewalks, patios, driveways, parking lots, and any other oiled, graveled, graded, or compacted surfaces.

(7) *Industrial sites* are those sites that contain industrial activities which require NPDES stormwater permits as set forth in regulations promulgated by U.S. EPA and Michigan Department of Environmental Quality.

(8) *Non-stormwater* is all flows to the stormwater system not defined as stormwater in paragraph 2:203(16) of this chapter or as determined by the administrator. This includes,

but is not limited to, cooling water, process water, ground water from a purge well and non-residential swimming pool discharge.

(9) *NPDES* means National Pollutant Discharge Elimination System, a program to issue permits for discharges to receiving waters, established under the Federal Clean Water Act, and administered by the Michigan Department of Environmental Quality.

(10) *Non-stormwater use charge* is the charge applicable to any non-stormwater use of the stormwater system, as defined by the Administrator.

(11) *Operation and maintenance* includes any component of a stormwater system expenditure for materials, labor, utilities and other items for the management and uninterrupted operation of the stormwater system in a manner for which the stormwater system was designed and constructed.

(12) *Operation and maintenance costs* include all costs, direct and indirect, of operation and maintenance of a stormwater system.

(13) *Pervious area* is all land area that is not impervious.

(14) *Pretreated non-stormwater* is non-stormwater that requires, under an NPDES permit or the permit provided by this chapter, pre-treatment (mechanical, physical or chemical) prior to being discharged into the stormwater system.

(15) *Property* means any land within the boundary of the City of Ann Arbor, both publicly and privately owned, including public and private rights of way, but excluding the Huron River.

(16) *Stormwater* means stormwater runoff, snowmelt runoff, footing drain discharges, surface runoff and drainage, and other discharges allowed by Administrative Regulations.

(17) *Stormwater discharge rate* means the portion of the stormwater utility charge proportionate to the quantity and representative of the quality of stormwater being discharged from a property, calculated based upon the impervious area of the property.

(18) *Stormwater utility charge* means a charge to property pursuant to this chapter and Chapter 29, intended to offset all or part of the cost incurred by city of preparing and conducting a stormwater management program, and operating and maintaining a stormwater system.

(19) *Stormwater management* means 1 or more of the following:

(a) The quantitative control achieved by the stormwater system of the increased volume and rate of surface runoff caused by alterations to the land;

(b) The qualitative control achieved by the stormwater system, pollution prevention activities, and ordinances to reduce, eliminate or treat pollutants that might otherwise be carried by stormwater; and

(c) Public education, information, and outreach programs designed to educate and inform the public on the potential impacts of stormwater.

(20) *Stormwater management program* means 1 or more aspects of stormwater management undertaken for the purpose of complying with applicable federal, state and local law and regulation or the protection of the public health, safety, and welfare related to stormwater runoff.

(21) *Stormwater system* means roads, streets, catch basins, curbs, gutters, ditches, storm sewers and appurtenant features, lakes, ponds, channels, swales, storm drains, canals, creeks, catch basins, streams, gulches, gullies, flumes, culverts, siphons, retention or detention basins, dams, floodwalls, levees, pumping stations, and other like

facilities, and natural watercourses and features located within the geographic limits of the city which are designed or used for collecting, storing, treating or conveying stormwater or through which stormwater is collected, stored, treated or conveyed, or any other physical means by which stormwater management is achieved.

(22) *User* is a firm, person or property that directly or indirectly contributes stormwater or non-stormwater to the stormwater system.

(Ord. No. 17-07, § 2, 7-2-07)

2.204. Establishment of a Stormwater Utility.

A stormwater utility is hereby established under the direction of the administrator to conduct the stormwater management program of the city. The stormwater management program shall include those activities necessary to protect public health, safety, and welfare from stormwater and fulfill the requirements of the City of Ann Arbor's stormwater NPDES permit, and all successor permits, including but not limited to the following activities:

(1) Planning, engineering, acquisition, construction, operation, maintenance, installation and debt service costs to acquire, construct, finance, operate and maintain a stormwater system.

(2) Administering the stormwater management program.

(3) Acquiring, constructing, improving, enlarging, repairing, enhancing, replacing, financing, operating and maintaining the stormwater system, together with such indirect and overhead costs which are fairly chargeable to such activities pursuant to accepted accounting principles and practices applicable to the local unit government, including practices required under the Uniform Budgeting and Accounting Act, 1968 PA 2, as amended, MCL 141.421 through 141.440a, and rules and regulations promulgated thereunder.

(4) Developing a stormwater management plan, as identified in section 2:205 of this chapter.

(5) Undertaking activities required in order to comply with federal and state law and regulations related to stormwater and permits issued thereunder.

(6) Paying drain assessments which are the obligation of the city.

(7) Providing public education, or information, or outreach related to the stormwater management program or required by federal or state regulations, or required by permits issued to the local unit of government by federal or state regulatory bodies.

(Ord. No. 17-07, § 2, 7-2-07)

2:205. Stormwater Management Plan.

The Administrator may adopt, amend, or extend a stormwater management plan from time to time. Any such adoption, amendment, or extension shall be approved by resolution of the Council.

(Ord. No. 17-07, § 2, 7-2-07)

2:206. Stormwater Utility Charges, General.

(1) Subject to the provisions of this chapter, all owners of property in the City of Ann Arbor shall be charged stormwater utility charges for their use of the stormwater system. The

stormwater utility charges shall be proportionate to the necessary cost of the stormwater management services provided to each property in the city. The basis for stormwater utility charges shall be computed by the Administrator.

(2) The stormwater utility charges shall be a quarterly or a regular interval service charge, shall be determined by the provisions of this chapter, and may be changed from time to time by Council.

(3) Revenue from the stormwater utility charge shall be used solely to defray the city's cost of conducting the stormwater management program defined in Section 2.204 and described in the stormwater management plan prepared according to criteria in Section 2:205.

(4) Stormwater utility charges are in addition to any special assessment, single lot assessment or public improvement charge that might be or become due for capital improvements to the stormwater system. Special assessments, single lot assessments and public improvement charges for improvements to the stormwater system that are financed in whole or in part by special assessments, single lot assessments or public improvement charges will be calculated and imposed as provided in Chapters 12 and 13.

(Ord. No. 17-07, § 2, 7-2-07)

2:207. Customer Charge.

Each property shall be charged a customer charge proportionate to the city's costs of administering the stormwater utility billing system, providing necessary public engagement services, and conducting other necessary services that are provided equitably to each customer, as defined by the stormwater management plan.

(Ord. No. 17-07, § 2, 7-2-07)

2:208. Stormwater Discharge Rate.

(1) Each property discharging stormwater into the city's stormwater system, either directly or indirectly, shall be charged an amount proportionate to the representative quantity of stormwater generated by that property. The principal stormwater generating characteristic of each property is its representative impervious area, which shall be used as the basis for the stormwater discharge rate. The stormwater discharge rate shall be used to fund those elements of the stormwater management program whose cost is directly related to the amount of stormwater managed.

(2) The representative impervious area of a property shall be the measured impervious area of the property except for single-family and 2-family residential properties or properties considered residential for storm and sanitary, which may be grouped into 1 or more representative impervious area rate categories based upon a statistical evaluation of the measured impervious area of a sample of all properties. Each property within a category shall be billed the same stormwater utility charge if such statistical similarity is demonstrated.

(3) The administrator may periodically change the representative impervious area of a property based upon information available to the city and/or provided by a property owner.

(Ord. No. 17-07, § 2, 7-2-07)

2:209. Charges for Non-Stormwater Discharges.

The Administrator may impose fees for the use of the stormwater system for non-stormwater

discharges permitted by the city under section 2.216 of this Chapter. Charges shall be proportionate to the capacity of the stormwater system that is used by the non-stormwater flow that would otherwise be available for stormwater, and any additional charges related to preparing, monitoring, and enforcing any permits related to non-stormwater discharges.

(Ord. No. 17-07, § 2, 7-2-07)

2:210. Other Charges.

Charges for other services provided by the City shall be on a time and materials basis, including direct and indirect costs, as established by the Administrator. The Administrator may also set charges for the fair share recovery of the cost, including direct and indirect costs, from users for the implementation and operation of any of the following:

(a) Monitoring, inspection and surveillance procedures;

(b) Reviewing accidental discharge procedures and construction;

(c) Discharge permit applications for stormwater and non-stormwater;

(d) Annual charges for multi-year permits, and

(e) Other charges as the Administrator may deem necessary to carry out the requirements of this chapter.

(Ord. No. 17-07, § 2, 7-2-07)

2:211. Credits.

(1) The purpose of this section is to provide for each property owner's control over contributions of storm flows to the stormwater utility system and the related stormwater utility charges and to advance protection of the public health, safety, and welfare.

(2) The City shall offer credits that will enable any property owner, through voluntary action, to reduce the stormwater utility charges calculated for that property owner's property and will provide a meaningful reduction in the cost of service to the stormwater system, or that shall be reasonably related to a benefit to the stormwater system:

(a) Credits will only be applied if requirements outlined in this Code are met, including, but not limited to: completion of on-going maintenance, guaranteed right-of-entry for inspections, and submittal of annual self-certification reports.

(b) Credits will be defined as either set charge reduction or percent (%) reductions applied as a Credit adjustment to the Charge calculation equation.

(c) Credits are additive for each Credit category.

(d) As long as the stormwater facilities or management practices are functioning as approved, the Credit reduction will be applied to the Charge. If the approved practice is not functioning as approved or is terminated, the Credit reduction will be cancelled and the Charge will return to the baseline calculation. Once the Credit reduction has been cancelled, a customer may not reapply for Credit for a period of 12 months and only then if the deficiency has been corrected, as determined by City inspection.

(e) Credits will be applied to the next complete billing cycle after the application has been approved.

(3) The administrator shall define a method for applying and granting credits, as well as criteria for determining the credits a property owner may receive. The administrator may by regulation

establish credits for 1 or more of the following property owner actions:

(a) Installation and maintenance of a stormwater control facility meeting the design standards referenced in Chapter 63.

(b) Installation and maintenance of rain barrels, rain gardens, cisterns, dry wells, bioswales, and other water quality controls in addition to those required of the property owner under Chapter 63.

(c) Property owners that satisfy the requirements of the RiverSafe Homes or the Partners for Clean Streams programs administered by the Washtenaw County Drain Commissioner.

(d) Providing a school-based education or information program which has obtained MDEQ approval related to stormwater management and its impacts, and

(e) Other actions of the property owner that, in the judgment of the administrator, result in a measurable reduction in stormwater runoff or pollutant loadings.

(4) The administrator shall define criteria for determining additional credits that lands dedicated for public use may receive. Such credits are appropriate because most of the City's drainage system lies within public rights of way, sharing that property with public roads and other public and private utility systems. Public roads and other impervious surfaces within these rights of way discharge stormwater to the stormwater system and are subject to stormwater utility charges like every other property within the City. Lands dedicated for public use are eligible for credits if they provide 1 or more of the following services to the stormwater utility:

(a) Use of the roadway for conveyance and storage of stormwater during major storm events that exceed the capacity of the underground storm drainage system.

(b) Use of right-of-way for retrofit of stormwater quality control systems required under NPDES permits issued to the City.

(c) Access to the stormwater system for operation and maintenance activities, often restricting traffic on the roadway.

(d) Reduced pavement life when stormwater system repairs require open cut excavation of the roadway.

(e) Education provided by storm inlet labeling, stream crossing signage, and other educational signs placed within the right-of-way.

(Ord. No. 17-07, § 2, 7-2-07)

2:212. Exemptions.

Except as provided in this section, no public or private property located in a stormwater district shall be exempt from stormwater utility charges.

(1) Properties that do not utilize the public stormwater system shall be exempt from the portion of the charge for stormwater discharge if the property owner follows the procedure detailed by the administrator to qualify for such an exemption.

(Ord. No. 17-07, § 2, 7-2-07)

2:213. Billing.

The City shall bill property owners and authorized tenants for stormwater systems on a periodic basis under procedures defined in Chapter 29 and by regulations promulgated by the Administrator.

(Ord. No. 17-07, § 2, 7-2-07)

2:214. Stormwater enterprise fund.

(1) All revenues raised from stormwater utility rates, fees, and charges shall be placed in a stormwater enterprise fund together with such other revenues from any source or combinations of sources of revenues otherwise legally available which have been designated to be used for the stormwater management program.

(2) No part of the funds held in the stormwater enterprise fund may be transferred to the general operating fund or used for any purpose other than undertaking the stormwater management program, and operating and maintaining a stormwater system.

(Ord. No. 17-07, § 2, 7-2-07)

2:215. Use of stormwater system.

(1) The primary use of the stormwater collection system shall be the collection and transportation of stormwater. Non-stormwater use shall be considered a secondary use of the stormwater system.

(2) The discharge of non-stormwater to the stormwater system is prohibited except as allowed under this section. No person shall place or cause to be placed any substance into the stormwater system other than stormwater (except for placement of recreational equipment in the Huron River or its impoundments), except when authorized by a permit granted by the Administrator. The Administrator may refuse to permit the discharge of non-stormwater into the stormwater system for any reason or combination of reasons that is reasonable.

(3) The following non-stormwater discharges are exempt from discharge prohibitions established in paragraph 2:215(2): water line flushing or other potable water sources, landscape irrigation or lawn watering, diverted stream flows, rising groundwater (permitted after demonstration of acceptability), groundwater infiltration to storm drains, uncontaminated pumped groundwater, foundation or footing drains (not including active groundwater dewatering systems), crawl space pumps, air conditioning condensation, residual street washing waters, springs, non-commercial washing of vehicles, natural riparian habitat or wetland flows, non-residential swimming pools (if de-chlorinated/typically less than one PPM chlorine), fire fighting activities, and any other water source not containing pollutants.

(4) Except for natural runoff water or pursuant to agreement approved by the City Council, the City shall not furnish use of the stormwater system to users outside city limits.

(5) Generally, no person, property, or firm shall cause or permit the introduction of any substance into the stormwater system, whether solid, liquid or gaseous, that will cause:

(a) Chemical reaction, either directly or indirectly with the materials of construction used in the stormwater system or that will impair the strength or durability of sewers or structures;

(b) Mechanical action that will destroy or damage sewers or structures;

(c) Restriction of the normal maintenance and inspection of sewers;

(d) Danger to public health and safety or to the environment;

(e) Conditions that create a public nuisance;

(f) An oil sheen or unusual color;

(g) Abnormal demand on the stormwater system capacity; or

(h) The stormwater system to violate its NPDES permit or applicable receiving water standards and all other federal, state, and local regulations.

(6) No person shall discharge into the stormwater system any treated non-stormwater that is subject to a discharge prohibition unless the discharge is authorized under permits issued by MDEQ and the City.

(7) No person shall use the storm water system for discharge from any environmental cleanup that is regulated under the Natural Resources and Environmental Protection Act, Chapter 7, Part 201 of Act 451, P.A. 1994, unless approved by city council. Approval by city council must be conditioned upon the discharge meeting all criteria for discharge under this chapter. Approval conditions may provide for measures appropriate to preventing harm due to possible exfiltration into the ground adjacent to the system or failure of any pretreatment system for the discharge.

(Ord. No. 17-07, § 2, 7-2-07)

2:216. Discharge permits.

(1) A permit is required from the Administrator to discharge treated non-stormwater otherwise subject to a discharge prohibition under this Chapter into the stormwater system. The Administrator may require each person or firm that applies for use or uses of the stormwater system for non-stormwater purposes to obtain a discharge permit on the form prescribed by the administrator, to be subject to all provisions of this chapter. A permit may be issued for a period not to exceed 5 years. The permit shall be subject to modification or revocation for failure to comply or provide safe access or provide accurate reports of the discharge constituents and characteristics. Permits are issued to specific persons or firms for specific operations and are not assignable to another person or firm without the prior written approval of the Administrator. Permits are not transferable to another location. Anyone seeking a permit to discharge treated non-stormwater otherwise subject to a discharge prohibition into the stormwater system must do the following:

(a) File a written statement with the Administrator setting forth the nature of the enterprise, the amount of water to be discharged with its present or expected bacterial, physical, chemical, radioactive or other pertinent characteristics;

(b) Provide a plan map of the building, works or complex with each outfall to the surface waters, sanitary system, storm sewer, natural watercourse or ground waters noted, described and the discharge stream identified; and

(c) Sample, test and file reports with the Administrator and the appropriate federal, state, and county agencies on appropriate characteristics of discharges on a schedule, at locations, and according to methods approved by the Administrator.

(2) Every permit to discharge into the stormwater system shall be conditioned upon the permittee providing insurance, security and/or indemnification satisfactory to the administrator protecting the City, City property and persons in the City from loss or damages associated with the permit or permit activities.

(3) The Administrator or other authorized employees are authorized to obtain information concerning industrial processes which have a direct bearing on the kind and source of the discharge to the stormwater system. The industrial user may withhold or restrict information if it can establish to the satisfaction of the administrator that release of the information would reveal trade secrets or would otherwise provide an advantage to competitors, except discharge constituents will not be recognized as confidential information.

(4) At the permittee's expense, the Administrator shall carry out independent surveillance and

field monitoring, in addition to the self-monitoring required of certain users to ascertain whether the purpose of this chapter is being met and all requirements are being satisfied.

(5) The method of determining flow of discharge to the stormwater system shall be approved by the Administrator.

(6) The user shall acquire and be in full compliance with applicable federal (NPDES), state and county permits for discharge prior to being granted a permit from the Administrator.

(Ord. No. 17-07, § 2, 7-2-07)

2:217. Regulations.

(1) The Administrator may adopt regulations implementing this chapter. These regulations may include, but not be limited to, the following topics:

(a) The design, operation, management, and maintenance of the stormwater system and for connections to that system.

(b) Control of the quality and quantity of stormwater from industrial sites by establishing management practices, design and operating criteria.

(c) Criteria used to determine whether the stormwater utility charge will be billed to the property owner or the occupant(s) of a property, including criteria that will be used to determine how to allocate the stormwater utility charge to multiple occupants of a single property.

(d) Procedures for updating billing data based upon changes in property boundaries, ownership, and stormwater runoff characteristics.

(e) Billing and payment procedures of the stormwater utility that define the billing period, and billing methodology.

(f) Policies establishing the type and manner of service delivery that will be provided by the utility.

(g) Regulations governing the resolution of stormwater management issues among several property owners within the district.

(h) Procedures for establishing, evaluating, and refining any credits granted according to criteria in Section 2:211, and appeals as defined according to criteria in Section 2:219.

(i) Enforcement policies and procedures.

(2) These regulations shall take effect 30 days after being filed with the City Clerk unless modified or disapproved by the City Council. Regulations which are modified by City Council take effect 30 days after the modification.

(Ord. No. 17-07, § 2, 7-2-07)

2:218. Stormwater taps.

(1) Except for public services area employees, only City of Ann Arbor registered plumbers, licensed sewer installers and bona fide homeowners, after first obtaining all necessary permits including but not limited to a plumbing permit, street cut permit and sewer tap permit, are authorized to uncover the stormwater system so that existing tees or deep sewer risers installed during public stormwater system construction may be utilized. The connection shall be made only by the public services area employees only upon payment of the required connection fee which shall be fixed by the public services area and shall not be less than the cost of materials,

installation and overhead attributable to the installation.

(2) All costs and expense incidental to the installation, connection, and maintenance of the stormwater tap and lead shall be borne by the owner(s).

(3) The public services area will furnish and install stormwater system taps of the size and at the location the applicant requests in writing, provided:

(a) The requests are reasonable;

(b) An adequate stormwater system fronts the premises;

(c) An adequate tee or deep stormwater system riser does not exist for required usage;

(d) A good and safe excavation is provided by the owner(s) or owner's agent for public services area tapping personnel;

(e) The maximum sized direct tapped connection shall not be larger than 1/2 the nominal diameter of the stormwater main (e.g., a 6-inch maximum tap into a 12-inch stormwater main). Connections greater than 1/2 the nominal diameter of the stormwater main shall be made in a minimum 3-foot diameter storm sewer structure or with a manufactured tee fitting.

(f) Existing tees and deep risers shall be utilized along with stormwater leads constructed (stubbed) to the property line at the time the stormwater system was constructed.

(Ord. No. 17-07, § 2, 7-2-07)

2:219. Right of appeal.

The Administrator shall establish a procedure for the submission of appeals and the adjustment of the customer's stormwater utility charges. This procedure shall provide the following:

(1) A property owner or occupant liable for a stormwater utility fee shall be provided the right to appeal the stormwater utility charge. Appeals shall be considered on the grounds that the stormwater generated by the property and discharged into the stormwater system is less than estimated by the Administrator. No appeal may be brought with respect to a stormwater utility charge more than 1 year after the rendering of the bill for which an appeal is sought.

(2) For an appeal to be successful, the property owner or occupant shall demonstrate that the stormwater generated by the property is less than the amount used by the administrator in the calculation of that property's stormwater utility charge. Factors that will be considered by the administrator include the impervious area of the property, the activities of the property owner or features of the property that are available for credits, the amount of direct discharge to the stormwater system, or other factors defined by the Administrator.

(3) A property owner or occupant must comply with all rules and procedures adopted by the administrator when submitting a request for appeal or adjustment of the stormwater utility charge and must provide all information necessary to make a determination.

(4) Upon a finding that the stormwater generated by a property is less than the amount used by the Administrator in the calculation of that property's stormwater utility charge, the sole remedy to the property owner shall be re-calculation of the stormwater utility charge based on the corrected level of stormwater.

(5) A finding that the stormwater generated by a property is not less than the amount

used by the Administrator in the calculation of that property's stormwater utility charge shall be conclusive with respect to that property and shall remain effective for 7 years, unless the property owner changes the impervious area or the stormwater management practices of the property. The property owner shall remain eligible for credits and exemptions under this chapter.

(Ord. No. 17-07, § 2, 7-2-07)

2:220. Landlord-tenant.

The property owner may request, subject to the approval of the Administrator, that the stormwater utility charge be billed to the owner's designated tenant. The Administrator may direct billing to the tenants of a property if the tenants are currently billed for water or sanitary sewer service. The property owner shall be liable for payment even if the stormwater utility charges are billed to the tenant of the property.

(Ord. No. 17-07, § 2, 7-2-07)

2:221. Enforcement.

(1) No person shall construct or maintain any property, residence or business not in compliance with the standards of this chapter.

(2) The Administrator and other authorized employees of the city bearing proper credentials and identification shall be permitted to enter upon all properties for the purposes of inspection, observation, measurement, sampling and testing in accordance with the provisions of this chapter.

(3) No person shall fail to provide any report or other information or perform any duty required by this chapter.

(4) The City Attorney is authorized to take appropriate legal action to require compliance with this chapter.

(5) If, after reasonable notice, a person fails to comply with this chapter, the city may cause the work to be done to obtain compliance and shall charge the cost of that work to the person responsible.

(6) If any person fails to pay any fees or charges required by this chapter, the amount may be assessed against the property involved in accordance with section 1:292 of Chapter 13 of this Code.

(7) In addition to any other remedy, the administrator, after 5 calendar days notice posted on the affected property, is authorized to disconnect water service, sanitary sewer and stormwater sewer services to any property in violation of this chapter. The notice shall state that persons affected may, within 5 calendar days, provide the Administrator with any information or reasons as to why services should not be disconnected.

(8) The Administrator is authorized to take all steps necessary to immediately halt any discharge of pollutants which reasonably appears to present an imminent danger to the health or welfare of persons or to the environment.

(9) In case of an emergency involving private stormwater facilities, the Administrator may direct that immediate action be taken to correct or abate the condition causing the emergency. City personnel may perform the required work and charge the appropriate owner(s) all such related and provable costs. Such costs (if remaining unpaid for 30 days following a bill being sent for their reimbursement) shall constitute a lien on the real property.

(9) Persons aggrieved by any determination of the Administrator in enforcing this chapter may appeal that determination pursuant to section 1:16 of Chapter 1 of this Code. Prosecution shall be stayed pending such an appeal.

(10) A person who violates any provision of this Chapter shall be responsible for a civil infraction for which the court may impose a civil fine of not more than $10,000.00 per day of violation plus all costs, direct or indirect, which the City has incurred in connection with the violation, including but not limited to fines paid by the City. Each day a violation occurs is a separate violation.

(Ord. No. 17-07, § 2, 7-2-07)

2:222. Conflict.

In the event of a conflict between a provision of this chapter and any other portion of the City Code, the provisions of this chapter shall prevail.

(Ord. No. 17-07, § 2, 7-2-07)

Stormwater Utility Regulations

City of Ann Arbor, Michigan

August 6, 2007

City Of Ann Arbor, Michigan
Stormwater Utility Regulations

Table of Contents

Section 1 – Introduction and Authorization

The City of Ann Arbor established a Stormwater Management Utility on August 20, 1980. The utility provides the City with the authorization to establish and collect just and equitable rates, fees, and charges for the services and facilities provided by the utility system. The City is further authorized by the Michigan Statutes to construct, reconstruct, improve, and extend the Stormwater Management system.

The City's Stormwater Management Utility establishes a mechanism for billing the costs of operating and maintaining the City's stormwater management system and financing the necessary repairs, replacements, improvements, and extensions in a manner that protects the health, safety, and welfare of the citizens of the City of Ann Arbor. The City's ordinance, codified under Chapters 29 and 33 of the Code, City of Ann Arbor, Michigan, provides the mechanisms for billing and payment, accounting for capital contributions, and establishing the Stormwater Utility Fund.

Chapters 29 (section 2:69) and 33 (sections 2:213 and 2:217) of the City Code authorize the public services area administrator to adopt regulations implementing those chapters. These regulations were adopted in the manner provided in the city code and took effect July 18, 2007.

These Regulations outline the guidelines and framework under which the stormwater utility will operate, including procedures for credits, adjustments, and appeals to stormwater utility bills. It also establishes policies and procedures for the operation and maintenance of the City's stormwater utility system.

Section 2 – Definitions

The following definitions shall apply in the use of these Regulations. Words used in the singular shall include the plural, and the plural, the singular; words used in the present tense shall include the future tense. The word "shall" is mandatory and not discretionary. The word "may" is permissive. Words not defined herein shall be construed to have the meaning given by common and ordinary use as defined in the latest edition of Webster's Dictionary.

ADJUSTMENT. The adjustment of the user charge assessed to a particular property based on the more detailed assessment of the impervious area on that property.

ADMINISTRATOR is the public services area administrator or such other person as the city administrator may designate.

APPEAL. The process of filing a dispute with the charge determination, charge adjustment or credit as recognized by the City.

APPLICANT. Any person, or a duly designated representative applying for a permit or other type of City, federal, or state regulatory approval to proceed with a project.

CITY. City of Ann Arbor, Michigan and its authorized agents.

CLEARING. The removal of trees, brush, and other ground cover from all or a part of a tract of land, but shall not include mowing.

COUNCIL. The City Council of City of Ann Arbor, Michigan.

CUSTOMER. The owner of any property that is receiving a stormwater utility service from City of Ann Arbor, Michigan.

CUSTOMER CHARGE shall mean a monthly or quarterly base charge that recovers costs for billing, collection, customer service, and public involvement and public education activities.

DETENTION or TO DETAIN. The prevention of, or to prevent, the discharge, directly or indirectly, of a given volume of stormwater runoff into the stormwater system by providing temporary on-site storage.

DEVELOPMENT or DEVELOPMENT ACTIVITY. The alteration, construction, installation, demolition or removal of a structure, impervious surface, pipe, conduit, cable or line, above or below ground, or the clearing, scraping, grubbing, killing or otherwise removing the vegetation from a site; or adding, removing, exposing, excavating, leveling, grading, digging, burrowing, dumping, piling, dredging or otherwise significantly disturbing the soil, mud, sand or rock of a site.

DISCHARGE. The flow of water from a project, site, aquifer, drainage basin, or other drainage facility.

DWELLING UNIT. Any building or portion thereof designed or used exclusively as the residence or sleeping place of one or more families, but not including a tent, cabin, trailer or trailer coach, boarding or rooming house, hotel, or mobile home.

EASEMENT. A grant by a property owner for a specified use of all or a specified portion of land to a person or the public at large.

EROSION. The wearing or washing away of soil by the action of water.

FREEBOARD. The space from the top of an embankment to the highest water elevation expected for the largest design storm stored. The space is often required as a safety margin in a pond or detention basin.

FREQUENCY YEAR STORM. A rainfall event expressed as an exceedence probability with a specified chance of being equaled or exceeded in any given year, as follows:

One Year.....100 percent
Two Year..... 50 percent
Ten Year..... 10 percent
Twenty-Five Year..... 4 percent
Fifty Year..... 2 percent
One-Hundred Year..... 1 percent

IMPERVIOUS SURFACE. means a surface which is compacted or covered with material that is resistant to or impedes permeation by water, including but not limited to, most conventionally surfaced streets, roofs, sidewalks, patios, driveways, parking lots, and any other oiled, graveled, graded, or compacted surfaces.

NON-RESIDENTIAL DEVELOPED PROPERTY. A developed property that is not utilized for dwelling units with the City.

NON-STORMWATER is all flows to the stormwater system not defined as stormwater, as determined by the administrator. This includes, but is not limited to, cooling water, process water, ground water from a purge well and non-residential swimming pool discharge.

NON-STORMWATER DISCHARGE RATE is the charge applicable to any non-stormwater use of the stormwater system, as defined by the Administrator.

NOTICE. A written or printed communication conveying information or warning.

OPERATION AND MAINTENANCE includes any component of a stormwater system requiring expenditure for materials, labor, utilities and other items for the management and uninterrupted operation of the stormwater system in a manner for which the stormwater system was designed and constructed.

OPERATION AND MAINTENANCE COSTS include all costs, direct and indirect, of operation and maintenance of a stormwater system.

OWNER. The person in whom the charge, ownership, dominion, or title of property (i.e., the proprietor) is vested. This term may also include a tenant, if chargeable under his lease for the maintenance of the property, and any agent of the owner or tenant including a developer.

PARCEL or PARCEL OF LAND. A tract, or contiguous tracts, of land in the possession of, owned by, or recorded as property of the same claimant person.

PERMITTEE. Any person who has been granted a permit to proceed with a project.

PERSON. Any individual, firm, association, public or private corporation or public agency or instrumentality.

PRIVATE. Property or facilities owned by individuals, firms, entities, corporations, and other organizations and not by local, state or federal governments.

PROFESSIONAL ENGINEER. A professional engineer licensed by the State of Michigan, skilled in the practice of civil engineering and the engineer of record for the project under consideration.

PROPERTY means any land within the boundary of the City of Ann Arbor, both publicly and privately owned, including public and private rights of way, but excluding the Huron River.

PUBLIC. Property or facilities owned by local, state or federal governments.

RETENTION or TO RETAIN. The prevention of, or to prevent, the discharge, directly or indirectly, of any stormwater volume into the stormwater system.

SEDIMENT. Solid material, whether mineral or organic, that is in suspension, is being transported, or has been moved from its place of origin by water.

SITE. Any tract, lot, or parcel of land or contiguous combination of tracts, lots, or parcels of land that is in one ownership, or contiguous and in diverse ownership, where development is to be performed as part of a unit, subdivision, or project.

SITE STORMWATER MANAGEMENT PLAN. Refers to the approved, detailed analysis, design, and drawings of the stormwater management system required for all construction.

STORM EVENT. A storm of a specific duration, intensity, and frequency.

STORMWATER means stormwater runoff, snowmelt runoff,footing drain discharges, surface runoff and drainage, and other discharges allowed by Administrative Regulations.

STORMWATER DESIGN STANDARDS. *Rules of the Washtenaw County Drain Commissioner, Procedures and Design Criteria for Storm Water Management Systems*, and such other standards that may be adopted by the City from time to time.

STORMWATER DISCHARGE RATE means the portion of the stormwater utility charge proportionate to the quantity and representative of the quality of stormwater being discharged from a property, calculated based upon the impervious area of the property.

STORMWATER MANAGEMENT means one or more of the following:

- The quantitative control achieved by the stormwater system of the increased volume and rate of surface runoff caused by alterations to the land;

- The qualitative control achieved by the stormwater system, pollution prevention activities, and ordinances to reduce, eliminate or treat pollutants that might otherwise be carried by stormwater; and

- Public education, information, and outreach programs designed to educate and inform the public on the potential impacts of stormwater.

STORMWATER MANAGEMENT PROGRAM means one or more aspects of stormwater management undertaken for the purpose of complying with applicable federal and state law and regulation or the protection of the public health, safety, and welfare related to stormwater runoff.

STORMWATER MANAGEMENT PLAN. The technical and policy manuals, plans, regulations and/or calculations, and any subsequent updates or amendments thereto, used by the City Engineer to administer the stormwater regulations.

STORMWATER SYSTEM means roads, streets, catch basins, curbs, gutters, ditches, storm sewers and appurtenant features, lakes, ponds, channels, swales, storm drains, canals, creeks, catch basins, streams, gulches, gullies, flumes, culverts, siphons, retention or detention basins, dams, floodwalls, levees, pumping stations, and other like facilities, and natural watercourses and features located within the geographic limits of the City which are designed or used for collecting, storing, treating or conveying stormwater or through which stormwater is collected, stored, treated or conveyed, or any other physical means by which stormwater management is achieved.

STORMWATER UTILITY CHARGE means a charge to property pursuant to Chapters 29 and 33 of the Code: City of Ann Arbor, Michigan, intended to offset all or part of the cost incurred by City of preparing and conducting a stormwater management program, and operating and maintaining a stormwater system.

STRUCTURE. Anything constructed or installed with a fixed location on or in the ground.

USER is a firm, person or property which directly or indirectly contributes stormwater or non-stormwater to the stormwater system.

UTILITY. The stormwater management utility provided for in Chapter 33 of the Code, City of Ann Arbor.

WATER QUALITY. Those characteristics that relate to the physical, chemical, biological or radiological integrity of water.

WATER QUANTITY. Those characteristics that relate to the rate and volume of the stormwater runoff to downstream areas.

WATERSHED. Drainage area contributing stormwater runoff to a single point.

Section 3 – Stormwater Utility Charge Adjustments

All customers shall report their changes in impervious area and submit these measurements to the City. The City also grants charge adjustments when customers identify incorrect information contained in the City's billing database. Adjustments typically occur when the City has incorrectly delineated the impervious area within a nonresidential property, when residential customers are assigned the incorrect stormwater billing category, or when some or all of the stormwater discharge from the property does not enter the City's stormwater system, either because it discharges directly to the Huron River, discharges across the City limit, or is completely retained on-site. Charge adjustment forms are available online at www.a2gov.org/storm or by calling 994-2666. The Administrator, or designee, will review adjustment requests within a 6-month period from the date of filing of the request.

The Administrator has authority to administer the procedures and standards, and review criteria for the adjustment of charges as established herein. All requests shall be judged on the basis of the amount of impervious area on the site, topography, and/or site drainage characteristics.

Any customer who has paid stormwater utility charges, and who believes the charge to be incorrect, may submit an adjustment request .Based on the information provided, the Administrator may grant an adjustment if one or more of the following situations exist:

- Owner demonstrates that the City has incorrectly interpreted and/or calculated the impervious area of the property.

- Owner demonstrates that some or all of the impervious area does not discharge into the City's stormwater system, including discharges directly to the Huron River as well as discharges to systems outside the City limits that do not subsequently re-enter the City limits.

- Owner demonstrates rainfall that occurs on property does not generate runoff as per WCDC code (has no outlet), is completely watertight, and has at least 18 inches of freeboard. This adjustment is for unusual structures, such as swimming pools, hazardous material storage areas, quarries, etc. For these specific cases, a customer's billable impervious area will be adjusted by removing the amount of impervious area that does not generate runoff.

- Owner demonstrates that on-site gravel is not compacted, not used for vehicular traffic, and not impervious. The City may grant adjustments for non-compacted gravel areas used for landscaping or other purposes. The City considers all compacted gravel areas (drives, storage areas, etc.) as impervious areas, and as such, no adjustment will be granted. The Administrator will make the decision regarding the intended purpose of gravel areas and the degree of imperviousness.

The City may request that the customer provide supplemental information to the Administrator including, but not limited to, survey data prepared by a registered Professional Land Surveyor (P.L.S.) that represents the amount of impervious area and compacted gravel area on a property and/or engineering reports prepared by a registered Professional Engineer (P.E.). Failure to provide such information may result in the denial of the adjustment request.

The Adminstrator shall respond in writing to all adjustment requests. The response shall provide an explanation of adjustment approval or denial. Adjustment denials may be appealed according to the process presented in Section 5.

Section 4 – Stormwater Utility Charge Credits

Any customer may qualify for stormwater credits when they can demonstrate that their existing or proposed stormwater facilities and management practices provide the City with a quantifiable cost savings in managing their stormwater system. The reduction available for each type of credit will be established by City Council in Chapter 29 of the

Code, City of Ann Arbor, Michigan, with the actual credit reduction for a specific property determined by the Administrator based on the characteristics of the actual facility or management practice employed by the customer.

Stormwater utility credits are associated with the construction, operation, and maintenance of privately owned stormwater facilities and/or actions by property owners that provide benefit to the City in the cost of providing stormwater services. Credit applications are available online at www.a2gov.org/storm or by calling 994-2666. The Administrator, or designee, will review credit requests within a 6-month period from the date of filing of the request.

4.1 Restrictions

- No public or private property shall receive Credit to offset Charges for any condition or activity unrelated to the City's cost of providing stormwater management services.
- No Credit will be applied to any property that reduces the Charge to an amount less than zero.
- Credits will not apply to Stormwater Pollution Prevention Plan (SWP) Review and Inspection fees attributable to new development or redevelopment projects.
- Credit shall only be given to the property..

4.2 Credits for Single Family and Two-Family Residential Properties

Credit may be issued to a single-family or two-family residential property where the property owner has implemented one or more of the following stormwater facilities or management practices. The application form will be posted online at www.a2gov.org/storm or may be obtained by calling 994-2666.

4.2.1 Credit for On-Site Stormwater Management Practices

A single-family or two-family resident may receive a credit for physical stormwater management practices installed on their property. Credit will be granted to both the stormwater discharge rate (proportionate to the reduction in stormwater discharges achieved by these practices) and to the customer charge (proportionate to the public education benefits provided to the City by citizen involvement in such practices). The following types of practices are eligible to receive credits based upon a complete application to the City and subject to review and inspection by the Administrator. More detailed information on each of these practices is available online at a2gov.org/storm or by calling 994-2666.

- Install rain barrel(s), totaling 35 gallons or more, onto the downspouts from structures on the property. Between storm events, owner shall direct discharges from rain barrels either directly or indirectly to pervious areas of the property.

- Install one or more cisterns or dry wells able to capture a total stormwater volume of at least 500 gallons or 66 cubic feet and drain the captured volume to soil in less than 24 hours. Facilities designed according to these criteria should accept runoff from at least 50 percent of the roof area of the property. In no event may the discharge from the facility cause an increase in the runoff to an adjoining property.

- Install one or more rain gardens at least 130 square feet in area, and at least 3 to 6 inches deep. The rain garden should be able to drain the captured volume to soil in less than 24 hours, and should accept runoff from at least 50 percent of the roof area of the property. In no event may the discharge from the facility cause an increase in the runoff to an adjoining property.

4.2.2 Credits for Off-Site Stormwater Management Practices

Most properties within the City developed since 1978 are served by stormwater detention facilities built as a condition of development. Design criteria for these facilities have evolved since then:

- ***1978***: Detention of the 100-year storm event for new impervious surfaces exceeding 15,000 square feet. Outlet rate restricted to 0.2 cfs/acre (also referred to as the agricultural runoff rate for the 10 year storm event)

- ***1994:*** Washtenaw County Drain Commissioner adopts new design standards requiring control of the First Flush, Bankfull, and 100-year storm events. City staff requests voluntary compliance with WCDC design standards as developments are proposed.

- ***2000:*** WCDC revises design rules. Lowers outlet restriction rate to 0.15 cfs. City adopts new stormwater management requirements. Eliminates the "grandfather clause". Requires compliance with the rules of the WCDC.

- ***2002:*** City makes minor revisions to it's stormwater management standards to provide an exception of minor projects that do not increase impervious area.

Generally, these facilities are owned and maintained by a homeowners association or similar organizations. The City maintains records of these facilities, their design criteria, and the properties served by these facilities. The City also periodically inspects these facilities to determine if they are properly maintained and operating as designed.

Single-family and two-family residential properties that completely drain into one or more stormwater management facilities designed according to criteria in Chapter 63 of the Code, City of Ann Arbor in effect at the time the facility was constructed are eligible for a credit to their stormwater discharge rate. To receive this credit, the facility must be fully maintained to preserve the intended functionality of the facility. . Credits will be granted based upon the design criteria of the facility, which determines the amount of stormwater discharged into the City's stormwater system. Credits will be granted to qualifying property owners based upon information available to the City. No application is required.

4.2.3 Credits for RiverSafe Home Participants

In 2007, the Washtenaw County Drain Commissioner initiated the RiverSafe Home program, which provides recognition to home owners or occupants who employ best stormwater management practices in the maintenance of their property. Information about this program and an on-line survey to determine if property owners are eligible can be found at the Drain Commissioner's web site:

http://www.ewashtenaw.org/government/drain_commissioner/dcRiverSafeHomes2

The City is supporting this program by providing customer credits as additional recognition to participating property owners and tenants who are in full compliance with the most current criteria of the RiverSafe Home program published by the Washtenaw County Drain Commissioner. Ann Arbor Stormwater Utility Customers must apply directly to the City for this credit by filling out the credit application online at a2gov.org/storm or by calling 994-2666. The City will periodically verify that the properties receiving this credit are in good standing with the WCDC's RiverSafe Home program.

4.3 Credits for Other Residential and Non-Residential Properties

Property owners or eligible tenants can apply for these credits, and may be required to submit supporting documentation with their credit application to allow the Administrator to properly determine the value of the credit to be granted. The following credits 4.3.1 through 4.3.4 are included as part of the program. The Application Form for other residential and non-residential properties can be found online at www.a2gov.org/storm or by calling 994-2666.

4.3.1 School-Based Education Credit

Those schools, public or private, that perform public education and outreach practices in full compliance with an NPDES stormwater discharge permit issued by the Michigan Department of Environmental Quality (MDEQ) may receive a Credit for educating students and employees in the area of water quality awareness and protection. To be considered for this credit, the school must submit a copy of the NPDES permit, with the permit number, the latest stormwater management plan and annual report prepared under this permit, and the estimated number of residents of the City of Ann Arbor who received or participated in each educational practice.

The Administrator will review the application, and determine a credit amount based on the estimated cost-reduction in the City's public education programs provided by the school-based educational activities.

4.3.2 Credits for Stormwater Management Practices Required under Chapter 63

Most properties within the City developed since 1978 are served by stormwater detention facilities built as a condition of development. Design criteria for these facilities have evolved since then:

- ***1978***: Detention of the 100-year storm event for new impervious surfaces exceeding 15,000 square feet. Outlet rate restricted to 0.2 cfs/acre (also referred to as the agricultural runoff rate for the 10 year storm event)

- ***1994:*** Washtenaw County Drain Commissioner adopts new design standards requiring control of the First Flush, Bankfull, and 100-year storm events. City staff requests voluntary compliance with WCDC design standards as developments are proposed.

- ***2000:*** WCDC revises design rules. Lowers outlet restriction rate to 0.15 cfs. City adopts new stormwater management requirements. Eliminates the "grandfather clause". Requires compliance with the rules of the WCDC.

- ***2002:*** City makes minor revisions to it's stormwater management standards to provide an exception of minor projects that do not increase impervious area.

The City maintains records of these facilities, their design criteria, and the properties served by these facilities. The City also periodically inspects these facilities to determine if they are properly maintained and operating as designed.

Other residential or non-residential properties that completely drain into one or more stormwater management facilities designed according to criteria in Chapter 63 of the Code, City of Ann Arbor in effect at the time the facility was constructed are eligible for a credit to their stormwater discharge rate. To receive this credit, the facility must be fully maintained according to criteria established by the Administrator. Credits will be granted based upon the design criteria of the facility, which determines the amount of stormwater discharged into the City's stormwater system. Properly designed and maintained facilities that receive stormwater from off-site sources may be eligible for an additional credit, subject to Administrator review. Credits will be granted to qualifying property owners based upon information available to the City. No application is required for facilities that were approved by the City prior to their construction.

4.3.3 Stormwater Quality Control Structural BMP Credit

Stormwater quality control structures that do not fully satisfy the criteria of Chapter 63 of the Code, City of Ann Arbor may be eligible for a credit. In order to qualify for this credit, one or more facilities must be able to capture runoff from the first one-half inch of rain and at least 50 percent of the impervious area of the property, release the captured volume to the City drainage system in no less than 24 hours, and otherwise be designed and maintained according to criteria in the Stormwater Design Standards, low impact design fact sheets available from the Washtenaw County Drain Commissioner, or generally accepted engineering practice. The City will determine whether to provide this Credit based upon a complete application including necessary hydrologic data, water quality data, design specifications, and other pertinent data supplied by qualified, licensed professionals on behalf of property owners. Structural stormwater quality management facilities that are eligible for credits include, but are not limited to the following:

- Vegetated Swales and Filter Strips,
- Infiltration and Percolation Basins,
- Percolation Trenches,
- Buffer Strips and Swales,
- Porous Pavement,
- Extended (Dry) Detention Basins,
- Retention (Wet) Ponds,
- Constructed Wetlands
- Media Filtration, and
- Other Stormwater Treatment System.

Credits for on-site stormwater facilities shall be generally proportional to the benefit that such systems have on complementing or enhancing the water quality benefit to the City's stormwater management system. Property access, adequate and routine facility maintenance, and self-reporting must be provided by the property owner to the City to verify that the facility is providing its intended benefit. Properly designed and maintained facilities that receive stormwater from off-site sources may be eligible for an additional credit, subject to Administrator review. In all cases, the facility must be designed to fully meet criteria in the Stormwater Design Standards based upon the total drainage area of the facility.

4.3.4 Credits for Community Partners for Clean Streams Participants

The Washtenaw County Drain Commissioner administers the Community Partners for Clean Streams program, which provides recognition to businesses that employ best stormwater management practices in the maintenance of their property. Information about this program can be found at the Drain Commissioner's web site:

http://www.ewashtenaw.org/government/drain_commissioner/dc_cpcs.html

The City is supporting this program by providing customer credits as additional recognition to participating businesses that are in full compliance with the latest criteria of the Community Partners for Clean Streams program published by the Washtenaw County Drain Commissioner. Ann Arbor Stormwater Utility Customers must apply directly to the City for this credit by filling out the credit application and attaching a copy of the letter of recognition provided by the Drain Commissioner. The City will periodically verify that the properties receiving this credit are in good standing with the WCDC's Community Partners for Clean Streams program.

4.4 Credits for Stormwater Systems within Public Rights of Way

Most of the City's drainage system lies within public rights of way, sharing that property with public roads and other public and private utility systems. Public roads and other impervious surfaces within these rights of way discharge stormwater to the stormwater system and are subject to stormwater utility charges like every other property within the City. However, the public ROW also provides service to the stormwater utility (and all of its other customers) by serving as a conduit for stormwater drainage that augments the utility's other assets – and that the Utility would have to construct independently but for the existence of the public ROW.

In this light, the Administrator shall periodically determine the value of the services provided by the public ROW to the stormwater utility compared with the stormwater utility charge for runoff from impervious areas within the public ROW.

4.5 Application Procedures

A property owner seeking a Stormwater Credit must comply with the procedures outlined in these Regulations and must submit the appropriate credit application. All information necessary for the Administrator to make a determination must be supplied as outlined in these Regulations and the Credit application. Failure to comply with the procedures outlined in these Regulations will result in a denial of the Credit application.

In cases requiring a hydrologic analysis, a qualified professional engineer registered in the State of Michigan must prepare and certify the documentation provided to verify the hydrologic benefit.

4.6 Enforcement Policy

The Administrator reserves the right to review a credit application for accuracy and/or inspect and review documentation confirming the provision of the stormwater facility or management practice at any time. If, after its review or inspection, the Administrator finds the application to be inaccurate or the projected level of service is not being provided or continued, the customer will be notified in writing and given 45 days to correct the deficiency. The property owner must provide written documentation to the Administrator within 45 days of the original notice by the Administrator that the stormwater facility or management practice is being provided or continued as agreed in addition to such evidence as the Administrator reasonably requires showing that the deficiency has been corrected. If, in the opinion of the Administrator, the deficiency is not satisfactorily corrected, the Credit attributable to the deficiency will be terminated on the following billing cycle and will remain in effect for a minimum of 12 months. Reapplication for Credit will not be reviewed until the delinquent stormwater facility or management practice has been adequately reinstated for three continuous months and evidence of the corrections has been provided with the reapplication.

Once the Credit reduction has been canceled, a customer may not reapply for that particular Credit for a period of 12 months and then only if the deficiency has been corrected, as determined by the City inspection. It will be the responsibility of the customer to prove the stormwater management goals are met prior to the Credit being reissued.

All structural water quality control systems that are not listed in the Stormwater Design Standards may require, at the request of the City and at no cost to the City, periodic certified laboratory water quality sampling and reporting to insure that the water quality standards are being met.

Section 5 – Appeals

Any person disagreeing with the interpretation or application of a provision of Chapters 33, 29 (as related to Stormwater), or the regulations in these Regulations may appeal in writing by using Stormwater Utility Petition to Appeal found online at www.a2gov.org/storm or by calling 995-2666.

All appeals will be processed first through the Administrator, for a recommendation, and then to the City of Ann Arbor, City Administrator for final decision. Any person still aggrieved may appeal the City Administrator's decision to a court of competent jurisdiction.

Stormwater Utility
Policies and Procedures Manual

City of Ann Arbor, Michigan

Final
September 15, 2008

City Of Ann Arbor, Michigan
Stormwater Utility
Policies And Procedures Manual

Table of Contents

Section 1 – Introduction and Authorization

The City of Ann Arbor established a Stormwater Management Utility on August 20, 1980. The utility provides the City with the authorization to establish and collect just and equitable rates, fees, and charges for the services and facilities provided by the utility system. The City is further authorized by the Michigan Statutes to construct, reconstruct, improve, and extend the Stormwater Management system.

The City's Stormwater Management Utility establishes a mechanism for billing the costs of operating and maintaining the City's stormwater management system and financing the necessary repairs, replacements, improvements, and extensions in a manner that protects the health, safety, and welfare of the citizens of the City of Ann Arbor. The City's ordinance, codified under Chapters 29 and 33 of the Code, City of Ann Arbor, Michigan, provides the mechanisms for billing and payment, accounting for capital contributions, and establishing the Stormwater Utility Fund.

This Policies and Procedures Manual outlines the guidelines and framework under which the stormwater utility will operate. The Policies and Procedures Manual is intended to identify and clarify the City's procedures for billing the charges and updating the billing data file. It also establishes policies and procedures for the operation and maintenance of the City's stormwater utility system.

Section 2 - Responsibility

The stormwater utility is administered by the City's Public Services Area. The Public Services Area Administrator (Administrator) is responsible for the operation and maintenance of the stormwater facilities. The Administrator is also responsible for the organization of the operation and maintenance staff, the planning and assessment of stormwater utility facilities, fiscal management, and the management of capital improvements programs. The responsibility for billing and collection of stormwater utility charges is that of the Customer Service Unit of the Public Services Area.

The Administrator is also responsible for ensuring that an accurate record of all properties using the services and facilities of said stormwater management system of the City is kept, and changes are made to update the record and keep it current in accordance with Chapter 33 of the Municipal Code of the City of Ann Arbor.

Section 3 – Stormwater Enterprise Fund

All revenues raised from stormwater utility rates, fees, and charges are placed in a stormwater enterprise fund together with such other revenues from any source or combinations of sources of revenues otherwise legally available which have been designated to be used for the stormwater management program. No part of the funds held in the stormwater enterprise fund may be transferred to any other operating fund or used for any purpose other than payment of direct and indirect services for undertaking the stormwater management program, and operating and maintaining a stormwater system.

Section 4 – Stormwater Utility Charge

A stormwater utility charge shall be charged to each property within the City for their use of the stormwater system. The Administrator shall be responsible for maintaining a list of lots and properties within the incorporated City limits and assigning them to an appropriate customer classification as defined in Chapter 33 of the Code: City of Ann Arbor Michigan. The Administrator shall also recommend the specific rates and charges that will be charged to customers based upon an assessment of the actual services provided, and City Council shall approve the charge. This charge shall be composed of three components whose charge is proportionate to the cost of service received by each property:

- A ***Customer Charge*** to every customer covering the cost of public education, public involvement, and utility billing administration, operation, and updates.

- A ***Stormwater Discharge Rate*** proportionate to the amount of stormwater discharged into the public stormwater system, based upon the impervious area of the property and charged at a rate per impervious acre per quarter established by City Council.

- ***Specific Charges*** to those subsets of customers receiving specialized services from the City. One category of specific charges are those for non-stormwater discharges. Under current standards, a storm sewer in the City of Ann Arbor is designed to convey the peak flow from a 10-year, 1-hour design storm, equal to 1.6 cfs for one acre of impervious area. Therefore, the rate for permitted non-stormwater discharges in $ per cfs shall equal the stormwater discharge rate in $ per impervious acre divided by 1.6 cfs per impervious acre.

Section 5 – Billing, Payment, Delinquent Charges and Non-Payment Penalties

Billing and payment of stormwater utility charges is to be done pursuant to Section 2:69 of the Code, City of Ann Arbor, Michigan. The stormwater utility charge shall be billed and paid under the same terms and conditions established for other utility services (water, sanitary sewer, etc.) and Sections 2:71 and 2:72 of the Code, City of Ann Arbor Michigan.

Section 6 -- Maintenance of Utility Billing Data

The Administrator shall be responsible for maintaining the measurements of the impervious area based on data supplied by the City, or by the property owner, tenant, or developer. The Administrator may require additional information as necessary to make the determination. The Administrator shall update the billing amount based on any additions to the impervious area as approved through the building permit process.

The stormwater utility billing system data file shall be updated periodically to include new stormwater utility customers who construct new developments or make modifications or improvements to existing developed property. It shall be necessary to obtain sufficient information regarding the new utility customers to determine the impervious area and the corresponding monthly utility charge.

6.1 Site Plan Review and Building Permit Application Procedures

Upon issuance of a Certificate of Occupancy, the Customer Service Unit will begin billing the new location a stormwater utility charge. New single-family and two-family residential customers shall be placed into the .07 acre impervious area category until such time as measured impervious area data becomes available for the property. All customers shall report their changes in impervious area and submit these measurements to the City.

6.2 Utility Billing Data File Update

Receipt of a copy of the Certificate of Occupancy for a property signifies a request for service from the City's stormwater utility. The Customer Service Unit initiates stormwater utility billing with the first billing cycle after the receipt of the Certificate of Occupancy. The System Planning Unit is responsible for the assignment of impervious area to the new customer and furnishing this impervious area to the Customer Service Unit. The Customer Service Unit is responsible for keeping the billing system data file current.

Section 7 - Requests for New Service and Change of Service

A stormwater account should remain active and chargeable regardless of occupant status. Requests by new tenants, owners, residents, or other persons or a request for discontinuation of utility service at an existing, developed property is handled by the Customer Service Unit.

1) For a **new request for utility service**, the Customer Service Unit will update the stormwater utility billing system data file with the new customer's name, billing address, and other pertinent information; and check to ensure that the account is active and chargeable.

2) For a **bill paying tenant moving out,** , the Customer Service Unit will transfer the current customer information from the account and replace it with information regarding the owner of the property (unless a replacement tenant has already moved in).

3) A request for **change of service** resulting from a demolition or other reduction in impervious area will follow the adjustment procedure outlined in Section 3 of the Regulations.

Section 8 – Stormwater Utility Billing Guidelines

The stormwater utility billing is provided as a line item on the City's utility billing statement. The customer identification number is used to bill the stormwater utility charge. General billing guidelines are described as follows:

- Residential multifamily such as condominiums, apartment complexes, trailer parks, etc., are generally served by utility accounts in the name of the owner or the property association. In these cases, the stormwater charge is assigned to the utility account for the master water meter and billed to the property owner / association.

- Residential condominiums that are serviced by multiple utility accounts will have the stormwater charge for each land parcel within that condominium divided equally among the utility accounts that are within that land parcel.

- Where multiple utility accounts exist on a single property and the accounts have the same customer name, the stormwater discharge rate and the customer charge shall be billed to one account, with the other accounts designated as zero charge for stormwater billing.

- Where multiple utility accounts exist on a single property and the accounts have different customer names and separate customer accounts (i.e., retail shopping center), the stormwater discharge rate is billed to property owners based on the percentage allocation of the total impervious area to that customer and the customer charge is charged to each customer. For these stormwater utility customers, the amount of impervious area is determined and assigned to each customer account based on the percentage of the total impervious area that can be attributed to the individual customer. The percentage allocation is determined on the basis of the ratio of the customer's building area to the total building area. The area of impervious surface assigned to the customer is determined by multiplying the customer's percentage allocation of total building area by the property's total impervious area.

- A property that is not receiving other utility services (i.e. water, sanitary sewer, or solid waste) from the City of Ann Arbor is designated as a "stormwater only" account, and billed based on the procedures mentioned previously. The Administrator may designate a less frequent billing cycle for stormwater only accounts.

Section 9 - Multiple Fund Projects

The City may participate in stormwater management projects with individual property owners or other political jurisdictions if, in the opinion of the City, the project provides stormwater control. The City will allocate project costs on an equitable basis. The City should evaluate the allocation methodology to parallel the stormwater utility concept: the amount of flow/volume/pollution discharged from varying areas should provide the basis for equitably distributing the costs of the required facilities to these areas.

Section 10 - Ancillary Improvements

The Administrator may authorize the construction of curbs, pavements, channels, watercourses, conduits, culverts, or other structures necessary to properly operate and maintain new and existing stormwater facilities within the City's right of way and other environs, and as adjuncts to stormwater facilities within the City's jurisdictional boundaries.

Section 11 - Routine and Remedial Maintenance

The Administrator will provide for inspection and routine maintenance of facilities owned by the City, within a right of way or drainage easement, or causing stormwater problems. Maintenance may include, but not be limited to, catch-basin cleaning, grating and casting repair, inlet and outlet structure repair, channel clearing, and erosion repair. The Administrator will provide for remedial maintenance of facilities based upon the severity of stormwater problems and potential hazard to the public health, safety, and welfare.

Appendix B
Public Engagement Plan

City of Ann Arbor, Michigan
Stormwater Utility Update

Public Engagement Plan

Submitted December 16, 2005

Prepared By
CDM Michigan Inc.
Ann Arbor Michigan

Contents

Purpose and Objectives

The Public Engagement Plan for the City of Ann Arbor Stormwater Utility Update Project establishes mechanisms for communication between the public, City Council, City staff, and the consultant team during the project. Objectives of this communication are to:

- Confirm community values regarding stormwater issues and opportunities.
- Define the desired level of stormwater service necessary to address critical stormwater issues within Ann Arbor
- Communicate identified stormwater needs to the entire community.
- Educate stakeholders about alternative funding sources for desired level of stormwater services.
- Explain basis for future stormwater utility user fees
- Resolve issues related to the stormwater level of service and the funding mechanism(s) selected to provide this service level.

The following mechanisms have been identified to provide public education and involvement during the project:

- Stormwater Rates Citizen Advisory Group (SRCAG)
- Two articles in the WaterMatters Newsletter and/or as press releases
- Up to three public meetings and/or presentations of project findings at existing civic, professional, or business organization meetings.
- Text and layout for a brochure or an advertisement in a format suitable for publication in the Ann Arbor News or the Ann Arbor Observer (City to provide printing and distribution)
- Briefings at up to two City Council meetings

At the City's request, several optional public engagement activities could be conducted depending on available budget:

- Assistance in planning and/or production of a cable television presentation
- Additional meetings with specific businesses, organizations, or institutions (e.g., U of M, Pfizer).
- Maintain a project website to disseminate materials being prepped for the advisory task force and assist task force members to educate their constituents.
- Conduct an on-line community survey on value of possible options relative to cost and disseminate findings via task force members.
- Assist City staff prepare for and participate in an interview on WEMU

Stormwater Rates Citizen Advisory Group

Purpose

Ann Arbor's Stormwater Rates Citizen Advisory Group (SRCAG) provides a structured forum to involve representatives of various segments of the community in defining the desired level of stormwater services in Ann Arbor and update the current stormwater utility so that it provides a fair, equitable method of financing these services that is consistent with state and local statues. The SRCAG structure will facilitate informed discussion about the stormwater needs in Ann Arbor, the costs to meet these needs, and appropriate methods of financing these costs. SRCAG members will provide a conduit between the project team and the various segments of the community on these issues.

Membership

The SRCAG will consist of up to 20 members, as needed to represent a broad cross-section of interests in the community. The Public Services Area Administrator is responsible for soliciting nominations for SRCAG membership and appointing SRCAG members by January, 2006. The following interest groups should be represented on the SRCAG:

- MDEQ (representing regulatory interests) – 1 representative
- Washtenaw County Drain Commissioner – 1 representative
- University of Michigan – 2 representatives
- Ann Arbor Public Schools – 1 or 2 representatives
- Pfizer (representing theirs and other large industrial interests) – 1 representative
- Downtown Development Association (representing commercial interests) – 1 to 2 representatives
- Chamber of Commerce (Includes representation of large shopping malls) – 1 to 2 representatives
- Ann Arbor Apartment Association (Representing multi-unit residential) – 1 representative
- Interfaith Council (Representing religious organizations; churches and mosques) – 1 representative
- Huron River Watershed Council – 1 representative
- Ecology Center – 1 representative
- Environmental Commission (Representing creek organizations) – 2 representatives
- Citizens (representing different residential impacts) – 3 representatives

Responsibilities of SRCAG Members

Each SRCAG member is intended to represent a specific segment of the community as a whole. Therefore, the active participation of each SRCAG member is imperative. Specific responsibilities for SRCAG members include the following:

- ***Attend SRCAG meetings.*** Evening or afternoon meetings are planned every 4 to 6 weeks and should last about 2 hours each. A regular meeting time will be established during the first meeting.
- ***Attend other SRCAG-sponsored events.*** Events may include a tour of stormwater problem areas and recent stormwater projects, and community forum meetings.
- ***Review materials.*** Brief written documents about stormwater problems, activities required to address these problems, and alternative financing methods will be provided to SRCAG members approximately one week prior to most SRCAG meetings. In addition, presentations about these topics will be given at many meetings.
- ***Provide informed opinions about stormwater issues.*** SRCAG members should interact with the community segment they represent and bring informed opinions from these segments to facilitated discussions about stormwater issues. In turn, members should brief others within the community about SRCAG business and solicit opinions. The SRCAG member is responsible for determining if formal or informal methods of soliciting community opinion are most appropriate.
- ***Coordinate briefings for interest groups.*** If critical unresolved issues emerge during SRCAG meetings, members of the project team will hold briefings about the stormwater program for particular interest groups on a limited basis. SRCAG members representing these groups should inform the SRCAG about these issues and work with City staff to identify an appropriate forum for a briefing.
- ***Help review recommendations.*** The SRCAG will review the recommendations that will be the basis of a brief report on how to address critical stormwater issues in Ann Arbor. The consultant team will prepare drafts of this report based on discussions at SRCAG meetings, distribute these drafts before SRCAG meetings, facilitate discussions oriented at reaching as much consensus as possible on these issues, and consolidate SRCAG comments into the report. Ultimately, this report will be delivered to the City Council and City Administrator for their consideration while developing stormwater policy for the City of Ann Arbor.
- ***Attend and/or participate in briefings for City Council.*** From time to time, the consultant team will provide briefings for City Council. SRCAG members are encouraged to participate in these briefings to afford Council with a comprehensive vision of priority stormwater issues facing the community.

Preliminary Meeting Agenda

SRCAG meetings are scheduled to begin in February. The initial term of SRCAG members is approximately one year, with meetings held about every 4 to 6 weeks. The following six meetings are scheduled to occur during the project:

- Meeting 1. Orientation and Overview of Stormwater Problems
- Meeting 2. Issue Identification
- Meeting 3. Cost of Service Analysis
- Meeting 4. Financing Options
- Meeting 5. Utility Rate Structure and Policies
- Meeting 6. Finalize Utility Implementation Report to City Council

Two additional meetings may be held if additional deliberations are required to address the subject matter covered during these meetings. A description of the agenda and objectives of each meeting is included in Appendix A of this report.

WaterMatters Articles

The City publishes the WaterMatters quarterly and provides it to every utility billing address in Ann Arbor. Articles highlight significant issues in Ann Arbor, and responses are encouraged to allow citizens to share their ideas, concerns and suggestions with the City. The stormwater utility update will provide three articles to WaterMatters during the project:

- Winter 2006: Ann Arbor Updates the Stormwater Management Utility, including a request to provide citizen input on stormwater problems in Ann Arbor
- Spring 2006: Critical Stormwater Issues in Ann Arbor (summary of the nature and severity of stormwater issues in Ann Arbor).
- Fall 2006: Methods of Funding Stormwater Programs

City Council Briefings

CDM, with the support of the SRCAG, will provide a briefing for City Council on the findings of the project. SRCAG recommendations will be a highlight of the City Council briefing.

Appendix A

Proposed Agenda

Stormwater Rates Citizen Advisory Group Meetings

City of Ann Arbor

Stormwater Utility Development Plan

Agenda for Stormwater Rates Citizen Advisory Group

Meeting 1 – Orientation and Overview of Stormwater Problems

Objective: Introduce subject of stormwater policy, organize task force, and review stormwater problems

Description: CDM will assist the SRCAG in discussing the City's stormwater policy development and provide task force members with information addressing:

- typical stormwater problems in Ann Arbor
- Ann Arbor's proposed stormwater utility program,
- SRCAG operation,
- objectives of the SRCAG,
- goals of the SRCAG, and
- the schedule for bringing recommendations to council.

CDM will prepare the necessary graphic aids and handouts for the meeting and will provide a summary of the meeting to be included in notebooks furnished to the advisory task force members and representatives of the city. These notebooks will be updated at each meeting with new materials developed for that presentation.

Deliverables:

- Notebooks with background information
- Presentation materials for Meeting 1

Schedule:

- Draft presentation material seven days prior to Meeting 1
- Preliminary date for Meeting 1 is February, 2006

City of Ann Arbor

Stormwater Utility Development Plan

Agenda for Stormwater Rates Citizen Advisory Group

Meeting 2 – Issue Identification

Objective: Identify stormwater policy issues

Description: CDM will review with the advisory task force the following stormwater policy issues:

- what drainage features are the responsibility of the City to operate and maintain
- what are acceptable drainage operation and maintenance practices compatible with the City, County, State, and Federal goals, policies and objectives
- what level of service should the City provide in different sections of the drainage system
- what are the property owner's responsibilities for drainage from/through their property, and what is the City's role in seeing these responsibilities are met
- what mechanisms should the City consider to raise revenue for drainage improvements that is fair and equitable
- other issues defined by the task force

CDM will prepare the necessary graphic aids and handouts for the meeting.

Deliverables:

- Meeting 2 inserts for notebooks
- Presentation materials for Meeting 2

Schedule:

- Draft presentation material seven days prior to Meeting 2
- Preliminary date for Meeting 2 is March 2006

City of Ann Arbor

Stormwater Utility Development Plan

Agenda for Stormwater Rates Citizen Advisory Group

Meeting 3– Cost of Service Analysis

Objective: Define cost of desired level of service

Description: CDM will use a matrix to describe a range of services and service levels that address critical policy issues identified in Meeting 2, will facilitate the advisory task force in discussion of the costs and benefits of the various services, and will seek to build consensus around a desired level of service.

Deliverables:

- Meeting 3 inserts for notebooks
- Presentation materials for Meeting 3

Schedule:

- Draft presentation material seven days prior to Meeting 3
- Preliminary date for Meeting 3 is May 2006

City of Ann Arbor

Stormwater Utility Development Plan

Agenda for Stormwater Rates Citizen Advisory Group

Meeting 4 –Financing Options

Objective: Determine a fair and equitable method to finance necessary stormwater management activities.

Description: CDM will present information to assist the advisory task force understand municipal financing principles, how municipal funds are operated, how they are burdened, the available financing options for stormwater management programs and the proposed stormwater utility rate structure. CDM will also present a five-year plan for financing the stormwater program under alternative combinations of these options and will facilitate a discussion oriented at reaching consensus on the preferred financing approach. CDM will prepare the necessary graphic aids and handouts for the meeting.

Deliverables:

- Meeting 4 inserts for notebooks
- Presentation materials for Meeting 4

Schedule:

- Draft presentation material seven days prior to Meeting 4
- Preliminary date for Meeting 4 is June 2006

City of Ann Arbor

Stormwater Utility Development Plan

Agenda for Stormwater Rates Citizen Advisory Group

Meeting 5 – Utility Rate Structure and Policies

Objective: Determine Required Stormwater Fee and Credit Policy

Description: CDM will present a required stormwater fee necessary to fund the desired level of services and accommodate/anticipate adjustments. CDM will facilitate the advisory task force in a discussion of concerns regarding the fee and credit policy.

CDM will prepare the necessary graphic aids and handouts for the meeting.

Deliverables:

- Meeting 5 inserts for notebooks
- Presentation materials for Meeting 5

Schedule:

- Draft presentation material seven days prior to Meeting 5
- Preliminary date for Meeting 5 is August 2006

City of Ann Arbor

Stormwater Utility Development Plan

Agenda for Stormwater Rates Citizen Advisory Group

Meeting 6 – Finalize Utility Implementation Report to City Council

Objective: Finalize report to City Council

Description: CDM will assist the advisory task force in preparing a summary document that addresses the task force's conclusions. This document should be brief and provide limited historical information, but concentrate on issues that were key to the advisory task force's recommendation.

Whether one meeting will be sufficient to develop concensus support is difficult to forecast. Previous experience has shown that one meeting is successful if proper information has been displayed and consensus developed progressively through previous meetings.

Deliverables:

- CDM will assist the City in developing the draft report for the meeting
- Meeting 6 inserts for notebooks

Schedule:

- Draft presentation material seven days prior to Meeting 6
- Preliminary date for Meeting 6 is September 2006

Appendix C
Summary of Existing Functional Stormwater Services

Attachment 1
Current Roles/Funding of City Departments in Stormwater Management

Functional Stormwater Service Area	Current Stormwater Management Role	FY 2005/06 Expenditures from SW Fund		Expenditure Category in Current SW Budget	Current Expenditures, Other Departments	Work Currently Performed By:		Potential Future Funding from SW Fund	
		Annual Amount	Notes			Department	Division	Annual Amount	Notes
Administrative Services	Administration by Public Services Department	$215,000		Administration		Public Services	Administration	$40,000	May increase if level of service increases
	Municipal Service Charge for equitable share of City administrative services	$39,000		Administration		Public Services	Administration		May increase if level of service increases
	Coordinate with/support WCDC and major stakeholders re: capital investments, IDEP, grants	$30,000	City pays WCDC ~ $30k/yr towards' Harry Sheehan's salary	Administration		Public Services	Systems Planning		Additional coordination may be needed to support additional County Ditch improvement projects
	MS4 Storm water permit -- Annual reporting, administration, and coordination	$12,000	Administered by Craig Hupy	Systems Planning		Public Services	Systems Planning		
	Coordinate with University of Michigan	$2,000	Wendy Rampson - 4 hrs/wk on UM related issues, very little stormwater related, suggest using 2 hr/mo at hourly rate	Systems Planning		Public Services	Systems Planning		
	Customer Service Requests (taken by phone); initiate work orders; answer questions	$209,000	Stormwater share estimated at 20% of Customer Service budget	Administration		Public Services	Customer Service Center		
	Subtotal for Administrative Services	**$507,000**			**$0**			**$40,000**	
Public Engagement	Public education (e.g., direct mail, advertising, storm drain stenciling)	$100,000	For all permit-required Pub. Ed. Performed under contract	Systems Planning		Public Services	Systems Planning		
	Support watershed, environmental, and "resource user" groups	$24,000	Jerry Hancock currently spends ~22 hrs/month on this	Administration		Public Services	Systems Planning	$12,000	50% increase in Jerry's time
	Public education, publications, web oversight	$0	Currently none, future services	NOT CHARGING TO SW		Community Services	Communications (Lisa)	$15,000	
	Source water protection including well head protection and river water.	$0	Will share public education with Water Treatment in future	NOT CHARGING TO SW	$75,000	Public Services	Water Treatment Plant	$75,000	Watershed protection recommendation from Janice Skadsen
	Education coordinator (Nancy Stone) - developing outreach to schools (Dexter 5th grade)	$0	10% of Ecology Center $35k contract ($3500), plus 30 hrs of Nancy Stone ($900), plus 30 hrs of Mickey ($336), plus hand outs ($150)	NOT CHARGING TO SW	$5,000	Public Services	Administration	$30,000	Should budget for 30% of Nancy Stone's time in the future
	Dues - Huron River Watershed Council	$11,400		Administration		Public Services	Administration		
	Leslie Science Center - water resources education	$0		NOT CHARGING TO SW	$10,000	Community Services	Parks & Recreation Department	$15,000	
	Environmental programming	$0		NOT CHARGING TO SW	$10,000	Community Services	Parks & Recreation Department	$15,000	
	Subtotal for Public Engagement	**$135,400**			**$100,000**			**$162,000**	
Regulation and Enforcement	Site plan reviews for SESC and post-construction SW controls	$30,000	Regulation of Natural Features/Wetlands/Floodplains/Steep Slopes/Trees, SESC with WCDC (Ch. 63 -- Jerry Hancock)	Administration		Public Services	Systems Planning		
	Floodplain management	$10,000	Jerry Hancock, 4-6 hrs/wk	Administration		Public Services	Systems Planning	$15,000	Double Jerry Hancock's time when implementation of Flood Mitigation Plan begins
	Miss Dig - locating utilities	$0	20% of the Miss Dig services budget of $120,000	NOT CHARGING TO SW	$24,000	Public Services	Field Operations	$24,000	20% of total Miss Dig budget ($120,000 in FY 05/06)
	Plan review for private projects. Examples include: subdivisions via Ch. 33 (not Ch. 63); projects to become donated to the public system (typically underground pipes and ponds in ROW, or extension of mains)	$35,000	Jerry Hancock 16 - 20 hrs/wk; Brad Ruppel 4 hrs/wk	????????		Public Services	Project Management		Future: Add long range natural resource planning/implementation
	Site plan coordination with WCDC; SESC - 2 positions; compliance inspections - related to private property (Ch. 63) and floodplain mgmt (enforce bldg code Ch. 98)	$142,800	Roland and Brad	??????		Community Services	Planning & Development Services		
	Illicit Discharge Detection and Elimination	$109,000	Historically done under contract using grant funds.	Field Storm Sewer Operation		Public Services	Field Operations	$30,000	Future grants can not be assured -- City may need to allocate staff to conduct this work
	Spill response with WCDC and Field Operations	$0	4 incidents over the past 2 years, average of 6 hrs/incident. Average hourly rate of personnel involved = $45 per hour	NOT CHARGING TO SW	$1,000	Safety Services	Emergency Management	$1,000	
	Natural Area Preservation (has a SW impact)	$0	Call Dave Borneman	NOT CHARGING TO SW	$5,000	Public Services	Field Operations	$5,000	CDM to call Dave Borneman (994-4834)
	Subtotal for Regulation and Enforcement	**$326,800**			**$30,000**			**$75,000**	
Operations and Maintenance	Storm sewer inspection and cleaning	$346,000	$15K for merchandising & jobbing, $5K for rodding, $57k for CCTV, $53k for ditches, and $216 for jetting.	Field Storm Sewer Operation		Public Services	Field Operations	$119,000	
	Curb inlet and catch basin cleaning	$165,000		Field Storm Sewer Operation		Public Services	Field Operations		
	SW treatment devices, swirl type, maintenance/repairs	$5,000	Cleaning to remove accumulated material every 5 years	Field Stormwater Capital		Public Services	Field Operations		
	Issue and track work orders based on customer calls	$248,000		Field Storm Sewer Operation		Public Services	Field Operations		
	Equipment Costs	$27,000		Field Storm Sewer Operation		Public Services	Field Operations		
	Street sweeping	$0	Starting in 2006/07, SW fund pays for only one of two Fall sweeping per year - right after leaves are down.	Administration		Public Services	Field Operations	$125,000	
	General housekeeping at maintenance yards,	$21,000	Sump cleaning, SESC compliance for stockpiled materials	Field Storm Sewer Operation		Public Services	Field Operations		
	Leaf removal	$0	$90k/yr for Mallet only, for lease of high efficiency sweepers	NOT CHARGING TO SW	$90,000	Public Services	Field Operations	$90,000	Mallets Creek Restoration plan recommends use of high efficiency sweepers
	Open channel maintenance	$20,000	Estimated annual effort: 50 staff/days (2 staff, 25 days each). For roadside ditches & county drains - not for private property or where benefit is to single property owner	Field Storm Sewer Operation		Public Services	Field Operations	$505,000	Suggest increasing budget to $60k
	Mosquito control	$100,000	$40k for materials, $40k for temporary staff, and $20k for equipment	Field Storm Sewer Operation		Public Services	Field Operations	$68,000	Additional mosquito control may be needed in the future
	Capital Outlays	$789,000	Budgeted under Field Operations, with administration of some projects by Project Management	Field Storm Sewer Operation		Public Services	Field Operations		
	Capital Outlays -- Manholes	$254,000	Budgeted under Field Operations, with administration of some projects by Project Management	Field Storm Sewer Operation		Public Services	Field Operations		
	Forestry (has a SW impact)	$0		NOT CHARGING TO SW		Public Services	Field Operations		
	Subtotal for Operations and Maintenance	**$1,975,000**			**$90,000**			**$907,000**	

Attachment 1
Current Roles/Funding of City Departments in Stormwater Management

Functional Stormwater Service Area	Current Stormwater Management Role	FY 2005/06 Expenditures from SW Fund		Expenditure Category in Current SW Budget	Current Expenditures, Other Departments	Work Currently Performed By:		Potential Future Funding from SW Fund	
		Annual Amount	Notes			Department	Division	Annual Amount	Notes
System Planning	Stormwater GIS and Drainage System Data		$1 M budgeted to establish GIS under capital improvement funding, $40K annual maintenance and software	Systems Planning		Public Services	Systems Planning	$290,000	Assumes 4 year implementation plus annual maintenance
	Stormwater Model and System Evaluation		$1.2 M budgeted to establish model and evaluation system under capital improvement funding, $35K annual maintenance and software, $600K for system re-evaluation study in 2013/14	Systems Planning		Public Services	Systems Planning	$335,000	Assumes 4 year implementation plus annual maintenance
	Flood mitigation planning via state grant		Jerry Hancock	Administration		Public Services	Systems Planning		
	Capital planning and Asset management (future) - plans for infrastructure replacement	$55,000	Planning estimated at 3% of CIP budget ($1.4 million replacement; $200,000 expansion; $200,000 ditch maintenance)	Systems Planning		Public Services	Systems Planning	$150,000	5% of estimated future CIP budget of $2 to $3 million
	Fund/maintain stream gages	$11,900	stream gage on Malletts Creek	Administration		Public Services	Systems Planning	$25,000	Add 20% of Wall St gage + add $12K for another gage in 2-3 years
	Fund/maintain rain gages	$2,000	50% of $4,000 for operation of 3 rain gages	Systems Planning		Public Services	Systems Planning	$10,000	Incr. funding to upgrade/maintain exist gages + add 1 at City Hall
	Subtotal for System Planning	**$68,900**						**$810,000**	
Capital Improvements	Incorporate SW controls into public roads projects whenever possible			Field Stormwater Capital		Public Services	Systems Planning		
	Design, contract administration, and construction management for SW capital projects		Stormwater CIP needs estimated at $1.4 million replacement; $200,000 expansion; $200,000 ditch maintenanceand studies	Capital Expenditures		Public Services	Project Management		Per input from Pete Perala, will be bond funded
	o Easy St. Design			Capital Expenditures		Public Services	Project Management	$454,000	
	o Bond Revenue for Capital Improvements			Capital Expenditures		Public Services	Project Management	$2,227,000	
	Develop capital projects to address miscellaneous drainage issues in response to customer complaints (in addition to CIP projects).			Not sure if currently charging to SW		Public Services	Project Management	$100,000	equivalent to $50,000 in 1988 budget
	Principal and interest for County Drain Project	$211,000							
	Principal and Interest for the Depot Street outlet project	$155,000							
	Depreciation of assets	$52,000	2003 Asset Listing Provided	Fund Depreciation		Public Services	Administration		
	Parks planning including SW improvements on public land	$0		NOT CHARGING TO SW		Community Services	Parks & Recreation Department		
	Subtotal for Capital Improvements	**$418,000**						**$2,781,000**	
Organization and Finance	Rate structures	$8,700	10% of Karen Fletcher's time (Tom's time for this project not included)	Administration		Public Services	Systems Planning		
	Calculations for SW utility billings for non-residential sites	$36,900	0.5 FTEs are dedicated to this activity, at an estimated cost of approximately $37,000	Systems Planning		Public Services	Project Management		Budget needs will change in future through acquisition, use of IR Imagery
	Financial planning including rate projections	$25,000	0.3 FTEs are dedicated to this activity, at an estimated cost of approximately $25,000	Administration		Public Services	Administration		
	Subtotal for Organization and Finance	**$70,600**							
		$3,501,700							

Total Annual Existing Stormwater Management Program Costs

Abbreviations
SESC = Soil Erosion and Sedimentation Control
WCDC = Washtenaw County Drain Commissioner
HRWC = Huron River Watershed Council

Appendix D
SCATF Level of Service Objectives Questionnaire

City of Ann Arbor
Residential and Commercial Stormwater Rate Structure Project
Level of Service Principles
10/31/06

Introduction

The Rate Structure approach to defining the stormwater revenue requirements involves defining and analyzing various Level of Service (LOS) options based on several factors:

- Technical feasibility and reliability based on current technology.
- Acceptability to the public and compliance with regulatory agency guidelines.
- A reasonable degree of public protection for the public funds expended.
- Consistency with known environmental goals.
- Financial feasibility.

The Stormwater Citizens Advisory Task Force (SCATF) is tasked with recommending the Level of Service objectives for City stormwater management programs. A questionnaire was used to assist with establishing consensus around preferred objectives. Level of service objectives were established for the following nine types of issues:

- Flooding of dwelling, business, industrial, and institutional structures
- Flooding of private property
- Flooding of roadways
- Preservation of floodplains, stream buffer, and wetland areas
- Stream bank erosion control and stream restoration
- Repair / renewal of deteriorated infrastructure (maintenance)
- Removal of sediment, debris and excessive vegetation
- Mosquito control
- Control of pollution in stormwater discharges

Recommended Principles

Addressing flooding of structures, repair of deteriorated infrastructure, and control of pollution in stormwater discharges were considered to be the most important issues for the SCATF members. In developing level of service objectives related to these issues, SCATF members suggested applying the following guiding principles to the City's stormwater management program:

- ***Protect public health, safety, and welfare.*** Extensive, frequent flooding should be addressed when it prevents long term access or causes property damage. Structures should also be protected from erosion based on priorities established through comprehensive planning. Control of vectors (such as mosquitoes) must be provided in a way that does not have significant side effects.

- ***Protect ecological health.*** The quality of the streams and water bodies in and downstream of Ann Arbor, including the Huron River, should meet regulatory and community goals. These goals should be achieved by controlling runoff and providing a healthy and diverse aquatic and riparian habitat. Maintenance of streams and open channels must provide both effective drainage and habitat enhancement in the methods that are employed.

- ***Conduct comprehensive planning to determine priorities.*** Comprehensive planning, supported by new planning tools developed by the City, is needed to understand impacts, set priorities, develop corrective options, define City responsibilities, assign resources, and recognize impacts of upstream new development. Opportunities to resolve priority stormwater problems should be incorporated into development and public improvement projects where possible. In addition, floodplain regulations should incorporate requirements to "recover" from past unregulated encroachments into the floodplain.

- ***Offer incentives to guide desired behaviors.*** Credits and incentives should be used to guide and reward behaviors that minimize negative effects on the stormwater system and water quality (e.g., encourage storage on private property). These incentives must be self enforcing and must account for changes in property ownership.

- ***Encourage shared responsibility.*** Every class of stormwater user should be treated equitably in terms of the protection and services that are provided, and the required property owner responsibilities for stormwater management. Owners in the floodplain share in the responsibility to prevent flooding issues. Property owners must also have responsibility for identifying (and possibly correcting) localized flooding issues.

- ***Educate stormwater system users.*** There needs to be broad education on how stormwater control is performed, and how management and pollution control is accomplished. Diverse methods and media must be used in order to engage and educate the varied property owners in the community.

- ***Provide an understandable, equitable rate structure***. The rate structure must be equitable and include credits for "green" behaviors. The intent is to create an equitable structure that is understandable to the users of the system. All rate classes should be clearly tied to the use of the stormwater system, and the structure should reward positive behaviors that reduce use of the stormwater system.

City of Ann Arbor
Stormwater Citizens Advisory Task Force

Meeting 2
Level of Service Questionnaire

The desired level of service for stormwater services provided by the City of Ann Arbor will be determined based on a consensus of the committee about the following issues:

Note: The City's primary drainage system drains areas of 1 square mile or more. Channels, roadside ditches and storm sewer pipes not included in the primary system are considered to be part of the secondary drainage system.

1. Rank the following stormwater issues from 1 (most important) to 8 (least important):

Issue	Rank within Primary System	Rank within Secondary System
A. Flooding of dwelling, business, industrial, and institutional structures		
B. Flooding of private property		
C. Flooding of roadways		
D. Preservation of floodplains and stream buffer areas		
E. Streambank erosion control		
F. Repair of deteriorated infrastructure		
G. Removal of sediment, debris and excessive vegetation		
H. Mosquito control		
I. Water quality impairment		

2. For each stormwater issue (A through I) listed in item 1, select the level of service option that best matches your expectations:

A. How should the City address flooding of dwelling, business, industrial, and institutional structures?	**Rank within Primary System**	**Rank within Secondary System**
Prevent flooding through capital projects and system maintenance		
Purchase flood prone property		
Require owners to floodproof structures		
Require owners to purchase flood insurance		
Other:		
B. How should the City address property flooding?	**Rank within Primary System**	**Rank within Secondary System**
Prevent all flooding of private property		
Prevent all flooding outside of public right of way and drainage easements		
Prevent all flooding within __ feet of occupied structures.		
Other:		
C. How should the City address roadway flooding?	**Rank within Primary System**	**Rank within Secondary System**
Prevent all roadway flooding		
Keep all streets passable (flood depths no more than 8 inches)		
Keep primary roads passable (flood depths no more than 8 inches), allow additional flooding on secondary roads.		
Other:		
D. Should the City allow fill/clearing within floodplains and stream buffer areas?	**Rank within Primary System**	**Rank within Secondary System**
Never		
Only if compensated by an equal amount adjacent to floodplain		
Only if the fill will not impact flooding or erosion		
Other:		

E. How should the City address streambank erosion?	**Rank within Primary System**	**Rank within Secondary System**
Repair/prevent all erosion along stream		
Repair/prevent all erosion of private property, allow erosion within public right-of-ways and easements		
Repair/prevent erosion near structures/roadways, allow other erosion		
Other:		
F. How should the City repair deteriorated infrastructure?	**Rank within Primary System**	**Rank within Secondary System**
Conduct preventive maintenance to extend life of infrastructure		
Only repair/replace inoperative infrastructure		
Other:		
G. How should the City address removal of vegetation, sediment and debris?	**Rank within Primary System**	**Rank within Secondary System**
Conduct preventive maintenance to prevent drainage problems		
Remove only if material causes flooding/erosion		
Require property owner to remove if material causes flooding/erosion on adjacent properties		
Do not remove any vegetation, sediment, or debris		
Other:		
H. What methods of mosquito control should the City utilize?	**Rank within Primary System**	**Rank within Secondary System**
Prohibit sources of standing water where mosquitos may breed.		
Utilize natural mosquito control methods		
Apply EPA-approved pesticides at known mosquito-breeding sites		
Aerial spray entire City		
Other:		

I. How should the City address stormwater pollution causing water quality degradation?	Rank within Primary System	Rank within Secondary System
City retrofits entire drainage system		
Require all property owners to install quality controls		
City requires developers and drainage improvement projects to incorporate stormwater quality controls, establishes incentives for existing properties		
Implement stormwater controls at minimum Phase II levels (i.e., through education, regulation, and maintenance)		
Other:		

3. What other uses of the drainage system and floodplain should the City allow?

Primary System	Secondary System	
		None: fence off system
		None: discourage entry to system
		Wildlife habitat
		Passive Recreation
		Any use that does not flood other properties
		Any use the property owner desires
		Other

4. When should the City obtain drainage easements or public right-of-ways along the drainage system (pick one or more)?

Primary System	Secondary System	
		Along public roads and streets
		Along stormwater infrastructure installed during land development
		Prior to conducting a capital improvement project for the drainage system
		Prior to conducting maintenance activities along the drainage system
		Along the entire primary drainage system
		Other

5. Should the City take actions outside of a drainage easement or public right-of-way along the drainage system:

Primary System	Secondary System	
		Never
		Yes, City requires property owners to take necessary actions to remediate problems
		Yes, City conducts necessary actions to remediate problems and bill the property owner
		Yes, City shares the cost of necessary actions with the property owner
		Yes, City remediates all problems affecting adjacent property owners
		Other:

Draft

City of Ann Arbor

Water Distribution Level of Service & Reinvestment

Prepared by:

AECOM
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Grand Rapids, Michigan 49512 616 940 4396 fax
www.aecom.com

Project Number:

60226187

Date:

August 2014

Technical Memorandum No. 3

Water Main Rehabilitation/Replacement

Prepared by:

AECOM
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Grand Rapids, Michigan 49512 616 940 4396 fax
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Project Number:

60226187

Date:

August 2014

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August 6, 2014

Ms. Jennifer Lawson
Water Quality Manager
Systems Planning Unit
Public Services Area
City of Ann Arbor
301 E. Huron Street
Ann Arbor, MI 48107

Dear Ms. Lawson:

Project No: 60226187

Regarding: TM 3 – Water Main Rehabilitation/Replacement (Final Draft Version 1.0)

Please find included herewith the final draft of TM 3 – Water Main Rehabilitation/Replacement.

Sincerely,

AECOM

Ryan Edison, PE

Project Manager

ryan.edison@aecom.com

Encl.
cc:

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
0	1	Jennifer Lawson / City of Ann Arbor

Version Log

Version #	Provided By	Date	Version Description
1.0	R. Edison	Aug 6, 2014	Final Draft

AECOM Signatures

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Richard Hope

Vice President

Project Summary

In September 2011, the City of Ann Arbor undertook the Water Distribution Level of Service (LOS) and Reinvestment project. The purpose of this project is to establish a sustainable LOS for the City's water distribution system in consideration of an associated level of reinvestment of the water mains. This will help the City with its capital planning by providing the amount of yearly, capital investment in the replacement/rehabilitation of its water mains required to maintain a selected LOS.

This type of LOS based capital planning helps the City identify critical water distribution system infrastructure (i.e., water mains) and establish priority/timing for their replacement/rehabilitation. As **Figure ES-1** below indicates, through LOS planning limited funds are spent on the assets with the greatest need. This in turn controls the risk of unexpected costs by reducing the probability of sudden and potentially costly water main failure. In the end, the public benefits because limited funds are efficiently used while the established LOS is maintained.

Figure ES-1 – Project Benefit Flow Chart

It is important to note that the LOS does not stand alone. The LOS summarizes the operational results that the City is attempting to achieve on its customer's behalf. As shown in **Figure ES-2**, the LOS forms the top level of a well organized program of infrastructure management for a specific asset – in this case the City's water distribution system. The LOS must be supported first by an understanding of the City's operational & management strategies. Next, building on top of this, there is a comprehensive set of asset, specific LOS Key Performance Indicators (KPI) & data, which will include additional, underlying performance indicators. A thoughtfully selected set of LOS KPI enables the City to conduct analysis and investigation regarding the optimal level of reinvestment that provides the required customer-based LOS that is economically sustainable.

At its core, the water distribution system LOS is a management framework that helps the City of Ann Arbor guide customer expectations about service and cost, while at the same time providing the City with facts and numbers to help guide operational and management strategies internally.

Through a process that included workshops and meetings, AECOM and City of Ann Arbor managers/staff

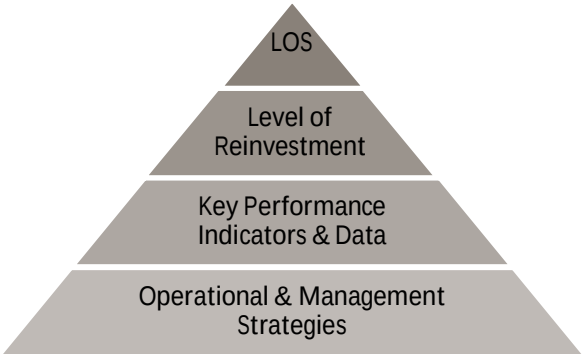

Figure ES-2 – Infrastructure Management Pyramid

begun this project by first identifying performance indicators that represent the City's operational and management strategies. Some of these performance indicators are recommended to be used in describing the tangible outcomes of the City of Ann Arbor's water distribution LOS to its customers including residents, businesses, and visitors to the City of Ann Arbor. These are referred to as KPI. Other performance indicators will be used internally by City staff to provide operational and maintenance metrics in maintaining the LOS.

An important aspect of developing the City's selected LOS was the engagement with the public through the formation of a Citizens Advisory Group (CAG). The CAG meet with City staff and AECOM in workshops aimed at receiving input on what is important to the public with respects to the City's water distribution system LOS and receiving comments on the results and technical memorandums throughout the progression of the project.

With the KPI serving as metrics for the LOS, the level of reinvestment analysis performed represents the other side of developing a sustainable LOS. While it is perhaps easy to set a high LOS, this will come at an obvious cost to the public. Therefore, it is essential to perform a level of reinvestment analysis. A finalized and agreed upon adopted LOS forms the "goal posts" for documenting the tangible quantification of benefits that customers are entitled to, and the specific responsibilities required by both customers and the City in exchange for fees, rates and charges.

While a level of reinvestment analysis can focus on all aspects of the water distribution system, this project focuses on the water mains, which represents the most significant asset within the water distribution system infrastructure. Specifically, the level of reinvestment analysis answers the following two specific questions for the City:

1. What level of investment should the City be making in the replacement/rehabilitation of the water distribution system's water mains to achieve/maintain the desired LOS, and
2. What water mains should be replaced first?

In order to perform the level of reinvestment analysis for the City as part of the LOS development, AECOM set-up a Capital Planning Tool tailored to the City's database structure and needs. This tool is developed in a manner to facilitate future adjustments to the LOS because LOS based capital planning is not meant to be a single snap-shot for the City, but rather an ongoing planning approach used by the Systems Planning Unit within the City of Ann Arbor. The LOS KPI should be updated annually and be presented in dashboard manner to help the City assess performance in maintaining the LOS.

This LOS based capital planning project for the City's water distribution system resulted in the compilation of five documents as follows. These documents should be viewed collectively.

- Technical Memorandum No. 1 (TM1) – Performance Indicators and Benchmarking
- Technical Memorandum No. 2 (TM2) – Level of Service
- Technical Memorandum No. 3 (TM3) – Water Main Rehabilitation/Replacement
- Technical Memorandum No. 4 (TM4) – Risk Analysis of Major Concrete Pipe Failure
- Capital Planning Tool User Manual

While TM 2 deals specifically with the LOS for the water distribution system, and is essentially the central TM of this project, it needs to be viewed in context with the underlying and supporting TMs also developed as part of this project listed above and shown organizationally below in **Figure ES-3**. In fact, the first three TMs developed as part of this project were written in an iterative process with findings and conclusions from each feeding and contributing to the final version of each TM.

Once the top three levels of the pyramid in **Figure ES-3** are established, a cascading suite of supporting performance indicators & data and the refinement of existing operational & management strategies can be developed over time to ensure that the LOS is maintained.

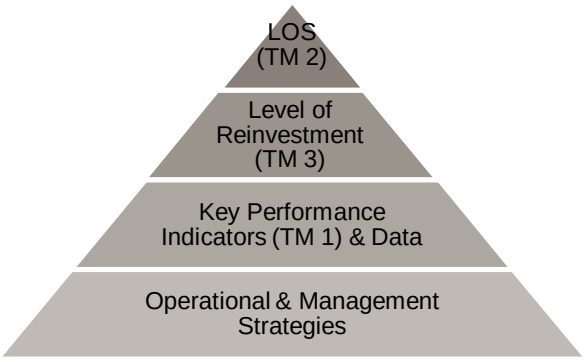

Figure ES-3 – Project Technical Memorandum Relational Pyramid

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1. Introduction

1.1 Background

Historically, buried assets have been under-invested in by utilities across the nation (*Dawn of the Replacement Era – Reinvesting in the Drinking Water Industry* and *Buried No Longer – Confronting America's Water Infrastructure Challenge*, published by American Water Works Association (AWWA)). Therefore, significant investment in buried assets is required to continue to maintain service. Acknowledging this challenge, the City developed a proactive water main replacement program aimed at minimizing water main.

1.2 Purpose

The purpose of this project is to establish an approach for the prioritization for the reinvestment in the water distribution system that will help the City with capital planning.

TM 3 (Water Main Rehabilitation/Replacement) includes the methodology and results of the following:

- Development of annual water main replacement rates
- Development of an approach to the prioritization of water main replacement, performance of prioritization analysis, and development of a prioritization model for future use
- Development a water main reinvestment strategy based on estimated annual water main replacement rates and prioritization analysis

.

2. Water Distribution System

This section provides a summary of the City's water main distribution system. A schematic of the City's water distribution system is illustrated in **Figure 2-1** and provides an overview of the main components of the City's water distribution system.

2.1 Existing Distribution System

The City's GIS includes approximately 533 miles of water main.

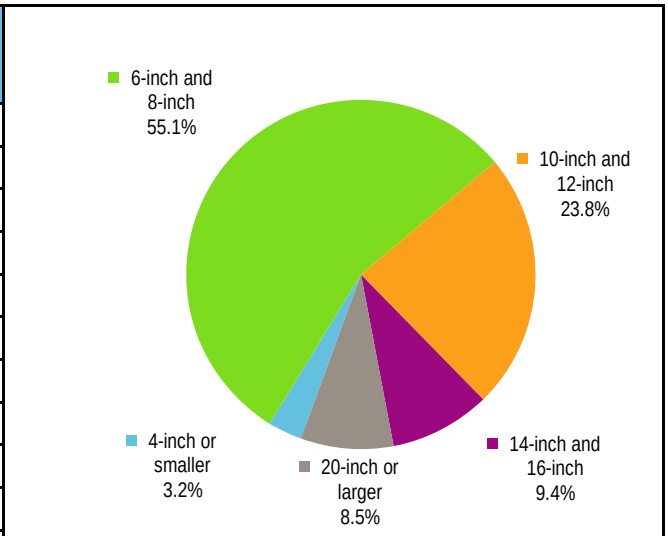
After discussions with City staff the following water mains were not included in the analysis included abandoned in place, water mains at facilities (Glen Fuller Pump Station, Huron River Pump Station and the water treatment plant), hydrant leads, water mains with a GIS segment length of less than 40 feet, duplicate GIS segments, service laterals, stubs, and other owners (AAT, PB, PNP, Private, PT, ST, and VA Hospital).

After removal of the water mains, approximately 424 miles of water mains were included in this analysis, as illustrated in **Figure 2-2**.

The City's water main inventory by diameter is summarized in **Table 2-1** and illustrated in **Figure 2-3.** Of the 424 miles of water main approximately 18 percent are 14-inches in diameter and larger and represent the transmission system while approximately 36 percent of the City's water distribution system is comprised of small diameter water main (6-inches and smaller).

Table 2-1: Water Main Size Inventory

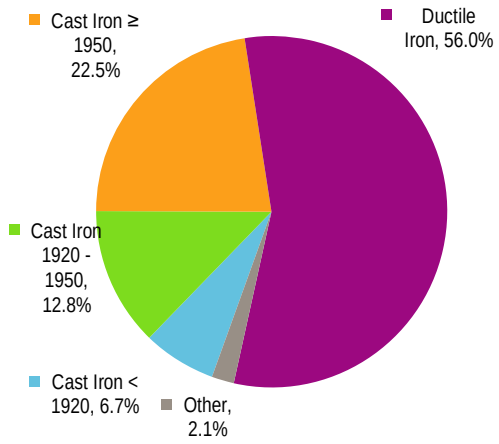
Diameter	Approximate Total Length	Percentage of Total
4-inch or smaller	12,950 feet	0.6%
4-inch	58,740 feet	2.6%
6-inch	726,110 feet	32.4%
8-inch	508,910 feet	22.7%
10-inch	56,270 feet	2.5%
12-inch	476,310 feet	21.3%
14-inch & 16-inch	209,560 feet	9.3%
20-inch & 24-inch	170,880 feet	7.6%
30-inch & 36-inch	19,390 feet	0.9%
42-inch& larger	1,260 feet	0.1%
Total	2,240,380 feet	100%



The water main inventory by material is summarized in **Table 2-2** and illustrated in **Figure 2-4**. The majority of the system was constructed of ductile iron and cast (nearly 56 percent are ductile iron and approximately 42 percent are cast iron).

Table 2-2: Water Main Material Inventory

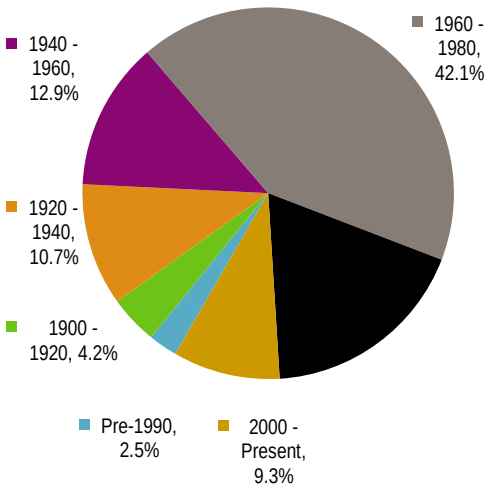
Material	Approximate Total Length	Percentage of Total
Asbestos Cement	23,510 feet	1.0%
Cast Iron < 1920	150,300 feet	6.7%
Cast Iron 1920 - 1950	285,790 feet	12.8%
Cast Iron ≥ 1950	504,050 feet	22.5%
Concrete	9,730 feet	0.4%
Copper	370 feet	<0.01%
Ductile Iron	1,253,760 feet	56.0%
Plastic	9,470 feet	0.4%
Steel	3,400 feet	0.2%
Total	2,240,380 feet	100%



The water main inventory by installation decade is summarized in **Table 2-3** and illustrated in **Figure 2-5.** Of the 424 miles of water main approximately 7 percent were installed over 100 years ago. Of the 424 miles of water main approximately 29 percent were installed in the 1960s and nearly 41 percent were installed between 1970 and the present.

Table 2-3: Water Main Installation Date Inventory

Installation Decade	Approximate Total Length	Percentage of Total
Pre-1900	57,110 feet	2.6%
1900	23,450 feet	1.1%
1910	70,650 feet	3.2%
1920	189,330 feet	8.5%
1930	50,460 feet	2.3%
1940	56,360 feet	2.5%
1950	233,530 feet	10.4%
1960	644,430 feet	28.8%
1970	299,350 feet	13.4%
1980	168,490 feet	7.5%
1990	238,220 feet	10.6%
2000	151,200 feet	6.8%
2010	57,800 feet	2.6%
Total	2,240,380 feet	100%



3. Analysis of Leaks/Breaks

The following sections discuss the analysis of leaks and breaks that was completed as part of the water main evaluation.

3.1 Location and Frequency of Leaks/Breaks

The City provided historical leak/break data for this analysis as summarized in **Table 3-1** and illustrated in **Figure 3-1**.

Table 3-1: Summary of Leak/Breaks

Year	Number of Breaks	Number of Breaks per 100 Miles per Year
1960-1970	194	6.4
1970-1980	459	12.1
1980-1990	436	10.5
1990-2000	632	13.6
2000-2005	364	15.1
2005	81	16.7
2006	53	10.8
2007	125	25.4
2008	117	23.5
2009	89	17.8
2010	96	19.0
2011	85	16.7
2012	88	17.1
2013	47	18.1
Average (1960-2013)		12
Note: Leak data provided by City staff in July 2013.		

One performance indicator of water main condition, as discussed in TM 1 and TM 2, is the frequency of leaks/breaks per 100 miles of water main per year. As summarized in **Table 3-1** the average number of breaks per 100 miles per year from 1960 to 2013 is approximately 12 breaks per 100 miles per year.

Figure 3-2, below**,** has been reproduced from the American Water Works Association Research Foundation (AwwaRF) report, *Prioritizing Water Main Replacement and Rehabilitation*, and provides the frequency distribution of failure rates in typical North American water utilities. Based on the City's leak/break history, the City is generally on the lower end of the water main failure rates for North American utilities.

3.2 Evaluation of Leaks/Breaks

The following sections evaluate the water main leak/break history since 1980 to assist in determining water main failure trends and to assist in identifying an appropriate water main replacement strategy. The evaluations of leak/break trends that were performed include: correlation with year reported, correlation with diameter, correlation with material, and correlation with pressure.

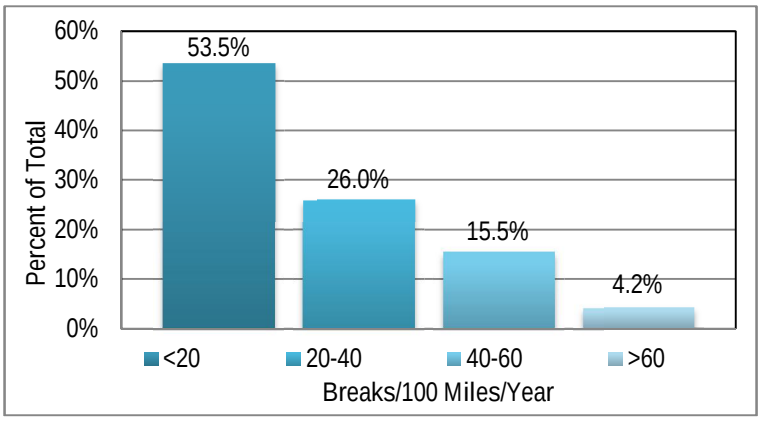


Figure 3-2: Frequency Distribution of North American Water Utility Failure Rates

3.2.1 Correlation of Leaks/Breaks with Year Reported

Figure 3-3 illustrates the trend in leaks/breaks over time.

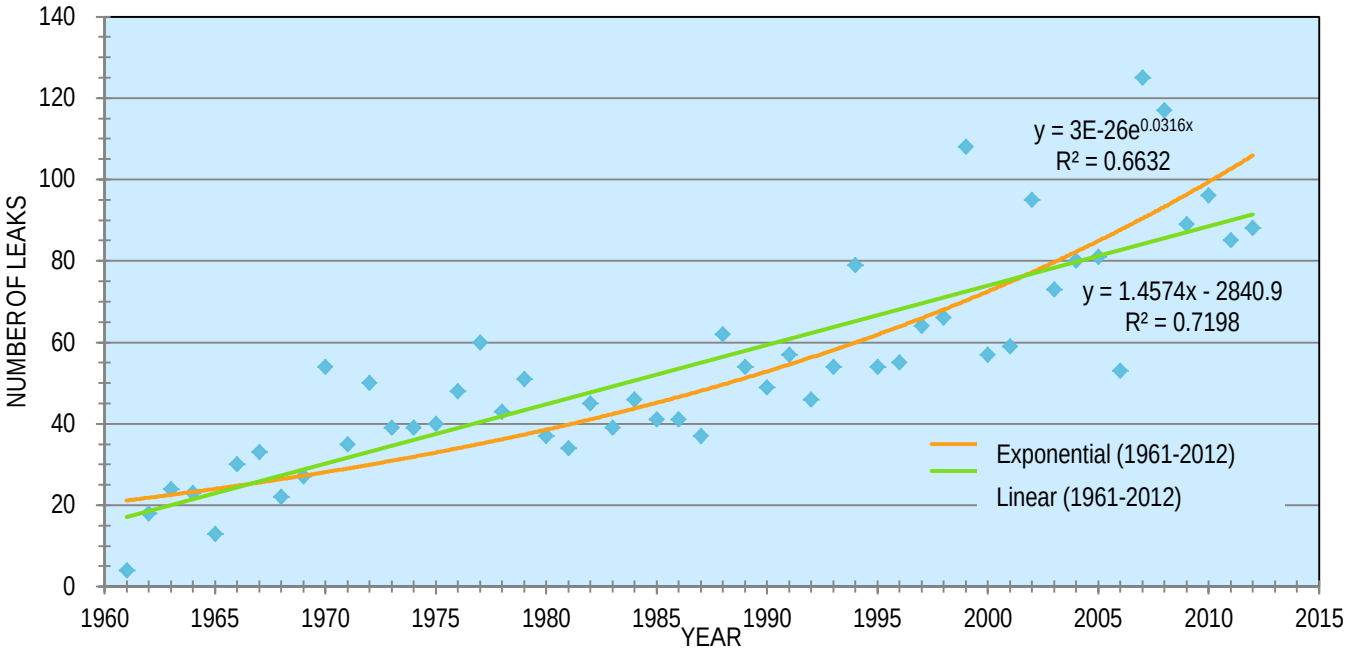


Figure 3-3: Correlation of Leaks with Year Reported

As illustrated, an upward trend in the number of leaks per year exists; however, it should be noted the length of water main increased over the time period.

3.2.2 Correlation of Leaks/Breaks with Diameter

The correlation of leaks with water main diameter was evaluated to identify potential trends between a specific pipe diameter and water main failure. The historical leak/break diameter analysis is summarized in **Table 3-2** and illustrated in **Figure 3-4**.

Figure 3-5 summarizes the number of leaks/breaks by pipe diameters and indicates the leaks/breaks per 100 miles per year for each pipe diameter category.

As illustrated, the highest frequency of leaks per 100 miles per year is on water main 6-inch and less.

Table 3-2: Summary of Leak/Breaks by Diameter

Water Main Diameter	Number of Breaks	Per 100 miles per year
3-inch or smaller	57	18.0
4-inch	180	20.9
6-inch	1,615	18.7
8-inch	503	8.2
10-inch	3	0.4
12-inch	296	5.2
14-inch	2	3.4
16-inch	117	5.1
20-inch	61	4.2
24-inch	24	4.3
30-inch	8	4.1
Total	2,866	

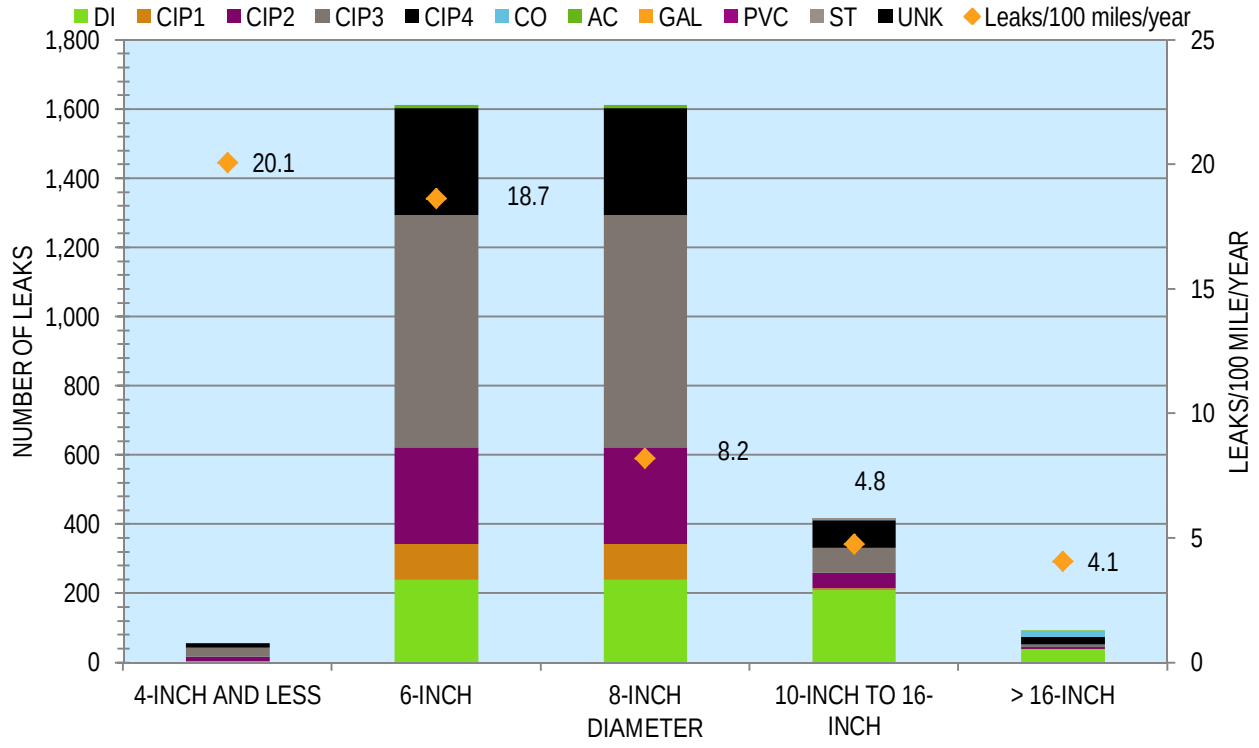


Figure 3-5: Correlation of Leaks with Diameter

3.2.3 Correlation of Leaks/Breaks with Material

The correlation of leaks/breaks with water main material was evaluated to identify potential trends between water main material and frequency of failure.

The historical leak/break data by material is summarized in **Table 3-3** and illustrated in **Figure 3-6.**

As illustrated in **Figure 3-7**, leaks per 100 miles of water main material per year ranges from a high of approximately 33 leaks per 100 miles per year for cast iron water mains installed between 1950 and 1960, to less than 2 leaks per 100 miles per year for PVC water mains.

Figure 3-8, is a further breakdown of water main breaks (since 1980) based on the installation date of cast iron water mains. As illustrated, the oldest cast iron mains (pre-1920) tend to have a relatively low number of leaks per 100 miles.

Table 3-3: Summary of Leak/Breaks by Material

Water Main Material	Number of Breaks	Per 100 miles per year
Asbestos Cement	14	8.9
Cast Iron < 1920	125	11.9
Cast Iron 1920 - 1949	387	9.2
Cast Iron 1950 - 1960	892	33.1
Cast Iron > 1960	625	17.9
Concrete	17	6.9
Ductile Iron	786	5.3
PVC	2	1.4
Steel	10	28.8
Unknown[1]	8	43.2
Total	2,866	

[1] One pipe, which is identified as AIP, has 8 leaks but does not have a material in the GIS.

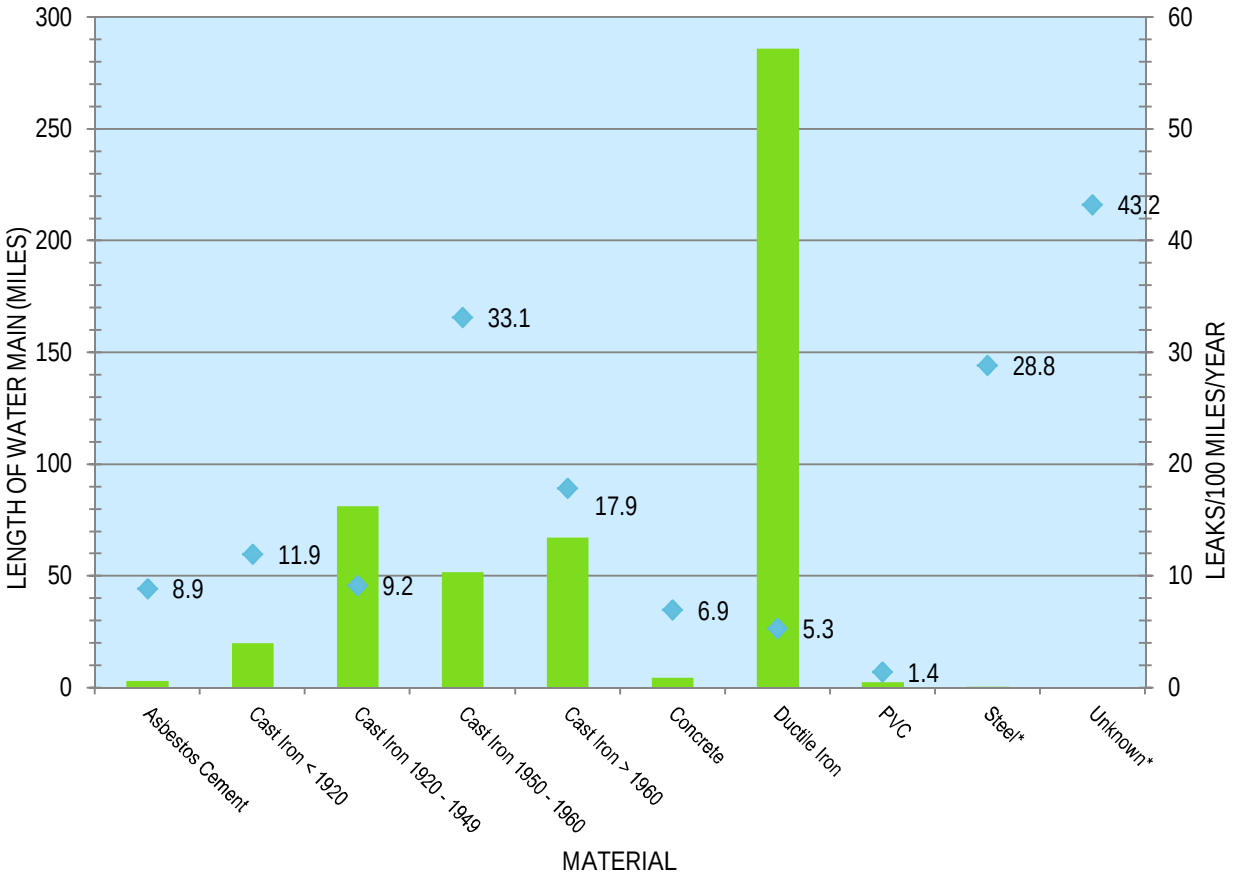


Figure 3-7: Correlation of Leaks with Material

Note: Less than one mile of steel and unknown material pipes

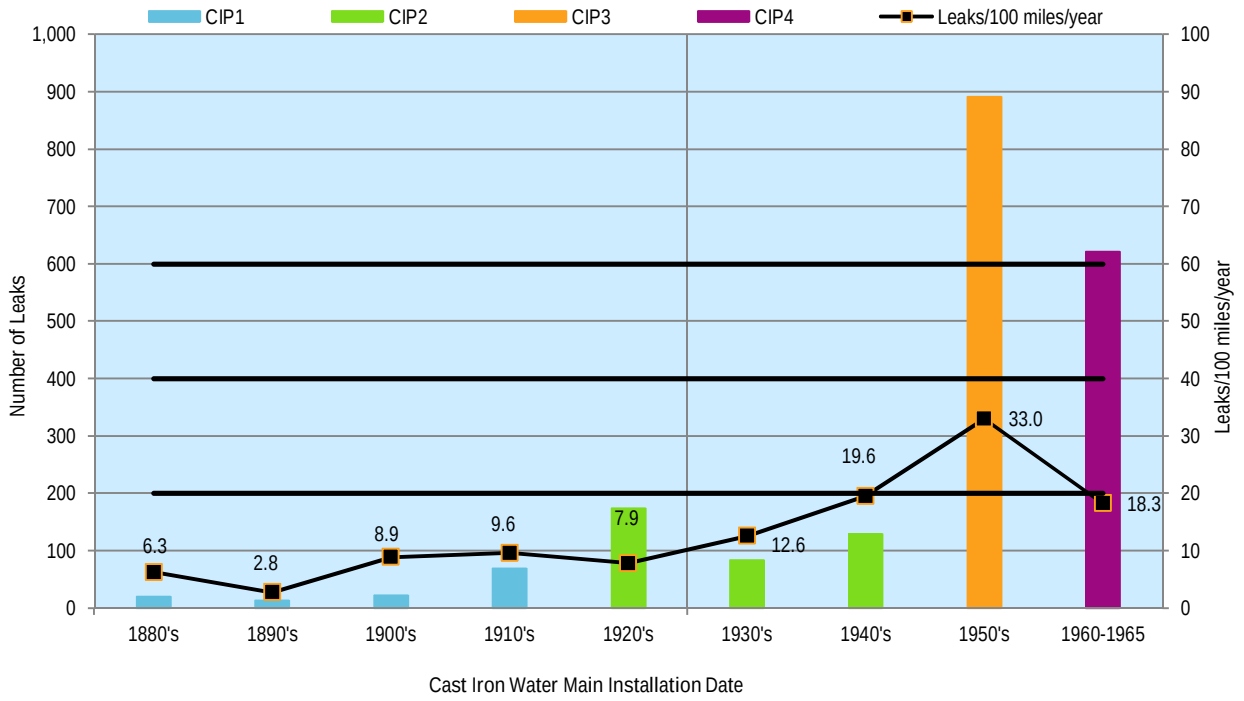


Figure 3-8: Correlation of Leaks on Cast Iron Pipes with Installation Date

3.2.4 Correlation of Leaks/Breaks with Pressure

The correlation of leaks/breaks with water distribution system pressure was evaluated to identify potential trends between water main pressure and the frequency of failure. The historical leak/break data by pressure is illustrated in **Figure 3-9.**

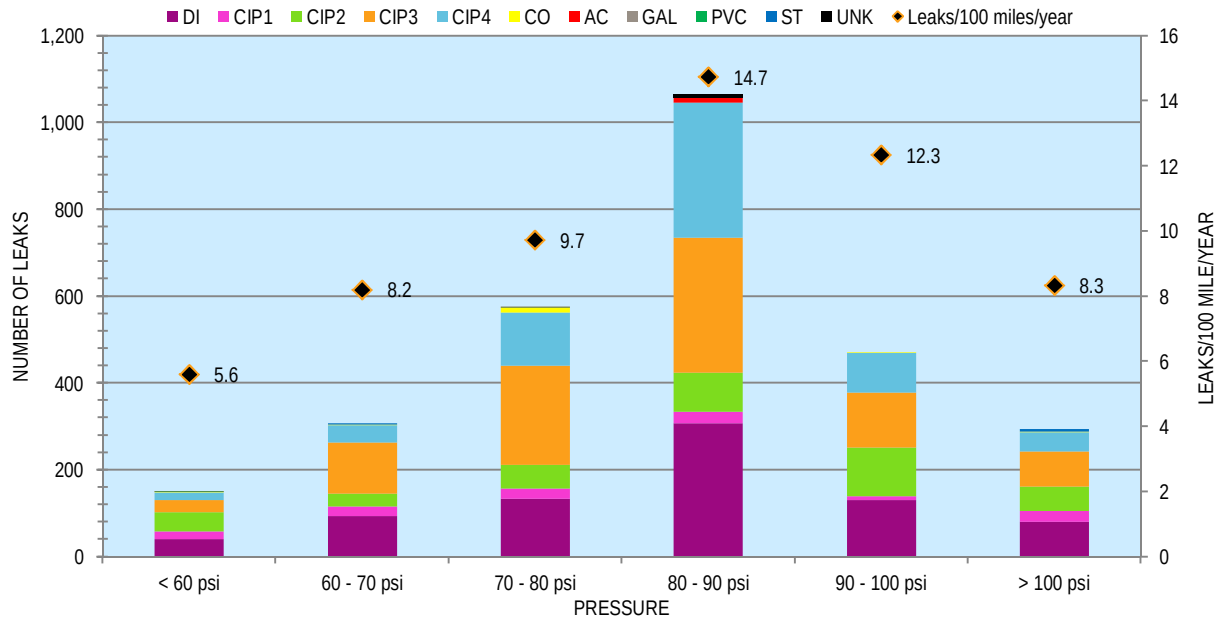


Figure 3-9: Correlation of Leaks on Cast Iron Pipes with Installation Date

As illustrated in **Figure 3-9**, leaks per 100 miles of water main per year ranges from a high of approximately 14 leaks per 100 miles per year for water mains with a pressure of 80 to 90 psi to approximately 6 leaks per 100 miles per year for water mains with a pressure of less than 60 psi

3.3 Summary

The following summarizes the break and leak analysis:

- Average breaks and leaks from 1960 to 2013 was 12 breaks per 100 miles per year which is in the lowest bracket in AwwaRF study
- Highest break/leak rates are on cast iron mains, specifically the cast iron mains constructed between 1950 and 1960.
- Highest frequency of breaks are in the smaller diameter pipes (6-inch and less)

4. Water Main Replacement Rate

Historically, guidelines for annual water main replacement of 1 percent of the total length of water main have been proposed. This correlates to replacement of water mains on average every 100 years. In many communities, replacement rates have been lower than 1 percent; therefore, the replacement rate may need to be higher than 1 percent. AwwaRF has developed an approach to estimate the annual water main replacement rate using the KANEW model.

This section summarizes a macro analysis of replacement requirements for the City's water mains using the AwwaRF software (KANEW). The KANEW software used to perform the replacement rate analysis was developed as part of the AwwaRF project: *Quantifying Future Rehabilitation and Replacement Needs of Water Mains* (1998). A copy of the executive summary of the AwwaRF project is included in Appendix B.

The objective of this analysis is to provide the City with guidelines for a long-range water main replacement strategy. The KANEW model predicts the length of water main that should be replaced on an annual basis based on the inventory of water mains (Section 2) and estimated lifespan. Because KANEW is a macro model, it does not provide location-specific replacement information, and it does not consider the physical condition of the pipe nor its historical performance (breaks / leaks). The AwwaRF project recommends that the KANEW analysis be expanded to establish the actual priority for water main replacement. The information required to perform the KANEW analysis is the age, diameter, material, and length of the water mains in the water distribution system.

Survival functions were established based on the life expectancy for each water main category. The survival function is a mathematical expression, which represents the aging process of the water main. The specific parameters of a survival function indicate the percentage of water mains that will survive beyond a given age. The survival functions are applied to the current inventory of water mains to estimate the length of water main that should be replaced.

4.1 Water Main Category Definitions

Based on a review of water mains within the City's water distribution system, the following water main categories were defined:

- Asbestos Cement (AC)
- Cast Iron Pipe prior to 1920 (CIP1)
- Cast Iron Pipe from 1920 to 1950 (CIP2)
- Cast Iron Pipe after 1950 (CIP3 (includes CIP3 and CIP4 from Chapter 3))
- Concrete (CO) pipe
- Copper (CU) pipe
- Ductile Iron (DI) Pipe
- Polyvinyl Chloride (PVC) Pipe
- Steel (ST) Pipe

4.2 Water Main Life Expectancies

The water main life expectancies are a key input in determining the survival function, which helps describe the nature of the lifespan for each water main category. The life expectancy range is the lifespan that 100 percent, 50 percent, and 10 percent of the pipes are expected to reach without failure. The lower and upper bounds of the life expectancy range are referred to as the "short (pessimistic)" and "long (optimistic)" estimates, respectively.

After discussions with City staff the , short (pessimistic) and long (optimistic) life expectancies for each water main category as provided in **Table 4-1** were established for the analysis.

Table 4-1: Water Main Category Life Expectancies

Water Main Category	Life Expectancy Range (years)		
	100% Survival	50% Survival	10% Survival
Asbestos Cement	40 – 60	60 – 80	80 – 100
Cast Iron <1920 (CIP1)	50 – 70	85 – 105	100 – 120
Cast Iron 1920 – 1950 (CIP2)	50 – 70	80 – 100	90 – 110
Cast Iron >1950 (CIP3 & CIP4)	40 – 60	60 – 75	80 – 100
Concrete (CO)	50 – 70	80 – 100	90 – 110
Copper (CU)	50 – 60	60 – 70	70 – 80
Ductile Iron (DI)	60 – 80	80 – 100	90 – 120
PVC	60 – 80	80 – 100	90 – 120
Steel (ST)	40 – 50	70 – 80	85 - 100

The survival curves developed for each water main category by the KANEW software for long and short life expectancies are presented in **Figures 4-1 and 4-2**, respectively.

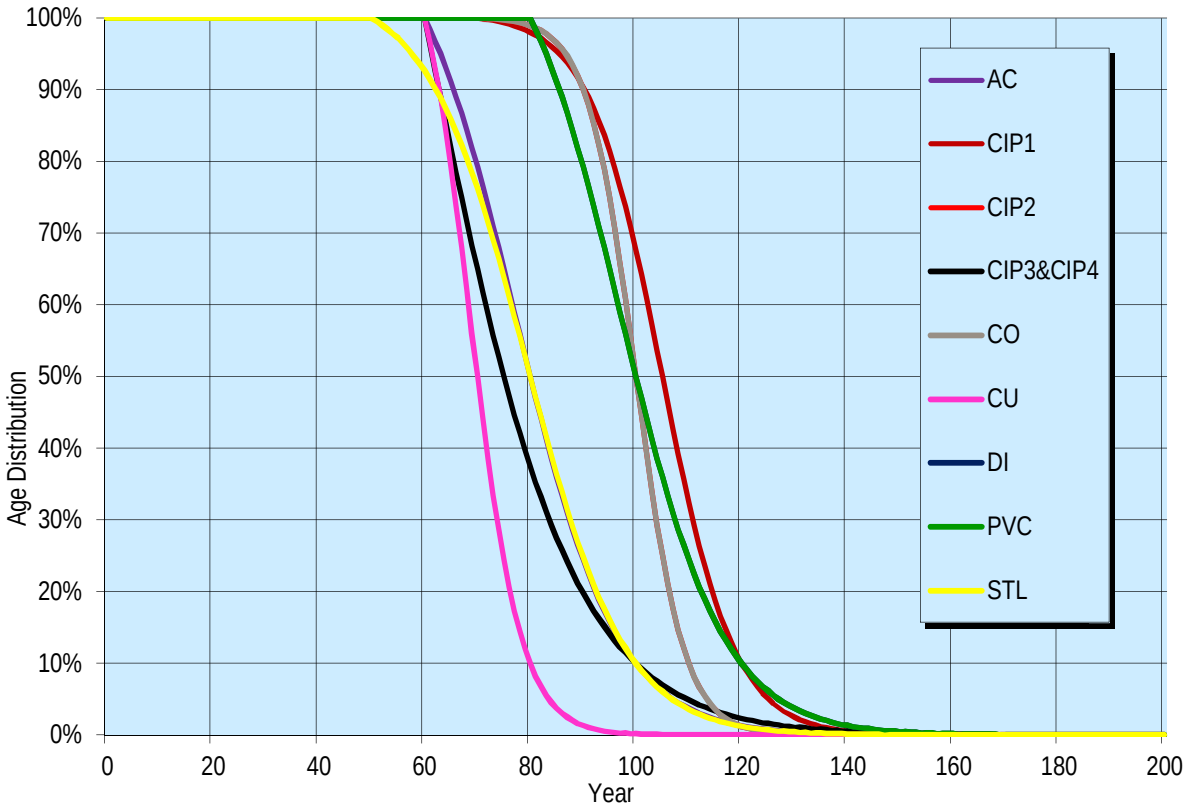


Figure 4-1- Water Main Survival Function - Long Life Expectancy

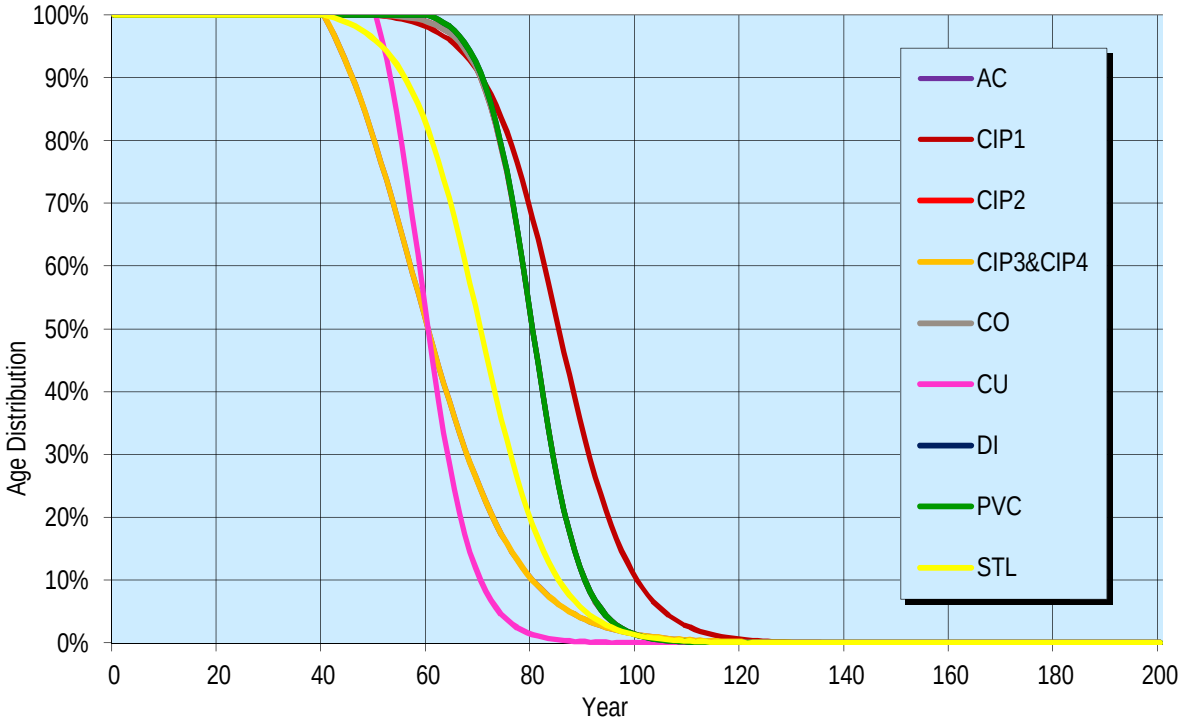


Figure 4-2- Water Main Survival Function - Short Life Expectancy

The following figures from KANEW have been included in this TM for documentation purposes.

Figure No.	Description
4-3	Distribution of water mains by installation year
4-4	Inventory of water mains by type and installation year
4-5	Age distribution of water mains in 2013
4-6	Cumulative age distribution of water mains in 2013
4-7	Average age and residual life expectancy for types of water mains

Figure 4-7 provides a useful illustration of the average age of water mains in the City's water distribution system and the average useful life based on long and short life expectancies. **Table 4-2** provides a summary of the information presented in t figure.

Table 4-2: Water Main Category Life Expectancies

Water Main Material	Average Age (years)	Average Residual Life[1] (years)	
		Pessimistic	Optimistic
Asbestos Cement	53	16	13
Cast Iron <1920 (CIP1)	114	7	1
Cast Iron 1920 – 1950 (CIP2)	88	6	8
Cast Iron >1950 (CIP3 & CIP4)	57	13	9
Concrete (CO)	62	20	17
Copper (CU)	85	8	1
Ductile Iron (DI)	33	46	22
PVC	8	71	22
Steel (ST)	82	10	5

Footnote:
[1] Average residual life is the remaining life expectancy of the pipe.

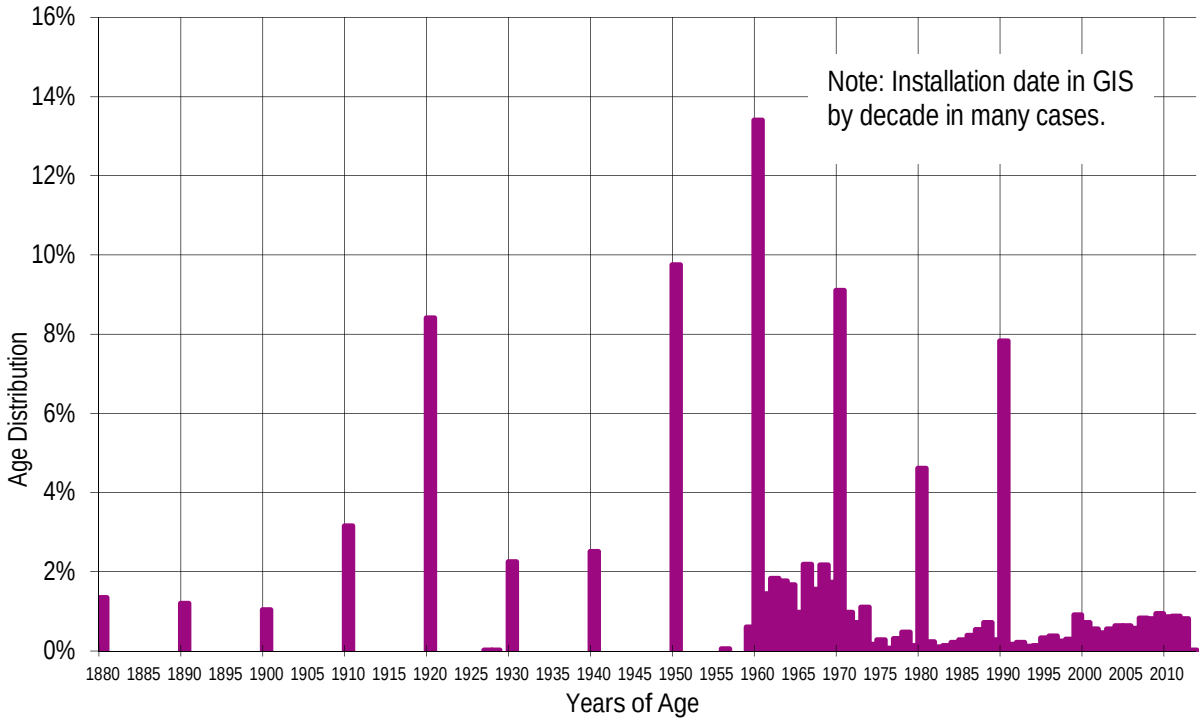


Figure 4-3- Distribution of Water Mains by Installation Year

Note: Installation date in GIS by decade in many cases.

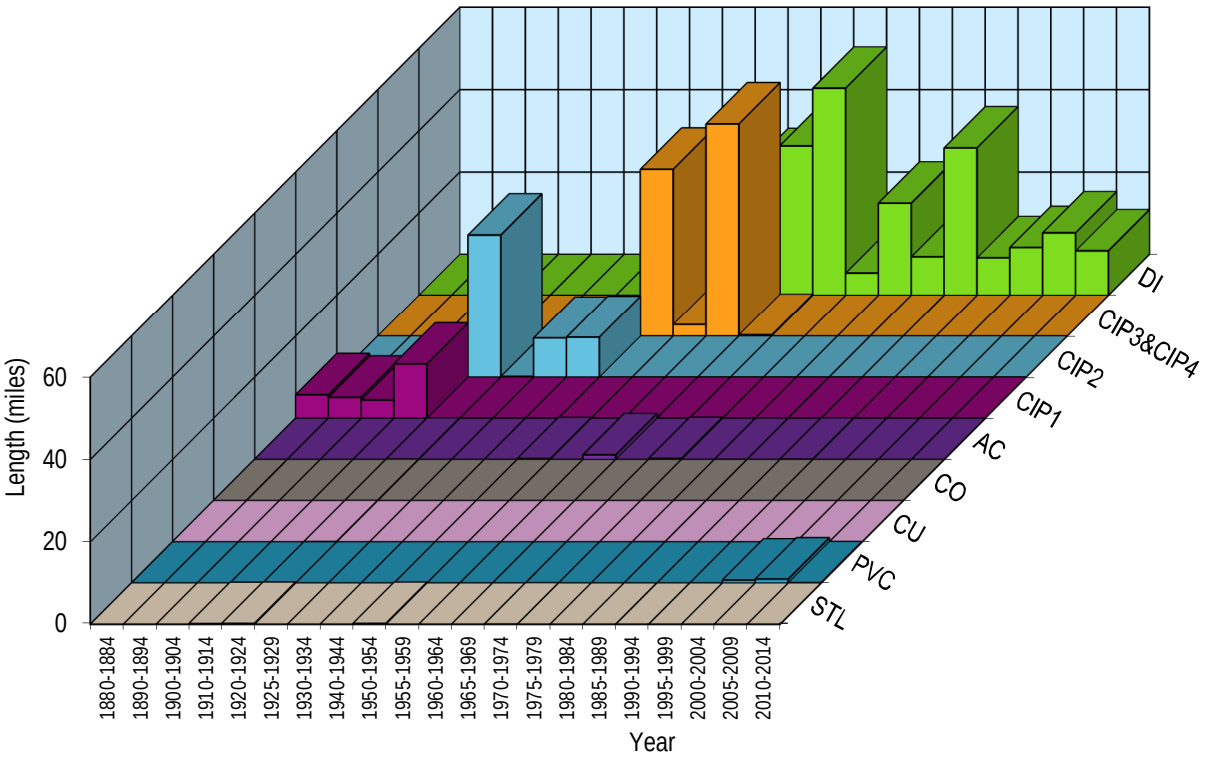


Figure 4-4- Inventory of Water Mains by Type and Installation Year

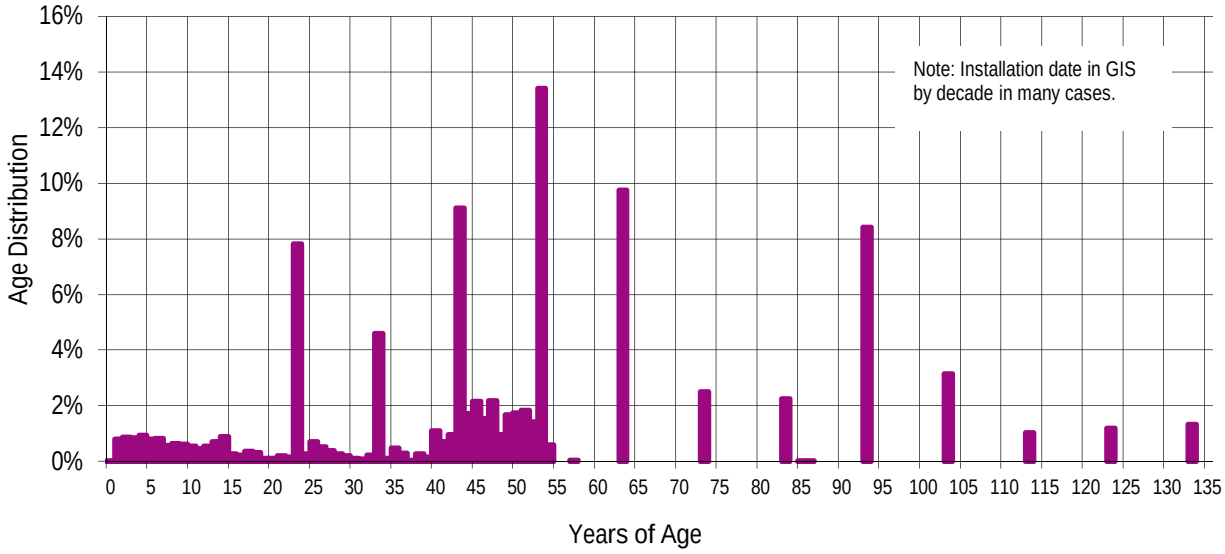


Figure 4-5- Age Distribution of Water Mains in 2013

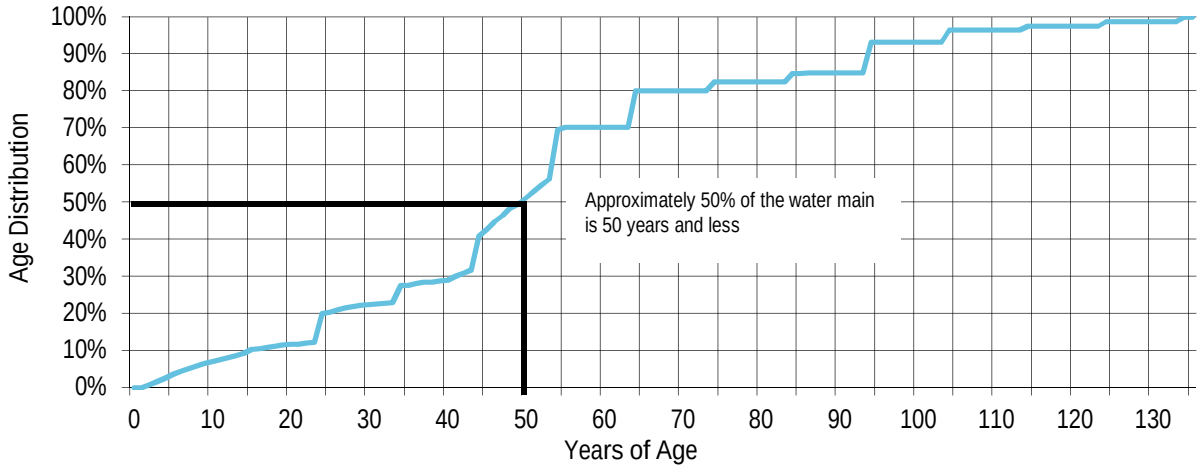


Figure 4-6- Cumulative Age Distribution of Water Mains in 2013

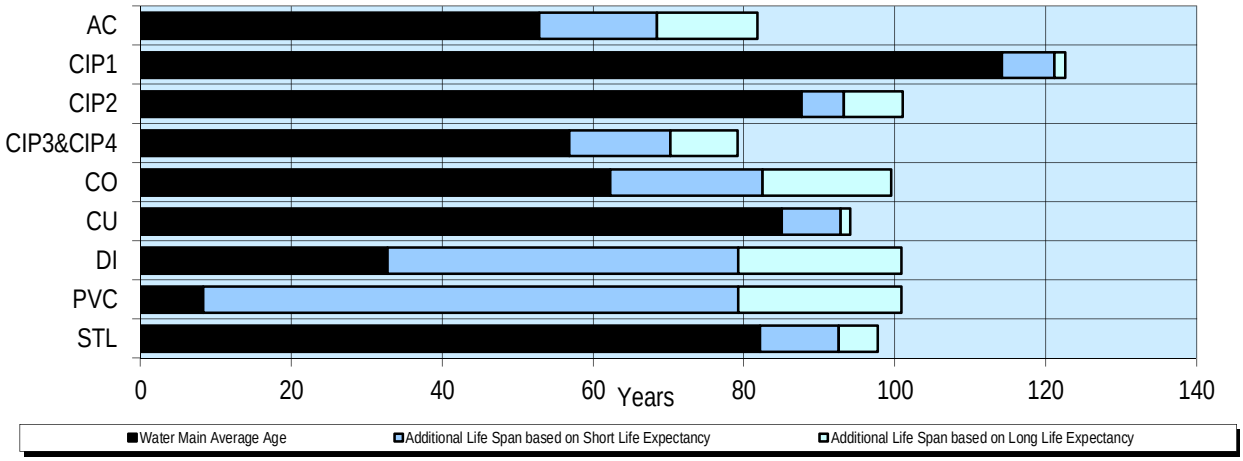


Figure 4-7- Average Age and Residual Life Expectancy for Types of Water Main

4.2.1 Results of KANEW Analysis

The results of the water main replacement KANEW analysis are summarized in the following figures.

Figure	Description
4-8	Length of water mains to be renewed based on long life expectancies for types of water mains
4-9	Length of water mains to be renewed based on short life expectancies for types of water mains
4-10	Annual renewal rates for types of water mains based on long life expectancies
4-11	Annual renewal rates for types of water mains based on short life expectancies
4-12	Average annual renewal rates based on long and short life expectancies

The annual renewal rates shown in **Figure 4-10 and 4-11** illustrate the percentage of water main that should be replaced for each water main category.

4.2.2 Findings from KANEW Analysis

The results of the KANEW analysis, based on the survival functions developed, indicate that the total length of water main to be replaced within the City's water distribution system in the next 20 years is approximately 121 miles to 166 miles based on long to short water main life expectancies, respectively. **Table 4-3** and **Figure 4-12** summarize the replacement needs of the City's water distribution system based on the analysis. **Figure 4-12** also includes a "medium" life expectancy (between the short and long life expectancies).

Table 4-3: Recommended Water Main Renewal Rates

Year	Long Life Expectancy		Short Life Expectancy	
	Annual Renewal Rate	Total Length (miles)	Annual Renewal Rate	Total Length (miles)
1	1.5%	6.42	4.4%	18.71
2	1.5%	6.37	3.9%	16.47
3	1.5%	6.33	3.4%	14.57
4	1.5%	6.29	3.1%	12.95
5	1.5%	6.22	2.7%	11.56
6	1.4%	6.12	2.4%	10.37
7	1.4%	6.09	2.2%	9.40
8	1.7%	7.03	2.0%	8.51
9	1.7%	7.02	1.8%	7.73
10	1.7%	7.02	1.7%	7.04
11	1.6%	6.96	1.5%	6.44
12	1.6%	6.66	1.4%	5.91
13	1.5%	6.32	1.3%	5.46
14	1.4%	5.98	1.2%	5.07
15	1.3%	5.66	1.1%	4.75
16	1.3%	5.35	1.1%	4.48
17	1.2%	5.07	1.0%	4.37
18	1.1%	4.80	1.0%	4.24
19	1.1%	4.54	1.0%	4.18
20	1.0%	4.31	1.0%	4.18
Total	--	120.56 miles	--	166. 38 miles

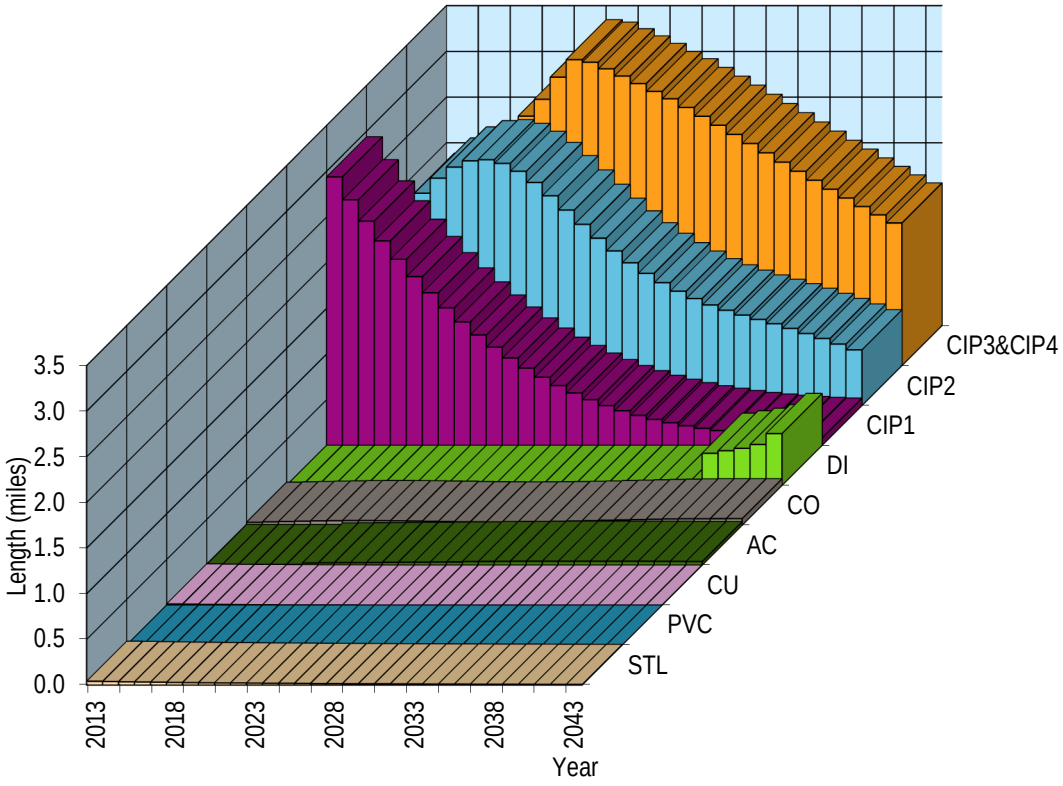


Figure 4-8- Length of Water Mains to Be Renewed Based on Long Life Expectancies

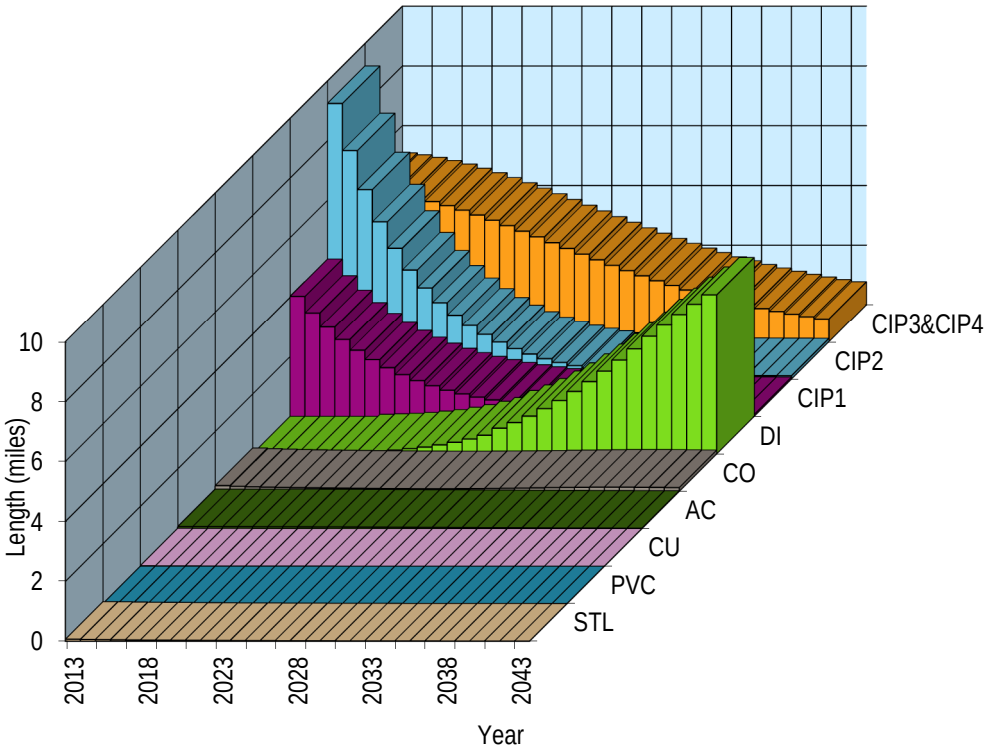


Figure 4-9- Length of Water Mains to Be Renewed Based on Short Life Expectancies

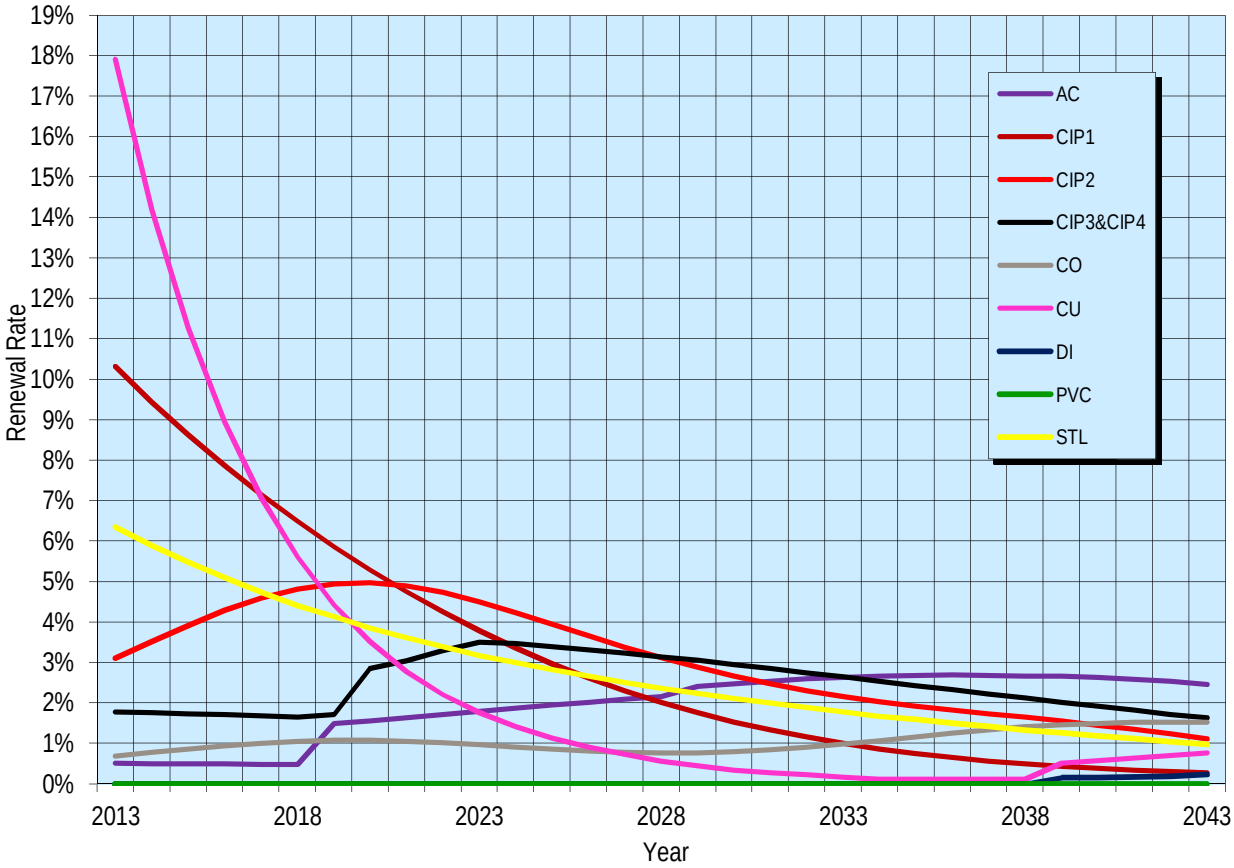


Figure 4-10- Annual Renewal Rates for Types of Water Mains Based on Long Life Expectancies

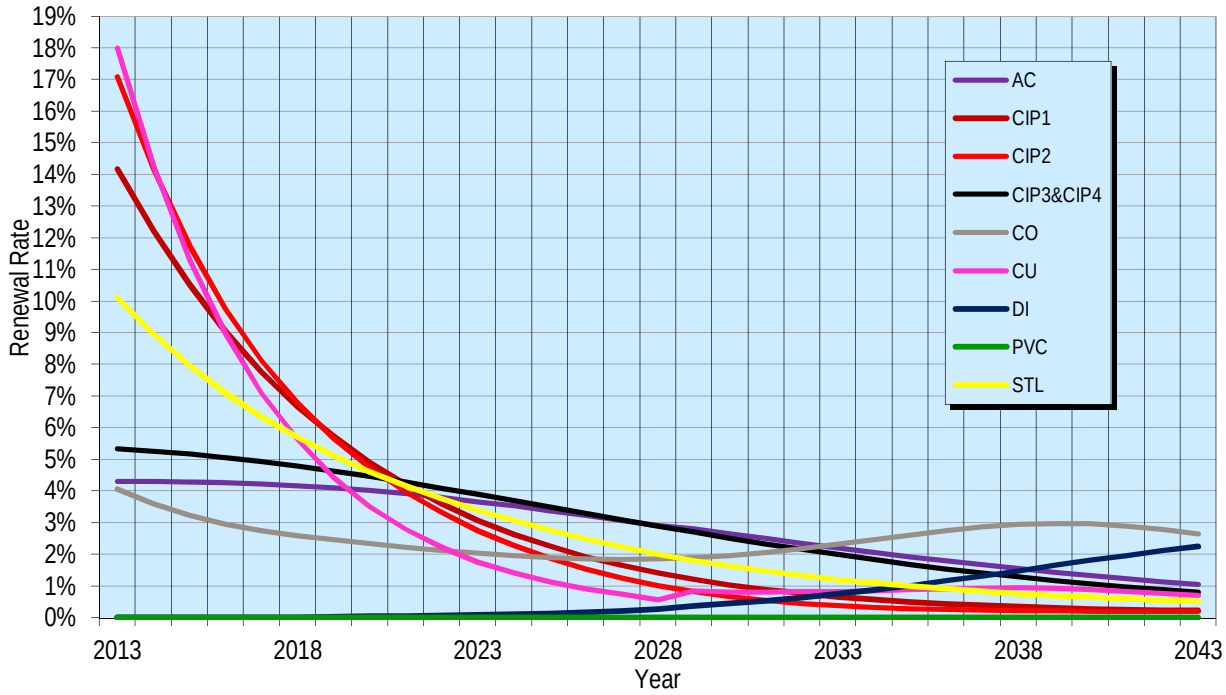


Figure 4-11- Annual Renewal Rates for Types of Water Mains Based on Short Life Expectancies

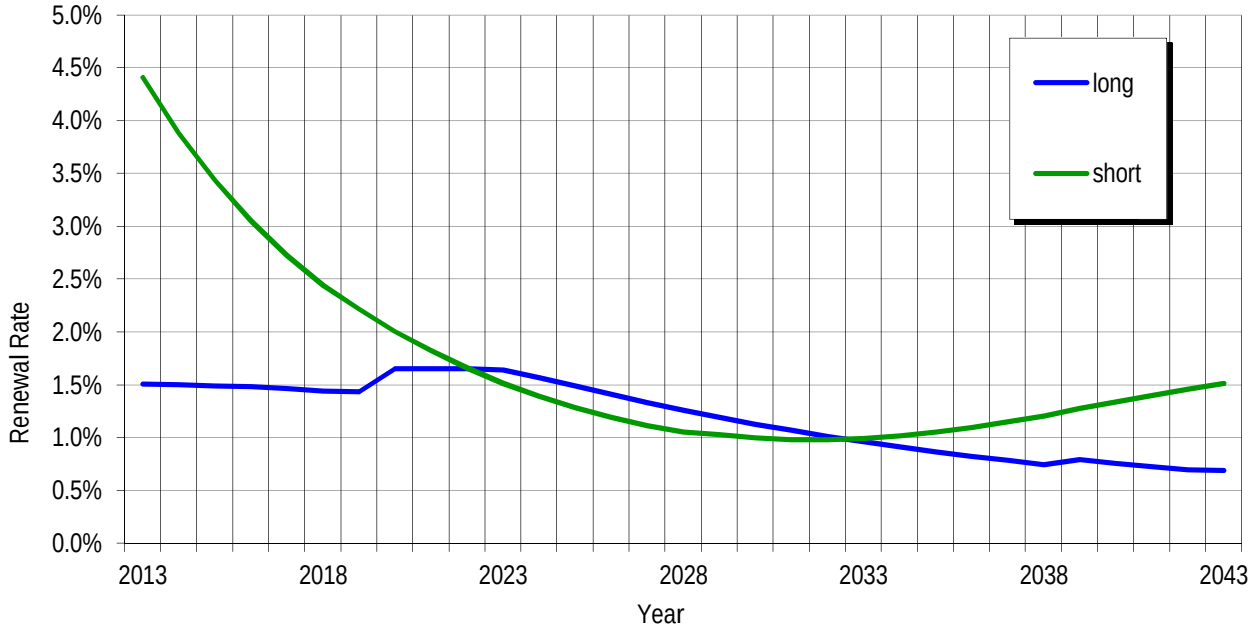


Figure 4-12- Recommended Water Main Renewal Rates

The KANEW analysis provides a further breakdown of water main replacement rates based on water main categories. Appendix C provides summaries of the replacement rates for each water main category based on long and short life expectancies.

The following summarizes the key findings from the macro (KANEW) analysis:

- The City's water distribution system is an "average aged" water system; approximately 50 percent of the water mains are over 50 years old and nearly 20 percent of the water mains are over 80 years old.
- Based on the long and short life expectancies in the KANEW analysis, the total recommended replacement lengths in the first 10 years of replacement are approximately 65 miles (15 percent) and 117 miles (28 percent), respectively.
- Based on the long and short life expectancies in the KANEW analysis, the total replacement lengths over the 30 year period of replacement are approximately 180 miles (37 percent) and 271 miles (51 percent), respectively.
- This analysis is based on age and material of the water mains; it does not consider the historical performance (leaks and breaks), water quality, reliability, cost of failure, hydraulic analysis, or the physical condition of the pipe.

4.2.3 Comparison of Analysis Results

The purpose of establishing a water main replacement program is to ensure adequate reinvestment in the water distribution system to ensure adequate and safe drinking water is provided to all the City's customers. The correct amount of water main to be replaced each year depends on past practices, current condition of the water distribution system, and a cost-benefit analysis.

A general rule of thumb has been provided by the industry that utilities should replace approximately 1 percent of water mains each year. This represents an average life expectancy of a water main of 100 years; therefore, the whole water distribution system is replaced every 100 years. However, this guideline is flawed for a number of reasons including:

1. Many water main materials last well over 100 years.
2. A lack of reinvestment and replacement in the past creating a need to replace more than 1 percent of the water main.

A review of literature and work performed by AECOM on water main replacement rates is summarized in **Table 4-4**.

The table illustrates that water main replacement rates vary throughout the United States. However, in many cases, the initial replacement rate is well above 1 percent.

Table 4-4: Recommended Water Main Renewal Rates

Water System	Distribution System	Long Life Expectancy	Short Life Expectancy
Philadelphia Water Department	3,300 miles	Fairly constant at 0.6% to 0.8% per year	1.25% initially, declining to 1%
Los Angeles Department of Water and Power	7,100 miles	2.2% initially, gradually declining to 1.2%	4.4% initially, declining to 2.1%
Boston Water and Sewer Commission	1,180 miles	2% initially, gradually declining to 1.5%	6.5% initially, drops significantly to nearly 1% later
Forth Worth Water Department	2,257 miles	Increases with time, initially 0.3%, increases to nearly 0.9%	
Nottinghamshire Water System of Severn Trent Water, Ltd.	412 miles	1.5% throughout planning period	Initially 3.3%, gradually declining to about 1.5%
Large Midwest System (large diameter pipes)	644 miles	1% throughout planning period	Initially 5%, gradually declining to about 1%
Large Utility – Southern U.S.	1,542 miles	4.5% initially, gradually declining to about 1.3%	5.5% initially, gradually declining to about 1.8%
Large Utility - North Carolina	333 miles	<0.1% initially, gradually increasing to about 1.2%	0.3% initially, increasing to 1.2% and declining to about 0.8%
Mid Sized Utility – Midwest	356 miles	9.4% initially, declining to about 0.6%	14.7% initially, declining to 0.8%
Air Force Base – California	82 miles	Increases with time, initially 0% increasing to 1-2%	0.6% initially, increasing to 2.4% and then declining to about 0.8%
Military Installation – East Coast	62 miles	0.9% initially, increasing to about 2.1% and then declining to 1.4%	7.5% initially, gradually declining to about 0.8%
Mid Sized Utility – Midwest	135 miles	0% initially, gradually increasing to about 0.8%	1.8% initially, gradually declining to about 0.6%
Mid Sized Utility – Midwest	176 miles	0.2% initially, gradually increasing to about 1%	3.5% initially, gradually declining to 1.1 – 0.8%
Mid Sized Utility – Midwest	370 miles	2.7% initially, decreasing to 1.5%, then gradually decreasing to 0.5%	5.3% initially, gradually declining to 0.7% - 1.0%
Large Utility – West Virginia	2,563 miles	1.0% initially, gradually increasing to about 1.2%	2.3% initially, gradually declining to 1.0%
Ann Arbor	425 miles	1.5% initially, gradually increasing to about 0.7%	4.4% initially, declining to 1.0% and increasing to about 1.5%

5. Water Main Prioritization

This section presents the approach used for the prioritization of water main replacement for the City of Ann Arbor. This section explains the overall approach, as well as the specific methodology developed for the City.

5.1 Risk Management

Risk management is a systematic and logical approach used to assist in the prioritization of infrastructure replacement. Risk depends on both the probability and consequence of an event and is often represented using the following equation:

Probability of failure (POF) represents the likelihood that a specific asset will fail (not deliver the required level of service). Consequence of failure (COF) represents the overall impact of an asset failing.

5.2 Approach for Prioritization Analysis

The purpose of the prioritization analysis is to provide a systematic methodology for the prioritization of water main replacement based on the consequence of failure (COF) and probability of failure (POF) of each water main segment.

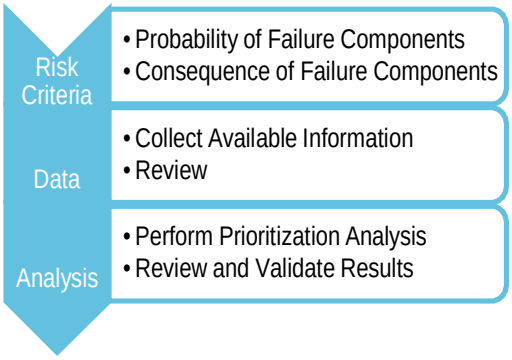
		Consequence of Failure	
		Low →	→High
Probability of Failure	High ↑	Low POF, Low COF	High POF, High COF
	Low	High POF, Low/ Moderate COF	Low/ Moderate POF, High COF

Figure 5-1- Risk Matrix

Figure 5-1 illustrates the risk matrix. The matrix indicates that a water main with a high consequence of failure and high probability of failure presents a high risk to the City. Conversely, a water main in very good condition with a low consequence of failure provides a low rest to the City. However, a water main with a high consequence of failure in good condition could still pose a moderate level of risk and consequently requires a greater level of action than a low risk water main.

The methodology to prioritize the City's water main replacement program is based on the risk equation that assigns an overall priority action number (PAN) to each water main. The PAN is scored from 0 to 100; with the higher the PAN associated with an asset, the higher the risk to the City.

The following sections explain the methodology for the prioritization of water main replacement, as well as present the findings.



The probability of failure and consequence of failure scoring components have varying levels of impact on overall risk. To address this in the prioritization methodology, a weighting factor was assigned to each probability of failure and consequence of failure components such that the weighting factors totaled to 100, for both probability of failure and consequence of failure.

5.3 Prioritization Analysis

As part of this project a prioritization model was developed to be used by the City based on the water main prioritization presented. The prioritization model will allow the City to continue update the prioritization analysis.

The probability of failure and consequence of failure components were reviewed with City staff in workshops and are discussed in the following sections.

5.3.1 Probability of Failure

For the prioritization analysis the following probability of failure components were included:

- Leaks and Breaks
- Remaining Useful Life
- Soil Type
- Headloss/Velocity
- Complaints
- Hydraulic Performance
- Pressure

Each of the probability of failure components are discussed in the following sections.

5.3.1.1 Breaks and Leaks

As water mains deteriorate and fail, pipes break; therefore, break history can provide a good indication of the condition of the water distribution system and the probability of failure. The history of water main failure (breaks and leaks) is a critical component in the evaluation of the water main performance.

Guidelines for an acceptable number of breaks per mile include the following:

1. 25 to 30 breaks/100 miles/year (AwwaRF - Distribution System Performance Evaluation, 1995)
2. 15 to 20 breaks/100 miles/year - Target Level of Some Utilities

As discussed and illustrated in Section 3, City staff has provided information on historical breaks and leaks since 1980.

The last 10 years of leaks was included for the probability of failure scoring. Each break and leak was assigned to the corresponding water main in GIS.

Data was reviewed to remove leaks assigned to a water main that has been replaced since the date of the leak. In addition, the City updated the spatial location where possible on records with location issues such as:

- Not located at correct address
- Located between two parallel mains
- Located near intersection

Table 5-1: Breaks and Leaks Probability of Failure Scoring

Breaks and Leaks Score	Prioritization Score
0 breaks per 100 miles per year	0
< 20 breaks per 100 miles per year	20
20 – 40 breaks per 100 miles per year	50
40 – 60 breaks per 100 miles per year	80
> 60 breaks per 100 miles per year	100

"Conversion" break data was assumed to be accurate as no additional data was available.

For the prioritization analysis, the probability of failure score for breaks and leaks on a water main was based on breaks per 100 miles per year for each pipe included in the prioritization analysis as summarized in **Table 5-1**.

5.3.1.2 Remaining Useful Life

The overall philosophy for establishing the probability of failure score for the remaining useful life of the water main is that in general, water mains deteriorate more during the latter part of the expected service life. The actual service life of a water main is dependent on many factors in addition to the age of the pipe, such as material, the quality of installation, soil conditions, and disturbances from adjacent construction and loading.

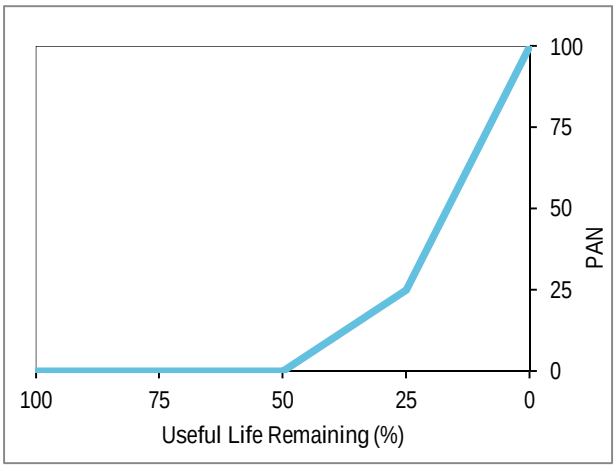


Figure 5-2- Remaining Useful Life Scoring

Table 5-2: Remaining Useful Life Probability of Failure Scoring

Remaining Useful Life Score	Prioritization Score
0	100
0-25	25-100
25-50	0-25
>50	0

For the prioritization analysis, a pipe is considered to be in the original structural condition if the pipe age is within 50 percent of its anticipated lifespan.

Table 5-2 summarizes the remaining useful life probability of failure score based on the remaining useful life. **Figure 5-2** illustrates the remaining useful life probability of scoring graphically.

5.3.1.3 Soil Type

Distribution water mains are subject to varying levels of external corrosion depending on the aggressiveness and type of soil. For example, the corrosivity of the soil can be increased by the level of soluble salts, chlorides, sulphates, soil acidity (pH), and resistivity.

The USDA rates soils in three categories: low, moderate, and high. The USDA site states the following regarding the rating system for steel:

> *"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.*

A table summarizing the ferrous and concrete corrosivity ratings for the soils included in the GIS is included in Appendix D.

The soil type (corrosivity) probability of failure score associated with the low, moderate and high categories are summarized in **Table 5-3**.

Figure 5-3 and **Figure 5-4** illustrate the ferrous and concrete corrosivity scoring categories associated with the soil types and water mains used for the prioritization analysis.

Table 5-3: Soil Type Probability of Failure Scoring

Soil Type Score	Prioritization Score
Not Applicable (non-concrete/non-ferrous)	10
Low	10
Moderate	30
High	100

Footnote:
1 Levels determined by soil type and material (ferrous and concrete corrosivity)

5.3.1.4 Headloss/Velocity

Headloss and velocity are two parameters used as indicators of whether individual water mains are reaching their hydraulic capacity. The City provided data from the calibrated hydraulic model to determine the input data for headloss and velocity. The model scenario used for headloss and velocity was a 48 hour 2035 maximum day simulation (maximum headloss and velocity over the 48 hour model simulation was used for the analysis).

The determination of the headloss/velocity probability of failure score was assigned in accordance with **Table 5-4**. **Figure 5-5** illustrates high headloss and velocity water mains for the probability of failure scoring.

Table 5-4: Headloss/Velocity Probability of Failure Scoring

Headloss/Velocity Score		Prioritization Score
Small diameter (less than 16-inch)	Headloss < 6 ft / 1,000 ft	1
	Headloss > 6 ft / 1,000 ft	10
or		
Large diameter (16-inch and larger)	Headloss < 3 ft / 1,000 ft	1
	Headloss > 3 ft / 1,000 ft	10
or		
Velocity < 5 fps		1
Velocity > 5 fps		10

AWWA Manual M32, *Computer Modeling of Water Distribution Systems,* Third Edition includes guidelines for maximum recommended limits of pipe headloss and velocity. M32 recommends that all pipe velocities should be less than 5 feet per second (fps) during normal operation. Additionally, M32 recommends headlosses in pipes less than 16-inches in diameter should be less than 5 to 7 feet per 1,000 feet of pipe during normal operating conditions. The recommended headloss limit for larger pipes in M32 is 2 to 3 feet per 1,000 feet of pipe during normal operating conditions.

5.3.1.5 Complaints

The water quality in the distribution network can provide an indication of the condition or deterioration of water mains. For example, high customer complaints (related to water quality issues such as odor, taste and appearance) can indicate that the mains in that area are corroding or deteriorating.

The City provided a database of historical complaints over the past 10 years. The complaints included in the prioritization analysis include the following water quality complaints:

- Cloudy water
- Dirty water
- Odor issues
- Sediment
- Taste

Table 5-5: Complaints Probability of Failure Scoring

Complaints per Year (over 10 years)	Prioritization Score
0-2	10
2-4	30
4-5	50
5-6	60
6-7	80
>7	100

Pressure complaints were not included in the analysis as replacing a particular water main does not typically result in higher pressures in a particular area. The number of complaints associated with a water main was used to determine the complaints probability of failure score as summarized in **Table 5-5**.

Figure 5-6 illustrates the number of complaints associated with the water mains included in the prioritization analysis for the complaints probability of failures score.

5.3.1.6 Hydraulic Performance

Similar to headloss and velocity, c-values from the hydraulic model were provided by City staff to be used as a probability of failure scoring component.

The c-values from the hydraulic model were associated with the corresponding GIS pipe as described in the previous section.

Table 5-6: Hydraulic Performance Probability of Failure Scoring

Hydraulic Performance Score	Prioritization Score
>120	10
120-100	30
99-80	50
79-70	90
<70	100

The hydraulic performance probability of failure scoring based on c-values is summarized in **Table 5-6** and illustrated in **Figure 5-7**.

5.3.1.7 Pressure

An important element when considering the prioritization of water main replacement and the probability of failure is the water distribution system pressure experienced by the water main. Generally, the higher the pressure experienced by the water main the higher the probability of failure.

Table 5-7 summarizes the pressure component scoring for probability of failure.

Table 5-7: Pressure Probability of Failure Scoring

Pressure Score	Prioritization Score
<60 psi	10
60-69 psi	20
70-79 psi	40
80-89 psi	60
90-99 psi	80
>100 psi	100

Figure 5-8 illustrates the water system pressure in the City's water distribution system.

5.3.1.8 Weighting Factors

After the probability of failure components were established, the level of importance (weighting) of each component was determined and agreed upon with City staff. The assignment of weighting factors is subjective and is based on experience and local knowledge. **Table 5-8** summarizes the probability of failure weighting factors, based upon AECOM's past experience and input from City staff. **Figure 5-9** illustrates the probability of failure results for the water mains

Table 5-8: Probability of Failure Weighting Factors

Probability of Failure Component	Score
Breaks and Leaks	40
Remaining Useful Life	20
Soil Type	10
Headloss and Velocity	10
Complaints	10
Hydraulic Performance	5
Pressure	5
Total	100

5.3.2 Consequence of Failure

For the prioritization analysis the following consequence of failure components were included:

- Critical Users
- Large Users
- Land Use
- Flow
- Diameter

Each of the consequence of failure components are discussed in the following sections.

5.3.2.1 Critical Users

An important element when considering the prioritization of water main replacement is the customers that a water main serves (critical customers) and the number of services each critical customer has.

First, the critical users were determined from the 2010 Master Plan and included schools, U of M Hospital, and the VA Hospital.

Table 5-9: Critical Users Scoring

Critical Users Score	Prioritization Score
Not critical user	10
>3 metered connections	30
3 connections	50
2 connections	70
1 connection	100

Second, the GIS was used to determine the number of connections for each critical user identified and then associated to the nearby water mains and scored accordingly. Appendix E illustrates each of the critical users.

Table 5-9 summarizes the critical user's component scoring for consequence of failure. As noted, water mains serving non-critical customers were scored a 10.

Figure 5-10 illustrates the critical user score for water mains in the City's water system, as well as illustrates parcels of the critical user identified.

5.3.2.2 Large Users (Consumption)

An important element when considering the prioritization of water main replacement is the volume of water the customers use. The large user consequence of failure component used the top 12 metered users from the 2012 consumption data provided by the City. Appendix F provides information on the large users.

Table 5-10 summarizes the large user component scoring for consequence of failure. **Figure 5-11** illustrates the large user consumption applied to the water mains in the City's water distribution system.

Table 5-10: Large User Scoring

User Consumption		Prioritization Score
< 50 gpm	< 0.07 MGD	10
50 – 100 gpm	0.07 – 0.14 MGD	20
100 – 250 gpm	0.14 – 0.36 MGD	30
250 – 500 gpm	0.36 – 0.72 MGD	50
500 – 1,000 gpm	0.72 – 1.44 MGD	60
1,000 – 2,000 gpm	1.44 – 2.88 MGD	80
> 2,000 gpm	>2.88 MGD	100

5.3.2.3 Land Use

To assist in assigning a consequence of failure score relevant to location, land use was evaluated. **Table 5-11** summarizes the land use component scoring for consequence of failure.

A land use map, provided by the City, was used to assign the appropriate location of each water main in the prioritization analysis. **Figure 5-12** illustrates the land use scoring of water mains in the City's water system.

Table 5-11: Land Use Scoring

Land Use	Score
Out of City Boundary	10
Vacant	10
Open Space or Restrictive Use	10
Park and Recreation	20
Public	30
Single-Family Residential	40
Multi-Family Residential	60
Commercial	70
Mixed Use	70
Institutional	80
Industrial	90
Transportation	100
River Crossing	100

5.3.2.4 Flow

An important element when considering the prioritization of water main replacement is the flow through a water main. The City provided data from a 48 hour maximum day 2035 model simulation. The maximum flow from the 48 hour simulation was associated with the corresponding GIS water main

Table 5-12 summarizes the flow scoring for consequence of failure.

Figure 5-13 illustrates the flow scoring of water mains in the City's water distribution system.

Table 5-12: Flow Scoring

Flow	Score
< 5 gpm	10
5 – 25 gpm	20
25 – 50 gpm	30
50 – 100gpm	40
100 – 250gpm	50
250 – 500gpm	60
500 – 1,000gpm	70
1,000 – 2,000gpm	80
2,000 – 4,000 gpm	90
> 4,000 gpm	100

5.3.2.5 Diameter

Generally speaking, the larger the diameter of the pipe the more significant the pipe is in the overall service to customers; therefore, water main diameter was used as one of the components for consequence of failure in the prioritization analysis. **Table 5-13** summarizes the diameter component scoring for consequence of failure.

Figure 2-2 illustrates the diameters of the water mains.

Table 5-13: Diameter Scoring

Diameter	Score
Less than 4-inch	10
4-inch	20
6-inch	30
8-inch	40
10-inch	50
12-inch	60
14-inch	70
16-inch	80
18-inch	80
20-inch	90
22-inch	90
24-inch	90
Greater than 24-inch	100

5.3.2.6 Weighting Factors

After the consequence of failure components were established, the level of importance (weighting) of each component was determined and agreed upon with the City. The assignment of weighting factors is subjective and is based on experience and local knowledge. **Table 5-14** summarizes the consequence of failure weighting factors, based upon AECOM's past experience and input from City staff, used for the prioritization analysis. **Figure 5-14** illustrates the consequence of failure results for the water mains.

Table 5-14: Weighting Factors

Consequence of Failure Component	Score
Critical Users	30
Large Users	20
Land Use	20
Flow	20
Diameter	10
Total	100

5.3.3 Sample Calculation

The methodology to systematically prioritize the City's water main replacement program was based on assigning an overall PAN to each water main based on the risk equation. A sample PAN calculation for a water main is summarized in **Table 5-15**.

Table 5-15: Sample Prioritization Action Number Calculation

AECOM_ID	24469			
Installation Year	2002			
Diameter	16-inch			
Material	Ductile Iron			
Length				
Breaks and Leaks	274			
Land Use	ROW			
Pressure	93 psi			
Soil Type	MmC			
C-Value	135			
Headloss	1.1 feet			
Velocity	2.2 fps			
Complaints	0			
Large User	100 gpm			
Critical User	No			
Flow	1,379 gpm			
Component	**Individual PAN Calculations**		**Weighting Factor**	**PAN**
Probability of Failure	Normalized with highest POF score (79.9)			64
POF- Breaks and Leaks	Critical customer	= 100	0.40	40
POF – Remaining Useful Life	Installation date = 2002	= 10	0.20	2
POF – Soil Type	Soil Type = MmC (Moderate)	= 30	0.10	3
POF – Headloss and Velocity	Headloss = 1.077 feet Velocity = 2.2 fps	= 10	0.10	1
POF – Complaints	Complaints = 0	= 10	0.10	1
POF – Hydraulic Performance	C-value = 135	= 10	0.05	0.5
POF – Pressure	Pressure = 93 psi	= 80	0.05	4
Consequence of Failure	Normalized with highest COF score (69.0)			75
COF- Critical Users	Not a critical customer	= 10	0.30	3
COF – Large Users	Large User = 100 gpm	= 30	0.20	6
COF – Land Use	Land Use = Right-of-way	= 100	0.20	20
COF – Flow	Flow = 1,379 gpm	= 80	0.20	16
COF – Diameter	Diameter = 16-iinch	= 70	0.10	7
Overall PAN (64 x 75) /(Max Score: 10,000)				49

5.3.5 Sensitivity Analysis

As part of the development of the prioritization analysis the following sensitivity analysis was performed to determine the impact on the priority of replacement

- Increase break and leak weighting factor by 5 (Remaining useful life weighting factor was adjusted by 5 such that the total of the weighting factors remained 100).
- Decrease the leak weighting factor by 5 (Remaining useful life weighting factor was adjusted by 5 such that the total of the weighting factors remained 100).
- Revised the break and leak scoring as follows:

Original Scoring		Sensitivity Analysis	
Breaks and Leaks Score	Prioritization Score	Breaks and Leaks Score	Prioritization Score
0 breaks per 100 miles per year	0	0 breaks per 100 miles per year	0
< 20 breaks per 100 miles per year	20	< 100 breaks per 100 miles per year	70
20 – 40 breaks per 100 miles per year	50	100 – 250 breaks per 100 miles per year	80
40 – 60 breaks per 100 miles per year	80	250 – 500 breaks per 100 miles per year	90
> 60 breaks per 100 miles per year	100	> 500 breaks per 100 miles per year	100

The prioritization model developed for the City allows changes in scoring and weighting factors to be made as more information on the criticality of the criteria becomes available.

5.3.6 Prioritization Model

As part of this project, AECOM developed a Microsoft Access prioritization model. The prioritization model includes the following data "flags" to be used while reviewing the prioritization analysis results as discussed with the City:

- U of M pipes
- Newer pipes (user defines installation date that determines "newer pipes")
- Pipes with small lengths (user defines length that determines "small lengths")
- Pipes in the area of a proposed capital improvement project (provided by the City)

5.3.7 Results

The results of the prioritization analysis are summarized in **Table 5-16** and illustrated in **Figure 5-15**, **Figure 5-16**, and **Figure 5-17**. **Figure 5-15** and **Figure 5-16** illustrate the water mains by risk category. **Figure 5-17** illustrates the overall Priority Action Number.

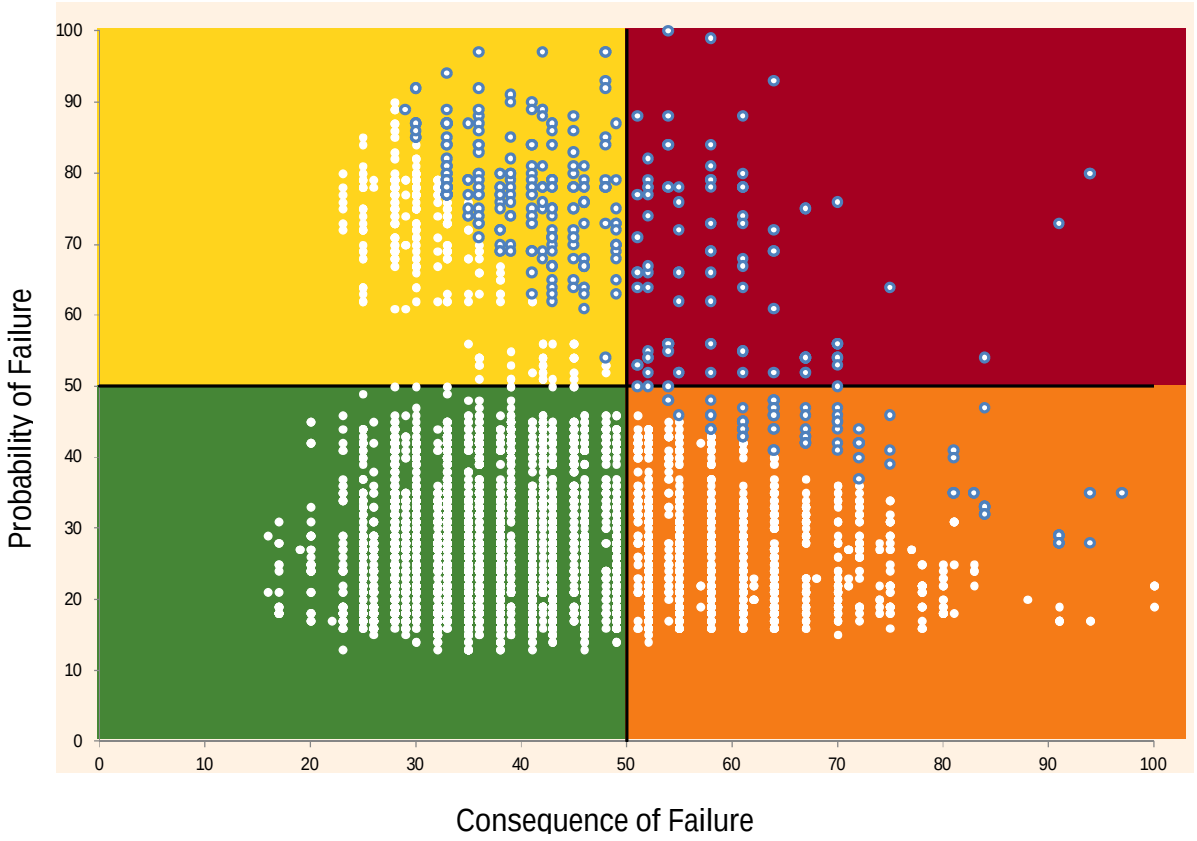
Table 5-16: Prioritization Analysis Results

Risk Category	Length of Main	Percentage	PAN Score	Length of Main	Percentage
Green	295 miles	69%	0-25	399 miles	94%
Yellow	33 miles	8%	26-50	25 miles	6%
Orange	91 miles	21%	51-75	< 1 mile	<1 %
Red	6 miles	1%	76-100	< 1 mile	< 1%
Total	424 miles	--	Total	424 miles	--
Probability of Failure	**Length of Main**	**Percentage**	**Consequence of Failure**	**Length of Main**	**Percentage**
0-25	178 miles	42%	0-25	15 miles	3%
26-50	208 miles	49%	26-50	313 miles	74%
51-75	18 miles	4%	51-75	92 miles	22%
76-100	19 miles	5%	76-100	4 miles	1%
Total	424 miles	--	Total	424 miles	--

As summarized, a small percentage (less than 1 percent) of the City's water mains are categorized as high risk (red).

Approximately 5 percent of the water mains have a probability of failure greater than 50 percent. In addition, approximately 23 percent of the water mains are considered to have a consequence of failure score above 50.

In addition, the top 20 PAN water mains are illustrated in **Figure 5-18** and summarized in **Table 5-17.** The risk matrix highlighting the top 20 PAN water mains is illustrated in **Figure 5-19.**



Note: The white dots with a blue outline represent 5 percent of the City's water distribution system with the highest PAN score.

Figure 5-16- Water Main Prioritization Risk Matrix

Table 5-17: Top 20 Water Mains

Rank	UniqueID	Probability of Failure Score	Consequence of Failure Score	PAN	Risk	Length (feet)
1	21880	80	94	76	Red	112
2	21879	80	94	76	Red	185
3	13702	73	91	67	Red	54
4	11905	93	64	59	Red	384
5	1325	99	58	58	Red	330
6	12171	100	54	54	Red	59
7	3086	88	61	54	Red	1,017
8	31699	76	70	53	Red	310
9	29841	75	67	50	Red	262
10	29840	75	67	50	Red	321
11	8422	84	58	49	Red	633
12	24469	64	75	49	Red	193
13	10912	80	61	49	Red	433
14	2946	78	61	48	Red	556
15	12766	97	48	47	Yellow	119
16	21448	81	58	47	Red	248
17	9339	88	54	47	Red	92
18	23384	78	61	47	Red	778
19	23385	78	61	47	Red	416
20	24239	97	48	47	Yellow	195

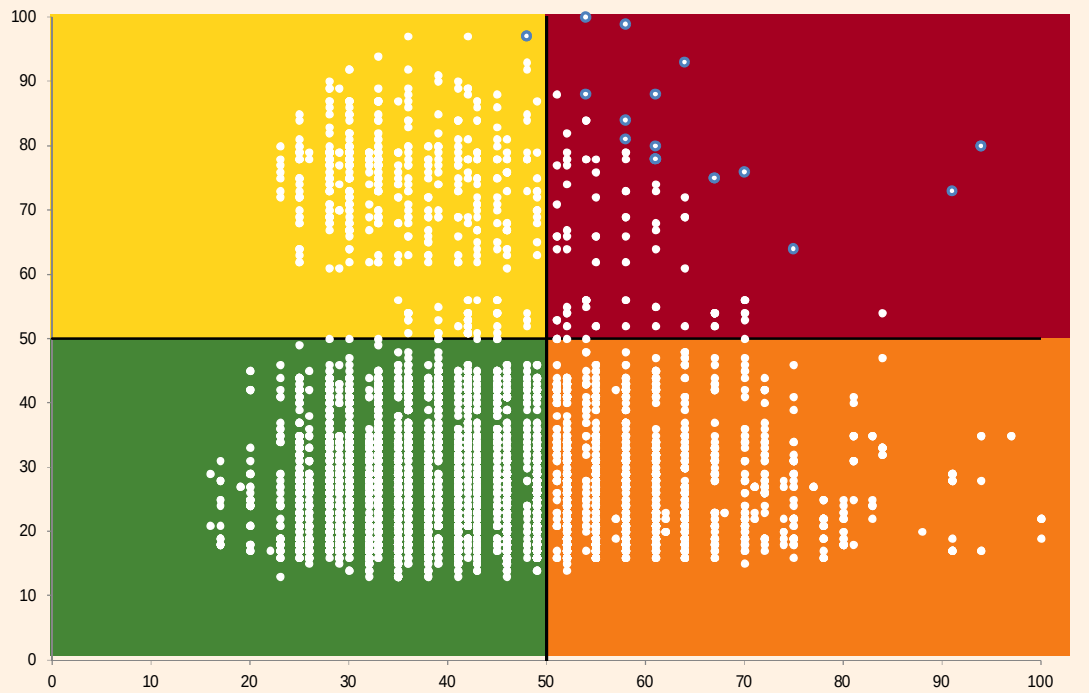


Figure 5-19-Top 20 Water Main Prioritization Risk Matrix

6. Water Main Reinvestment Planning

This section discusses the water main reinvestment plan for the City.

As discussed in Section 4, the macro analysis determined the recommended water main replacement requirements for the City based on both short and long life expectancies of water mains over the next 30 years. The results of the macro analysis include an annual replacement rate based on water main age. The findings of the macro approach for the City is that, based on water main age alone; the City should replace approximately 15 percent to 28 percent (long and short life expectancies, respectively) of the water main in the next 10 year, with an average annual replacement rate of 1.5 percent to 2.8 percent.

A risk based approach was used for prioritization of water main replacement. Based on the risk based prioritization analysis, the City has approximately 1 percent of water main (6 miles) in the high risk (red) category.

The following sections discuss:

- Developing a long-term capital improvement plan for water main reinvestment
- Considering risk in water main reinvestment
- Identifying considerations for water main reinvestment in the future

6.1 Water Main Reinvestment Based on Water Main Replacement Rate

An approach for budgeting the water main replacement forecasting in the future is to determine the amount of water main to replace annually from the from the KANEW analysis and use the prioritization analysis to determine which water mains to replace.

Figure 6-1 and **Figure 6-2** illustrate the result of this approach for long life expectancy and short life expectancy results, respectively. Each figure illustrates the water main replacement rate (percent of total water main), length of pipe, and replacement costs for the next 30 years.

Table 6-1 summarizes the long life expectancy annually estimates for the first 10 years, as well as 10 year, 25 year, and 50 year averages and totals. **Table 6-2** summarizes the short life expectancy annually estimates for the first 10 years, as well as 10 year, 20 year, and 30 year averages and totals **Figure 6-3** and **Figure 6-4** illustrate the spatial location of the water mains identified to be replaced for the first 10 years for long life expectancy and short life expectancy, respectively.

For planning purposes, this analysis provides the overall percent of water mains to be replaced based on the aging water mains in the City's water distribution system and the associated capital costs. Based on the long life expectancies of the water mains, the annual average replacement rate over the 30 year period is approximately 1 percent. The initial annual average is higher as a result of the City not replacing sufficient water main historically.

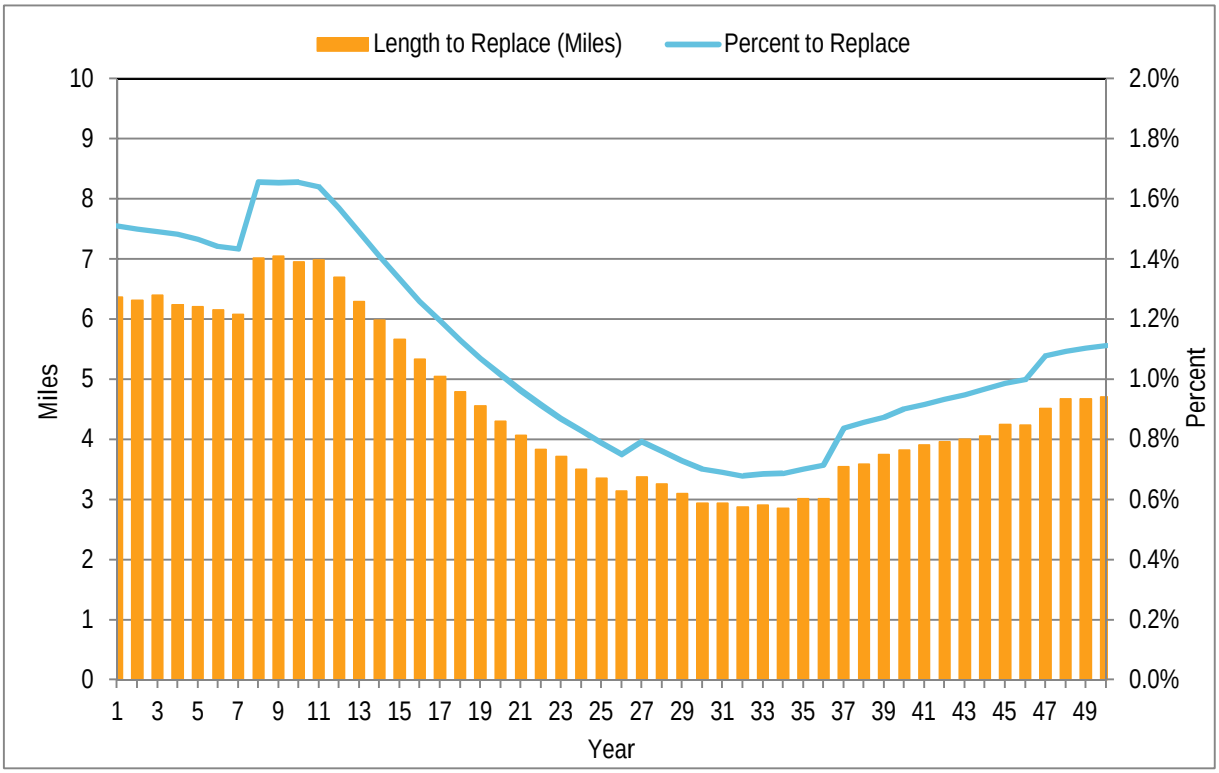


Figure 6-1: Water Main Renewal Based on Long Life Expectancy

Table 6-1: Water Main Renewal – Long Life Expectancy

Year	Percent to Replace	Length to Replace (Miles)
1	1.5%	6.4
2	1.5%	6.3
3	1.5%	6.4
4	1.5%	6.2
5	1.5%	6.2
6	1.4%	6.2
7	1.4%	6.1
8	1.7%	7.0
9	1.7%	7.1
10	1.7%	7.0
10 Year		
Total	15%	64.8
Average	1.5%	6.5
25 Years		
Total	33%	139.1
Average	1.3%	5.6
50 Years		
Total	54%	230.3
Average	1.1%	4.6

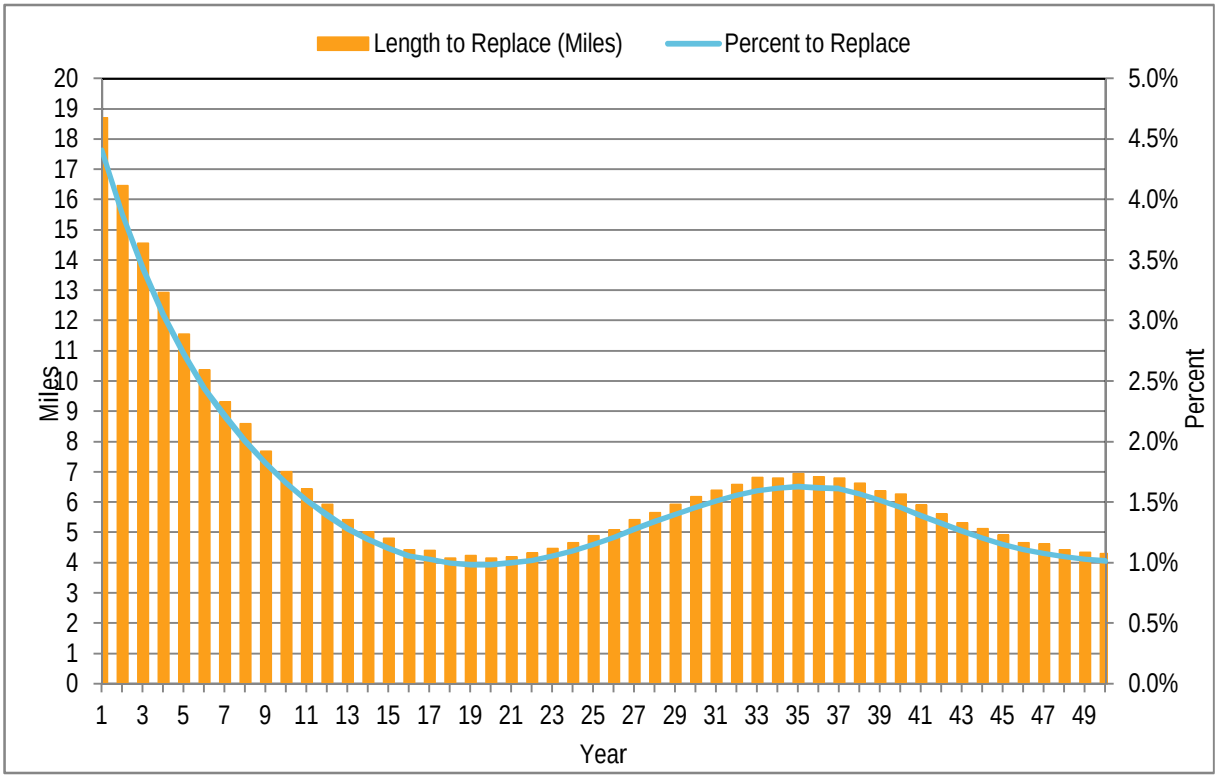


Figure 6-2: Water Main Renewal Based on Short Life Expectancy

Table 6-2: Water Main Renewal – Short Life Expectancy

Year	Percent to Replace	Length to Replace (Miles)
1	4.4%	18.7
2	3.9%	16.5
3	3.4%	14.6
4	3.1%	12.9
5	2.7%	11.6
6	2.4%	10.4
7	2.2%	9.3
8	2.0%	8.6
9	1.8%	7.7
10	1.7%	7.0
10 Year		
Total	28%	117.3
Average	2.8%	11.7
20 Years		
Total	45%	189.0
Average	1.8%	7.6
30 Years		
Total	79%	333.2
Average	1.6%	6.7

6.2 Risk Based Water Main Replacement

As presented in Section 5, the prioritization analysis was based on risk. In general, the action associated with each risk is summarized in **Table 6-3**. Overtime, the probability of failure for each water main will increase, causing a corresponding increase in the risk category. For example, water mains that currently have a risk category of "Orange" will over time move into the "Red" risk category.

Table 6-3: Risk Categories and Associated Action

Risk Category	Risk Description	Recommended Action
Red	High POF, High COF	Immediately repair/replace.
Orange	Low/Moderate POF, High COF	Proactively inspect and evaluate repair/replacement alternatives. Replace as necessary.
Yellow	High POF, Moderate/Low COF	Proactively plan replacement. Continue monitoring/assessing for timing of replacement.
Green	Low POF, Low COF	Normal O&M, continue monitoring.

6.3 Conclusions and Recommendation

The water and wastewater industry is faced with a huge challenge to replace/rehabilitate the buried infrastructure. Many pipes have reached or exceeded the design life and the City is taking a proactive approach to address the replacement of water mains. Main conclusions from the study are:

- A systematic, logical and defensible approach for the prioritization of water mains has been developed for the City, which can be used to justify future capital expenditures.
- City should increase their annual replacement rate of existing water mains to approximately 2 percent per year for the next 25 years.
- High risk water mains have been identified and priority should be given for replacement.
- All water mains have been assigned a Priority Action Number (PAN), which is the first phase in planning water main replacement.
- The results of the study should be incorporated with other considerations when packaging water main construction project such as:
    - Economical size of construction projects
    - Minimize impact to customer during construction
    - Coordination with other utilities and street projects
- Further work is recommended to balance risk with capital expenditure to optimize the impact on customer water rates.

It is recommended that the City start using the prioritization model to assist with water main replacement planning. **Table 6-4** summarizes some of the data gaps identified during this project and recommendations for improving the data as the City moves forward.

Table 6-4: Data Gaps

Data[1]	Description	Recommendation
Unique Pipe ID in GIS	Unique ID for each water main allows for a link to be made between the prioritization model, GIS, and hydraulic model to share data.	Develop Unique ID for each pipe segment
Missing Data in GIS	Diameters, Installation Date, and Material was missing	Complete data
Inconsistent Data in GIS	Inconsistent data between material and installation date, large diameter pipes materials potentially incorrect (for example, 1990 cast iron pipe)	Review inconsistent data and update accordingly
GIS Pipe Installation Dates	Pipe Installation dates in some cases are by decade	Review as-builts and update installation dates
Link Between GIS and Hydraulic Model Pipes	Headloss, velocity, pressure, and c-value in prioritization analysis are inputs from hydraulic model.	Develop a process to share data between the GIS and hydraulic model pipes efficiently
Differences between GIS and Hydraulic Model Data	Diameter and installation date	Review discrepancies and update data accordingly.
Breaks and Leaks	Break database currently does not include cause of break, pipe diameter, or link to GIS water main	Record additional data on each break going forward in the break database

Footnote:
1 Appendix A includes additional details on data gaps

Appendix A

Executive Summary - AWWARF

EXECUTIVE SUMMARY

INTRODUCTION AND OBJECTIVES

Due to the aging of the water distribution systems and the lack of timely maintenance on the part of most water utilities, there is an urgent need for the development of a predictive distribution system condition assessment model. This model should consider factors such as age, material, joints, and environmental conditions in identifying and estimating rehabilitation and replacement needs of a water distribution system. The American Water Works Association Research Foundation (AWWARF) contracted Roy F. Weston, Inc., (WESTON) to provide North American water utilities with such a model. The specific objectives of this study were the following:

- Develop a user friendly software suitable for use by North American water utilities to forecast water main rehabilitation and replacement needs, and develop long-term cost-effective strategies for water main rehabilitation and replacement.
- Demonstrate the effectiveness and applicability of this software by testing it at four North American and one British water utility.
- Develop a user manual for the easy use of the software.
- Identify and define the characteristics of the North American water distribution systems in terms of rehabilitation and replacement needs.

BACKGROUND AND SCOPE

To date, few if any, standardized techniques are available for North American water utilities to evaluate distribution systems and to develop proactive procedures. Water utility operators, in general, manage and operate distribution systems in a reactive mode by responding to emergency breaks and water main leaks. In Europe, however, Raimund K. Herz, a faculty member at Dresden University of Technology, and formerly at Karlsruhe University, Germany, developed the Karlsruhe model (KAMODEL) and applied it successfully at more than ten European utilities (Herz 1996).

WESTON teamed with Raimund K. Herz to develop a user friendly software (KANEW) for North American utilities and to enhance KAMODEL's capabilities.

As detailed input from water utilities was crucial to the development of KANEW, WESTON also teamed with the Philadelphia Water Department (PWD), and worked with Boston Water and Sewer Commission (BWSC), Los Angeles Department of Water and Power (LADWP), Fort Worth Water Department (FWWD), and Severn Trent Water, Ltd., (STW) United Kingdom, (UK) to test the software. Additional utilities participated by responding to a survey.

CHARACTERIZATION OF NORTH AMERICAN WATER DISTRIBUTION SYSTEMS

In order to provide a frame of reference for water utilities using the model, a study of available distribution system data was conducted to characterize North American water distribution systems. The goal was to determine "typical" distribution system characteristics for systems of various sizes and in different geographic regions. Three primary data sources were utilized for this purpose:

- American Water Works Association (AWWA) Water Industry Database (WIDB)
- Questionnaire developed for this project
- Previous AWWARF projects

In examining the data, North America was divided into seven geographic regions, six for the U.S., and one for Canada. It was found that in both countries, the use of both types of cast iron pipe, lined and unlined, is similar - in the range of 43% to 48%. However, in the U.S., the percentage of lined and unlined cast iron pipe are almost equal, in the range of 22% to 26%. In contrast, Canadian systems have substantially more unlined cast iron pipe than lined cast iron pipe (35% unlined versus 9% lined). Regional differences showed that the generally older sections of the country represented by the Northeast and Midwest have the highest percentages of cast iron pipe at 62% and 57%, respectively. The Northwest and West both have significant quantities of steel pipe (10% and 14%, respectively) compared to the rest of the country. The West region also has a substantial percentage (45%) of asbestos cement (AC) pipe, which is

much higher than any other region of the country. Also the average percentage of the distribution system pipe that is replaced annually in the U.S. and Canada is 0.5% and 0.6%, respectively. Within the U.S. the annual replacement rates vary from 0.4% in the Midwest region to 0.7% in the Southeast region. Utilities are expanding their distribution systems at annual rates of 1.5% and 0.9% in the U.S. and Canada, respectively. Expansion rates vary from 1.0% in the South Central and Northwest regions to 2.3% in the Southeast region.

MODEL DESCRIPTION

The primary objective of KANEW is to provide water utilities with a tool to develop their long range pipe rehabilitation and replacement strategies. Based on the historical inventory of water main and the estimated life-span data, KANEW predicts the length of different categories of pipe to be rehabilitated or replaced on an annual basis. KANEW is a macro model and does not provide location specific rehabilitation and replacement information.

The process involves importing data on the water distribution network to the model, differentiated according to year of installation or rehabilitation and pipe categories which are defined with respect of aging behavior and data availability. Most important criteria for the definition of types of water mains are age, material, diameter and bedding quality.

For each type of water main survival functions must be determined. Survival functions are mathematical expressions of the life expectancies of each water main category, and are defined based on three ages, "low", "medium" and "high". These functions are estimated on the basis of failure, rehabilitation and replacement rates in the past and, particularly for modern pipe materials, through expert estimates of the useful life-span of the different water main categories. These estimates are used by the software to determine the parameters of the survival function for each pipe category. The model then simulates the aging process. The survival functions are applied to the current inventory of water mains year by year, and calculations are made to determine the lengths of water mains which reach the end of their useful lives and must therefore be rehabilitated or replaced.

There is considerable uncertainty in estimating future events, so, for each pipe category pessimistic and optimistic estimates of the useful life-spans are made. This results in a pessimistic

survival function based on short life expectancies and an optimistic survival function based on long life expectancies of each pipe category.

The KANEW model developed in this study is user friendly and capable of providing 13 different sets of graphical and tabular outputs primarily showing percent or length of water mains of each category to be rehabilitated or replaced each year during a specified planning period.

CASE STUDIES

KANEW was applied to four U.S. and one UK water utility. The project team worked with each utility to select water main categories for modeling and to estimate life expectancies for each category. In some cases, the project team also worked closely with the utility to collect the data necessary to complete the water main inventory for modeling.

Each water utility was unique in terms of data availability. Some had detailed computerized databases with which the water main inventory could be readily generated. Others had more limited data available and relied on known information about the distribution system and assumptions by personnel familiar with the system. In one case, the utility had enough historic data available to calculate aging functions for several of its water main categories. Regardless of the level of detail available, the model was shown to provide valuable guidance for utilities in planning long-term rehabilitation and replacement programs. The results of the case studies and the characterization of North American water utilities indicate that due to lack of availability of a detailed inventory of pipes for water utilities, inventory of each separate group of pipes cannot be developed. Rather, several groups of pipes can be consolidated to compromise with the lack of data. Additionally, it was found that the unlined cast iron water mains were the predominant type of mains in North American water utilities, and required most of the replacement or rehabilitation. For the test case utilities the following observations were made:

1. Under optimistic assumptions for PWD, the rehabilitation and replacement rate is fairly constant at approximately 0.6% to 0.8% of water mains per year. Under pessimistic assumptions, about 1.2% rehabilitation and replacement is required at the beginning of the planning period with this rate dropping during the latter part of the

planning period. Small diameter cast iron mains are the predominant pipes for rehabilitation and replacement.

2. Under optimistic assumptions LADWP would require rehabilitation and replacement rates of approximately 2.3% of its water main annually, gradually declining to 1.1% by year 2015. Under pessimistic assumptions, the predicted rehabilitation and replacement rates start at the rate of 4.4% annually and then decline to 1.1% by year 2015. LADWP's actual rehabilitation and replacement rate of 2.7% for fiscal year 1995 fell between the optimistic and pessimistic assumptions. Again, most of the water mains that are rehabilitated or replaced are cast iron mains.
3. BWSC water systems require about 2% per year (optimistic assumptions) to about 6.5% per year (pessimistic assumptions) at the beginning of the planning period. Most of these candidates mains are 8 inch to 12 inch unlined cast iron mains. In recent years the actual replacement and rehabilitation rates at BWSC have been very close to the optimistic estimation.
4. Due to its relatively young age, FWWD's rehabilitation and replacement needs increased with time as the average age of the system increased coming closer to the life-span estimates.
5. Under optimistic assumptions the water main replacement and rehabilitation rate for Nottinghamshire Water System of STW is 1.5% per year. Under pessimistic assumptions, the rate of rehabilitation and replacement starts initially at 3.3% annually and then reduces to about 1.5% by year 2015. Most of the candidate water mains for replacement and rehabilitation are cast iron and gray iron pipes.

RECOMMENDATIONS

To develop good estimates of water main replacement and rehabilitation needs the following recommendations are made for North American water utilities:

1. KANEW should be used by other water utilities for assessing and developing water main replacement and rehabilitation programs.

2. Water utilities should develop better database management systems for their existing distribution system inventories and for capturing historical water main replacement and rehabilitation data.
3. Water utilities should develop geographic information systems (GIS) which would also assist utilities in the use of the model.
4. A workshop should be conducted to discuss and develop consensus on estimation of survival functions for various categories of water mains.

FUTURE WORK

The following are recommended for future work:

1. The present model should be enhanced by incorporating
    - main break functions to predict water main break frequency changes as a result of the implementation of different rehabilitation and replacement strategies
    - the impact of future rehabilitation and replacement work in the development of rehabilitation and replacement strategies
    - the impact of the frequency and cost of failures on rehabilitation and replacement strategies
2. A companion model should be developed. This model would derive survival functions for various water main categories from historical data on main failures, and replacement and rehabilitation data.
3. Additional investigations should be conducted on the prioritization of rehabilitation and replacement work using results from KANEW and other information found in engineering literature.

Appendix B

KANEW Results

Appendix B KANEW Results

Long Life Expectancy Annual Renewal Rates for Categories of Water Main

TABLE B-1: LONG LIFE EXPECTANCY ANNUAL RENEWAL LENGTHS BY LENGTH (FEET)

Year	AC	CIP1	CIP2	CIP3&CIP4	CO	CU	DI	PVC	STL
1	44	15,517	8,883	8,981	170	66	0	0	216
2	44	14,192	10,065	8,880	192	52	0	0	200
3	43	12,963	11,214	8,757	214	41	0	0	186
4	42	11,820	12,261	8,664	233	33	0	0	173
5	42	10,754	13,136	8,500	249	26	0	0	161
6	41	9,756	13,776	8,316	260	21	0	0	150
7	128	8,821	14,138	8,630	267	16	0	0	141
8	135	7,947	14,202	14,411	267	13	0	0	131
9	141	7,135	13,990	15,382	261	10	0	0	123
10	148	6,382	13,528	16,657	252	8	0	0	115
11	154	5,686	12,882	17,666	239	6	0	0	108
12	161	5,050	12,114	17,519	225	5	0	0	102
13	168	4,468	11,291	17,138	212	4	0	0	96
14	174	3,937	10,464	16,727	200	3	0	0	90
15	180	3,460	9,665	16,291	192	3	0	0	85
16	186	3,029	8,926	15,832	188	2	0	0	81
17	208	2,645	8,245	15,410	192	2	0	0	76
18	214	2,300	7,635	14,913	198	1	0	0	72
19	219	2,001	7,092	14,402	209	1	0	0	68
20	223	1,740	6,603	13,883	224	1	0	0	64
Total	2,696	139,602	220,108	266,957	4,442	314	0	0	2,437

TABLE B-2: LONG LIFE EXPECTANCY ANNUAL RENEWAL LENGTHS BY PERCENTAGE

Year	AC	CIP1	CIP2	CIP3&CIP4	CO	CU	DI	PVC	STL
1	0.5%	10.3%	3.1%	1.8%	0.7%	17.9%	0.0%	0.0%	6.3%
2	0.5%	9.4%	3.5%	1.8%	0.8%	14.2%	0.0%	0.0%	5.9%
3	0.5%	8.6%	3.9%	1.7%	0.9%	11.3%	0.0%	0.0%	5.5%
4	0.5%	7.9%	4.3%	1.7%	0.9%	9.0%	0.0%	0.0%	5.1%
5	0.5%	7.2%	4.6%	1.7%	1.0%	7.1%	0.0%	0.0%	4.7%
6	0.5%	6.5%	4.8%	1.6%	1.1%	5.6%	0.0%	0.0%	4.4%
7	1.5%	5.9%	4.9%	1.7%	1.1%	4.4%	0.0%	0.0%	4.1%
8	1.6%	5.3%	5.0%	2.9%	1.1%	3.5%	0.0%	0.0%	3.9%
9	1.6%	4.7%	4.9%	3.1%	1.1%	2.8%	0.0%	0.0%	3.6%
10	1.7%	4.2%	4.7%	3.3%	1.0%	2.2%	0.0%	0.0%	3.4%
11	1.8%	3.8%	4.5%	3.5%	1.0%	1.8%	0.0%	0.0%	3.2%
12	1.9%	3.4%	4.2%	3.5%	0.9%	1.4%	0.0%	0.0%	3.0%
13	1.9%	3.0%	4.0%	3.4%	0.9%	1.1%	0.0%	0.0%	2.8%
14	2.0%	2.6%	3.7%	3.3%	0.8%	0.9%	0.0%	0.0%	2.7%
15	2.1%	2.3%	3.4%	3.2%	0.8%	0.7%	0.0%	0.0%	2.5%
16	2.2%	2.0%	3.1%	3.1%	0.8%	0.6%	0.0%	0.0%	2.4%
17	2.4%	1.8%	2.9%	3.1%	0.8%	0.5%	0.0%	0.0%	2.2%
18	2.5%	1.5%	2.7%	3.0%	0.8%	0.3%	0.0%	0.0%	2.1%
19	2.5%	1.3%	2.5%	2.9%	0.8%	0.3%	0.0%	0.0%	2.0%
20	2.6%	1.2%	2.3%	2.8%	0.9%	0.2%	0.0%	0.0%	1.9%
Total	31.4%	92.9%	77.0%	53.0%	18.0%	85.8%	0.0%	0.0%	71.8%

Short Life Expectancy Annual Renewal Rates for Categories of Water Main

TABLE B-3: SHORT LIFE EXPECTANCY ANNUAL RENEWAL LENGTHS BY LENGTH (FEET)

Year	AC	CIP1	CIP2	CIP3&CIP4	CO	CU	DI	PVC	STL
1	371	21,305	48,814	26,873	1,004	66	0	0	344
2	371	18,354	40,482	26,529	886	52	0	0	304
3	369	15,796	33,584	26,078	796	41	0	0	271
4	367	13,580	27,899	25,526	729	33	0	0	241
5	363	11,665	23,225	24,881	679	26	0	0	216
6	358	10,012	19,380	24,157	639	21	0	0	194
7	353	8,588	16,203	23,360	606	16	349	0	174
8	345	7,362	13,560	22,500	577	13	432	0	157
9	337	6,308	11,345	21,587	550	10	533	0	141
10	326	5,400	9,474	20,634	524	8	670	0	128
11	316	4,623	7,876	19,646	501	6	915	0	115
12	304	3,958	6,527	18,636	482	5	1,186	0	104
13	291	3,390	5,368	17,617	467	4	1,590	0	94
14	278	2,901	4,387	16,598	457	3	2,040	0	84
15	265	2,480	3,571	15,585	454	3	2,621	0	76
16	251	2,118	2,904	14,589	458	2	3,285	0	68
17	241	1,809	2,347	13,617	468	3	4,524	0	61
18	228	1,547	1,911	12,670	485	3	5,512	0	56
19	215	1,328	1,563	11,756	508	3	6,645	0	50
20	202	1,145	1,282	10,879	537	3	7,968	0	45
Total	6,151	143,669	281,700	393,718	11,806	322	38,269	0	2,923

TABLE B-4: SHORT LIFE EXPECTANCY ANNUAL RENEWAL LENGTHS BY PERCENTAGE

Year	AC	CIP1	CIP2	CIP3&CIP4	CO	CU	DI	PVC	STL
1	4.3%	14.2%	17.1%	5.3%	4.1%	18.0%	0.0%	0.0%	10.1%
2	4.3%	12.2%	14.2%	5.3%	3.6%	14.3%	0.0%	0.0%	9.0%
3	4.3%	10.5%	11.8%	5.2%	3.2%	11.3%	0.0%	0.0%	8.0%
4	4.3%	9.0%	9.8%	5.1%	3.0%	9.0%	0.0%	0.0%	7.1%
5	4.2%	7.8%	8.1%	4.9%	2.8%	7.1%	0.0%	0.0%	6.4%
6	4.2%	6.7%	6.8%	4.8%	2.6%	5.6%	0.0%	0.0%	5.7%
7	4.1%	5.7%	5.7%	4.6%	2.5%	4.4%	0.0%	0.0%	5.1%
8	4.0%	4.9%	4.7%	4.5%	2.3%	3.5%	0.0%	0.0%	4.6%
9	3.9%	4.2%	4.0%	4.3%	2.2%	2.8%	0.0%	0.0%	4.2%
10	3.8%	3.6%	3.3%	4.1%	2.1%	2.2%	0.1%	0.0%	3.8%
11	3.7%	3.1%	2.8%	3.9%	2.0%	1.8%	0.1%	0.0%	3.4%
12	3.5%	2.6%	2.3%	3.7%	2.0%	1.4%	0.1%	0.0%	3.1%
13	3.4%	2.3%	1.9%	3.5%	1.9%	1.1%	0.1%	0.0%	2.8%
14	3.2%	1.9%	1.5%	3.3%	1.9%	0.9%	0.2%	0.0%	2.5%
15	3.1%	1.7%	1.2%	3.1%	1.8%	0.7%	0.2%	0.0%	2.2%
16	2.9%	1.4%	1.0%	2.9%	1.9%	0.6%	0.3%	0.0%	2.0%
17	2.8%	1.2%	0.8%	2.7%	1.9%	0.9%	0.4%	0.0%	1.8%
18	2.7%	1.0%	0.7%	2.5%	2.0%	0.8%	0.4%	0.0%	1.6%
19	2.5%	0.9%	0.5%	2.3%	2.1%	0.8%	0.5%	0.0%	1.5%
20	2.4%	0.8%	0.4%	2.2%	2.2%	0.8%	0.6%	0.0%	1.3%
Total	71.5%	95.6%	98.6%	78.1%	47.9%	88.0%	3.1%	0.0%	86.1%

Appendix C

Soil Corrosivity

Soil Corrosivity

Code	Defined_Code	Ferrous Corrosivity	Concrete Corrosivity
Ad	Adrian muck	High	Moderate
BbB	Blount loam, 2 to 6 percent slopes	High	High
BnB	Boyer loamy sand, 0 to 6 percent slopes	Low	Moderate
BnC	Boyer loamy sand, 6 to 12 percent slopes	Low	Moderate
BnD	Boyer loamy sand, 12 to 18 percent slopes	Low	Moderate
BnE	Boyer loamy sand, 18 to 25 percent slopes	Low	Moderate
BnF	Boyer loamy sand, 25 to 40 percent slopes	Low	Moderate
BP	Borrow pit		
Br	Brookston loam	High	Low
Cc	Cohoctah fine sandy loam, frequently flooded	High	Low
CoB	Conover loam, 0 to 4 percent slopes	High	Moderate
CpA	Conover-Brookston loams, 0 to 2 percent slopes	High	Moderate
Ee	Edwards muck, shallow variant	High	Low
Fd	Fill land		
FoA	Fox sandy loam, 0 to 2 percent slopes	Moderate	Moderate
FoB	Fox sandy loam, 2 to 6 percent slopes	Moderate	Moderate
FoC	Fox sandy loam, 6 to 12 percent slopes	Moderate	Moderate
FoD	Fox sandy loam, 12 to 18 percent slopes	Moderate	Moderate
FoE	Fox sandy loam, 18 to 25 percent slopes	Moderate	Moderate
FpB	Fox cobbly sandy loam, cobbly variant, 2 to 6 %	Low	Moderate
Gf	Granby fine sand	High	Moderate
GP	Gravel pit		
Hn	Houghton muck	High	Moderate
Ho	Hoytville silty clay loam	High	Low
INT	Intermitten Water		
KeB	Kendallville loam, 2 to 6 percent slopes	Moderate	Moderate
KnA	Kibbie fine sandy loam, 0 to 4 percent slopes	High	Moderate
KrB	Kidder sandy loam, 2 to 6 percent slopes	Moderate	Low
KrC	Kidder sandy loam, 6 to 12 percent slopes	Moderate	Low
Mb	Made land		
MdA	Matherton sandy loam, 0 to 4 percent slopes	Moderate	Low
MfA	Metamora sandy loam, 0 to 4 percent slopes	Moderate	Moderate
MmB	Miami loam, 2 to 6 percent slopes	Moderate	Moderate
MmC	Miami loam, 6 to 12 percent slopes	Moderate	Moderate
MmD	Miami loam, 12 to 18 percent slopes	Moderate	Moderate
MmE	Miami loam, 18 to 25 percent slopes	Moderate	Moderate
MmF	Miami loam, 25 to 35 percent slopes	Moderate	Moderate

Code	Defined_Code	Ferrous Corrosivity	Concrete Corrosivity
MoB	Morley loam, 2 to 6 percent slopes	High	Moderate
MoC	Morley loam, 6 to 12 percent slopes	High	Moderate
MoD	Morley loam, 12 to 18 percent slopes	High	Moderate
NaA	Nappanee silty clay loam, 0 to 2 percent slopes	High	Low
NaB	Nappanee silty clay loam, 2 to 6 percent slopes	High	Low
OaB	Oakville fine sand, 0 to 6 percent slopes	Low	Moderate
OsB	Oshtemo loamy sand, 0 to 6 percent slopes	Low	High
OsC	Oshtemo loamy sand, 6 to 12 percent slopes	Low	High
OwB	Owosso-Miami complex, 2 to 6 percent slopes	Moderate	Moderate
OwC	Owosso-Miami complex, 6 to 12 percent slopes	Moderate	Moderate
Pa	Palms muck	High	Moderate
Pc	Pella silt loam	High	Low
Pe	Pewamo clay loam	High	Low
Sb	Sebewa loam	High	Low
SeB	Seward loamy fine sand, 2 to 6 percent slopes	High	Moderate
SeC	Seward loamy fine sand, 6 to 12 percent slopes	High	Moderate
SfB	Seward sandy loam, loamy subsoil variant, 2 to 6 %	High	Moderate
SnB	Sisson fine sandy loam, 2 to 6 percent slopes	Low	Low
SnC	Sisson fine sandy loam, 6 to 12 percent slopes	Low	Low
So	Sloan silt loam, wet	High	Low
SpB	Spinks loamy sand, 0 to 6 percent slopes	Low	Low
SpC	Spinks loamy sand, 6 to 12 percent slopes	Low	Low
SpD	Spinks loamy sand, 12 to 18 percent slopes	Low	Low
SpE	Spinks loamy sand, 18 to 25 percent slopes	Low	Low
SrB	Spinks-Oshtemo loamy sands, 0 to 6 percent slopes	Low	Low
StB	St. Clair clay loam, 2 to 6 percent slopes	High	Moderate
StC	St. Clair clay loam, 6 to 12 percent slopes	High	Moderate
StD	St. Clair clay loam, 12 to 18 percent slopes	High	Moderate
StE	St. Clair clay loam, 18 to 35 percent slopes	High	Moderate
ThA	Thetford loamy sand, 0 to 4 percent slopes	Low	Moderate
URB	Urban area		
W	Water		
WaA	Wasepi sandy loam, 0 to 4 percent slopes	Moderate	Low
YpA	Ypsi sandy loam, 0 to 4 percent slopes	High	Moderate

Appendix D

Consequence of Failure – Critical Users Data

Appendix E

Consequence of Failure – Large Users Data

Appendix F

Data Gaps and Assumption

DATA GAPS AND ASSUMPTIONS

Summary of Data

- GIS data – some missing data, some inconsistent data, no unique IDs
- No link between model pipes and GIS pipes
  - Hydraulic performance (c-values)
  - High headloss and velocity
- Leaks and breaks
  - Spatial location not on pipes
  - Break data does not include pipe diameter, etc.
  - Break data does not include cause
- Critical Users – 5 from Master Plan, identified pipes
- Large Users – Top 12 users from 2012 Consumption
  - > 50 gpm

Modifications to GIS – Material and Installation Date

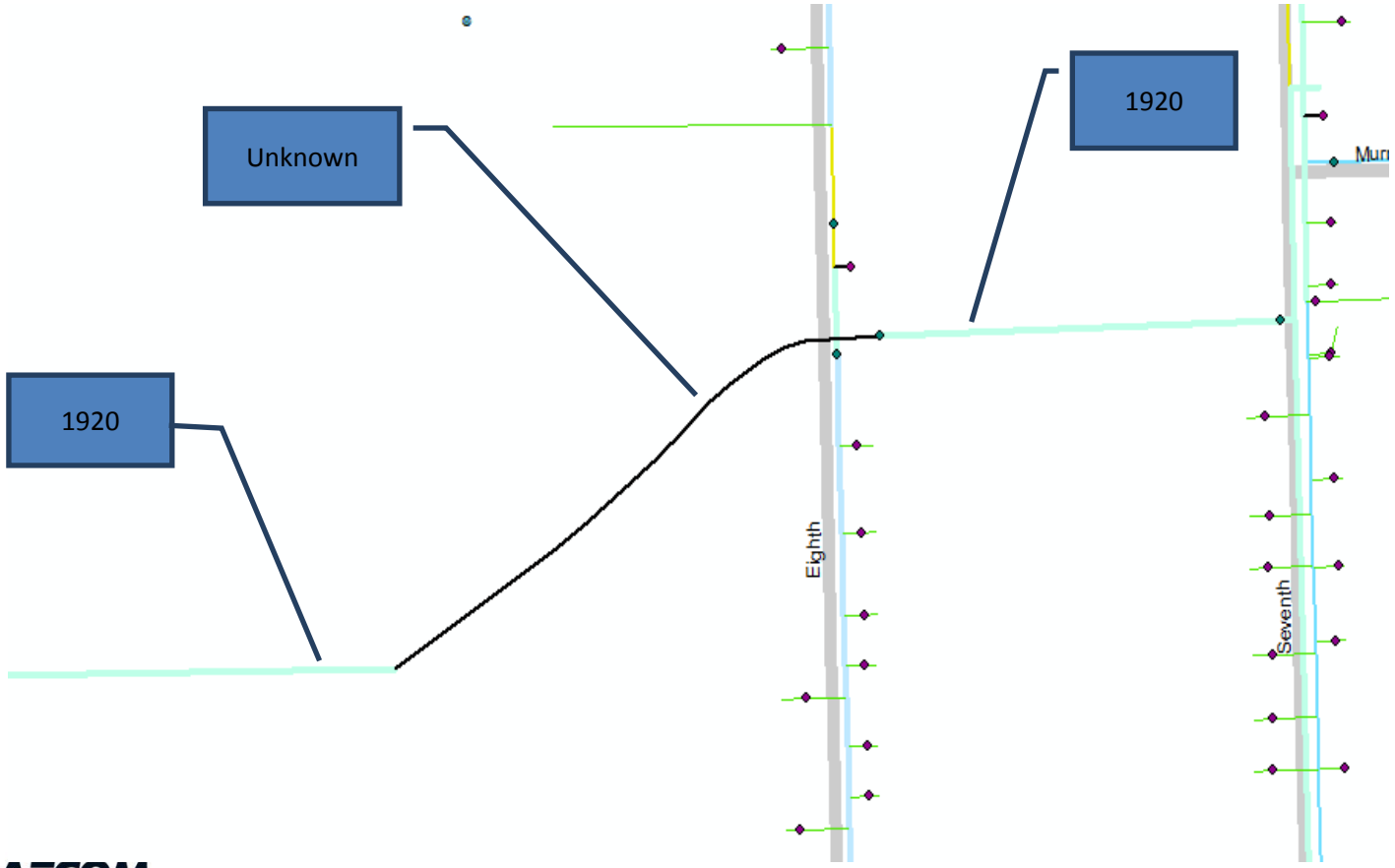
- Unknown materials and installation dates
- Inconsistent material and installation dates
  - 1/1/1960 – did not change (may be cast iron or ductile iron)
  - Pre1964 ductile iron was changed to cast iron
  - Post1964 cast iron was changed to ductile iron
- Examples of other inconsistent data
  - Small diameter steel pipe
  - Large diameter copper pipe
  - Small piece of pipe with different diameter pipe on both sides

Modifications to GIS – Material and Installation Date – Summary of Changes

- Installation date modified on 229 GIS pipes (8.8 miles/1.6%)
- Material modified on 1,509 pipes (64 miles/12%)
  - 662 pipes changed to DIP from CIP with installation date after 1964
  - 725 pipes changed to CIP from DIP with installation date pre 1964
- 1/1/1960 installation date → No edit, 566 pipes (22 miles/4%)
- 287 GIS pipes modified based on adjacent pipe; as-builts; utility discussions; and hydrant, valve, and/or water tap data

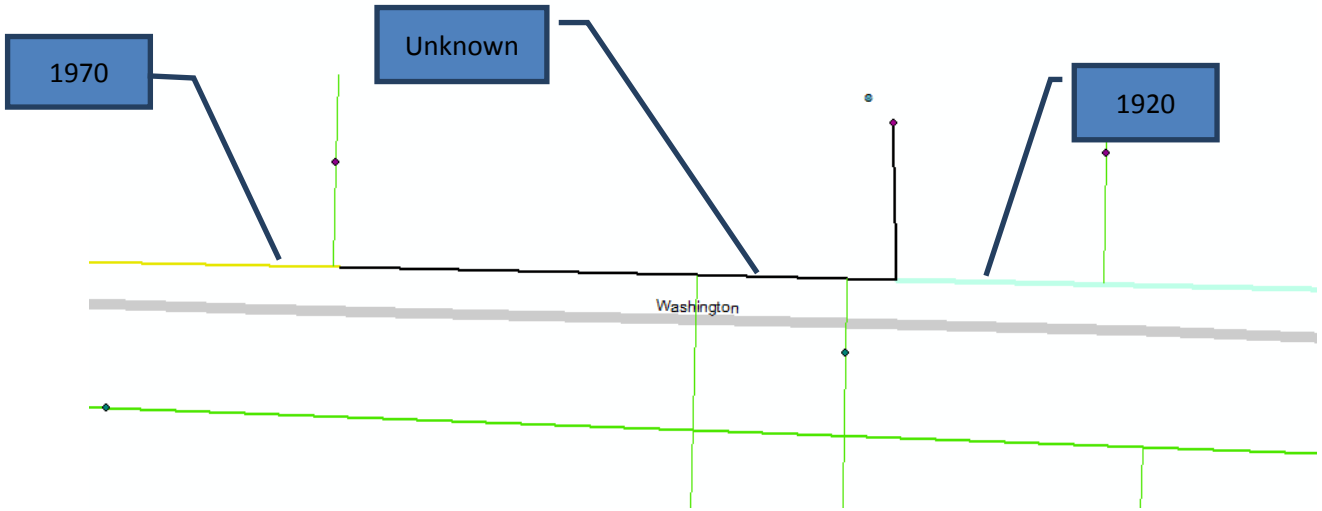
Situation 1: Unknown installation date segment with the same installation date on both sides

- Assumption:
  - Unknown segments same as adjacent water mains



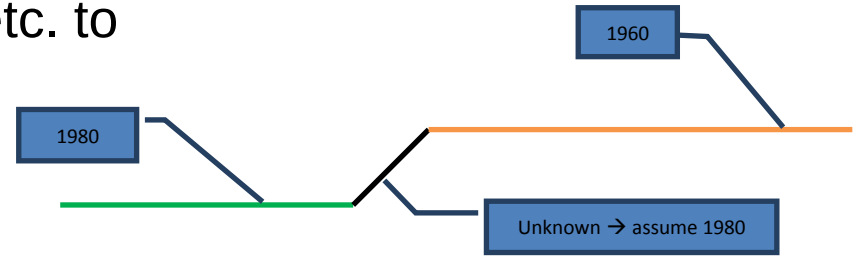
Situation 2: Unknown installation date segment with different installation date on both sides

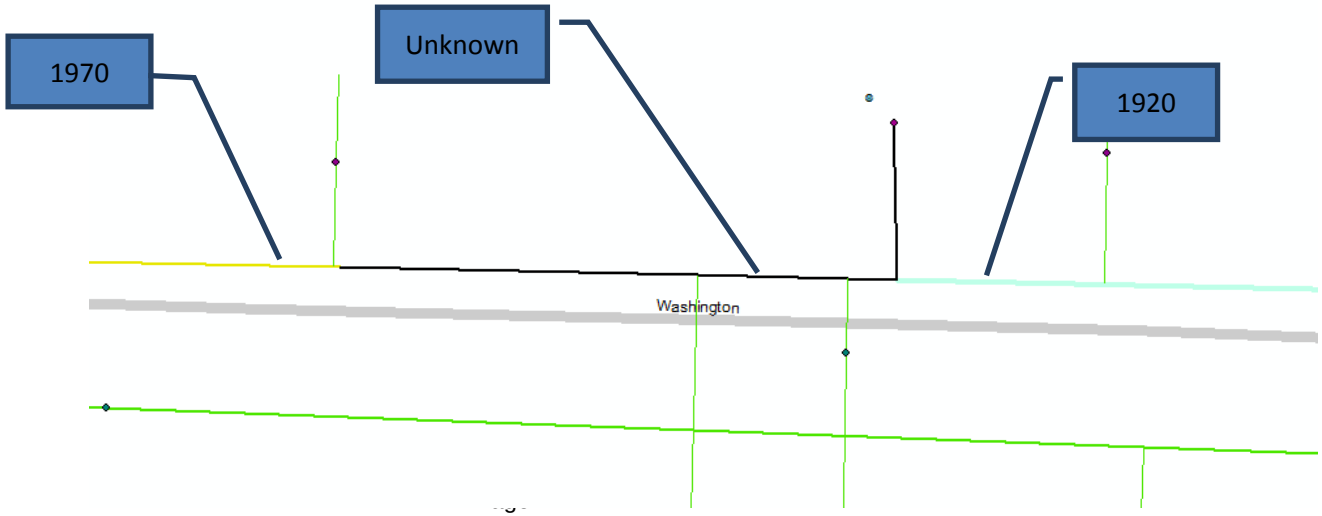
- Assumption:
  - Take date of water main with matching material. Use services, valves, hydrants, etc. to help estimate which year. No information, assume newer installation year.



Situation 2: Unknown installation date segment with different installation date on both sides

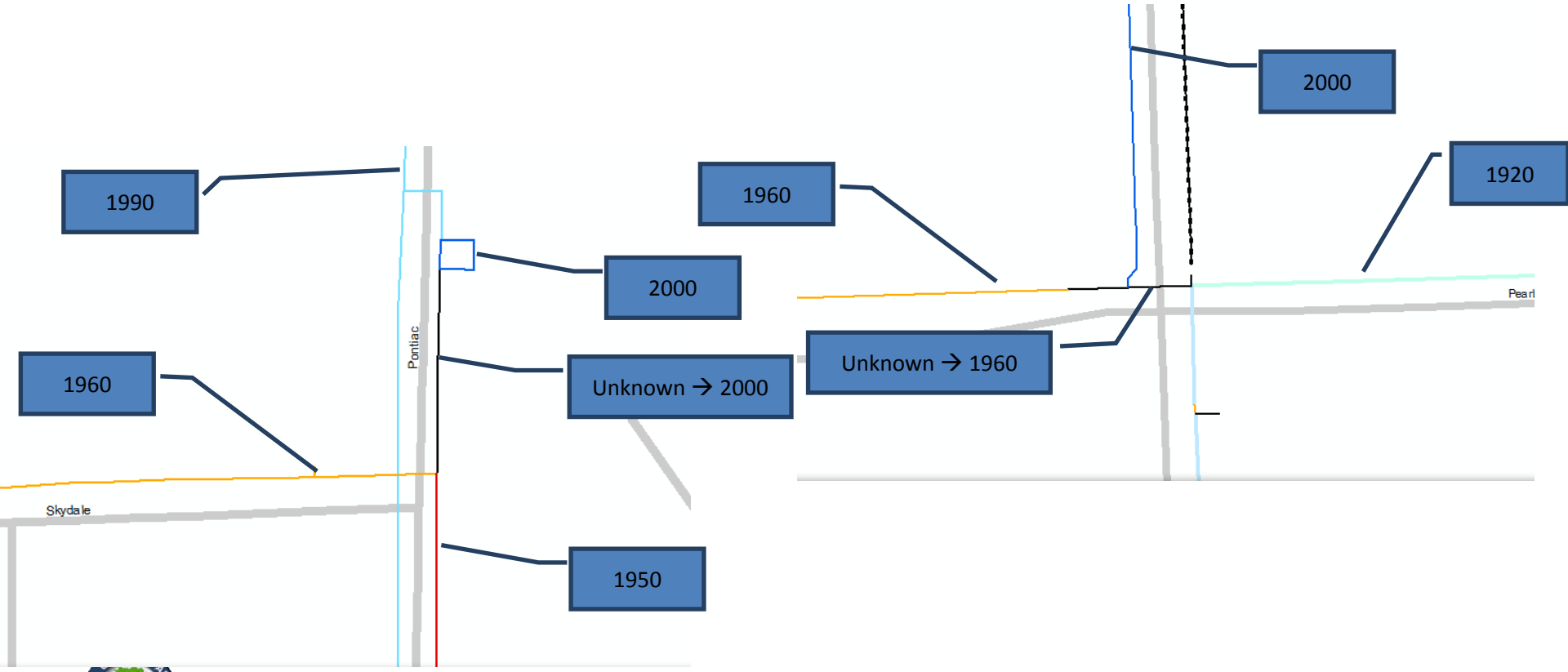
- Assumption:
  - Take date of water main with matching material.
  - Use services, valves, hydrants, etc. to help estimate which year.
  - No information, assume newer installation year.
  - Kink in water main likely part of the newer main





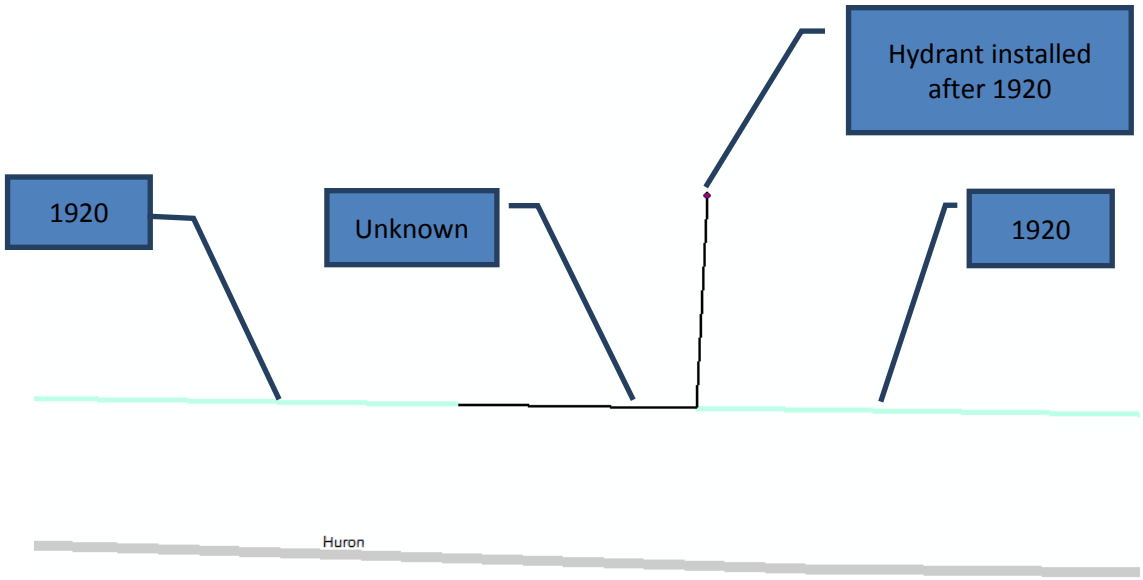
Situation 3: Intersection with different installation dates

- Assumption:
  - Unknown segment is the same as the main on the same side of the intersection.



Situation 4: Unknown installation by newer installed hydrant

- Assumption:
  - Unknown main most likely not replaced with hydrant and is the same as the rest of the main.



GIS/Model Link for Hydraulic Performance and Headloss/Velocity

- Link between model and GIS pipes does not exist
- Join to make link
  - Inconsistencies in data such as:
    - Diameters (925 pipes)
    - Model does not include all pipes (ex. raw water)
    - Model has AIP pipe, not newer pipe

Hydraulic Performance (C-values)

- Inconsistent installation date and material between model and GIS
- C-values in model summary

Material	Number of Pipes	Range of Installation Dates	Range of C-values
Cast Iron	6	2007 and 9999	120 - 140
Ductile Iron	863	1968 to 2008	65 - 140
Plastic	46	2001 to 2005	115 - 140
Copper	1	1968	65
GI	1	1938	65
SJP/RJP	17	2000	110 - 140
Unknown	10,905	1920 to 2013	61 - 140
Total	11,839		

Hydraulic Performance (C-value) Assumptions

Material / Installation Date	C-value
Cast Iron	
1880	60
1890	62
1900	65
1910	70
1920	75
1930	85
1940	95
1950	110
1960	120
Ductile Iron	
1960	100
1970	115
1980	110
1990	120
2000	130
2010	135

Material	C-value
PVC	135
HDPE	135
C909	135
AC	110
Concrete	70
Copper	100

Headloss/Velocity

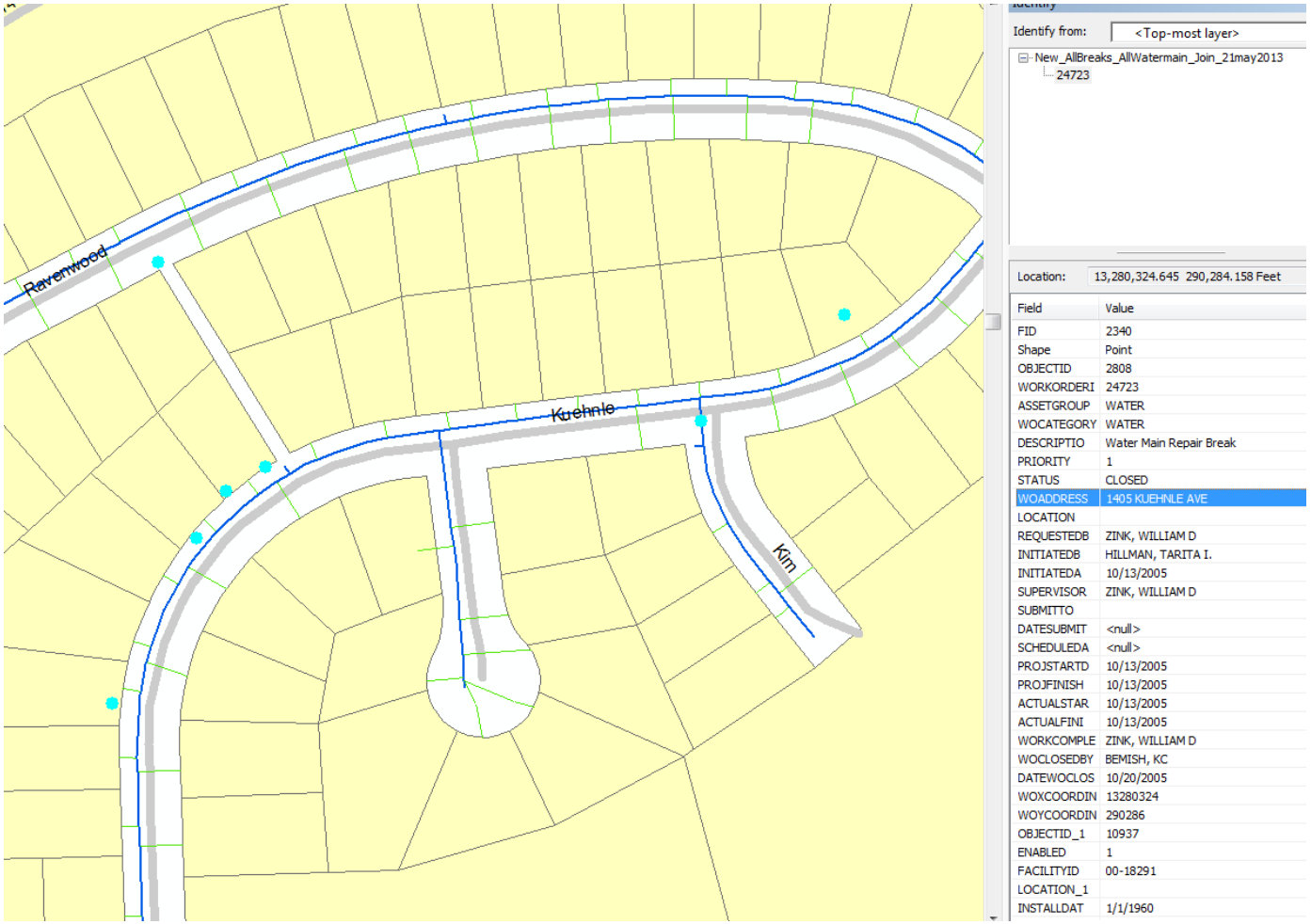
- Some mains with high headloss/velocity in model were pipes in the model that did not have the same diameter as the GIS
  - If GIS diameter was larger, recalculated based on model flow
  - If GIS diameter was smaller, results assumed were okay
  - If GIS main was not in model, main was assumed not to have high headloss/velocity

Leaks and Breaks

- Used last 10 years
- City updated spatial location where possible on records with location issues
  - Not located at correct address
  - Located between two parallel mains
  - Located near intersection
  - “Conversion” breaks were assumed okay
- Breaks on water main newer than break year occurred were removed.
- Spatial join to nearest water main

Leaks and Breaks – Data

- Spatial locations typically not on water mains
  - Uncertain if assigned to correct main (examples follow)
- Limited data associated with leak
  - Diameter of water main not included as a check
  - Reason for leak/break not included
- Some leak/breaks were removed about review by Ann Arbor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Kuehnle
Kim
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2808
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24723
ASSETGROUP
WATER
WOCATEGORY
WATER
DESCRIPTIO
Water Main Repair Break
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PROJFINISH
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ACTUALSTAR
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ACTUALFINI
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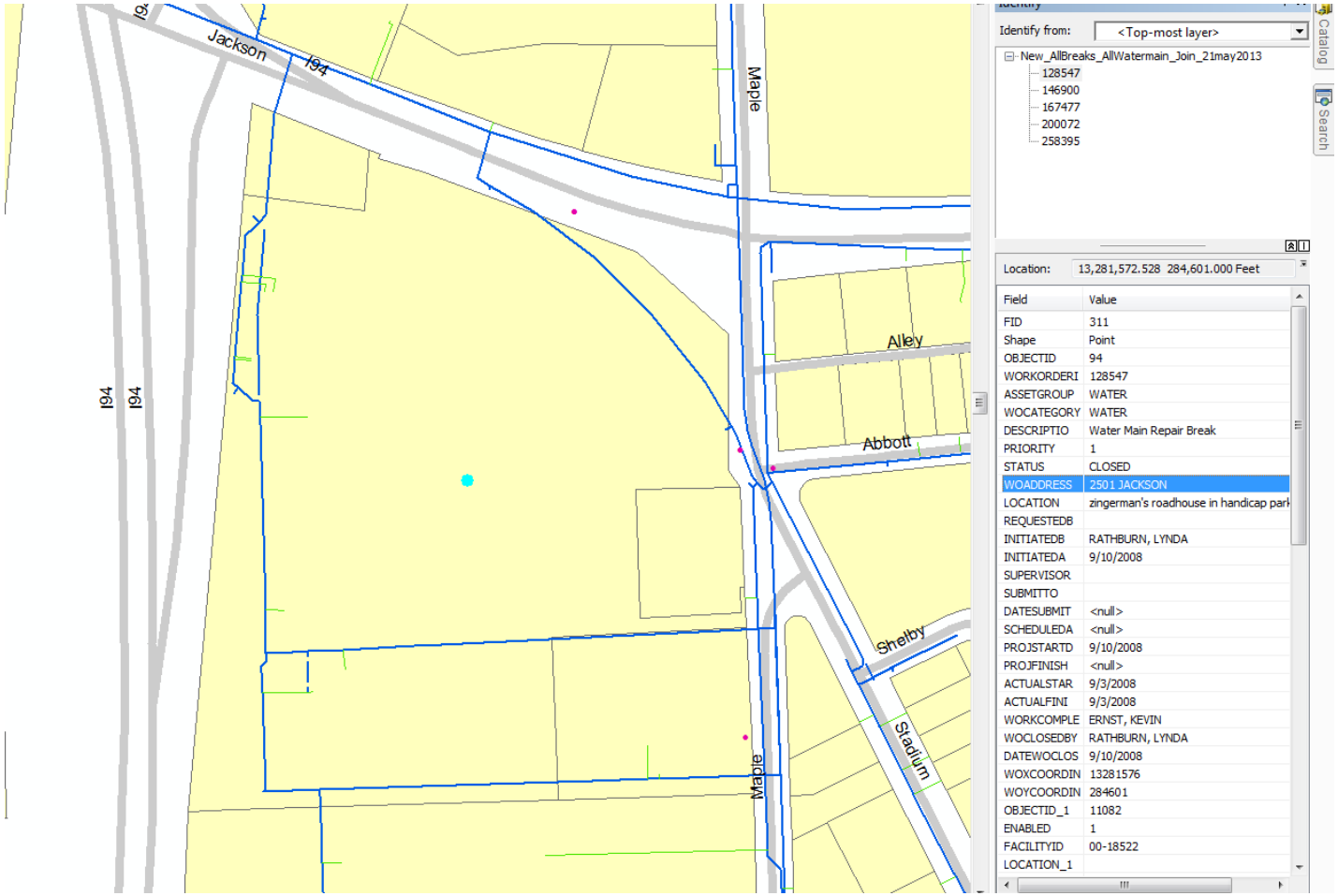
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Maple
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Abbott
Shelby
Stadium
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WOCATEGORY WATER
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INITIATEDA 9/10/2008
SUPERVISOR
SUBMITTO
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PROJSTARTD 9/10/2008
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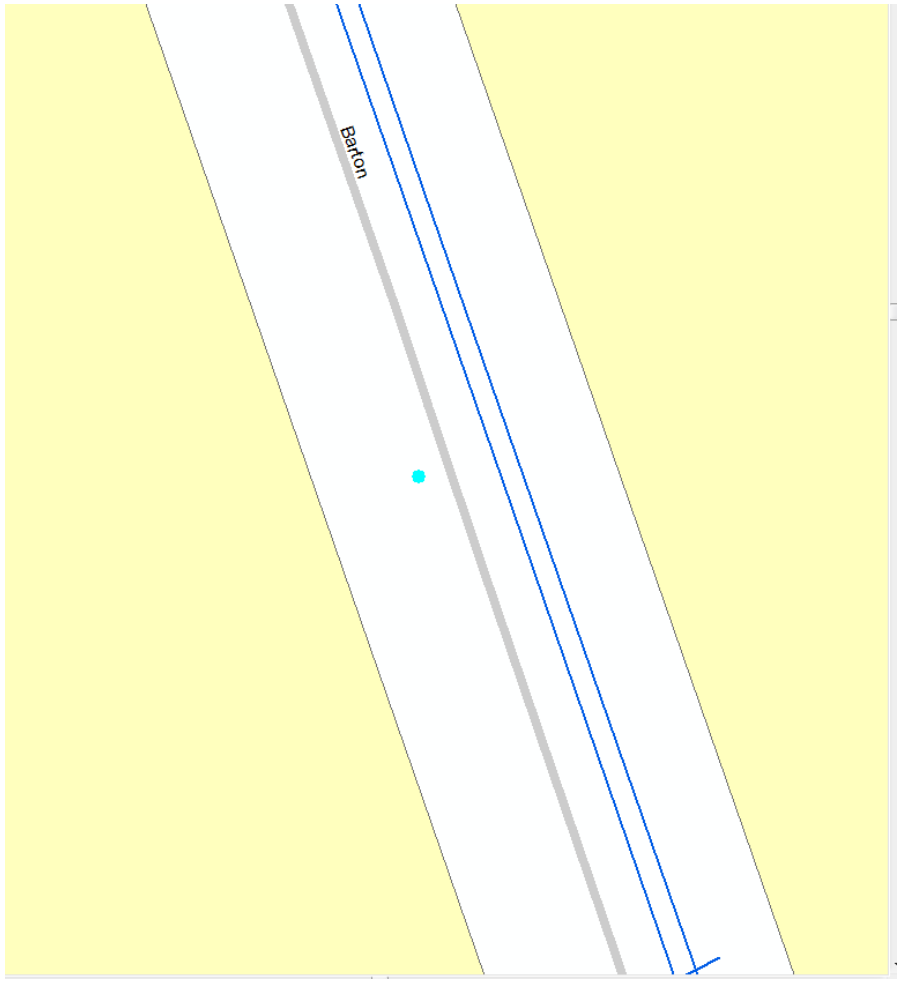
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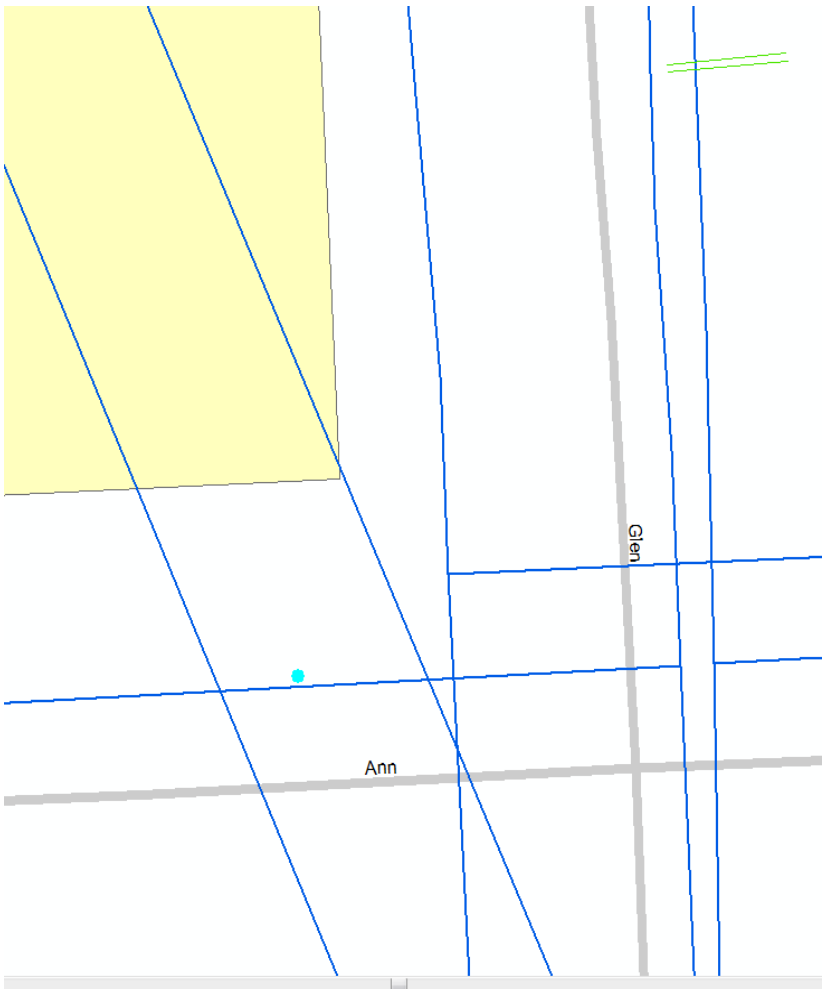
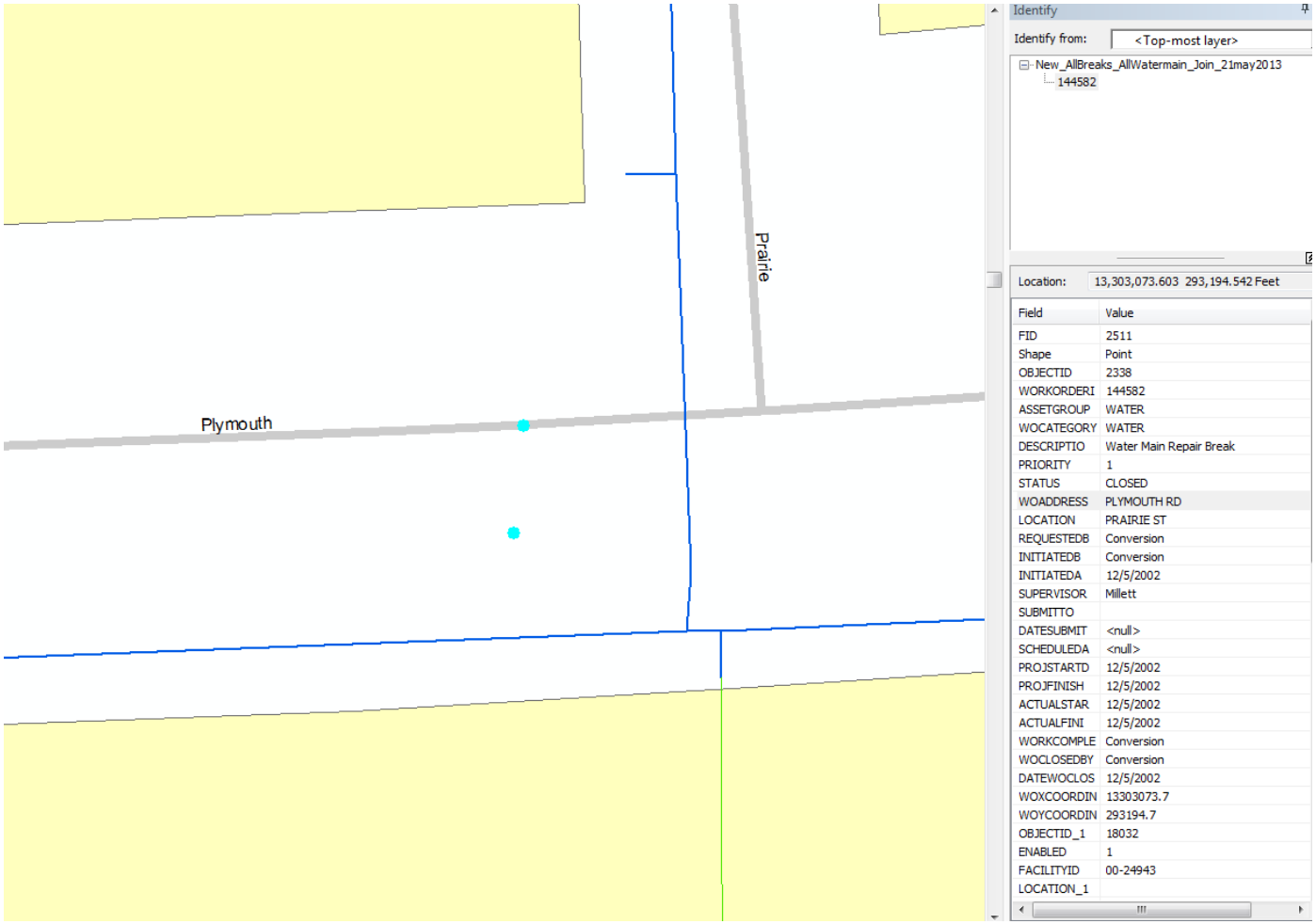

Glen
Ann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Prairie
Identify
Identify from:
<Top-most layer>
New_AllBreaks_AllWatermain_Join_21may2013
144582
Location:
13,303,073.603 293,194.542 Feet
Field
Value
FID 2511
Shape Point
OBJECTID 2338
WORKORDERI 144582
ASSETGROUP WATER
WOCATEGORY WATER
DESCRIPTIO Water Main Repair Break
PRIORITY 1
STATUS CLOSED
WOADDRESS PLYMOUTH RD
LOCATION PRAIRIE ST
REQUESTEDB Conversion
INITIATEDB Conversion
INITIATEDA 12/5/2002
SUPERVISOR Millett
SUBMITTO
DATESUBMIT <null>
SCHEDULEDA <null>
PROJSTARTD 12/5/2002
PROJFINISH 12/5/2002
ACTUALSTAR 12/5/2002
ACTUALFINI 12/5/2002
WORKCOMPLE Conversion
WOCLOSEDBY Conversion
DATEWOCLOS 12/5/2002
WOXCOORDIN 13303073.7
WOYCOORDIN 293194.7
OBJECTID_1 18032
ENABLED 1
FACILITYID 00-24943
LOCATION_1