







CITY OF Bloomington ILLINOIS

2014 City of Bloomington Stormwater and Sanitary Sewer Master Plans

January 2014

Foth No. 12B005

Foth | 75 YEARS

OHM Advancing Communities

Baker

Navigating the Master Plan



The *2014 City of Bloomington Stormwater and Sanitary Sewer Master Plans* document has one (1) Master Executive Summary. The plan document is then divided into three main sections (Sanitary Sewer, Stormwater, and Asset Management), each containing five (5) individual Technical Memoranda, with its own Executive Summary.

The Master Plans are organized and presented in a single document as follows:

2014 City of Bloomington Stormwater and Sanitary Sewer Master Plans	
Master Executive Summary	
Sanitarys Sewer Technical Memoranda	
SAN1	East Side Interceptor System Hydrologic Analysis
SAN2	East Side Interceptor / GE Valley Collector System Capacity Assessment
SAN3	Sanitary Sewer Evaluation Survey (SSES)
SAN4	Wet Weather Alternatives East Side Interceptor System
SAN5	Sanitary Pump Station SCADA (Supervisory Control And Data Acquisition) System
Stormwater Technical Memoranda	
ST1	Delineation Of Stormwater Problem Areas
ST2	Hydrologic/Hydraulic Modeling In Priority Watersheds, Oakland Avenue Watershed Stormwater Model, Combined Sewer Separation Opportunities
ST3	Streambank Inventory
ST4	Greenways Plan – Sustainable Design Initiatives
ST5	Sugar Creek Analysis
Asset Management Technical Memoranda	
AM1	Pipe Condition Rating Methodology Recommendations
AM2	GIS Based Infrastructure Rating System
AM3	Asset Management Program Work Order Needs Analysis
AM4	Assessment For CCTV Inspections
AM5	Best Management Practices (BMPS) For Bloomington Storm And Sanitary Utility Operations

This document's table of contents is furnished with links to the respective pages. A mouse click on the page number will navigate you to that page within the document.

For convenience, the Master Executive Summary and all fifteen individual executive summaries have been compiled into a single document entitled *Compilation of Executive Summaries for 2014 City of Bloomington Stormwater and Sanitary Sewer Master Plans.*

Table of Contents



Page #

MASTER EXECUTIVE SUMMARY

What is the State of the City's Infrastructure? E-1
How do we Define Level of Service? E-1
Total Program Cost E-2
Managing Infrastructure as "Business" E-2
Determining Existing Problems E-3
Regulatory Considerations E-3
Impact of this Master Plan on City and BNWRD Facilities E-4
Educating and Involving the Public E-4
APPENDIX
Q&A – Bloomington Stormwater and Sanitary Sewer Master Plan E-A1
Master Plan Cost Summary (Detailed) E-A2
List of Technical Memoranda E-A3

Foth
1610 Broadmoor Drive
Champaign, IL 61821
(217) 352-4169 • Fax: (217) 352-0085
www.foth.com

Table of Contents



Page #

SANITARY SEWER TECHNICAL MEMORANDA

SAN1- East Side Interceptor System Hydrologic Analysis

Executive Summary 1
Project Summary 2
Methodology 4
I/I Analysis 5
Hydrologic Model Development 6
Evaluation of Future System Flows 9
Long Term Simulation of Flows and Frequency Analysis 11
Benchmarking Analysis 15
Baseflows 16
Findings & Recommendations 17
Appendix A ..... 6 pgs
- Model Description 1
- Model Parameters 2-6

Appendix B ..... 38 pgs
- Model Calibration and Validation Results 1-38



SAN2 - East Side Interceptor System Capacity Assessment

Executive Summary 1
Project Summary 2
Need for Study 2
Extents of Hydraulic Analysis 3
Methodology 5
Hydraulic Model Results – Interceptor Sewer 7
Hydraulic Model Results - GE Valley Collector Sewer 10
Recommended System Improvements 12
Conclusions 14
Planning-Level Cost Estimates 14

SAN3 - East Side Interceptor Sanitary Sewer Evaluation Survey (SSES)

Executive Summary 1
Project Summary 2
Key Findings 3
SSES – Technical Approach 5
- Smoke Testing Process 5
  - Smoke Testing Results 5
- Manhole Inspections 10
  - Locating Structures 10
  - Data Collection 10
  - Inspection Results 11
- Rehabilitation Methods 12
- Rehabilitation Costs 14

Recommendations 15
Appendix ..... A-G
- A Smoke Testing Summary 1-4

Foth
1610 Broadmoor Drive
Champaign, IL 61821
(217) 352-4169 • Fax: (217) 352-0085
www.foth.com



B Smoke Testing Photos 1-36
C Relationship of I/I Removal to Storage Capacity 1-1
D Manhole Inspection Photos 1-151
E Manhole Inspection Summary Tables 1-7
F Manhole Inspection Forms 1-152
G Manhole Rating System 1-1

SAN4 - East Side Interceptor System - Wet Weather Alternatives

Executive Summary 1
Project Summary 2
Background 3
Approach for Alternative Evaluation 5
Short Term Program to Verify I/I Removal Effectiveness 5
Long Term Program for managing Wet Weather Flows 9
Life Cycle Cost Evaluation of Alternatives 15
Recommendations 17
Review of Other I/I Reduction Programs 21
APPENDIX ..... 4 pgs
I/I Source Removal Calculations Cost Estimates 1-4



SAN5 - Sanitary Pump Station SCADA

Executive Summary 1
Introduction 2
Key Findings 3
Sanitary Pump Stations 3
Existing Electrical Systems 4
Existing Control Systems 4
Existing Alarm Monitoring 5
Observations - Specific Locations 5
Sugar Creek Sanitary Pump Station 5
Wittenburg Woods Sanitary Pump Station 5
Fell Avenue Sanitary Pump Station 6
Regency Drive Sanitary Pump Station 6
Holiday Drive Sanitary Pump Station 6
Eagle Crest East Sanitary Pump Station 6
Kickapoo Main Branch Sanitary Pump Station 7
Key Recommendations – General 7
Recommendations - Specific Locations 11
All Pump Stations 11
Sugar Creek Sanitary Pump Station 11
Wittenberg Woods Sanitary Pump Station 12
Fell Avenue Sanitary Pump Station 12
Regency Drive Sanitary Pump Station 13
Holiday Drive Sanitary Pump Station 13
Eagle Crest East Sanitary Pump Station 13
Kickapoo Main Branch Sanitary Pump Station 13
Budget Cost Opinion 13
Appendix A ..... 1 pg
Sanitary Pump Station Location Map 1-1
Appendix B ..... 7 pgs
Pump Station Data Summary Sheets 1-7





STORM SEWER TECHNICAL MEMORANDA

ST1- Delineation Of Stormwater Problem Areas

Executive Summary 1
Technical Memorandum 2
Introduction 2
Methodology 2
- GIS Data 2
- Questionnaire 3
- City Staff 3

Analysis 3
Conclusion 5
Exhibits
- 1-Storm Watershed Areas 1-1
- 2-Drainage / Flooding Survey 1-2
- 3-Problem Areas Identified by City Staff 1-3
- 4-Surface Flooding Heat Gradient 1-1
- 5-Basement Flooding Heat Gradient 1-1

Attachments
- 1-Questionnaire Response Tables 1-67
- 2-Questionnaire Response Figures 1 thru 8 1-8



ST2 – Hydrologic/Hydraulic Modeling in Priority Watersheds

Executive Summary 1
- Introduction 1
- Key Findings 1
- Recommendations 1
- Summary 2

Introduction 3
Methodology 5
- Watershed Definition 5
- XP-SWMM Model 7
- Existing Conditions Analysis 9
- Separation Options Assessment 9
- Proposed Conveyance Network And Detention Ponds 9

Analysis 10
- Problems Determined Via XP-SWMM Model Results 10
- Problems Depicted By The City Of Bloomington Staff 12
- Problems Depicted Via Questionnaire 14

Recommendations 17
- Phase 1 – Localized Improvements 17
- Phase 2 - Separate Stormwater System 24
- Phase 3 – Downtown Detention Facility 29
- Phase 4 – New Detention Pond And Stormwater Trunkline Tosugar Creek 32

Summary 35
Attachment 1 ..... 1 pg
- Subwatershed Data 1-1

Attachment 2 ..... 15 pgs
- Existing Conditions (20% Event) 2-15





ST3 – Streambank Inventory

Executive Summary 1
- Key Findings 1
- Recommendations 1

Introduction 2
Methodology 3
Analysis 7
- 1. Watershed F6 Reach 2 8
- 2. Watershed F1 Reach 3 9

Recommendations 11
- 1. Complete Initial Assessments Of All Open Channels 11
- 2. Re-Inspect Channels At Planned Intervals 11
- 3. Develop A Capital Improvement Plan 12
- 4. Early Action Repairs 12
  - 1. Watershed F6 Reach 2 12
  - 2. Watershed F1 Reach 3 14

Attachment 1 ..... 10 pgs
- Unified Stream Assessment Data Sheets 1-10

Attachment 2 ..... 4 pgs
- Unified Stream Assessment Data Sheets 1-4

Attachment 3 ..... 13 pgs
- Stream Reach Photos 1-13



ST4 - Greenways Plan Sustainable Design Initiatives

Executive Summary 1
- Key Findings 1
- Recommendations 1

Summary 2
Definition of Greenway 2
Existing Problems - Urbanized Areas 3
Key Recommendations 10
- Urbanized Greenways 10
- Publicly-Owned Detention Ponds 12
- Privately-Owned Detention Ponds 14

Future Development Areas 16
- Existing Issues / Problems – Future Development Areas 16

Recommendations – Future Development Areas 17
- A. Trigger Points for Establishment of Greenways 17
- B. Appropriate Greenway Geometry 19
- C. Land Dedication for Greenways 30
- D. Regional Stormwater Detention 32
- E. Sustainability Design Initiatives 40
- F. Redevelopment and Stormwater Detention 50
- G. Fee-In-Lieu (Stormwater Detention) 51
- H. Pathways 52
- I. Water Quality – Meeting Current and Future Permit Requirements. 53
- J. Public and Property Owner Buy-in and Education 54

Appendix A ..... 2 pgs
- Fee-In-Lieu Examples 1-2

Appendix B ..... 1 pg
- Planning Area Map 1-1





ST5 - Sugar Creek Analysis

Executive Summary 1
Project Summary 2
Methodology 4
- Detention Ponds 4
- Rainfall Statistics 5
- Runoff Calculations 5
- Critical Duration Analysis 5

Model Calibration 9
Key Findings 13
- Maintenance of City-Owned Dry and Wet Detention Ponds 13
- Tipton Park Detention Ponds 13
- Impact of Detention Ponds in the Sugar Creek Headwaters 13
- Comparison Between 1993 FIS Data and 2013 XP-SWMM Model Output 16

Key Recommendations 23
Appendix A ..... 2 pgs
- Sub-basin Map XP-SWMM Hydrologic Parameters 1-2



ASSET MANAGEMENT TECHNICAL MEMORANDA

AM1 – Pipe Condition Rating Methodology Recommendations

Executive Summary 1
PACP Pipe Rating 2
Recommended Pipe Condition Rating System 3
Integration of Pipe Condition Rating Methodology into Infrastructure Rating 4
1. CCTV NASSCO Prioritization 4
2. Business Risk Exposure Prioritization 4
Management of Pipe Ratings and GIS Incorporation 5

AM2 - GIS Based Infrastructure Rating System

Executive Summary 1
Pilot Area Evaluation – Phase 1 (Cap 1 & 2) 3
Overview 3
Methodology 3
Levels of the Rating System 4
Phase 1 of Rating System (CAP 1) 6
Supplemental Rating Factors – Sanitary Pipe Infrastructure 7
Consequences of Failure – Sanitary Pipe Infrastructure 8
CAP 1 Calculation of BREs 8
CoFs for Sanitary Sewer Pipes 8
CoFs for Storm Pipes 10
PoFs for Sanitary Sewer and Storm Pipes 10
Phase 2 (CAP 2) of GIS Based Rating System 14
CAP 2 Calculation of BREs 15
Results CAP 1 & CAP 2: Pilot Areas 21
RESULTS – CAP 1 23
Pilot Area 1: Sanitary Sewer 23
Pilot 1: Storm Sewer 25
Pilot 2: Sanitary Sewer 27
Pilot 2: Storm Sewer 28
RESULTS – CAP 2 30
Pilot Area 2 - CAP 2 Results: Sanitary Sewer 31
Pilot Area 2 - CAP 2 Results: Storm Sewer 33
Service & Condition Assessment Rating (SCAR) 35
Recommendations 36
Bibliography 38

AM3 - Asset Management Program Work Order Needs Analysis

Executive Summary 1
Introduction 3
Work Order Management System 4
Creating Work Orders 4
Tracking Work Progress 6
Closeout of Work Orders 7
Workflow Examples 7
Scenario 1: Encountering a New Asset 8
Scenario 2: Sewer Relocation 10
Scenario 3: Cave-in Repair 12
Scenario 4: Street Flooding 13
Summary 13
Appendix - Evaluation Table – GIS Based AMP Software and MUNIS .. 1-2







AM4 - Assessment for CCTV Inspections

Executive Summary 1
Background 2
Evaluation Process 2
Summary Of Observations 3
Recommendations 4

AM5 - BMPs for Storm and Sanitary Utility Operations

Executive Summary 1
CCTV Inspection Program Recommendations 6
Recommendations for GIS Attributes to Track and Incorporate for Bloomington's Asset Management Program 11
- Data Management BMP for Water/Wastewater 11
  - Geodatabase 13
  - Versioning 13
  - Workflows 14
  - Standardized Data Model 14
  - Geometric Networks 15
  - Using Geoprocessing Models or Scripts 15
- Data Collection and Inventory 15
- Data Modeling & Business Tools 17
- Future BRE Modeling Considerations 18
- Support BRE Tools 19
- Staffing & Support 21
  - Bloomington Staffing Recommendations 24
- Summary of Recommended Investments 24

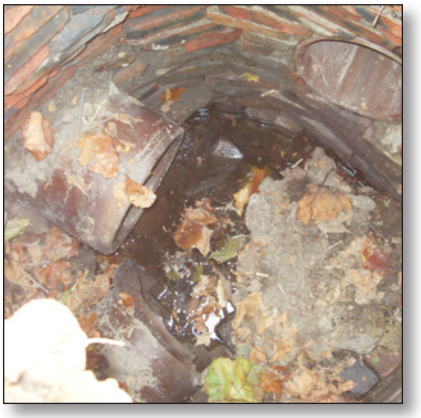
Considerations and Steps for Implementation of a Manhole Rehabilitation Program 25
- Discussion 26
  - Municipal Interviews/Reviews 26
- Rehabilitation Defects 27
  - Frame, Cover, & Insert 27
  - Adjustment Rings & Chimney Seal 27
  - Manhole Structure (Chimney/Cone/Barrel/Bench/Channel) 29
- Summary 35
- Recommendations 36

Considerations and Steps for Implementation of a Sewer Lining Program 40
Best Practices for Management of Assets and Life Cycle Cost Optimization 45
- Establishing Levels of Service 45
- Reducing Lifecycle Costs Associated with Sanitary and Stormwater Infrastructure 49
  - Inventory Assets and Establish Information Tracking 50
  - Assessment and Risk Evaluation of COBPW Sewer Infrastructure 50
  - Prioritization of Maintenance, Repair and Replacement Actions 50
  - Optimization Strategies for O&M and CIP Actions 55
  - Business Cases for Optimization 55
  - Case Examples within Pilot Area 55
    - Hannah Street 55
    - McGregor Street 61







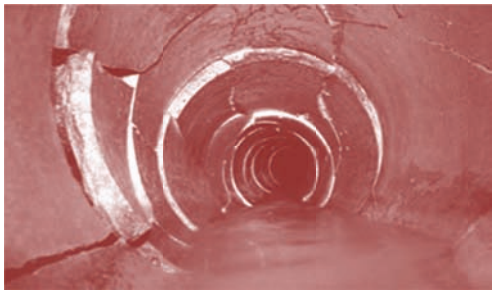


Recommendations and General Considerations for
Root Control Program 64
Decision Triggers for Root Control 64
Root Control Program Methods 65
Non-Chemical Control 65
Chemical Root Control 67
Root Control Program Implementation Options 68
Recommendations for Developing a Grease, Oil and Fats Program 70
Introduction 70
Background 70
Overview 70
Legal Authority 71
City Code Analysis 71
Code Comparison 72
Permitting Programs 73
Overview 73
Program Comparison 74
Establishment Permits 74
Hauler Permits 75
Miscellaneous Permitting Coordination 76
Design Issues 76
Overview 76
Design Sizing Standards 77
Method 1 & 2 77
Method 3 77
Maintenance requirements 78
Overview 78
Discharge Concentration-Based Maintenance Frequency 78
Sampling/Analysis Issues 78
Maintenance issues 78
Time-Based Maintenance Frequency 79
Inspection Programs 79
1. Overview 79
2. Construction Inspections 79
3. Routine Device Inspections 80
4. Sewer Main Inspections 80
5. Sewer Pumping Station Inspections 81
Enforcement Programs 81
Overview 81
Program Comparison 81
Data management 82
Public Education and Outreach 82
Preliminary Recommended Program 82
Cost/ Benefit 83
FOG Conclusions 86
Bibliography 87
Appendix A – Work Examples: Wastewater Benefit Cost Scenario 1-3
Appendix B – Sample Chemical Root Treatment Specification 1-11

City of Bloomington







Stormwater and Sanitary Sewer Master Plans

Master Executive Summary

In the 21st century, the City of Bloomington will rely on dependable infrastructure to attract businesses and maintain a high quality of life for its residents. Implementing the recommendations in this document will be necessary to allow the City to meet those needs.

January 2014

Foth

OHM Advancing Communities

Baker

What is the State of the City's Infrastructure?

The City of Bloomington's sanitary and storm sewer systems provide a critical service to its residents and business owners through the collection and conveyance of stormwater and wastewater. These systems satisfy the fundamental needs of public safety and public health.

As the City of Bloomington has grown and prospered during the last 60 years, the overall footprint of its infrastructure, which includes sewer pipes, detention ponds, manholes, curb inlets, pump stations, and open drainage channels, rapidly expanded. Much of that growth occurred from 1950-1980. **Some of the infrastructure installed as part of the expansion is deteriorating to a point where it is not providing an adequate Level of Service**. Some of the primary infrastructure problems identified by this study are:

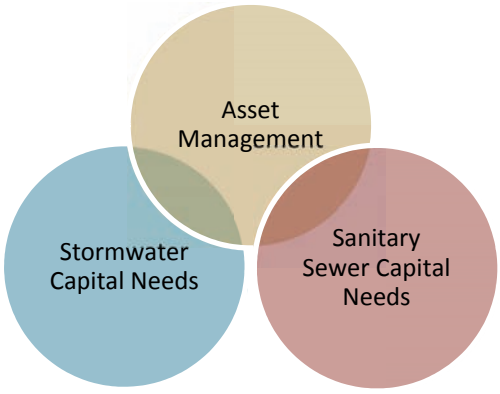
Stormwater Infrastructure

- Flooding
- Detention pond shoreline erosion
- Streambank erosion
- Outdated floodplain maps
- Undersized sewer pipes
- Deteriorating pipes/manholes

Sanitary Sewer Infrastructure

- Deteriorating pipes/manholes
- Unwanted inflow and infiltration
- Deteriorating pumps and pump control systems
- Basement flooding
- Combined Sewer Overflows

This Master Plan identifies specific components of the City's sanitary and storm sewer systems that will require investment in the next 20 years in order to maintain an adequate Level of Service. An Asset Management Plan, a critical part of this report, ties both systems together by providing recommendations to continuously track infrastructure condition and plan for adequate rehabilitation efforts. This will allow the City to set realistic goals for maintenance, rehabilitation, and eventual replacement of aging infrastructure.



How do we Define Level of Service?

Level of Service is broadly defined in this Master Plan as:

- Storm and sanitary sewers flowing freely and without placing a burden on property owners by way of frequent surface flooding or basement backups due to inadequate pipe size or structural failure.
- Drainage channels, culverts, bridges and detention ponds operating efficiently and without significant erosion and/or flooding that may threaten adjacent homes, businesses or public institutions.
- Maintaining sanitary sewer flows (dry and wet weather conditions) at a level that is manageable for cost-effective wastewater treatment and without hastening the need for treatment plant expansion, and reducing or eliminating Combined Sewer Overflows.

This Master Plan recommends a program of capital improvements and ongoing labor commitments to allow the City to address its existing infrastructure and manage urban growth in a way that controls future infrastructure costs while maintaining a desirable Level of Service. The Master Plan includes 15 Technical Memoranda (see Table A-2 for a complete list) that highlight the need for the following infrastructure enhancements:

Asset Management

- Develop condition rating system to inventory and prioritize storm / sanitary infrastructure
- Integrate field repair information with rating system
- Establish annual sewer televising and rehabilitation goals for sewers and manholes

Stormwater System

- Reduce frequency of flooding
- Establish inspection and repair program for streambanks and ponds
- Enhance land use policy along greenways
- Promote sustainable land development

Sanitary Sewer System

- Reduce inflow/infiltration in collection system
- Replace undersized sewers
- Avoid premature expansion of treatment plants
- Reduce potential for Combined Sewer Overflows
- Continue combined sewer separation program

Total Program Cost

The estimated cost of system improvements, over a 20-year period, is approximately $139 million. About 15% of this total represents additional City staff necessary to manage the capital improvement program and to provide the increased level of recommended infrastructure inspection and Asset Management.

Table 1 includes a summary of the project and program costs defined in this Master Plan. These costs were determined after a process that included a City-wide web-based survey, close coordination with City staff, consultation with key stakeholders, such as the Bloomington-Normal Water Reclamation District (BNWRD), and a detailed analysis of the City's infrastructure. A more detailed breakdown of costs is included in Table A-1 in the Executive Summary Appendix.

Table 1
Master Plan Cost Summary

	Years 1-5	Years 6-20	Total	Additional Staffing Required (FTEs)
Sanitary	$26 million	$58 million	$83 million	2.5
Storm	$9 million	$27 million	$36 million	1.55
Asset Management	$6 million	$11 million	$17 million	5.75
TOTALS	**$41 million**	**$95 million**	**$136 million**	**9.8 FTEs**

The largest single cost component of this Master Plan ($63 million) is represented by sanitary sewer system televising and rehabilitation (Items 9 and 26 in Table A-1). Municipalities that operate under a formal Asset Management Plan typically target approximately *one percent* of the sanitary sewer system for rehabilitation or replacement each year to address structural concerns related to pipe/manhole deterioration. This allows the City to replace the oldest and most vulnerable sewer components (Figure 1) to reduce the likelihood of system failure. For the City of Bloomington, this translates to rehabilitating or replacing about **four to five miles of sewer pipe per year.**

Figure 1 illustrates a deteriorated sewer pipe. Cracks along the pipes and separating joints allow for soil and water to enter the pipe, increasing the likelihood of flow blockage, which can result in basement flooding. This scenario is not uncommon in the City of Bloomington.



Figure 1
Deteriorated Sanitary Sewer Pipe

Managing Infrastructure as a "Business"

This Master Plan establishes a strategy to run the City's storm and sanitary sewer infrastructure as a business. Effectively running a business (or infrastructure) requires, at a minimum, a thorough understanding of the costs necessary to provide a sustainable level of service to customers while meeting regulatory obligations. This also requires an earnest and continuous investment to replace aging components so as to prevent an overall degradation in the level of service and a resulting decrease in customer satisfaction.

For a municipality, short-term needs include assessment, repair and rehabilitation of storm and sanitary sewer collection networks to reduce the likelihood of flooding, erosion, and property damage (i.e. meeting the customer's basic needs). Long-term needs include ongoing investments to prevent infrastructure degradation and to address wastewater treatment limitations. Running a complex system of storm and sanitary infrastructure also requires an investment in information systems capable of tracking infrastructure conditions on a dynamic basis and alerting City staff of pending repair needs (i.e. Asset Management).

The key components of this Master Plan establish a "business plan" to meet the needs of the City's current residents and property owners while creating a foundation on which the City can build a growing and thriving economy.

In the 21st century, the City of Bloomington will rely on dependable infrastructure to attract businesses and maintain a high quality of life for its residents. Implementing the recommendations in this document will be necessary to allow the City to meet those needs.

Determining Existing Problems

A drainage questionnaire was used to generate citywide feedback on the location and severity of storm and sanitary problems, such as street flooding and basement sewer backups. The response was excellent, and it revealed that residents experience problems throughout the system, especially in the City's older areas (Figure 2 includes an example based on flooding complaints).

- Hydrologic/hydraulic analysis of storm and sanitary sewer system components to identify flow bottlenecks
- Sewer televising data (interior pipe inspection reports in select locations)
- Sanitary sewer manhole inspections and smoke testing in select locations
- Sanitary sewer pump station inspections
- Streambank assessment

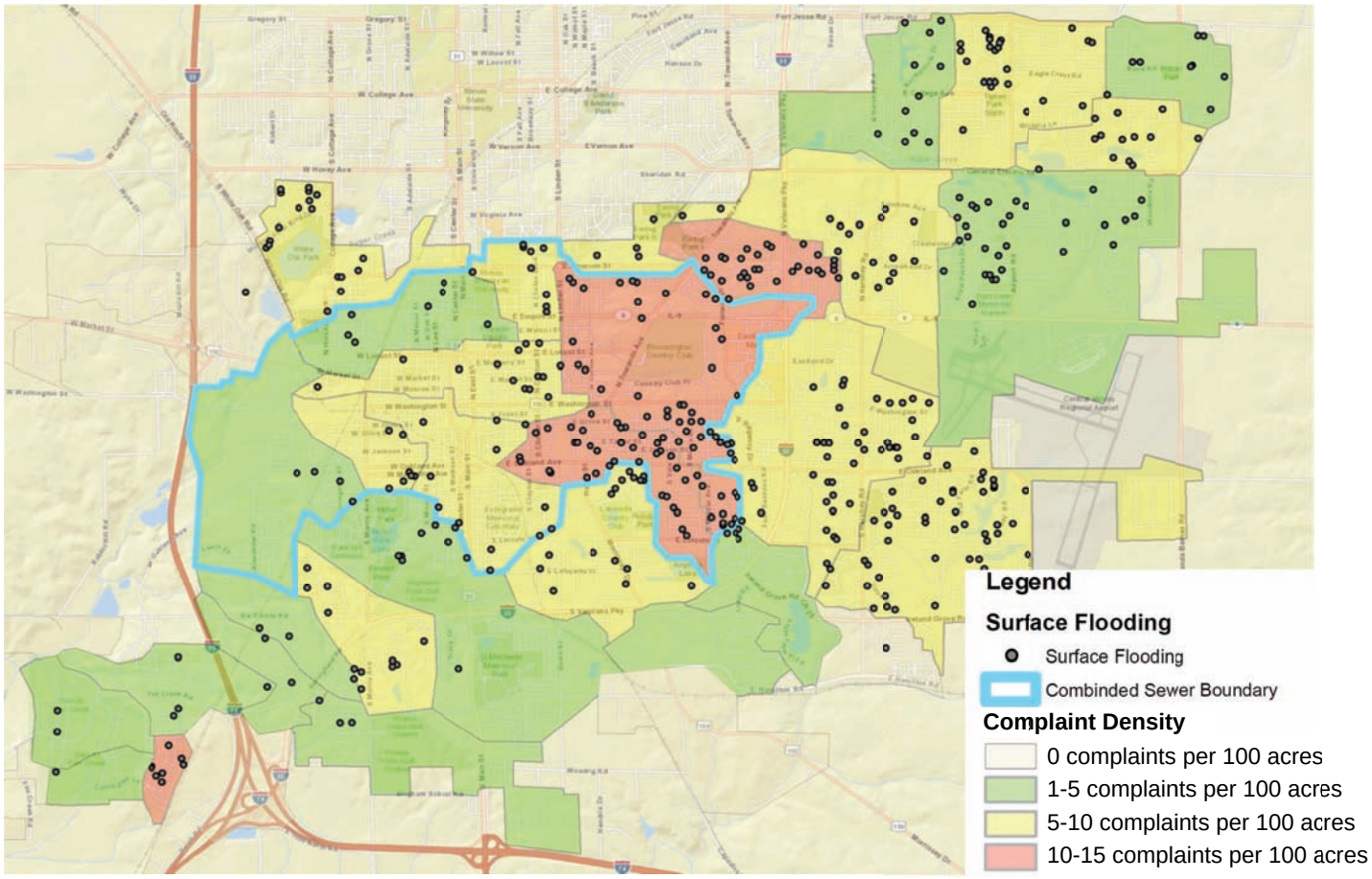


Figure 2 – Surface Flooding Complaints (2012 Drainage & Flooding Survey)

In addition to the questionnaire, multiple sources of information were used to identify and confirm the location and severity of system deficiencies:

- Flow meter and rainfall data for the sanitary sewer system (East Side Interceptor)
- Feedback from BNWRD staff regarding known system deficiencies and wet weather flow concerns in the sanitary sewer system
- Photos and personal accounts of known problems from City Public Works staff

Regulatory Considerations

Significant changes are occurring at the US EPA and IEPA that will impact both wastewater and stormwater, and these changes will increase the role that communities will play in controlling wet weather flows, reducing surface water pollution, and investing in aging infrastructure. **Most importantly, these rules have incentivized communities throughout the United States to increase infrastructure investment by enforcing financial penalties for non-compliance.**





Stormwater Regulations: The City of Bloomington is regulated by a Municipal Separate Storm Sewer System (MS4) Permit administered by the IEPA. Currently, this permit requires the City to take specific steps to reduce stormwater pollution. Proposed rules by the US EPA would require the City to update land development ordinances and increase inspection/enforcement. This Master Plan includes projects and programs to address the likelihood of these changes.

Wastewater Regulations: The City's wastewater collection system flows into interceptor sewers and two wastewater treatment plants operated by BNWRD. BNWRD is regulated through an IEPA permit for its treated wastewater discharge. This permit obliges BNWRD to control wet weather flows and avoid any untreated or partially-treated discharge. Existing regulations also prohibit the bypass of flows from a separate sanitary sewer system (East Side Interceptor) to a combined sewer system. The US EPA is also considering new rules that would require the City of Bloomington to have their own permit for its collection system. This Master Plan includes projects that anticipate the wastewater regulatory environment through a Capacity, Management, Operation and Maintenance (CMOM) program.

Combined Sewer Regulations: The City has an IEPA permit for Combined Sewer Overflows (CSOs). Part of this permit requires a Long Term Control Plan (LTCP), which was drafted in 2003. The LTCP sets specific goals for CSO reduction or elimination. Many of the projects in this document are directly related to these regulatory commitments.

Impact of this Master Plan on City and BNWRD Facilities

Although BNWRD is responsible for the system of interceptor sewers and two wastewater treatment plants serving the City of Bloomington, they are also directly impacted by the condition of the City's wastewater collection system. Deteriorating sewers allow more inflow/infiltration (wet weather flow) to enter the system, which creates an operational burden at both treatment plants. The recommendations in this Master Plan are focused on identifying the most cost-efficient solutions to meet the needs of both the City and BNWRD while extending the useful lives of both treatment plants.

Capital improvements will be focused on sewer system rehabilitation, wet weather storage, and meeting the needs of state/federal regulatory agencies.

The projects recommended in this Master Plan will:

- Maximize the use of both treatment plants, thereby avoiding more expensive capital investments to increase treatment capacity.
- Reduce the potential for Combined Sewer Overflows or other illegal untreated sewage discharges.
- Eliminate the bypass of wet weather flows from the East Side Interceptor system to the City's combined sewer system.
- Reduce operating costs at both treatment plants through reduced annual flow volumes.

Educating and Involving the Public

Storm and sanitary infrastructure includes many components that are often not completely understood by the general public. Unfortunately, degradation of underground utilities remains unseen by the public until a system failure occurs, which explains the lack of public support for investment in something that is needed but cannot be observed. This Master Plan provides an opportunity for City staff and elected officials to reach out to the general public and educate them on the following issues:

- State of the City's infrastructure
- Importance of adequate investment for the benefit of the economy and future generations
- Need to comply with state and federal regulations
- Need to rehabilitate and replace infrastructure in order to prevent major disruption to the City's residents, businesses, and public institutions

The Executive Summary Appendix includes a set of questions and answers (Q&A) that can be used as a platform to communicate the overall intent of this Master Plan and achieve public buy-in to the goals established herein.

City of Bloomington

Stormwater and Sanitary Sewer Master Plans

Master Executive Summary
APPENDIX

Q&A Summary
Cost Summary (Detailed)
List of Technical Memoranda

Foth OHM Advancing Communities Baker

Q&A – Bloomington Stormwater and Sanitary Sewer Master Plan

Q: What are the benefits to residents through the implementation of this Master Plan?

A: The implementation of this Master Plan includes a rollout of a strategic asset management plan which will lower the overall life-cycle costs of the storm and sanitary sewer infrastructure through prioritizing expenditures on the most critical infrastructure, while identifying and fixing problems before they cause catastrophic problems to businesses and residents.

Q: Are the costs in this Master Plan redundant to work the City is already doing?

A: No. The costs identified in this document represent additional projects and programs necessary to manage existing infrastructure, meet Level of Service expectations, inspect/repair/rehabilitate aging infrastructure, and meet the City's obligations to state/federal regulatory agencies and BNWRD.

Q: Must the City of Bloomington spend the entire amount of money defined in this Master Plan?

A: These estimates are planning-level and intended to be comprehensive. The City should determine which recommendations are most critical. It may be possible to delay some projects to save money in early years, but the programs and projects identified in this document are important to meet the City's long-term needs.

Q: Why has the management of our infrastructure suddenly become so expensive?

A: Much of the City's current infrastructure was subsidized by federal programs (most of which are no longer available) and developers who financed the construction of sewers for new subdivisions. As those subsidized facilities (sewers, manholes, pump stations, treatment plants, etc.) are nearing the end of their service lives, it now becomes the City's (and its ratepayers') responsibility to maintain, rehabilitate, and replace this infrastructure.

Q: Are these infrastructure problems unique to the City of Bloomington?

A: No. Most cities like Bloomington have an increasing backlog of sewer infrastructure needs. Only recently have these issues manifested themselves in widespread problems as much of the explosive growth in the 1950s – 1990s has started to "catch up" with cities as this infrastructure begins to fail.

Q: Have state/federal regulations impacted the City's infrastructure costs?

A: Yes. Stricter wastewater regulations place more pressure on BNWRD to control wet weather flows and provide wastewater treatment under dry ***and*** wet conditions. New stormwater regulations require the City to maintain a program to reduce stormwater pollution. Emerging federal stormwater regulations will require additional attention to stormwater infrastructure and at a higher cost.

Q: Will storm and sanitary infrastructure costs go down after this Master Plan is fully-implemented?

A: The increased level of investment in sanitary and storm infrastructure will likely need to be sustained in order to maintain a system that meets the City's needs for future generations. As the City's infrastructure continues to age, new high-priority projects will emerge and will need to be addressed.

Table A-1
Master Plan Cost Summary (Detailed)

Present Value* of Capital Projects and Labor Needs

	Memo ID**	Item #	Critical Project or Program	Early Action Projects (Years 1-5)	Long-Term CIP (Years 6-20)	Additional City Staffing Needs (FTEs)	Total 20-year Cost
Sanitary Sewer	SA4	1	Complete Smoke Testing, Manhole Inspection and Sewer Televising in Priority Sewersheds	$ 635,000	$ -	-	$ 635,000
	SA3	2	Manhole and Pipe Repairs Identified in SSES Memorandum	$ 410,000	$ -	-	$ 410,000
	SA4	3	Arcadia / Broadmoor Rehabilitation Pilot Study	$ 1,653,000	$ -	-	$ 1,653,000
	SA3	4	Post-Rehabilitation Flow Analysis	$ 100,000	$ -	-	$ 100,000
	SA2	5	Hawthorne Collector Sewer Hydraulic Upgrade	$ -	$ 1,450,000	-	$ 1,450,000
	SA5	6	Pump Station Control Upgrades	$ 583,000	$ -	-	$ 583,000
	SA4	7	Wet Weather Storage Project (10 MG Tank)	$ -	$ 12,160,000	-	$ 12,160,000
	N/A	8	Locust/Colton – Remaining Sewer Separation Projects (primarily sanitary sewer costs)	$ 4,000,000	$ 4,900,000	-	$ 8,900,000
	N/A	9	Citywide Sanitary Sewer Rehabilitation Program***	$ 16,250,000	$ 39,250,000	2.50	$ 55,500,000
	N/A	10	Pay off inter-fund advance	$ 1,900,000	$ -	-	$ 1,900,000
			SUBTOTAL (SANITARY)	**$ 25,531,000**	**$ 57,760,000**	**2.50**	**$ 83,291,000**
Storm Sewer	ST4	11	Pond Inspection and Maintenance Program (Public and Private Ponds)	$ 2,055,000	$ 6,165,000	0.55	$ 8,220,000
	ST5	12	Floodplain/Floodway Encroachment Program	$ 375,000	$ 1,125,000	0.25	$ 1,500,000
	ST4	13	Urban Channel Retrofits	$ 1,375,000	$ 2,225,000	0.15	$ 3,600,000
	ST5	14	Floodplain Remapping	$ 330,000	$ -	-	$ 330,000
	ST5	15	Detention Pond Retrofits	$ 450,000	$ -	-	$ 450,000
	ST4	16	Streambank Stabilization (Planning Areas 4, 7, and 8)	$ -	$ 5,550,000	0.10	$ 5,550,000
	ST4	17	Remove Railroad Hydraulic Restriction (Planning Area 8)	$ -	$ 3,300,000	-	$ 3,300,000
	ST3	18	Urban Stream Repairs (From Streambank Inventory) and Ongoing Stream Inspections	$ 3,510,000	$ 300,000	0.20	$ 3,810,000
	ST4	19	Update Stormwater Ordinances	$ 130,000	$ -	-	$ 130,000
	ST2	20	Storm Sewer Hydraulic Improvements	$ 642,000	$ -	-	$ 642,000
	ST2	21	Sewer Separation Projects	$ 100,000	$ 3,354,000	0.20	$ 3,454,000
	ST2	22	Storm Trunk Sewer to Sugar Creek	$ -	$ 2,000,000	-	$ 2,000,000
	ST2	23	Regional Stormwater Detention Facilities (Ponds 1 and 2)	$ -	$ 2,900,000	0.10	$ 2,900,000
	N/A	24	Pay off inter-fund advance	$ 250,000	$ -	-	$ 250,000
			SUBTOTAL (STORM)	**$ 9,217,000**	**$ 26,919,000**	**1.55**	**$ 36,136,000**
Asset Management	AM2	25	ESRI/GIS/CCTV/MUNIS Tool Upgrades	$ 280,000	$ 158,000	-	$ 438,000
	AM5	26	CCTV Inspection Program (Ongoing)	$ 3,700,000	$ 4,300,000	2.00	$ 8,000,000
	AM5	27	Inventory Manholes/Structures	$ 120,000	$ -	-	$ 120,000
	AM5	28	Manhole Inspection Program (Ongoing)	$ 446,000	$ 850,000	0.25	$ 1,296,000
	AM5	29	FOG Inspection Program	$ 1,200,000	$ 3,700,000	2.50	$ 4,900,000
	AM5	30	GIS Coordinator Position	$ 450,000	$ 1,500,000	1.00	$ 1,950,000
			SUBTOTAL (ASSET MANAGEMENT)	**$ 6,196,000**	**$ 10,508,000**	**5.75**	**$ 16,704,000**
			MASTER PLAN TOTAL	**$ 40,944,000**	**$ 95,187,000**	**9.80**	**$ 136,131,000**

* Present value based on a 20-year cycle of all costs identified above (assumes discount rate and inflation rate will cancel each other out)
Assumed overhead/fringe burden for new City staff: 50%

** Technical Memoranda Designation (identified costs referenced in memoranda as listed in Table A-2)

*** Based on approximately 1% of sewer system rehab/replacement per year

Table A-2
List of Technical Memoranda

	Technical Memorandum Title	Projects / Programs Covered
Sanitary Sewer	East Side Interceptor Hydrologic Analysis **(SA1)***	• Summarizes flow metering results, model calibration, and design peak flow calculations for the East Side Interceptor. • Projects wastewater flows under future (Year 2035) conditions. • Identifies high priority sewersheds requiring further evaluation.
	East Side Interceptor / GE Valley Collector: System Capacity Assessment **(SA2)**	• Hydraulic analysis of the East Side Interceptor and collector sewers in the GE Valley sewer district. • Identifies existing hydraulic bottlenecks and proposed capital improvements.
	East Side Interceptor – Sanitary Sewer Evaluation Survey (SSES) **(SA3)**	• Results from smoke testing and manhole inspections in high priority sewersheds. • Identifies inflow elimination and rehabilitation projects to reduce flows.
	East Side Interceptor – Wet Weather Alternatives **(SA4)**	• Details pilot program for sewer rehabilitation and wet weather flow reduction. • Identifies wet weather storage needs and potential locations. • Includes a cost-effectiveness analysis of various alternatives.
	Sanitary Pump Stations: SCADA Recommendations **(SA5)**	• Identifies improvements to control systems for efficient pump operations.
Storm Sewer	Delineation of Stormwater Problem Areas **(ST1)**	• GIS-based mapping of the results from the public survey for drainage and sewers. • Establishes patterns used to prioritize areas for further analysis.
	Hydrologic / Hydraulic Modeling in Priority Watersheds – Oakland Avenue Watershed and Combined Sewer Separation Opportunities **(ST2)**	• Identifies solutions to relieve flooding in areas along Oakland Avenue (southeast of downtown). • Identifies sewer separation and wet weather storage. • Identifies significant wet weather flow reduction to the WWWTP.
	Streambank Inventory **(ST3)**	• Visual inspection of select reaches of open drainage channel, including the development of a new iPad application for GIS-based streambank assessment. • Identifies repairs for high priority drainage channels.
	Greenways Plan / Sustainable Design Initiatives **(ST4)**	• Details a proposed City-wide detention pond inspection and maintenance/enforcement program for public and private ponds. • Recommends specific locations for floodplain mapping revisions. • Recommends standards for drainage channel protection and right-of-way widths in developing areas. • Recommends urban drainage channel retrofits to enhance safety and ease-of-maintenance. • Recommends planning/design policies for sustainable land development.
	Sugar Creek Analysis **(ST5)**	• Recommends floodplain remapping in the upper reaches of the Sugar Creek watershed. • Identifies detention pond retrofit opportunities for peak flow reduction and water quality enhancement.
Asset Management	Pipe Condition Rating Methodology Recommendations **(AM1)**	• Establishes a methodology for the City to use in rating the structural condition of storm and sanitary sewers.
	GIS Based Infrastructure Rating System Pilot Area Evaluation – Phase 1 (CAP 1 & 2) **(AM2)**	• Summarizes the risk-based approach to evaluate existing infrastructure. • Establishes methodologies for the City to use in determining *risk of failure* and *consequence of failure*.
	Asset Management Program Work Order Needs Analysis **(AM3)**	• Recommendations to enhance the tracking of maintenance, work orders, and its integration with MUNIS.
	Assessment for CCTV Inspections **(AM4)**	• Includes recommendations to improve the CCTV inspection process to more accurately represent actual pipe conditions.
	Best Management Practices (BMPs) for Bloomington Storm and Sanitary Utility Operations **(AM5)**	• Program recommendations, staffing levels, and cost estimates to implement the Asset Management Program. • References to best practices from other communities.

* *Memo designation (see Table A-1 for links between costs and associated memoranda)*

Sanitary Sewer Technical Memoranda

SAN1 - EAST SIDE INTERCEPTOR SYSTEM HYDROLOGIC ANALYSIS

East Side Interceptor System
Hydrologic Analysis

Executive Summary

The hydrologic analysis was performed to quantify the response of the East Side Interceptor Sewer to wet weather events and to determine the design event for future capital improvements. This effort is a result of concerns about excessive inflow and infiltration ("I/I") entering the sewer system and overwhelming the Southeast Wastewater Treatment Plant (SEWWTP).

During wet weather, the collection system conveys higher flows. When the flow rate is expected to exceed the treatment capacity at the SEWWTP, the Bloomington-Normal Water Reclamation District (BNWRD) diverts flows from the East Side Interceptor to the City's older sewers. This situation is not desirable, as it can place an additional burden on the sanitary sewers on the City's west side.

This analysis relied on data received from over a dozen temporary flow meters, each strategically placed in the collection system to help define the wet weather response in different locations.

Key Findings

- The Year 2012 design event wet weather flow generated in the East Side Interceptor system, 46 cfs, exceeds the treatment capacity of the SEWWTP of 26 cfs. This results in significant flow diversion to the older sewer systems on the City's west side.
- The Year 2035 design event wet weather flow is estimated at 69.2 cfs.
- Several sub-districts within the East Side Interceptor service area were identified as having elevated I/I response compared to other sub-districts.
- Seasonal variations in observed 7-day minimum flows are typical of other wastewater collection systems, although spikes during wet weather suggest there is an opportunity to reduce the magnitude of wet weather fluctuations and reduce the volume of treated flow to the SEWWTP.
- Based on our review of similar collection systems throughout the Midwest, the East Side Interceptor system does not appear to have extraordinarily high I/I levels as compared to other collection systems, although the measured wet weather flow volume is slightly higher than the median of similar metered sewer systems

Recommendations

- The City should work closely with BNWRD to continue the flow metering program. Additional flow data will only help to increase the confidence in the sizing and design of future capital projects.

No specific cost summaries are included with this memorandum. This document consists of hydrologic findings only. All recommended projects resulting from this analysis are covered in the accompanying memoranda in the Sanitary Sewer Master Plan.

ARCHITECTS. ENGINEERS. PLANNERS.

OHM Advancing Communities

technical memorandum

Date: December 11, 2013

To: Ryan Otto, City of Bloomington DPW

From: Greg Kacvinsky, Orchard, Hiltz & McCliment, Inc.
Robert Czachorski, Orchard, Hiltz & McCliment, Inc.

Re: East Side Interceptor Hydrologic Analysis

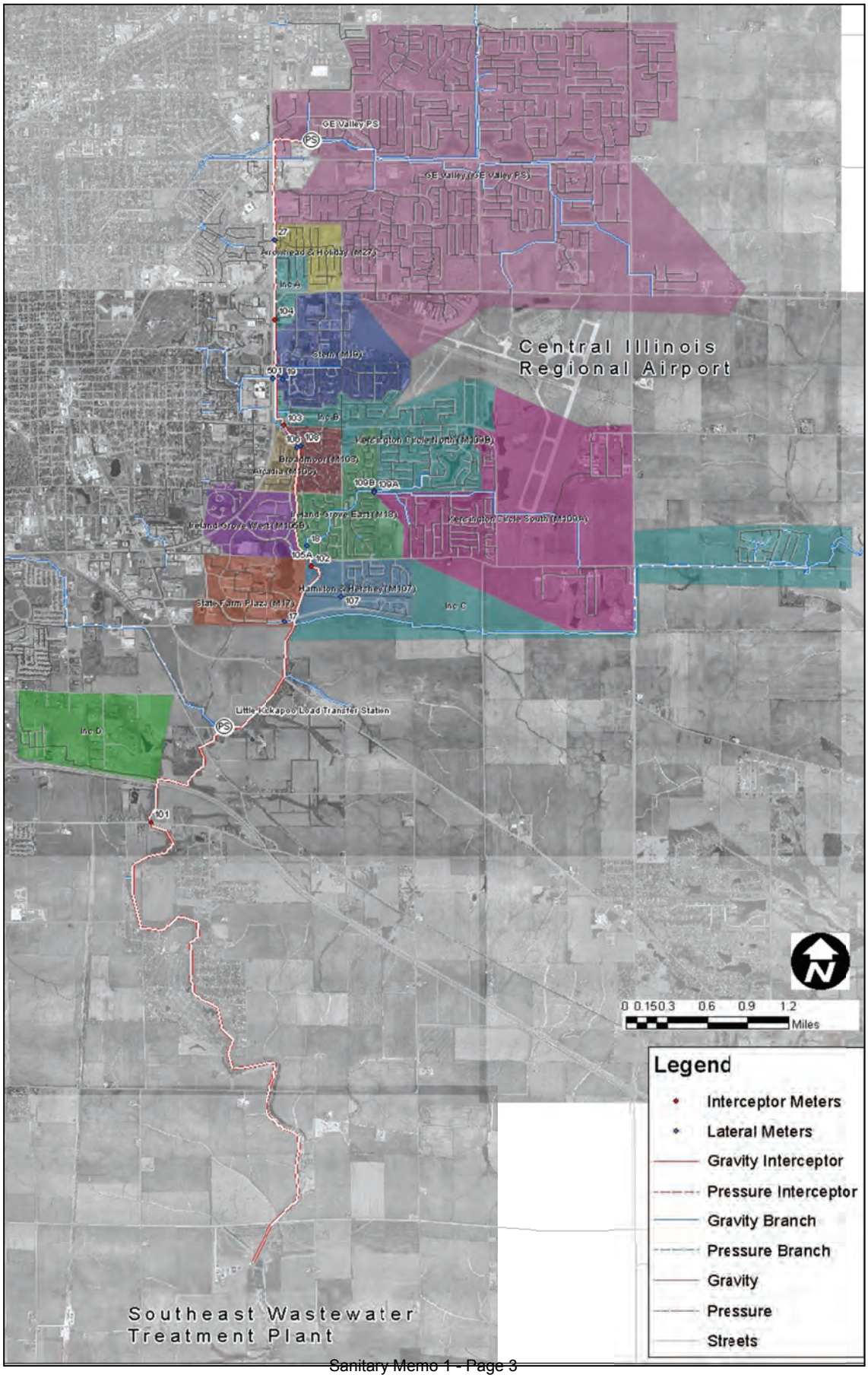
Project Summary

The City of Bloomington recognizes the importance of better managing their sanitary sewer system in order to meet regulatory, customer and regional sewer district expectations, including ensuring that adequate capacity is available for existing customers and new development.

A primary focus for the City is the East Side Interceptor system, which is a separate sanitary sewer collection system, portions of which have been previously reported to have elevated base flows and inflow and infiltration (I&I) during wet weather events. Flows from the East Side Interceptor discharge to the Bloomington Normal Water Reclamation District's (BNWRD's) Southeast Wastewater Treatment Plant (SEWWTP). During significant wet weather events (generally exceeding 2-3 inches of rainfall), the SEWWTP influent approaches the plant's treatment capacity, which results in flow diversions to the City's west sewer system. These diversions include an overflow pipe at the GE Valley Pump Station (GEVPS) wet well and a pumped diversion at the Little Kickapoo Pump Station (LKPS). Both diversions send wet weather flows to the City's older sewer collection system that ultimately discharges to BNWRD's West Wastewater Treatment Plant (WWWTP) on the City's west side. These diversions are not desired by BNWRD, as the older (west) components of the City's collection system include combined sewers. Additional flows to the combined system could make it more difficult for the City to meet its CSO Permit obligations with the Illinois Environmental Protection Agency (IEPA).

Orchard, Hiltz, and McCliment, Inc. (OHM) has been retained as a consultant to perform an evaluation of the wet weather flows generated by the East Side Interceptor system using the i3D Antecedent Moisture (AM) model. The City of Bloomington desires to have a better understanding of the system flows from the tributary areas within the Eastside Interceptor system in order to effectively evaluate alternatives to improve system performance during wet weather conditions for existing and future build-out conditions. Figure 1 shows the location and layout of the East Side Interceptor study area.

Figure 1: Study Area Location



Methodology

The evaluation of peak design flows for the study areas used the following methodology:

1. **Perform Infiltration and Inflow (I/I) Analysis of System**
   An analysis of the I/I levels within the system was performed to demonstrate how the antecedent moisture conditions impact peak flows and total volumes.

2. **Hydrologic Model Development**
   A hydrologic model was calibrated using rainfall, temperature, and flow measurements from the each of the tributary areas to the East Side Interceptor system using the i3D antecedent moisture model during the monitoring period from 2008 to 2011 to characterize the system flows during wet weather conditions. The hydrologic model was validated to recent large storm events that occurred in July through August of 2012. The hydrologic model description, model parameters, model certifications, and model calibration/validation results are contained in Appendix A.

3. **Evaluation of Future System Flows**
   For this task, the City's Comprehensive Plan document was used to estimate population growth tributary to the East Side Interceptor. The population growth was then used to estimate future average and peak system flows. Populations used for future system flows are assumed to be based on land use growth to year 2035, including the Town of Normal and the recently-added Village of Downs.

4. **Long Term Simulation of Flows and Frequency Statistics for Flow**
   The calibrated hydrologic model was then used to develop a synthetic long-term record of flow for the study areas from 1990 to 2005 using rainfall and temperature measurements at Mason City from this same period as inputs to the model. The Mason City gage was the nearest gage that provided long-term and reliable rainfall data for the purposes of a long-term simulation. The location of the rain gage is not as important as having a rain gage that represents regional long-term climate patterns. The purpose of the long-term simulation is not to predict the actual flows that were generated in the system from the long-term precipitation record, but rather to generate the statistics of peak flows that are likely, if rainfall and climatologic patterns remain the same as they were in the long-term record. With that goal in mind, it is not important for a long-term precipitation record to be within or nearby the system being simulated, but rather that it contains the same long-term rainfall intensity, duration and frequency (IDF) characteristics. Examination of the IDF characteristics published in the Rainfall Frequency Atlas of the Midwest (Huff & Angel, 1992) shows very little difference in the IDF characteristics between Mason City and Bloomington areas. The term "synthetic" means that we have applied regional climate data to the calibrated model to develop a frequency analysis of annual peak flows. It is synthetic because it is not based on direct flow measurements but instead on a long-term series of predicted peak flows. The synthetic long-term record of flows was then used as an input to a frequency analysis in which peak design flows were estimated.

5. **Perform Benchmarking Analysis to Evaluate Relative Level of System I/I**
   A benchmarking method was used to estimate I/I levels relative to 65 other separate sewer systems that have been evaluated by OHM throughout the Midwest over the past six years. The results of the benchmarking analysis were used to confirm the initial I/I analysis and sewer system evaluation survey (SSES) site selections.

I/I Analysis

An analysis of I/I levels within the system was performed at the SEWWTP to show how the antecedent moisture conditions impact system flows. I/I levels were quantified by computing capture coefficients for several key storm events during the flow monitoring period for the year of 2009. The capture coefficient represents the percent of the total rainfall volume over the service area that enters the sanitary collection system. A summary of the I/I analysis for the SEWWTP is provided in Table 1.

Table 1: I/I Analysis Results for the SE WWTP

Storm	Rain (in)	RDII Volume (Mcf)	Capture % (C%)
02/10/09	1.49	1640.6	3.4%
03/07/09	0.74	528.1	1.8%
03/09/09	1.54	1465.5	2.7%
03/28/09	1.33	768.9	2.0%
04/09/09	0.72	470.8	2.0%
04/12/09	0.84	627.5	2.3%
05/12/09	2.12	2971.1	2.9%
07/04/09	0.83	220.8	0.7%
07/24/09	1.17	199.6	0.6%
	Highest C%		3.4%
	Lowest C%		0.6%
	AM Variability		616.4%

Notes

1. RDII = Rainfall Dependent Inflow and Infiltation
2. Capture % = Percent of the total rainfall volume over the service area that enters the sanitary collection system.
3. Total Service Area = 8944 acres.
4. Diversion occurred at GE Valley Pump Station for 3/9/09 event. Actual C% should be higher due to lost volume.
5. Mcf = Thousands of cubic feet
6. RDII Volumes do not contain base groundwater flows

The I/I analysis indicates that the capture coefficients can vary by as much as 616% for different storm events. The analysis also shows that the capture coefficients are typically higher during the wet spring months and lower during the dry summer. These findings indicate that antecedent moisture conditions vary significantly between events and that a hydrologic model that takes into account varying antecedent moisture conditions is needed to analyze the system. The flow meter data was also checked and analyzed using water consumption data. In comparing the water usage data by flow meter district, it is possible to perform a continuity check on the water consumption versus average sanitary flows. Table 2 presents the comparison of consumption versus sanitary flows by meter district.

Table 2: Dry and Wet Weather Flow Statistics by Meter District

Meter District	Average Water Usage (cfs)	Average Winter-time Sanitary Flow (cfs)	Average Groundwater Infiltration (cfs)	Peak Observed Flow (cfs)++	Average Per Capita Usage (gpcpd)	Peak Per Capita Usage (gpcpd)	Maximum Observed Peaking Factor
GE Valley	1.74	2.96	1.22	12.87	93.5	406.8	4.35
Hamilton and Hershey	0.10	0.12	0.02	0.50	145.2	604.0	4.16
Broadmoor	0.06	0.16	0.10	0.65	143.9	602.3	4.18
Arcadia	0.08	0.23	0.15	0.90	260.7	1510.8	3.97
Ireland Grove West	0.07	0.27	0.20	1.40	--+	--+	5.13
State Farm Plaza**	0.18	--	--	--	--+	--+	--
Stern	0.35	0.78	0.44	6.10	--+	--+	7.77
Arrowhead and Holiday	0.13	0.09	-0.04	0.47	95.6	289.3	5.13
Ireland Grove East	0.56	1.00	0.45	10.40	--+	--+	10.35

** Frequent drop outs in flow data at meter 17 (State Farm Plaza); Average sanitary flows not computed

+ Population not estimated; Commercial land use area

++ Flow diverted from GEVPS during peak flow event

A comparison of the domestic consumption to observed sanitary flow data reveals that the average sanitary flows are consistently higher than the water consumption data. This finding is expected as the observed sanitary flows contain the additional groundwater infiltration component of flow. For the metering districts that were primarily residential, the average and peak per capita flow rates were also computed. The population in each of the residential meter districts was computed using the number of service leads in the districts while assuming a per household population of 2.5. The per capita flow rates can be compared to Environmental Protection Agency (EPA) benchmarks for dry weather infiltration. The EPA guidance suggests that if 120 gallons per capita per day (gpcpd) is exceeded during dry weather periods of high groundwater conditions or if 275 gpcpd is exceeded during wet weather conditions, then a cost effectiveness analysis for removing I/I sources is warranted. It can be noted from the table that three of the residential meter districts exceed the EPA benchmark for dry weather infiltration and all five residential meter districts exceeded the EPA benchmark for wet weather conditions. It is important to remember that just because the EPA benchmark is exceeded, does not mean that all I/I sources in the system are excessive (i.e. cost effective to remove). A sanitary sewer evaluation survey (SSES) is also being performed as part of the Master Plan process. The SSES includes field inspections to identify I/I sources and a cost effectiveness analysis to determine if the I/I sources can be cost effectively removed.

Hydrologic Model Development

The i3D Antecedent Moisture (AM) Model was calibrated and validated using hydrologic measurements for each of the areas tributary to the East Side Interceptor system during the monitoring period from 2008 to 2012 to characterize the system flows during wet weather conditions. The calibration results for the SEWWTP are presented this document as an example. The results for the sub-sewersheds within the East Side Interceptor service area are similar and are provided in Appendix B. The i3D model uses rainfall and air temperature to continuously determine the surface and sub-surface soil moisture conditions and adjusts the hydrologic model to account for these varying antecedent moisture conditions. A description of the model is provided in Appendix A. Table 3 contains the calibration results.

Table 3: Calibration Results for the SE WWTP

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
07/11/08	1.70	19.34	15.59	-19.4%	1,077	927	-14.0%	
01/07/08	3.36	40.83	43.26	6.0%	3,677	3,728	1.4%	
10/14/08	0.92	6.88	7.70	11.9%	1,166	1,049	-10.1%	
10/22/08	1.41	8.84	8.30	-6.1%	2,282	2,033	-10.9%	
09/11/08	5.70	25.08	40.74		4,658	5,522		Diversion Event
03/07/09	0.74	10.86	12.67	16.7%	1,320	1,555	17.8%	
02/10/09	1.49	22.09	17.38	-21.3%	3,381	2,940	-13.0%	
03/28/09	1.33	11.46	12.75	11.2%	2,064	2,170	5.1%	
04/09/09	0.72	14.38	13.89	-3.4%	1,829	1,795	-1.9%	
04/12/09	0.84	20.19	18.89	-6.4%	2,746	2,815	2.5%	
05/12/09	2.12	19.58	19.33	-1.2%	2,027	2,052	1.2%	
07/04/09	0.83	6.95	6.44	-7.3%	785	726	-7.5%	
07/24/09	1.17	6.97	7.45	6.9%	618	722	16.9%	
03/09/09	1.54	23.81	27.34		5,291	6,270		Diversion Event
11/21/10	1.57	6.92	8.10		1,170	1,734		Meter Issue
08/31/10	2.25	9.35	9.78	4.7%	1,405	1,323	-5.8%	
06/14/11	1.92	15.86	15.17	-4.3%	1,129	994	-11.9%	
04/18/11	3.83	24.99	23.14	-7.4%	7,893	7,546	-4.4%	
		Net Average Error		-1.3%			-2.3%	
		Total Average Error		9.0%			8.3%	

Notes

1. Hydrograph volumes include base groundwater flow volumes

Both net error and total error were calculated in Table 3. Net error is the average of all the errors and allows positive and negative values to offset each other. The net error is a measure of the model bias and should be as close to zero as possible. Total error is the average of the absolute value of the errors and is a measure of the model's ability to predict volumes and flows for individual storm events. The detailed calibration and validation results are provided in Appendix B of this memo. A review of the net and total errors shown in Table 3 shows that the calibrated model has a net peak error of -1.3% and a net volume error of -2.3% indicating that the model has little or no bias. The net and total errors are considered excellent for a single, continuous model that simulates varying capture coefficients of up to 616% from wet and dry conditions, as tabulated in the I/I analysis.

Once the model was calibrated to the 2007 to 2011 flow and rainfall data, the model was validated to test its performance using a portion of the flow observations in 2012 that were not used to calibrate the model. The validation process was used to test the model and provide confidence in its predictive capabilities. Figure 2 presents the model validation for the SE WWTP, in which good concurrence is shown between the model and observed flows. Based on the calibration and validation results, the hydrologic model provides a good representation of wet weather flows in the systems and is suitable for use in long term simulation to develop peak design flow and volume statistics for the system.

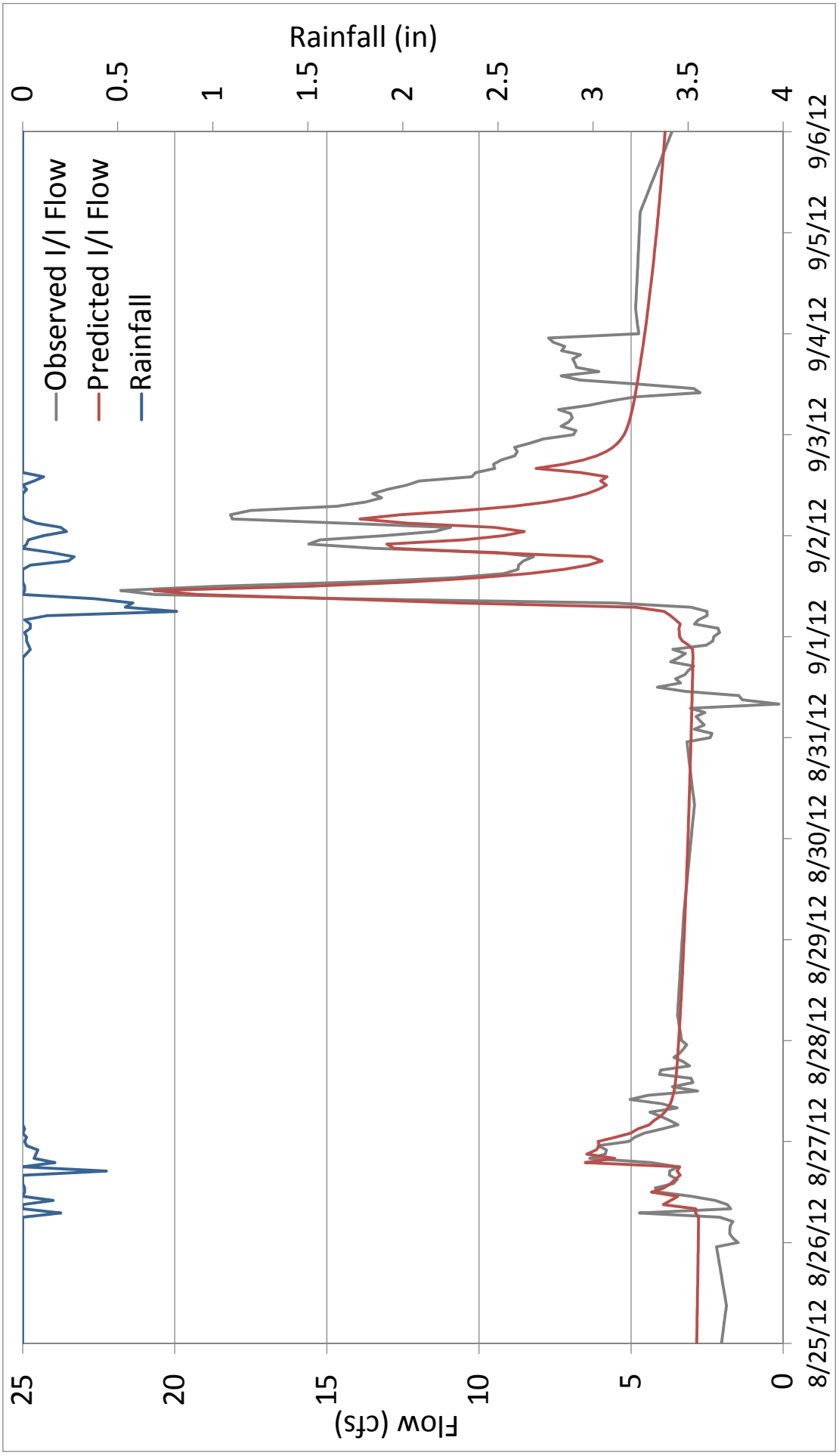


Figure 2: Model Validation for SE WWTP

Evaluation of Future System Flows

For this task, the City's Comprehensive Plan document was used to estimate population growth tributary to the East Side Interceptor. The population growth was then used to estimate future average and peak system flows for year 2035. The estimated population growth map from the City's Comprehensive Plan document is presented in Figure 3.

Figure 3: Growth Map Excerpt from City of Bloomington 2005 Comprehensive Plan

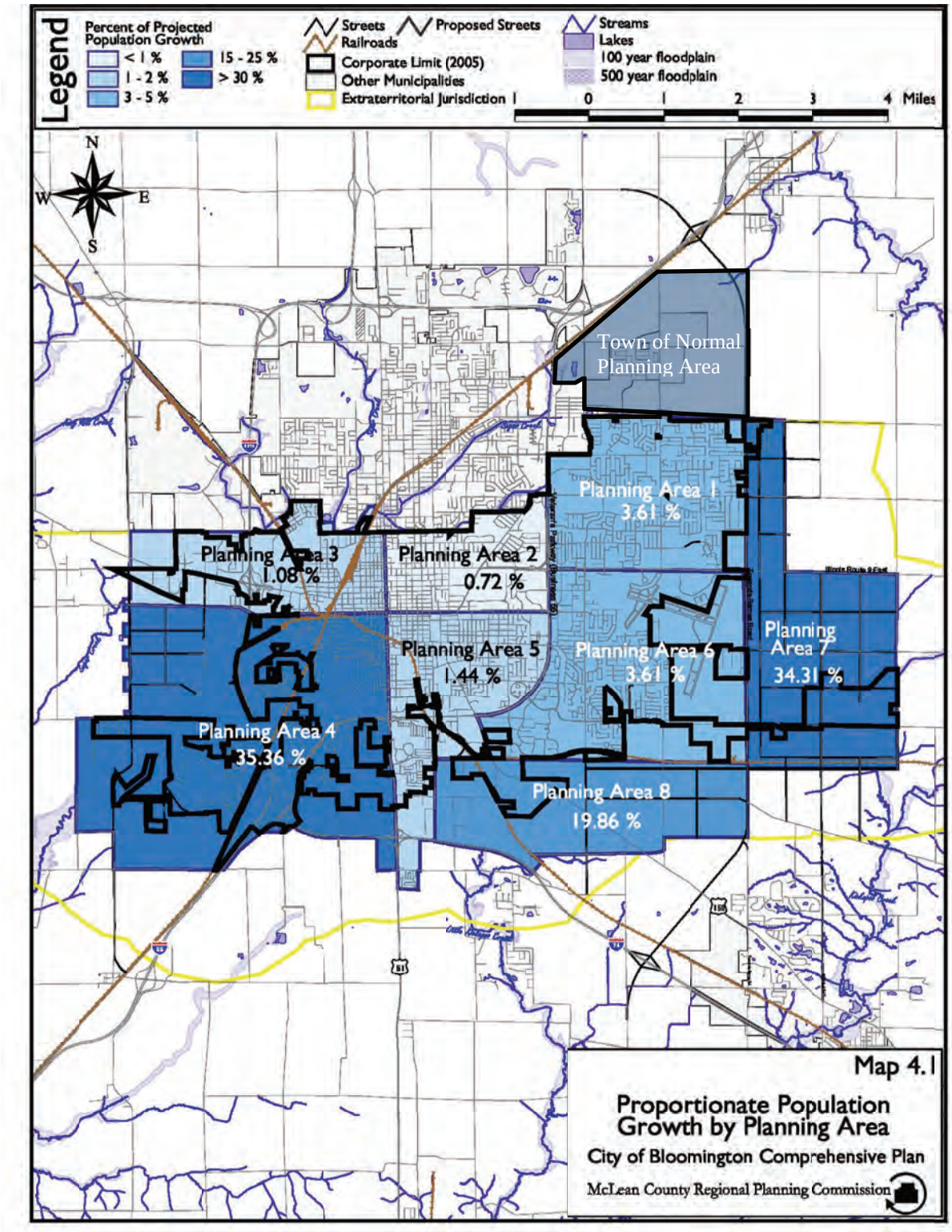


Figure 3 depicts the estimated population growth by planning area for the City of Bloomington. Planning Areas 1, 6, 7, & 8 are contained within the East Site Interceptor tributary area and the percent growth from each of these areas was used to estimate the assumed future flows within the East Side Interceptor system for year 2035. The map has been modified to depict the growth areas from the Town of Normal, in which growth rates were estimated based on the Town of Normal Comprehensive Plan. The population growth in each of these areas was estimated using the assumed land use density factors shown in Table 4.

Table 4: Land Use Density Factors for Future Growth

Code	Description	Density (equivalent persons per acre)
PR	Parks/Recreational	0
ND	Neighborhood Commercial	6.5
LM	Low/Medium Residential	8
LI	Light Industrial	6.5
HR	Regional Highway Commercial	6.5
HI	Heavy Industrial	6.5
HD	High Density Residential	20
GI	Government Institutional	6.5

Once the population estimate was computed based on assumed land use densities, average future flows were estimated assuming 100 gallons per capita per day (gpcpd). In previous studies of the system, including the 1998 BNWRD Facilities Plan, a peaking factor of 2.25 was applied to future flows for planning purposes. This peaking factor appears to be consistent with the peaking factor equations used in the 10 States Recommended Standards for Wastewater Facilities when taking into account the entire SEWWTP service population; however, for individual meter districts, we recommend a peaking factor of 4.0, which is more consistent with recommended peaking factors for smaller populations. Since the Comprehensive Plan was completed back in 2005, it was also assumed that the 3.61% growth rate in Planning Areas 1 and 6 has already occurred and is reflected in the existing flow estimates. Portions of Incremental Area D and the Cedar Ridge area are already developed and are reflected in the meter data. The undeveloped portions of these areas are included in the projections for Incremental Area C. The resulting future population and flow projections by meter district are presented in Table 5.

Table 5: Future Population and Flow Projections

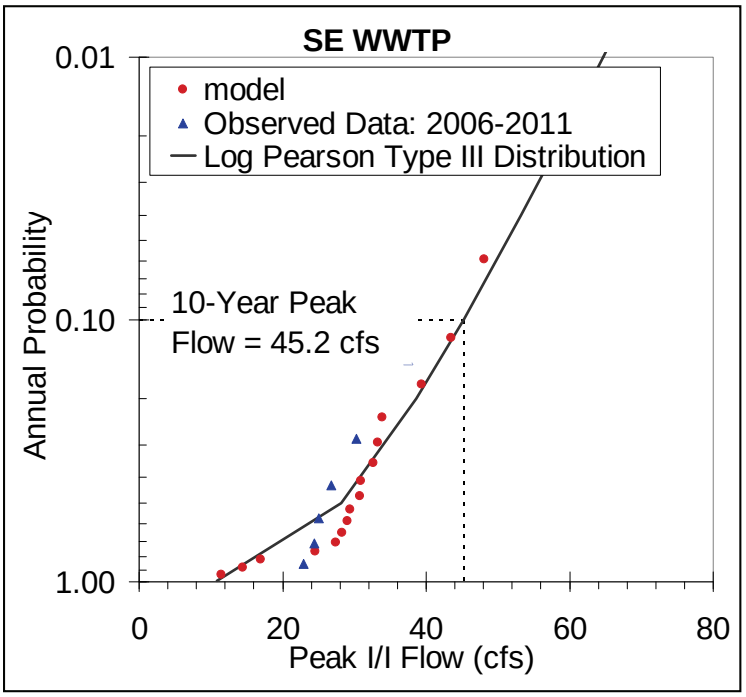
Meter District	**Estimated Population Growth (persons)**	**Additional Average Flow (cfs)**	**Additional Peak Wet Weather Flow (cfs)**
GE Valley Pump Station*	17,024	2.63	10.54
Ireland Grove East	8,448	1.31	5.23
Ireland Grove West	0	0.00	0.00
Broadmoor	0	0.00	0.00
Hamilton and Hershey	0	0.00	0.00
Arrowhead and Holiday	0	0.00	0.00
Stern	0	0.00	0.00
Arcadia	0	0.00	0.00
State Farm Plaza	0	0.00	0.00
Incremental Area A	0	0.00	0.00
Incremental Area B	0	0.00	0.00
Incremental Area C	6,361	0.98	3.94
Village of Downs	1,005	0.16	0.62
SE WWTP (Total)	**32,838**	**5.08**	**20.32**
*Future Town of Normal flows estimated based on Comprehensive Plan			

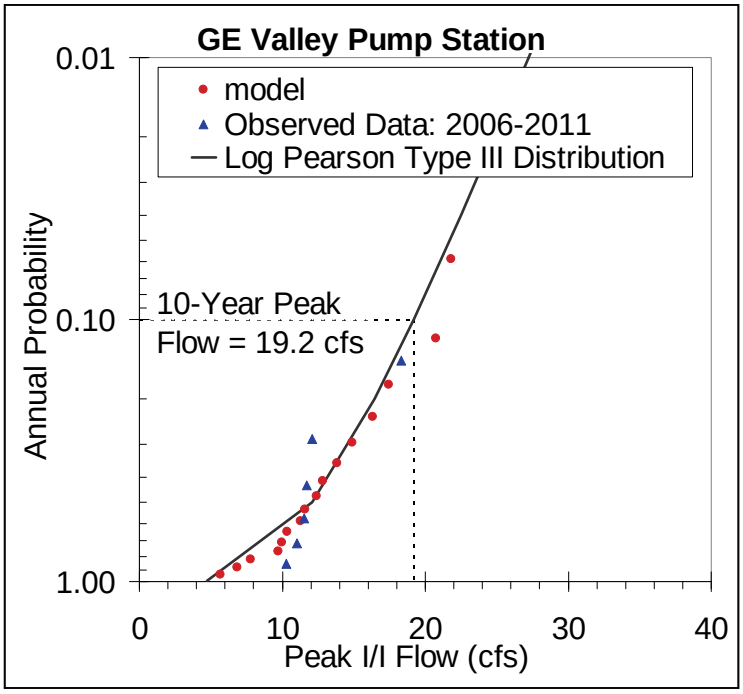
Long Term Simulation of Flows and Frequency Analysis

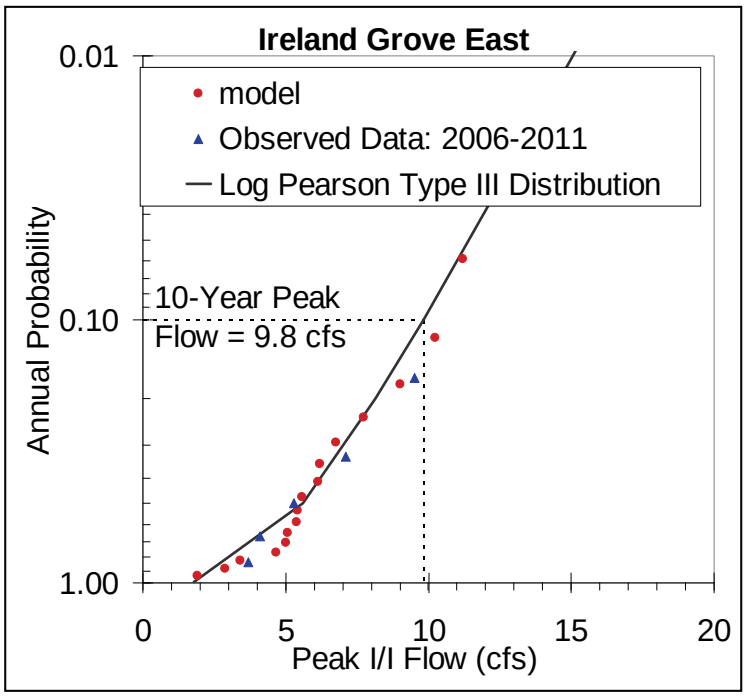
There are several options for developing a peak flow design basis. Some of these options include the use of a design storm or the use of continuous simulation coupled with a frequency analysis. The use of a design storm to develop a peak design flow provides challenges as it requires the selection of rainfall and a single antecedent moisture (AM) condition upon which to design the system, with limited knowledge of how often that particular rainfall and AM combination will occur in the system. Using this method provides system operators and regulators very little sense as to how often the resultant peak design flow will be exceeded; thus, a level of risk in exceeding the design flow rate cannot be explicitly selected using this method. For this reason, continuous simulation coupled with a frequency analysis was selected as this method allows the explicit selection of a level of risk and doesn't require the selection of a particular rainfall and AM condition. One potential basis for selecting a level of risk is the use of a 10-year frequency flow rate to evaluate system performance. This basis of evaluation provides that the system would be designed to handle flow rates that would have a 10% chance of being exceeded in any given year. The 10-year recurrence interval flow has been used throughout the Midwest as a standard for sanitary system performance evaluation under wet weather conditions. The Illinois Environmental Protection Agency (IEPA) has accepted the 10-year frequency flow approach in the past, specifically, for the City of Rockford. The State of Michigan has allowed for a 10-year frequency design approach in their Sanitary Sewer Overflow policy with "enforcement discretion" for events that exceed this threshold, and the USEPA has accepted this policy.

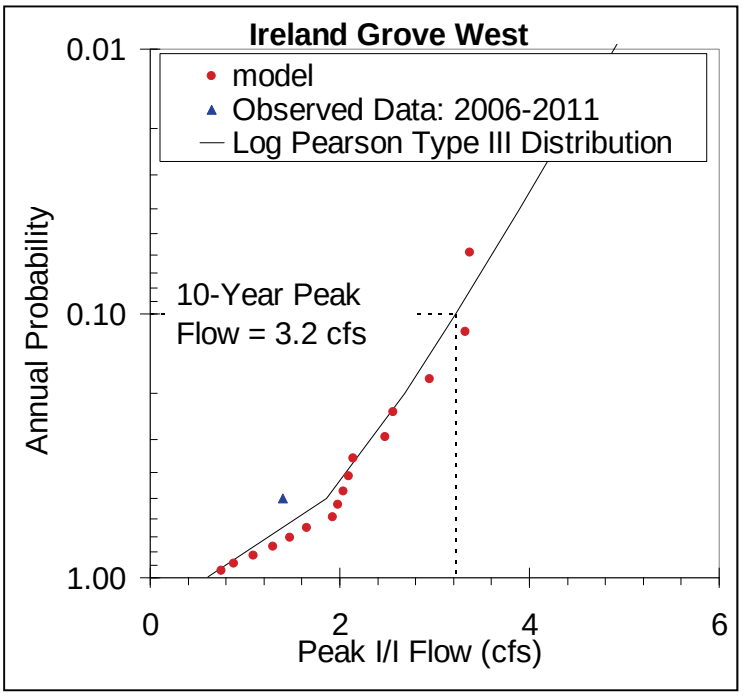
In selecting the frequency-based method, the calibrated hydrologic model was used to develop a synthetic long term (16-year) record of flow from 1990 to 2005 using rainfall and temperature measurements at the Mason City weather station from this same period as inputs to the model. This long-term synthetic flow record was analyzed to determine the peak flow statistics that have a 10% chance of being exceeded in any given year, representing the 10-year frequency peak flow. In order to estimate the 10-year peak design flow rates, an annual maximum series was selected from the 16-year simulation of flows to produce an annual exceedance series with sixteen (16) peak flow data points. This annual maximum series was then used to develop a frequency analysis to estimate the 10-year frequency flow. The 10-year frequency flow was estimated using the Log-Pearson Type III Distribution. The frequency analyses for the study areas are illustrated in Figure 4.

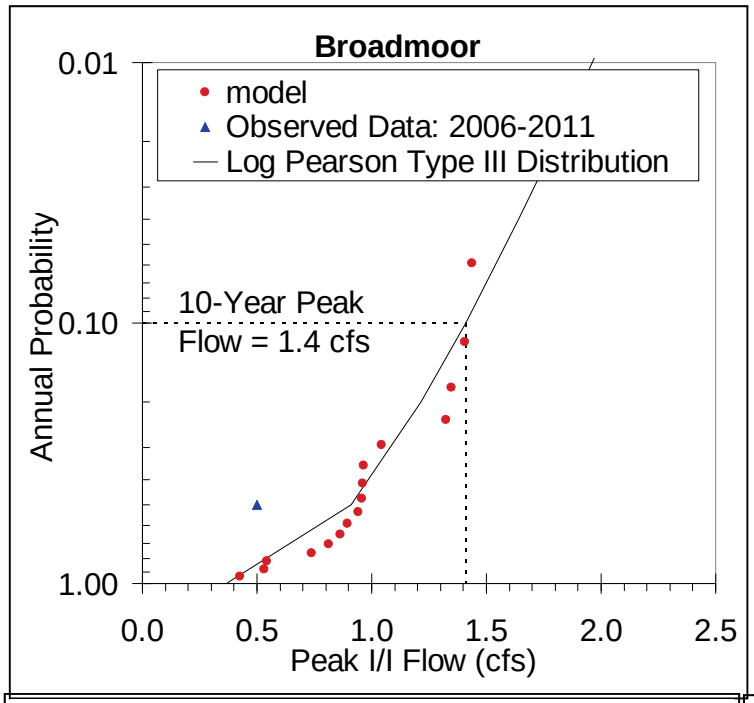
Figure 4: Frequency Analysis of Peak Flows for East Side Interceptor Districts

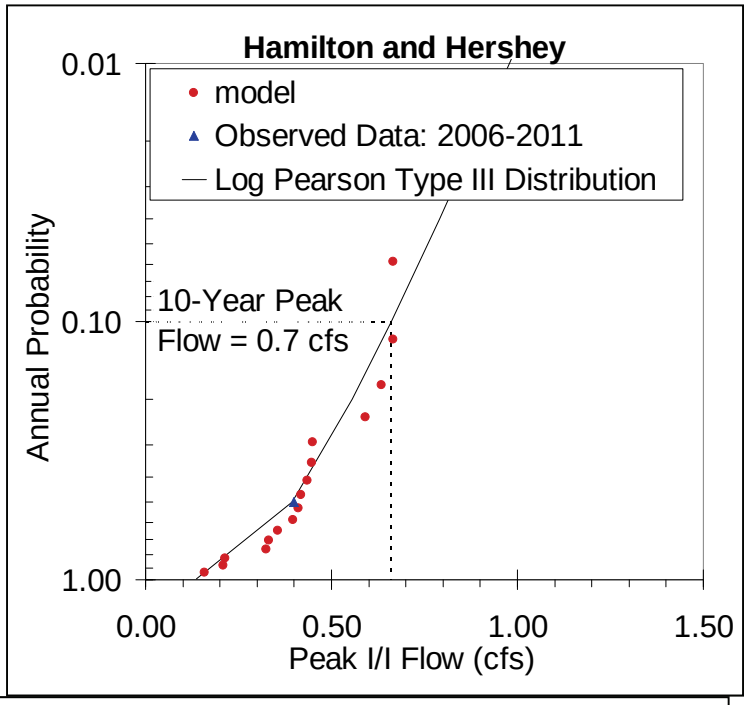


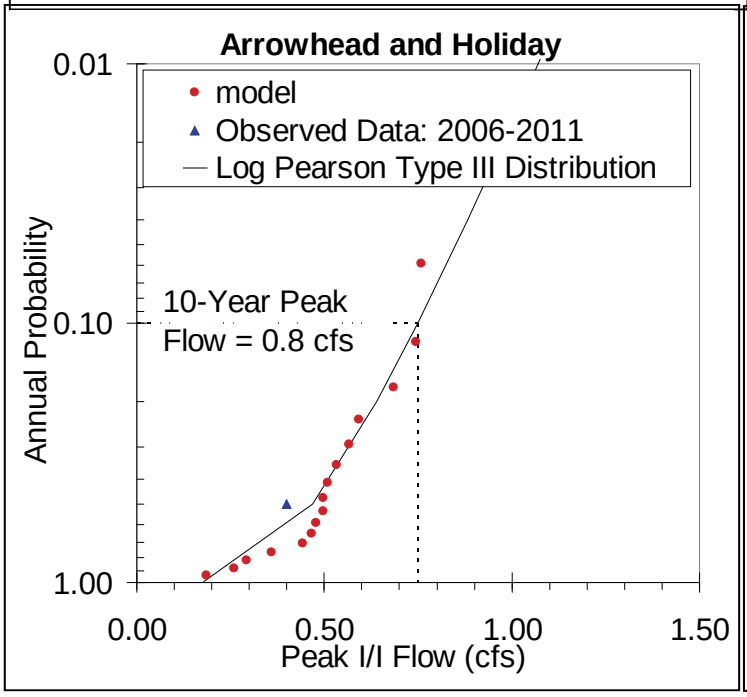


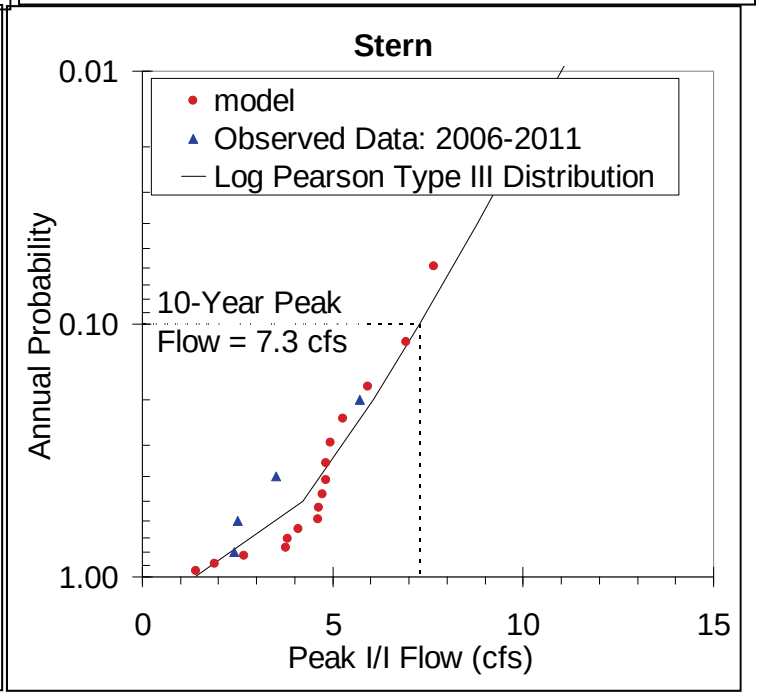


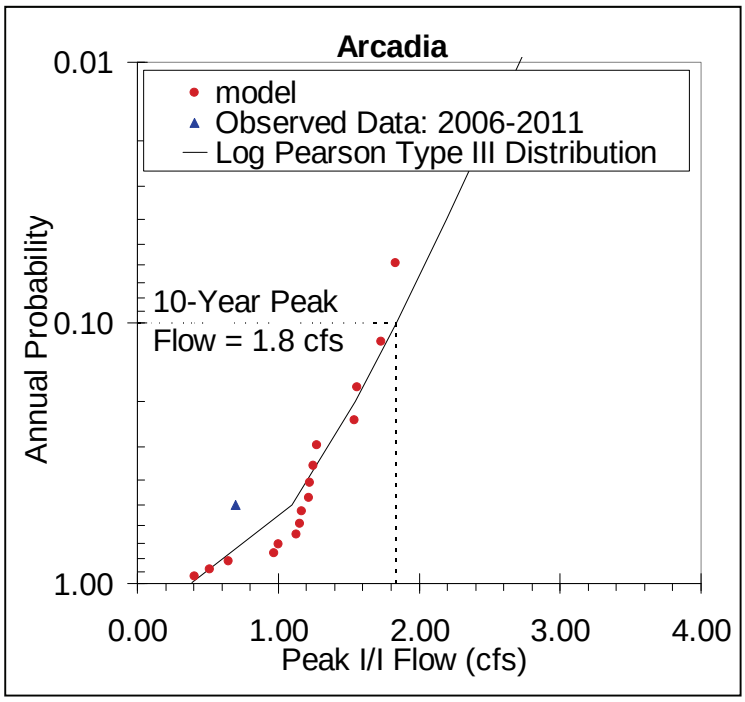



Broadmoor
model
Observed Data: 2006-2011
Log Pearson Type III Distribution
10-Year Peak
Flow = 1.4 cfs
Annual Probability
0.01
0.10
1.00
0.0
0.5
1.0
1.5
2.0
2.5
Peak I/I Flow (cfs)


Hamilton and Hershey
model
Observed Data: 2006-2011
Log Pearson Type III Distribution
10-Year Peak
Flow = 0.7 cfs
Annual Probability
0.01
0.10
1.00
0.00
0.50
1.00
1.50
Peak I/I Flow (cfs)


Arrowhead and Holiday
model
Observed Data: 2006-2011
Log Pearson Type III Distribution
10-Year Peak
Flow = 0.8 cfs
Annual Probability
0.01
0.10
1.00
0.00
0.50
1.00
1.50
Peak I/I Flow (cfs)


Stern
model
Observed Data: 2006-2011
Log Pearson Type III Distribution
10-Year Peak
Flow = 7.3 cfs
Annual Probability
0.01
0.10
1.00
0
5
10
15
Peak I/I Flow (cfs)



Discussion of Frequency Analysis Results

The results of the frequency analysis are summarized in Table 6.

Table 6: Frequency Analysis Results (Existing Land Use)

Meter District	Estimated 10-year frequency I/I flow rate (cfs)	Estimated 10-year frequency I/I flow rate (MGD)
GE Valley Pump Station	19.2	12.4
Ireland Grove East	9.8	6.3
Ireland Grove West	3.2	2.1
Broadmoor	1.4	0.9
Hamilton and Hershey	0.7	0.5
Arrowhead and Holiday	0.8	0.5
Stern	7.3	4.7
Arcadia	1.8	1.2
State Farm Plaza	0.0	0.0
Incremental Area A	0.5	0.3
Incremental Area B	1.0	0.6
Incremental Area C	0.0	0.0
Village of Downs	0.0	0.0
SE WWTP (Total)	**45.7**	**29.5**

As part of the frequency analysis, a high-level comparison was also performed with the frequency analysis by plotting the actual yearly maximum flow rates measured at the flow meter from 2008 to 2012. The blue triangle data points in Figure 4 represent the actual measured flows and show concurrence with the modeled data points. It should also be noted that I/I modeling was not performed on the State Farm Plaza area as the system had no discernible wet weather response. Flow rates from the smaller service areas south of Hamilton Road are represented in the SEWWTP total flow rate.

Benchmarking Analysis to Evaluate Relative Level of System I/I

Benchmarking is a way of comparing the performance of one meter district to another through a standardized set of comparisons under similar conditions. Traditionally, it has been challenging to benchmark I/I performance due to the impacts of antecedent moisture. Flows observations are collected for different systems in different years and under different AM conditions. It is difficult to directly compare flow observations from different systems under these circumstances and draw meaningful conclusions. The use of the AM model allows for us to control these conditions and assess the performance of each modeled system under identical AM conditions and rainfall. For a given system, the I/I response to the identical AM and rainfall conditions can be summarized by peak flow, volume, or capture coefficient on a unitized basis (per capita or per acre). Comparing these metrics across several meter districts can help the City prioritize areas for rehabilitation across the City, even if the data were collected for each district in different years, under different wetness conditions and rain events. Figures 5 and 6 depict system benchmarking that compares the nine study districts from the City of Bloomington to over 65 other meter districts throughout the Midwest.

Figure 5: System Benchmarking for Peak I/I Flow per 1,000 acres

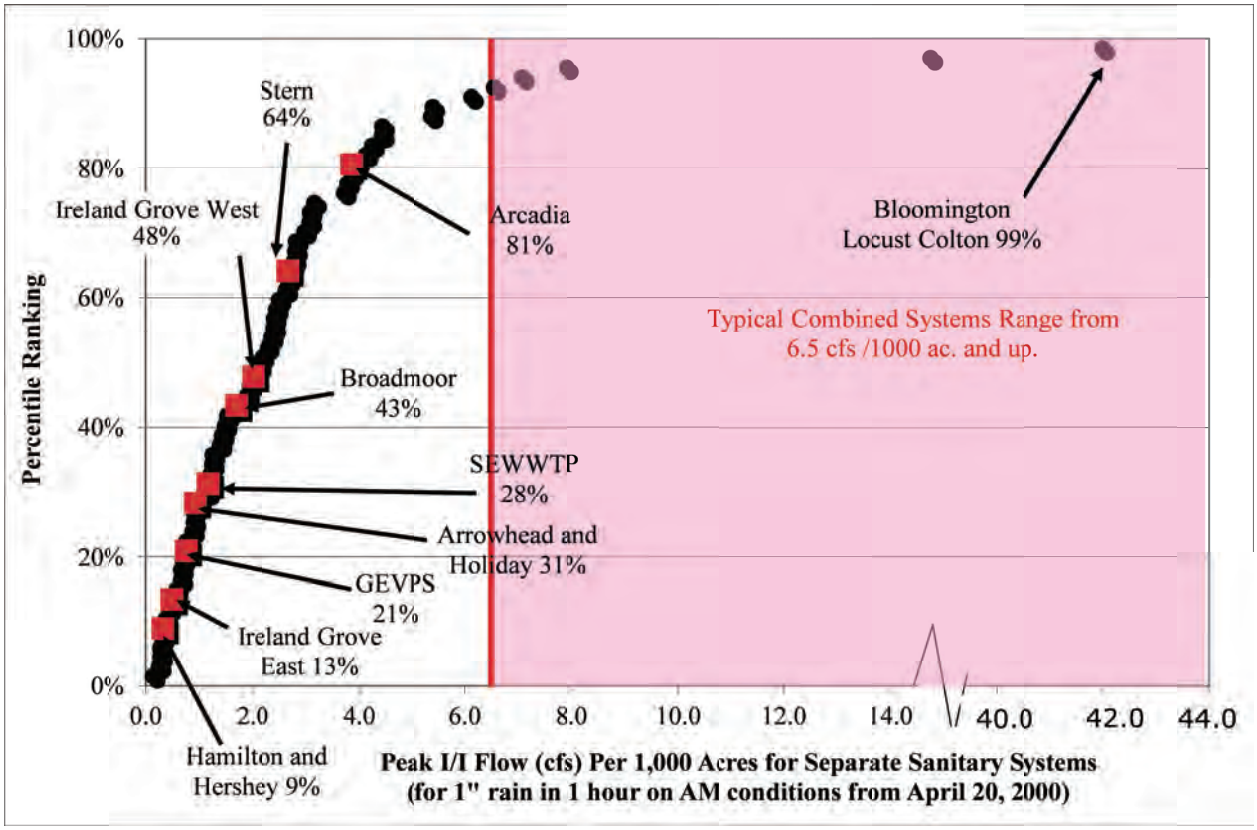
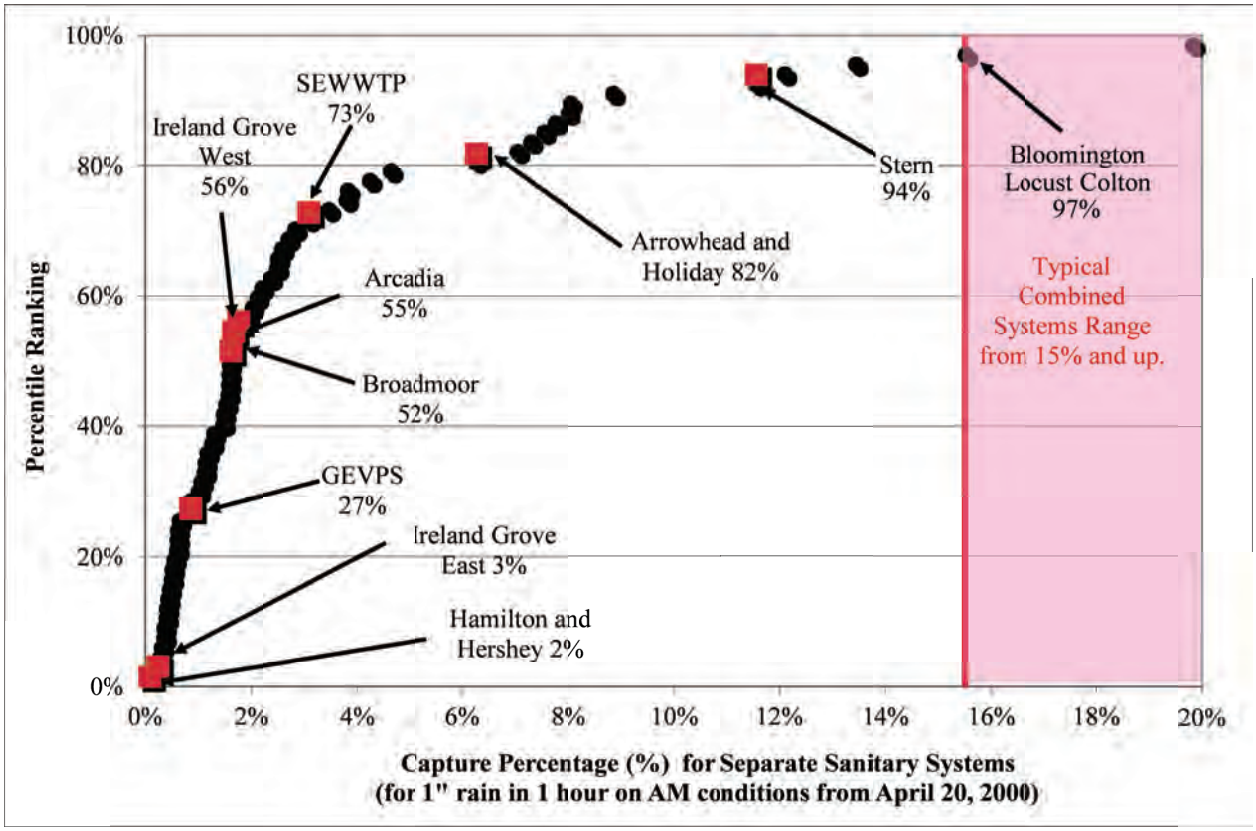


Figure 6: System Benchmarking for Capture Coefficient



Based on the system benchmarking, the Stern metering district appeared to have the highest overall metrics in terms of peak I/I flow and capture coefficients. In addition, the results also indicate that the overall SEWWTP system does not have high peak I/I flow per 1,000 acres as the system is only at the 28th percentile in the data set. The SEWWTP system ranks higher in terms of capture coefficients at the73rd percentile.

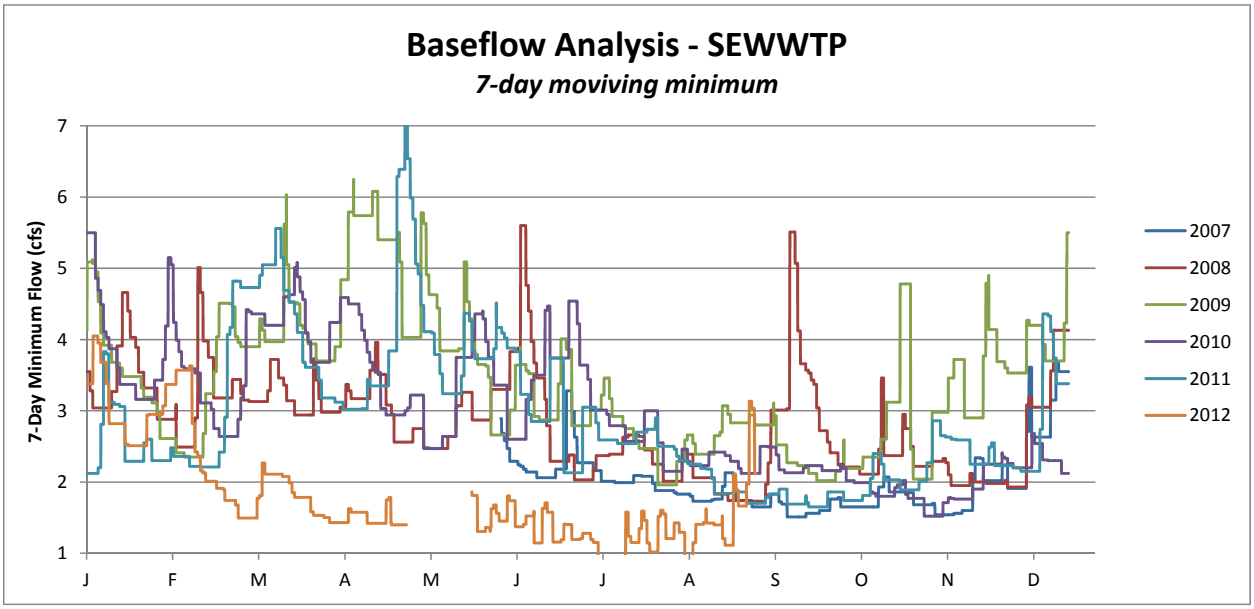
The benchmarking plots also illustrate the knee-of-the-curve concept, in which a community can identify the potential for I/I reductions based on their location along the curve. If a community's data point is at the far right of the curve, the potential for I/I is greater than if the community's data point were at the far left of the curve. The knee-of-the-curve analysis for the East Side Interceptor suggests that Bloomington's system is within a range for which there is limited potential for major source reduction.

Baseflows

Most separate sanitary sewer collection systems convey a significant amount of non-sanitary flows. This is due to varying (seasonal) groundwater levels that infiltrate into pipe joints and manholes. The sanitary sewer trench, which consists of gravel and granular backfill, acts as a conduit to receive and convey groundwater, and the sanitary sewer is often the only reliable outlet for this groundwater. Even newer (tighter) systems experience this unwanted flow component.

The 7-day rolling minimum flow rate at the SEWWTP was plotted for the flow monitoring period (mid-2007 to mid-2012) to demonstrate the wide variation in baseflow levels (see Figure 7). The short-term spikes represent elevated baseflows following wet weather events. These spikes do not represent the peak flows, but rather the low points of the diurnal curve following significant rainfall. Although the 2007-2011 data show significant variation, they reveal seasonal changes in baseflow, with winter baseflows generally between 3.0 to 4.5 cfs (2.0 to 3.0 MGD) and summer baseflows more concentrated in the 1.75 to 2.5 cfs (1.2 to 1.7 MGD) range.

Figure 7 – Baseflow Patterns



Baseflows are often elevated in the spring months following rainfall events, with sustained flows exceeding 5 cfs (3.4 MGD) observed at the SEWWTP for, in some cases, several weeks or more.

2012 baseflow data provide a unique perspective, as a severe drought reduced soil moisture levels to historical minimums. Although we would not recommend using 2012 data as a benchmark for future system performance, it provides an approximation of baseflows with minimal to no groundwater influence. During the driest periods of 2012, the minimum observed baseflow was in the range of 1.0 to 1.25 cfs (0.7 to 0.8 MGD).

Controlling baseflows in the East Side Interceptor will be a component of the recommendations under wet weather alternatives.

Findings & Recommendations

The results of the hydrologic analysis for the study meter districts are presented in Table 7.

Table 7: Study Area Design Flows

	Existing Flows		Future Incremental Flows			Future Total Flows
Column	A	B	C	D	E	F
Formula	From statistics	From Metering	From Table 4	= C*100	= D*4.0	= A+B+E
Meter District	**Estimated 10-year frequency I/I flow rate (cfs)**	**Domestic Flows (cfs)**	**Estimated Population Growth (persons)**	**Additional Average Dry Weather Flow at 100 gpcd (cfs)**	**Additional Peak Wet Weather Flows (cfs)**	**Estimated Total Future Peak Flows (cfs)**
GE Valley Pump Station	19.2	2.0	17,024	2.6	10.5	31.7
Ireland Grove East	9.8	0.5	8,448	1.3	5.2	15.5
Ireland Grove West	3.2	0.1	0	0.0	0.0	3.3
Broadmoor	1.4	0.1	0	0.0	0.0	1.5
Hamilton and Hershey	0.7	0.1	0	0.0	0.0	0.8
Arrowhead and Holiday	0.8	0.0	0	0.0	0.0	0.8
Stern	7.3	0.3	0	0.0	0.0	7.6
Arcadia	1.8	0.2	0	0.0	0.0	2.0
State Farm Plaza	0.0	0.0	0	0.0	0.0	0.0
Incremental Area A	0.5	0.0	0	0.0	0.0	0.5
Incremental Area B	1.0	0.0	0	0.0	0.0	1.0
Incremental Area C	0.0	0.0	6,361	1.0	3.9	3.9
Village of Downs	0.0	0.0	1,005	0.2	0.6	0.6
SE WWTP (Total)	**45.7**	**3.2**	**32,838**	**5.1**	**20.3**	**69.2**

Based on the results, we offer the following findings:

1. The SEWWTP future peak design flow rate is 69.2 cfs (44.7 MGD), which exceeds the WWTP capacity of 26 cfs (16.875 MGD).
2. Based on a review of the benchmarking analysis, the overall system does not appear to have extraordinarily high I/I levels as compared to similar communities, although the measured wet weather flow volume is slightly higher than the median of similar metered sewer systems.
3. The collection system has a wide variance in flow responses based on antecedent moisture conditions.
4. Seasonal variations in observed 7-day minimum flows are typical of other wastewater collection systems, although spikes during wet weather suggest there is an opportunity to reduce the magnitude of wet weather fluctuations and reduce the volume of treated flow to the SEWWTP.
5. The results from this study will be used to develop the hydraulic model of the interceptor sewer and determine what system improvements are necessary to manage wet weather flows, reduce baseflow (groundwater infiltration) and reduce/eliminate flow diversions to the west collection system.
6. The flow meters installed by BNWRD in February 2012 should remain in place through late spring / early summer 2013 in order to measure system response under more typical climate conditions.

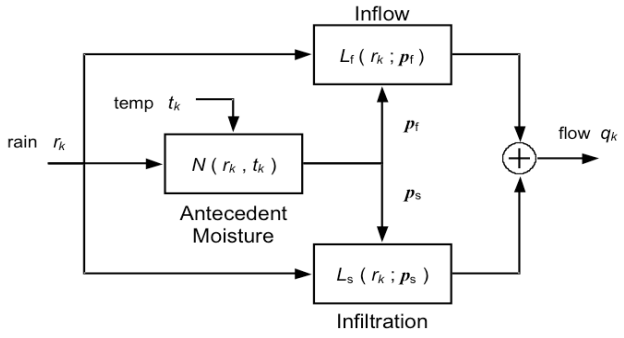
APPENDIX A
MODEL DESCRIPTION
MODEL PARAMETERS

Attachment A: Antecedent Moisture (AM) Model Description

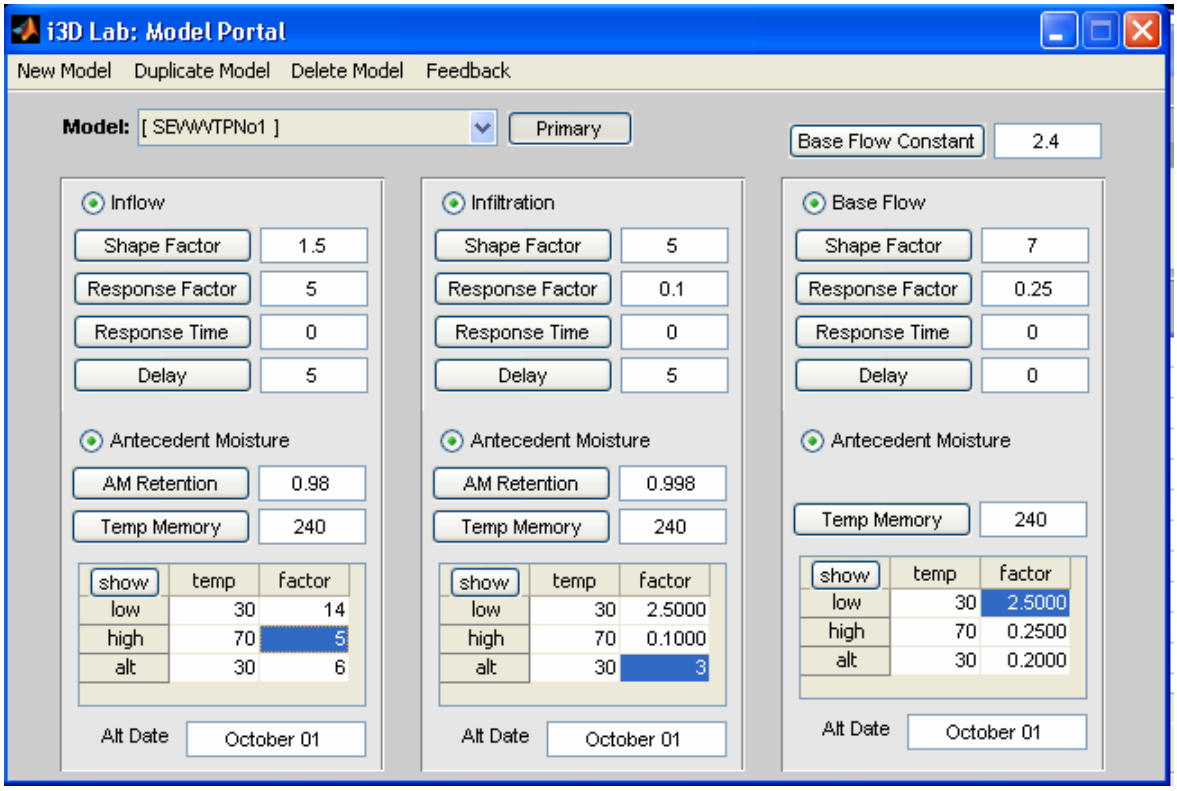
I/I into sanitary collection systems occurs through a complex series of mechanisms that include direct and indirect inflow, seepage into manholes, sewer defects, footing drains and numerous other sources. Because of the complex transport mechanisms of these flow sources, they are heavily dependent on variables that are not normally included in traditional stormwater-based models for I/I such as soil moisture conditions and ground water levels. These variables continuously change during storms and in between storms in response to antecedent moisture conditions. The AM model used for this study takes into account the overall antecedent moisture condition of the sewershed, resulting in a more accurate model based on the sewer system's response to wet weather.

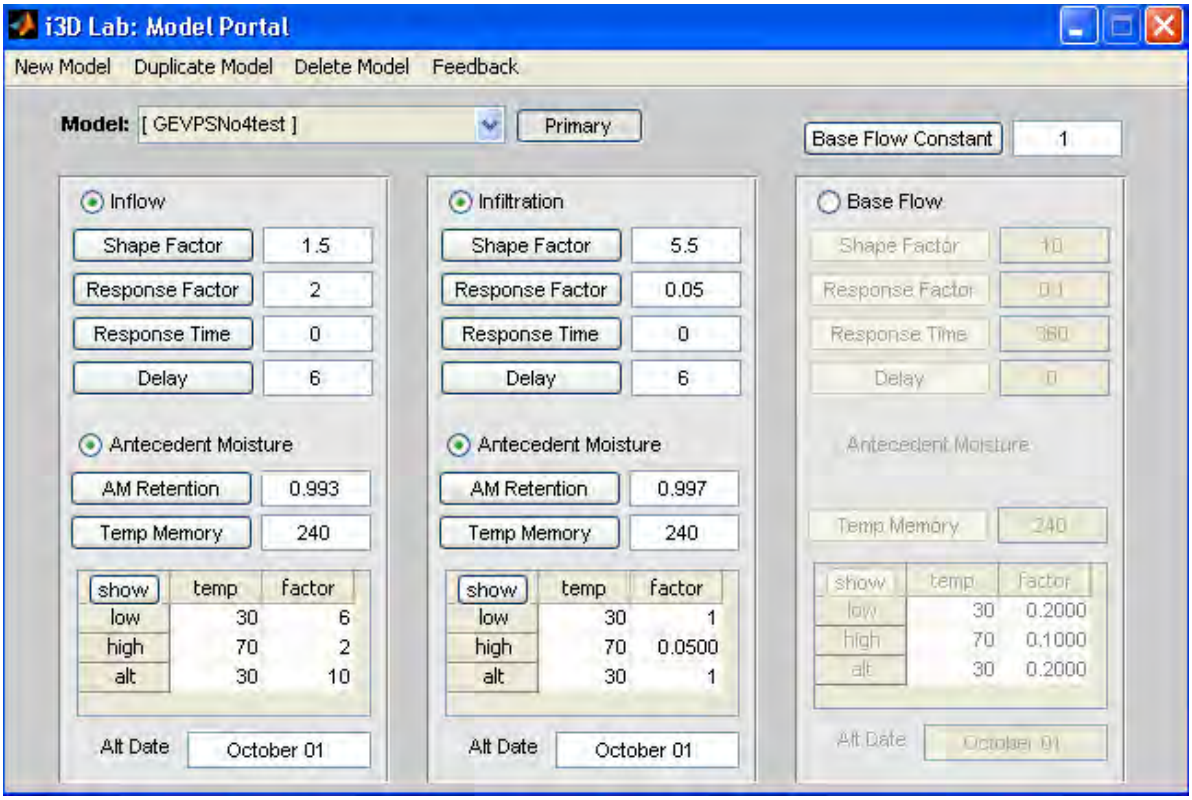
In order to account for the effects of antecedent moisture, the AM modeling technique is based on system identification theory. The model utilizes tools from the fields of digital signal processing, control systems and time series analysis to model variable I/I using data-based models. System identification is the approach of identifying the most appropriate and simplest numerical model that accurately describes the observed data and then gaining insight into the physical characteristics of the system through interpretation of the resulting model structure. A block diagram of the resulting antecedent model structure is depicted in Figure 1. Note that the model structure contains an antecedent moisture block that is automatically modified based on the recent rainfall and temperature conditions. This approach allows the model to simulate the variation in capture coefficients that occur as a result of antecedent moisture conditions. The resulting numerical model structure identifies physical phenomenon from the data such as fast dynamics (inflow) and slow dynamics (infiltration), long term ground water flow variations, and responses to previous rainfall and temperature (antecedent moisture). In some cases, the system identification process also uncovers other phenomenon such as river inflow or system deterioration.

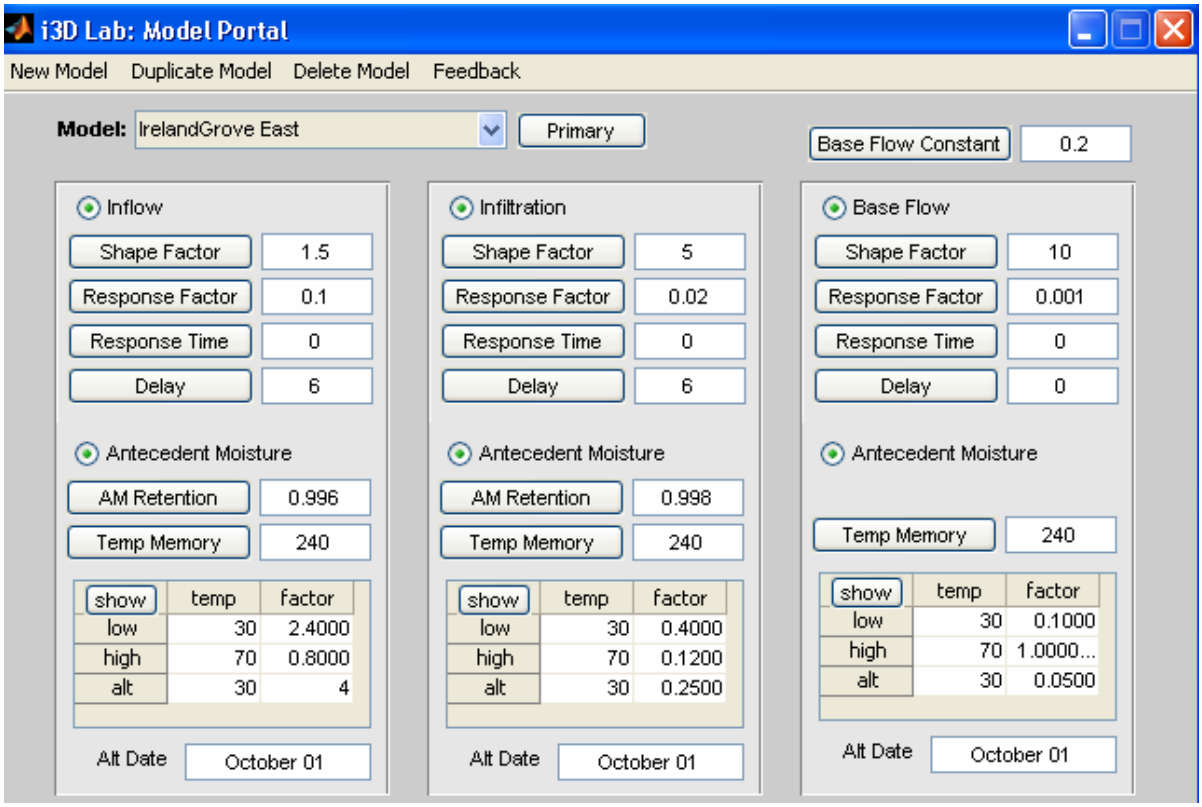
Figure 1: Antecedent Moisture Model Structure

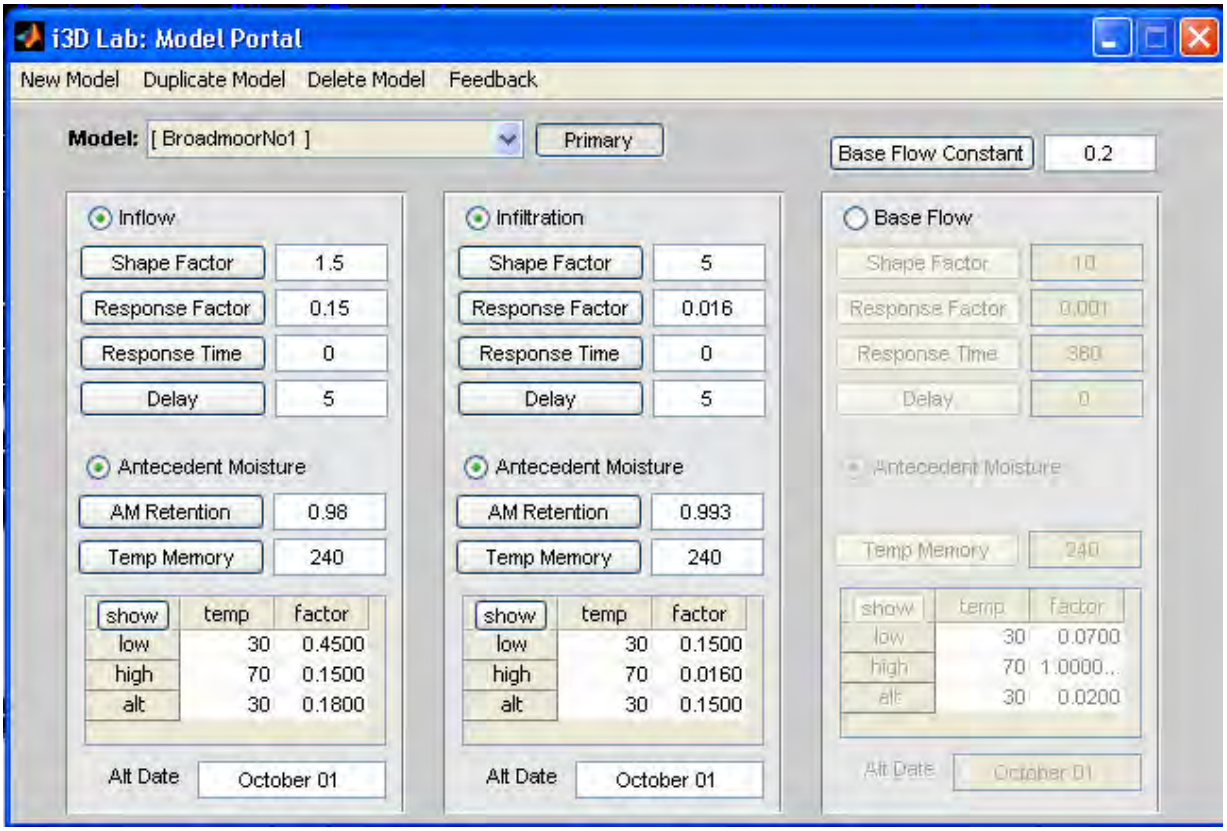


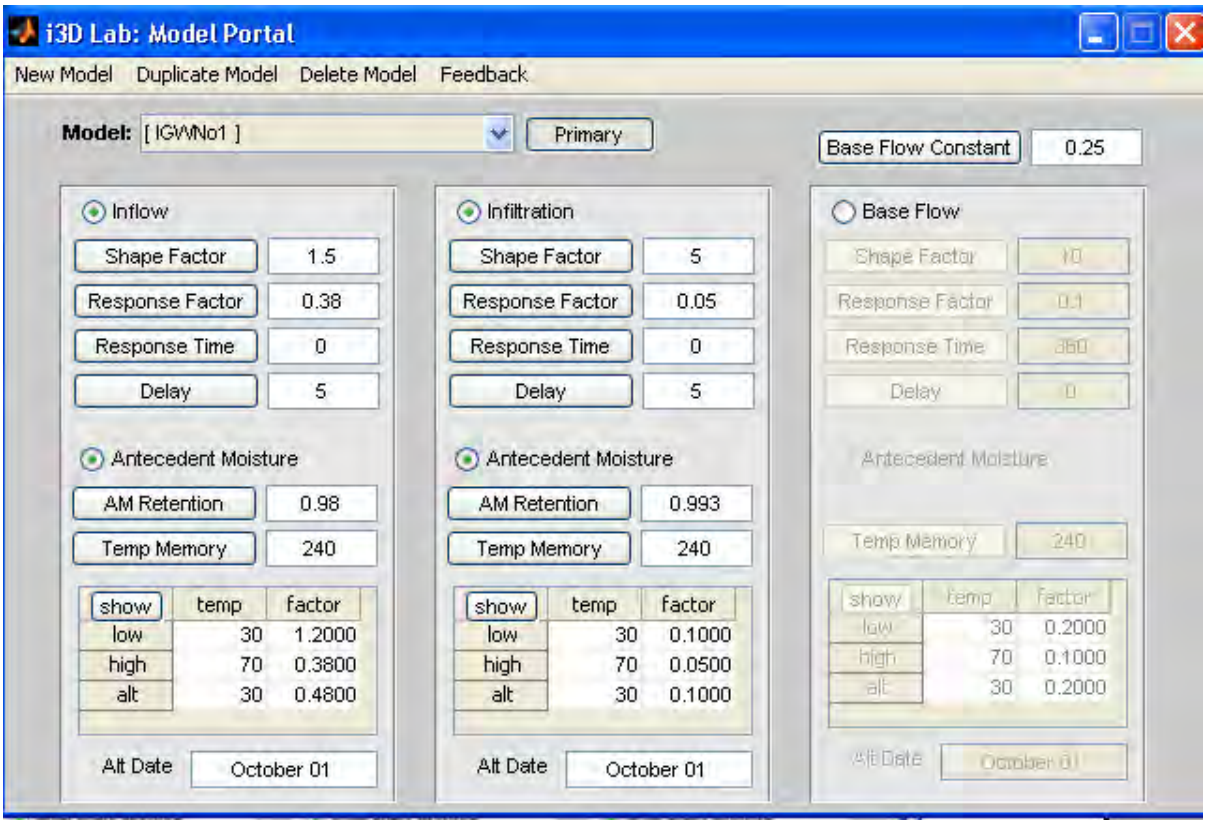
i3dLab version 2.8 release 30 model parameters

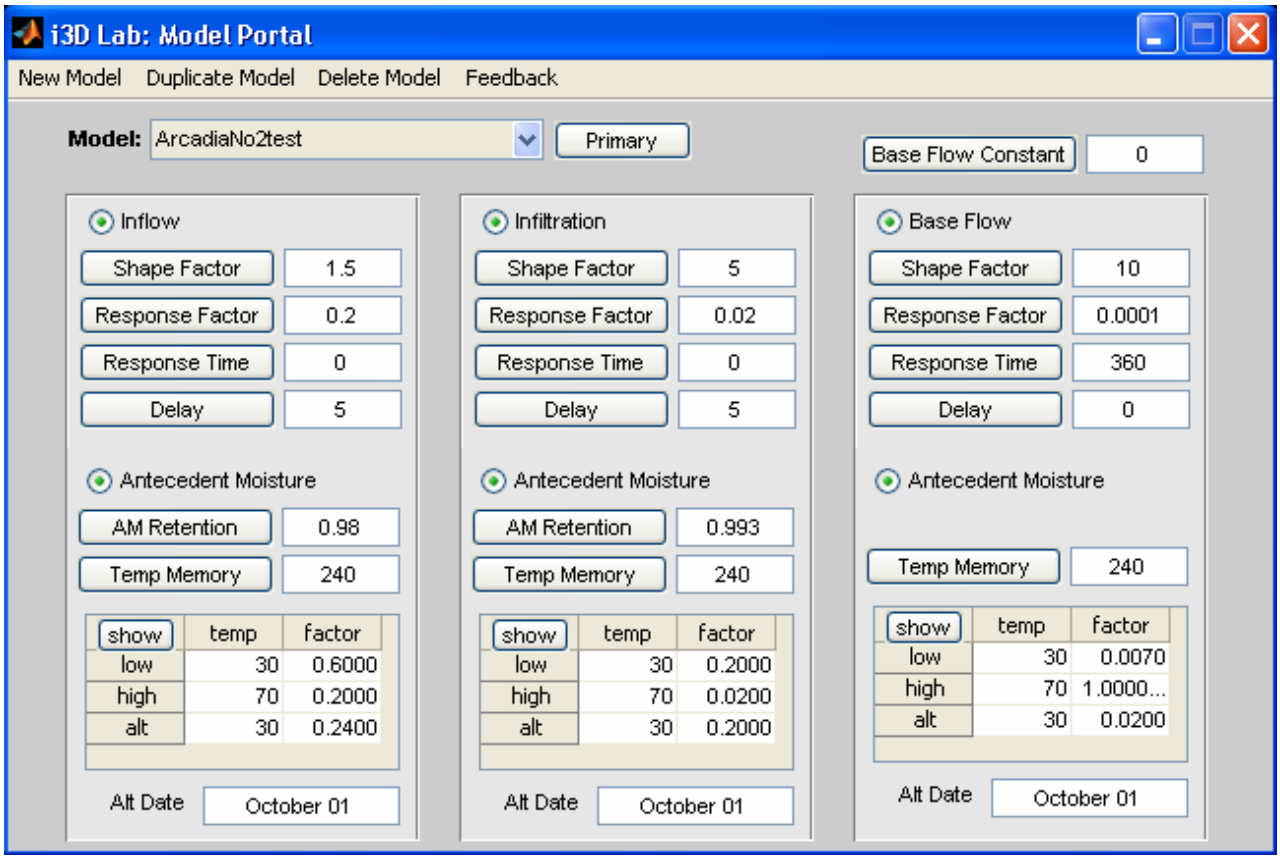


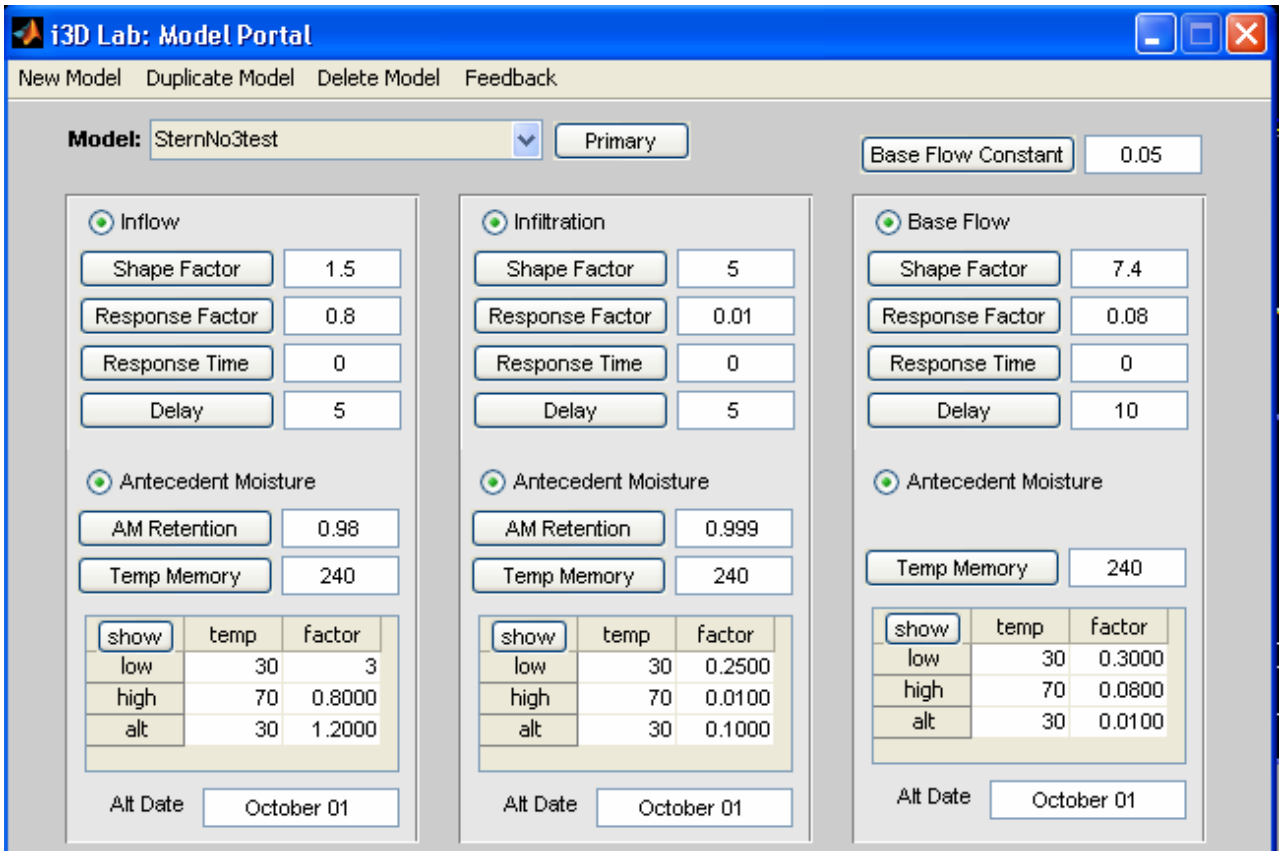


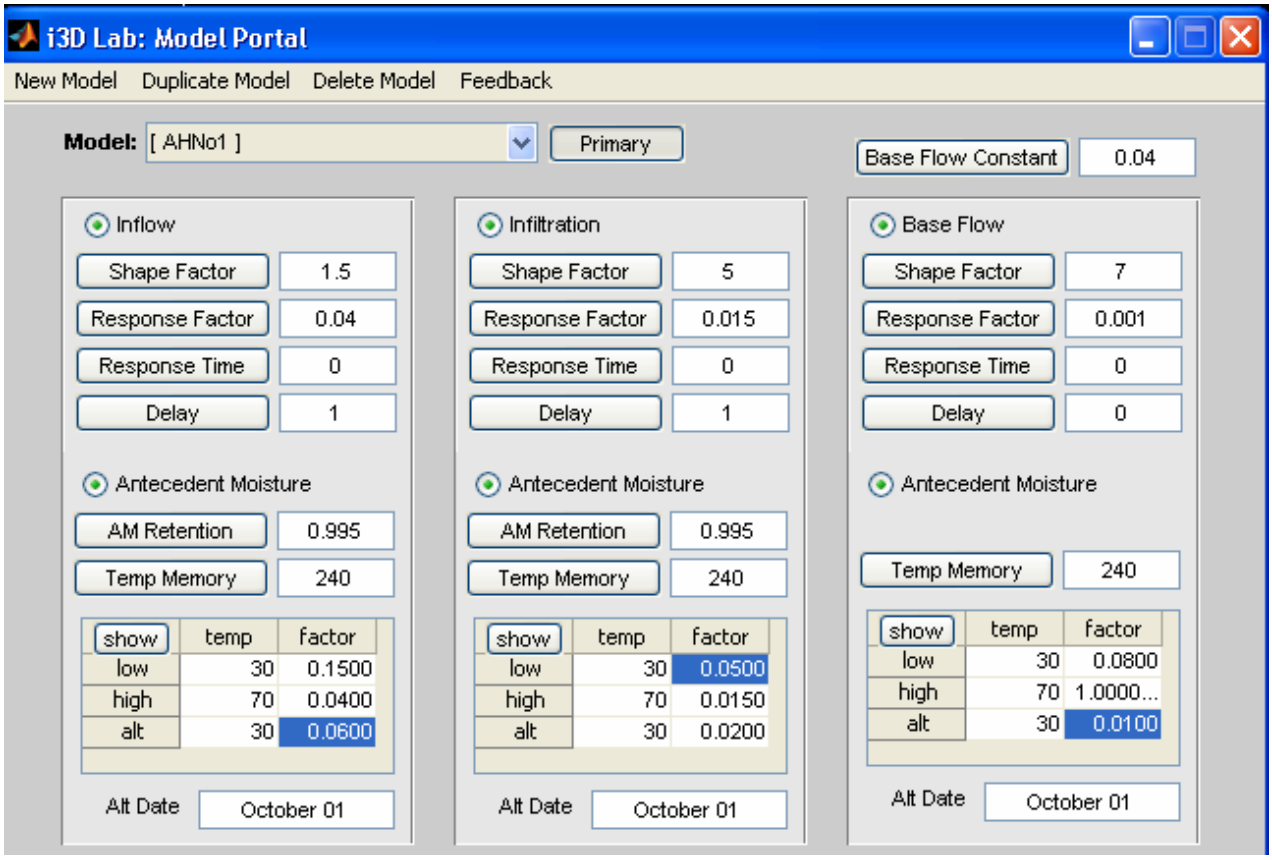

i3D Lab: Model Portal
New Model
Duplicate Model
Delete Model
Feedback
Model:
IrelandGrove East
Primary
Base Flow Constant
0.2
Inflow
Shape Factor
1.5
Response Factor
0.1
Response Time
0
Delay
6
Antecedent Moisture
AM Retention
0.996
Temp Memory
240
show
temp
factor
low
30
2.4000
high
70
0.8000
alt
30
4
Alt Date
October 01
Infiltration
Shape Factor
5
Response Factor
0.02
Response Time
0
Delay
6
Antecedent Moisture
AM Retention
0.998
Temp Memory
240
show
temp
factor
low
30
0.4000
high
70
0.1200
alt
30
0.2500
Alt Date
October 01
Base Flow
Shape Factor
10
Response Factor
0.001
Response Time
0
Delay
0
Antecedent Moisture
Temp Memory
240
show
temp
factor
low
30
0.1000
high
70
1.0000...
alt
30
0.0500
Alt Date
October 01

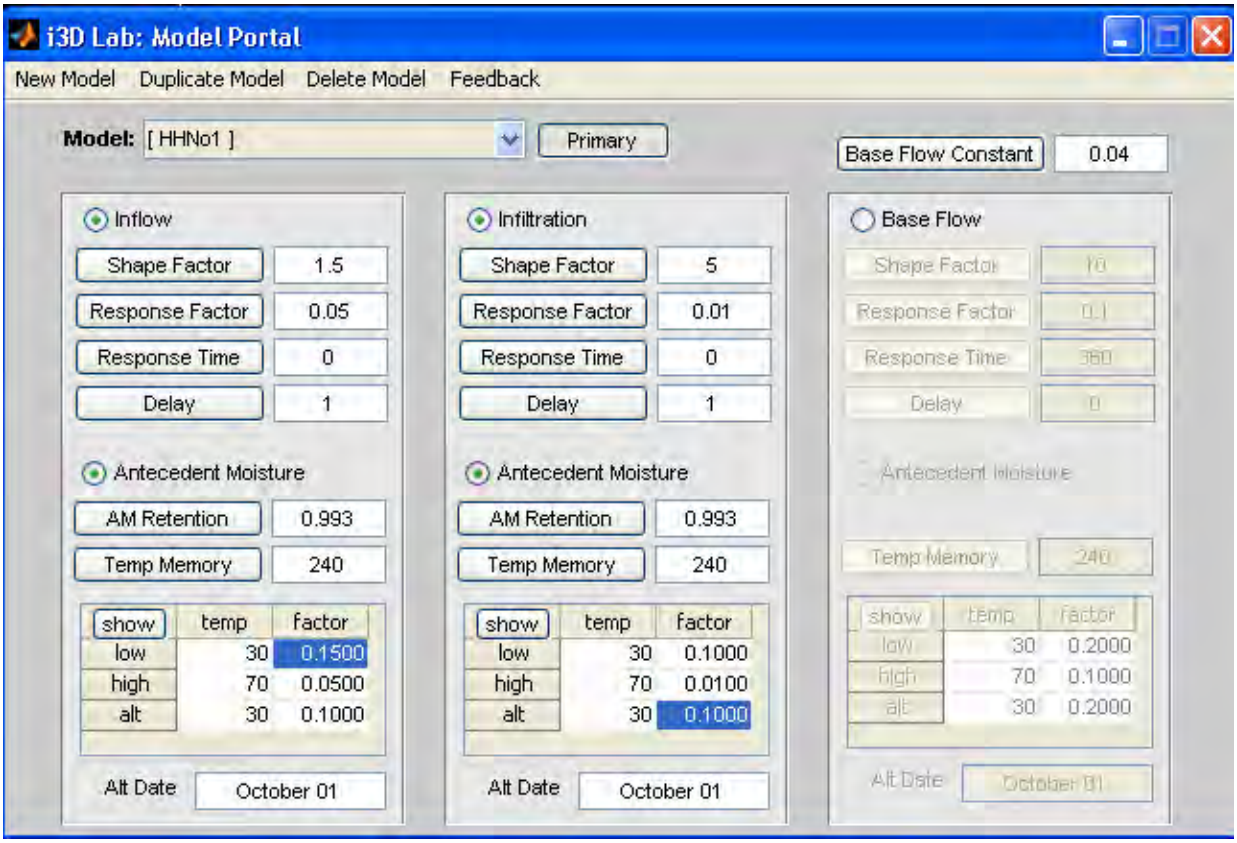

i3D Lab: Model Portal
New Model
Duplicate Model
Delete Model
Feedback
Model:
[BroadmoorNo1]
Primary
Base Flow Constant
0.2
Inflow
Shape Factor
1.5
Response Factor
0.15
Response Time
0
Delay
5
Antecedent Moisture
AM Retention
0.98
Temp Memory
240
show
temp
factor
low
30
0.4500
high
70
0.1500
alt
30
0.1800
Alt Date
October 01
Infiltration
Shape Factor
5
Response Factor
0.016
Response Time
0
Delay
5
Antecedent Moisture
AM Retention
0.993
Temp Memory
240
show
temp
factor
low
30
0.1500
high
70
0.0160
alt
30
0.1500
Alt Date
October 01
Base Flow
Shape Factor
10
Response Factor
0.001
Response Time
360
Delay
0
Antecedent Moisture
Temp Memory
240
show
temp
factor
low
30
0.0700
high
70
1.0000...
alt
30
0.0200
Alt Date
October 01


i3D Lab: Model Portal
New Model
Duplicate Model
Delete Model
Feedback
Model: [IGWNo1]
Primary
Base Flow Constant
0.25
Inflow
Shape Factor
1.5
Response Factor
0.38
Response Time
0
Delay
5
Antecedent Moisture
AM Retention
0.98
Temp Memory
240
show
temp
factor
low
30
1.2000
high
70
0.3800
alt
30
0.4800
Alt Date
October 01
Infiltration
Shape Factor
5
Response Factor
0.05
Response Time
0
Delay
5
Antecedent Moisture
AM Retention
0.993
Temp Memory
240
show
temp
factor
low
30
0.1000
high
70
0.0500
alt
30
0.1000
Alt Date
October 01
Base Flow
Shape Factor
10
Response Factor
0.1
Response Time
360
Delay
0
Antecedent Moisture
Temp Memory
240
show
temp
factor
low
30
0.2000
high
70
0.1000
alt
30
0.2000
Alt Date
October 01


i3D Lab: Model Portal
New Model
Duplicate Model
Delete Model
Feedback
Model: ArcadiaNo2test
Primary
Base Flow Constant
0
Inflow
Shape Factor
1.5
Response Factor
0.2
Response Time
0
Delay
5
Antecedent Moisture
AM Retention
0.98
Temp Memory
240
show
temp
factor
low
30
0.6000
high
70
0.2000
alt
30
0.2400
Alt Date
October 01
Infiltration
Shape Factor
5
Response Factor
0.02
Response Time
0
Delay
5
Antecedent Moisture
AM Retention
0.993
Temp Memory
240
show
temp
factor
low
30
0.2000
high
70
0.0200
alt
30
0.2000
Alt Date
October 01
Base Flow
Shape Factor
10
Response Factor
0.0001
Response Time
360
Delay
0
Antecedent Moisture
Temp Memory
240
show
temp
factor
low
30
0.0070
high
70
1.0000...
alt
30
0.0200
Alt Date
October 01


i3D Lab: Model Portal
New Model
Duplicate Model
Delete Model
Feedback
Model: SternNo3test
Primary
Base Flow Constant 0.05
Inflow
Shape Factor 1.5
Response Factor 0.8
Response Time 0
Delay 5
Antecedent Moisture
AM Retention 0.98
Temp Memory 240
show temp factor
low 30 3
high 70 0.8000
alt 30 1.2000
Alt Date October 01
Infiltration
Shape Factor 5
Response Factor 0.01
Response Time 0
Delay 5
Antecedent Moisture
AM Retention 0.999
Temp Memory 240
show temp factor
low 30 0.2500
high 70 0.0100
alt 30 0.1000
Alt Date October 01
Base Flow
Shape Factor 7.4
Response Factor 0.08
Response Time 0
Delay 10
Antecedent Moisture
Temp Memory 240
show temp factor
low 30 0.3000
high 70 0.0800
alt 30 0.0100
Alt Date October 01


i3D Lab: Model Portal
New Model
Duplicate Model
Delete Model
Feedback
Model: [AHNo1]
Primary
Base Flow Constant 0.04
Inflow
Shape Factor 1.5
Response Factor 0.04
Response Time 0
Delay 1
Antecedent Moisture
AM Retention 0.995
Temp Memory 240
show temp factor
low 30 0.1500
high 70 0.0400
alt 30 0.0600
Alt Date October 01
Infiltration
Shape Factor 5
Response Factor 0.015
Response Time 0
Delay 1
Antecedent Moisture
AM Retention 0.995
Temp Memory 240
show temp factor
low 30 0.0500
high 70 0.0150
alt 30 0.0200
Alt Date October 01
Base Flow
Shape Factor 7
Response Factor 0.001
Response Time 0
Delay 0
Antecedent Moisture
Temp Memory 240
show temp factor
low 30 0.0800
high 70 1.0000...
alt 30 0.0100
Alt Date October 01


i3D Lab: Model Portal
New Model
Duplicate Model
Delete Model
Feedback
Model: [HHNo1]
Primary
Base Flow Constant
0.04
Inflow
Shape Factor
1.5
Response Factor
0.05
Response Time
0
Delay
1
Antecedent Moisture
AM Retention
0.993
Temp Memory
240
show
temp
factor
low
30
0.1500
high
70
0.0500
alt
30
0.1000
Alt Date
October 01
Infiltration
Shape Factor
5
Response Factor
0.01
Response Time
0
Delay
1
Antecedent Moisture
AM Retention
0.993
Temp Memory
240
show
temp
factor
low
30
0.1000
high
70
0.0100
alt
30
0.1000
Alt Date
October 01
Base Flow
Antecedent Moisture
low
30
0.2000
high
70
0.1000
alt
30
0.2000

APPENDIX B
MODEL CALIBRATION AND VALIDATION RESULTS

Arrowhead and Holiday - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

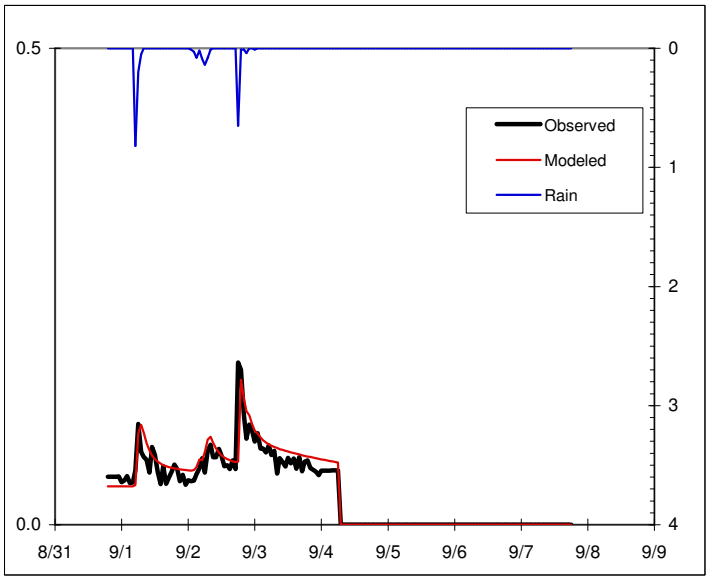
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
11/22/10	0.85	0.11	0.10	-8.6%	8	9	20.3%		
08/31/10	2.25	0.17	0.15	-10.7%	20	22	8.4%		
09/18/10	0.67	0.08	0.08	3.1%	7	7	-7.6%		
01/01/04	0.00	0.00	0.00		0	0		0.00	
01/01/04	0.00	0.00	0.00		0	0		0.00	
03/04/11	1.53	0.33	0.31	-6.7%	165	173	5.1%		
		Net Average Error		-5.7%			6.5%		
		Total Average Error		7.3%			10.3%		

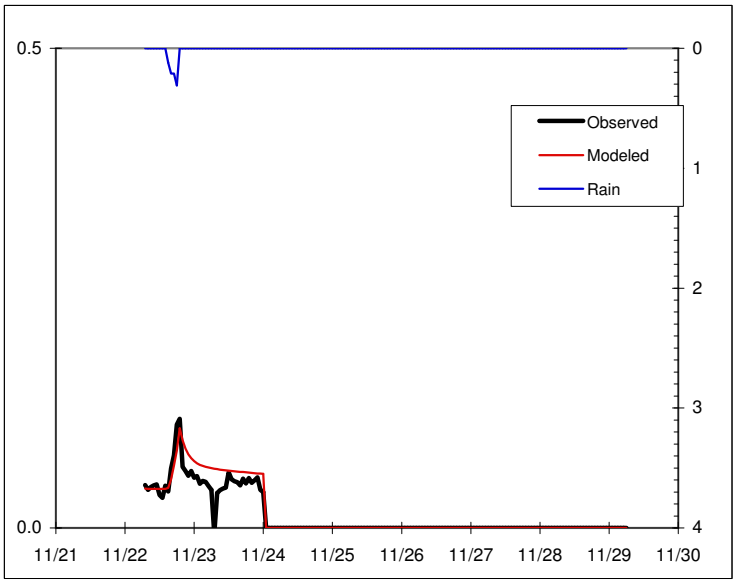
Arrowhead and Holiday - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2010

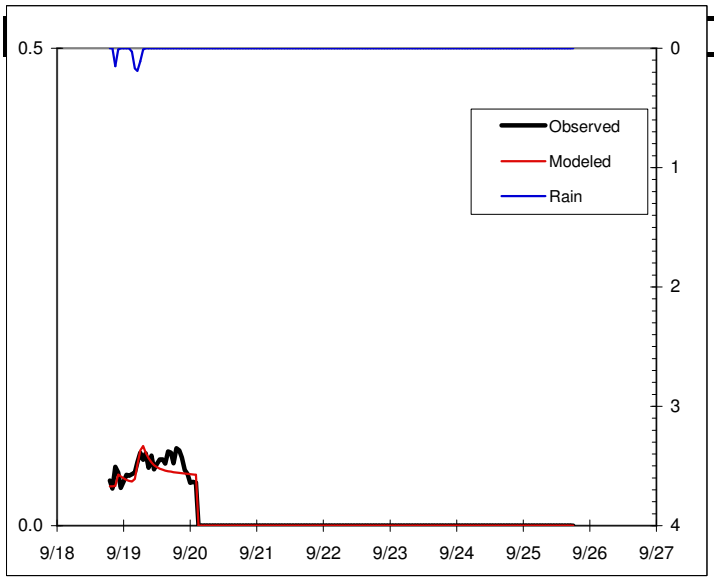
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
11/22/10	0.85	0.1	0.1	-8.6%	8	9	20.3%	
08/31/10	2.25	0.2	0.2	-10.7%	20	22	8.4%	
09/18/10	0.67	0.1	0.1	3.1%	7	7	-7.6%	

Net Average Error	-5.4%	7.0%
Total Average Error	9.6%	14.3%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)





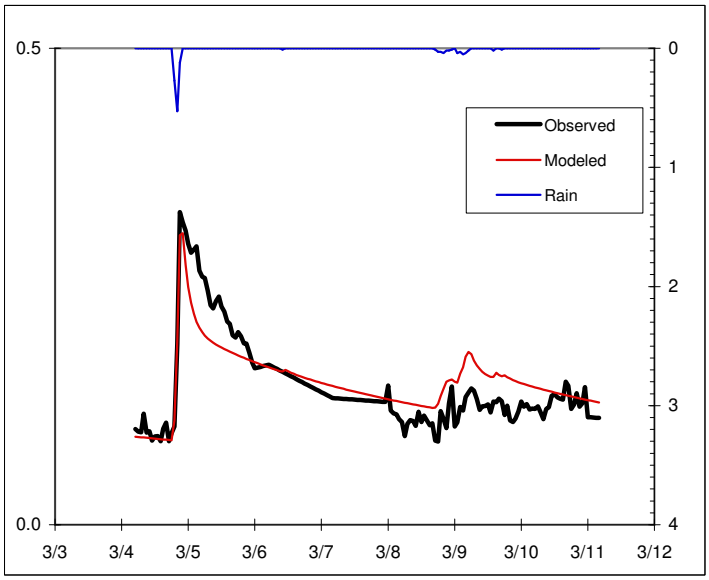


Arrowhead and Holiday - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2011

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
03/04/11	1.53	0.3	0.3	-6.7%	165	173	5.1%	

Net Average Error	-6.7%	5.1%
Total Average Error	3.3%	2.5%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

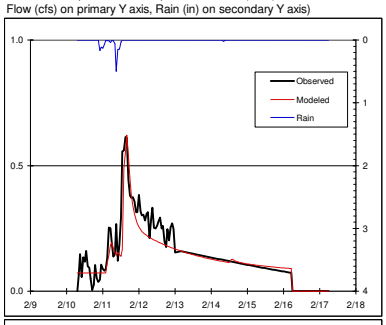


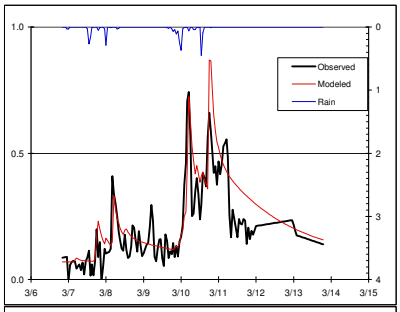
Arcadia - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2009

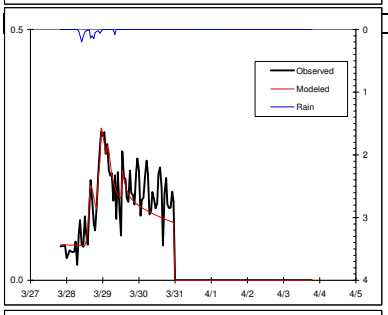
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
03/06/09	2.68	0.7	0.9	17.0%	141	164	16.0%	
02/10/09	1.49	0.6	0.6	1.2%	87	78	-10.0%	
03/27/09	1.18	0.3	0.3	2.3%	43	40	-7.7%	
04/09/09	0.72	0.3	0.3	-4.3%	42	36	-12.2%	
04/12/09	0.84	0.5	0.5	-2.4%	33	46	38.1%	
05/12/09	3.2	0.6	0.6	-12.0%	101	94	-7.0%	
02/26/09	0.94	0.4	0.4	-0.1%	46	44	-4.1%	

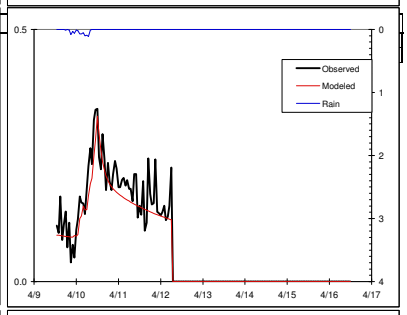
Net Average Error	0.2%	1.9%
Total Average Error	9.1%	13.0%

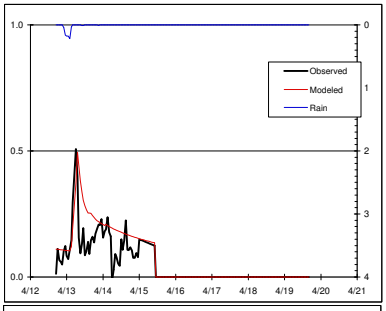
Child Model - parameters adopted from Stern (M19) District
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

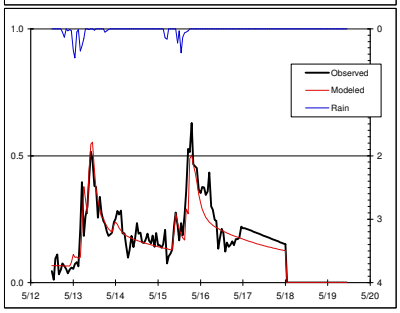


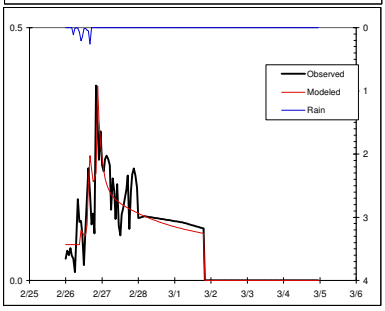












Arcadia - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
No 2008 Data Available									
03/06/09	2.68	0.74	0.87	17.0%	141	164	16.0%		
02/10/09	1.49	0.61	0.62	1.2%	87	78	-10.0%		
03/27/09	1.18	0.30	0.30	2.3%	43	40	-7.7%		
04/09/09	0.72	0.34	0.33	-4.3%	42	36	-12.2%		
04/12/09	0.84	0.51	0.49	-2.4%	33	46	38.1%		
05/12/09	3.20	0.63	0.55	-12.0%	101	94	-7.0%		
02/26/09	0.94	0.39	0.39	-0.1%	46	44	-4.1%		
No 2010/2011 Data Available									
		Net Average Error		0.2%			1.9%		
		Total Average Error		2.3%			4.5%		

Broadmoor - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

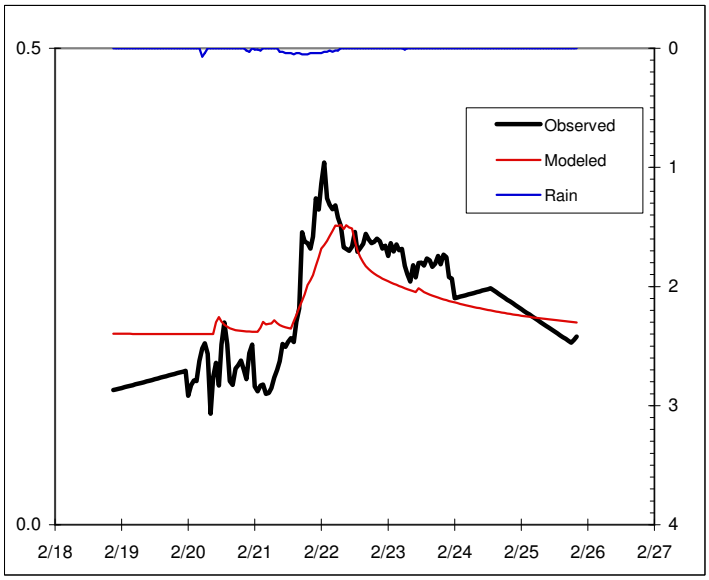
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
03/23/10	1.88	0.33	0.30	-9.9%	207	243	17.3%		
02/18/10	1.02	0.38	0.31	-17.2%	208	223	7.1%		
06/10/10	2.21	0.33	0.41	22.9%	129	136	5.2%		
06/18/10	1.06	0.37	0.38	1.4%	43	46	5.8%		
		Net Average Error		-0.7%			8.8%		
		Total Average Error		12.8%			8.8%		

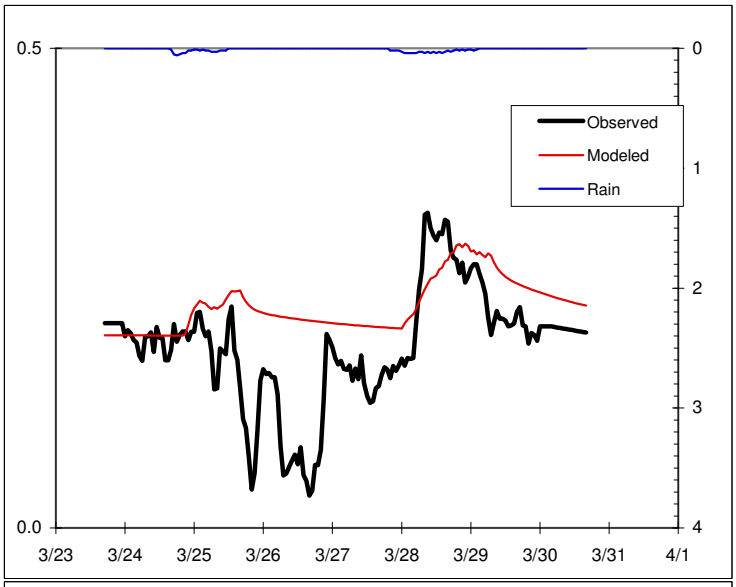
Broadmoor - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2010

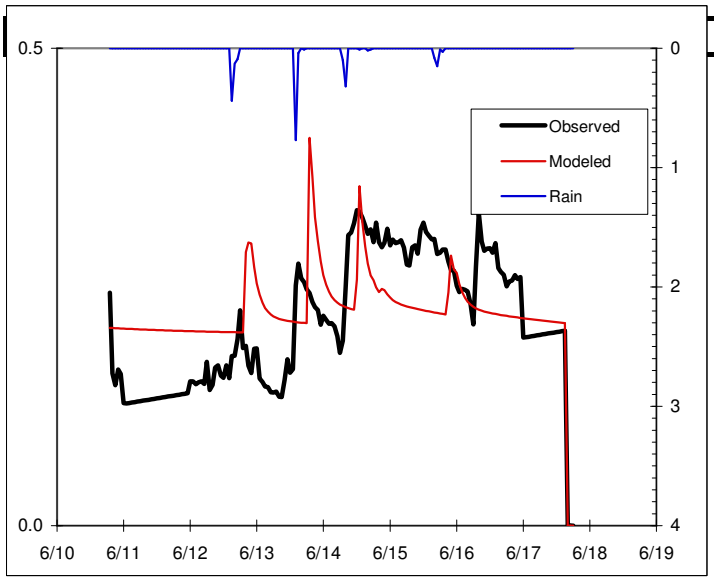
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
03/23/10	1.88	0.3	0.3	-9.9%	207	243	17.3%	
02/18/10	1.02	0.4	0.3	-17.2%	208	223	7.1%	
06/10/10	2.21	0.3	0.4	22.9%	129	136	5.2%	
06/18/10	1.06	0.4	0.4	1.4%	43	46	5.8%	

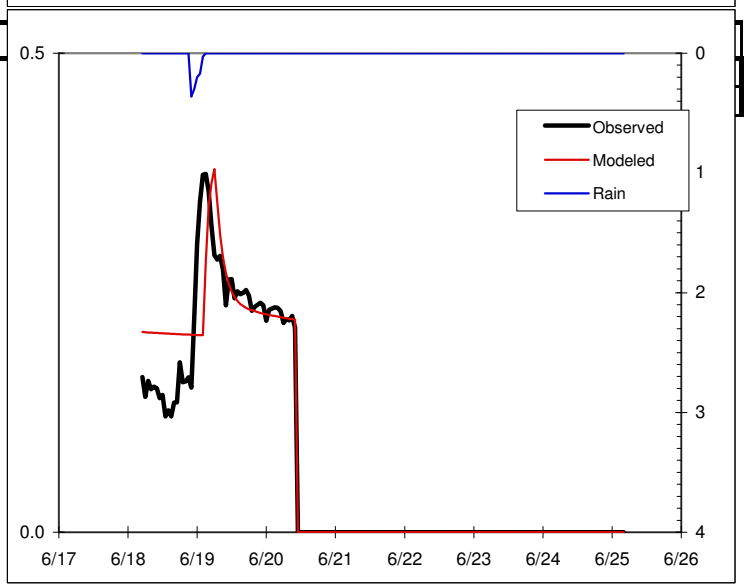
Net Average Error	-0.7%	8.8%
Total Average Error	13.5%	12.2%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)









GE Valley Pump Station - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

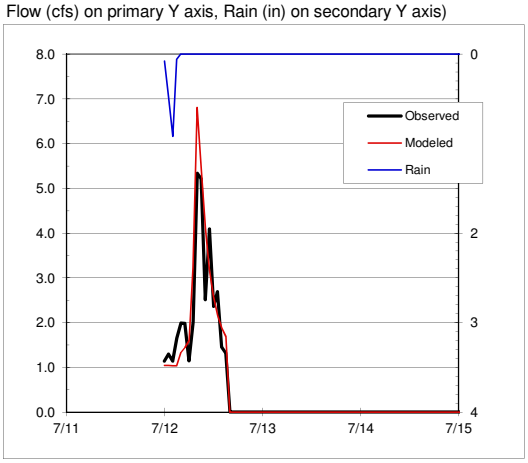
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
09/04/08	2.55	6.12	6.68	9.2%	278	302	8.3%		
07/11/08	1.61	5.34	6.81	27.5%	138	146	6.4%		
10/14/08	0.90	3.37	3.34	-1.0%	196	258	31.4%		
10/23/08	1.41	5.15	4.17		282	353		Low signal to noise ratio	
09/11/08	5.70	10.03	16.29		1,312	1,517		Diversion Event	
04/09/09	0.70	5.03	4.70	-6.6%	271	296	9.2%		
03/28/09	2.74	6.69	6.22	-6.9%	2,359	2,144	-9.1%		
04/12/09	0.84	7.29	7.17	-1.7%	510	516	1.2%		
05/12/09	2.00	5.29	6.72	26.8%	475	487	2.4%		
07/03/09	1.00	2.62	2.47		200	284		Low signal to noise ratio	
07/24/09	1.17	3.00	2.84		68	127		Meter issue	
02/10/09	1.49	6.93	5.83	-15.9%	3,086	2,545	-17.5%		
03/09/09	1.71	7.11	10.07		1,616	1,670		Diversion Event	
11/24/10	0.71	3.44	4.31		188	287		Meter Issue	
08/31/10	2.25	4.88	4.15	-15.0%	336	407	20.9%		
06/14/11	1.92	6.30	5.89	-6.4%	310	291	-6.0%		
04/18/11	1.41	4.91	5.11	4.1%	727	575	-21.0%		
		Net Average Error		1.3%			2.4%		
		Total Average Error		11.0%			12.1%		

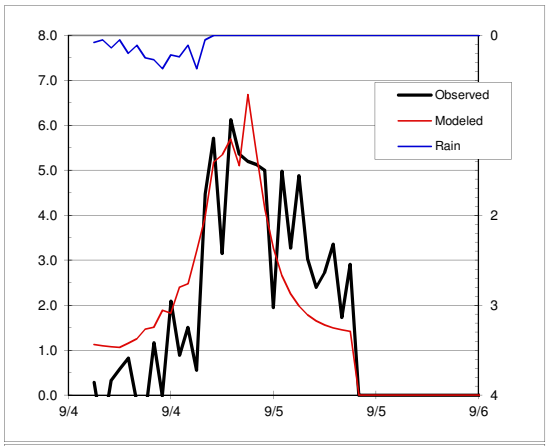
GE Valley Pump Station - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2008

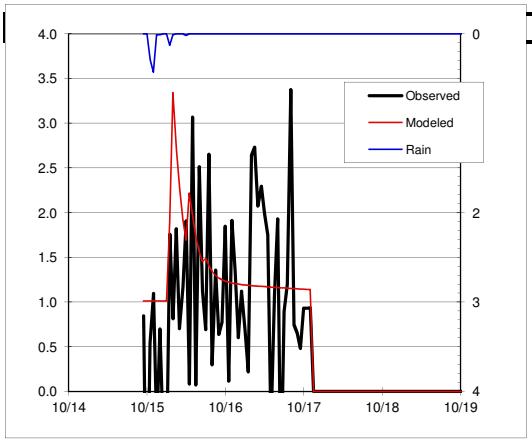
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
09/04/08	2.55	6.1	6.7	9.2%	278	302	8.3%	
07/11/08	1.61	5.3	6.8	27.5%	138	146	6.4%	
10/14/08	0.9	3.4	3.3	-1.0%	196	258	31.4%	
10/23/08	1.41	5.2	4.2	-19.1%	282	353	25.4%	Low signal to noise ratio
09/11/08	5.7	10.0	16.3		1,312	1,517		Diversion Event

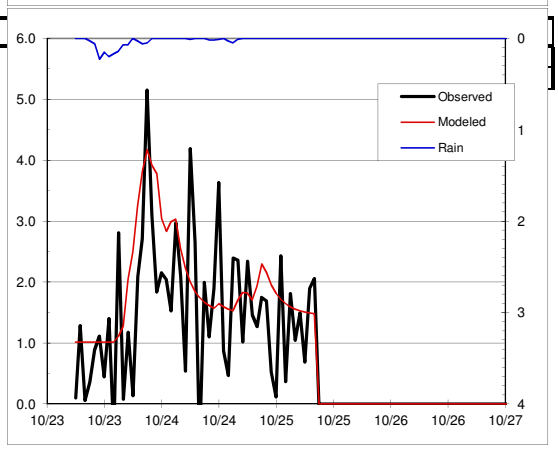
Net Average Error	4.2%	17.9%
Total Average Error	18.3%	7.3%

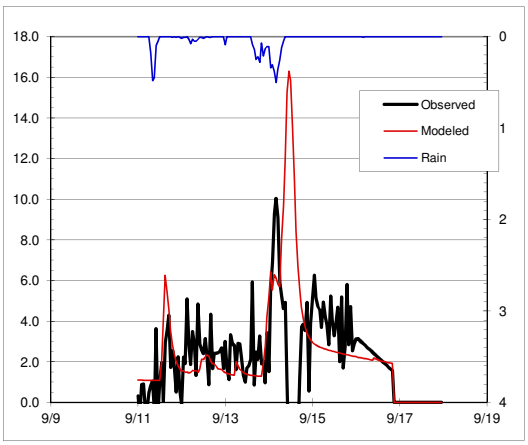
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)









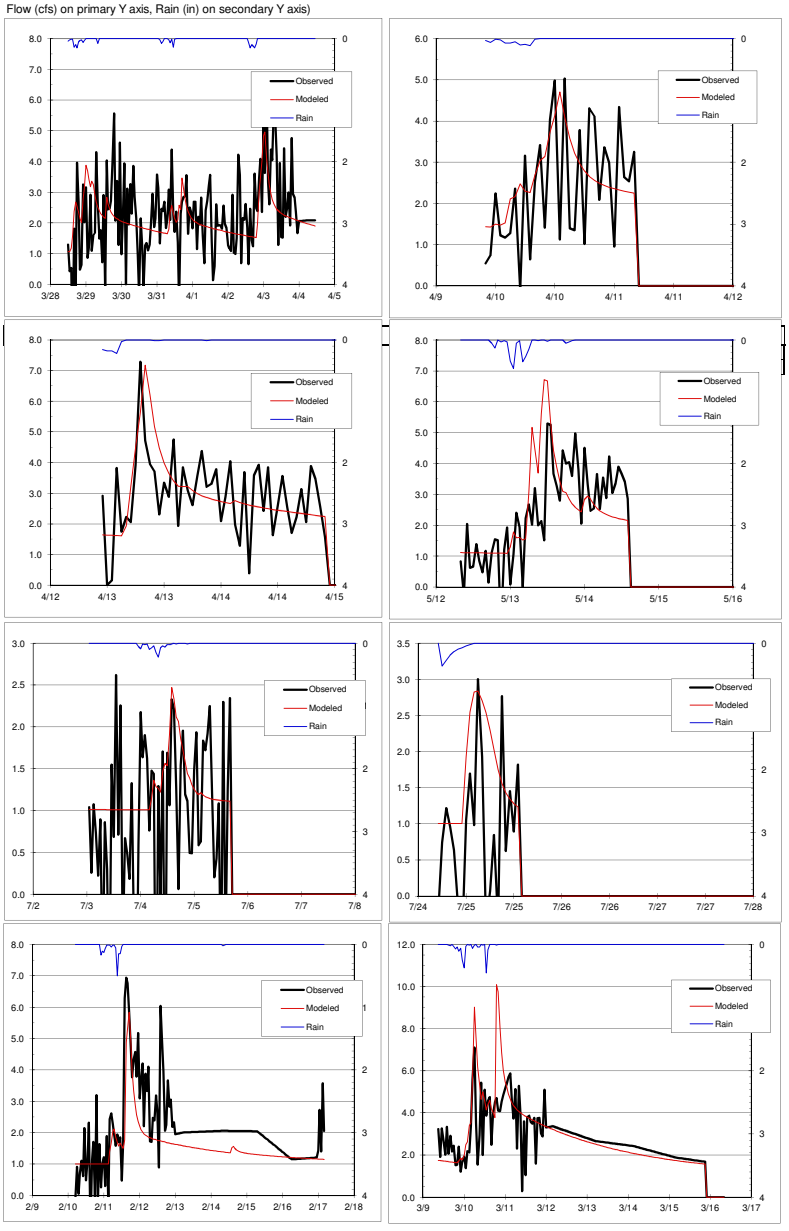


GE Valley Pump Station - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2009

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/09/09	0.7	5.0	4.7	-6.6%	271	296	9.2%	
03/28/09	2.74	6.7	6.2	-6.9%	2,359	2,144	-9.1%	
04/12/09	0.84	7.3	7.2	-1.7%	510	516	1.2%	
05/12/09	2	5.3	6.7	26.8%	475	487	2.4%	
07/03/09	1	2.6	2.5		200	284		Low signal to noise ratio
07/24/09	1.17	3.0	2.8		68	127		Meter Issue
02/10/09	1.49	6.9	5.8	-15.9%	3,086	2,545	-17.5%	
03/09/09	1.71	7.1	10.1		1,616	1,670		Diversion Event

Net Average Error	-0.8%	-2.8%
Total Average Error	6.8%	9.2%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

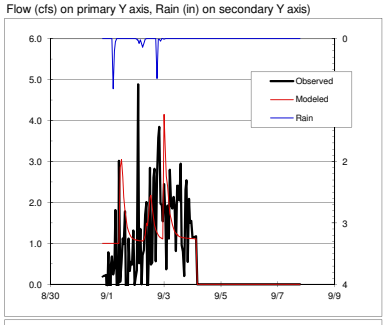


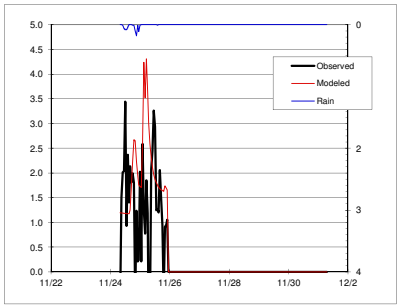
GE Valley Pump Station - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2010

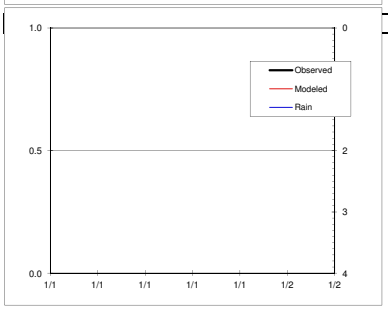
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
11/24/10	0.71	3.4	4.3		188	287		Meter Issues
08/31/10	2.25	4.9	4.1	-15.0%	336	407	20.9%	

Net Average Error	-15.0%		20.9%
Total Average Error	7.5%		10.5%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)





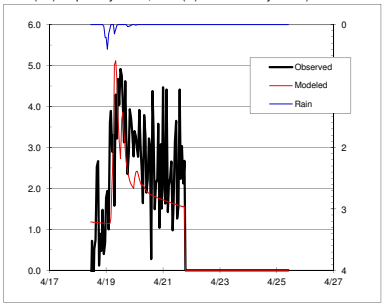


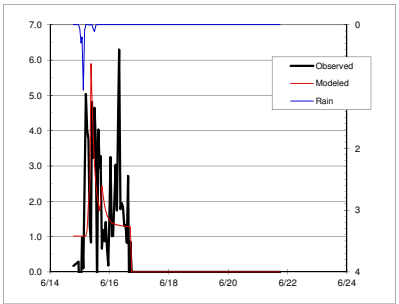
GE Valley Pump Station - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2011

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
06/14/11	1.92	6.3	5.9	-6.4%	310	291	-6.0%	
04/18/11	1.41	4.9	5.1	4.1%	727	575	-21.0%	

Net Average Error	-1.2%		-13.5%
Total Average Error	5.3%		13.5%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)





Hamilton and Hershey - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

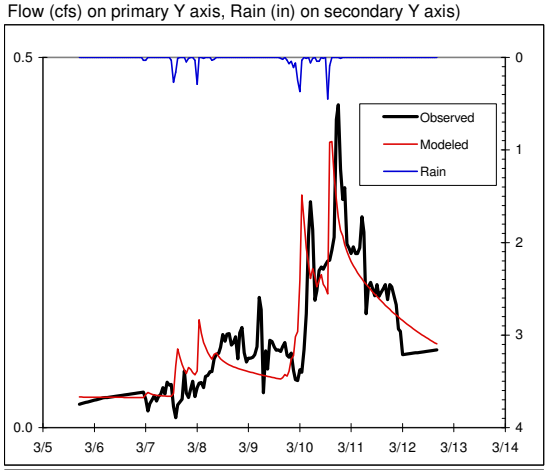
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
04/08/09	1.56	0.28	0.24	-15.0%	71	63	-10.0%		
03/05/09	2.68	0.44	0.39	-11.4%	76	105	37.6%		
05/11/09	3.21	0.21	0.23	7.4%	98	80	-17.8%		
05/31/09	2.60	0.18	0.17	-3.5%	35	40	17.0%		
06/17/09	0.99	0.09	0.12	27.6%	2	6		Low signal to noise ratio	
		Net Average Error		1.0%			6.7%		
		Total Average Error		7.5%			16.5%		

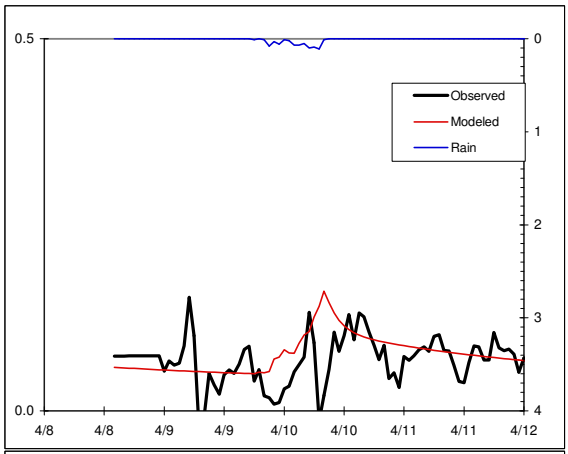
Hamilton and Hershey - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2009

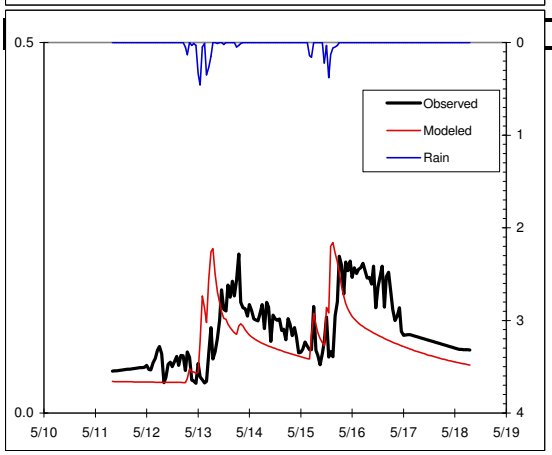
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/08/09	1.56	0.3	0.2	-15.0%	71	63	-10.0%	
03/05/09	2.68	0.4	0.4	-11.4%	76	105	37.6%	
05/11/09	3.21	0.2	0.2	7.4%	98	80	-17.8%	
05/31/09	2.6	0.2	0.2	-3.5%	35	40	17.0%	
06/17/09	0.99	0.1	0.1	27.6%	2	6		Low signal to noise ratio

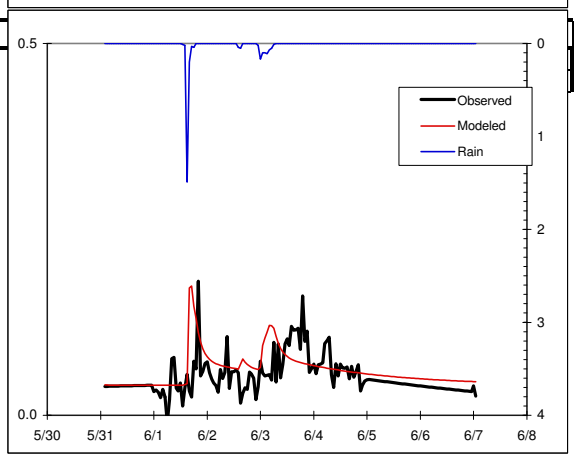
Net Average Error	1.0%	6.7%
Total Average Error	13.2%	23.8%

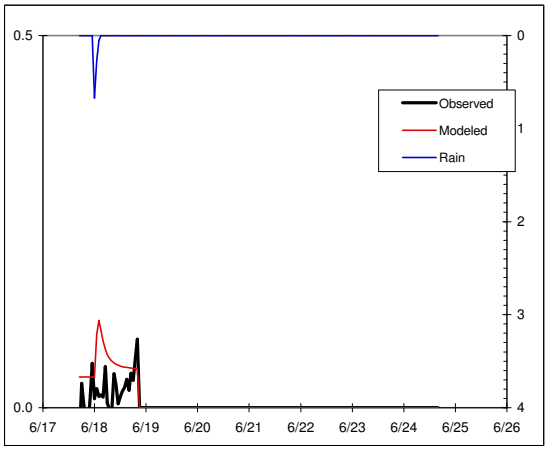
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)











Ireland Grove East - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

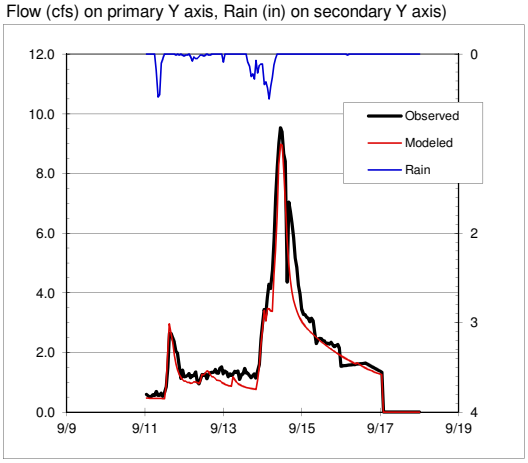
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
09/03/08	2.58	2.84	2.95	4.1%	193	224	16.2%		
09/11/08	5.70	9.53	8.97	-5.8%	1,207	1,046	-13.3%		
07/11/08	1.70	2.96	2.87	-3.1%	221	243	10.2%		
01/07/08	3.46	7.05	6.45	-8.4%	807	962	19.2%		
10/14/08	0.92	1.72	1.40	-18.8%	150	156	4.3%		
02/10/09	1.49	3.96	2.56		486	355		Frozen Ground Conditions	
03/07/09	2.62	6.22	5.04	-19.0%	1,625	1,572	-3.2%		
03/27/09	1.18	2.11	2.43	14.8%	342	389	13.5%		
04/09/09	0.72	2.59	2.91	12.6%	364	376	3.4%		
04/12/09	0.84	3.34	4.20	25.8%	415	407	-1.8%		
05/12/09	3.20	4.59	4.17	-9.1%	1,357	1,248	-8.0%		
07/03/09	1.00	1.25	1.38	9.9%	232	286	23.2%		
07/24/09	1.20	1.48	1.37	-7.6%	269	326	21.2%		
11/22/10	1.57	1.60	1.54	-4.0%	239	251	4.9%		
08/30/10	2.25	1.52	1.58	3.8%	385	354	-7.9%		
06/14/11	1.92	3.19	2.72	-14.8%	344	355	3.2%		
04/18/11	3.83	5.29	4.56	-13.9%	1,910	1,575	-17.5%		
		Net Average Error		-2.1%			4.2%		
		Total Average Error		11.0%			10.7%		

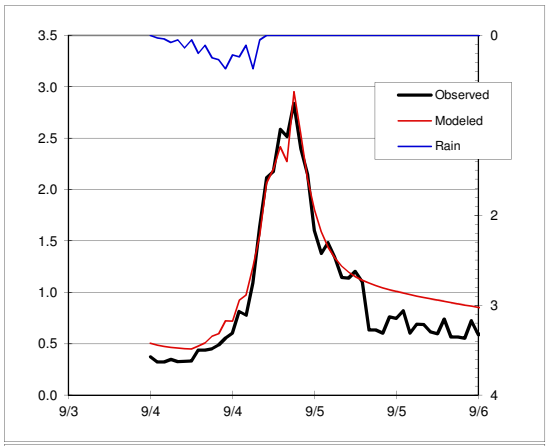
Ireland Grove East - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2008

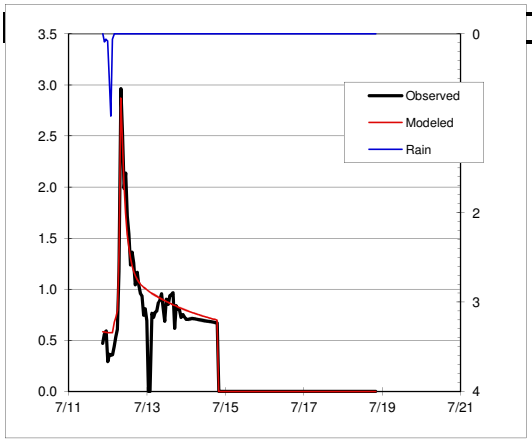
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
09/03/08	2.58	2.8	3.0	4.1%	193	224	16.2%	
09/11/08	5.7	9.5	9.0	-5.8%	1,207	1,046	-13.3%	
07/11/08	1.7	3.0	2.9	-3.1%	221	243	10.2%	
01/07/08	3.46	7.0	6.5	-8.4%	807	962	19.2%	
10/14/08	0.92	1.7	1.4	-18.8%	150	156	4.3%	

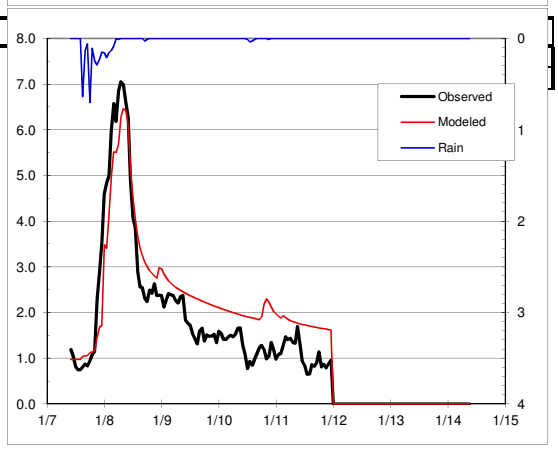
Net Average Error	-6.4%	7.3%
Total Average Error	4.9%	14.8%

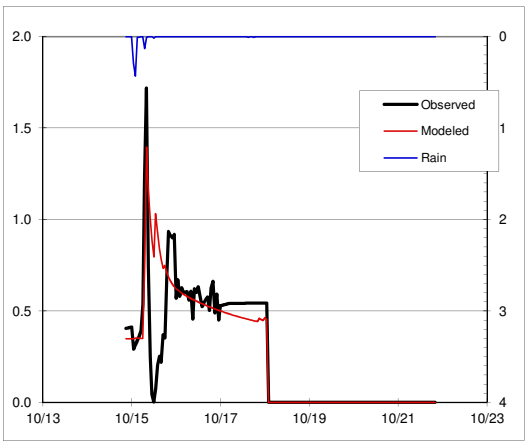
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)









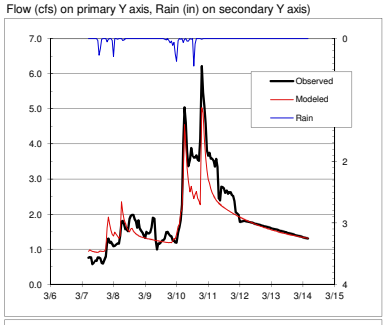


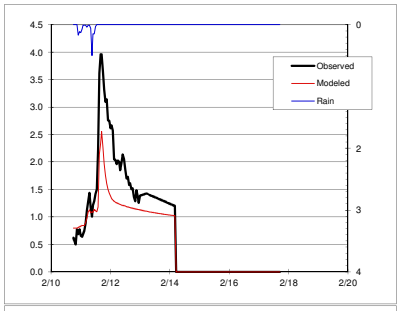
Ireland Grove East - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2009

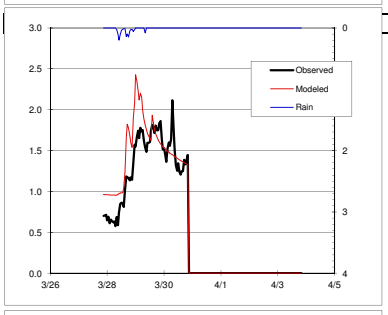
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
02/10/09	1.49	4.0	2.6	-35.5%	486	355	-27.0%	
03/07/09	2.62	6.2	5.0	-19.0%	1,625	1,572	-3.2%	
03/27/09	1.18	2.1	2.4	14.8%	342	389	13.5%	
04/09/09	0.72	2.6	2.9	12.6%	364	376	3.4%	
04/12/09	0.84	3.3	4.2	25.8%	415	407	-1.8%	
05/12/09	3.2	4.6	4.2	-9.1%	1,357	1,248	-8.0%	
07/03/09	1	1.3	1.4	9.9%	232	286	23.2%	
07/24/09	1.20	1.5	1.4	-7.6%	269	326	21.2%	

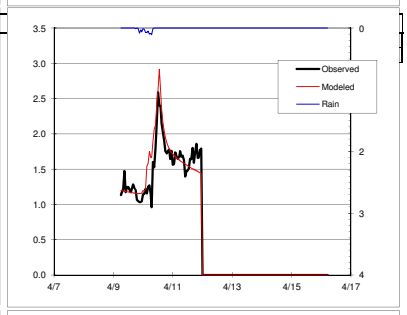
Net Average Error	-1.0%	2.7%
Total Average Error	27.2%	15.1%

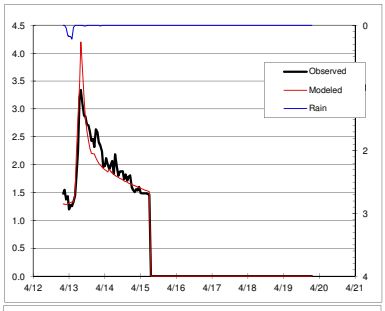
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

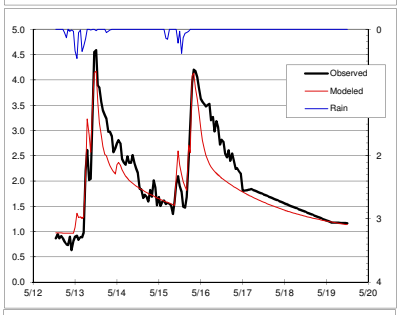


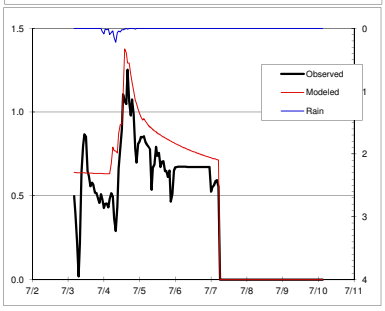


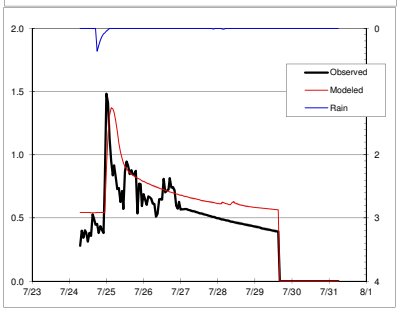










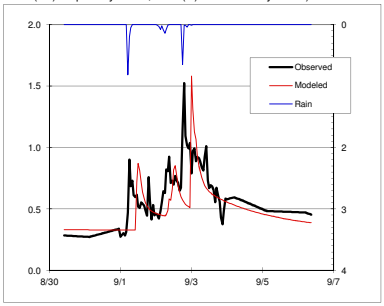


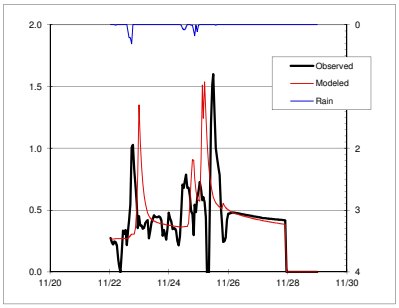
Ireland Grove East - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2010

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
11/22/10	1.57	1.6	1.5	-4.0%	239	251	4.9%	
08/30/10	2.25	1.5	1.6	3.8%	385	354	-7.9%	

Net Average Error	-0.1%		-1.5%
Total Average Error	3.9%		6.4%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)



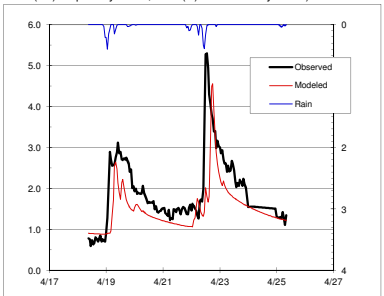


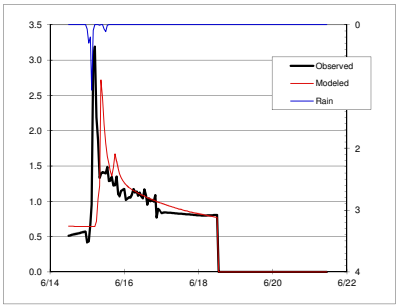
Ireland Grove East - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2011

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
06/14/11	1.92	3.2	2.7	-14.8%	344	355	3.2%	
04/18/11	3.83	5.3	4.6	-13.9%	1,910	1,575	-17.5%	

Net Average Error	-14.4%		-7.2%
Total Average Error	14.4%		10.4%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)





Ireland Grove West - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

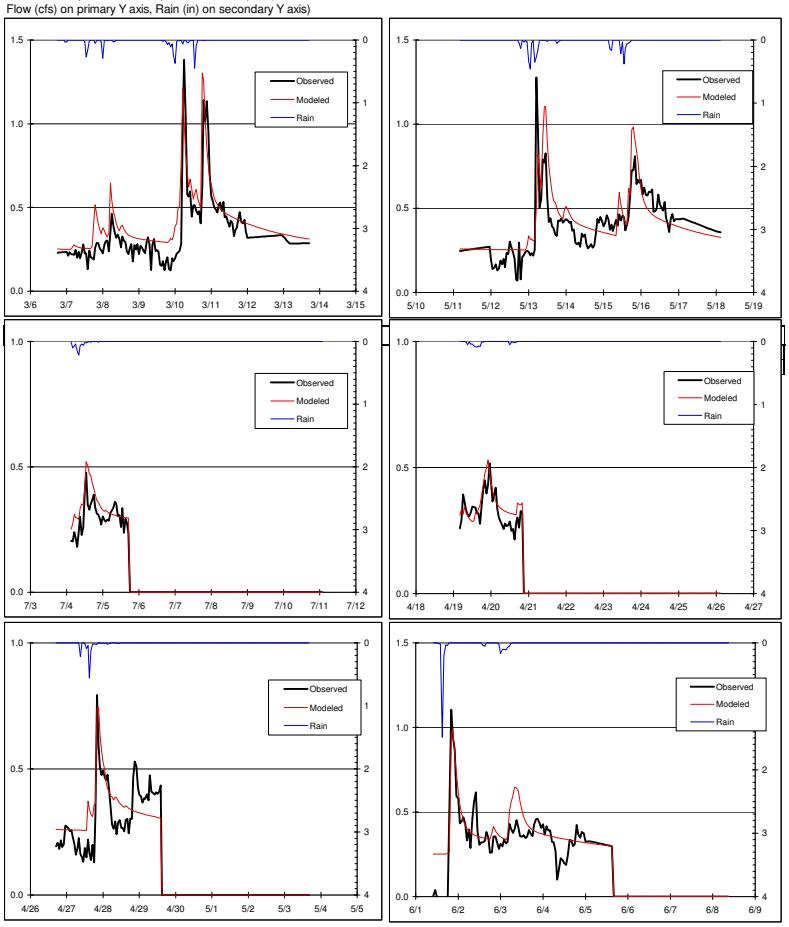
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
No 2008 Data Available									
05/11/09	3.20	1.28	1.35	5.7%	305	312	2.2%		
03/06/09	2.68	1.38	1.30	-5.7%	234	272	16.5%		
07/04/09	0.85	0.48	0.52	8.9%	43	49	14.2%		
04/19/09	0.66	0.52	0.53	2.6%	49	52	7.6%		
04/26/09	1.18	0.79	0.74	-6.2%	80	86	7.4%		
06/01/09	2.51	1.10	0.99	-10.3%	124	142	14.5%		
No 2010/2011 Data Available									
		Net Average Error		-0.8%			10.4%		
		Total Average Error		2.3%			4.1%		

Ireland Grove West - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2009

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
05/11/09	3.2	1.3	1.4	5.7%	305	312	2.2%	
03/06/09	2.68	1.4	1.3	-5.7%	234	272	16.5%	
07/04/09	0.85	0.5	0.5	8.9%	43	49	14.2%	
04/19/09	0.66	0.5	0.5	2.6%	49	52	7.6%	
04/26/09	1.18	0.8	0.7	-6.2%	80	86	7.4%	
06/01/09	2.51	1.1	1.0	-10.3%	124	142	14.5%	

Net Average Error	-0.8%	10.4%
Total Average Error	5.7%	9.3%

Child Model - parameters adopted from Stern (M19) District
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)



SE WWTP - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

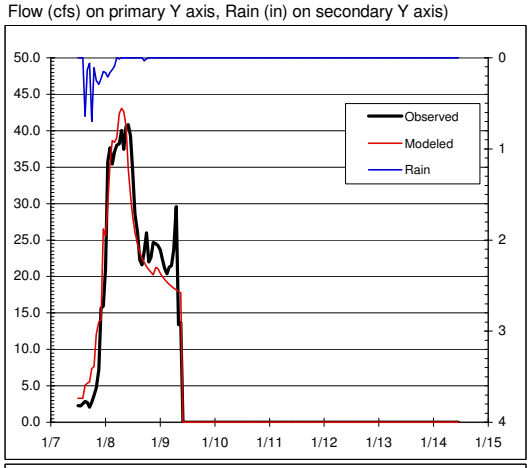
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
07/11/08	1.70	19.34	15.76	-18.5%	1,076	941	-12.6%		
01/07/08	3.36	40.82	43.08	5.5%	3,677	3,648	-0.8%		
09/11/08	1.66	10.52	12.21	16.0%	633	746	17.9%		
10/14/08	0.92	6.88	7.55	9.8%	1,166	1,012	-13.2%		
10/22/08	1.41	8.84	8.20	-7.3%	2,284	1,999	-12.5%		
09/13/08	3.94	25.08	34.52		3,501	3,009		Diversion Event	
03/07/09	0.74	10.86	12.67	16.7%	1,320	1,555	17.8%		
02/10/09	1.49	22.09	17.38	-21.3%	3,381	2,940	-13.0%		
03/28/09	1.33	11.46	12.75	11.2%	2,064	2,170	5.1%		
04/09/09	0.72	14.38	13.89	-3.4%	1,829	1,795	-1.9%		
04/12/09	0.84	20.19	18.89	-6.4%	2,746	2,815	2.5%		
05/12/09	2.12	19.58	19.33	-1.2%	2,027	2,052	1.2%		
07/04/09	0.83	6.95	6.44	-7.3%	785	726	-7.5%		
07/24/09	1.17	6.97	7.45	6.9%	618	722	16.9%		
03/09/09	1.54	23.81	27.34		5,291	6,270		Diversion Event	
11/21/10	1.57	6.92	8.10		1,170	1,734		Meter Issue	
08/31/10	2.25	9.35	9.78	4.7%	1,405	1,323	-5.8%		
06/14/11	1.92	15.86	15.06	-5.1%	1,130	973	-13.8%		
04/18/11	1.41	13.78	13.55	-1.7%	1,984	1,833	-7.6%		
		Net Average Error		-0.1%			-1.7%		
		Total Average Error		8.9%			9.4%		

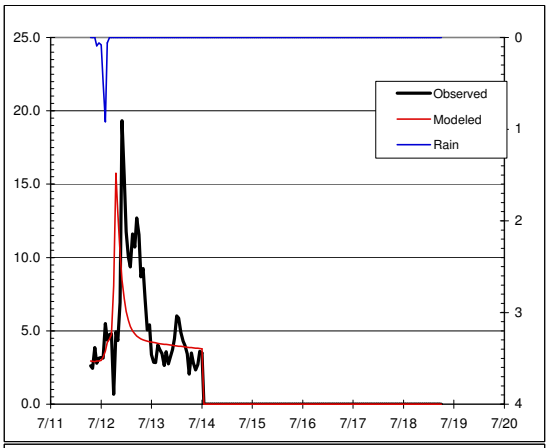
SE WWTP - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2008

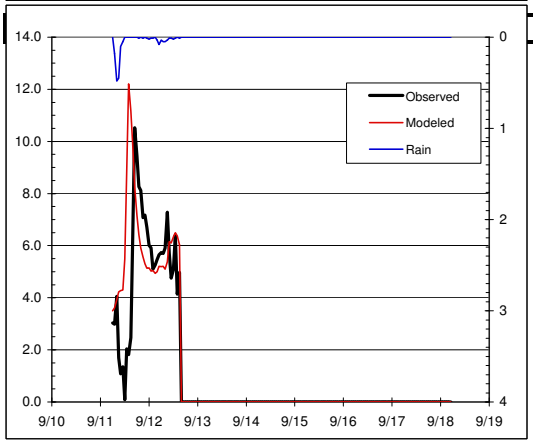
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
07/11/08	1.7	19.3	15.8	-18.5%	1,076	941	-12.6%	
01/07/08	3.36	40.8	43.1	5.5%	3,677	3,648	-0.8%	
09/11/08	1.66	10.5	12.2	16.0%	633	746	17.9%	
10/14/08	0.92	6.9	7.6	9.8%	1,166	1,012	-13.2%	
10/22/08	1.41	8.8	8.2	-7.3%	2,284	1,999	-12.5%	
09/13/08	3.94	25.1	34.5		3,501	3,009		Diversion Event

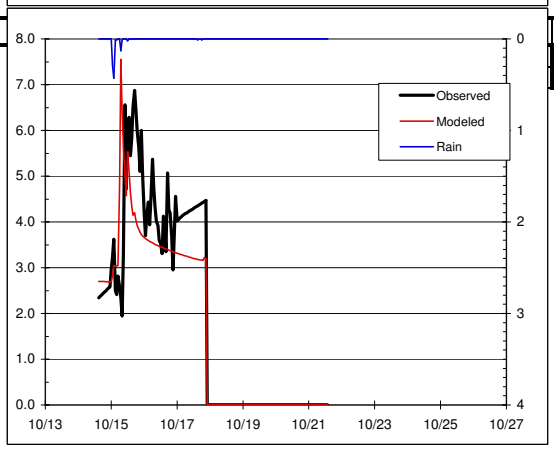
Net Average Error	1.1%	-4.2%
Total Average Error	12.0%	6.7%

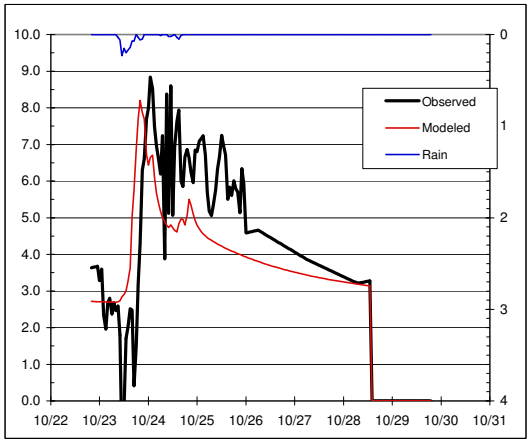
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

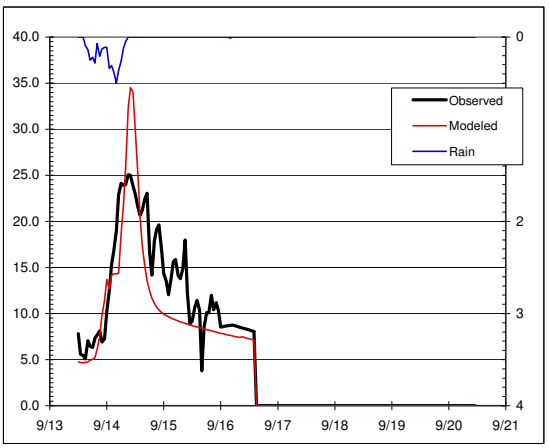










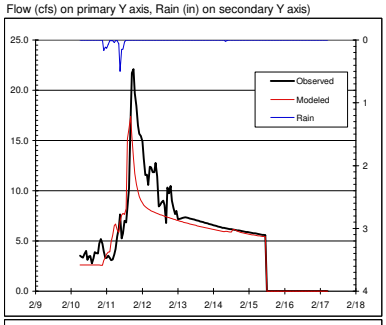


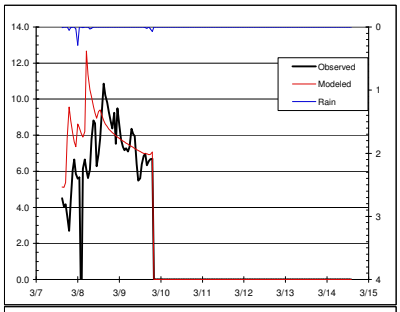
SE WWTP - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2009

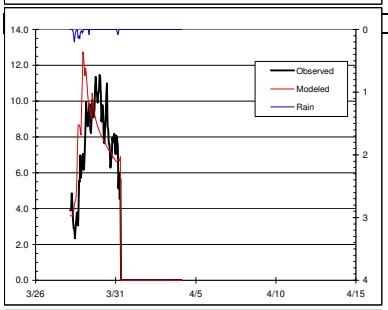
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
03/07/09	0.74	10.9	12.7	16.7%	1,320	1,555	17.8%	
02/10/09	1.49	22.1	17.4	-21.3%	3,381	2,940	-13.0%	
03/28/09	1.33	11.5	12.7	11.2%	2,064	2,170	5.1%	
04/09/09	0.72	14.4	13.9	-3.4%	1,829	1,795	-1.9%	
04/12/09	0.84	20.2	18.9	-6.4%	2,746	2,815	2.5%	
05/12/09	2.12	19.6	19.3	-1.2%	2,027	2,052	1.2%	
07/04/09	0.83	7.0	6.4	-7.3%	785	726	-7.5%	
07/24/09	1.17	7.0	7.4	6.9%	618	722	16.9%	
03/09/09	1.54	23.8	27.3		5,291	6,270		Diversion Event

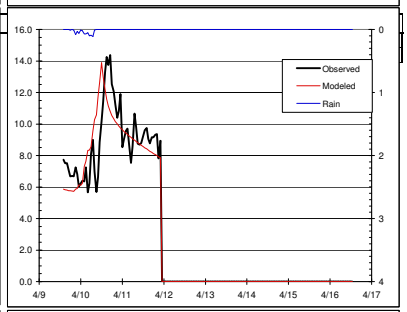
Net Average Error	-0.6%		2.6%
Total Average Error	19.0%		15.4%

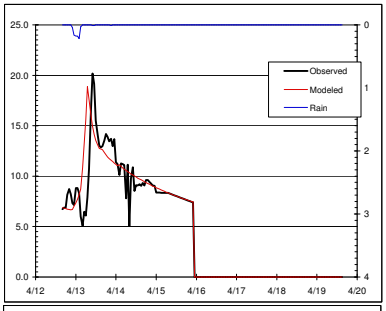
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

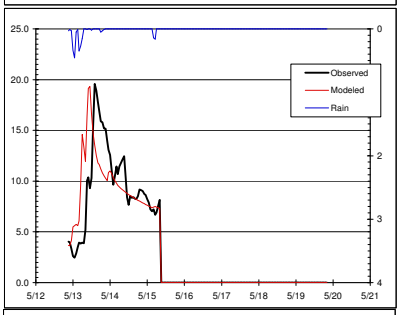


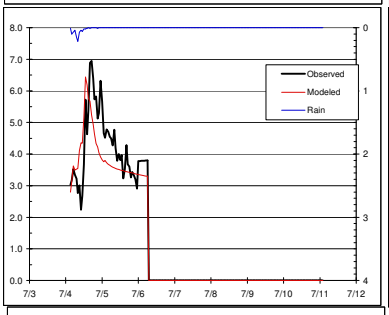


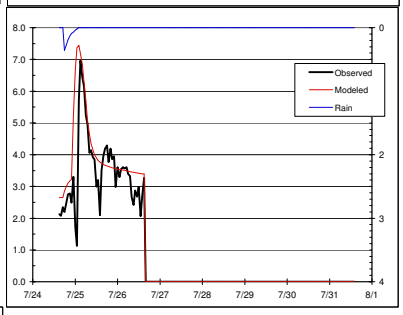


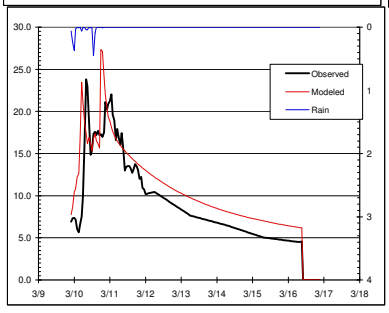










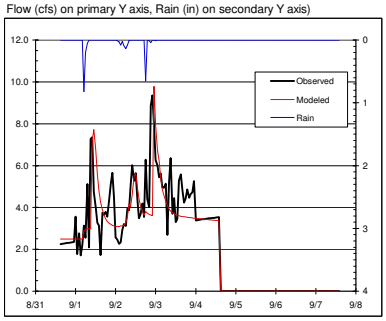


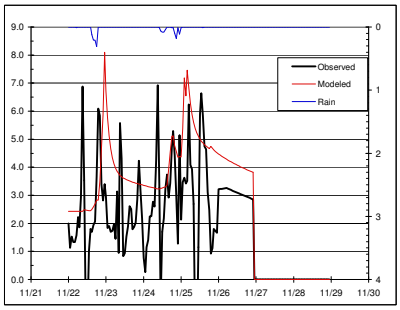
SE WWTP - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2010

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
11/21/10	1.57	6.9	8.1		1,170	1,734		Meter Issues
08/31/10	2.25	9.3	9.8	4.7%	1,405	1,323	-5.8%	

Net Average Error	4.7%	-5.8%
Total Average Error	2.3%	2.9%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)



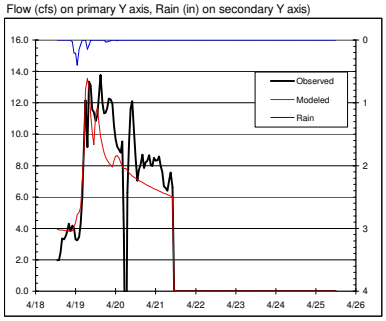


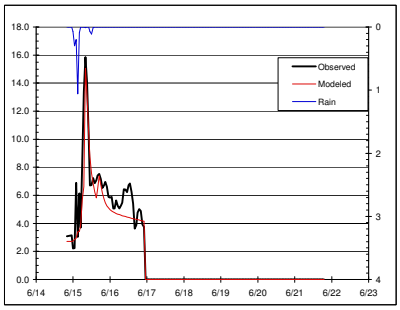
SE WWTP - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2011

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
06/14/11	1.92	15.9	15.1	-5.1%	1,130	973	-13.8%	
04/18/11	1.41	13.8	13.6	-1.7%	1,984	1,833	-7.6%	

Net Average Error	-3.4%		-10.7%
Total Average Error	3.4%		10.7%

Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)





Stern - Antecedent Moisture Model - Accuracy of Fit Analysis
Summary of Model Calibration

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes	
01/06/08	3.46	5.61	6.48	15.4%	1,053	1,273	20.9%		
07/11/08	1.70	2.38	2.39	0.6%	131	148	13.5%		
02/03/08	1.91	3.52	2.92	-17.1%	658	644	-2.2%		
09/13/08	3.94	5.74	5.54	-3.3%	706	651	-7.7%		
10/14/08	0.90	0.86	0.92	6.7%	43	45	4.2%		
02/10/09	1.50	2.65	2.27	-14.4%	536	377	-29.6%	Frozen Ground Conditions	
03/09/09	1.68	3.50	3.95	13.0%	773	943	22.1%		

Data not available for 2010-2011

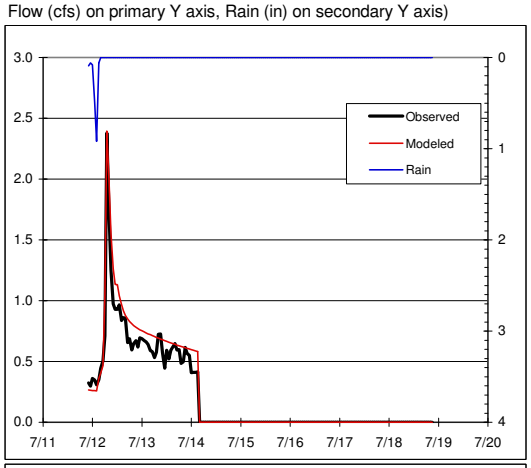
	Net Average Error	0.1%	3.0%
	Total Average Error	10.1%	14.3%

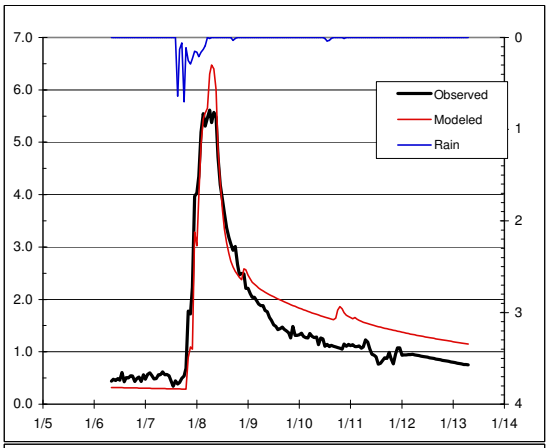
Stern - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2008

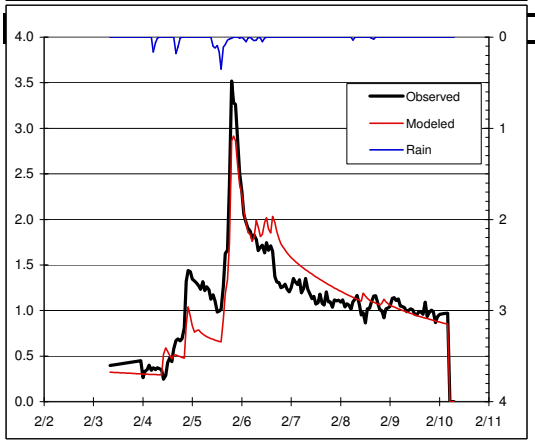
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
01/06/08	3.46	5.6	6.5	15.4%	1,053	1,273	20.9%	
07/11/08	1.7	2.4	2.4	0.6%	131	148	13.5%	
02/03/08	1.91	3.5	2.9	-17.1%	658	644	-2.2%	
09/13/08	3.94	5.7	5.5	-3.3%	706	651	-7.7%	
10/14/08	0.9	0.9	0.9	6.7%	43	45	4.2%	
10/23/08	1.41	1.0	1.0	-3.1%	163	144	-11.8%	

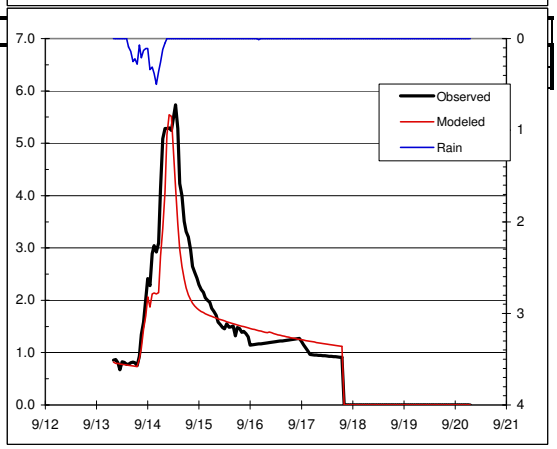
Net Average Error	-0.1%	2.8%
Total Average Error	8.0%	17.2%

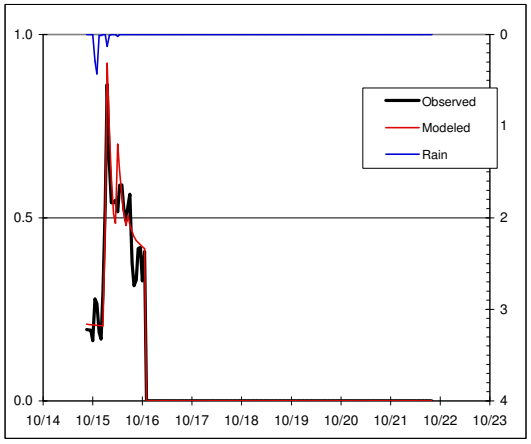
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)









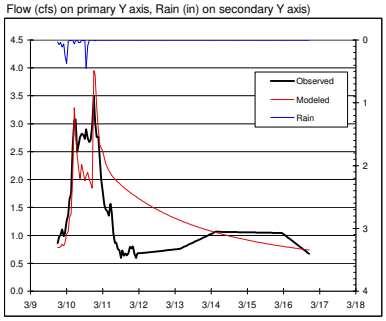


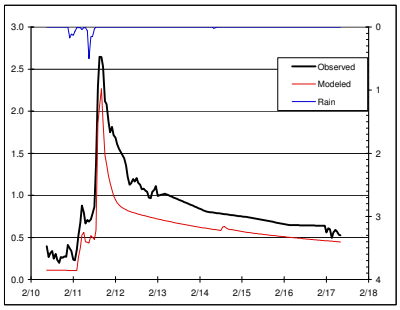
Stern - Antecedent Moisture Model - Accuracy of Fit Analysis
Calibration Events - 2009

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
02/10/09	1.5	2.6	2.3	-14.4%	536	377	-29.6%	
03/09/09	1.68	3.5	4.0	13.0%	773	943	22.1%	

Net Average Error	-0.7%		-3.8%
Total Average Error	13.7%		25.8%

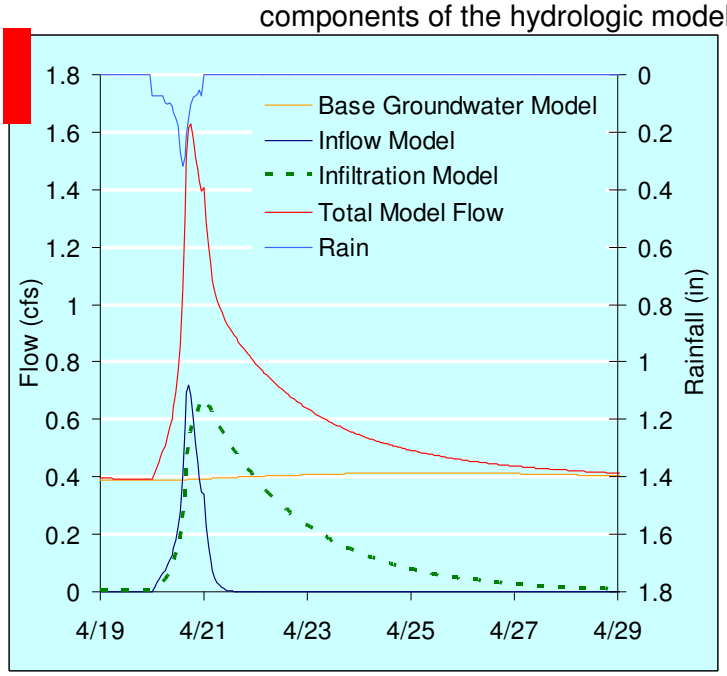
Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)



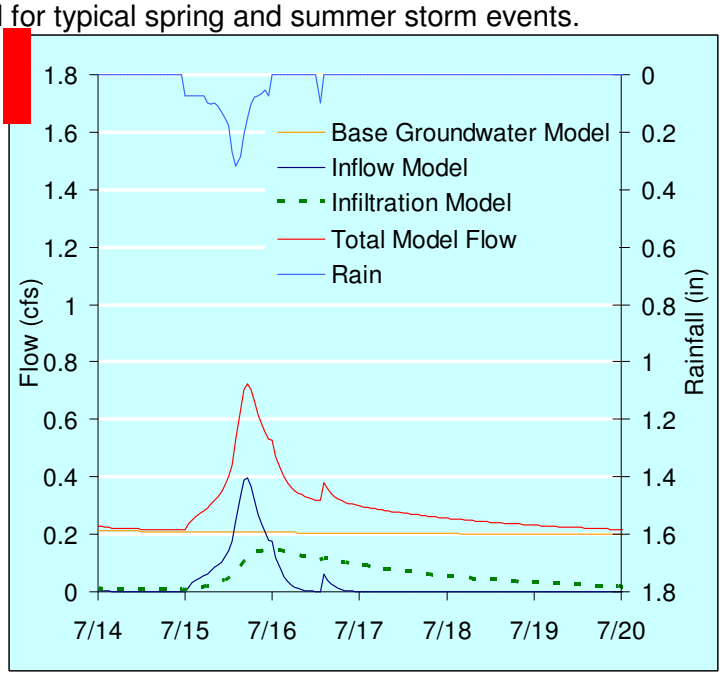


Arcadia – Quantification of I/I Components

1. The figures below show base groundwater flow, infiltration and inflow components of the hydrologic model for typical spring and summer storm events.



Spring I/I Components



Summer I/I Components

2. During typical spring storm events, peak flows are dominated by both inflow and infiltration component, and the volume response is dominated by the base groundwater flow and infiltration. During typical summer storm events, peak flows are dominated by the inflow component, and the volume response is dominated by the base groundwater flow and infiltration.

3. Significant inflow and infiltration components during the springtime would suggest that a full battery of SSES activities such as smoke testing, CCTV, and manhole inspections would be appropriate for this meter district.

Spring I/I Components

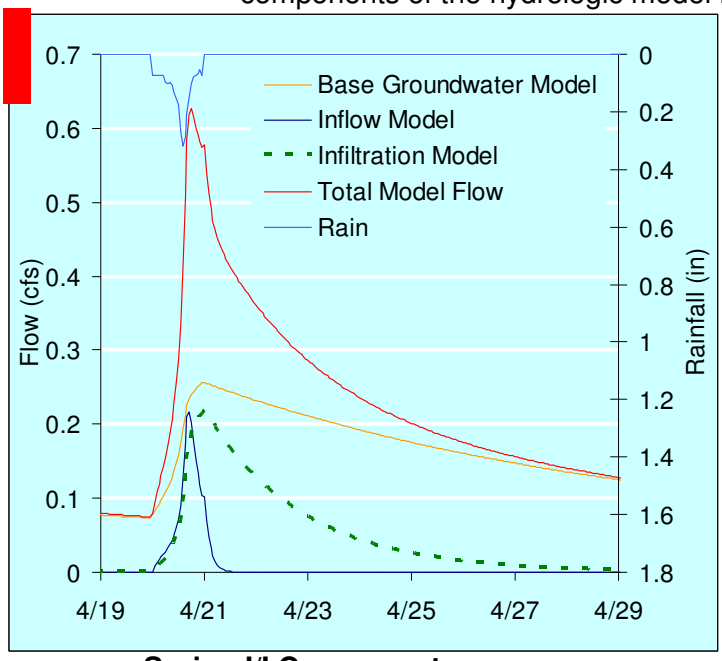
Component	Peak Flow Component (cfs)	Peak Flow Percentage (%)	Volume Component (Mcf)	Volume Percentage (%)
Base Groundwater	0.39	24.0%	384	70.6%
Inflow	0.68	41.9%	28	5.2%
Infiltration	0.55	34.1%	131	24.1%
Totals	1.63	100.0%	543	100.0%

Summer I/I Components

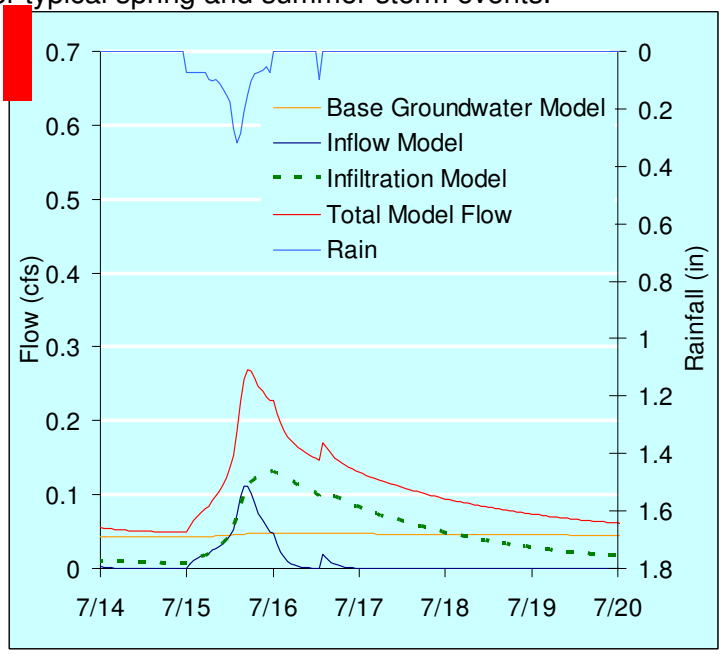
Component	Peak Flow Component (cfs)	Peak Flow Percentage (%)	Volume Component (Mcf)	Volume Percentage (%)
Base Groundwater	0.21	28.7%	47	55.7%
Inflow	0.40	54.7%	17	20.2%
Infiltration	0.12	16.6%	20	24.1%
Totals	0.72	100.0%	84	100.0%

Arrowhead and Holiday – Quantification of I/I Components

1. The figures below show base groundwater flow, infiltration and inflow components of the hydrologic model for typical spring and summer storm events.



Spring I/I Components



Summer I/I Components

2. During typical spring storm events, peak flows and volume are dominated by base groundwater infiltration component. During typical summer storm events, peak flows are dominated by the inflow and infiltration component, and the volume response is dominated by the base groundwater flow and infiltration.

3. A significant base groundwater infiltration component during the springtime and summer events would suggest that this meter district is under heavy groundwater influence. This finding would suggest that SSES activities such as CCTV, and manhole inspections would be appropriate for this meter district.

Spring I/I Components

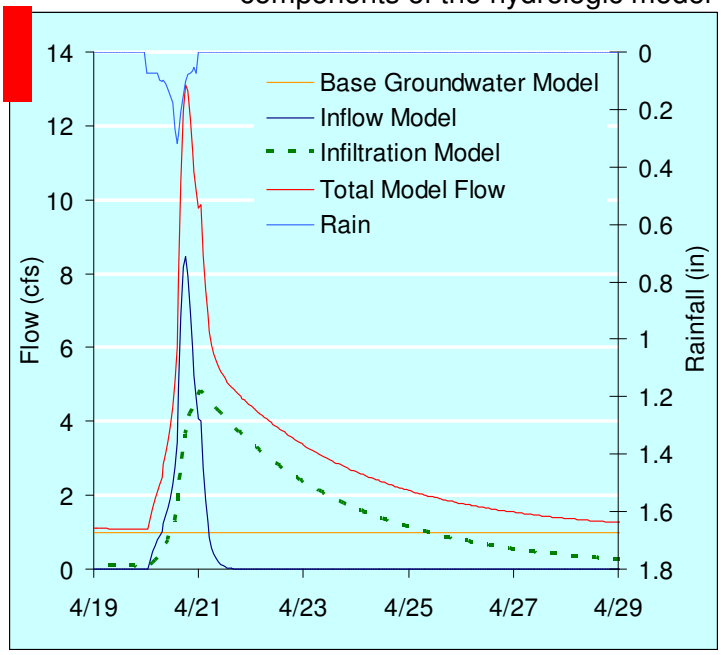
Component	Peak Flow Component (cfs)	Peak Flow Percentage (%)	Volume Component (Mcf)	Volume Percentage (%)
Base Groundwater	0.24	38.2%	159	75.4%
Inflow	0.20	32.3%	9	4.1%
Infiltration	0.19	29.5%	43	20.5%
Totals	0.63	100.0%	211	100.0%

Summer I/I Components

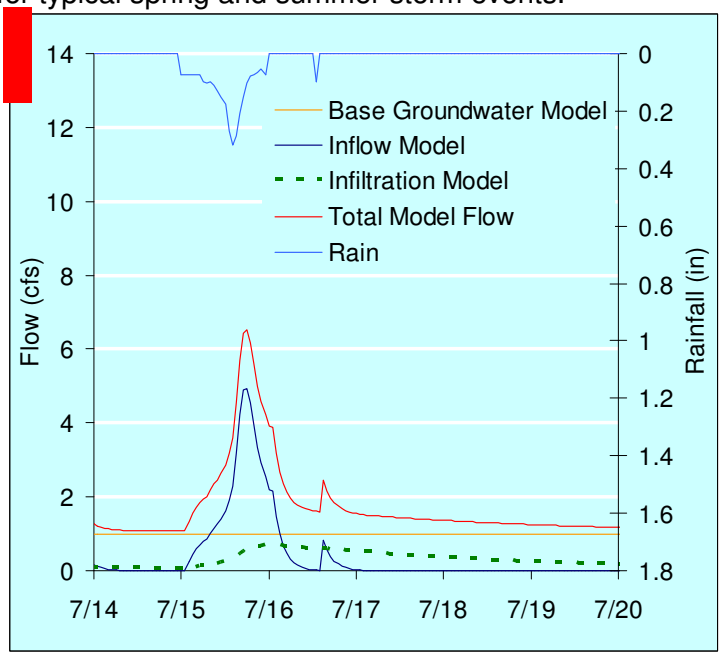
Component	Peak Flow Component (cfs)	Peak Flow Percentage (%)	Volume Component (Mcf)	Volume Percentage (%)
Base Groundwater	0.05	17.6%	11	31.2%
Inflow	0.11	41.6%	5	14.7%
Infiltration	0.11	40.8%	18	54.1%
Totals	0.27	100.0%	34	100.0%

GE Valley Pump Station – Quantification of I/I Components

1. The figures below show base groundwater flow, infiltration and inflow components of the hydrologic model for typical spring and summer storm events.



Spring I/I Components



Summer I/I Components

2. During typical spring and summer storm events, peak flows are dominated by the inflow component, and the volume response is dominated by the base groundwater flow and infiltration.

3. The dominant inflow component would suggest that SSES activities such as smoke testing that identify inflow sources would be appropriate for this meter district.

Spring I/I Components

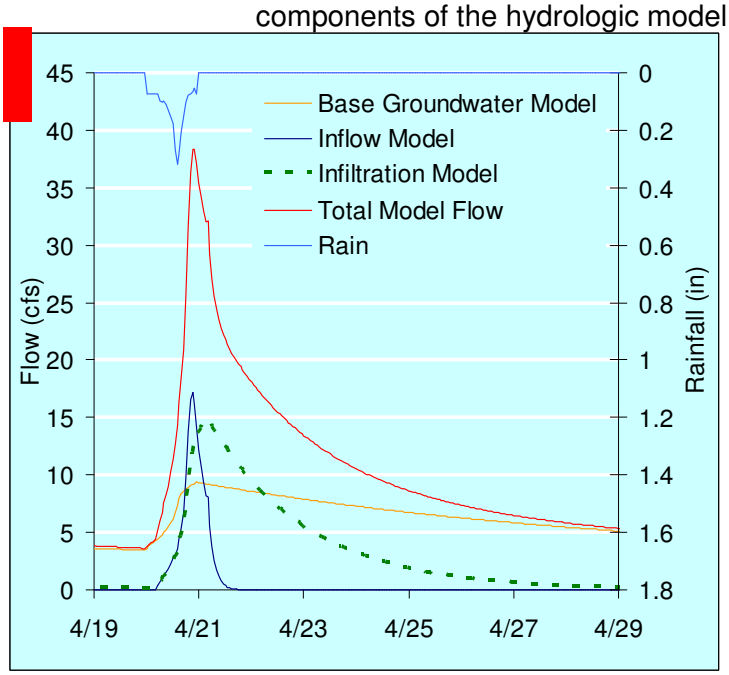
Component	Peak Flow Component (cfs)	Peak Flow Percentage (%)	Volume Component (Mcf)	Volume Percentage (%)
Base Groundwater	1.00	7.6%	947	36.8%
Inflow	8.45	64.4%	341	13.2%
Infiltration	4.84	36.9%	1,288	50.0%
Totals	13.12	100.0%	2,575	100.0%

Summer I/I Components

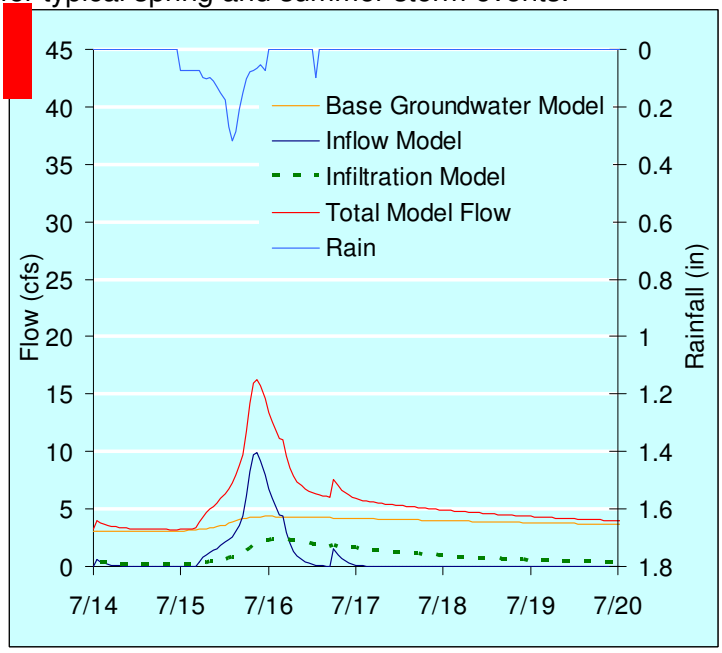
Component	Peak Flow Component (cfs)	Peak Flow Percentage (%)	Volume Component (Mcf)	Volume Percentage (%)
Base Groundwater	1.00	15.3%	227	41.2%
Inflow	4.93	75.6%	218	39.5%
Infiltration	0.59	9.1%	107	19.4%
Totals	6.52	100.0%	551	100.0%

Southeast WWTP – Quantification of I/I Components

1. The figures below show base groundwater flow, infiltration and inflow components of the hydrologic model for typical spring and summer storm events.



Spring I/I Components



Summer I/I Components

2. During typical spring storm events, peak flows are dominated by the inflow component and the volume is dominated by base groundwater infiltration. During typical summer storm events, peak flows are dominated by the inflow component, and the volume response is dominated by the base groundwater flow.

3. A significant base groundwater infiltration influence on hydrograph volumes during the springtime and summer events is significant as this is typically the most difficult component of flow to remove from the system as groundwater infiltration tends to migrate from repaired defects to the next hydraulically closest unrepaired defect. This finding would suggest that I/I removal activities would be of limited effectiveness in reducing hydrograph volumes.

Spring I/I Components

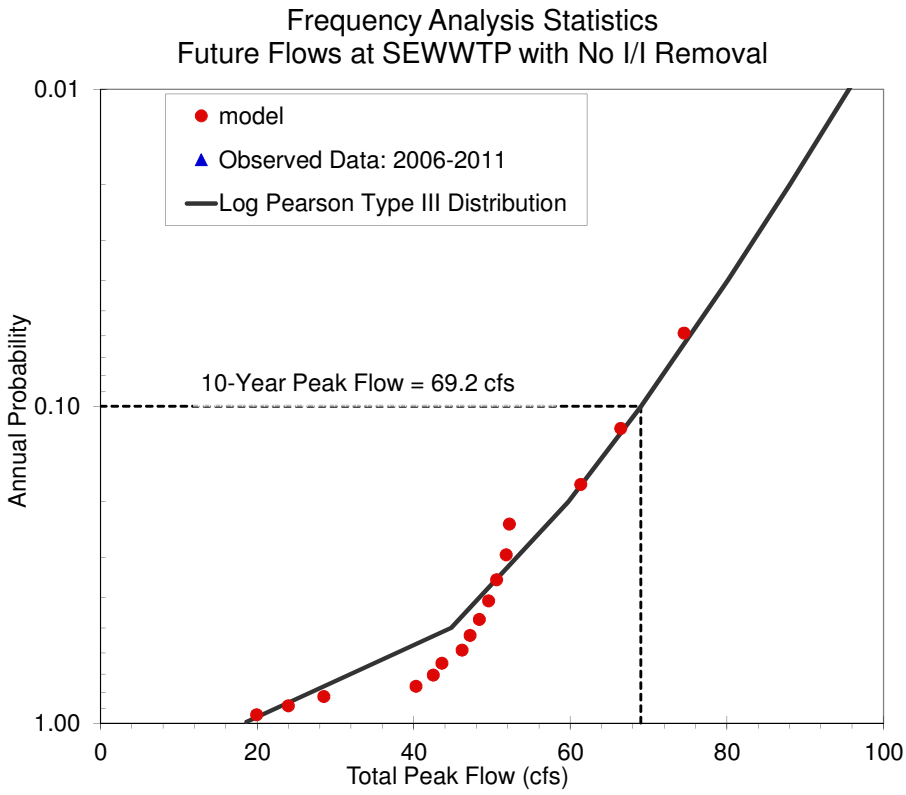
Component	Peak Flow Component (cfs)	Peak Flow Percentage (%)	Volume Component (Mcf)	Volume Percentage (%)
Base Groundwater	9.25	24.1%	6,168	62.9%
Inflow	16.21	42.2%	679	6.9%
Infiltration	12.93	33.7%	2,956	30.2%
Totals	38.39	100.0%	9,802	100.0%

Summer I/I Components

Component	Peak Flow Component (cfs)	Peak Flow Percentage (%)	Volume Component (Mcf)	Volume Percentage (%)
Base Groundwater	4.32	26.5%	912	55.0%
Inflow	9.90	60.7%	426	25.7%
Infiltration	2.08	12.7%	321	19.4%
Totals	16.30	100.0%	1,658	100.0%

City of Bloomington (SEWWTP) Modeled

Year	Max Flow (cfs)	Rank	Ranked Values	Log Max Flow (cfs)	Annual Probability	Return Period (yrs)
1990	50.58	1	74.54	1.87	0.059	17.0
1991	52.23	2	66.47	1.82	0.118	8.5
1992	40.29	3	61.36	1.79	0.176	5.7
1993	66.47	4	52.23	1.72	0.235	4.3
1994	19.95	5	51.82	1.71	0.294	3.4
1995	74.54	6	50.58	1.70	0.353	2.8
1996	28.54	7	49.58	1.70	0.412	2.4
1997	42.52	8	48.38	1.68	0.471	2.1
1998	46.20	9	47.20	1.67	0.529	1.9
1999	43.60	10	46.20	1.66	0.588	1.7
2000	49.58	11	43.60	1.64	0.647	1.5
2001	51.82	12	42.52	1.63	0.706	1.4
2002	61.36	13	40.29	1.61	0.765	1.3
2003	48.38	14	28.54	1.46	0.824	1.2
2004	47.20	15	23.98	1.38	0.882	1.1
2005	23.98	16	19.95	1.30	0.941	1.1



		-0.10	-0.20		Cw =	-0.19		
	Tr	K(-0.1)	K(-0.2)	ılumn Look	slope	3637928(	Q (cfs)	
0.99	1.0101	-2.4	-2.472	2	0.720	-2.4638	18.64	0.01
0.5	2	0.017	0.033	3	-0.160	0.0312	44.81	0.5
0.2	5	0.846	0.85	4	-0.040	0.8495	59.75	0.8
0.1	10	1.27	1.258	5	0.120	1.2594	69.02	0.9
0.04	25	1.716	1.68	6	0.360	1.6841	80.13	0.96
0.02	50	2	1.945	7	0.550	1.9512	88.03	0.98
0.01	100	2.252	2.178	8	0.740	2.1864	95.62	0.99
0.005	200	2.482	2.388	9	0.940	2.3987	103.02	0.995

Skew Coeff$_1$	-1.00	
Skew Coeff$_2$	-1.38	
Average	1.65	
Standard Deviation	0.15	
Variance	0.02	
Cm =	-0.40	(determined from USGS skewness map)
V(Cm) =	0.30	standard coefficient
A =	-0.33	
B =	0.93	
n =	16.00	
V(Cs) =	0.30	
W =	0.50	
Cw =	-0.19	

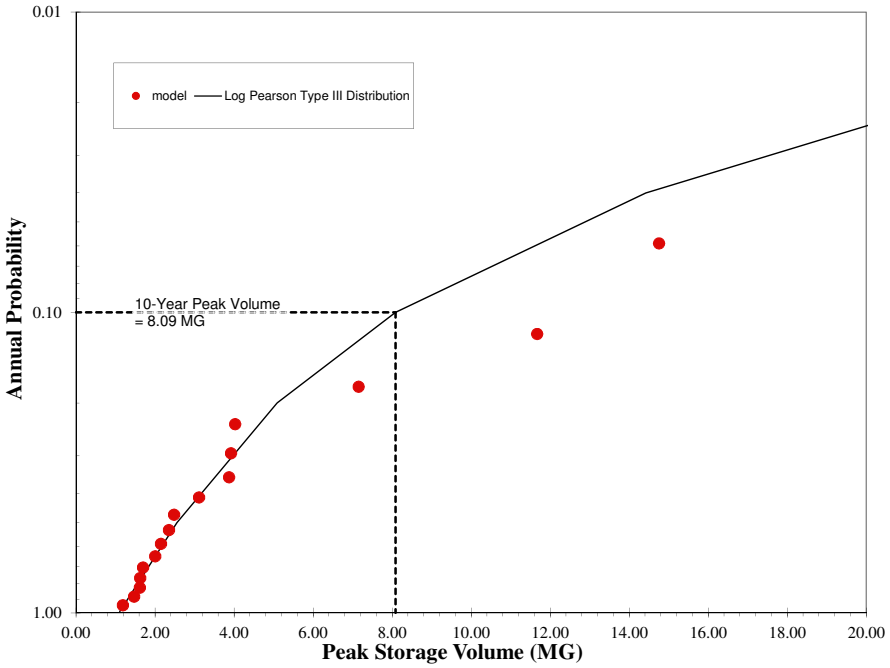
City of Bloomington (SEWWTP) Observed

Year	Max Flow (cfs)	Date	Rank	Ranked Values	Log Max Flow (cfs)	Annual Probability	Return Period (yrs)
1993			1		#NUM!	0.143	7.0
1994			2		#NUM!	0.286	3.5
1995			3		#NUM!	0.429	2.3
1996			4		#NUM!	0.571	1.8
1997			5		#NUM!	0.714	1.4
1998			6		#NUM!	0.857	1.2
1999			7		#NUM!	0.636	1.6
2000			8		#NUM!	0.727	1.4
2001			9		#NUM!	0.818	1.2
2002			10		#NUM!	0.909	1.1
2003			11		#NUM!	0.579	1.7
2004			12		#NUM!	0.632	1.6
2005			13		#NUM!	0.684	1.5
2006	26.84		14		#NUM!	0.737	1.4
2007	22.93		15		#NUM!	0.789	1.3
2008	37.52		16		#NUM!	0.842	1.2
2009	30.34		17		#NUM!	0.895	1.1
2010	24.46		18		#NUM!	0.947	1.1
2011	25.07		19		#NUM!	1.000	1.0

City of Bloomington (SEWWTP) Modeled

Year	Max Flow (cfs)	Rank	Ranked Values	Log Max Flow (cfs)	Annual Probability	Return Period (yrs)
		1	14.75	1.17	0.059	17.0
		2	11.66	1.07	0.118	8.5
		3	7.15	0.85	0.176	5.7
		4	4.02	0.60	0.235	4.3
		5	3.91	0.59	0.294	3.4
		6	3.87	0.59	0.353	2.8
		7	3.11	0.49	0.412	2.4
		8	2.48	0.39	0.471	2.1
		9	2.35	0.37	0.529	1.9
		10	2.14	0.33	0.588	1.7
		11	2.00	0.30	0.647	1.5
		12	1.69	0.23	0.706	1.4
		13	1.62	0.21	0.765	1.3
		14	1.61	0.21	0.824	1.2
		15	1.47	0.17	0.882	1.1
		16	1.18	0.07	0.941	1.1

Frequency Analysis Statistics With 10% I/I Removal System-Wide & 16.875 MGD WWTP Capacity



		1.30	1.20		Cw =	1.36		
	Tr	K(1.3)	K(1.2)	olumn Look	slope	i6864190:	Q (cfs)	
0.99	1.0101	-1.383	-1.449	2	0.660	-1.3455	1.11	0.01
0.5	2	-0.21	-0.195	3	-0.150	-0.2185	2.56	0.5
0.2	5	0.719	0.732	4	-0.130	0.7116	5.09	0.8
0.1	10	1.339	1.34	5	-0.010	1.3384	8.09	0.9
0.04	25	2.108	2.087	6	0.210	2.1199	14.42	0.96
0.02	50	2.666	2.626	7	0.400	2.6887	21.96	0.98
0.01	100	3.211	3.149	8	0.620	3.2463	33.17	0.99
0.005	200	3.745	3.661	9	0.840	3.7928	49.69	0.995

Skew Coeff$_1$	0.99	
Skew Coeff$_2$	1.36	
Average	0.48	
Standard Deviation	0.32	
Variance	0.10	
Cm =	-0.40	(determined from USGS skewness map)
V(Cm) =	0.30	standard coefficient
A =	-0.32	
B =	0.91	
n =	16.00	
V(Cs) =	0.31	
W =	0.49	
Cw =	-0.15	

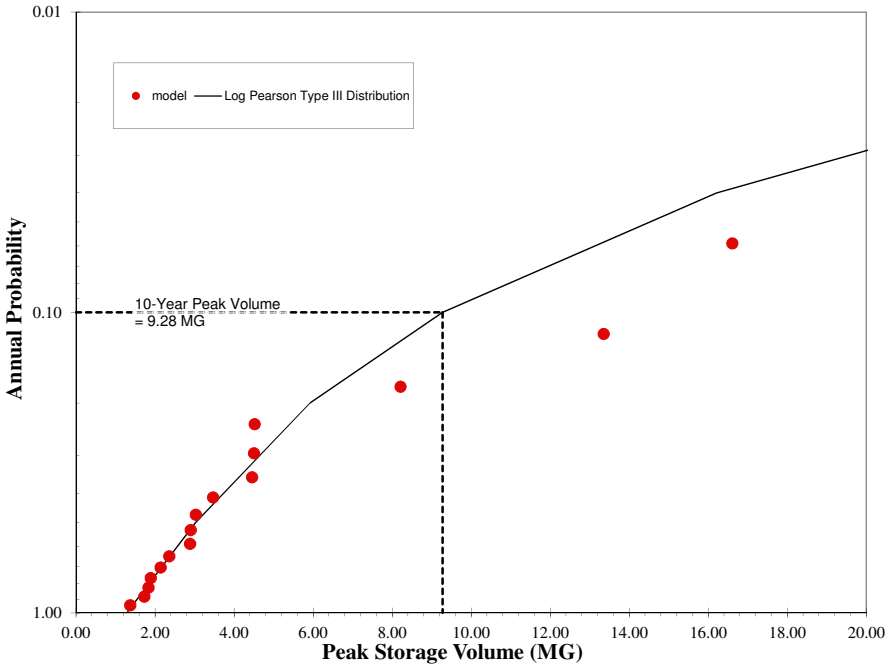
City of Bloomington (SEWWTP) Observed

	Year	Max Flow (cfs)	Date	Rank	Ranked Values	Log Max Flow (cfs)	Annual Probability	Return Period (yrs)
	1993			1	37.52	1.57	0.143	7.0
	1994			2	30.34	1.48	0.286	3.5
	1995			3	26.84	1.43	0.429	2.3
	1996			4	25.07	1.40	0.571	1.8
	1997			5	24.46	1.39	0.714	1.4
	1998			6	22.93	1.36	0.857	1.2
	1999			7		#NUM!	0.636	1.6
	2000			8		#NUM!	0.727	1.4
	2001			9		#NUM!	0.818	1.2
	2002			10		#NUM!	0.909	1.1
	2003			11		#NUM!	0.579	1.7
	2004			12		#NUM!	0.632	1.6
	2005			13		#NUM!	0.684	1.5
26.84	2006	26.84		14		#NUM!	0.737	1.4
22.93	2007	22.93		15		#NUM!	0.789	1.3
37.52	2008	37.52		16		#NUM!	0.842	1.2
30.34	2009	30.34		17		#NUM!	0.895	1.1
24.46	2010	24.46		18		#NUM!	0.947	1.1
25.07	2011	25.07		19		#NUM!	1.000	1.0

City of Bloomington (SEWWTP) Modeled

Year	Max Flow (cfs)	Rank	Ranked Values	Log Max Flow (cfs)	Annual Probability	Return Period (yrs)
		1	16.60	1.22	0.059	17.0
		2	13.35	1.13	0.118	8.5
		3	8.21	0.91	0.176	5.7
		4	4.52	0.65	0.235	4.3
		5	4.50	0.65	0.294	3.4
		6	4.46	0.65	0.353	2.8
		7	3.46	0.54	0.412	2.4
		8	3.02	0.48	0.471	2.1
		9	2.90	0.46	0.529	1.9
		10	2.88	0.46	0.588	1.7
		11	2.36	0.37	0.647	1.5
		12	2.13	0.33	0.706	1.4
		13	1.89	0.28	0.765	1.3
		14	1.83	0.26	0.824	1.2
		15	1.72	0.24	0.882	1.1
		16	1.37	0.14	0.941	1.1

Frequency Analysis Statistics With 5% I/I Removal System-Wide & 16.875 MGD WWTP Capacity



		1.30	1.20		Cw =	1.32		
	Tr	K(1.3)	K(1.2)	olumn Look	slope	8779516 Q (cfs)		
0.99	1.0101	-1.383	-1.449	2	0.660	-1.3706	1.31	0.01
0.5	2	-0.21	-0.195	3	-0.150	-0.2128	3.03	0.5
0.2	5	0.719	0.732	4	-0.130	0.7166	5.92	0.8
0.1	10	1.339	1.34	5	-0.010	1.3388	9.28	0.9
0.04	25	2.108	2.087	6	0.210	2.1119	16.21	0.96
0.02	50	2.666	2.626	7	0.400	2.6735	24.31	0.98
0.01	100	3.211	3.149	8	0.620	3.2226	36.13	0.99
0.005	200	3.745	3.661	9	0.840	3.7608	53.27	0.995

Skew Coeff$_1$	0.96	
Skew Coeff$_2$	1.32	
Average	0.55	
Standard Deviation	0.31	
Variance	0.10	
Cm =	-0.40	(determined from USGS skewness map)
V(Cm) =	0.30	standard coefficient
A =	-0.32	
B =	0.91	
n =	16.00	
V(Cs) =	0.31	
W =	0.49	
Cw =	-0.15	

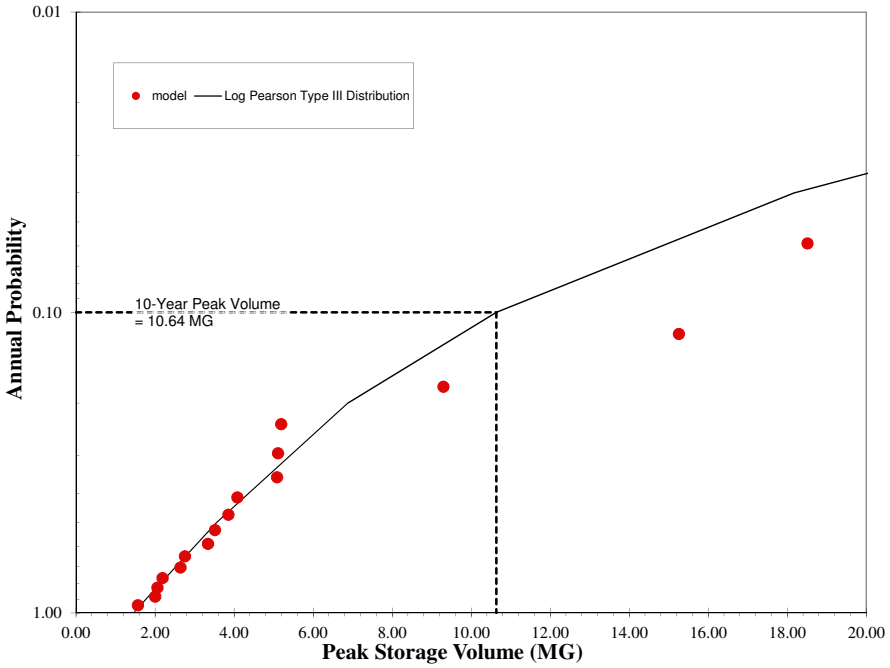
City of Bloomington (SEWWTP) Observed

	Year	Max Flow (cfs)	Date	Rank	Ranked Values	Log Max Flow (cfs)	Annual Probability	Return Period (yrs)
	1993			1	37.52	1.57	0.143	7.0
	1994			2	30.34	1.48	0.286	3.5
	1995			3	26.84	1.43	0.429	2.3
	1996			4	25.07	1.40	0.571	1.8
	1997			5	24.46	1.39	0.714	1.4
	1998			6	22.93	1.36	0.857	1.2
	1999			7		#NUM!	0.636	1.6
	2000			8		#NUM!	0.727	1.4
	2001			9		#NUM!	0.818	1.2
	2002			10		#NUM!	0.909	1.1
	2003			11		#NUM!	0.579	1.7
	2004			12		#NUM!	0.632	1.6
	2005			13		#NUM!	0.684	1.5
26.84	2006	26.84		14		#NUM!	0.737	1.4
22.93	2007	22.93		15		#NUM!	0.789	1.3
37.52	2008	37.52		16		#NUM!	0.842	1.2
30.34	2009	30.34		17		#NUM!	0.895	1.1
24.46	2010	24.46		18		#NUM!	0.947	1.1
25.07	2011	25.07		19		#NUM!	1.000	1.0

City of Bloomington (SEWWTP) Modeled

Year	Max Flow (cfs)	Rank	Ranked Values	Log Max Flow (cfs)	Annual Probability	Return Period (yrs)
		1	18.51	1.27	0.059	17.0
		2	15.25	1.18	0.118	8.5
		3	9.29	0.97	0.176	5.7
		4	5.18	0.71	0.235	4.3
		5	5.10	0.71	0.294	3.4
		6	5.08	0.71	0.353	2.8
		7	4.08	0.61	0.412	2.4
		8	3.85	0.59	0.471	2.1
		9	3.51	0.55	0.529	1.9
		10	3.33	0.52	0.588	1.7
		11	2.75	0.44	0.647	1.5
		12	2.64	0.42	0.706	1.4
		13	2.18	0.34	0.765	1.3
		14	2.06	0.31	0.824	1.2
		15	2.00	0.30	0.882	1.1
		16	1.56	0.19	0.941	1.1

Frequency Analysis Statistics With No I/I Removal System-Wide & 16.875 MGD WWTP Capacity

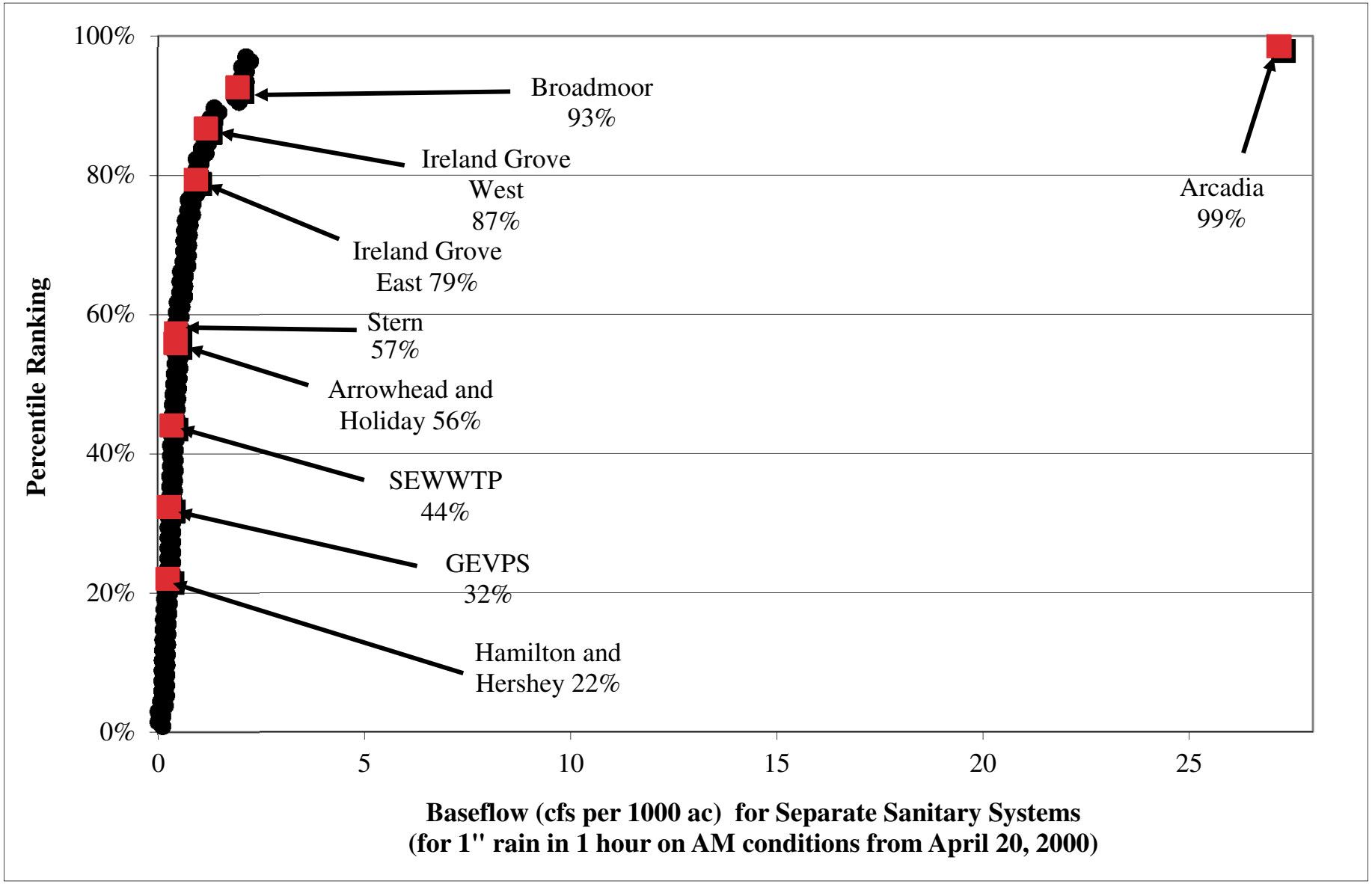


		1.20	1.10		Cw =	1.23		
	Tr	K(1.2)	K(1.1)	olumn Look	slope	i1382026(	Q (cfs)	
0.99	1.0101	-1.449	-1.518	2	0.690	-1.4273	1.49	0.01
0.5	2	-0.195	-0.18	3	-0.150	-0.1997	3.56	0.5
0.2	5	0.732	0.745	4	-0.130	0.7279	6.89	0.8
0.1	10	1.34	1.341	5	-0.010	1.3397	10.64	0.9
0.04	25	2.087	2.066	6	0.210	2.0936	18.17	0.96
0.02	50	2.626	2.585	7	0.410	2.6389	26.76	0.98
0.01	100	3.149	3.087	8	0.620	3.1685	38.99	0.99
0.005	200	3.661	3.575	9	0.860	3.6880	56.39	0.995

Skew Coeff$_1$	0.90	
Skew Coeff$_2$	1.23	
Average	0.61	
Standard Deviation	0.31	
Variance	0.10	
Cm =	-0.40	(determined from USGS skewness map)
V(Cm) =	0.30	standard coefficient
A =	-0.32	
B =	0.92	
n =	16.00	
V(Cs) =	0.31	
W =	0.49	
Cw =	-0.16	

City of Bloomington (SEWWTP) Observed

	Year	Max Flow (cfs)	Date	Rank	Ranked Values	Log Max Flow (cfs)	Annual Probability	Return Period (yrs)
	1993			1	37.52	1.57	0.143	7.0
	1994			2	30.34	1.48	0.286	3.5
	1995			3	26.84	1.43	0.429	2.3
	1996			4	25.07	1.40	0.571	1.8
	1997			5	24.46	1.39	0.714	1.4
	1998			6	22.93	1.36	0.857	1.2
	1999			7		#NUM!	0.636	1.6
	2000			8		#NUM!	0.727	1.4
	2001			9		#NUM!	0.818	1.2
	2002			10		#NUM!	0.909	1.1
	2003			11		#NUM!	0.579	1.7
	2004			12		#NUM!	0.632	1.6
	2005			13		#NUM!	0.684	1.5
26.84	2006	26.84		14		#NUM!	0.737	1.4
22.93	2007	22.93		15		#NUM!	0.789	1.3
37.52	2008	37.52		16		#NUM!	0.842	1.2
30.34	2009	30.34		17		#NUM!	0.895	1.1
24.46	2010	24.46		18		#NUM!	0.947	1.1
25.07	2011	25.07		19		#NUM!	1.000	1.0


100%
80%
60%
40%
20%
0%
Percentile Ranking
0
5
10
15
20
25
Broadmoor
93%
Ireland Grove
West
87%
Ireland Grove
East 79%
Stern
57%
Arrowhead and
Holiday 56%
SEWWTP
44%
GEVPS
32%
Hamilton and
Hershey 22%
Arcadia
99%
Baseflow (cfs per 1000 ac) for Separate Sanitary Systems
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

Sanitary Sewer Technical Memoranda

SAN2 - EAST SIDE INTERCEPTOR / GE VALLEY COLLECTOR SYSTEM CAPACITY ASSESSMENT

East Side Interceptor / GE Valley Collector
System Capacity Assessment

Executive Summary

This Technical Memorandum serves as a companion document to the *East Side Interceptor Hydrologic Analysis*. This document focuses on the hydraulic capacity of the East Side Interceptor, GE Valley collector sewer, and the GE Valley Pump Station. Specific actions are identified to address the hydraulic deficiencies that may have an adverse impact on existing and/or future flow scenarios. This will help to accomplish the following:

- Ensure the long-term functionality of the East Side Interceptor and an adequate Level of Service for City of Bloomington residents and businesses.
- Prevent hydraulic surcharging that could result in basement backups or Sanitary Sewer Overflows.
- Eliminate flow diversions to the City's older sewer systems tributary to the West Wastewater Treatment Plant.

Key Findings

- The East Side Interceptor is adequately sized to handle design-event wet weather flows with no or minimal hydraulic surcharge.
- The GE Valley Pump Station does not have enough capacity to manage wet weather flows without diverting flows to the City's combined sewer system.
- The Hawthorne Collector Sewer (City-owned sewer system component upstream of the GE Valley Pump Station) is undersized and presents a risk for system surcharge, especially as the City continues to grow eastward.

Recommendations

- Increase the hydraulic capacity of the Hawthorne Collector Sewer by installing a hydraulic relief at the GE Road / Airport Road intersection.
- Upgrade the GE Valley Pump Station to provide pumping capacity to manage the design event flow rate without diversion to the combined sewer system.

Cost Summary	
Hawthorne Collector Hydraulic Improvements (Alternate 2)	$ 640,000
GE Valley Pump Station Expansion	$ 810,000
TOTAL	**$ 1,450,000**

ARCHITECTS. ENGINEERS. PLANNERS.

OHM Advancing Communities

technical memorandum

Date: November 4, 2013

To: Ryan Otto, City of Bloomington

From: Greg Kacvinsky, Orchard, Hiltz & McCliment, Inc.
Robert Czachorski, Orchard, Hiltz & McCliment, Inc.

Re: City of Bloomington
East Side Interceptor / GE Valley Collector - System Capacity Assessment

Project Summary

This document serves as a companion document to the *East Side Interceptor Hydrologic Analysis*. Whereas the hydrologic analysis focuses on the calculation of wet weather flow rates within the East Side Interceptor system, this document focuses on the hydraulic capacity of the East Side Interceptor and GE Valley collector sewer. Specific actions are identified to address the hydraulic deficiencies that may have an adverse impact on existing and/or future flow scenarios.

Need for Study

Portions of the East Side Interceptor sewer, which is owned by the Bloomington Normal Water Reclamation District (BNWRD), have been previously reported to have elevated base flows and inflow and infiltration (I&I) during wet weather events. Flows from the East Side Interceptor discharge to BNWRD's Southeast Wastewater Treatment Plant (SEWWTP). During significant wet weather events (generally exceeding 2-3 inches of rainfall), the SEWWTP influent approaches the plant's treatment capacity, which requires flow diversions to the City's west sewer system in order to avoid any overflows or flow bypasses at the SEWWTP. These diversions include an overflow pipe at the GE Valley Pump Station (GEVPS) wet well and a pumped diversion at the Little Kickapoo Pump Station (LKPS). Both diversions send wet weather flows to the City's older combined sewer collection system that ultimately discharges to BNWRD's West Wastewater Treatment Plant (WWWTP) on the City's west side. These diversions are not desired by BNWRD, as the older (west) components of the City's collection system include combined sewers. Additional flows to the combined system will make it more difficult for the City to meet its CSO Permit obligations with the Illinois Environmental Protection Agency (IEPA).

Orchard, Hiltz, and McCliment, Inc. (OHM) has been retained as part of a team of consultants led by Foth, LLC to perform an evaluation of the wet weather flows generated by the East Side Interceptor system and determine where (if any) hydraulic restrictions exist.

Extents of Hydraulic Analysis

The hydraulic analysis extends from the headworks of the SEWWTP (downstream limits) to the GEVPS (upstream limits) for a total of 60,000 lineal feet of interceptor sewer and forcemain, ranging from 36-inch diameter to 54-inch diameter.

Foth, LLC developed the XP-SWMM hydraulic model of the interceptor sewer and the two pump stations. OHM incorporated wet weather hydrographs as calculated in the *Hydrologic Analysis* and analyzed the interceptor system under wet weather hydraulic scenarios.

Additionally, the City of Bloomington collector sewer within the GE Valley sewer district (primarily between the GEVPS and Airport Road) was studied in order to determine whether future flows from the Town of Normal (as identified in the *Hydrologic Analysis*) can be accommodated in the existing collector sewer along GE Road. Figure 1 illustrates the interceptor and collector sewers modeled as part of this effort.

It was assumed that no adverse hydraulic conditions would exist at the SEWWTP headworks and the interceptor sewer would be in a free-flowing regime at this location under all modeled conditions.



Figure 1: Limits of Hydraulic Analysis

Methodology

The evaluation of system hydraulic capacity used the following methodology:

1. **Hydraulic Analysis of Wet Weather Flows**
   XP-SWMM v. 12.0 (XP Solutions) was used to develop a hydraulic model of the East Side Interceptor and select components of the GE Valley collector system. Sewer invert elevations, slopes, and sizes were determined using the City's GIS sewer database and available as-built drawings. Pump station characteristics (including wet well volumes, pump curves, pump control logic and force main attributes) were determined using BNWRD-supplied pump station plans for the GEVPS and LKPS. No field survey data were collected as part of this effort.

2. **Wet Weather Flow Hydrographs**
   Future conditions (Year 2035) wet weather flow hydrographs were developed by modeling a 24-hour Huff 3rd Quartile rainfall using the calibrated i3D Antecedent Moisture Model (referred to in the *Hydrologic Analysis*) for each identified sewer district. Each resultant hydrograph was scaled accordingly so that the peak flow matched the 10-year recurrence interval peak flow from the frequency analysis described in the *Hydrologic Analysis*). Using a flow hydrograph allows for a better understanding of how to manage the ***volume*** of wet weather flow and allows us to determine the impacts of timing/routing on downstream peak flows. An example of the wet weather (design) flow hydrograph for the Stern sewer district is illustrated in Figure 2.

3. **GE Valley Collector Sewer Flows**
   Future wet weather flows from the GE Valley area, including future flows from the Town of Normal which enter the GE Valley collector system along Airport Road, were assigned to specific locations along the City's collector sewers based on the contributing sewershed areas. It was assumed that the GE Valley wet weather response (as measured upstream of the GEVPS and as predicted by the i3D Antecedent Moisture Model) would be equally distributed across the entire GE Valley sewer district.

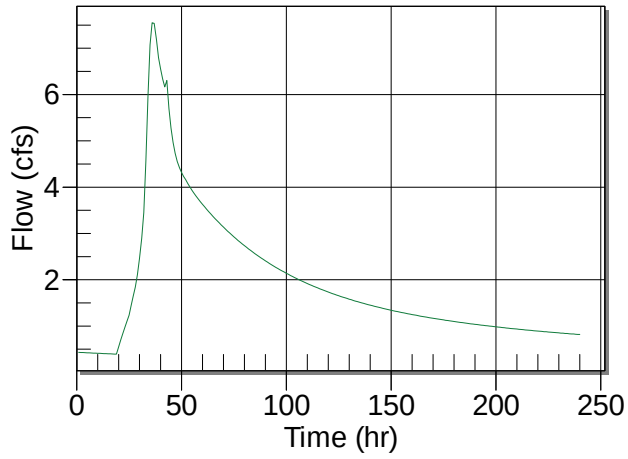


Figure 2
Design Wet Weather Hydrograph – STERN SEWER DISTRICT

4. Pump Station Operating Criteria

Existing pump curves were used to evaluate current pumping capacities. For the purposes of this hydraulic modeling effort, the following assumptions were made:

- GEVPS: The existing pumps would operate at full capacity and no diversion to the west collection system would occur. This scenario results in the maximum potential flow in the existing 36-inch forcemain and along the entire reach of the East Side Interceptor.
- LKPS: The existing pumps would not operate during the design event so that all system flows would be conveyed to the SEWWTP. This scenario results in the maximum potential flow along the interceptor between LKPS and the SEWWTP.

The GEVPS consists of two 7,000 gallons per minute (gpm) pumps (see Figure 3) that operate under a Total Dynamic Head (TDH) of approximately 80 feet (about 95 feet when both pumps are on). A third pump pad is available for pump station expansion.

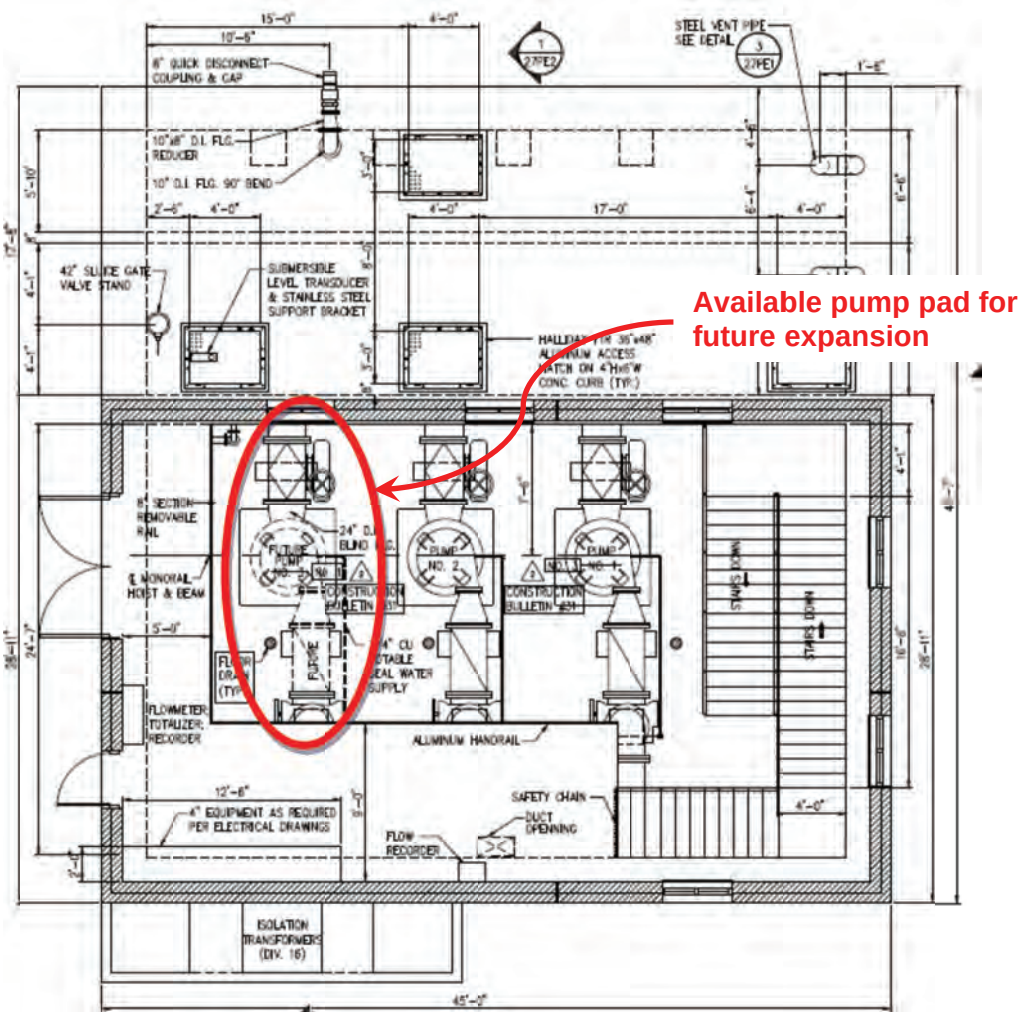


Figure 3: GE Valley Pump Station Plan

The firm capacity of the GEVPS is approximately 16 cfs. With both pumps operating, the theoretical capacity is 32 cfs. Since the GEVPS includes an overflow to the existing combined sewer system that flows to the WWWTP, it is possible to operate the GEVPS under a flow split scenario under which some flows are pumped to the SEWWTP and the remaining flow is diverted to the WWWTP. During wet weather events, BNWRD occasionally throttles down the GEVPS to approximately 6 cfs and allows excess flows to bypass the pump station to the combined sewer system (and ultimately the WWWTP). This is done to prevent excess flows that would otherwise enter the East Side Interceptor and exceed the treatment capacity at the SEWWTP.

The hydraulic scenario modeled as part of this effort can only be realized upon an expansion of the pumping capacity at GEVPS. Specific recommendations for GEVPS expansion are included in the Recommended System Improvements section of this document.

5. Key Assumptions

- No structural deficiencies or other blockages exist that would inhibit flows within the modeled interceptor or collector sewers. Our review of flow meter data along the interceptor confirms this, as flow/depth measurements generally agree with the XP-SWMM hydraulic model.
- Under modeled hydraulic conditions, the pump stations would operate so as to prevent any flow diversion to the collection system tributary to the West Wastewater Treatment Plant (WWWTP).

Hydraulic Model Results – Interceptor Sewer

The East Side Interceptor Sewer has adequate hydraulic capacity to convey existing wet weather flows and future (Year 2035) wet weather flows with minimal to no surcharge along its length (Figures 4 and 5). The reach between Lincoln Street and the LKPS shows up to 1.5 feet of surcharge above the crown of pipe. This reach includes the flow inputs from Ireland Grove East and Ireland Grove West.

Based on our review of GIS-based data on sewer laterals entering the East Side Interceptor, the hydraulic surcharge should have no adverse impact on the City's collection system, as the only City sewers (lateral sewers) entering the interceptor along this reach are at Ireland Grove Road. These laterals do not appear to have any individual service connections within the most downstream segments, and the impact of the surcharge is only observed within the most downstream segments of each of the two connecting sewers at Ireland Grove Road.

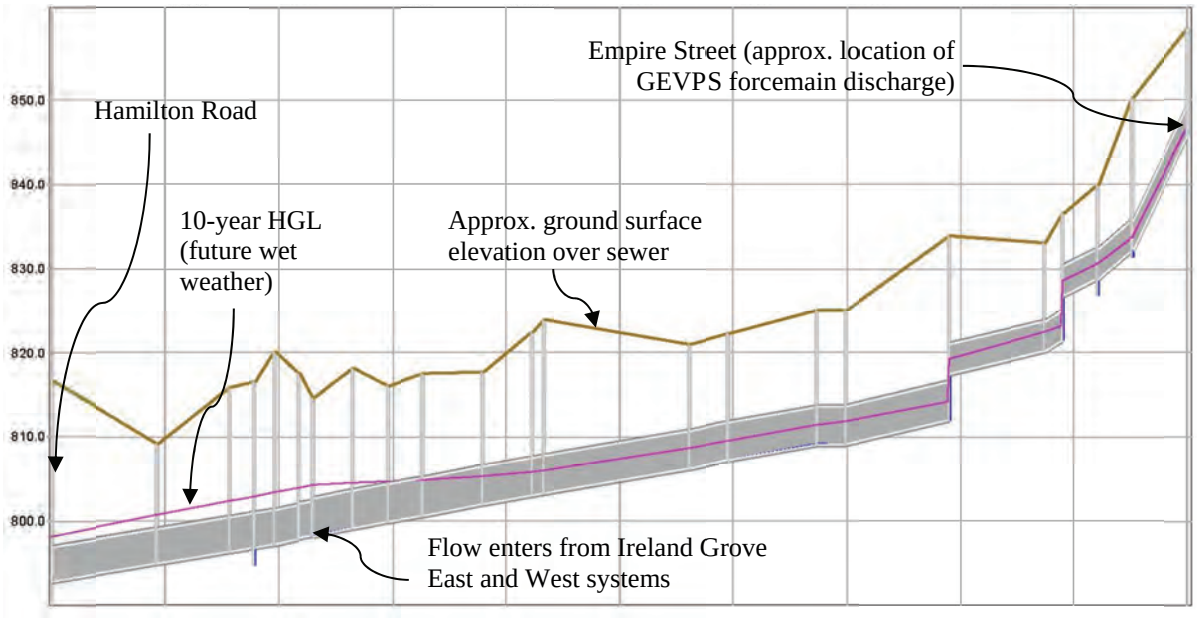


Figure 4: East Side Interceptor Hydraulic Profile (Upstream Reach)

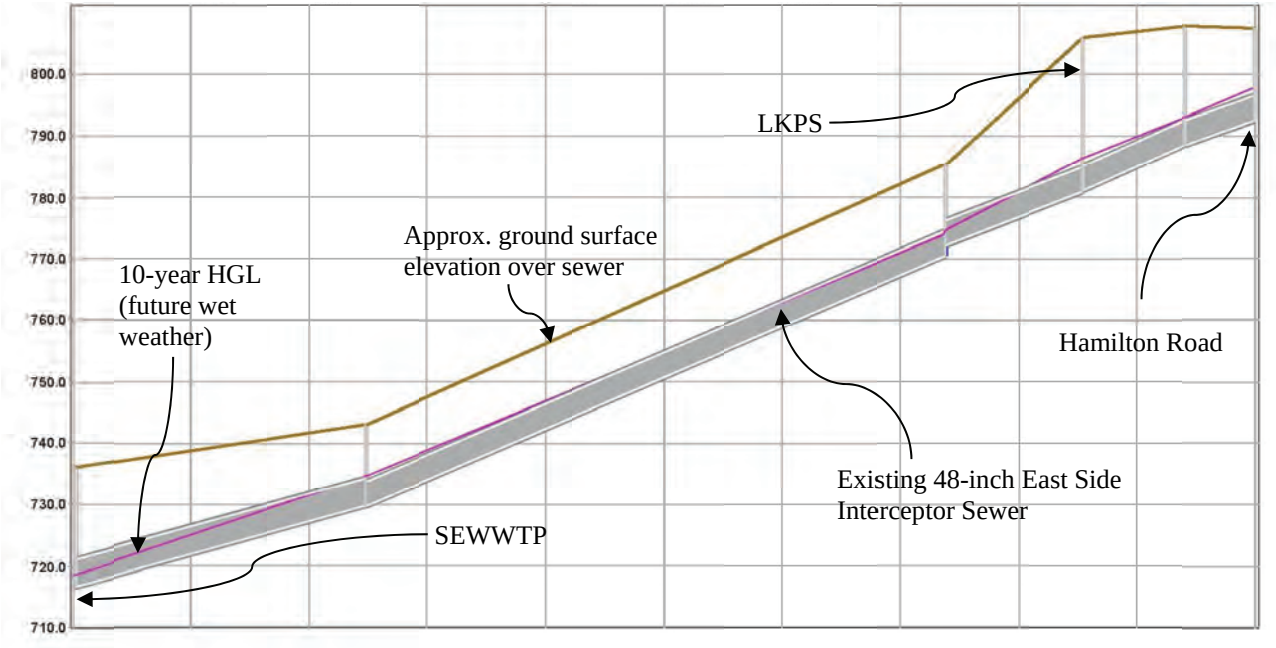


Figure 5: East Side Interceptor Hydraulic Profile (Downstream Reach)

Figure 6 illustrates the modeled system with associated flow rates and flow capacities at key points along the East Side Interceptor and GE Valley Collector. The peak flow rate at the downstream end of the East Side Interceptor, 62 cfs, is lower than the sum of peak flow rates from individual sewer districts as listed in the *Hydrologic Analysis* (69 cfs). This is due to the effects of hydraulic routing, as flow hydrographs enter the East Side Interceptor at different times and at different locations. Therefore, the peaks of the hydrographs are not coincidental and the modeled peak flow rate at the downstream end of the interceptor (SEWWTP) is about 10% less than the sum of all individual peak flow components.

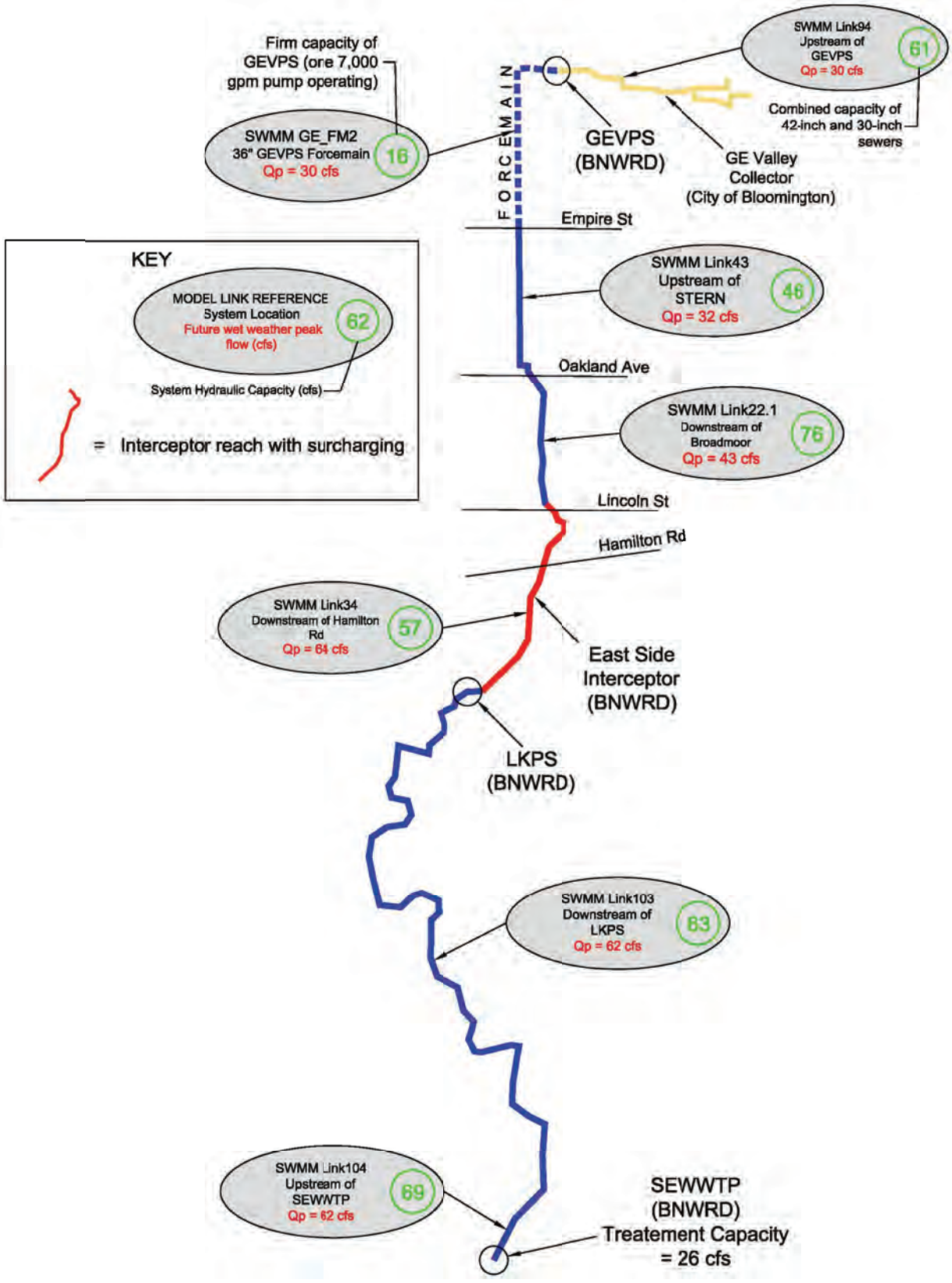


Figure 6: Flow / Capacity Schematic

Hydraulic Model Results – GE Valley Collector Sewer

OHM modeled a limited component of the GE Valley collector sewer to measure the impacts of expected future wet weather flows from the Town of Normal, which enters the GE Valley collection system on Airport Road. Two main branches of the GE Valley collection system converge at GE Road about ½ mile west of Airport Road.

The Town of Normal flow component enters the collection system on Airport Road, which discharges to a 42-inch diameter collector sewer on the north side of GE Road. The 42-inch sewer has adequate capacity for the Year 2035 wet weather flow rate (Figure 7). The downstream end of the 42-inch sewer is subject to the hydraulic impacts of the GEVPS wet well, which causes the pipe immediately upstream of the GEVPS to fill completely.

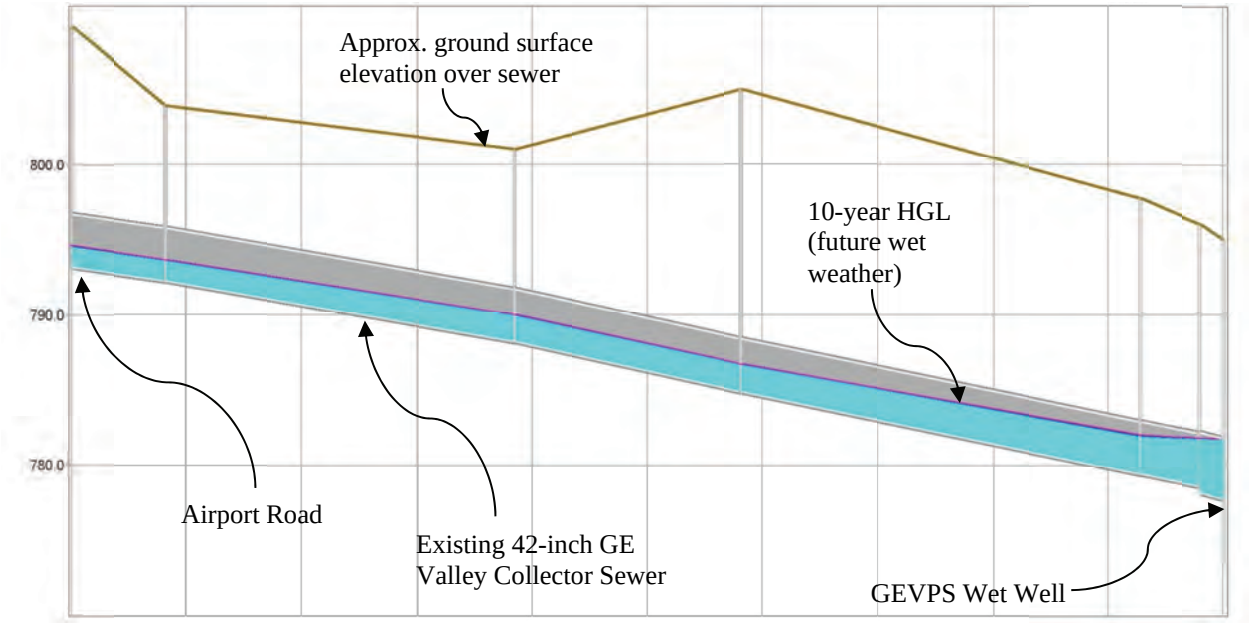


Figure 7: Hydraulic Profile (GE Valley 42-inch Collector Sewer)
10-year Recurrence Interval Peak Flow

The southern branch of the collector sewer (a/k/a "Hawthorne Collector"), which conveys wastewater from Hawthorne Subdivision and developed areas southeast of the Airport/GE intersection, has a significant hydraulic bottleneck west of Airport Road (Figure 8a). A 1,900-foot reach of this sewer, starting immediately west of Airport Road, is 21-inch diameter. Upstream of this hydraulic restriction, the sewer size increases to 30-inch diameter. Immediately downstream of this hydraulic restriction, the sewer size increases to 24-inch diameter (see Figure 8b).

The 21-inch sewer is undersized and cannot convey the future wet weather flows without surcharging. Although we are relying on a base assumption of equally-distributed wet weather flows across the entire GE Valley sewer district, the relatively large difference between modeled wet weather flow and existing sewer capacity (10.3 cfs and 6 cfs, respectively) suggests that this sewer would still be undersized, even if the distribution of wet weather flows were weighted slightly to reduce the wet weather flow component tributary to the Hawthorne Collector.

Under normal circumstances, this level of surcharging would likely cause basement flooding. However, as this reach does not have any apparent direct connections to residential structures with basements, it is possible that a hydraulic surcharge could occur on this sewer segment without negatively impacting property owners in the immediate vicinity.

The impact of the hydraulic surcharge continues east on GE Road to Broad Creek Road, but does not appear to negatively impact local sewers, as the only local sewer connection is at the west end of Shoal Creek Court. The invert elevation of the connecting sewer from Shoal Creek Court enters the 30-inch GE Road sewer at a higher elevation.

The drainage questionnaire was reviewed to determine if any nearby properties reported basement backups. No basement backups were reported in this area, which confirms our assumption that the surcharge does not directly impact individual homes.



Figure 8a: Hawthorne Collector Sewer Hydraulic Bottleneck
10-year Recurrence Interval Peak Flow

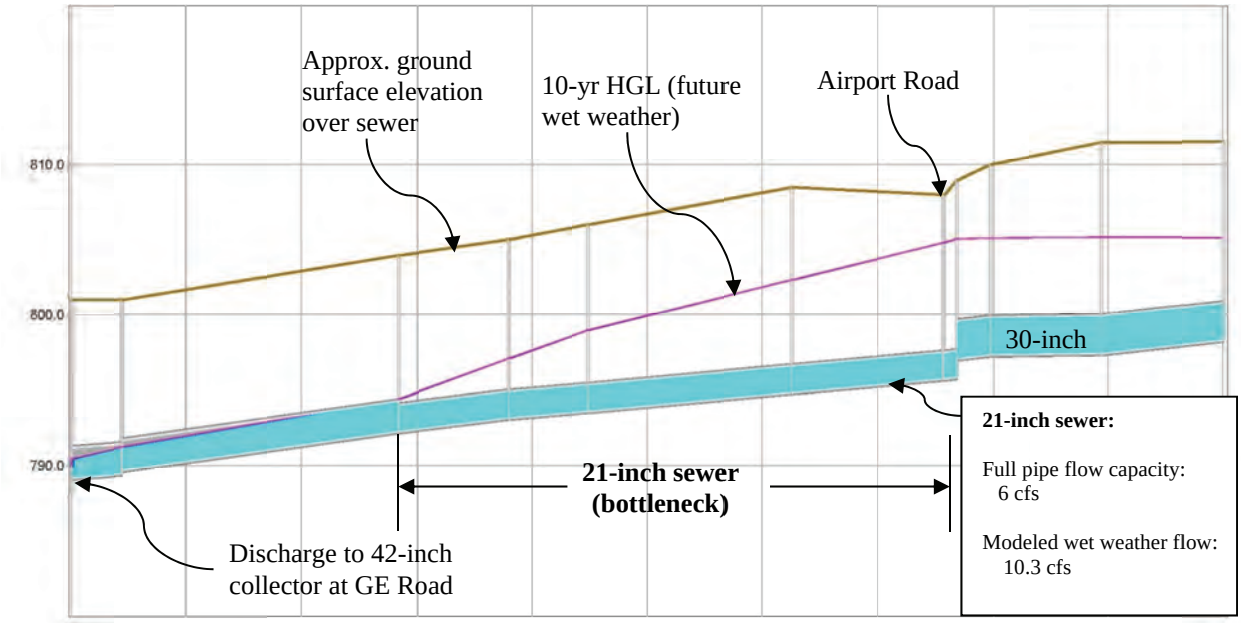


Figure 8b: Hawthorne Collector Sewer (Plan and Profile)
10-year Recurrence Interval Peak Flow

Recommended System Improvements

The system improvements recommended in this document are limited to those projects that will directly address the capacity of the modeled collector/interceptor system. Wet weather control alternatives are addressed in separate documents:

- I/I Source Removal: *Sanitary Sewer Evaluation Study (SSES)*
- Wet Weather Storage/Treatment: *Wet Weather Management Alternatives*

Specific recommendations and estimated costs for I/I source removal and wet weather storage/treatment are included in the memoranda associated with the above (SSES Memo and Wet Weather Alternatives Memo).

The following improvements are recommended to provide adequate system capacity for the East Side interceptor and GE Valley collector sewers:

1. The 21-inch component of the GE Valley collector sewer ("Hawthorne Collector") should be addressed by one of the following alternatives (see Figure 9):
    a. Replace the existing 21-inch reach with a 30-inch sewer to eliminate the hydraulic surcharge on the collector sewer. Of the two alternatives, this would likely be the most expensive and most disruptive, given the need to open cut immediately adjacent to Sugar Creek, disturb existing industrial properties, and cross Sugar Creek two times (once in the immediate vicinity of the GE Road bridge).
    b. Connect the Hawthorne Collector sewer to the 42-inch interceptor with a 30-inch sewer connection under the Airport Road / GE Road intersection (approximately 300 lineal feet). There is enough vertical drop between the two systems to justify directional drilling, which could accommodate a 30-inch sewer at a slope of 0.8%

or greater. This alternative should be *significantly less expensive* than replacing the 1,900-foot reach of 21-inch sewer, provided that the directional drilling could take place without disrupting existing utilities. The new pipe should be at least 15 feet below existing grade, which should minimize the potential for utility conflicts.

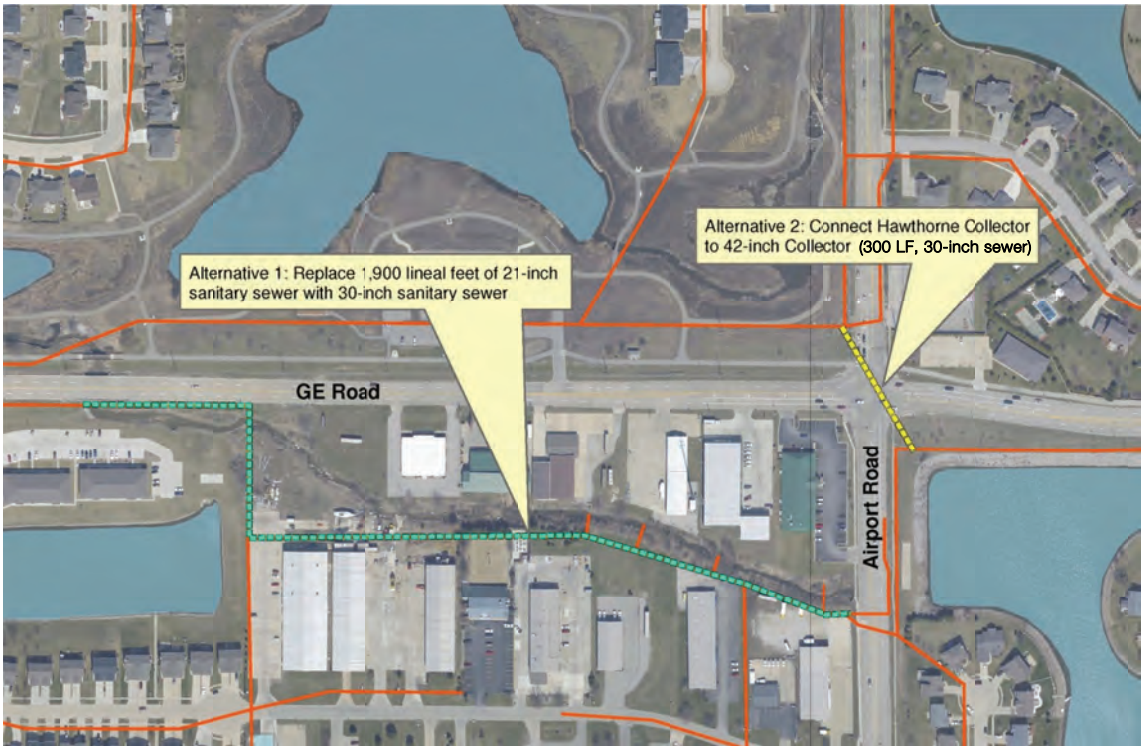


Figure 9: Improvement Alternatives
Hawthorne Collector Sewer Hydraulic Bottleneck

2. Upgrade the GEVPS to a firm capacity of 31 cfs and isolate the overflow (diversion) sewer
    a. Install a 7,000 gpm pump (similar size and type as existing pumps) in the existing GEVPS pump building. The existing structure has a third, unused pump pad for this purpose.
    b. Install a VFD and associated controls and piping to accommodate the new pump.
    c. Adding a third pump will double the firm capacity from 16 cfs to approximately 31 cfs.
    d. The existing 36-inch forcemain will be adequate to convey the additional flow.
    e. The GEVPS can be operated as it is today (occasional diversions to the WWWTP) until downstream storage/treatment measures are fully-implemented.
    f. Upon the implementation of downstream storage/treatment measures, the GEVPS operational protocol can be changed to eliminate flow diversions during wet weather. At that time, a sluice gate can be added to isolate the overflow pipe so that it is only used during pump station maintenance.

Conclusions

Based on the results of the hydraulic modeling effort, we offer the following conclusions:

1. The East Side Interceptor, in its current configuration and physical condition, has adequate hydraulic capacity to convey the future (Year 2035) wet weather peak flow without diversions to the west system. All flows should be contained within the interceptor with minimal pipe surcharging that should not adversely impact the City's collection system.
    a. Hydraulic surcharging along the identified reach of the interceptor sewer may be reduced or eliminated through inflow and infiltration source reduction measures as recommended in the Sanitary Sewer Evaluation Study (SSES) Technical Memorandum.
2. The GEVPS does not have adequate capacity (firm capacity) to convey existing or future wet weather flows to the East Side Interceptor. Recommended upgrades to the GEVPS will accommodate increased future wet weather flows as areas north of GE Valley (Town of Normal) continue to grow.
3. The 36-inch forcemain downstream of the GEVPS has enough hydraulic capacity to accommodate future wet weather flows. However, typical flow rates in the forcemain (based on meter data) are too low to provide adequate cleanout velocity. Directing all wet weather flows through this forcemain (as recommended) should reduce the potential of maintenance problems resulting in low flow velocities.
4. Upon the full implementation of future wet weather storage/treatment options, the LKPS can be upgraded to serve as a wet weather storage tank pump station. See the *Wet Weather Alternatives Memorandum* for additional discussion on this recommendation.

Planning-Level Cost Estimates

The following planning-level cost estimates address the recommended system improvements in this document. Although the GEVPS upgrade would be a BNWRD project, the anticipated costs related to that upgrade are included in this document as it is an integral component of the future operations of the East Side Interceptor.

Cost estimates for inflow/infiltration source reduction and downstream storage/treatment options are not included in this document. I/I source reduction options are detailed in the *SSES Memorandum*, as well as I/I pilot study recommendations outlined in the *Wet Weather Alternatives Memorandum.* Wet weather storage and treatment options are discussed in the *Wet Weather Alternatives Memorandum.*

Two alternative cost scenarios are presented:

- Alternate 1: GEVPS Upgrade + Hawthorne Collector sewer upsizing
- Alternate 2: GEVPS Upgrade + Hawthorne Collector redirection to 42-inch sewer

Figure 9 illustrates the two separate Hawthorne Collector improvement options.

Table 1
East Side Interceptor - Capacity Improvements
Planning-Level Cost Opinions

Owner:	**City of Bloomigton, Illinois**	**Date:**	**12/9/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**GE Valley Collector - Alternate 1**	**Prepared By:**	**GPK**
	GEVPS Upgrade + Replace Existing 21-inch Hawthorne Collector	**Reviewer:**	

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	Furnish and install 7,000 gpm pump and motor	1	LS	$400,000.00	$400,000
2	Furnish and install pump controls and piping	1	LS	$60,000.00	$60,000
3	Furnish and install sluice gate on GEVPS diversion	1	LS	$40,000.00	$40,000
4	30-inch Sanitary Sewer Main, 12-14 foot depth	1,900	LF	$140.00	$266,000
5	Sugar Creek Stream Crossings (Bore and Jack)	2	EA	$30,000.00	$60,000
6	5-foot Diameter Sanitary Manholes, 12-14 foot depth	8	EA	$6,000.00	$48,000
7	Reconnect service laterals	4	EA	$5,000.00	$20,000
8	Bypass Pumping	1	LS	$40,000.00	$40,000
9	Restoration	1	LS	$200,000.00	$200,000
				SUBTOTAL	**$1,134,000**
	Contingencies	30%			$340,000
				SUBTOTAL (w/CONTINGENCIES)	**$1,474,000**
	PROJECT COSTS				
	Design/Admin Costs	25%			$368,500
	TOTAL PLANNING-LEVEL COST OPINION				**$1,850,000**

Table 2
East Side Interceptor - Capacity Improvements
Planning-Level Cost Opinions

Owner:	**City of Bloomigton, Illinois**	**Date:**	**12/9/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**GE Valley Collector - Alternate 2**	**Prepared By:**	**GPK**
	GEVPS Upgrade + Connect Hawthorne Collector to 42-inch Collector	**Reviewer:**	

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	Furnish and install 7,000 gpm pump and motor	1	LS	$400,000.00	$400,000
2	Furnish and install pump controls and piping	1	LS	$60,000.00	$60,000
3	Furnish and install sluice gate on GEVPS diversion	1	LS	$40,000.00	$40,000
4	30-inch HDPE Sanitary Sewer, Directional Drill	250	LF	$1,300.00	$325,000
5	6-foot Diameter Sanitary Manholes, 15-20 foot depth	1	EA	$10,000.00	$10,000
6	30-inch Sanitary Sewer, Open Cut	40	LF	$200.00	$8,000
7	Connect to existing manhole	1	LS	$2,500.00	$2,500
8	Bypass Pumping	1	LS	$15,000.00	$15,000
9	Restoration	1	LS	$30,000.00	$30,000
				SUBTOTAL	**$891,000**
	Contingencies	30%			$267,000
				SUBTOTAL (w/CONTINGENCIES)	**$1,158,000**
	PROJECT COSTS				
	Design/Admin Costs	25%			$289,500
	TOTAL PLANNING-LEVEL COST OPINION				**$1,450,000**

Sanitary Sewer Technical Memoranda

SAN3 - SANITARY SEWER EVALUATION SURVEY (SSES)

Sanitary Sewer Evaluation Survey (SSES)

Executive Summary

This field-based effort targeted the sewer districts identified in the *Hydrologic Analysis Memorandum* where the City has the greatest potential to achieve inflow/infiltration (I/I) source reduction through the elimination of unintended inflow sources and rehabilitating sewer structures that may be susceptible to elevated infiltration levels.

The SSES investigation included a field evaluation of 151 manholes and approximately 40,000 lineal feet of sewer mains within the East Side Interceptor service area.

Key Findings

- Numerous defects were observed in the inspected sanitary manholes. Although most of these defects do not require immediate attention, many introduce inflow/infiltration into the sanitary sewer system.
- A total of 731 gpm (about 1.6 cfs) of inflow/infiltration is estimated to enter the sanitary sewer system through the inspected manholes. About 75% of this is due to direct inflow and about 25% due to infiltration.
- Four locations were identified where surface runoff can directly enter the sanitary sewer system.

Recommendations

- Rehabilitate sewer manholes that have been identified as significant I/I sources. Most of these manholes have significant defects (cracks, openings) that can be cost-effectively addressed.
- Eliminate known inflow sources as identified in this document. These include direct connection of surface runoff to the sanitary sewer system.
- Contact property owners where private sources of I/I were identified through smoke testing, and request the necessary repairs be made. These sources can usually be repaired at minimal cost.
- Complete the SSES within the Stern, Arcadia and Broadmoor sewer districts.
- Re-evaluate the collection system after early rehabilitation using post-rehabilitation flow meter and rainfall data.

Planning-Level Cost Summary	
Complete the SSES for remaining priority districts	$ 240,000
Targeted I/I source removal projects	$ 510,000
TOTAL	$ 750,000

ARCHITECTS. ENGINEERS. PLANNERS.

OHM Advancing Communities

technical memorandum

Date: December 11, 2013

To: Ryan Otto, City of Bloomington

From: Derek Klenke, Orchard, Hiltz & McCliment, Inc.

Re: East Side Interceptor – Sanitary Sewer Evaluation Survey (SSES)

Project Summary

The City of Bloomington recognizes the importance of better managing their wastewater collection system in order to meet regulatory, customer and regional sewer district expectations, ensuring that adequate capacity is available for existing customers and new development.

A primary focus for the City is the East Side Interceptor system, which is a separate sanitary sewer collection system, portions of which have been previously reported to have elevated base flows and inflow and infiltration (I/I) during wet weather events. Our *Hydrologic Analysis* document quantified the level of I/I throughout the system and identified several sewer districts where elevated I/I levels required additional field reconnaissance to verify potential I/I sources.

This SSES effort targeted the sewer districts identified in the *Hydrologic Analysis* where the City has the greatest potential to achieve I/I source reduction through the elimination of unintended inflow sources and rehabilitating sewer structures that may be susceptible to elevated infiltration levels. Figure 1 illustrates the area where field work was performed.

The SSES investigation included a field evaluation of 151 manholes and approximately 40,000 lineal feet of sewer mains using the following approach:

1. Perform field investigation of collection system components
2. Identify structural and I/I defects within the collection system
    a. Evaluate I/I contribution for each collection system component
    b. Evaluate the cost to perform I/I rehabilitation
3. Perform cost effectiveness analysis
4. Identify targeted system rehabilitation efforts to reduce I/I peak flows and volumes

The recommendations in this document are intended to reduce I/I peak flows and volumes in areas of known elevated wet weather flows from recent flow metering efforts. These recommendations are only part of a larger capital improvement plan and are not intended to be a single solution for I/I source removal. Additional conveyance and/or wet weather storage solutions will likely be necessary and are covered in the *Sanitary Sewer: Alternative Evaluation* document. Additional sewer pipe rehabilitation recommendations are covered as part of the *Infrastructure Assessment* analysis.

Key Findings

Numerous opportunities exist to reduce I/I in the East Side Interceptor service area. Future evaluation and rehabilitation efforts are estimated to cost approximately $750,000. These efforts will reduce, but not eliminate, the need for wet weather storage and/or treatment.



Figure 1 – Smoke Testing and Manhole Inspection Areas

SSES – Technical Approach

Smoke Testing Process

Smoke testing is an effective tool for locating inflow (surface runoff from leaking covers or cross connections to storm sewers, downspouts, or other piped sources) and infiltration (ground water from leaking joints or cracks within the pipe) that is entering the sewer. This type of testing is effective in identifying specific sources of surface runoff that can be cost-effectively eliminated from the sanitary sewer system. It is also used to locate other system defects, such as missing sanitary sewer clean-outs and traps. Smoke testing can also aid in evaluating structure repair needs by providing indications of defects not readily observed by visual inspection alone. It is important to note that smoke testing is used for detecting significant inflow sources and is not a reliable tool for *quantifying* infiltration flow rates or volumes.

The smoke that was used during testing was a non-toxic, non-staining, odorless material that creates no fire hazard. Prior to performing the smoke testing of the system, OHM worked with City staff to provide notification to area residents and businesses so as to belay any concerns if smoke was to be observed entering buildings. This is a real possibility if floor drains are constructed with improper traps or have not been used for long periods of time, which allows water to evaporate and prevents the traps from operating as designed. The project was coordinated with the City of Bloomington Police and Fire Departments.

The smoke tests were conducted in July 2012 under dry soil conditions using a gasoline-powered air blower to introduce a smoke source (smoke bomb) at an open manhole structure. The blower forced air down into the system, pushing the smoke through the sanitary sewers and into adjacent sewer structures. A partially inflated rubber inner tube was used as a seal between the blower and manhole. Sand bags were used as necessary to contain the smoke within the pipe run being tested. Once the smoke was introduced into the system, observations of the adjacent structures and surrounding areas were recorded. Copies of the field inventory forms are included in Appendix H. Photographs were also taken during the smoke testing and are provided in Appendix B.

Once the smoke testing was completed, the field observations and photographs were added to a summary spreadsheet. This spreadsheet identifies which manholes and sewer runs were tested, what findings were determined, and what follow-up activities are needed. The information also identifies where smoke was observed leaking from cracks along the ground, at structures, or other potential inflow sources. The spreadsheet summary is included in Appendix A.

Smoke Testing Results

Estimates of peak Inflow and Infiltration (I/I) rates were prepared based on approximate tributary area and each type of observed defect. These estimates are only approximate and were developed to provide an order-of-magnitude comparison to peak flows from other sources. It is estimated that 0.96 cfs (430 gpm) of peak flow could be removed from those defects observed in the East Side Interceptor system by addressing the deficiencies that are identified in Appendix A. A reduction of 0.96 cfs (430 gpm) from the peak flow could reduce marginal wet weather storage construction costs by $$700,000, based on a typical range of above-ground wet weather storage tank costs (similar to the

storage scenario recommended in the *Wet Weather Alternatives Memorandum*). Table 1 summarizes the most common problems observed.

Table 1
Summary of Common Smoke Testing Defects

Defect	Quantity	Peak estimated I/I (gpm)	Peak estimated I/I (cfs)
Missing or broken clean-out cap	25	130	0.29
Smoke leaking around manholes	78	161	0.36
Manholes located in low areas that are prone to flooding	8	139	0.31
Total	**123**	**430**	**0.96**

Only a portion of the East Side Interceptor sewer system was smoke tested as part of this project. Expanding the smoke testing program into other areas will likely increase the potential for inflow/infiltration source elimination.

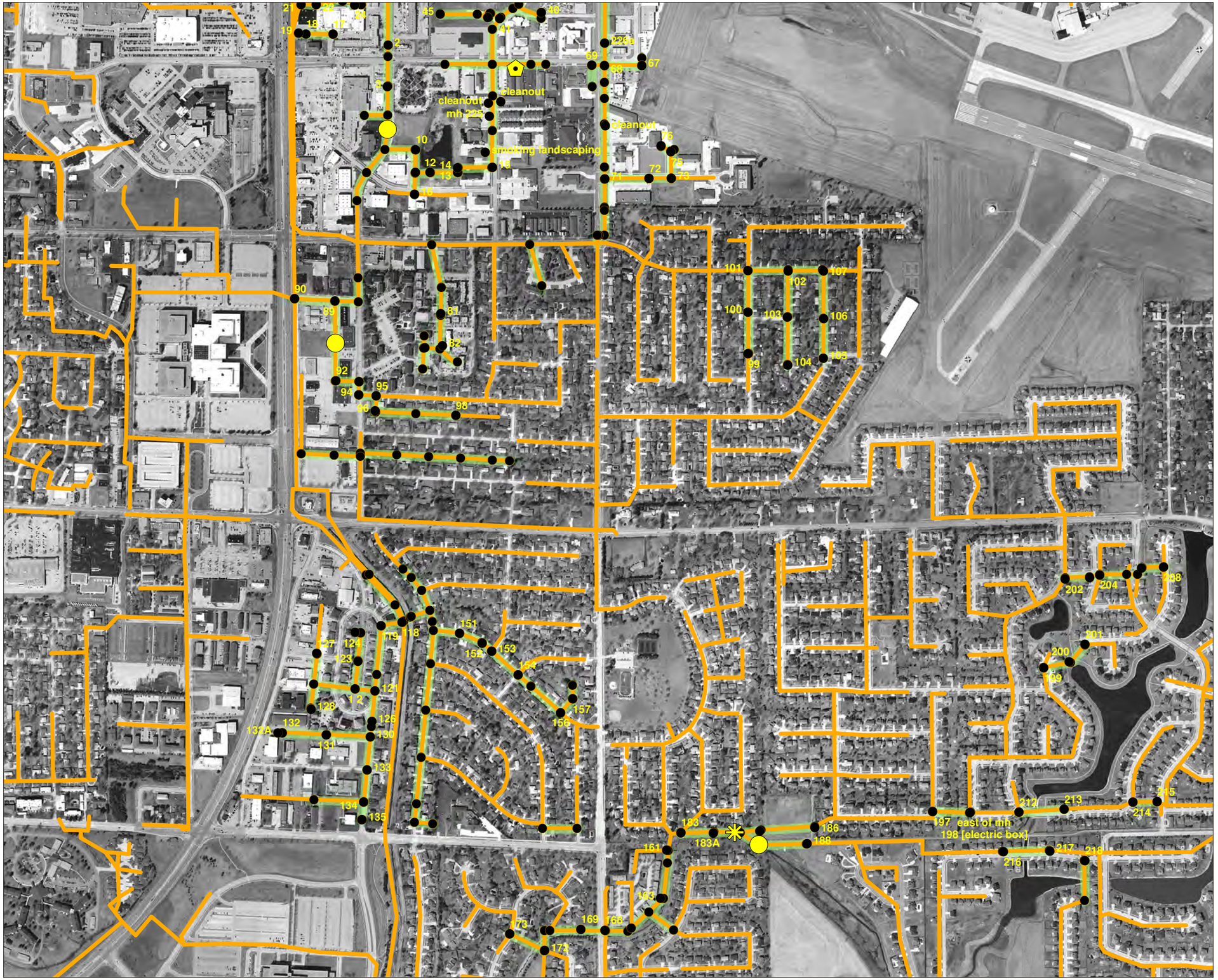
Additionally, there were four significant sources of inflow that were discovered during the four days of smoke testing. Each of these sources could be a considerable contributor to excess flow to the sanitary sewer during intense rain events. Figure 2 illustrates the inflow sources and inspected manhole locations.

The first significant source is a cleanout servicing a commercial building along Eastland Drive. The cleanout was obscured by a large spruce tree. When the smoke test was underway, smoke billowed out from under the spruce tree. The crew discovered a cleanout without a cap located in a swale which takes the roof runoff for the two adjacent buildings as well as the ground runoff from the space between the buildings, with a drainage area approximated at 16,000 square feet. A one hour rain of 1.5 inches could generate up to 0.37 cfs (165 gpm) at the open cleanout, based on an approximation of runoff potential tributary to the cleanout. The costs for replacing the cleanout cover and sealing the cleanout are minimal and reducing the peak flow by 0.37 cfs (165 gpm) or more could reduce marginal wet weather storage costs by over $275,000.

The second source is an indirect cross-connection between the storm and sanitary sewer along North Prospect Road just south of Eastland Drive. The sanitary manhole where the inflow is getting into the sanitary system is in the approach for the side entrance of First State Bank off of North Prospect Road. Immediately adjacent to this manhole is a catch basin which is draining North Prospect Road. The chimneys of both the sanitary manhole and the catch basin are in poor condition and will allow stormwater to spill over into the sanitary sewer in the event that the storm sewer gets overwhelmed with runoff. The costs for correcting the defects to the sanitary manhole are included in the manhole inspection estimate. Although it is not practical to estimate the amount of I/I that could be removed by rehabilitating these structures, the results of the smoke testing reveal that the cross-connection may introduce a significant amount of unwanted flow.

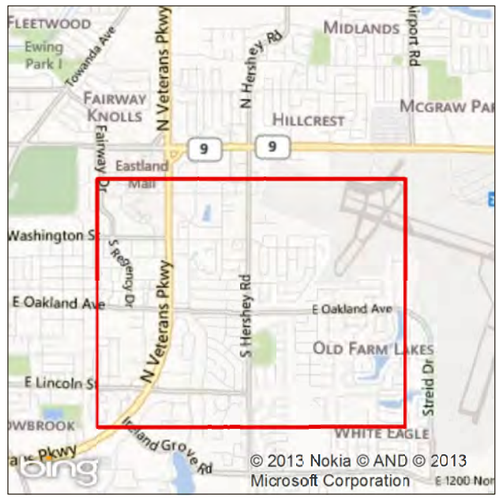
Figure 2
Significant Inflow Locations

City of Bloomington



Suspected Sources of Inflow

- Cleanout
- Manhole
- Open Joint
- Inspected Manholes
- sewers
- Smoke Tested Sewer



0 700 1,400 2,100 Feet

Source: Data provided by the City of Bloomington. Orchard, Hiltz and McCliment does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: NAD 1983 HARN StatePlane Illinois East FIPS 1201 Feet

Map Published: December 16, 2013

OHM 888.522.6711 | ohm-advisors.com

The third source is adjacent to a large parking area that drains towards a low area where a sanitary manhole is located. The subject sanitary manhole is located between South Prospect Road and South Veterans Parkway, approximately 380 feet south of Stern Drive. The manhole sits in the low area adjacent to the parking lot where the sheet flow is directed. Additionally, a portion of the roof runoff from the adjacent building discharges onto the parking lot. It is estimated that 19,000 square feet of hard surface is contributing runoff to the low area. The top portion of the subject manhole is damaged and smoked heavily when the OHM/Foth crew smoke tested this area. It is suspected that this manhole is providing drainage for the parking lot and low area. This is supported by the fact that the smoke testing crew was unable to complete smoke testing on this run of pipe initially due to a suspected obstruction and the amount of sediment seen in the channel. A one hour rain of 1.5 inches could generate 0.56 cfs (250 gpm) to the subject manhole. The cost to repair the manhole cover is estimated at $1,740 and reducing the peak flow by 0.56 cfs (250 gpm) could reduce marginal wet weather storage costs by over $400,000.

The fourth source is likely due to an open joint between two pipe segments in the 21-inch sanitary sewer that runs between Constitution Trail and a tributary to the Little Kickapoo in the vicinity of Kensington Circle. When smoke testing along this run of sewer, smoke was seen emanating from the ground directly above the 21-inch sewer. The ground was very dry when the smoke testing was performed which allowed the smoke to travel to the surface easily. The source of the smoke was a few feet vertically above the existing stream channel. In a heavy rain event, the water running through the stream channel would likely rise to the point where the sewer would be cross-connected with the open channel. If the defect is limited to a single joint, the issue could be corrected with a grout sleeve or sectional CIPP liner for about $5,000. If several joints are affected or the pipe has additional issues, a full CIPP liner could be installed for about $20,000. Estimating the amount of inflow from this pipe defect is difficult. It is safe to assume that this defect could be a major source of infiltration when the water level in the stream channel rises.

It is also suspected that a manhole approximately 235 feet upstream of the source describe above (fourth source) may be another significant source of inflow (see Figure 2). The manhole could not be field-located by the OHM/Foth crew, but is suspected to be in the flow line of the stream channel. While no smoke was seen coming from the assumed vicinity of this manhole, it is believed to be submerged in the stream channel. This manhole should be inspected to determine if it is leaking and verify its location. Televising this segment of sanitary sewer should be sufficient to locate the subject manhole. Once this manhole is located, appropriate measures should be taken to seal and isolate the sewer from the storm flows in the stream channel.

Most of the results of the smoke testing are similar to the observations made during manhole inspections. As such, the key recommendations and cost estimates for source removal (which consist primarily of manhole rehabilitation and cleanout repairs) are listed together at the end of this document.

During the smoke testing, the following problems were observed:

- Smoke leaking from a cleanout due to a missing or damaged cap
- Smoke leaking through manhole frames

- Smoke leaking through damaged or offset manholes
- Smoke leaking through bolt holes in manhole covers
- Smoke leaking from pavement cracks

The majority of smoke sources discovered were attributed to structural deficiencies of the sanitary manholes, such as a bad seal between the frame and the structure or a damaged chimney. The *Manhole Inspections* section of this report includes a summary of recommended rehabilitation efforts to address the inflow sources observed during the smoke testing effort.

Below is a sample calculation using the rational formula to estimate the peak flow resulting from a broken sanitary lead cleanout, leaking service connection, window well drain connection, or storm ditch drain connection in a typical lawn of average slope with an estimated tributary area 30 feet by 20 feet:

C = 0.20
I = 1.50 in/hr (typical intensity for a significant wet weather event)
A = 30 feet x 20 feet = 600 ft^2 = 0.0138 acres

$$Q_p = CIA$$

$$Q_p(cfs) = 0.20 \times \frac{1.50in}{hr} \times 600\,ft^2 \times \frac{acre}{43{,}560\,ft^2} = 0.00413cfs$$

Converting to gpm:

$$Q_p(gpm) = \frac{0.00413\,ft^3}{\sec} \times \frac{60\sec}{\min} \times \frac{7.48gal}{ft^3} = 1.85gpm$$

The variable *C* is a dimensionless runoff coefficient based on the land use/ground cover in the respective area, *I* represents the average rainfall intensity (inches/hour) for a typical wet weather event, and *A* represents the size of the respective drainage area in acres.

Table 2
Runoff Coefficients based on land use/type

Land Use/Type of Surface	Range of 'C' Values
Multi-Residential units, attached	0.60 to 0.75
Neighborhood Businesses	0.50 to 0.70
Cultivated Lands with Loamy Soils	0.40 to 0.45
Suburban Residential	0.25 to 0.40
Playgrounds	0.20 to 0.35
General unimproved lands	0.10 to 0.40
Parks and cemeteries	0.10 to 0.25
Woodlands with sandy soils	0.10 to 0.15

Manhole Inspections

Locating Structures

A data point for each sanitary manhole was collected using a Global Positioning System (GPS). The identification number of each manhole was recorded as the manhole location was collected with the GPS. These data points were used to create a GIS layer for the inspected components of the City of Bloomington's wastewater collection system. There were 164 sanitary structures located with the GPS, but only 151 were visually inspected, due to the inability of our field crews to open some manhole lids.

Data Collection

The condition information for each manhole was recorded using handheld digital data recorders. The following information was recorded for each manhole:

- Structure identification number
- Surface material around the manhole cover (i.e. pavement, vegetation, etc)
- Materials used to construct walls, corbel, and adjusting ring
- Flow characterization (type, clarity)
- Diameter, material, and direction of incoming/outgoing pipes
- Condition of structure walls, corbel, adjusting ring, frame, cover and channel/bench
- I/I ratings based on observed deficiencies
- Recommended repairs

For the I/I ratings, each structure was assigned an infiltration, inflow and structure rating of 1 to 7 (1 is excellent and 7 is very poor). Inflow (rated as I-1 through I-7) was classified as any water entering the manhole within the top 3 feet. Infiltration (rated as F-1 through F-7) was related to any dampness, mineral deposits, active leaks, and root intrusion from the bottom of the structure up to 3 feet below the rim. The structure rating (rated as S-1 through S-7) was based on the presence of any structural deficiencies below the top 3 feet of the manhole. Each individual manhole was then given an overall

rating with 7 indicating severe deficiencies and an overall rating of 1 indicating the manhole was in good condition.

At least three photographs were taken of each structure: one showing the cover, one showing the chimney, and one showing the wall and channel. Additional pictures were taken as necessary. The photographs from the manhole inspection are provided in Appendix D.

Inspection Results

A summary of the results of the manhole inspections, organized by priority for repair, is included in Appendix E. This summary includes the recommended rehabilitation method for each manhole. Individual manhole reports are in Appendix F. Based on the standard technique OHM utilizes to estimate flows per type of manhole deficiency, flow rates were assigned to each infiltration, inflow, and structure rating (see Appendix G) as a starting point to estimate total I/I from the study area.

It was estimated that approximately 731 gpm of I/I is entering the sanitary sewer system through identified manhole deficiencies during peak hours. Approximately 551 gpm is contributed through inflow during peak hours and 180 gpm through infiltration. To compute the annual volume of I/I entering the system, half the peak hour inflow rate is applied for 150 hours a year, which is a typical duration of rainfall in the Midwest during an average year. The infiltration rate applies 24 hours a day, 365 days a year.

Based on the manhole inspections and I/I ratings, each manhole was ranked into high (category 7, 6 and 5), medium (category 4, 3, and 2), and low (category 1) priority for repair. The category and rankings are used to signify the severity of the deficiencies within each manhole and the urgency for rehabilitation, but are not used to indicate if the manhole can be rehabilitated cost effectively. Table 3 provides the number of manholes in each priority ranking, peak hour I/I, annual volume of I/I, the number of manholes that can be cost-effectively repaired, and the potential I/I removal volumes.

Table 3
Manhole ranking, I/I, and potential I/I removal summary

Priority Ranking	Number of MHs	Peak Hour Contributing I/I (gpm)	Average Year I/I (x1,000 gal)	Number of *Cost Effective* Manholes to be repaired	Potential Yearly I/I removal (x1,000 gal)
High	110	667	116,992	54	18,096
Medium	38	64	8,516	4	159
Low	3	0	0	0	0
Total	**151**	**731**	**125,508**	**58**	**18,255**

Some of the I/I resulting from deficiencies in the manholes could be removed through rehabilitation/repairs. Multiple rehabilitation techniques are available to decrease I/I. Many of those techniques can be used for the City of Bloomington's collection system. Table 4 shows the various recommended rehabilitation methods and the number of

manholes that fall within each category that can be repaired cost-effectively, as well as the associated cost.

A detailed Cost-Effectiveness Analysis was performed comparing the excess I/I to the potential marginal cost for wet weather storage. The graph in Appendix C demonstrates the relationship between the volume of storage required and the percentage of I/I removed. This graph shows that it is possible to control wastewater collection system capital costs by reducing the peak flows in the sanitary sewer system resulting from I/I at the most obvious sources as identified as part of the smoke testing and manhole inspection efforts.

It should be noted that determining the estimated I/I rate per deficiency is not a simple process, and the estimates are not definitive. The I/I results are good for prioritization and determining cost effectiveness, but do not represent measured (actual) rates of I/I within the inspected portion of the collection system.

Overall, the condition of the manholes in this study area were determined to be fair. The majority of manholes inspected had deficiencies in the top two feet of the manhole. Of the 151 manholes that were inspected, 107 have rehabilitation recommended for the frame and/or chimneys.

Rehabilitation Methods

Standard rehabilitation techniques were referenced to provide the City with a cost estimate for recommended manhole rehabilitation. Four types of rehabilitation were considered for each manhole:

Frame and Cover Rehabilitation

Frame and cover rehabilitation includes repair and replacement of the castings that allow access to the manhole. The items specified include resetting the frame where a good seal is not present and replacement of the frame and cover where a non-standard cover is currently in service.

Adjustment (Chimney) Rehabilitation

Adjustment rehabilitation includes lining the inside of the chimney, complete replacement of the chimney and the application of a wrap on the outside of the chimney to waterproof it from the outside.

Leak Sealing

Leak sealing is the use of injected epoxy grout to seal leaks in manhole walls. This method is being specified for leaks in joints in pre-cast manholes, at lift holes in pre-cast manhole sections, at pipe penetrations, at steps, and at miscellaneous leaks in pre-cast walls and benches.

Manhole Lining

Manhole lining includes the use of a spray-in cementitious liner to seal leaks in brick and block manhole walls and corbels. This is typically the most cost-effective rehabilitation method and is assumed as the rehabilitation method in the enclosed cost estimates. Other methods include:

- Fiberglass inserts manufactured to fit the manhole. Inserts are expensive and take longer to install (relative to spray-in liners).
- Polyurea lining system (Spectra-Shield or similar): These typically cost about two times that of cementitious liners but bind better to the concrete and come with long (i.e. 10-year guarantees).
- Epoxy spray-in liners: even more expensive than polyurea, but long-lasting and highly resistant to hydrogen sulfide and other chemicals.

The assumed costs for each type of manhole rehabilitation are presented in Table 4. Total quantities represent only those manholes inspected as part of the SSES effort. Some manholes have more than one recommended rehabilitation method.

Table 4
Manhole Rehabilitation Cost Summary

Rehabilitation Method		Estimated Unit Cost	Number of Manholes for Application	Total Cost Per Rehab Method
1	Remove & Replace Lid	$400.00	0	$ -
2	Remove & Reset Frame (Vegetation/Gravel)	$350.00	14	$ 4,900
3	Remove & Reset Frame (Pavement)	$750.00	10	$ 7,500
4	Remove & Replace Frame (Vegetation/Gravel)	$440.00	0	$ -
5	Remove & Replace Frame (Pavement)	$1,000.00	0	$ -
6	Replace Adjusting Rings (< 2 ft, Vegetation/Gravel)	$700.00	8	$ 5,600
7	Replace Adjusting Rings (> 2 ft, Vegetation/Gravel)	$1,200.00	1	$ 1,200
8	Replace Adjusting Rings (< 2 ft, Pavement)	$1,700.00	15	$ 25,500
9	Replace Adjusting Rings (> 2 ft, Pavement)	$2,200.00	0	$ -
10	Apply Calcium Aluminate (CA) Cement Lining[1]	$210.00	1	$ 998
11	Seal Leak(s) With Mortar	$400.00	44	$ 17,600
12	Apply Heat Shrinkable Manhole Wrap[2]	$510.00	0	$ -
13	Adjust Elevation (< 2 ft)	$530.00	1	$ 530
14	Replace Corbel (Pavement)	$550.00	1	$ 550
15	Replace Corbel (Veg/Gravel)	$500.00	0	$ -
16	Rebuild Manhole	$10,000.00	0	$ -
17	Mortar Adjusting Rings	$350.00	0	$ -
18	Seal Leak(s) With Injectable Polyurethane Grout	$350.00	0	$ -
TOTALS (Field work only)			**58**	**$ 64,400**
TOTALS (Field work + engineering + contract admin)				**$ 93,000**

[1] *$210 per vertical foot; application assumes entire manhole*
[2] *Assumes chimney heights of 2 feet*

Rehabilitation Costs

In calculating the cost-effectiveness of rehabilitating each manhole, the cost of rehabilitation was compared against the volume reduction realized and how it would reduce the size (and cost) of a wet weather storage tank (assuming such a facility could be constructed at about $2 per gallon of storage, which is slightly higher than the cost of storage estimated for the proposed project in the Wet Weather Alternatives Memorandum). Assuming that rehabilitation would remove approximately 50% of the I/I estimated at each manhole and a wet weather storage construction cost of $2 per gallon, spending approximately $93,000 on manhole rehabilitation would save nearly $210,000 through reduced costs on a wet weather storage facility.

Given the relatively low implementation cost of manhole rehabilitation, this effort will provide a targeted and cost-effective approach to reducing the wet weather burden on the Southeast Wastewater Treatment Plant (SEWWTP) prior to implementing other larger capital programs.

These costs reflect only a small component of the East Side Interceptor collection system and only a portion of the sewer districts identified as having higher-than-normal wet weather flows. At a minimum, the City should plan for additional manhole rehabilitation efforts that will result from future manhole inspections and smoke testing efforts. *Given the numbers summarized above, the City should plan to rehabilitate between 2 and 3 times the number of manholes recommended in this memorandum*. Those additional manholes would be identified in future SSES efforts. This will provide better coverage in the sewer district "hot spots" of Stern, Arcadia, and Broadmoor and will further reduce the source of I/I.

Recommendations

In general, the investigation within the pilot area revealed that a majority of the manholes had moderate deficiencies associated with the chimneys and castings. Smoke testing identified a few major inflow sources which can be rehabilitated for relatively low cost. The manhole and sewer rehabilitation recommended in this memorandum will have a measurable impact on the peak flow in the East Side Interceptor Sewer.

These recommendations will not eliminate the need for other capital improvements to address wet weather flows. Although the system rehabilitation recommendations in this document will reduce peak flows and volumes as measured at the sewer district level, they will not reduce peak flows and volumes enough to avoid other regional wet weather alternatives such as storage and/or high-rate treatment at the SEWWTP.

These recommendations should instead be considered a *first phase* of system improvements. Upon rehabilitating known pipeline/manhole problem areas, the City may wish to re-evaluate flow meter data in selected sewer districts and use that data to further refine larger-scale improvements needed along the East Side Interceptor or at the SEWWTP.

Based upon the findings of this Sanitary Sewer Evaluation Study, we recommend the following:

- Complete the SSES within the Stern, Arcadia and Broadmoor sewer districts. The remaining sewer and manholes in these districts should be inspected and smoke tested and a manhole rehabilitation program implemented to repair defects which are deemed to be cost-effective. Follow-up flow metering will allow the City to verify the effectiveness of the rehabilitation and determine if additional rehabilitation in other areas of the City should be pursued.

- Rehabilitate manholes as listed in Table 4 and detailed in Appendix A.

- Repair the 4 significant inflow sources as listed in this document.

- Contact the property owners where private sources of I/I were identified through smoke testing, and request the necessary repairs be made. These sources can usually be repaired at minimal cost.

The cost estimate to implement the source removal recommended in this document, as well as expanding the SSES through the rest of the known problem areas, is included in Table 5. See the *Wet Weather Alternatives Memorandum* for additional discussion on collection system rehabilitation that focuses on the sewer pipe components.

Table 5
Sanitary Sewer Evaluation Study
Recommended Projects

Owner:	**City of Bloomigton, Illinois**	**Date:**	**11/8/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**SSES - East Side Interceptor Sewer**	**Prepared By:**	**GPK**
		Reviewer:	

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	Complete SSES for remaining priority districts[1]	1	LS	$189,000.00	$189,000.00
2	Repair the 4 identified significant inflow sources[2]	1	LS	$40,000.00	$40,000.00
3	Implement manhole rehabilitation as recommended	1	LS	$93,000.00	$93,000.00
4	Future rehabilitaton projects (from future SSES efforts)	1	LS	$186,000.00	$186,000.00
5	Re-evaluate post-rehab meter data: update storage needs	1	LS	$60,000.00	$60,000.00
				SUBTOTAL	**$568,000.00**
	Contingencies	25%			$142,000.00
		SUBTOTAL (w/CONTINGENCIES)			**$710,000.00**
	PROJECT COSTS				
	Admin Costs for Rehab Program (Items 2-4 only)	10%			$31,900.00
TOTAL PLANNING-LEVEL COST OPINION					**$750,000.00**

[1] Current SSES covered only select portions of "hot spot" sewer districts. Additional field analysis recommended.

[1] Districts to be included in additional SSES: Stern, Broadmoor, Arcadia, Ireland Grove East/West, and Arrowhead/Holiday

[2] See Figure 2 for locations of inflow sources

Appendix A

Smoke Testing Summary

City of Bloomington Smoke Testing

Manhole Tested	Manhole Smoked	Problem (Y/N)	Comments	Recommendation	Estimated I/I (gpm)	Estimated Drainage Area (sft)	Estimated I/I (gpm)*
1	1		Smoke in Quality Inn (FD on site)				0.0000
2	2	Y	KFC grease trap leaking - roof drain flowing over	Ensure casting is sealed.		1,500	11.5909
2	1						0.0000
3	2	Y	Rim leaking	Rehab manhole		25	0.1932
4	5	Y	Smoke from rim	Rehab manhole		25	0.1932
4	2		Smoke in Eastland Suites (FD on site)				0.0000
5	2		Smoke in carwash utility room (no FD call)				0.0000
6	5	Y	adjacent storm smoking- passing through void	Repair storm and sanitary manholes		15,600	120.5455
6	5	Y	Smoke from rim	Rehab manhole		25	0.1932
7	5	Y	Smoke from rim	Rehab manhole		25	0.1932
7	8						0.0000
8	8	Y	smoke from cleanout - GPSd	Issue letter to owner instructing repair of cleanout		25	0.1932
8	5						0.0000
9	8	Y	smoke from rim	Rehab manhole		25	0.1932
10	12	Y	smoke from rim	Rehab manhole		25	0.1932
10	5						0.0000
11	12						0.0000
12	12	Y	smoking cleanout - GPSd	Issue letter to owner instructing repair of cleanout		25	0.1932
13	12	Y	smoke from rim	Rehab manhole		25	0.1932
13	15	Y	smoking cleanout	Issue letter to owner instructing repair of cleanout			0.0000
14	12	Y	faint smoke from rim	Rehab manhole		25	0.1932
14	15	Y	smoke coming from rocks in landscaping	Issue letter to owner instructing repair of cleanout			0.0000
15	224	Y	208 N williamsburg - landscaping smoking	Rehab manhole		500	3.8636
15	12						0.0000
15	15						0.0000
16	12						0.0000
17	17	Y	smoking cleanout by Schnuck's	Issue letter to owner instructing repair of cleanout			0.0000
18	17	Y	smoking rim	Rehab manhole		25	0.1932
19	17	Y	smoking rim	Rehab manhole		25	0.1932
20	20						0.0000
21	20	Y	smoking pickholes			25	0.1932
22	20						0.0000
23	26						0.0000
24	26	Y	manhole smoking	Rehab manhole		25	0.1932
25	26	Y	smoking crack in sidewalk	Rehab manhole		25	0.1932
26	26						0.0000
27	28	Y	smoking rim	Rehab manhole		25	0.1932
28	28	Y	smoking rim	Rehab manhole		25	0.1932
29	28	Y	smoking rim	Rehab manhole		25	0.1932
31	28	Y	smoking cleanout by Popeyes	Issue letter to owner instructing repair of cleanout			0.0000
31	32	Y	Smoking vent at base of IHOP foundation	Issue letter to owner instructing repair of cleanout			0.0000
32	32	Y	Smoke in Lowe's and Erntz Construction				0.0000
33	32	Y	smoking rim	Rehab manhole		25	0.1932
33	35						0.0000
34	32	Y	smoking cleanout (above grade)	Issue letter to owner instructing repair of cleanout			0.0000
34	35						0.0000
35	35						0.0000
36	35						0.0000
40	40						0.0000
41	42	Y	smoking rim	Rehab manhole		25	0.1932
42	42						0.0000
43	42	Y	smoke around rim	Rehab manhole		25	0.1932
44	42	Y	smoking rim	Rehab manhole		25	0.1932
45	42						0.0000
46	46						0.0000
46	220						0.0000
47	46a						0.0000
49	46a	Y	smoking rim	Rehab manhole		25	0.1932
50	46a	Y	smoking pick hole	Rehab manhole		25	0.1932
51	54	Y	smoking clean out	Issue letter to owner instructing repair of cleanout		25	0.1932
51	46a						0.0000
52	54	Y	smoking pavement cracks around MH	rehab manhole		50	0.3864
53	54	Y	smoking bushes	Issue letter to owner instructing repair of cleanout		50	0.3864
54	54	Y	smoking ground at 902 Hershey (from cleanout)	Issue letter to owner instructing repair of cleanout		25	0.1932
54	54	Y	smoke in bathroom at Summit Family Medical				0.0000
54	54	Y	smoking sink at Bloomington Family Dental				0.0000
55	54	Y	rim smoking	Rehab manhole		25	0.1932
56	54	Y	rim smoking	Rehab manhole		25	0.1932
56	68						0.0000
57	58	Y	smoking rim	Rehab manhole		25	0.1932
57	68						0.0000
58	58	Y	smoking cleanout	Issue letter to owner instructing repair of cleanout		25	0.1932
59	63	Y	smoking from rim- above grade				0.0000
60	63	Y	smoking MH	Rehab manhole		50	0.3864
60	58	Y	smoke from cracks and rim	Rehab manhole		50	0.3864
61	63	Y	smoking MH	Rehab manhole		50	0.3864
61	58	Y	smoking rim	Rehab manhole		25	0.1932
62	63	Y	smoking rim (downhill)	Rehab manhole		50	0.3864
63	63	Y	smoke from cracks & MH	Rehab manhole		50	0.3864
64	63						0.0000
65	63						0.0000
66	68						0.0000
67	68						0.0000
68	68						0.0000

City of Bloomington Smoke Testing

Manhole Tested	Manhole Smoked	Problem (Y/N)	Comments	Recommendation	Estimated I/I (gpm)	Estimated Drainage Area (sft)	Estimated I/I (gpm)*
68	68						0.0000
68	227						0.0000
69	68	Y	MH and ground smoking	Rehab manhole		50	0.3864
69	68						0.0000
70	68	Y	smoking cleanout by PNC	Issue letter to owner instructing repair of cleanout		25	0.1932
71	72	Y	MH smoking	Rehab manhole		150	1.1591
71	230	Y	manhole and adjacent sidewalk smoking			50	0.3864
71	227						0.0000
72	75	Y	smoking rim and cleanout	Rehab manhole		125	0.9659
72	72						0.0000
73	75	Y	smoking rim	Rehab manhole		25	0.1932
74	75						0.0000
75	75	Y	smoking cleanout in bushes	Issue letter to owner instructing repair of cleanout		25	0.1932
76	75	Y	smoke from around MH			25	0.1932
76	75	Y	smoking cleanout by 76	Issue letter to owner instructing repair of cleanout			0.0000
77	77						0.0000
78	77						0.0000
79	81						0.0000
80	81						0.0000
81	81	Y	Smoking cleanout w/out lid	Issue letter to owner instructing repair of cleanout			0.0000
82	82						0.0000
83	82						0.0000
84	82	Y	Smoking cleanout near MH	Issue letter to owner instructing repair of cleanout			0.0000
85	82						0.0000
86	82	Y	Smoking cleanout near MH	Issue letter to owner instructing repair of cleanout			0.0000
87	89						0.0000
88	89						0.0000
89	89						0.0000
89	92						0.0000
89	89						0.0000
90	89						0.0000
91	92	Y	a lot of smoke (& large capture area)	Rehab manhole		19,000	146.8182
91	89						0.0000
92	95						0.0000
92	93	Y	missing	Locate and raise to grade if buried			0.0000
92	92						0.0000
93	92	Y	smoking MH				0.0000
93	95						0.0000
93	89						0.0000
93	93						0.0000
94	95	Y	Smoking pickhole			50	0.3864
94	92	Y	smoking MH				0.0000
94	89						0.0000
94	93						0.0000
95	98						0.0000
95	95						0.0000
95	93						0.0000
96	98	Y	Ground smoking around MH	Rehab manhole. Install locking cover.		25	0.1932
96	95						0.0000
97	98	Y	Could not find MH	Locate and raise to grade if buried			0.0000
98	98						0.0000
99	100						0.0000
100	100						0.0000
101	100						0.0000
101	107						0.0000
102	104						0.0000
102	107						0.0000
103	104						0.0000
104	104						0.0000
105	105	Y	smoking CO @ 113	Issue letter to owner instructing repair of cleanout			0.0000
106	105						0.0000
106	107						0.0000
107	105						0.0000
107	107						0.0000
108	111	Y	smoking frame seal	Rehab manhole		25	0.1932
109	111						0.0000
110	111	Y	smoking frame seal	Rehab manhole		5	0.0386
111	112						0.0000
111	111						0.0000
112	112	Y	smoking frame seal	Rehab manhole		200	1.5455
113	115						0.0000
113	112						0.0000
114	115	Y	smoking MH			25	0.1932
114	112						0.0000
115	115						0.0000
116	118	Y	heavy smoke at wet well			0	0.0000
117	118	Y	buried w/ smoke	Raise to grade		0	0.0000
118	118						0.0000
121	130	Y	smoking pick hole			0	0.0000
121	118	Y	pick hole smoke			0	0.0000
121	126	Y	crack in lot	Rehab manhole		30	0.2318
122	126						0.0000
124	124						0.0000
125	124						0.0000

City of Bloomington Smoke Testing

Manhole Tested	Manhole Smoked	Problem (Y/N)	Comments	Recommendation	Estimated I/I (gpm)	Estimated Drainage Area (sft)	Estimated I/I (gpm)*
126	126						0.0000
127	126						0.0000
128	126	Y	pickhole and rim smoking			0	0.0000
129	130	Y	smoking pick hole			0	0.0000
130	135	Y	smoking frame seal and pick hole			25	0.1932
130	130						0.0000
131	130	Y	smoking pick hole			0	0.0000
132	130						0.0000
133	135						0.0000
135	135	Y	smoking frame seal and pavement cracks	Rehab manhole		50	0.3864
136	135						0.0000
139	140						0.0000
140	140						0.0000
141	140						0.0000
142	140						0.0000
143	140						0.0000
144	153	Y	smoking pickhole			25	0.1932
144	145						0.0000
145	145						0.0000
146	145						0.0000
147	149						0.0000
147	145						0.0000
148	149	Y	smoking pick hole			0	0.0000
149	149						0.0000
150	149	Y	smoking frame seal			0	0.0000
151	153	Y	smoking pickhole			25	0.1932
152	153	Y	crack	Rehab manhole		25	0.1932
153	153						0.0000
154	153						0.0000
155	156						0.0000
156	156						0.0000
157	156						0.0000
158	156						0.0000
159	159						0.0000
160	159	Y	Faint smoke from rim			0	0.0000
161	184	Y	smoking rim				0.0000
161	163						0.0000
161	161						0.0000
162	163						0.0000
163	163						0.0000
164	163						0.0000
168	168						0.0000
169	168						0.0000
170	168						0.0000
171	168						0.0000
172	168						0.0000
176	178						0.0000
177	178						0.0000
178	178	Y	Smoke from ground- frame offset	Rehab manhole		50	0.3864
181	178						0.0000
181	181						0.0000
182	181						0.0000
183	181						0.0000
183	186						0.0000
183	188						0.0000
183	184						0.0000
184	186						0.0000
184	184	Y	smoke out of ground in 3 locations				0.0000
185	186						0.0000
185	184						0.0000
186	186	Y	Smoke leaking out from gap under frame				0.0000
187	188						0.0000
187	184						0.0000
188	188						0.0000
192	194						0.0000
193	194						0.0000
194	194						0.0000
196	194						0.0000
197	198	Y	smoke in adjacent elec box	Rehab manhole			0.0000
198	198						0.0000
199	201						0.0000
200	201	Y	rim smoke	Rehab manhole			0.0000
201	201						0.0000
202	204	Y	light smoke at rim	Rehab manhole		25	0.1932
203	204						0.0000
204	208	Y	smoking MH	Rehab manhole		25	0.1932
204	204						0.0000
205	208						0.0000
206	208						0.0000
207	208	Y	smoking MH			25	0.1932
208	208						0.0000
209	211						0.0000
210	211	Y	smoke from ground where missing MH should be	Raise to grade and inspect		25	0.1932
211	211						0.0000

City of Bloomington Smoke Testing

Manhole Tested	Manhole Smoked	Problem (Y/N)	Comments	Recommendation	Estimated I/I (gpm)	Estimated Drainage Area (sft)	Estimated I/I (gpm)*
212	212	Y	smoking rim				0.0000
213	212						0.0000
214	214						0.0000
215	214	Y	smoking rim				0.0000
216	217						0.0000
217	217						0.0000
218	218						0.0000
219	218						0.0000
220	220						0.0000
220	46						0.0000
220	223						0.0000
220	220						0.0000
221	220	Y	smoke at manhole (bolt holes)	Rehab manhole		25	0.1932
221	221						0.0000
221	46						0.0000
221	223						0.0000
221	220						0.0000
222	220						0.0000
222	222						0.0000
222	46						0.0000
222	223						0.0000
222	220						0.0000
223	223	Y	Smoking CO under tree at 2103 Eastland	Issue letter to owner instructing repair of cleanout		16000	123.6364
223	222						0.0000
223	46						0.0000
223	224						0.0000
224	224	Y	smoke around outer frame	Rehab manhole		400	3.0909
224	46						0.0000
224	223						0.0000
225	224	Y	frame and surrounding area smoking	Rehab manhole		125	0.9659
226	68						0.0000
227	68						0.0000
227	227						0.0000
228	227	Y	cleanout smoking neat MH 228	Issue letter to owner instructing repair of cleanout		25	0.1932
228	68						0.0000
229	227						0.0000
230	230						0.0000
231	230						0.0000
232	230						0.0000
233	230						0.0000
234	230						0.0000
111a	111						0.0000
128a	126	Y	pickhole smoking	Rehab manhole		125	0.9659
132a	130	Y	offset rim	Rehab manhole			0.0000
177a	178	Y	smoking MH bt cul-de-sac	Rehab manhole		25	0.1932
183a	184	Y	smoking rim	Rehab manhole			0.0000
183a	186						0.0000
183a	188						0.0000
226a	68						0.0000
46a	46a	Y	smoking cleanout - pickhole- back of curb	Issue letter to owner instructing repair of cleanout		25	0.1932
				Total I/I (gpm) =	**0**	**55,610**	429.7136
				Total I/I (cfs) =	**0.00**	**0.957**	

* I/I estimated based on Q=CIA, with C=0.5, I =1.5 inches, and A = estimated contributing drainage area

Appendix B

Smoke Testing Photos

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012





Manhole 6, Smoke at rim



Manhole 7, Smoke at rim



Manhole 9, Smoke at rim

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Smoking cleanout near Manhole 13, 14



Smoke from cleanout



Smoke from concrete joint near Manhole 15



Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012





Manhole 27, smoke at rim



Manhole 27-3-051, Smoke from bolt holes



Manhole 43, Smoke at rim

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012









Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012





Manhole 62, Smoking



Manhole 61, Smoke at rim



Manhole 60, Smoke at rim and cracks

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 59, Smoke at rim, above grade



Manhole 58?



Manhole 57, Smoke at rim



Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 63?







Near Manhole 76, Smoke from cleanout and bushes

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 76, Smoke from rim



Near Manhole 76, Smoke from surrounding rocks



Near manhole 76, Smoke from bushes



Smoke from cleanout near MH 72

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 71, Smoke from rim



7/12/2012 Manhole 85, Smoke at rim



Smoking cleanout near Manhole 84



Smoking cleanout near Manhole 86

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012







Manhole 152, Smoke from pick hole and from cracked cement around MH



Close up of broken pavement near MH 152

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012







Manhole 132A, Offset rim



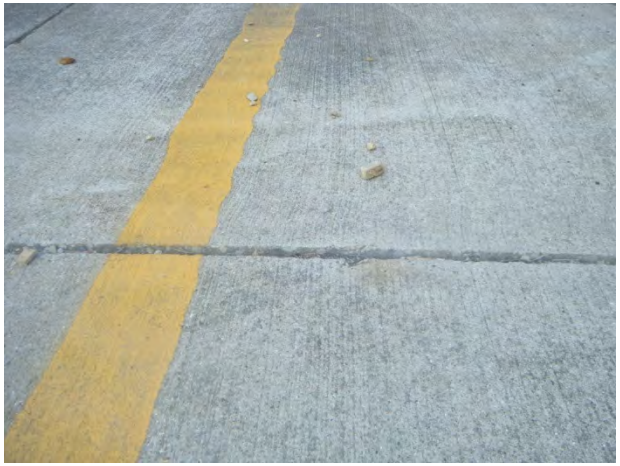
Manhole 132A, Offset rim

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012





Cleanout near MH 126



Smoking from crack in parking lot near MH 126



Cleanout

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



7/13/2012 Manhole 221, smoke from bolt holes



8/1/2012 Manhole 186, Smoke from gap under frame. Source type =11, Location = 9



Manhole 161, Smoke at rim



Manhole 161, Smoke at rim

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 161, Smoke at rim



Electric box East of MH 197, location 6



Smoke from the ground where Manhole 210 should be.



Manhole 204, Surrounding area 25 sq.ft.

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 200, Smoke at rim, corner of Cygnet & Mallard



Manhole 94, Smoke from pick hole



Manhole 93, Smoke from pick hole



Manhole 71, Smoking and on sidewalk

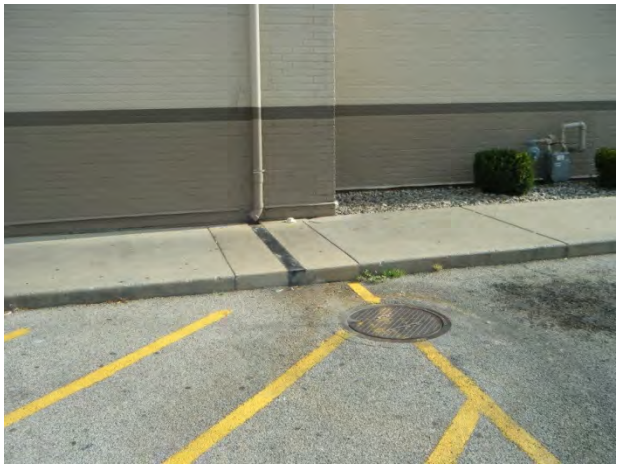
Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Next to manhole 71



Next to manhole 71



7/11 Manhole 3, smoke from pick hole



KFC, smoke from grease trap

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



7/11 Manhole 4, Smoke from rim



Smoke from drain



Manhole 6, Smoke from rim



Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012





Manhole 9, Smoke from rim



Manhole 10, Smoke from rim



Smoke from cleanout

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 13, smoke at rim



Smoking cleanout near Manhole 14



Manhole 14, smoke at rim



Smoking cleanout near Manhole 11

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 25, smoke at rim



Manhole 24, Smoking



Manhole 21, Smoke from rim and pick hole



Manhole 29, Smoking

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 31



Manhole 33, Smoking



Smoking cleanout



Manhole 44, Smoke at rim

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 44, Near apartment complex



Manhole 41, Smoke at rim and from ground around the MH



Manhole 18, Smoke at rim



Manhole 19, Smoke at rim

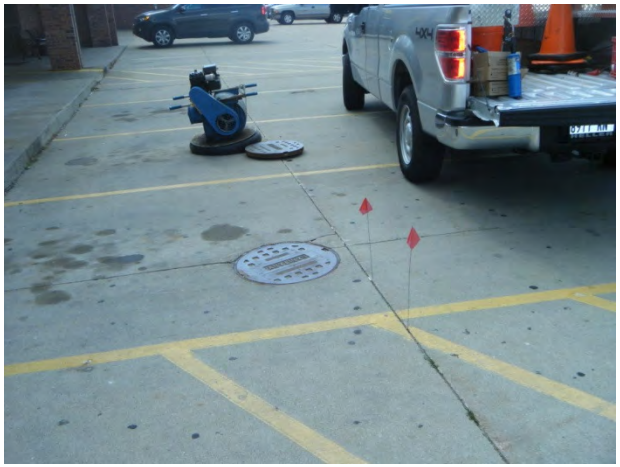
Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Smoking cleanout by Schnucks



Smoking cleanout, pick hole





Smoking cleanout

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 69, Smoking



Smoking cleanout by PNC bank





Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 75, Smoke at rim



Manhole 72, Smoke at rim

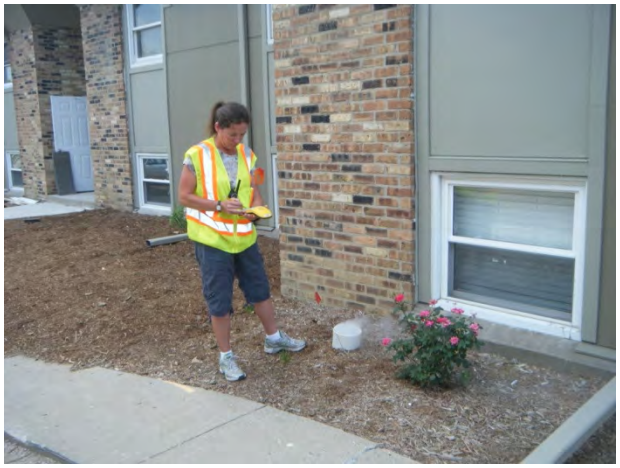


Smoking cleanout



Manhole 71, Smoke at rim

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



7/12/2012



Manhole 96, Smoking



Manhole 97, smoking



Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012





Manhole 114

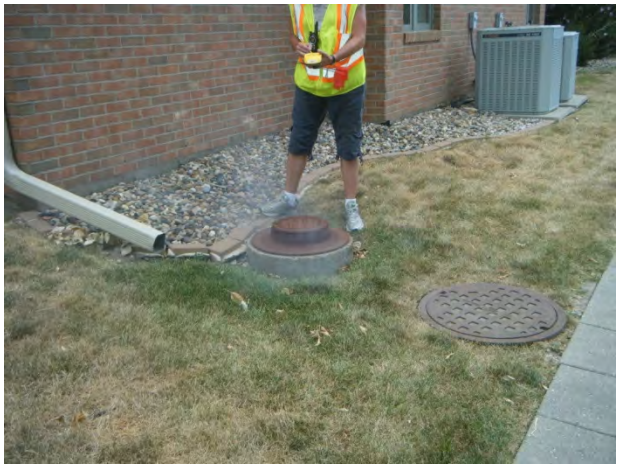


Manhole 114



Manhole 110

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Water Meter Pit



Manhole 108, Smoke at rim



Manhole 152, Pavement cracked



Manhole 151, pick hole

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 149



Manhole 148, pick hole



Manhole 135, Pavement cracked



Manhole 135, Pavement cracked

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 129, pick hole



Manhole 121, pick hole



Manhole 116?



Manhole 117, Buried with smoke

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012









7/13/2012 Manhole 160, Faint smoke from rim

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Smoke coming from ground along MH 178, frame offset alot



Manhole 172



Manhole 177A near culdesac, Smoking



8/1/2012 Smoke out of ground West of MH 184

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Smoke out of ground West of MH 184



Manhole 183A, Smoke from rim



Manhole 212, Smoke at rim



Manhole 207, Surrounding area 25 sq.ft.

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Manhole 202, Light smoke at rim, 25 sq.ft.



Manhole 91, Smoke at rim



Smoking cleanout, 2103 at Eastland, 16,000 sq.ft (building runoff), Source type = 3



2101 Eastland

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012



Tree where cleanout is located



Cleanout beneath tree



Cleanout



212 Prospect, Smoking around & along sidewalk

Manhole Smoke Testing Photo Album
City of Bloomington, IL. 2012





Landscape smoking at 208 N. Williamsburg



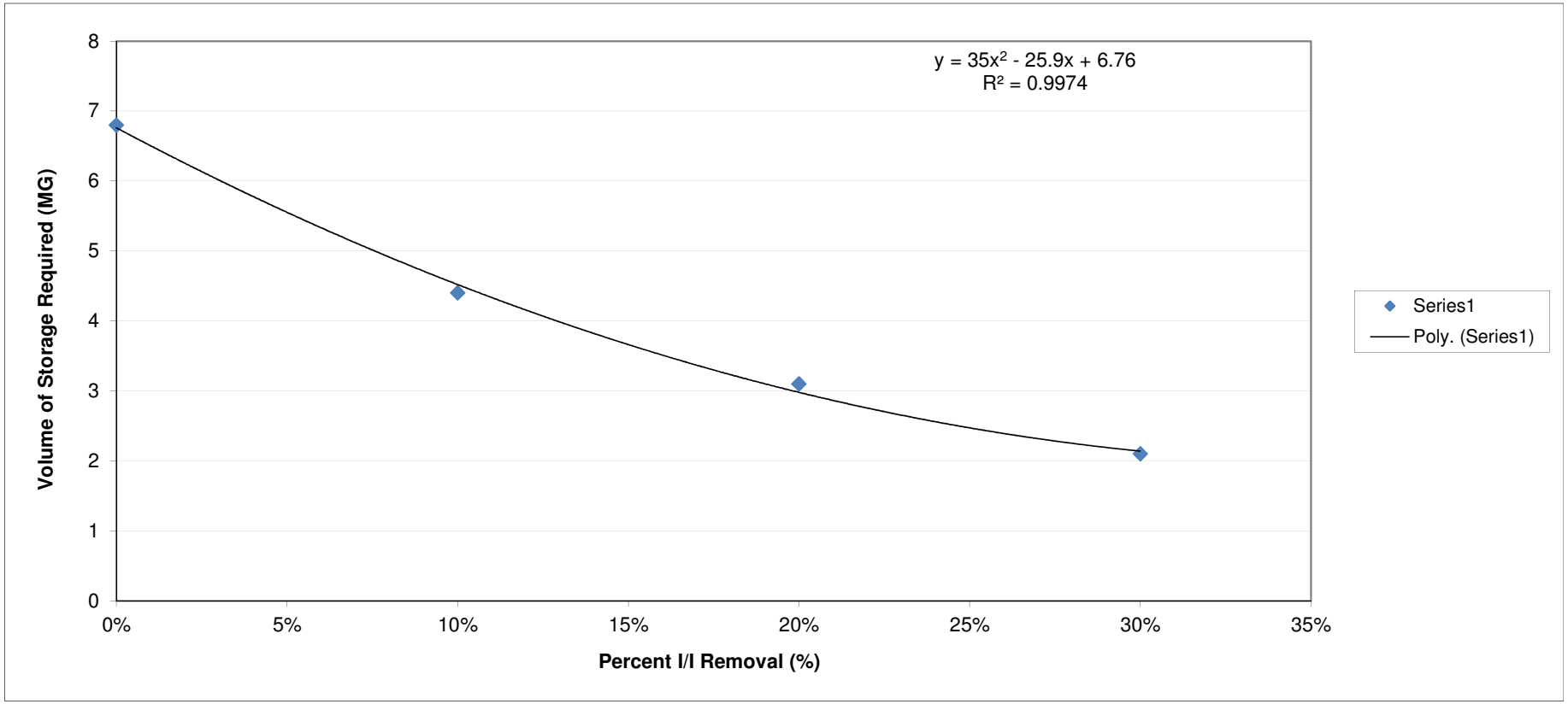
Manhole 227?, Smoke in Carwash, Fire Dept. visit, on Hershey



Manhole 228

Appendix C

Relationship of I/I Removal to Storage Capacity


y = 35x² - 25.9x + 6.76
R² = 0.9974
Volume of Storage Required (MG)
Percent I/I Removal (%)
0
1
2
3
4
5
6
7
8
0%
5%
10%
15%
20%
25%
30%
35%
Series1
Poly. (Series1)

Appendix D

Manhole Inspection Photos



218_a.jpg



218_b.jpg



218_c.jpg



217_a.jpg



217_b.jpg



217_c.jpg



216_a.jpg



216_b.jpg



216_c.jpg



216_d.jpg



215_a.jpg



215_b.jpg



215_c.jpg



214_a.jpg



214_b.jpg



214_c.jpg



213_a.jpg



213_b.jpg



213_c.jpg



212_a.jpg



212_b.jpg



212_c.jpg



211_a.jpg



211_b.jpg



211_c.jpg



209_a.jpg



209_b.jpg



209_c.jpg



208_a.jpg



208_b.jpg



208_c.jpg



207_a.jpg



207_b.jpg



207_c.jpg



204_a.jpg



204_b.jpg



204_c.jpg



203_a.jpg



203_b.jpg



203_c.jpg



202_a.jpg



202_b.jpg



201_a.jpg



201_b.jpg



201_c.jpg



200_a.jpg



200_b.jpg



200_c.jpg



199_a.jpg



199_b.jpg



199_c.jpg



198_a.jpg



198_b.jpg



198_c.jpg



197_a.jpg



197_b.jpg



197_c.jpg



196_a.jpg



196_b.jpg



196_c.jpg



194_a.jpg



194_b.jpg



194_c.jpg



193_a.jpg



193_b.jpg



193_c.jpg



192_a.jpg



192_b.jpg



192_c.jpg



191_a.jpg



191_b.jpg



191_c.jpg



190_a.jpg



190_b.jpg



190_c.jpg



188_a.jpg



188_b.jpg



188_c.jpg



186_a.jpg



186_b.jpg



186_c.jpg



185_a.jpg



185_b.jpg



185_c.jpg



184_a.jpg



184_b.jpg



184_c.jpg



183A_a.jpg



183A_b.jpg



183A_c.jpg



183_a.jpg



183_b.jpg



183_c.jpg



173_a.jpg



173_b.jpg



173_c.jpg



172_a.jpg



172_b.jpg



172_c.jpg



169_a.jpg



169_b.jpg



169_c.jpg



168_a.jpg



168_b.jpg



168_c.jpg



163_a.jpg



163_b.jpg



163_c.jpg



161_a.jpg



161_b.jpg



161_c.jpg



158_a.jpg



158_b.jpg



158_c.jpg



157_a.jpg



157_b.jpg



156_a.jpg



156_b.jpg



156_c.jpg



154_a.jpg



154_b.jpg



154_c.jpg



153_a.jpg



153_b.jpg



153_c.jpg



152_a.jpg



152_b.jpg



152_c.jpg



151_a.jpg



151_b.jpg



151_c.jpg



151_d.jpg



136_a.jpg



136_b.jpg



136_c.jpg



135_a.jpg



135_b.jpg



135_c.jpg



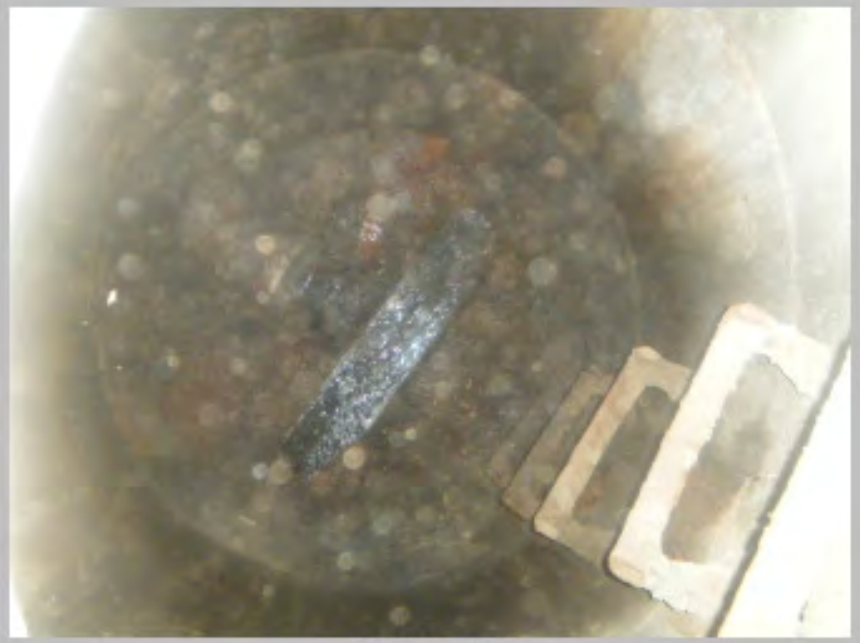
135_d.jpg



134_a.jpg



134_b.jpg



134_c.jpg



133_a.jpg



133_b.jpg



133_c.jpg



132A_a.jpg



132A_b.jpg



132A_c.jpg



132_a.jpg



132_b.jpg



132_c.jpg



131_a.jpg



131_b.jpg



131_c.jpg



130_a.jpg



130_b.jpg



130_c.jpg



129_a.jpg



129_b.jpg



129_c.jpg



128_a.jpg



128_b.jpg



128_c.jpg



127_a.jpg



127_b.jpg



127_c.jpg



126_a.jpg



126_b.jpg



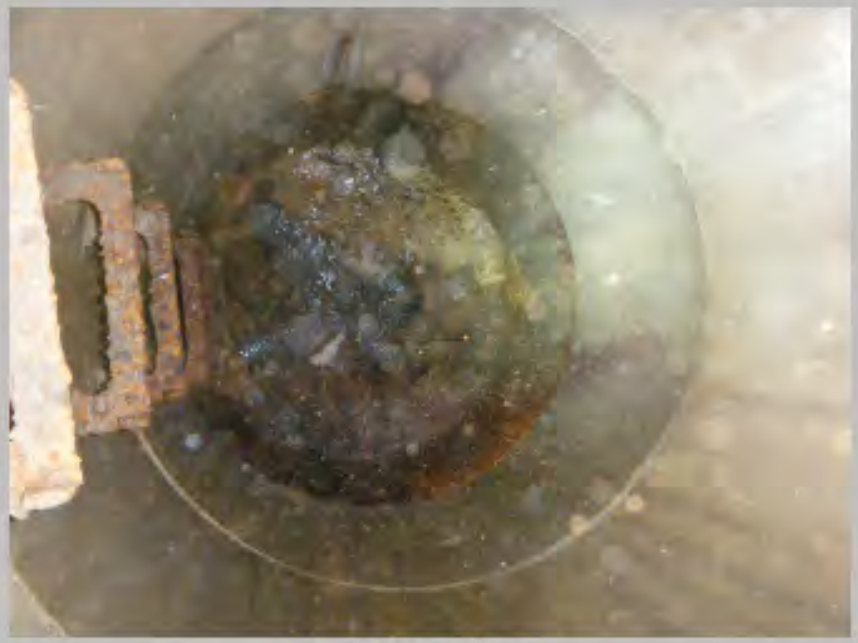
126_c.jpg



125_a.jpg



125_b.jpg



125_c.jpg



124_a.jpg



124_b.jpg



124_c.jpg



123_a.jpg



123_b.jpg



123_c.jpg



122_a.jpg



122_b.jpg



122_c.jpg



121_a.jpg



121_b.jpg



121_c.jpg



119_a.jpg



119_b.jpg



119_c.jpg



118_a.jpg



118_b.jpg



118_c.jpg



107_a.jpg



107_b.jpg



107_c.jpg



106_a.jpg



106_b.jpg



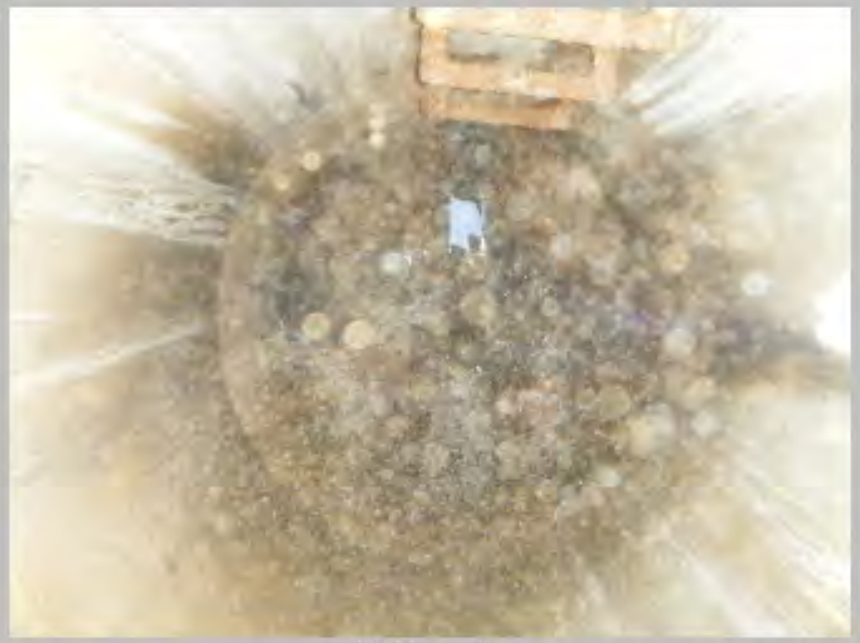
106_c.jpg



105_a.jpg



105_b.jpg



105_v.jpg



104_a.jpg



104_b.jpg



104_c.jpg



103_a.jpg



103_b.jpg



103_c.jpg



102_a.jpg



102_b.jpg



102_c.jpg



101_a.jpg



101_b.jpg



101_c.jpg



100_a.jpg



100_b.jpg



100_c.jpg



99_a.jpg



99_b.jpg



99_c.jpg



98_a.jpg



98_b.jpg



98_c.jpg



96_a.jpg



96_b.jpg



96_c.jpg



95_a.jpg



95_b.jpg



95_c.jpg



94_a.jpg



94_b.jpg



94_c.jpg



93_a.jpg



93_b.jpg



93_c.jpg



92_a.jpg



92_b.jpg



92_c.jpg



91_a.jpg



91_b.jpg



91_c.jpg



90_a.jpg



90_b.jpg



90_c.jpg



89_a.jpg



89_b.jpg



89_c.jpg



85_a.jpg



85_b.jpg



85_c.jpg



82_a.jpg



82_b.jpg



82_c.jpg



82_d.jpg



81_a.jpg



81_b.jpg



81_c.jpg



81_d.jpg



76_a.jpg



76_b.jpg



76_c.jpg



75_a.jpg



75_b.jpg



75_c.jpg



73_a.jpg



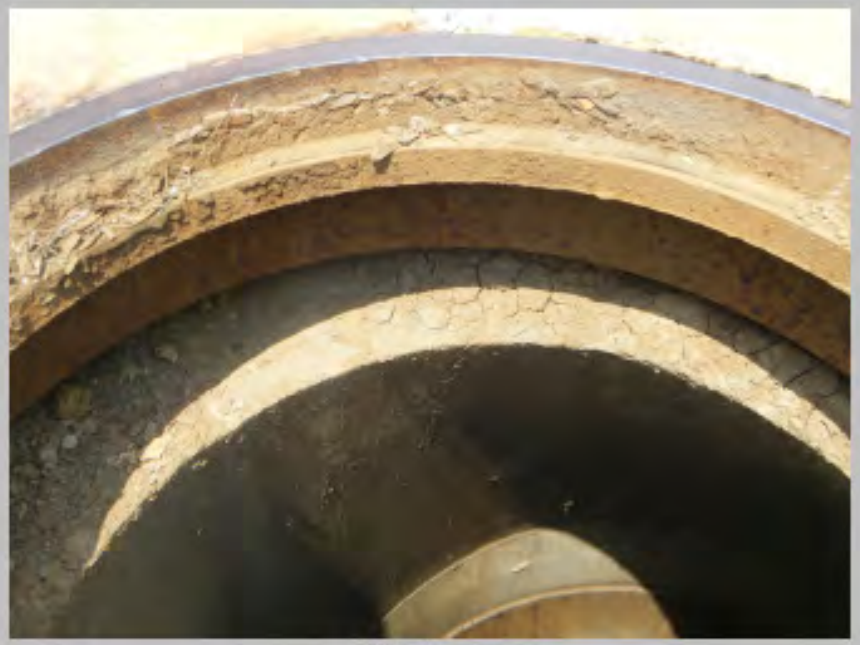
73_b.jpg



73_c.jpg



72_a.jpg



72_b.jpg



72_c.jpg



71_a.jpg



71_b.jpg



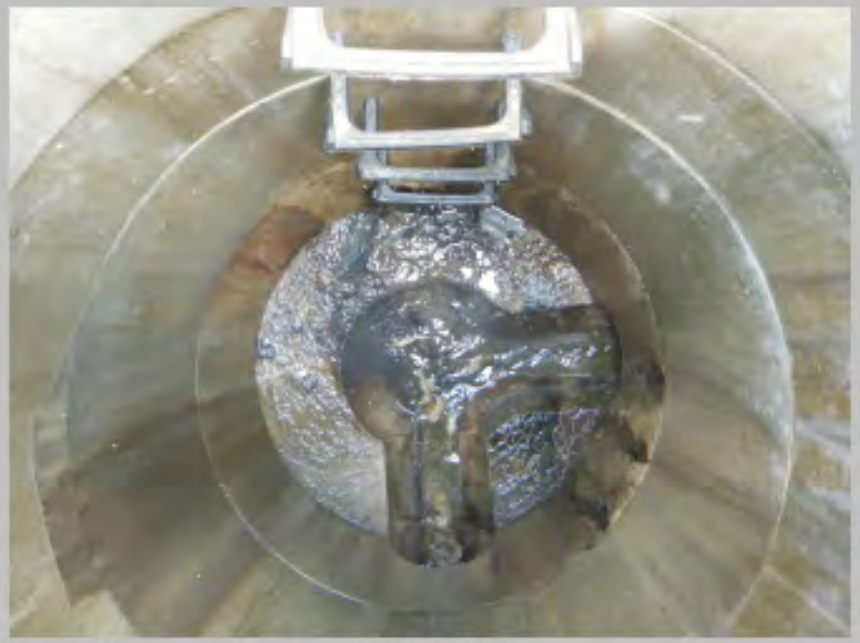
71_c.jpg



69_a.jpg



69_b.jpg



69_c.jpg



68_a.jpg



68_b.jpg



68_c.jpg



67_a.jpg



67_b.jpg



67_c.jpg



64_a.jpg



64_b.jpg



64_c.jpg



63_a.jpg



63_b.jpg



63_c.jpg



62_a.jpg



62_b.jpg



62_c.jpg



61_a.jpg



61_b.jpg



61_c.jpg



60_a.jpg



59_a.jpg



59_b.jpg



59_c.jpg



58_a.jpg



58_b.jpg



58_c.jpg



57_a.jpg



57_b.jpg



57_c.jpg



56_a.jpg



56_b.jpg



56_c.jpg



55_a.jpg



55_b.jpg



55_c.jpg



54_a.jpg



54_b.jpg



54_c.jpg



53_a.jpg



53_b.jpg



53_c.jpg



52_a.jpg



52_b.jpg



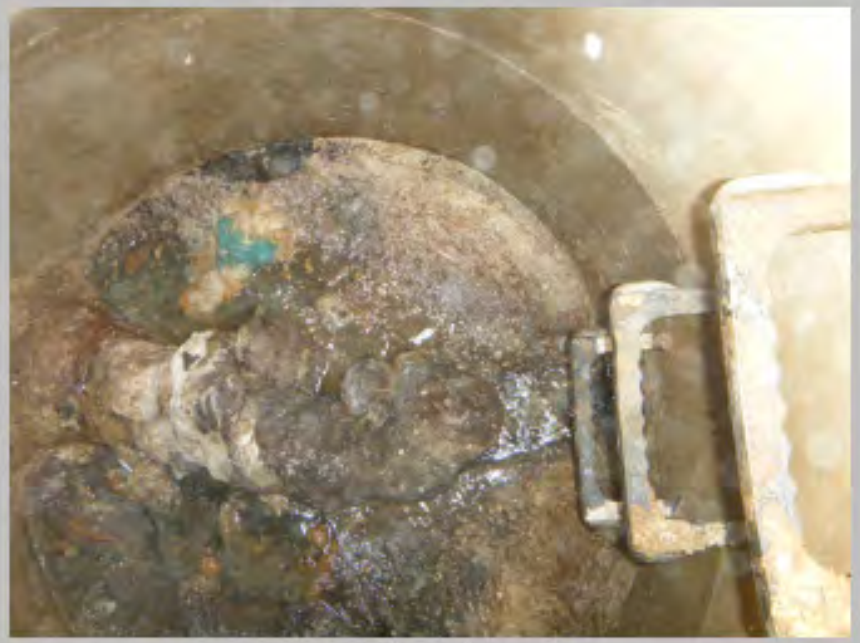
52_c.jpg



51_a.jpg



51_b.jpg



51_c.jpg



50_a.jpg



50_b.jpg



50_c.jpg



49_a.jpg



49_b.jpg



49_c.jpg



47_a.jpg



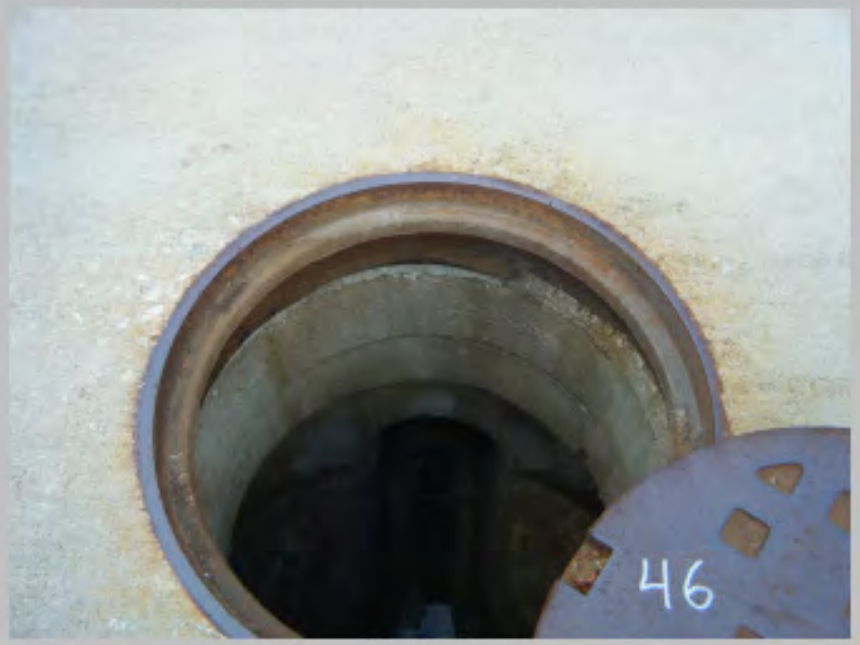
47_b.jpg



47_c.jpg



46_a.jpg



46_b.jpg



46_c.jpg



45_a.jpg



45_b.jpg



45_c.jpg



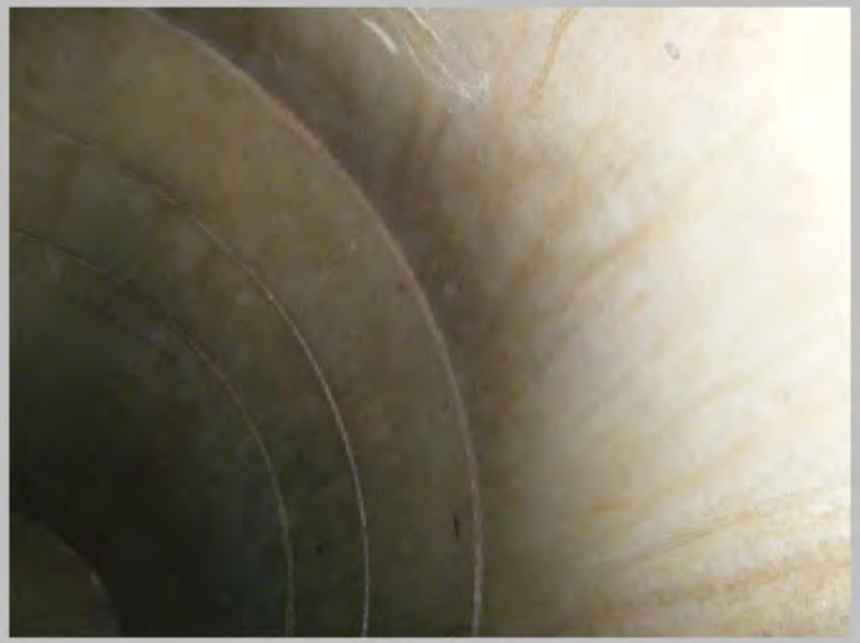
44_a.jpg



44_b.jpg



44_c.jpg



44_d.jpg



43_a.jpg



43_b.jpg



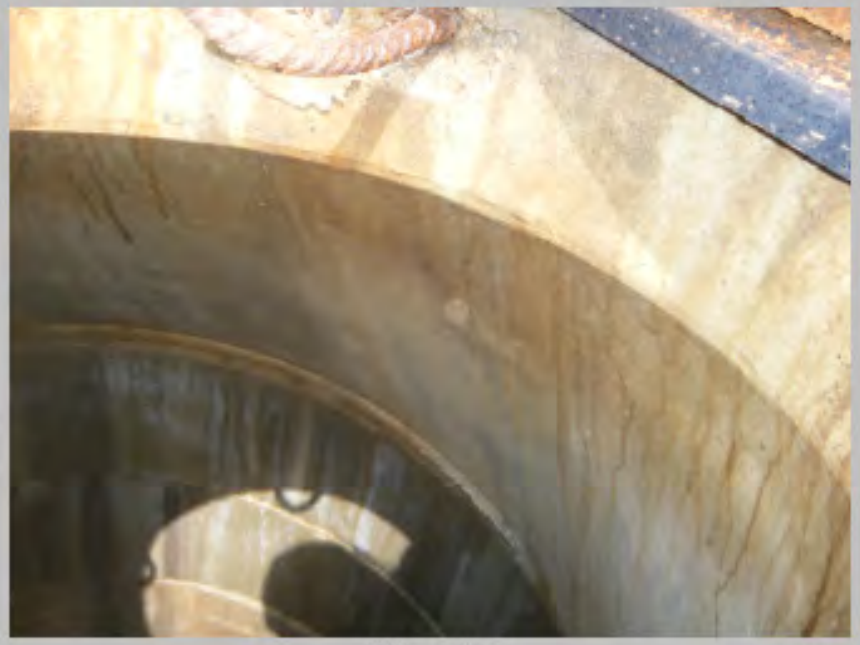
43_c.jpg



42_a.jpg



42_b.jpg



42_c.jpg



42_d.jpg



41_a.jpg



41_b.jpg



41_c.jpg



40_a.jpg



40_b.jpg



40_c.jpg



35_a.jpg



35_b.jpg



35_c.jpg



34_a.jpg



34_b.jpg



34_c.jpg



33_a.jpg



33_b.jpg



33_c.jpg



32_a.jpg



32_b.jpg



32_c.jpg



31_a.jpg



31_b.jpg



31_c.jpg



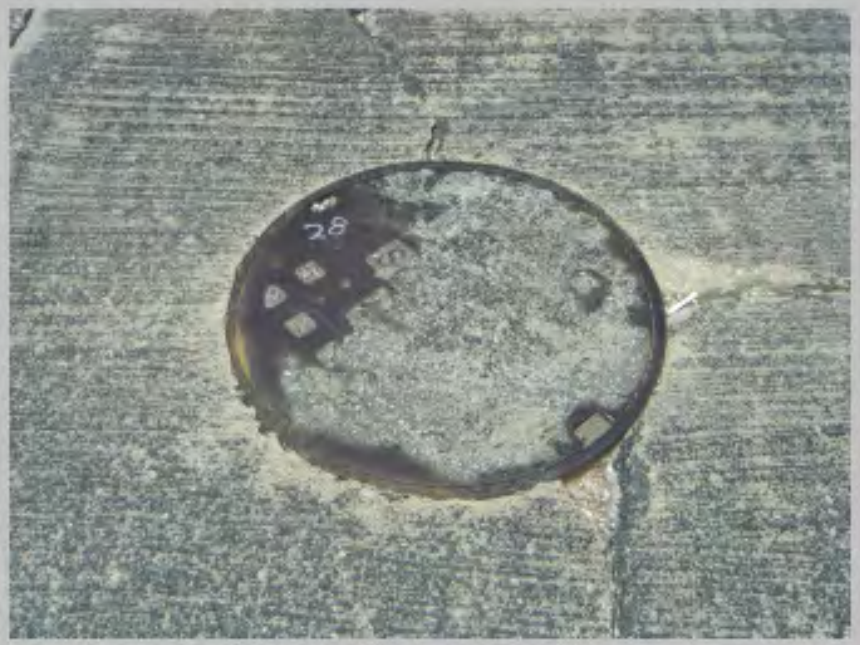
29_a.jpg



29_b.jpg



29_c.jpg



28_a.jpg



28_b.jpg



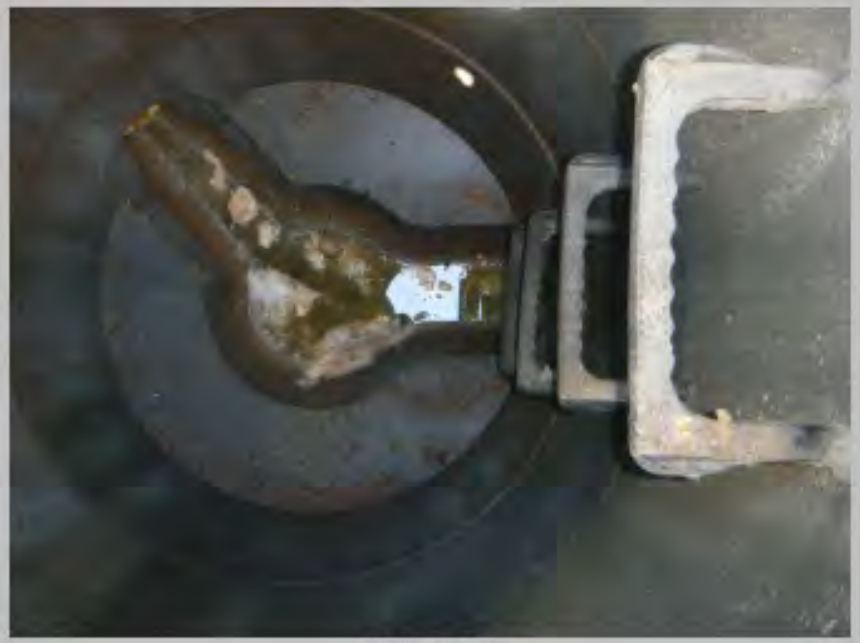
28_c.jpg



27_a.jpg



27_b.jpg



27_c.jpg



26_a.jpg



26_b.jpg



26_c.jpg



25_a.jpg



25_b.jpg



25_c.jpg



24_a.jpg



24_b.jpg



24_c.jpg



23_a.jpg



23_b.jpg



23_c.jpg



23_d.jpg



22_a.jpg



22_b.jpg



22_c.jpg



21_a.jpg



21_b.jpg



21_c.jpg



20_a.jpg



20_b.jpg



20_c.jpg



19x_a.jpg



19x_b.jpg



19x_c.jpg



19_a.jpg



19_b.jpg



19_c.jpg



18_a.jpg



18_b.jpg



18_c.jpg



17_a.jpg



17_b.jpg



17_c.jpg



16_a.jpg



16_b.jpg



16_c.jpg



15_a.jpg



15_b.jpg



15_c.jpg



14_a.jpg



14_b.jpg



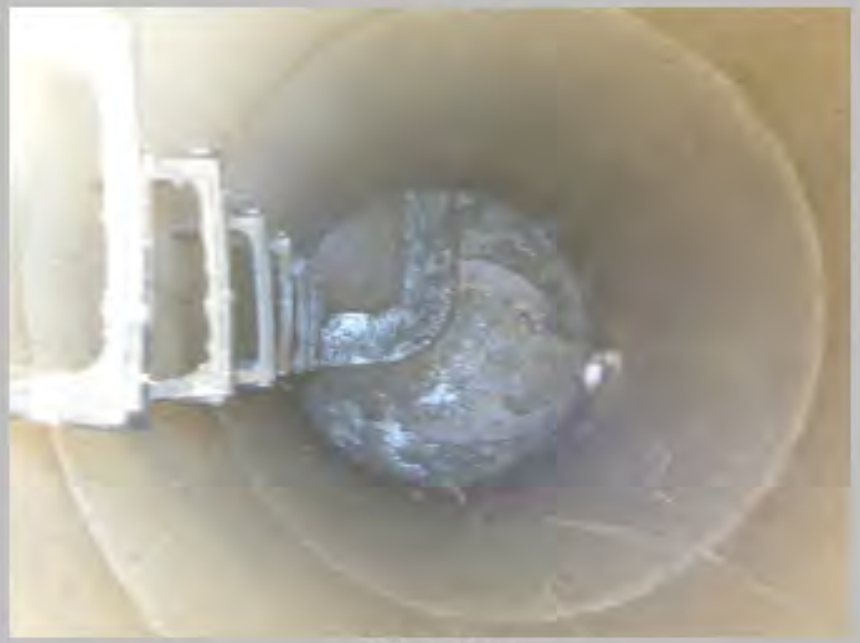
14_c.jpg



13_a.jpg



13_b.jpg



13_c.jpg



12_a.jpg



12_b.jpg



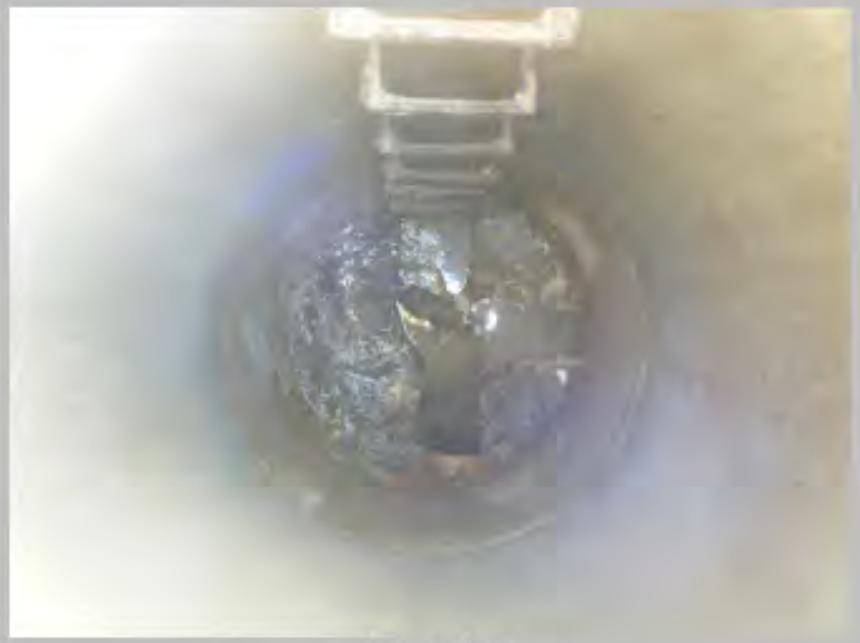
12_c.jpg



11_a.jpg



11_b.jpg



11_c.jpg



10_a.jpg



10_b.jpg



10_c.jpg



9_a.jpg



9_b.jpg



9_c.jpg



8_a.jpg



8_b.jpg



8_c.jpg



7_a.jpg



7_b.jpg



7_c.jpg



6_a.jpg



6_b.jpg



6_c.jpg



5_a.jpg



5_b.jpg



5_c.jpg



4_a.jpg



4_b.jpg



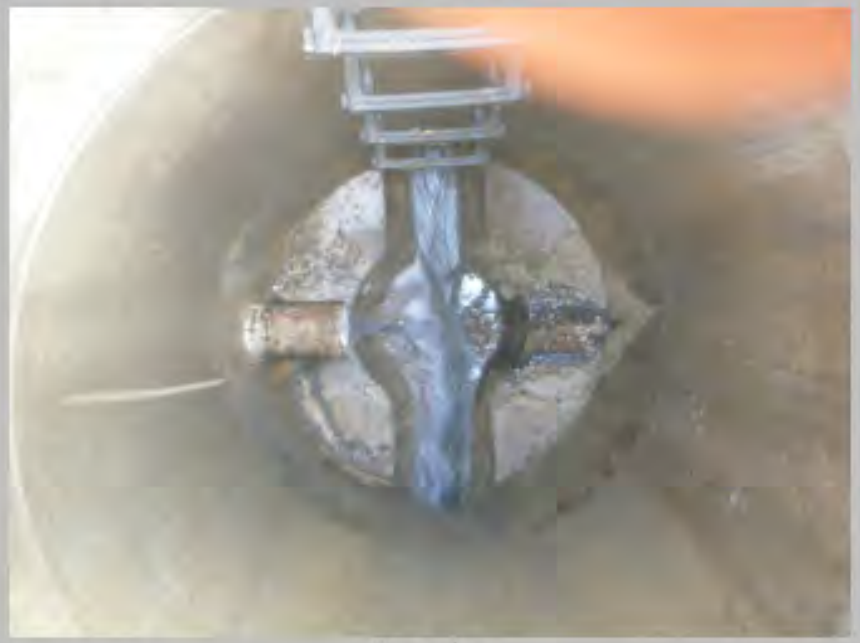
4_c.jpg



3_a.jpg



3_b.jpg



3_c.jpg



2_a.jpg



2_b.jpg



2_c.jpg



1_a.jpg



1_b.jpg



1_c.jpg

Appendix E

Manhole Inspection Summary Tables

City of Bloomington, IL SSES
Cost-Effective Analysis

Manhole Number	Manhole Type		Category	179.46	Rehab Costs	Associated Storage Construction Cost Saved (@ $2/gallon removed)	Cost-Effective Rehab?	Project Phasing (CER = Sum of the Cost-Effective Rehab)
21	San MH	1	7	3.63	580.00	6,068.37	Yes	Immediate Priority Repair = $5,488
25	San MH	1	7	6.28	2,465.00	10,488.88	Yes	Immediate Priority Repair = $8,024
26	San MH	1	7	3.65	1,446.38	6,101.80	Yes	Immediate Priority Repair = $4,655
42	San MH	1	7	3.63	1,667.50	6,068.37	Yes	Immediate Priority Repair = $4,401
52	San MH	1	7	3.39	1,087.50	5,667.22	Yes	Immediate Priority Repair = $4,580
63	San MH	1	7	3.51	1,740.00	5,867.80	Yes	Immediate Priority Repair = $4,128
69	San MH	1	7	3.75	2,827.50	6,268.95	Yes	Immediate Priority Repair = $3,441
72	San MH	1	7	3.63	4,205.00	6,068.37	Yes	Immediate Priority Repair = $1,863
81	San MH	1	7	3.51	3,625.00	5,867.80	Yes	Immediate Priority Repair = $2,243
91	San MH	1	7	2.77	1,740.00	4,622.50	Yes	Immediate Priority Repair = $2,883
93	San MH	1	7	3.51	1,087.50	5,867.80	Yes	Immediate Priority Repair = $4,780
94	San MH	1	7	3.27	2,465.00	5,466.64	Yes	Immediate Priority Repair = $3,002
98	San MH	1	7	2.89	1,015.00	4,823.09	Yes	Immediate Priority Repair = $3,808
101	San MH	1	7	3.51	2,465.00	5,867.80	Yes	Immediate Priority Repair = $3,403
102	San MH	1	7	3.39	2,465.00	5,667.22	Yes	Immediate Priority Repair = $3,202
105	San MH	1	7	3.27	1,087.50	5,466.64	Yes	Immediate Priority Repair = $4,379
106	San MH	1	7	3.27	2,465.00	5,466.64	Yes	Immediate Priority Repair = $3,002
107	San MH	1	7	3.15	2,465.00	5,266.05	Yes	Immediate Priority Repair = $2,801
118	San MH	1	7	6.25	2,537.50	10,447.10	Yes	Immediate Priority Repair = $7,910
121	San MH	1	7	3.75	4,205.00	6,268.95	Yes	Immediate Priority Repair = $2,064
124	San MH	1	7	3.75	3,625.00	6,268.95	Yes	Immediate Priority Repair = $2,644
134	San MH	1	7	3.75	4,785.00	6,268.95	Yes	Immediate Priority Repair = $1,484
135	San MH	1	7	3.51	2,465.00	5,867.80	Yes	Immediate Priority Repair = $3,403
173	San MH	1	7	3.63	3,045.00	6,068.37	Yes	Immediate Priority Repair = $3,023

City of Bloomington, IL SSES
Cost-Effective Analysis

Manhole Number	Manhole Type		Category	179.46	Rehab Costs	Associated Storage Construction Cost Saved (@ $2/gallon removed)	Cost-Effective Rehab?	Project Phasing (CER = Sum of the Cost-Effective Rehab)
188	San MH	1	7	0.70	1,160.00	1,170.36	Yes	Immediate Priority Repair = $10
198	San MH	1	7	3.01	3,407.50	5,023.68	Yes	Immediate Priority Repair = $1,616
202	San MH	1	7	0.84	1,160.00	1,400.24	Yes	Immediate Priority Repair = $240
209	San MH	1	7	3.39	2,465.00	5,667.22	Yes	Immediate Priority Repair = $3,202
216	San MH	1	7	3.51	2,465.00	5,867.80	Yes	Immediate Priority Repair = $3,403
33	San MH	1	6	0.72	580.00	1,199.62	Yes	Immediate Priority Repair = $620
40	San MH	1	6	1.38	1,522.50	2,307.21	Yes	Immediate Priority Repair = $785
55	San MH	1	6	1.26	1,087.50	2,106.59	Yes	Immediate Priority Repair = $1,019
57	San MH	1	6	1.01	1,522.50	1,688.64	Yes	Immediate Priority Repair = $166
76	San MH	1	6	1.38	1,015.00	2,307.21	Yes	Immediate Priority Repair = $1,292
90	San MH	1	6	1.01	1,667.50	1,680.28	Yes	Immediate Priority Repair = $13
123	San MH	1	6	0.72	1,087.50	1,199.62	Yes	Immediate Priority Repair = $112
133	San MH	1	6	0.63	580.00	1,053.33	Yes	Immediate Priority Repair = $473
151	San MH	1	6	0.88	1,087.50	1,462.94	Yes	Immediate Priority Repair = $375
161	San MH	1	6	1.01	507.50	1,688.64	Yes	Immediate Priority Repair = $1,181
163	San MH	1	6	0.77	507.50	1,287.39	Yes	Immediate Priority Repair = $780
168	San MH	1	6	0.89	1,087.50	1,488.02	Yes	Immediate Priority Repair = $401
199	San MH	1	6	0.86	1,160.00	1,429.50	Yes	Immediate Priority Repair = $270
212	San MH	1	6	1.01	1,595.00	1,688.64	Yes	Immediate Priority Repair = $94
183A	San MH	1	6	0.77	1,015.00	1,287.39	Yes	Immediate Priority Repair = $272
8	San MH	1	5	0.89	580.00	1,479.66	Yes	Immediate Priority Repair = $900
15	San MH	1	5	1.51	580.00	2,524.54	Yes	Immediate Priority Repair = $1,945
49	San MH	1	5	0.83	1,087.50	1,391.88	Yes	Immediate Priority Repair = $304
60	San MH	1	5	0.74	507.50	1,228.88	Yes	Immediate Priority Repair = $721

City of Bloomington, IL SSES
Cost-Effective Analysis

Manhole Number	Manhole Type		Category	179.46	Rehab Costs	Associated Storage Construction Cost Saved (@ $2/gallon removed)	Cost-Effective Rehab?	Project Phasing (CER = Sum of the Cost-Effective Rehab)
62	San MH	1	5	0.60	768.50	998.99	Yes	Immediate Priority Repair = $230
73	San MH	1	5	0.63	507.50	1,049.15	Yes	Immediate Priority Repair = $542
75	San MH	1	5	0.63	1,015.00	1,049.15	Yes	Immediate Priority Repair = $34
92	San MH	1	5	0.89	1,015.00	1,479.66	Yes	Immediate Priority Repair = $465
186	San MH	1	5	0.60	507.50	998.99	Yes	Immediate Priority Repair = $491
203	San MH	1	5	0.63	507.50	1,049.15	Yes	Immediate Priority Repair = $542
3	San MH	1	4	0.35	507.50	585.19	Yes	Immediate Priority Repair = $78
13	San MH	1	4	0.38	507.50	626.99	Yes	Immediate Priority Repair = $119
158	San MH	1	4	0.35	507.50	585.19	Yes	Immediate Priority Repair = $78
215	San MH	1	4	0.62	507.50	1,028.25	Yes	Immediate Priority Repair = $521
41	San MH	1	7	0.98	2,102.50	1,630.12	No	
125	San MH	1	7	0.84	1,740.00	1,400.24	No	
127	San MH	1	7	0.70	2,320.00	1,170.36	No	
128	San MH	1	7	0.99	1,667.50	1,651.02	No	
132A	San MH	1	7	0.99	1,667.50	1,651.02	No	
132	San MH	2	7	0.70	2,900.00	1,170.36	No	
34	San MH	1	6	1.14	2,465.00	1,905.98	No	
44	San MH	1	6	1.14	2,465.00	1,905.98	No	
47	San MH	1	6	0.88	2,465.00	1,462.94	No	
61	San MH	1	6	0.72	1,928.50	1,199.62	No	
71	San MH	1	6	1.19	2,827.50	1,993.75	No	
99	San MH	1	6	1.26	2,465.00	2,106.59	No	
100	San MH	1	6	1.38	2,465.00	2,307.21	No	
103	San MH	1	6	1.26	2,465.00	2,106.59	No	

City of Bloomington, IL SSES
Cost-Effective Analysis

Manhole Number	Manhole Type		Category	179.46	Rehab Costs	Associated Storage Construction Cost Saved (@ $2/gallon removed)	Cost-Effective Rehab?	Project Phasing (CER = Sum of the Cost-Effective Rehab)
119	San MH	1	6	1.02	2,465.00	1,705.36	No	
129	San MH	1	6	0.58	1,740.00	969.73	No	
130	San MH	1	6	0.63	1,740.00	1,053.33	No	
153	San MH	1	6	0.88	2,465.00	1,462.94	No	
156	San MH	1	6	1.38	4,205.00	2,307.21	No	
172	San MH	1	6	0.58	1,740.00	969.73	No	
193	San MH	1	6	0.87	1,667.50	1,450.40	No	
197	San MH	1	6	0.58	1,160.00	969.73	No	
214	San MH	1	6	0.93	2,537.50	1,550.71	No	
217	San MH	1	6	1.26	3,625.00	2,106.59	No	
43	San MH	1	6	1.01	4,132.50	1,680.28	No	
82	San MH	1	6	0.63	4,060.00	1,053.33	No	
96	San MH	1	6	0.86	3,915.00	1,429.50	No	
126	San MH	1	6	0.58	3,480.00	969.73	No	
152	San MH	2	6	0.90	3,552.50	1,504.73	No	
192	San MH	1	6	0.51	1,740.00	844.34	No	
11	San MH	1	5	0.51	1,087.50	848.52	No	
45	San MH	1	5	0.74	1,740.00	1,228.88	No	
51	San MH	1	5	1.07	2,465.00	1,793.13	No	
54	San MH	1	5	0.75	2,175.00	1,249.77	No	
67	San MH	1	5	0.74	1,522.50	1,228.88	No	
85	San MH	1	5	0.74	1,740.00	1,228.88	No	
89	San MH	1	5	0.74	1,740.00	1,228.88	No	
95	San MH	1	5	0.95	3,045.00	1,592.51	No	

City of Bloomington, IL SSES
Cost-Effective Analysis

Manhole Number	Manhole Type		Category	179.46	Rehab Costs	Associated Storage Construction Cost Saved (@ $2/gallon removed)	Cost-Effective Rehab?	Project Phasing (CER = Sum of the Cost-Effective Rehab)
104	San MH	1	5	0.83	2,465.00	1,391.88	No	
131	San MH	1	5	0.46	1,160.00	769.10	No	
183	San MH	1	5	0.51	1,667.50	848.52	No	
185	San MH	1	5	0.74	2,320.00	1,228.88	No	
190	San MH	1	5	0.74	2,175.00	1,228.88	No	
196	San MH	1	5	0.60	1,015.00	998.99	No	
207	San MH	1	5	0.46	1,160.00	769.10	No	
211	San MH	1	5	0.60	1,160.00	998.99	No	
218	San MH	1	5	0.60	1,740.00	998.99	No	
5	San MH	1	5	0.74	3,813.50	1,228.88	No	
6	San MH	1	5	0.69	3,915.00	1,149.46	No	
9	San MH	1	5	0.69	2,465.00	1,149.46	No	
10	San MH	1	5	0.39	3,770.00	643.71	No	
58	San MH	1	5	0.89	3,552.50	1,479.66	No	
154	San MH	1	5	0.71	3,190.00	1,191.26	No	
213	San MH	1	5	0.74	3,915.00	1,228.88	No	
2	San MH	1	4	0.35	768.50	585.19	No	
12	San MH	1	4	0.48	1,087.50	798.36	No	
17	San MH	1	4	0.50	1,087.50	835.98	No	
23	San MH	1	4	0.50	1,087.50	835.98	No	
28	San MH	1	4	0.77	2,465.00	1,279.03	No	
29	San MH	1	4	0.77	2,465.00	1,279.03	No	
31	San MH	1	4	0.77	2,465.00	1,279.03	No	
50	San MH	1	4	0.77	2,247.50	1,279.03	No	

City of Bloomington, IL SSES
Cost-Effective Analysis

Manhole Number	Manhole Type		Category	179.46	Rehab Costs	Associated Storage Construction Cost Saved (@ $2/gallon removed)	Cost-Effective Rehab?	Project Phasing (CER = Sum of the Cost-Effective Rehab)
56	San MH	1	4	0.38	1,087.50	626.99	No	
200	San MH	1	4	0.62	1,667.50	1,028.25	No	
4	San MH	1	4	0.50	1,740.00	835.98	No	
18	San MH	1	4	0.50	2,465.00	835.98	No	
27	San MH	1	4	0.50	2,465.00	835.98	No	
59	San MH	1	4	0.65	3,552.50	1,078.40	No	
122	San MH	1	4	0.39	1,450.00	652.07	No	
35	San MH	1	3	0.36	1,015.00	597.73	No	
16	San MH	1	3	0.21	1,015.00	355.30	No	
68	San MH	1	5	0.46	0.00	769.10	NA	
191	San MH	1	5	0.46	0.00	769.10	NA	
7	San MH	1	4	0.50	0.00	835.98	NA	
19	San MH	1	4	0.50	0.00	835.98	NA	
20	San MH	1	4	0.50	0.00	835.98	NA	
32	San MH	1	4	0.27	0.00	443.07	NA	
136	San MH	1	4	0.48	0.00	798.36	NA	
201	San MH	1	4	0.58	0.00	965.55	NA	
204	San MH	1	4	0.52	0.00	861.06	NA	
53	San MH	1	3	0.34	0.00	564.29	NA	
64	San MH	1	3	0.36	0.00	597.73	NA	
169	San MH	1	3	0.24	0.00	397.09	NA	
194	San MH	1	3	0.21	0.00	355.30	NA	
195	San MH	1	3	0.22	0.00	367.83	NA	
208	San MH	1	3	0.21	0.00	355.30	NA	

City of Bloomington, IL SSES
Cost-Effective Analysis

Manhole Number	Manhole Type		Category	179.46	Rehab Costs	Associated Storage Construction Cost Saved (@ $2/gallon removed)	Cost-Effective Rehab?	Project Phasing (CER = Sum of the Cost-Effective Rehab)
1	San MH	1	2	0.10	0.00	167.20	NA	
46	San MH	1	2	0.13	0.00	209.00	NA	
157	San MH	1	2	0.08	0.00	125.40	NA	
184	San MH	1	2	0.10	0.00	167.20	NA	
14	San MH	1	1	0.00	0.00	0.00	NA	
22	San MH	1	1	0.00	0.00	0.00	NA	
24	San MH	1	1	0.00	0.00	0.00	NA	

Appendix F

Manhole Inspection Forms

Preliminary Error Checking for Manhole Report - Project 67110011

Input Parameters Used:

Title Line 1:	City of Bloomington
Title Line 2:	SSES
Project Number:	67110011
Page Footer:	Manhole Report
Average Month Units:	MCF
Average Year Units:	MCF
Average Month Factor:	5.774
Average Year Factor:	69.296
Cost Type:	Storage Construction
Cost Type Value:	100.00
Inspection Group:	1
Priority:	All
Engineering and Legal Cost Percentage:	25.00
Contingency Cost Percentage:	20.00
OHM Logo to Use:	New OHM Logo

Manholes without Pipe Data

AW_Project_Number	BF_Manhole_Number	DC_Inspection_Group

Pipes without Manhole Data

AW_Project_Number	BF_Manhole_Number	DC_Inspection_Group

Duplicate Manhole Numbers

AW_Project_Number	BF_Manhole_Number	Check_for_Duplicates

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

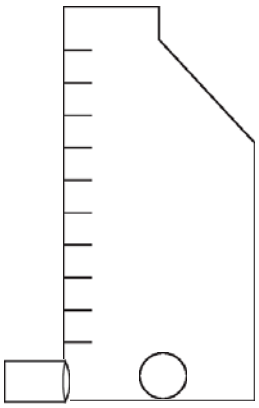
Manhole Inspection Form for Structure:

1

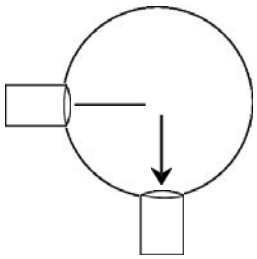
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	DNR
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.17
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.17
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.00
	12.00
Max Manhole Depth (ft):	12.00



Pipe Size (in)	Material	Direction	Drop
8		S	12.00
8		W	12.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**0.10**	**0.58**	**6.93**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$167.20**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 2 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

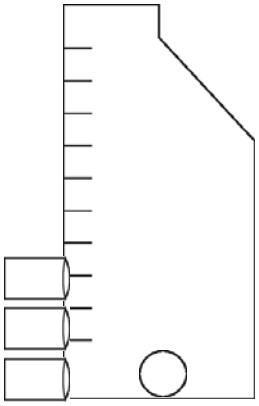
Manhole Inspection Form for Structure:

10

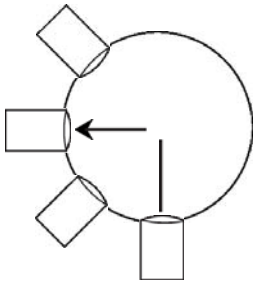
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Fair
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.40 11.10 13.10 13.10
Max Manhole Depth (ft):	13.10



Pipe Size (in)	Material	Direction	Drop
10		SW	10.40
10	Clay	NW	11.10
12		S	13.10
12		W	13.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-1
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.00	0.00	0.00
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.39**	**2.22**	**26.68**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (> 2 ft. Pavement)	$2,200.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$2,600.00
25% Engineering and Legal:	650.00
20% Contingency:	$520.00
TOTAL COST:	**$3,770.00**

Total Rehab Cost: **$3,770.00**
Storage Construction Costs: **$643.71**

Cost-effective to Rehab?: NO

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

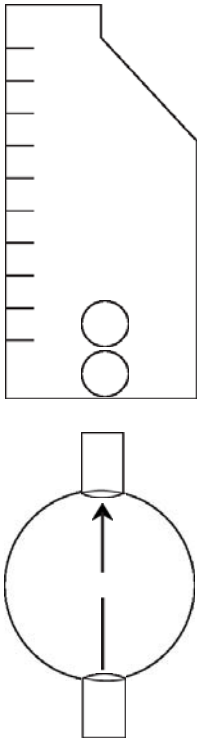
Manhole Inspection Form for Structure:

100

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	0.80
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.80
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.80
	9.90
Max Manhole Depth (ft):	9.90

Pipe Size (in)	Material	Direction	Drop
8		N	9.80
8		S	9.90

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**1.38**	**7.97**	**95.63**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$2,307.21**

Cost-effective to Rehab?: NO

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

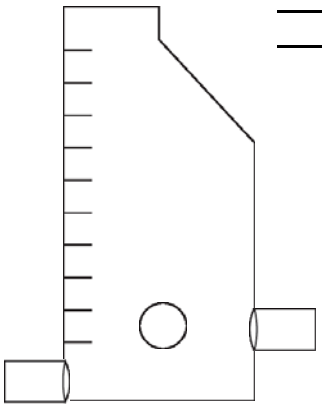
Manhole Inspection Form for Structure:

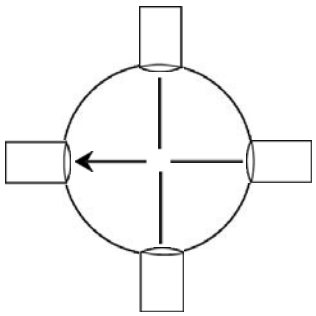
101

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	0.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.70
	11.90
	11.90
	12.00
Max Manhole Depth (ft):	12.00

Pipe Size (in)	Material	Direction	Drop
10	Clay	E	11.70
8	Clay	S	11.90
8	Clay	N	11.90
12	Clay	W	12.00

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**3.51**	**20.27**	**243.23**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$5,867.80**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

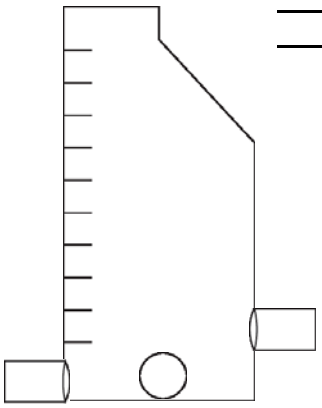
Manhole Inspection Form for Structure:

102

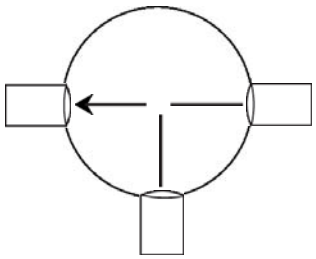
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	8.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	8.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.00 10.90 10.90
Max Manhole Depth (ft):	10.90



Pipe Size (in)	Material	Direction	Drop
10	Clay	E	10.00
10		W	10.90
8		S	10.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**3.39**	**19.57**	**234.91**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$5,667.22**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

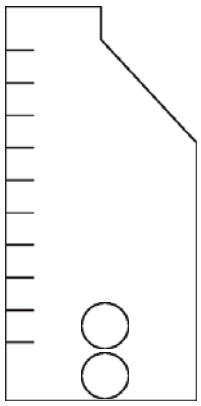
Manhole Inspection Form for Structure:

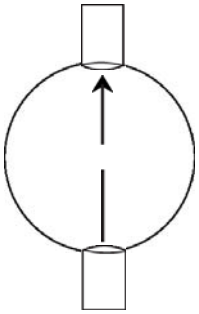
103

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	0.10
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.10
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.20
	9.30
Max Manhole Depth (ft):	9.30

Pipe Size (in)	Material	Direction	Drop
8		N	9.20
8		S	9.30

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.26**	**7.28**	**87.31**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$2,106.59**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

Manhole Inspection Form for Structure:

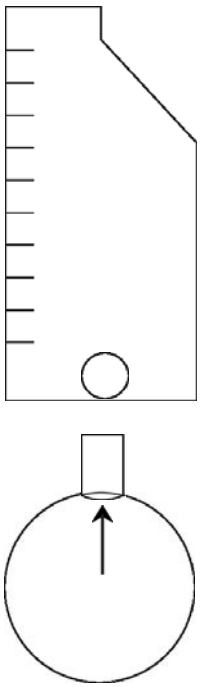
104

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
needs cleaning

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	14.00
Max Manhole Depth (ft):	14.00

Pipe Size (in)	Material	Direction	Drop
8		N	14.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Debris
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.69	3.97	47.64
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.83**	**4.81**	**57.69**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,391.88**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

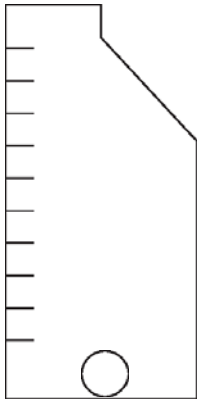
Manhole Inspection Form for Structure:

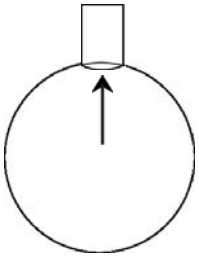
105

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.40
Max Manhole Depth (ft):	10.40

Pipe Size (in)	Material	Direction	Drop
8		N	10.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**3.27**	**18.88**	**226.60**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$5,466.64**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 7 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

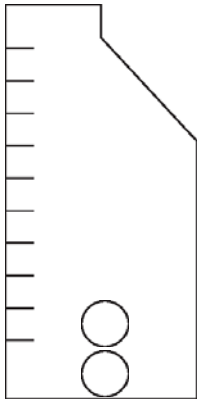
Manhole Inspection Form for Structure:

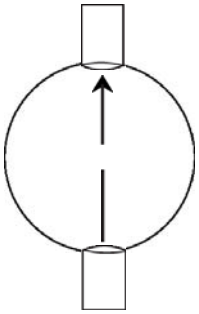
106

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	1.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.13
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	1.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.20
	10.30
Max Manhole Depth (ft):	10.30

Pipe Size (in)	Material	Direction	Drop
8		S	10.20
8		N	10.30

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**3.27**	**18.88**	**226.60**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$5,466.64**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 7 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

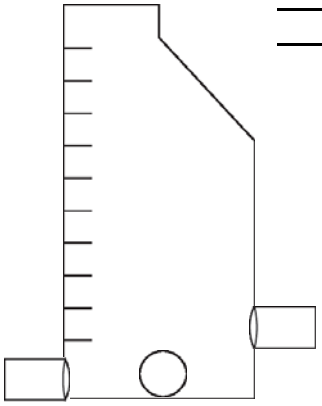
Manhole Inspection Form for Structure:

107

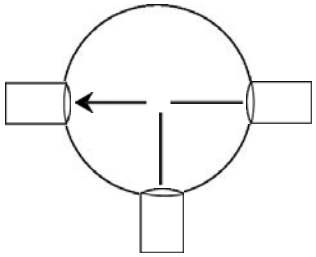
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	7.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	7.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.70
	9.80
	9.80
Max Manhole Depth (ft):	9.80



Pipe Size (in)	Material	Direction	Drop
10		E	9.70
10		W	9.80
8		S	9.80

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**3.15**	**18.19**	**218.28**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$5,266.05**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 7 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

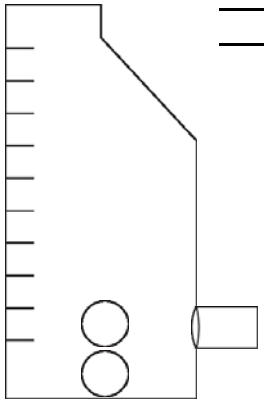
Manhole Inspection Form for Structure:

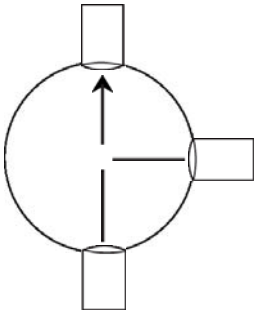
11

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.80
	13.00
	13.10
Max Manhole Depth (ft):	13.10

Pipe Size (in)	Material	Direction	Drop
8		S	12.80
12		E	13.00
12		N	13.10

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.51**	**2.93**	**35.17**

Recommended I/I Rehabilitation — **Cost**

1. Remove and Reset Frame (Veg./Gravel) — $350.00
2. Seal Leaks with Mortar — $400.00
3.
4.
5.
6.
7.

Total Rehab Cost: **$1,087.50**
Storage Construction Costs: **$848.52**

Cost-effective to Rehab?: NO

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

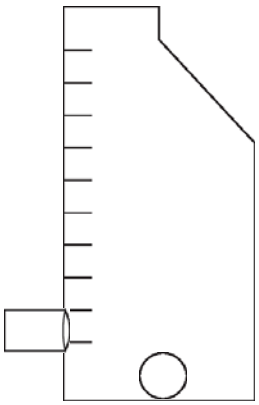
Manhole Inspection Form for Structure:

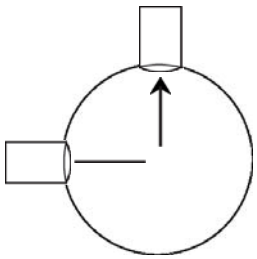
118

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Poor
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.40
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	14.60
	15.30
Max Manhole Depth (ft):	15.30

Pipe Size (in)	Material	Direction	Drop
10		W	14.60
15		N	15.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-7
Inflow Rating:	I-7
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	2.50	14.44	173.24
Structure Rating:	3.13	18.04	216.55
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**6.25**	**36.09**	**433.10**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Replace Corbel (Pavement)	$550.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Construction Cost:	$1,750.00
25% Engineering and Legal:	437.50
20% Contingency:	$350.00
TOTAL COST:	**$2,537.50**

Total Rehab Cost: **$2,537.50**
Storage Construction Costs: **$10,447.10**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

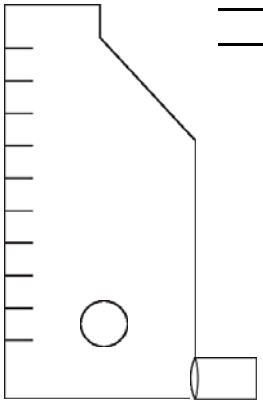
Manhole Inspection Form for Structure:

119

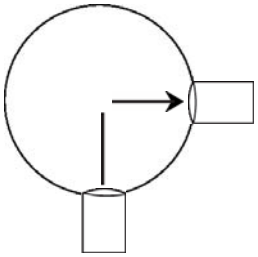
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Block
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	15.50 15.60
Max Manhole Depth (ft):	15.60



Pipe Size (in)	Material	Direction	Drop
10		S	15.50
10		E	15.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**1.02**	**5.89**	**70.68**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,705.36**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

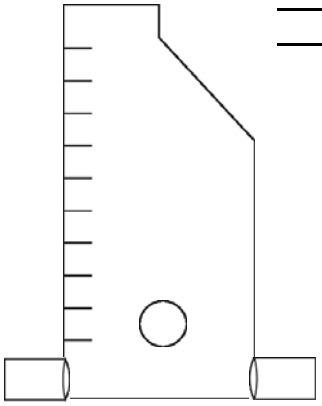
Manhole Inspection Form for Structure:

12

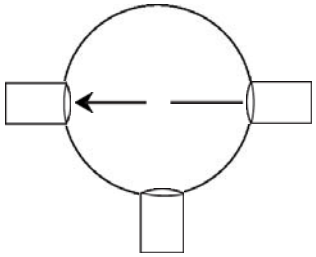
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	13.70
	14.10
	14.10
Max Manhole Depth (ft):	14.10



Pipe Size (in)	Material	Direction	Drop
8		S	13.70
12		W	14.10
10		E	14.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.48**	**2.76**	**33.09**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$798.36**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 4 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

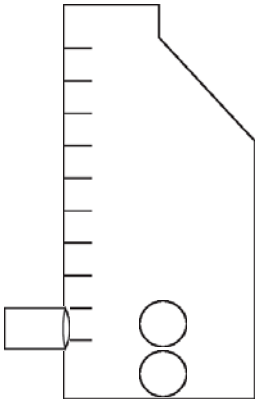
Manhole Inspection Form for Structure:

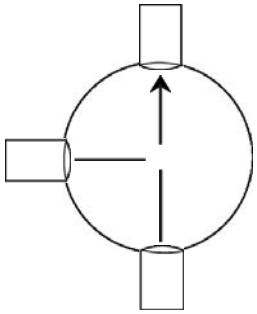
121

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Poor
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.25
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.10 10.60 10.70
Max Manhole Depth (ft):	10.70

Pipe Size (in)	Material	Direction	Drop
8	Clay	W	10.10
10	Clay	S	10.60
10	Clay	N	10.70

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	Yes
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**3.75**	**21.65**	**259.86**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Construction Cost:	$2,900.00
25% Engineering and Legal:	725.00
20% Contingency:	$580.00
TOTAL COST:	**$4,205.00**

Total Rehab Cost:	**$4,205.00**
Storage Construction Costs:	**$6,268.95**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

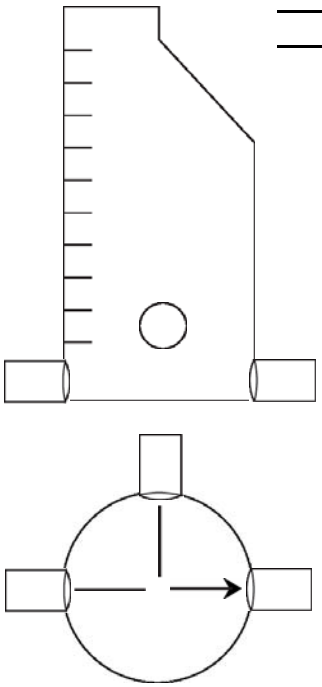
Manhole Inspection Form for Structure:

122

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Broken
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.75
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Poor
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.75
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	14.25 14.30 14.30
Max Manhole Depth (ft):	14.30

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	14.25
8	Clay	E	14.30
8	Clay	W	14.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	Yes
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.13	0.72	8.66
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.39**	**2.25**	**27.03**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Replace Frame (Pavement)	$1,000.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,450.00**
Storage Construction Costs:	**$652.07**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,000.00
25% Engineering and Legal:	250.00
20% Contingency:	$200.00
TOTAL COST:	**$1,450.00**

This is a Category 4 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

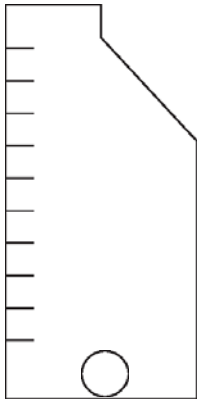
Manhole Inspection Form for Structure:

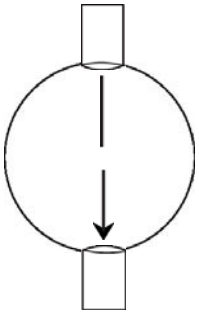
123

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	14.80
	14.80
Max Manhole Depth (ft):	14.80

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	14.80
8	Clay	S	14.80

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.72**	**4.14**	**49.72**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$1,199.62**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

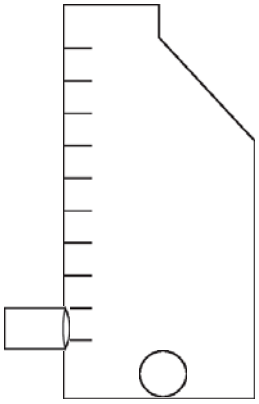
Manhole Inspection Form for Structure:

124

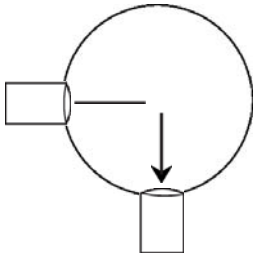
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Poor
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.10 12.60
Max Manhole Depth (ft):	12.60



Pipe Size (in)	Material	Direction	Drop
8	Clay	W	12.10
8	Clay	S	12.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Drive Way
Manhole Surcharge:	Yes
Flooding/Ponding:	Yes
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**3.75**	**21.65**	**259.86**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$2,500.00
25% Engineering and Legal:	625.00
20% Contingency:	$500.00
TOTAL COST:	**$3,625.00**

Total Rehab Cost: **$3,625.00**
Storage Construction Costs: **$6,268.95**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

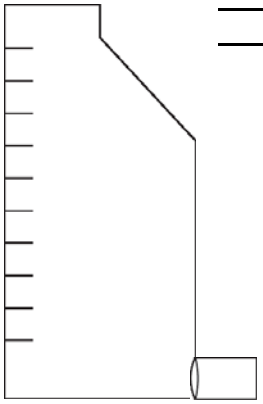
Manhole Inspection Form for Structure:

125

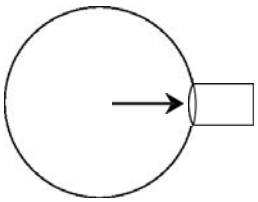
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Centric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Poor
Flow Depth (ft):	0.00
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.70
Max Manhole Depth (ft):	12.70



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	12.70

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	none
Flow Clarity:	DNR
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**0.84**	**4.84**	**58.04**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$1,400.24**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 7 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

Manhole Inspection Form for Structure:

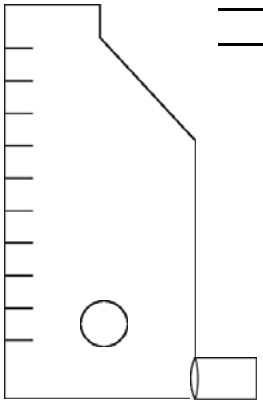
126

Structural Information

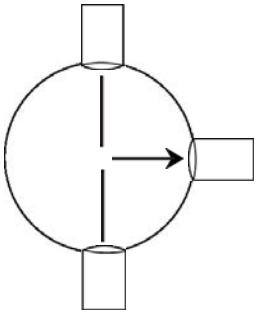
Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Poor
Flow Depth (ft):	0.50
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
debris

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	16.00
	16.00
	16.40
Max Manhole Depth (ft):	16.40



Pipe Size (in)	Material	Direction	Drop
8	Clay	N	16.00
8		S	16.00
8		E	16.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.58**	**3.35**	**40.19**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5. Seal Leaks with Mortar	$400.00
6. Seal Leaks with Mortar	$400.00
7.	

Total Construction Cost:	$2,400.00
25% Engineering and Legal:	600.00
20% Contingency:	$480.00
TOTAL COST:	**$3,480.00**

Total Rehab Cost: **$3,480.00**
Storage Construction Costs: **$969.73**

Cost-effective to Rehab?: NO

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

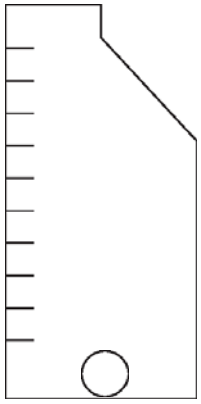
Manhole Inspection Form for Structure:

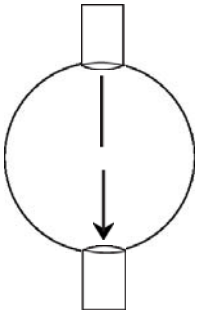
127

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	2.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.08
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	2.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	13.90
	13.90
Max Manhole Depth (ft):	13.90

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	13.90
8	Clay	S	13.90

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**0.70**	**4.04**	**48.51**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Rehab Cost:	**$2,320.00**
Storage Construction Costs:	**$1,170.36**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,600.00
25% Engineering and Legal:	400.00
20% Contingency:	$320.00
TOTAL COST:	**$2,320.00**

This is a Category 7 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

Manhole Inspection Form for Structure:

128

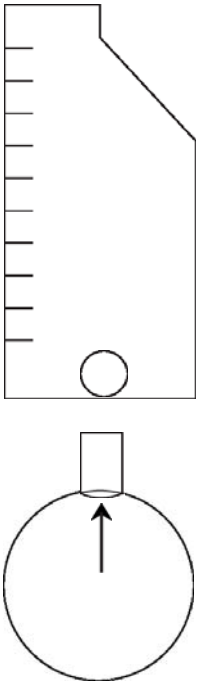
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	DNR
Flow Depth (ft):	0.00
Steps Condition:	Good
Step Material:	DNR

Structure Notes:

many roots - like sod coming from east apt service

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	15.00
Max Manhole Depth (ft):	15.00

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	15.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Wooded Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**0.99**	**5.70**	**68.43**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,667.50**
Storage Construction Costs:	**$1,651.02**

Cost-effective to Rehab?: NO

Total Construction Cost:	$1,150.00
25% Engineering and Legal:	287.50
20% Contingency:	$230.00
TOTAL COST:	**$1,667.50**

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

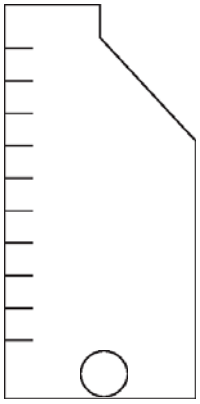
Manhole Inspection Form for Structure:

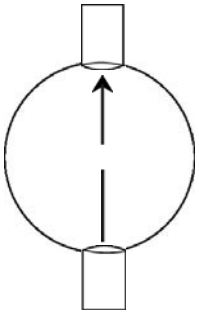
129

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.60
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.60
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.85
	9.85
Max Manhole Depth (ft):	9.85

Pipe Size (in)	Material	Direction	Drop
10	Clay	S	9.85
10	Clay	N	9.85

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Shoulder
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.58**	**3.35**	**40.19**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$969.73**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

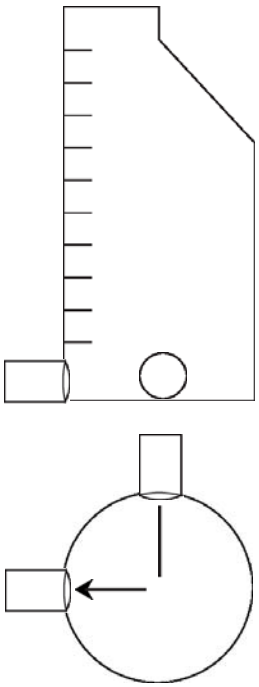
Manhole Inspection Form for Structure:

13

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.66
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.66
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	13.60
	13.60
Max Manhole Depth (ft):	13.60

Pipe Size (in)	Material	Direction	Drop
10		N	13.60
10		W	13.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**0.38**	**2.17**	**25.99**

Recommended I/I Rehabilitation — **Cost**

1. Remove and Reset Frame (Veg./Gravel) — $350.00
2.
3.
4.
5.
6.
7.

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$626.99**

Cost-effective to Rehab?: YES

This is a Category 4 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

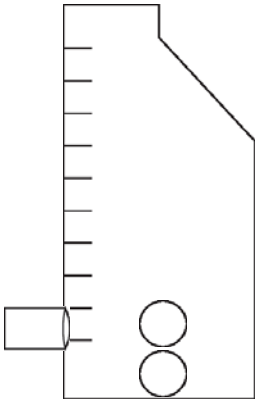
Manhole Inspection Form for Structure:

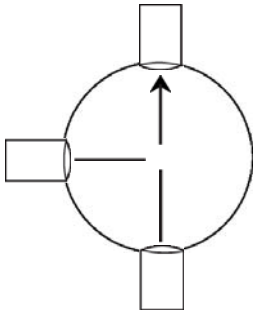
130

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	4.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	4.00
Pipe Invert Depth(s) (ft):	9.30 9.70 9.90
Max Manhole Depth (ft):	9.90

Pipe Size (in)	Material	Direction	Drop
8	Clay	W	9.30
10	Clay	N	9.70
10	Clay	S	9.90

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.13	0.72	8.66
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.63**	**3.64**	**43.66**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$1,053.33**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

Manhole Inspection Form for Structure:

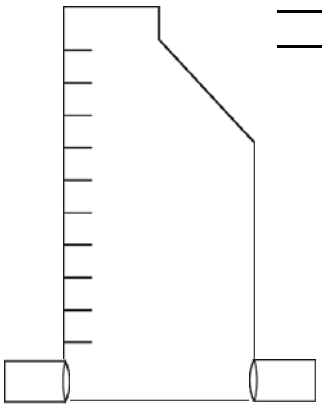
131

Structural Information

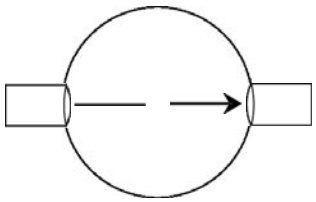
Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	DNR
Flow Depth (ft):	0.00
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
no channel

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	16.40
	16.40
Max Manhole Depth (ft):	16.40



Pipe Size (in)	Material	Direction	Drop
8		W	16.40
8		E	16.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.46**	**2.66**	**31.88**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,160.00**
Storage Construction Costs:	**$769.10**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$800.00
25% Engineering and Legal:	200.00
20% Contingency:	$160.00
TOTAL COST:	**$1,160.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

Manhole Inspection Form for Structure:

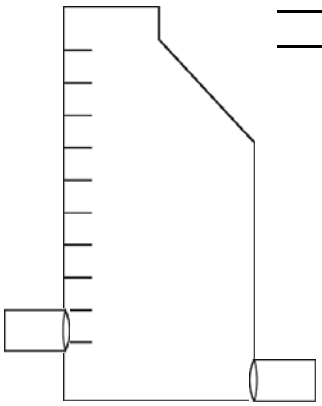
132

Structural Information

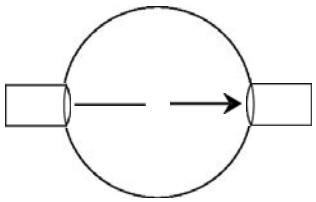
Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Fair
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	2.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	DNR
Flow Depth (ft):	0.00
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
no channel

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	2.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.05
	12.60
Max Manhole Depth (ft):	12.60



Pipe Size (in)	Material	Direction	Drop
8		W	12.05
8		E	12.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	DNR
Flow Clarity:	DNR
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**0.70**	**4.04**	**48.51**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5. Seal Leaks with Mortar	$400.00
6.	
7.	

Total Rehab Cost:	**$2,900.00**
Storage Construction Costs:	**$1,170.36**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$2,000.00
25% Engineering and Legal:	500.00
20% Contingency:	$400.00
TOTAL COST:	**$2,900.00**

This is a Category 7 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

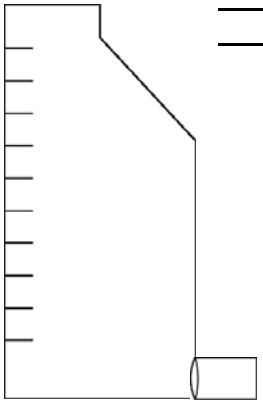
Manhole Inspection Form for Structure:

132A

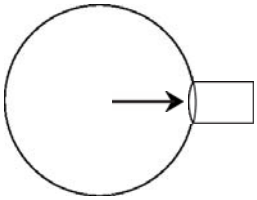
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.40
Max Manhole Depth (ft):	10.40



Pipe Size (in)	Material	Direction	Drop
8		E	10.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**0.99**	**5.70**	**68.43**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,150.00
25% Engineering and Legal:	287.50
20% Contingency:	$230.00
TOTAL COST:	**$1,667.50**

Total Rehab Cost:	**$1,667.50**
Storage Construction Costs:	**$1,651.02**
Cost-effective to Rehab?:	**NO**

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

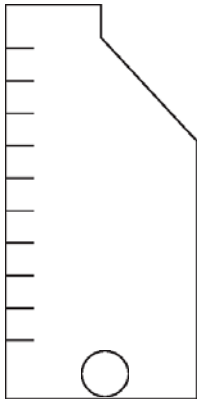
Manhole Inspection Form for Structure:

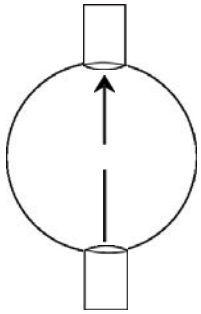
133

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	2.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	2.00
Pipe Invert Depth(s) (ft):	12.90
	12.90
Max Manhole Depth (ft):	12.90

Pipe Size (in)	Material	Direction	Drop
10		S	12.90
10		N	12.90

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.13	0.72	8.66
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.63**	**3.64**	**43.66**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$580.00**
Storage Construction Costs:	**$1,053.33**

Cost-effective to Rehab?: YES

Total Construction Cost:	$400.00
25% Engineering and Legal:	100.00
20% Contingency:	$80.00
TOTAL COST:	**$580.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

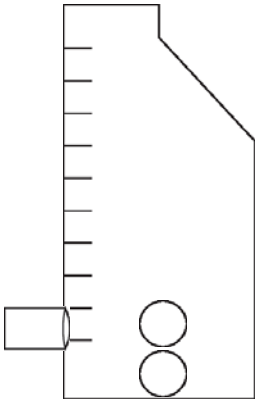
Manhole Inspection Form for Structure:

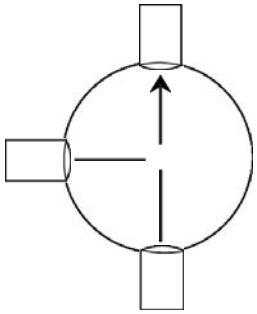
134

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Broken
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	1.80
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	1.80
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.00 10.90 11.00
Max Manhole Depth (ft):	11.00

Pipe Size (in)	Material	Direction	Drop
8		W	10.00
10		S	10.90
10		N	11.00

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	Yes
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**3.75**	**21.65**	**259.86**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5. Seal Leaks with Mortar	$400.00
6.	
7.	

Total Construction Cost:	$3,300.00
25% Engineering and Legal:	825.00
20% Contingency:	$660.00
TOTAL COST:	**$4,785.00**

Total Rehab Cost: **$4,785.00**
Storage Construction Costs: **$6,268.95**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

Manhole Inspection Form for Structure:

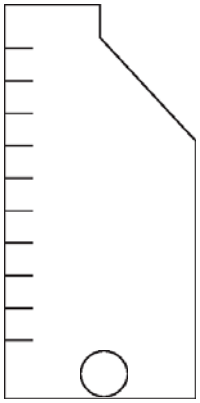
135

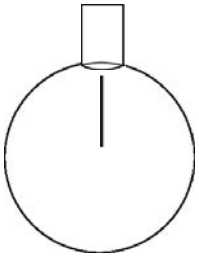
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Brick
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	0.25
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.00
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
no flow

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	0.25
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.60
Max Manhole Depth (ft):	9.60

Pipe Size (in)	Material	Direction	Drop
10	Clay	N	9.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	DNR
Flow Clarity:	DNR
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**3.51**	**20.27**	**243.23**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$5,867.80**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

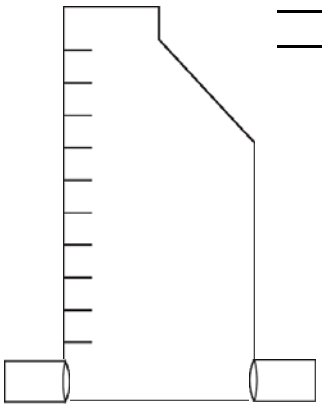
Manhole Inspection Form for Structure:

136

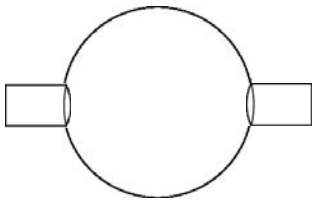
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	2.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	2.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	14.00
	14.00
Max Manhole Depth (ft):	14.00



Pipe Size (in)	Material	Direction	Drop
8		E	14.00
8		W	14.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Wooded Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.48**	**2.76**	**33.09**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$798.36**

Cost-effective to Rehab?: YES

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 4 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

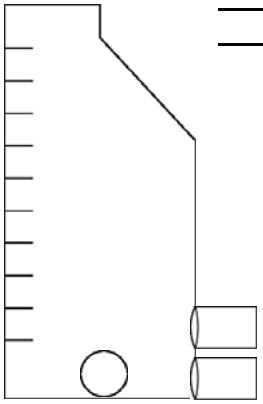
Manhole Inspection Form for Structure:

14

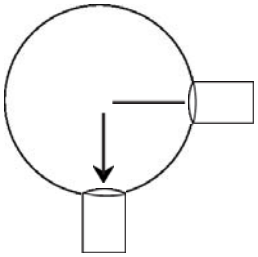
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.67
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.67
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	5.70
	13.20
	13.20
Max Manhole Depth (ft):	13.20



Pipe Size (in)	Material	Direction	Drop
6		E	5.70
10		E	13.20
10		S	13.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	DNR
Flow Clarity:	DNR
Structure Rating:	S-1
Inflow Rating:	I-1
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.00	0.00	0.00
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.00**	**0.00**	**0.00**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$0.00**

Cost-effective to Rehab?: NO

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 1 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

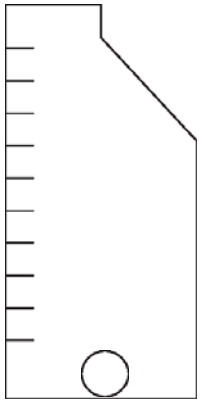
Manhole Inspection Form for Structure:

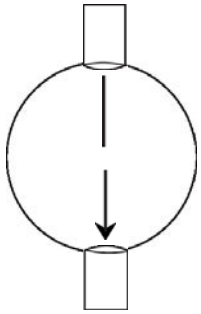
15

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	2.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	2.00
Pipe Invert Depth(s) (ft):	17.40
	17.40
Max Manhole Depth (ft):	17.40

Pipe Size (in)	Material	Direction	Drop
10		N	17.40
10		S	17.40

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-5
Inflow Rating:	I-1
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.00	0.00	0.00
Structure Rating:	1.13	6.50	77.96
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.51**	**8.72**	**104.64**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$580.00**
Storage Construction Costs:	**$2,524.54**

Cost-effective to Rehab?: YES

Total Construction Cost:	$400.00
25% Engineering and Legal:	100.00
20% Contingency:	$80.00
TOTAL COST:	**$580.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

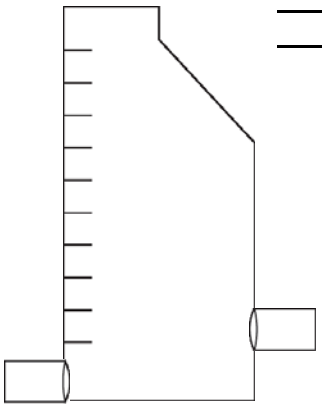
Manhole Inspection Form for Structure:

151

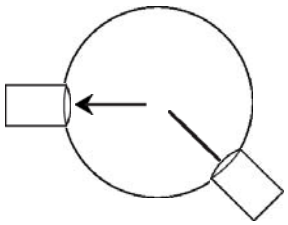
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	0.10
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	
debris	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.10
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.50 9.55
Max Manhole Depth (ft):	9.55



Pipe Size (in)	Material	Direction	Drop
8		SE	9.50
8		W	9.55

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.88**	**5.05**	**60.63**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$1,462.94**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

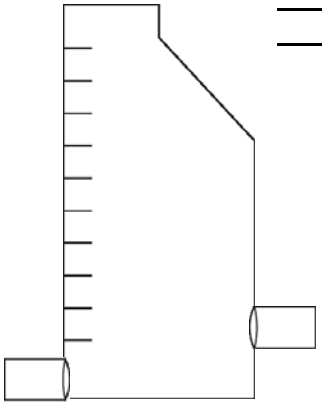
Manhole Inspection Form for Structure:

152

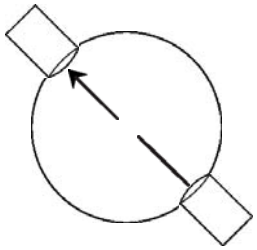
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Fair
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Broken
Adjusting Ring Type:	Brick
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	4.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	4.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.95
	10.00
Max Manhole Depth (ft):	10.00



Pipe Size (in)	Material	Direction	Drop
8		SE	9.95
8		NW	10.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**0.90**	**5.20**	**62.37**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$3,552.50**
Storage Construction Costs:	**$1,504.73**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$2,450.00
25% Engineering and Legal:	612.50
20% Contingency:	$490.00
TOTAL COST:	**$3,552.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

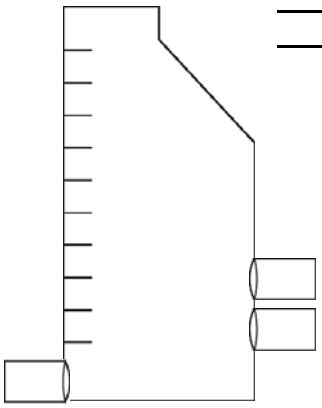
Manhole Inspection Form for Structure:

153

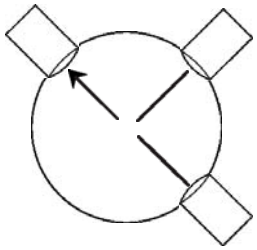
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	6.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	6.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.95 10.00 10.10
Max Manhole Depth (ft):	10.10



Pipe Size (in)	Material	Direction	Drop
8		SE	9.95
8		NE	10.00
8		NW	10.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	DNR
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.88**	**5.05**	**60.63**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,462.94**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

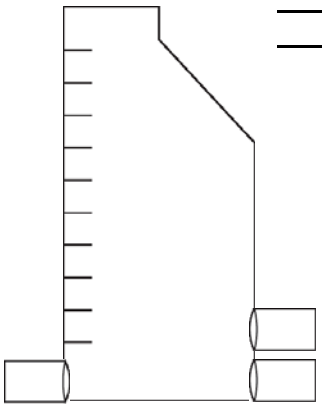
Manhole Inspection Form for Structure:

154

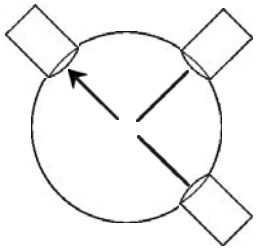
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	8.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	8.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.90
	9.00
	9.00
Max Manhole Depth (ft):	9.00



Pipe Size (in)	Material	Direction	Drop
8	Clay	NE	8.90
8	Clay	SE	9.00
8	Clay	NW	9.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.69	3.97	47.64
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**0.71**	**4.11**	**49.37**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (> 2 ft. Pavement)	$2,200.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$2,200.00
25% Engineering and Legal:	550.00
20% Contingency:	$440.00
TOTAL COST:	**$3,190.00**

Total Rehab Cost:	**$3,190.00**
Storage Construction Costs:	**$1,191.26**

Cost-effective to Rehab?: NO

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

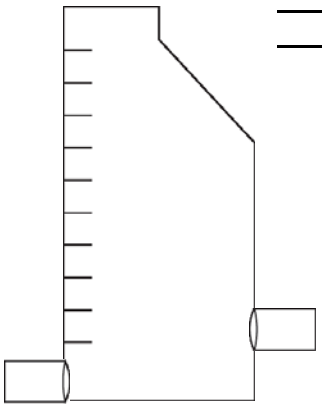
Manhole Inspection Form for Structure:

156

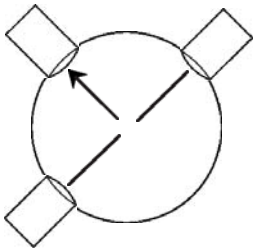
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	10.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	10.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.70
	10.05
	10.05
Max Manhole Depth (ft):	10.05



Pipe Size (in)	Material	Direction	Drop
8	Clay	NE	9.70
8	Clay	SW	10.05
8	Clay	NW	10.05

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**1.38**	**7.97**	**95.63**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Construction Cost:	$2,900.00
25% Engineering and Legal:	725.00
20% Contingency:	$580.00
TOTAL COST:	**$4,205.00**

Total Rehab Cost:	**$4,205.00**
Storage Construction Costs:	**$2,307.21**

Cost-effective to Rehab?: NO

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

Manhole Inspection Form for Structure:

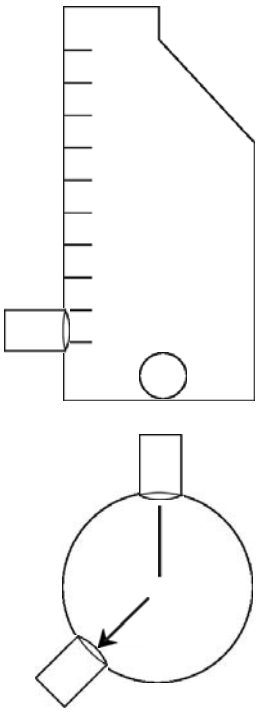
157

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.10
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
needs cleaning

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.10
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.90 8.95
Max Manhole Depth (ft):	8.95

Pipe Size (in)	Material	Direction	Drop
8	Clay	SW	8.90
8	Clay	N	8.95

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.08**	**0.43**	**5.20**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$125.40**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 2 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

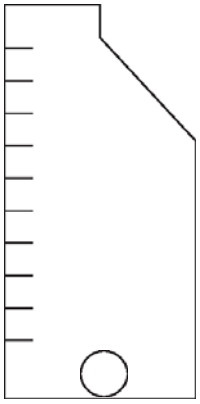
Manhole Inspection Form for Structure:

158

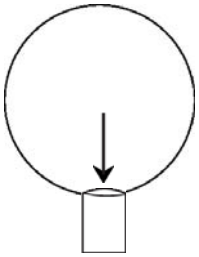
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.00
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.50
Max Manhole Depth (ft):	8.50



Pipe Size (in)	Material	Direction	Drop
8	Clay	S	8.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	none
Flow Clarity:	None
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.35**	**2.02**	**24.25**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$585.19**
Cost-effective to Rehab?:	**YES**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

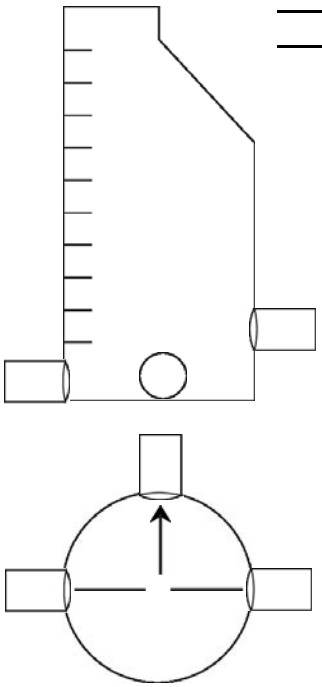
Manhole Inspection Form for Structure:

16

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.33
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.33
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.10
	11.90
	11.90
Max Manhole Depth (ft):	11.90

Pipe Size (in)	Material	Direction	Drop
8	Clay	E	10.10
8	Clay	W	11.90
8		N	11.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.21**	**1.23**	**14.73**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,015.00**
Storage Construction Costs:	**$355.30**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$700.00
25% Engineering and Legal:	175.00
20% Contingency:	$140.00
TOTAL COST:	**$1,015.00**

This is a Category 3 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

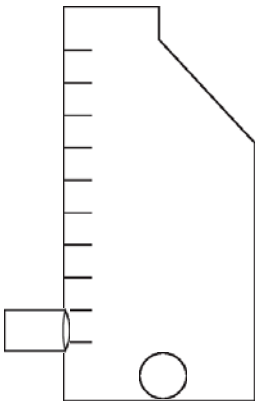
Manhole Inspection Form for Structure:

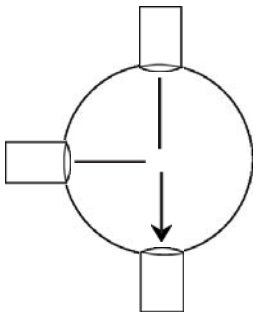
161

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.30
	10.50
	10.50
Max Manhole Depth (ft):	10.50

Pipe Size (in)	Material	Direction	Drop
8		W	9.30
21		N	10.50
21		S	10.50

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.63	3.61	43.31
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.01**	**5.83**	**69.99**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$1,688.64**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

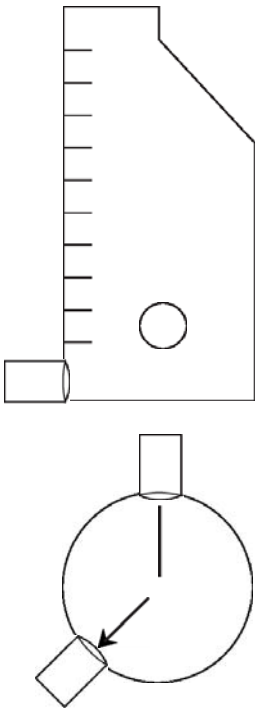
Manhole Inspection Form for Structure:

163

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.70
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.90 11.95
Max Manhole Depth (ft):	11.95

Pipe Size (in)	Material	Direction	Drop
21		N	11.90
21		SW	11.95

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.63	3.61	43.31
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.77**	**4.45**	**53.36**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$1,287.39**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

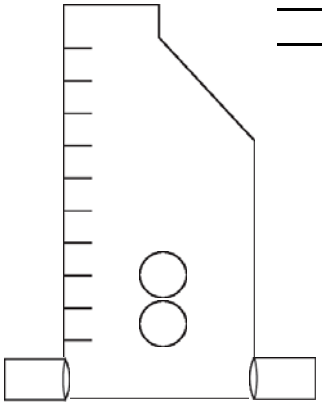
Manhole Inspection Form for Structure:

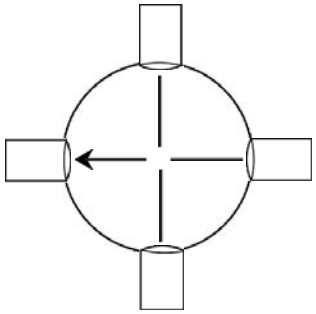
168

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	2.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.50
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	2.00
Pipe Invert Depth(s) (ft):	9.90
	10.90
	11.80
	11.80
Max Manhole Depth (ft):	11.80

Pipe Size (in)	Material	Direction	Drop
12	Clay	N	9.90
10	Clay	S	10.90
24	Clay	E	11.80
24	Clay	W	11.80

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Side Walk
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.63	3.61	43.31
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.89**	**5.14**	**61.67**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$1,488.02**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

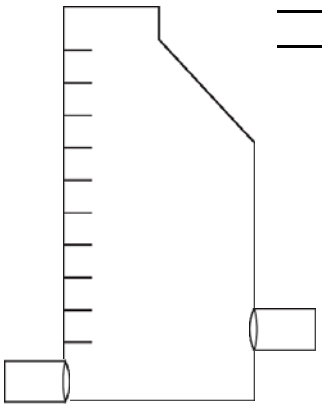
Manhole Inspection Form for Structure:

169

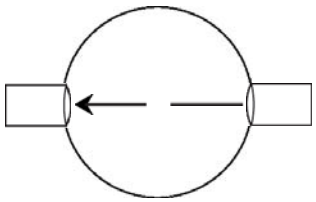
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.50
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.00
	11.05
Max Manhole Depth (ft):	11.05



Pipe Size (in)	Material	Direction	Drop
24		E	11.00
24	Conc	W	11.05

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**0.24**	**1.37**	**16.46**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$397.09**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 3 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

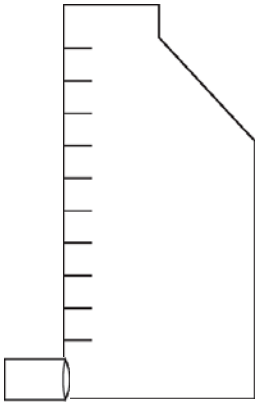
Manhole Inspection Form for Structure:

17

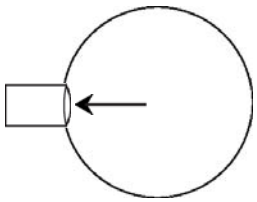
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	DNR
Corbel Condition:	DNR
Corbel Centricity:	Eccentric
Corbel Depth (ft):	0.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.00
Steps Condition:	DNR
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	0.00
Pipe Invert Depth(s) (ft):	3.30
Max Manhole Depth (ft):	3.30



Pipe Size (in)	Material	Direction	Drop
8		W	3.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	DNR
Flow Clarity:	DNR
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.50**	**2.89**	**34.65**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$835.98**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

Manhole Inspection Form for Structure:

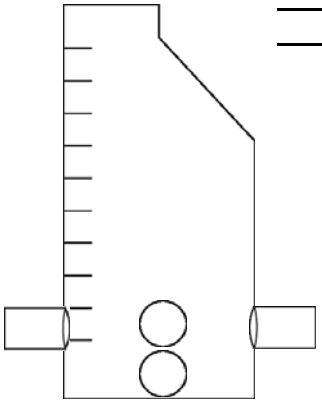
172

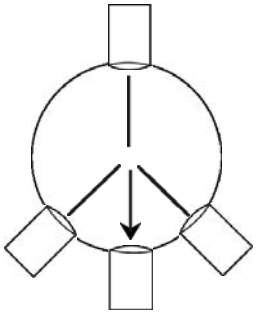
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	6.00
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
cement block on bottom

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.10
	10.90
	12.00
	12.10
Max Manhole Depth (ft):	12.10

Pipe Size (in)	Material	Direction	Drop
8		SE	10.10
8		SW	10.90
24		N	12.00
24		S	12.10

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.58**	**3.35**	**40.19**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$969.73**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

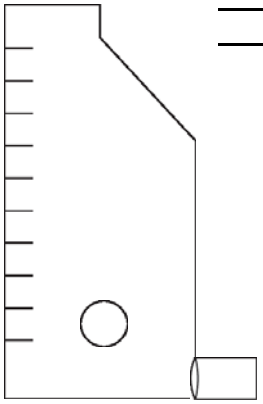
Manhole Inspection Form for Structure:

173

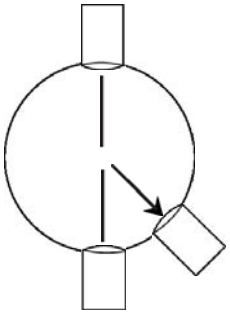
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Brick
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	0.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.10 9.10 9.20
Max Manhole Depth (ft):	9.20



Pipe Size (in)	Material	Direction	Drop
8		N	9.10
8	Clay	S	9.10
8		SE	9.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**3.63**	**20.96**	**251.54**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$3,045.00**
Storage Construction Costs:	**$6,068.37**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$2,100.00
25% Engineering and Legal:	525.00
20% Contingency:	$420.00
TOTAL COST:	**$3,045.00**

This is a Category 7 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

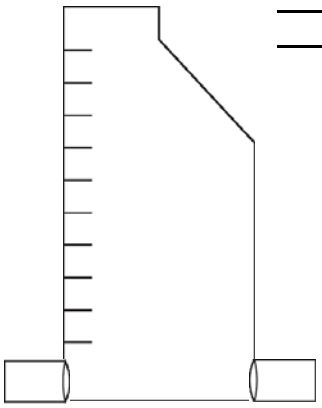
Manhole Inspection Form for Structure:

18

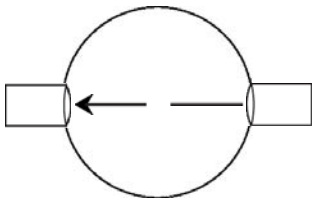
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.33
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.33
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.10
	8.10
Max Manhole Depth (ft):	8.10



Pipe Size (in)	Material	Direction	Drop
8		E	8.10
8		W	8.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.50**	**2.89**	**34.65**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$835.98**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

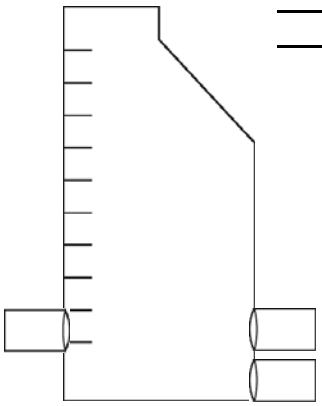
Manhole Inspection Form for Structure:

183

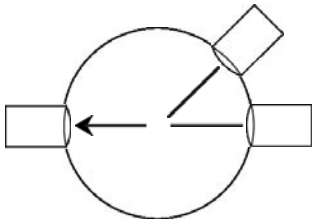
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	6.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	6.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.50 10.25 10.50
Max Manhole Depth (ft):	10.50



Pipe Size (in)	Material	Direction	Drop
8	Clay	NE	9.50
21		W	10.25
21		E	10.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.51**	**2.93**	**35.17**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,667.50**
Storage Construction Costs:	**$848.52**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,150.00
25% Engineering and Legal:	287.50
20% Contingency:	$230.00
TOTAL COST:	**$1,667.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

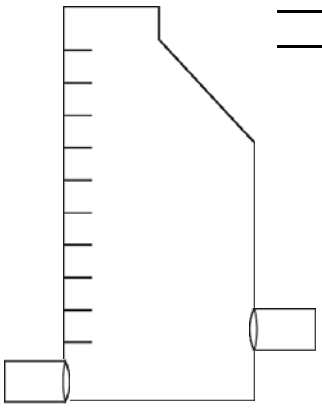
Manhole Inspection Form for Structure:

183A

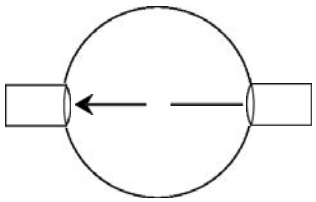
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	6.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	6.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.30
	7.40
Max Manhole Depth (ft):	7.40



Pipe Size (in)	Material	Direction	Drop
21	Conc	E	7.30
21	Conc	W	7.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	Yes
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.63	3.61	43.31
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.77**	**4.45**	**53.36**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,015.00**
Storage Construction Costs:	**$1,287.39**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$700.00
25% Engineering and Legal:	175.00
20% Contingency:	$140.00
TOTAL COST:	**$1,015.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

Manhole Inspection Form for Structure:

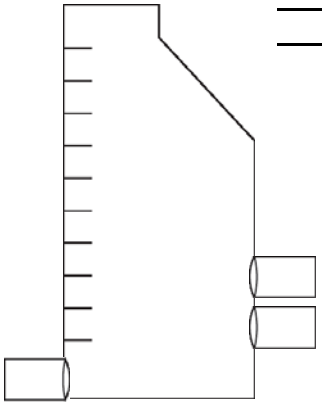
184

Structural Information

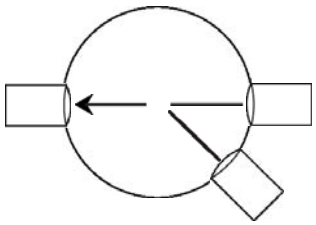
Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	Yes
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	None
Corbel Condition:	DNR
Corbel Centricity:	Eccentric
Corbel Depth (ft):	0.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.40
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
flat top

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	0.00
Pipe Invert Depth(s) (ft):	6.10 6.25 6.30
Max Manhole Depth (ft):	6.30



Pipe Size (in)	Material	Direction	Drop
24	Conc	SE	6.10
21	Conc	E	6.25
21	Conc	W	6.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	Yes
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**0.10**	**0.58**	**6.93**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$167.20**

Cost-effective to Rehab?: YES

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 2 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

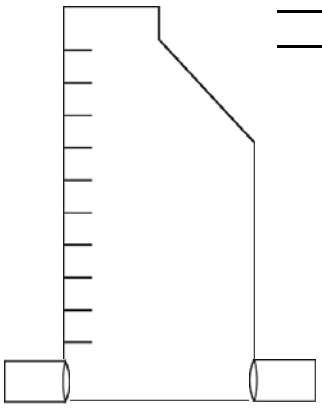
Manhole Inspection Form for Structure:

185

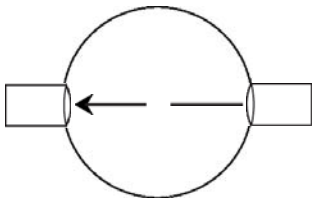
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.70
	7.70
Max Manhole Depth (ft):	7.70



Pipe Size (in)	Material	Direction	Drop
18	Clay	E	7.70
21		W	7.70

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Construction Cost:	$1,600.00
25% Engineering and Legal:	400.00
20% Contingency:	$320.00
TOTAL COST:	**$2,320.00**

Total Rehab Cost: **$2,320.00**
Storage Construction Costs: **$1,228.88**

Cost-effective to Rehab?: NO

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

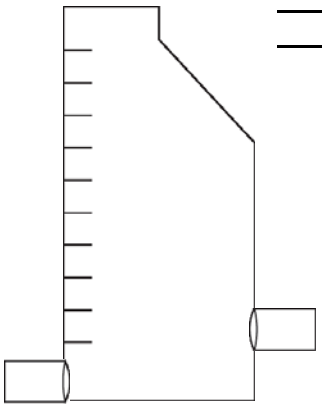
Manhole Inspection Form for Structure:

186

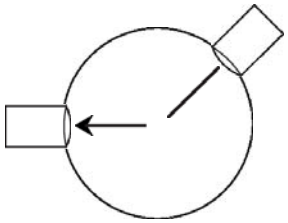
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	13.70 13.80
Max Manhole Depth (ft):	13.80



Pipe Size (in)	Material	Direction	Drop
18		NE	13.70
18		W	13.80

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.60**	**3.45**	**41.40**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$998.99**

Cost-effective to Rehab?: YES

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

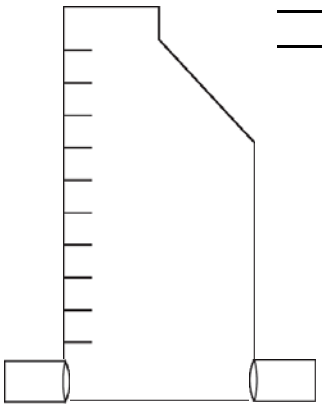
Manhole Inspection Form for Structure:

188

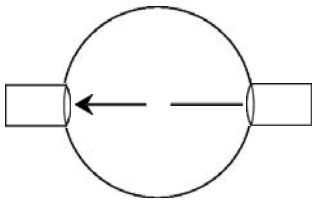
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	8.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	8.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.25 10.25
Max Manhole Depth (ft):	10.25



Pipe Size (in)	Material	Direction	Drop
24	Clay	E	10.25
24	Clay	W	10.25

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**0.70**	**4.04**	**48.51**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,160.00**
Storage Construction Costs:	**$1,170.36**

Cost-effective to Rehab?: YES

Total Construction Cost:	$800.00
25% Engineering and Legal:	200.00
20% Contingency:	$160.00
TOTAL COST:	**$1,160.00**

This is a Category 7 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

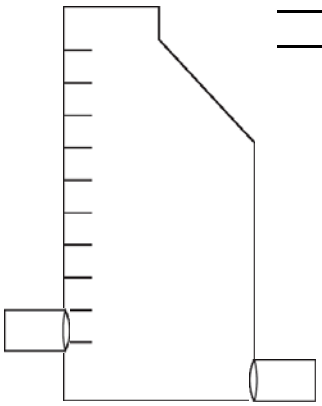
Manhole Inspection Form for Structure:

19

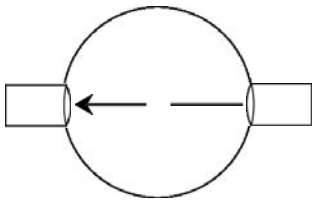
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.25
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.25
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.40 9.50
Max Manhole Depth (ft):	9.50



Pipe Size (in)	Material	Direction	Drop
8	Clay	W	9.40
8	Clay	E	9.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	DNR
Flow Clarity:	DNR
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.50**	**2.89**	**34.65**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$835.98**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

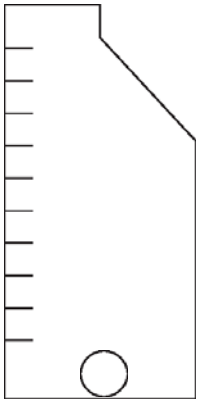
Manhole Inspection Form for Structure:

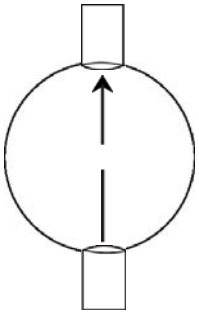
190

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	6.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	6.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.30
	9.30
Max Manhole Depth (ft):	9.30

Pipe Size (in)	Material	Direction	Drop
8	Clay	S	9.30
8	Clay	N	9.30

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,500.00
25% Engineering and Legal:	375.00
20% Contingency:	$300.00
TOTAL COST:	**$2,175.00**

Total Rehab Cost: **$2,175.00**
Storage Construction Costs: **$1,228.88**

Cost-effective to Rehab?: NO

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

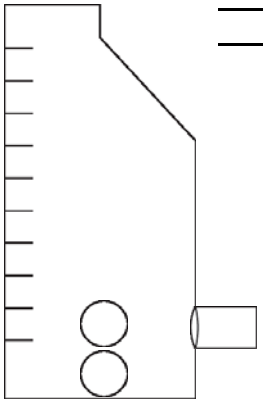
Manhole Inspection Form for Structure:

191

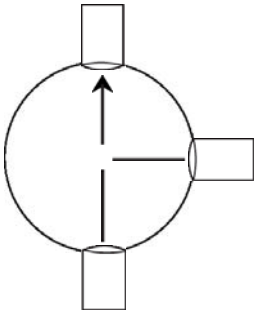
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.20
Corbel Type:	Precast
Corbel Condition:	Poor
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.95 11.25 11.30
Max Manhole Depth (ft):	11.30



Pipe Size (in)	Material	Direction	Drop
12		E	10.95
8		S	11.25
15		N	11.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.46**	**2.66**	**31.88**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$769.10**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

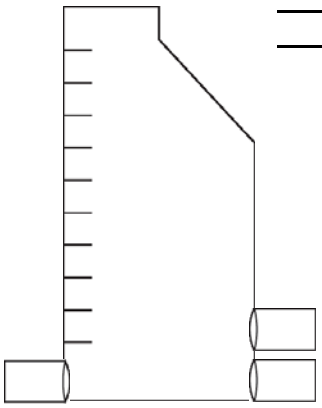
Manhole Inspection Form for Structure:

192

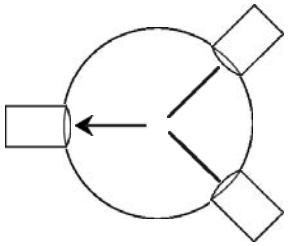
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	6.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	6.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.85
	8.00
	8.00
Max Manhole Depth (ft):	8.00



Pipe Size (in)	Material	Direction	Drop
12		SE	7.85
8		NE	8.00
12		W	8.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-1
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.00	0.00	0.00
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.51**	**2.92**	**34.99**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$844.34**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

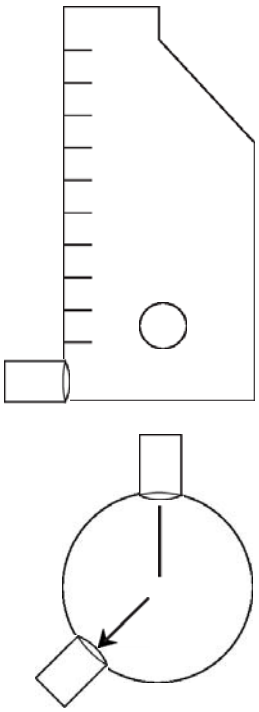
Manhole Inspection Form for Structure:

193

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Missing
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.60 10.70
Max Manhole Depth (ft):	10.70

Pipe Size (in)	Material	Direction	Drop
8		N	10.60
12		SW	10.70

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.87**	**5.01**	**60.11**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,150.00
25% Engineering and Legal:	287.50
20% Contingency:	$230.00
TOTAL COST:	**$1,667.50**

Total Rehab Cost:	**$1,667.50**
Storage Construction Costs:	**$1,450.40**

Cost-effective to Rehab?: NO

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

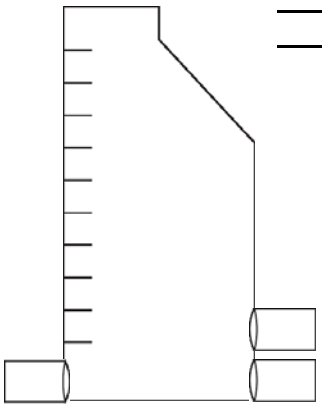
Manhole Inspection Form for Structure:

194

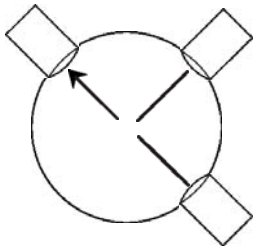
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Fair
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	6.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	6.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.15 7.20 7.20
Max Manhole Depth (ft):	7.20



Pipe Size (in)	Material	Direction	Drop
12		SE	7.15
12		NW	7.20
12		NE	7.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	DNR
Flooding/Ponding:	Yes
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.21**	**1.23**	**14.73**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$355.30**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 3 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

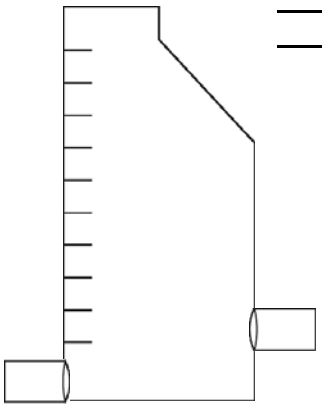
Manhole Inspection Form for Structure:

195

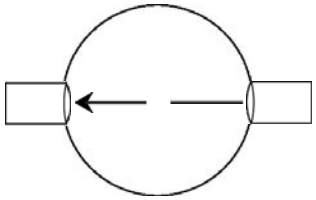
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.30 9.40
Max Manhole Depth (ft):	9.40



Pipe Size (in)	Material	Direction	Drop
12		E	9.30
12		W	9.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.22**	**1.27**	**15.25**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$367.83**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 3 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

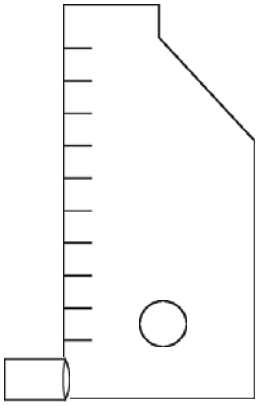
Manhole Inspection Form for Structure:

196

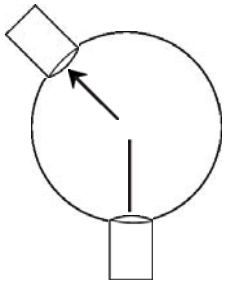
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	4.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	4.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.40
	10.50
Max Manhole Depth (ft):	10.50



Pipe Size (in)	Material	Direction	Drop
8		S	10.40
8	Clay	NW	10.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.60**	**3.45**	**41.40**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,015.00**
Storage Construction Costs:	**$998.99**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$700.00
25% Engineering and Legal:	175.00
20% Contingency:	$140.00
TOTAL COST:	**$1,015.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

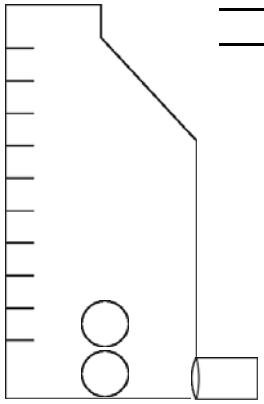
Manhole Inspection Form for Structure:

197

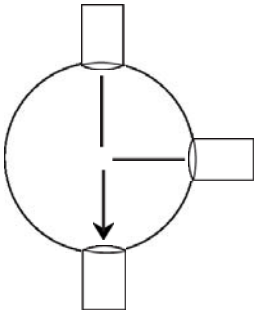
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.50
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	16.40 16.60 16.60
Max Manhole Depth (ft):	16.60



Pipe Size (in)	Material	Direction	Drop
8	PVC	N	16.40
18	Clay	E	16.60
18	Clay	S	16.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Side Walk
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.58**	**3.35**	**40.19**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,160.00**
Storage Construction Costs:	**$969.73**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$800.00
25% Engineering and Legal:	200.00
20% Contingency:	$160.00
TOTAL COST:	**$1,160.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

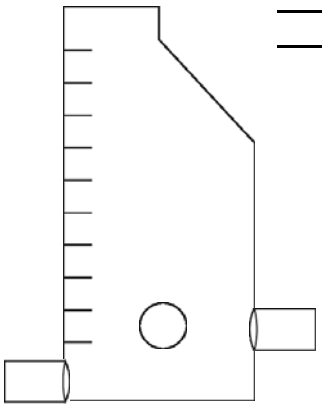
Manhole Inspection Form for Structure:

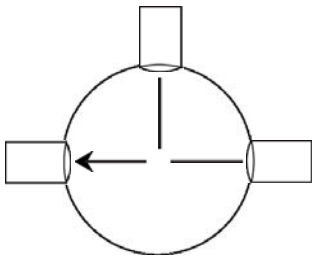
198

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	6.00
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	15.60 16.00 16.30
Max Manhole Depth (ft):	16.30

Pipe Size (in)	Material	Direction	Drop
15	Clay	N	15.60
12	Clay	E	16.00
18	Clay	W	16.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	2.50	14.44	173.24
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**3.01**	**17.35**	**208.23**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5. Seal Leaks with Mortar	$400.00
6. Seal Leaks with Mortar	$400.00
7.	

Total Construction Cost:	$2,350.00
25% Engineering and Legal:	587.50
20% Contingency:	$470.00
TOTAL COST:	**$3,407.50**

Total Rehab Cost: **$3,407.50**
Storage Construction Costs: **$5,023.68**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

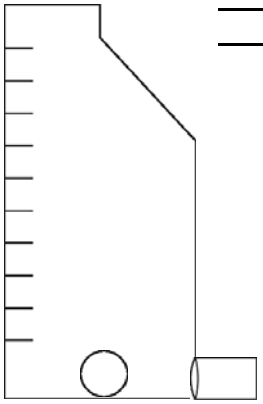
Manhole Inspection Form for Structure:

199

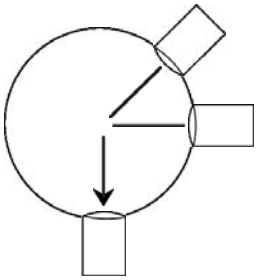
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.80
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.80
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.50
	11.50
	11.50
Max Manhole Depth (ft):	11.50



Pipe Size (in)	Material	Direction	Drop
8		NE	11.50
8		E	11.50
8		S	11.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.86**	**4.94**	**59.25**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,160.00**
Storage Construction Costs:	**$1,429.50**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$800.00
25% Engineering and Legal:	200.00
20% Contingency:	$160.00
TOTAL COST:	**$1,160.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

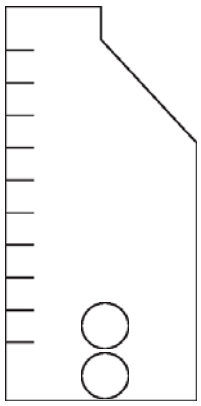
Manhole Inspection Form for Structure:

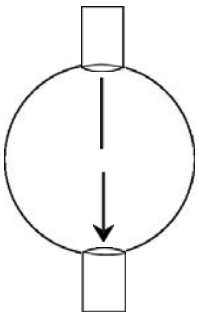
2

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.33
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.33
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.10
	10.20
Max Manhole Depth (ft):	10.20

Pipe Size (in)	Material	Direction	Drop
8		N	10.10
8		S	10.20

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.35**	**2.02**	**24.25**

Recommended I/I Rehabilitation	**Cost**
1. Adjust Elevation (< 2 ft.)	$530.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$768.50**
Storage Construction Costs:	**$585.19**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$530.00
25% Engineering and Legal:	132.50
20% Contingency:	$106.00
TOTAL COST:	**$768.50**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

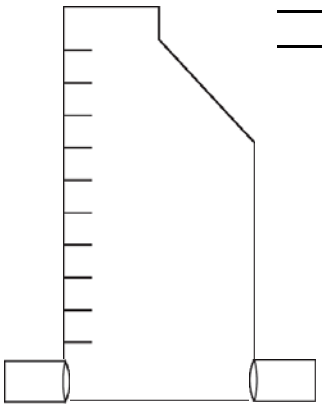
Manhole Inspection Form for Structure:

20

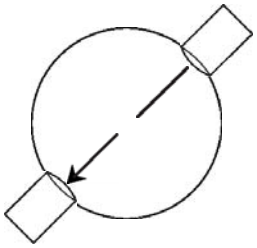
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	DNR
Corbel Condition:	DNR
Corbel Centricity:	Eccentric
Corbel Depth (ft):	0.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.10
Steps Condition:	DNR
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	0.00
Pipe Invert Depth(s) (ft):	4.80
	4.80
Max Manhole Depth (ft):	4.80



Pipe Size (in)	Material	Direction	Drop
8	Clay	NE	4.80
8	Clay	SW	4.80

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.50**	**2.89**	**34.65**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$835.98**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

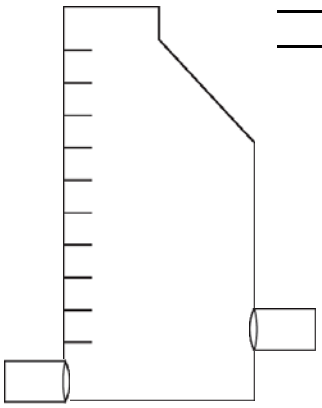
Manhole Inspection Form for Structure:

200

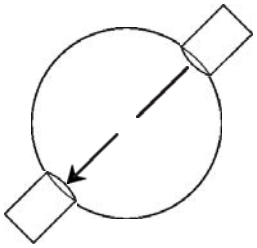
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	5.10 5.20
Max Manhole Depth (ft):	5.20



Pipe Size (in)	Material	Direction	Drop
8	Clay	NE	5.10
8	Clay	SW	5.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Side Walk
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.62**	**3.55**	**42.62**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,150.00
25% Engineering and Legal:	287.50
20% Contingency:	$230.00
TOTAL COST:	**$1,667.50**

Total Rehab Cost:	**$1,667.50**
Storage Construction Costs:	**$1,028.25**
Cost-effective to Rehab?:	**NO**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

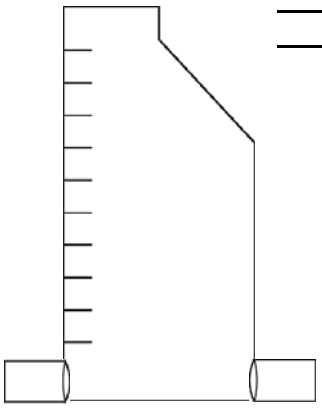
Manhole Inspection Form for Structure:

201

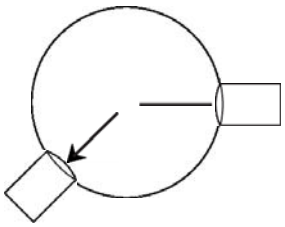
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.25
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.25
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.40
	10.40
Max Manhole Depth (ft):	10.40



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	10.40
8	Clay	SW	10.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Side Walk
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.31	1.80	21.66
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.58**	**3.33**	**40.02**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$965.55**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 4 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

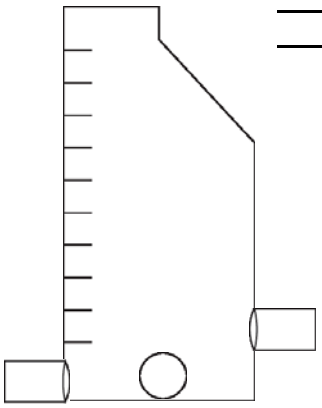
Manhole Inspection Form for Structure:

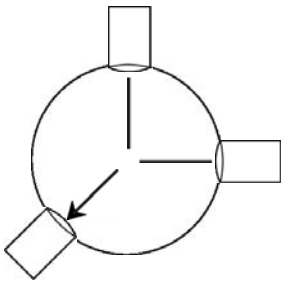
202

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.30
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	0.30
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.30
	9.50
	9.50
Max Manhole Depth (ft):	9.50

Pipe Size (in)	Material	Direction	Drop
12	Clay	E	9.30
12		SW	9.50
8		N	9.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**0.84**	**4.84**	**58.04**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,160.00**
Storage Construction Costs:	**$1,400.24**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$800.00
25% Engineering and Legal:	200.00
20% Contingency:	$160.00
TOTAL COST:	**$1,160.00**

This is a Category 7 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

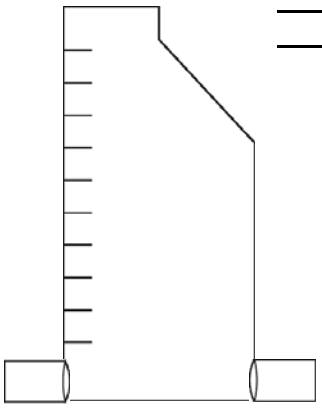
Manhole Inspection Form for Structure:

203

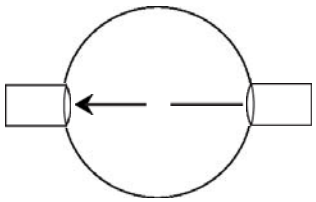
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.20
	8.20
Max Manhole Depth (ft):	8.20



Pipe Size (in)	Material	Direction	Drop
12	Clay	E	8.20
12	Clay	W	8.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.63**	**3.62**	**43.48**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$1,049.15**
Cost-effective to Rehab?:	**YES**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

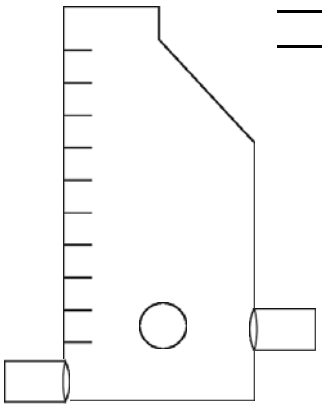
Manhole Inspection Form for Structure:

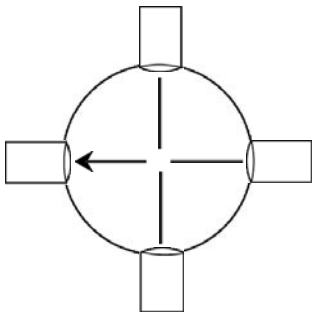
204

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.70
	8.70
	8.70
	8.80
Max Manhole Depth (ft):	8.80

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	8.70
8		S	8.70
12	Clay	E	8.70
12		W	8.80

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-2
Inflow Rating:	I-3
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.04	0.22	2.60
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.52**	**2.97**	**35.69**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$861.06**

Cost-effective to Rehab?: YES

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 4 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

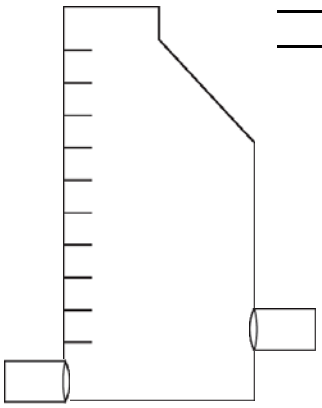
Manhole Inspection Form for Structure:

207

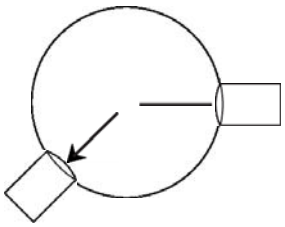
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.05
	7.10
Max Manhole Depth (ft):	7.10



Pipe Size (in)	Material	Direction	Drop
10		E	7.05
10		SW	7.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.46**	**2.66**	**31.88**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,160.00**
Storage Construction Costs:	**$769.10**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$800.00
25% Engineering and Legal:	200.00
20% Contingency:	$160.00
TOTAL COST:	**$1,160.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

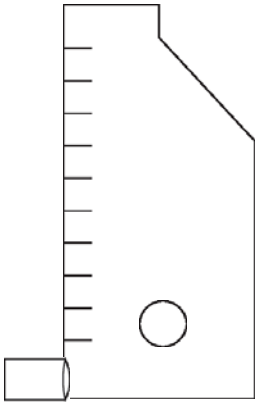
Manhole Inspection Form for Structure:

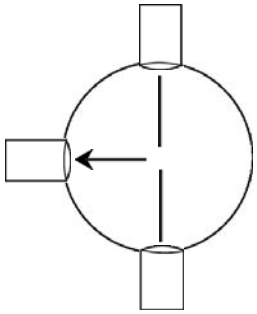
208

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	None
Corbel Condition:	DNR
Corbel Centricity:	Eccentric
Corbel Depth (ft):	0.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	0.00
Pipe Invert Depth(s) (ft):	5.55
	5.55
	5.60
Max Manhole Depth (ft):	5.60

Pipe Size (in)	Material	Direction	Drop
10	Clay	N	5.55
10		S	5.55
10		W	5.60

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.21**	**1.23**	**14.73**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$355.30**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 3 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

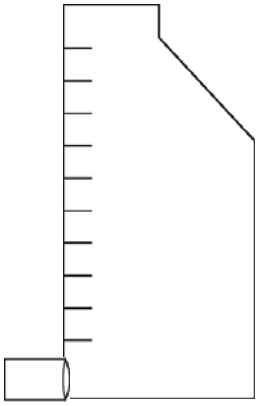
Manhole Inspection Form for Structure:

209

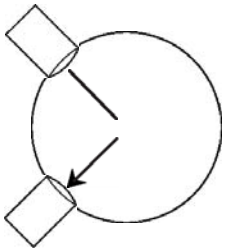
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	1.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.20
	10.20
Max Manhole Depth (ft):	10.20



Pipe Size (in)	Material	Direction	Drop
10		NW	10.20
8		SW	10.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Drive Way
Manhole Surcharge:	No
Flooding/Ponding:	Yes
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**3.39**	**19.57**	**234.91**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$5,667.22**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

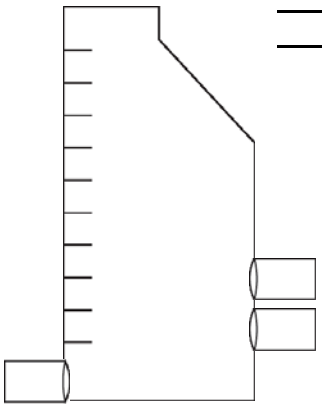
Manhole Inspection Form for Structure:

21

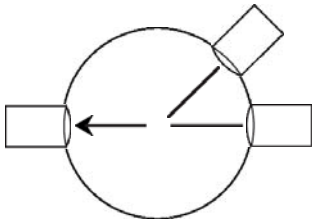
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Block
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Block
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Block
Wall Condition:	Good
Channel/Bench Condition:	DNR
Flow Depth (ft):	0.50
Steps Condition:	Fair
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.00
	9.80
	10.00
Max Manhole Depth (ft):	10.00



Pipe Size (in)	Material	Direction	Drop
8	Clay	NE	9.00
8	Clay	E	9.80
8	Clay	W	10.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-7
Inflow Rating:	I-1
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.00	0.00	0.00
Structure Rating:	3.13	18.04	216.55
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**3.63**	**20.96**	**251.54**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$580.00**
Storage Construction Costs:	**$6,068.37**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$400.00
25% Engineering and Legal:	100.00
20% Contingency:	$80.00
TOTAL COST:	**$580.00**

This is a Category 7 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

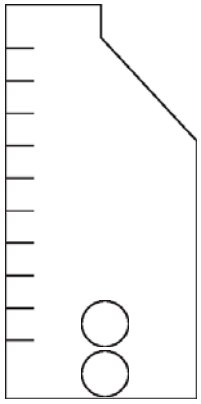
Manhole Inspection Form for Structure:

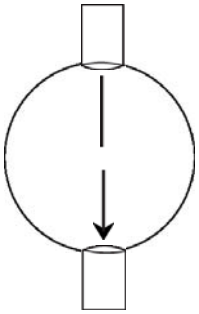
211

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.60
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.60
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.70
	9.80
Max Manhole Depth (ft):	9.80

Pipe Size (in)	Material	Direction	Drop
8		N	9.70
8		S	9.80

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:
crack

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.60**	**3.45**	**41.40**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,160.00**
Storage Construction Costs:	**$998.99**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$800.00
25% Engineering and Legal:	200.00
20% Contingency:	$160.00
TOTAL COST:	**$1,160.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

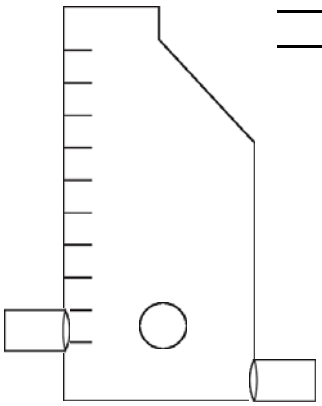
Manhole Inspection Form for Structure:

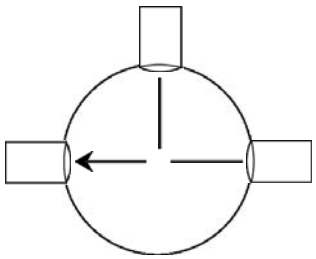
212

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	1.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	1.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	14.00
	15.90
	16.00
Max Manhole Depth (ft):	16.00

Pipe Size (in)	Material	Direction	Drop
8		N	14.00
12		W	15.90
12		E	16.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	DNR
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.63	3.61	43.31
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.01**	**5.83**	**69.99**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,595.00**
Storage Construction Costs:	**$1,688.64**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,100.00
25% Engineering and Legal:	275.00
20% Contingency:	$220.00
TOTAL COST:	**$1,595.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

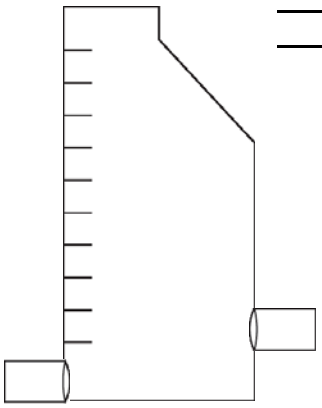
Manhole Inspection Form for Structure:

213

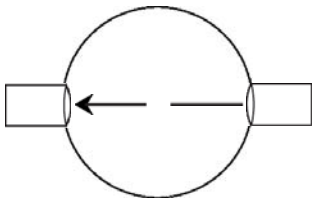
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	4.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	4.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	14.90
	15.00
Max Manhole Depth (ft):	15.00



Pipe Size (in)	Material	Direction	Drop
12		E	14.90
12		W	15.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5. Seal Leaks with Mortar	$400.00
6. Seal Leaks with Mortar	$400.00
7.	

Total Construction Cost:	$2,700.00
25% Engineering and Legal:	675.00
20% Contingency:	$540.00
TOTAL COST:	**$3,915.00**

Total Rehab Cost: **$3,915.00**
Storage Construction Costs: **$1,228.88**

Cost-effective to Rehab?: NO

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

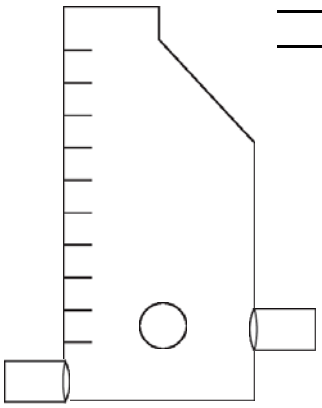
Manhole Inspection Form for Structure:

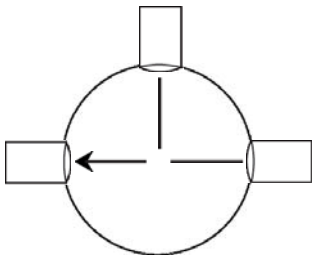
214

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Poor
Corbel Centricity:	Eccentric
Corbel Depth (ft):	2.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	2.00
Pipe Invert Depth(s) (ft):	10.90
	11.70
	11.75
Max Manhole Depth (ft):	11.75

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	10.90
12	Clay	E	11.70
12	Clay	W	11.75

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-2
Inflow Rating:	I-6
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.63	3.61	43.31
Structure Rating:	0.04	0.22	2.60
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.93**	**5.36**	**64.27**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Replace Corbel (Pavement)	$550.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Rehab Cost:	**$2,537.50**
Storage Construction Costs:	**$1,550.71**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,750.00
25% Engineering and Legal:	437.50
20% Contingency:	$350.00
TOTAL COST:	**$2,537.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

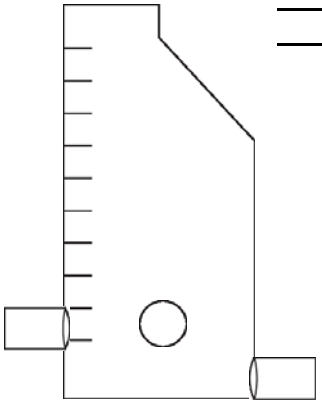
Manhole Inspection Form for Structure:

215

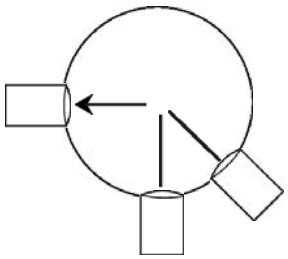
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.70 12.70 12.80
Max Manhole Depth (ft):	12.80



Pipe Size (in)	Material	Direction	Drop
8	Clay	S	12.70
12	Clay	W	12.70
12	Clay	SE	12.80

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.62**	**3.55**	**42.62**

Recommended I/I Rehabilitation — **Cost**

1. Remove and Reset Frame (Veg./Gravel) — $350.00
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$1,028.25**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

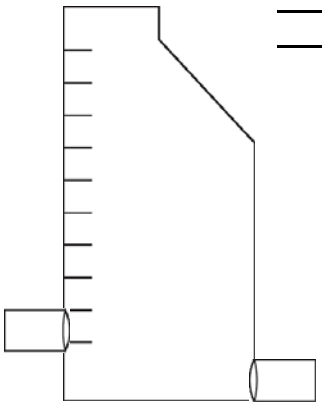
Manhole Inspection Form for Structure:

216

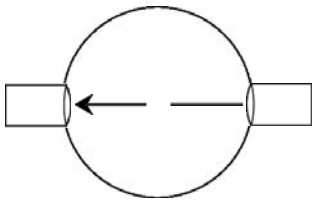
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	8.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	8.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	15.60 15.65
Max Manhole Depth (ft):	15.65



Pipe Size (in)	Material	Direction	Drop
24	Clay	W	15.60
24	Clay	E	15.65

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Side Walk
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**3.51**	**20.27**	**243.23**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$5,867.80**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

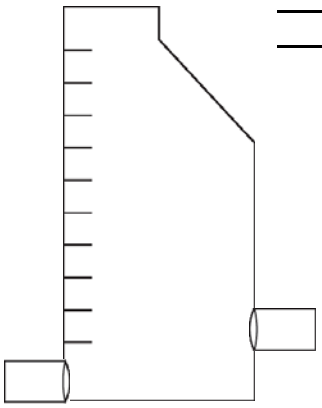
Manhole Inspection Form for Structure:

217

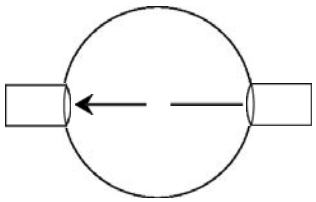
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	1.80
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.80
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	15.05 15.10
Max Manhole Depth (ft):	15.10



Pipe Size (in)	Material	Direction	Drop
24	Clay	E	15.05
24	Clay	W	15.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Drive Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.26**	**7.28**	**87.31**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$2,500.00
25% Engineering and Legal:	625.00
20% Contingency:	$500.00
TOTAL COST:	**$3,625.00**

Total Rehab Cost: **$3,625.00**
Storage Construction Costs: **$2,106.59**

Cost-effective to Rehab?: NO

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/31/2001

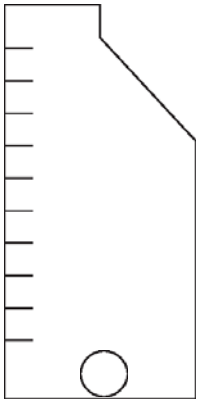
Manhole Inspection Form for Structure:

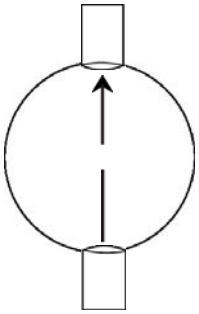
218

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.12
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.60
	12.60
Max Manhole Depth (ft):	12.60

Pipe Size (in)	Material	Direction	Drop
10		N	12.60
10		S	12.60

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.60**	**3.45**	**41.40**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$998.99**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

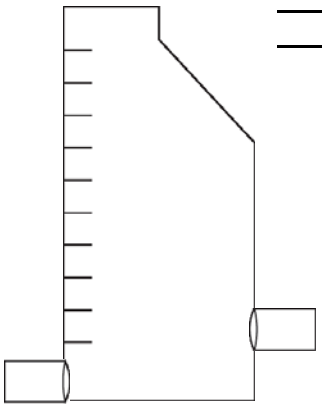
City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

Manhole Inspection Form for Structure:
22

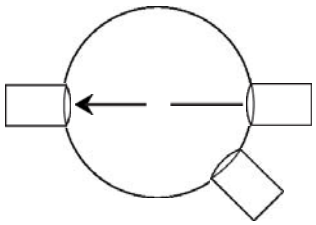
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	130.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	130.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.20
	7.20
	7.30
Max Manhole Depth (ft):	7.30



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	7.20
8	Bulkhead	SE	7.20
8	Clay	W	7.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-1
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.00	0.00	0.00
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.00**	**0.00**	**0.00**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$0.00**

Cost-effective to Rehab?: NO

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 1 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

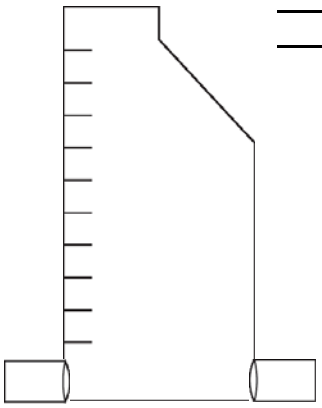
Manhole Inspection Form for Structure:

23

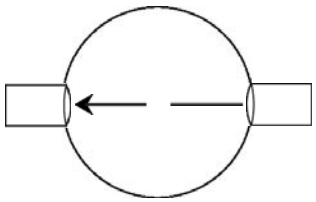
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.83
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.83
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	5.90
	5.90
Max Manhole Depth (ft):	5.90



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	5.90
8	Clay	W	5.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.50**	**2.89**	**34.65**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$835.98**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

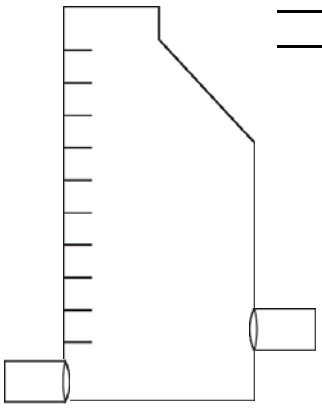
Manhole Inspection Form for Structure:

24

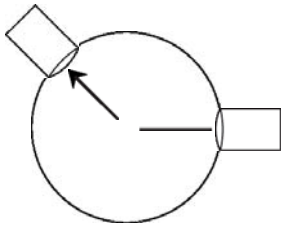
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.83
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Clay
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.01
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.83
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	5.90
	6.00
Max Manhole Depth (ft):	6.00



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	5.90
8	Clay	NW	6.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-1
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.00	0.00	0.00
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.00**	**0.00**	**0.00**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$0.00**

Cost-effective to Rehab?: NO

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 1 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

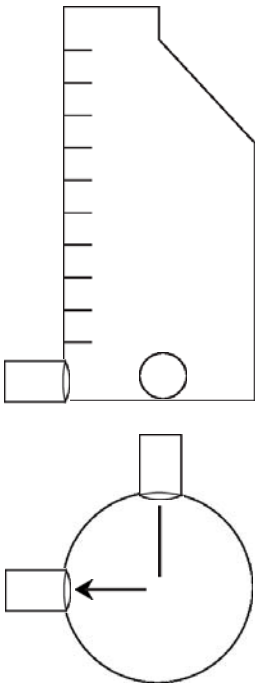
Manhole Inspection Form for Structure:

25

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	2.00
Corbel Type:	Block
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Block
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.10
Steps Condition:	DNR
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	2.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	5.60
	5.60
Max Manhole Depth (ft):	5.60

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	5.60
8	Clay	W	5.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-7
Inflow Rating:	I-7
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	3.13	18.04	216.55
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**6.28**	**36.23**	**434.83**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$10,488.88**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 7 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

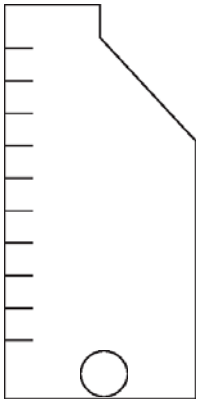
Manhole Inspection Form for Structure:

26

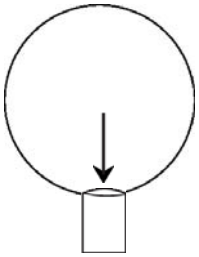
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.17
Corbel Type:	Block
Corbel Condition:	Poor
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Block
Wall Condition:	Poor
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.01
Steps Condition:	DNR
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.17
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	4.75
Max Manhole Depth (ft):	4.75



Pipe Size (in)	Material	Direction	Drop
8	Clay	S	4.75

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-7
Inflow Rating:	I-4
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	3.13	18.04	216.55
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**3.65**	**21.08**	**252.93**

Recommended I/I Rehabilitation	**Cost**
1. Apply Calcium Aluminate (CA) Cement Lining	$997.50
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$997.50
25% Engineering and Legal:	249.38
20% Contingency:	$199.50
TOTAL COST:	**$1,446.38**

Total Rehab Cost:	**$1,446.38**
Storage Construction Costs:	**$6,101.80**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

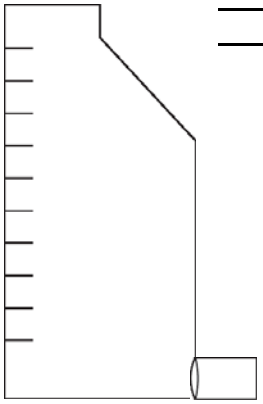
Manhole Inspection Form for Structure:

27

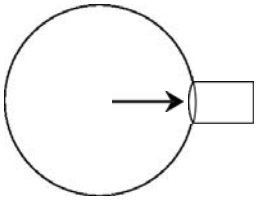
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.20
Max Manhole Depth (ft):	8.20



Pipe Size (in)	Material	Direction	Drop
8		E	8.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.50**	**2.89**	**34.65**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$835.98**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

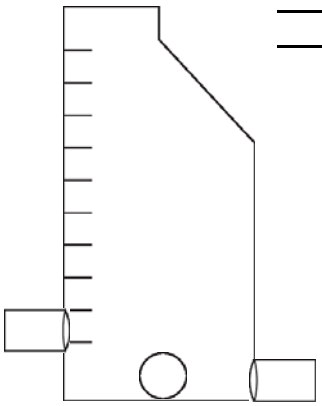
Manhole Inspection Form for Structure:

28

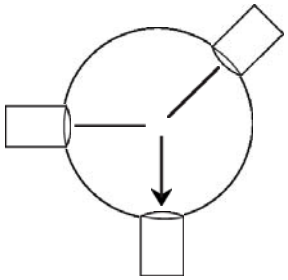
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.00 10.10 10.10
Max Manhole Depth (ft):	10.10



Pipe Size (in)	Material	Direction	Drop
8		W	10.00
6	PVC	NE	10.10
8		S	10.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.77**	**4.42**	**53.01**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,279.03**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

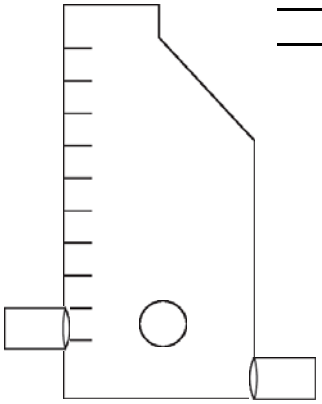
Manhole Inspection Form for Structure:

29

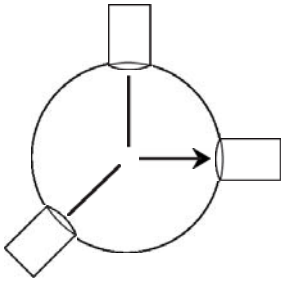
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.90 9.00 9.10
Max Manhole Depth (ft):	9.10



Pipe Size (in)	Material	Direction	Drop
8		SW	8.90
8		N	9.00
8		E	9.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.77**	**4.42**	**53.01**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,279.03**

Cost-effective to Rehab?: NO

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

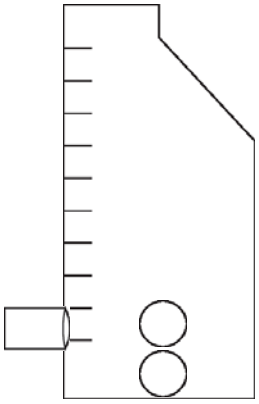
Manhole Inspection Form for Structure:

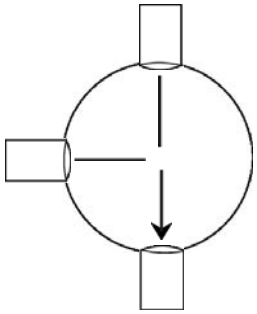
3

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.33
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.33
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.20
	10.20
	10.30
Max Manhole Depth (ft):	10.30

Pipe Size (in)	Material	Direction	Drop
8		W	9.20
8		N	10.20
8		S	10.30

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.35**	**2.02**	**24.25**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$585.19**

Cost-effective to Rehab?: YES

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

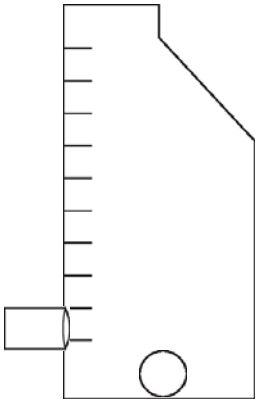
Manhole Inspection Form for Structure:

31

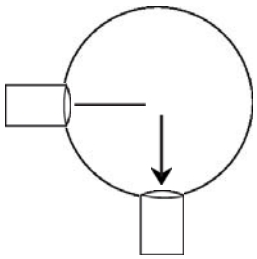
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Fair
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.70
	10.90
Max Manhole Depth (ft):	10.90



Pipe Size (in)	Material	Direction	Drop
8		W	10.70
8		S	10.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.77**	**4.42**	**53.01**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,279.03**

Cost-effective to Rehab?: NO

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

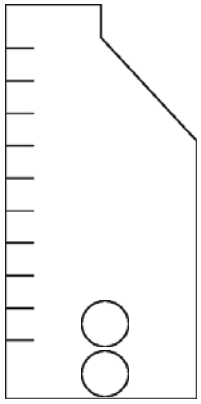
Manhole Inspection Form for Structure:

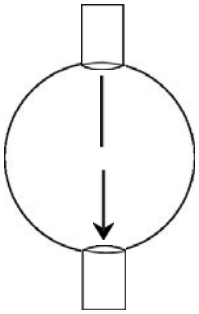
32

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.50
	11.60
Max Manhole Depth (ft):	11.60

Pipe Size (in)	Material	Direction	Drop
8		N	11.50
8		S	11.60

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-1
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.00	0.00	0.00
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.27**	**1.53**	**18.36**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$443.07**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

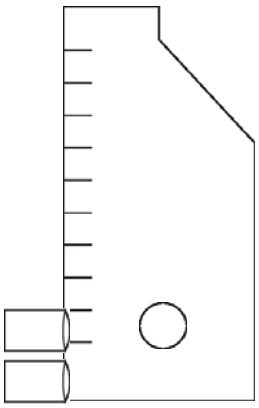
Manhole Inspection Form for Structure:

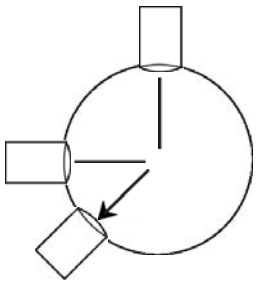
33

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.60
	9.65
	9.70
Max Manhole Depth (ft):	9.70

Pipe Size (in)	Material	Direction	Drop
8		N	9.60
8		W	9.65
8		SW	9.70

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.72**	**4.14**	**49.72**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$580.00**
Storage Construction Costs:	**$1,199.62**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$400.00
25% Engineering and Legal:	100.00
20% Contingency:	$80.00
TOTAL COST:	**$580.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

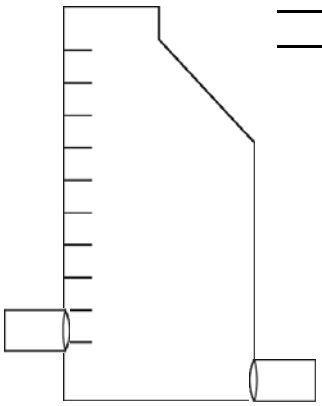
Manhole Inspection Form for Structure:

34

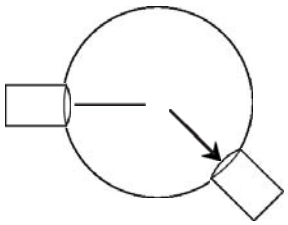
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.00
	10.10
Max Manhole Depth (ft):	10.10



Pipe Size (in)	Material	Direction	Drop
8		W	10.00
8		SE	10.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**1.14**	**6.58**	**79.00**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,905.98**
Cost-effective to Rehab?:	**NO**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

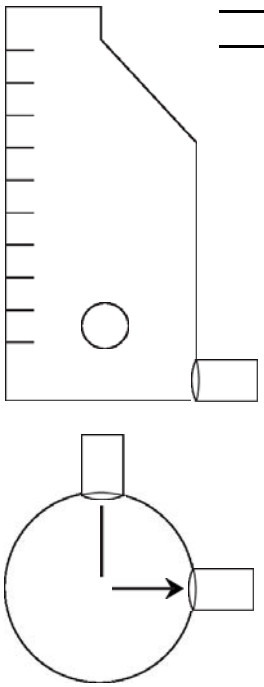
Manhole Inspection Form for Structure:

35

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.40
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Clay
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.40
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	6.40
	6.50
Max Manhole Depth (ft):	6.50

Pipe Size (in)	Material	Direction	Drop
8		N	6.40
8		E	6.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.36**	**2.06**	**24.77**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,015.00**
Storage Construction Costs:	**$597.73**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$700.00
25% Engineering and Legal:	175.00
20% Contingency:	$140.00
TOTAL COST:	**$1,015.00**

This is a Category 3 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

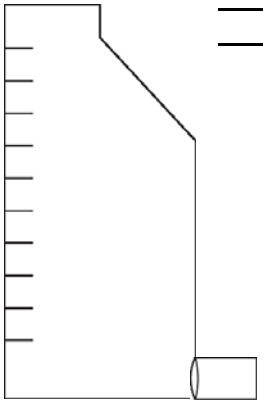
Manhole Inspection Form for Structure:

4

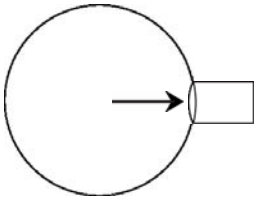
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	6.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	DNR
Flow Depth (ft):	1.00
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.60
Max Manhole Depth (ft):	11.60



Pipe Size (in)	Material	Direction	Drop
8		E	11.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	Yes
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Debris
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.50**	**2.89**	**34.65**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (> 2 ft. Veg./Gravel)	$1,200.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$835.98**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

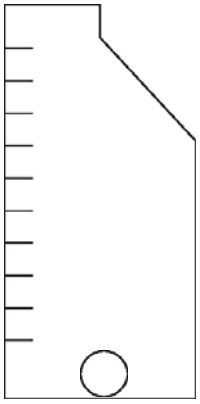
Manhole Inspection Form for Structure:

40

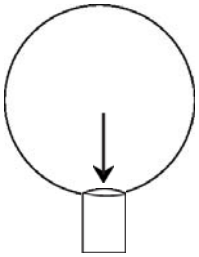
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Brick
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.00
Max Manhole Depth (ft):	11.00



Pipe Size (in)	Material	Direction	Drop
8		S	11.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Gravel
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**1.38**	**7.97**	**95.63**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,522.50**
Storage Construction Costs:	**$2,307.21**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,050.00
25% Engineering and Legal:	262.50
20% Contingency:	$210.00
TOTAL COST:	**$1,522.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

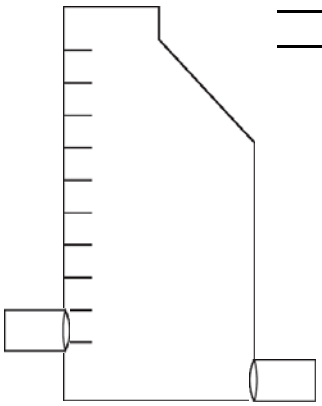
Manhole Inspection Form for Structure:

41

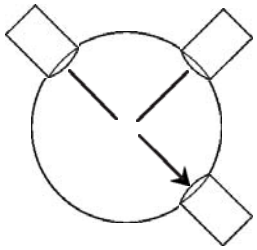
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Fair
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.90 13.50 13.50
Max Manhole Depth (ft):	13.50



Pipe Size (in)	Material	Direction	Drop
8		NW	12.90
8		NE	13.50
8		SE	13.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**0.98**	**5.63**	**67.56**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,102.50**
Storage Construction Costs:	**$1,630.12**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,450.00
25% Engineering and Legal:	362.50
20% Contingency:	$290.00
TOTAL COST:	**$2,102.50**

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

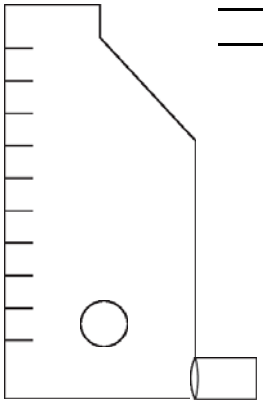
Manhole Inspection Form for Structure:

42

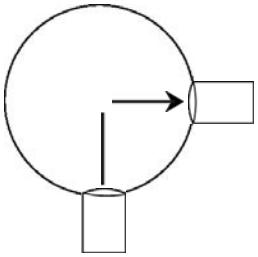
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.20
	11.60
Max Manhole Depth (ft):	11.60



Pipe Size (in)	Material	Direction	Drop
8		S	11.20
8		E	11.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**3.63**	**20.96**	**251.54**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,667.50**
Storage Construction Costs:	**$6,068.37**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,150.00
25% Engineering and Legal:	287.50
20% Contingency:	$230.00
TOTAL COST:	**$1,667.50**

This is a Category 7 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

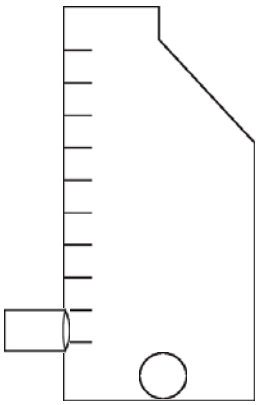
Manhole Inspection Form for Structure:

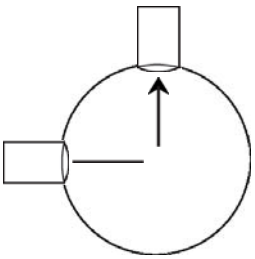
43

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.17
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	0.17
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.50
	10.80
Max Manhole Depth (ft):	10.80

Pipe Size (in)	Material	Direction	Drop
8		W	10.50
8		N	10.80

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	DNR
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**1.01**	**5.80**	**69.64**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Rehab Cost:	**$4,712.50**
Storage Construction Costs:	**$1,680.28**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$3,250.00
25% Engineering and Legal:	812.50
20% Contingency:	$650.00
TOTAL COST:	**$4,712.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

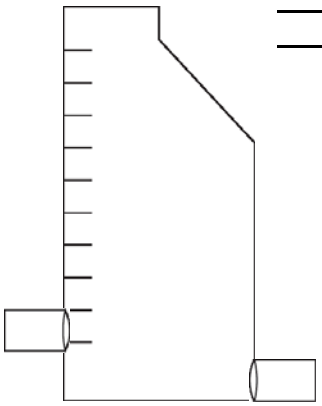
Manhole Inspection Form for Structure:

44

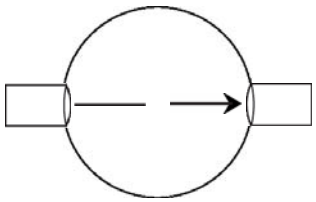
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	0.17
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.17
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.70
	11.80
Max Manhole Depth (ft):	11.80



Pipe Size (in)	Material	Direction	Drop
8		W	11.70
8		E	11.80

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**1.14**	**6.58**	**79.00**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,905.98**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

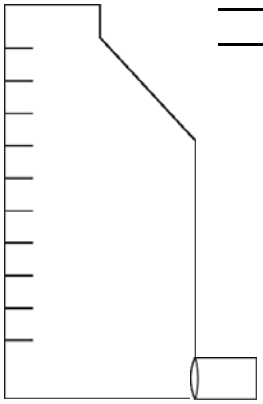
Manhole Inspection Form for Structure:

45

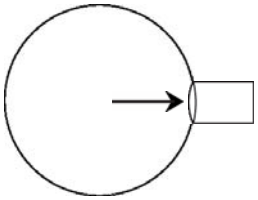
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	6.60
Max Manhole Depth (ft):	6.60



Pipe Size (in)	Material	Direction	Drop
8		E	6.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$1,228.88**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

Manhole Inspection Form for Structure:

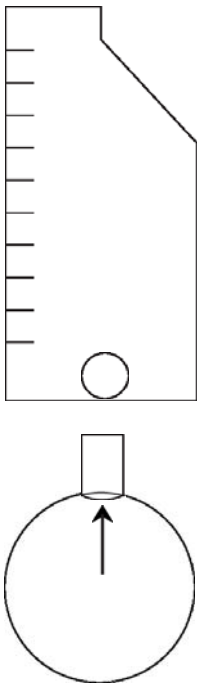
46

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.66
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	DNR
Step Material:	DNR

Structure Notes:
gasket falling apart

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.66
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	3.60
Max Manhole Depth (ft):	3.60

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	3.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.13	0.72	8.66
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.13**	**0.72**	**8.66**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$209.00**

Cost-effective to Rehab?: YES

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 2 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

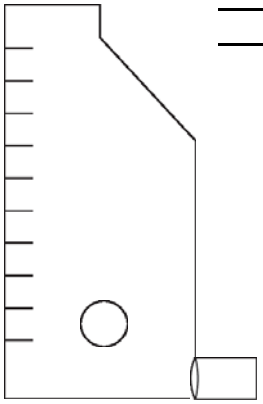
Manhole Inspection Form for Structure:

47

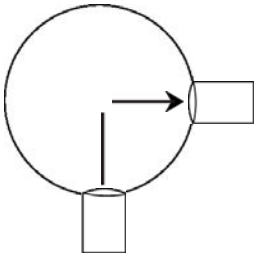
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.33
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.33
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	5.40
	5.50
Max Manhole Depth (ft):	5.50



Pipe Size (in)	Material	Direction	Drop
8	Clay	S	5.40
8	Clay	E	5.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.88**	**5.05**	**60.63**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,462.94**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

Manhole Inspection Form for Structure:

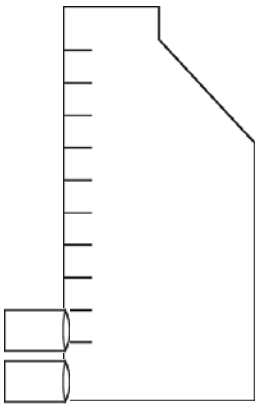
49

Structural Information

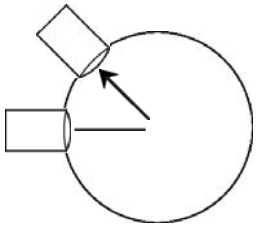
Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
seal is off lid. damaged beyond repair

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	6.20 6.30
Max Manhole Depth (ft):	6.30



Pipe Size (in)	Material	Direction	Drop
8		W	6.20
8		NW	6.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.69	3.97	47.64
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.83**	**4.81**	**57.69**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$1,391.88**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

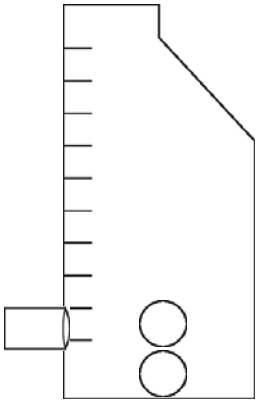
Manhole Inspection Form for Structure:

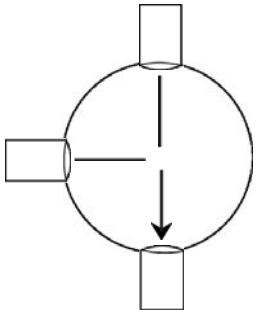
5

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Fair
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.10 10.20 10.30
Max Manhole Depth (ft):	10.30

Pipe Size (in)	Material	Direction	Drop
8		N	10.10
8		W	10.20
8		S	10.30

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3. Adjust Elevation (< 2 ft.)	$530.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$2,630.00
25% Engineering and Legal:	657.50
20% Contingency:	$526.00
TOTAL COST:	**$3,813.50**

Total Rehab Cost: **$3,813.50**
Storage Construction Costs: **$1,228.88**

Cost-effective to Rehab?: NO

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

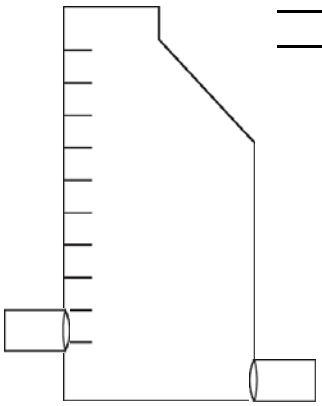
Manhole Inspection Form for Structure:

50

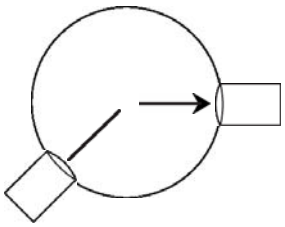
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	6.40 6.55
Max Manhole Depth (ft):	6.55



Pipe Size (in)	Material	Direction	Drop
8	Clay	SW	6.40
8	Clay	E	6.55

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.77**	**4.42**	**53.01**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5. Seal Leaks with Mortar	$400.00
6.	
7.	

Total Rehab Cost:	**$3,407.50**
Storage Construction Costs:	**$1,279.03**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$2,350.00
25% Engineering and Legal:	587.50
20% Contingency:	$470.00
TOTAL COST:	**$3,407.50**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

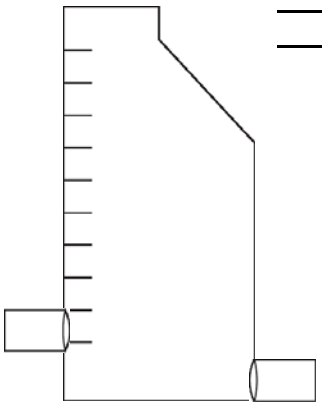
Manhole Inspection Form for Structure:

51

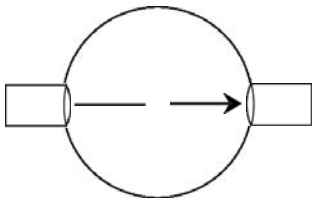
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.30
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.00
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.30
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	6.90
	7.00
Max Manhole Depth (ft):	7.00



Pipe Size (in)	Material	Direction	Drop
8		W	6.90
8		E	7.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Debris
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.69	3.97	47.64
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.07**	**6.19**	**74.32**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,793.13**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

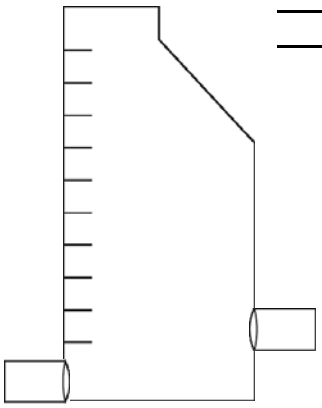
Manhole Inspection Form for Structure:

52

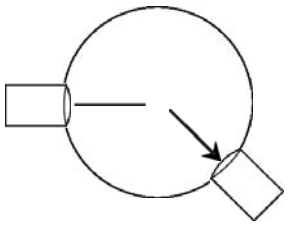
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.17
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.17
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.00 8.10
Max Manhole Depth (ft):	8.10



Pipe Size (in)	Material	Direction	Drop
8		SE	8.00
8		W	8.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**3.39**	**19.57**	**234.91**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$5,667.22**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

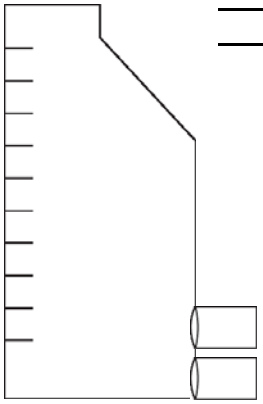
Manhole Inspection Form for Structure:

53

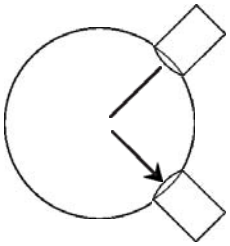
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.67
Corbel Type:	None
Corbel Condition:	DNR
Corbel Centricity:	Eccentric
Corbel Depth (ft):	0.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.67
Corbel Depth (ft):	0.00
Pipe Invert Depth(s) (ft):	7.60
	7.70
Max Manhole Depth (ft):	7.70



Pipe Size (in)	Material	Direction	Drop
8		SE	7.60
8		NE	7.70

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.31	1.80	21.66
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**0.34**	**1.95**	**23.39**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$564.29**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 3 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

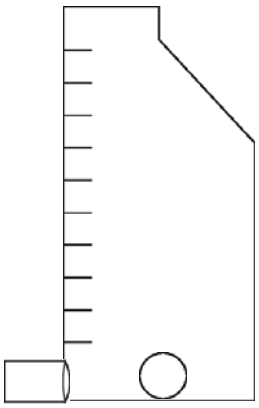
Manhole Inspection Form for Structure:

54

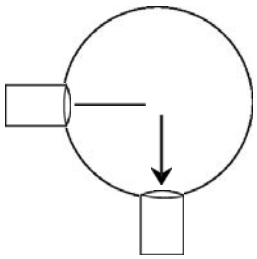
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.33
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.33
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.30
	8.30
Max Manhole Depth (ft):	8.30



Pipe Size (in)	Material	Direction	Drop
8		W	8.30
8		S	8.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.75**	**4.32**	**51.80**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$1,500.00
25% Engineering and Legal:	375.00
20% Contingency:	$300.00
TOTAL COST:	**$2,175.00**

Total Rehab Cost:	**$2,175.00**
Storage Construction Costs:	**$1,249.77**

Cost-effective to Rehab?: NO

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

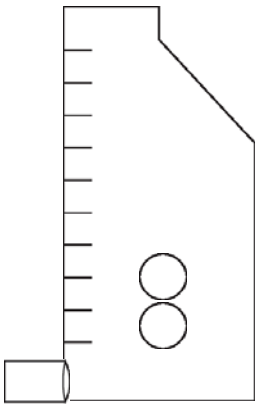
Manhole Inspection Form for Structure:

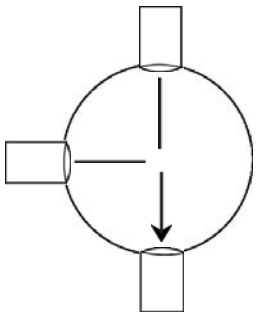
55

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.80
	9.20
	9.40
Max Manhole Depth (ft):	9.40

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	8.80
8		S	9.20
8		W	9.40

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Drive Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.26**	**7.28**	**87.31**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$2,106.59**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

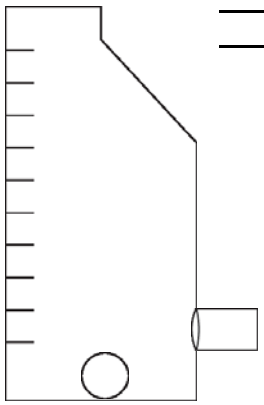
Manhole Inspection Form for Structure:

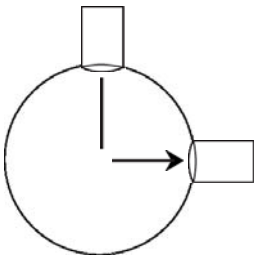
56

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.60
	7.70
Max Manhole Depth (ft):	7.70

Pipe Size (in)	Material	Direction	Drop
8	Clay	E	7.60
8	Clay	N	7.70

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-2

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.03	0.14	1.73
Total I/I:	**0.38**	**2.17**	**25.99**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$626.99**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 4 Manhole
Monitor Again in 5 Years

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

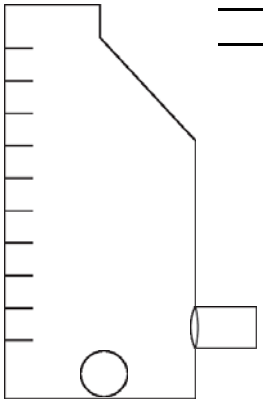
Manhole Inspection Form for Structure:

57

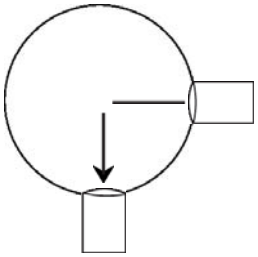
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Brick
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Centric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.85 12.90
Max Manhole Depth (ft):	12.90



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	12.85
8	Clay	S	12.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.63	3.61	43.31
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.01**	**5.83**	**69.99**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,522.50**
Storage Construction Costs:	**$1,688.64**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,050.00
25% Engineering and Legal:	262.50
20% Contingency:	$210.00
TOTAL COST:	**$1,522.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

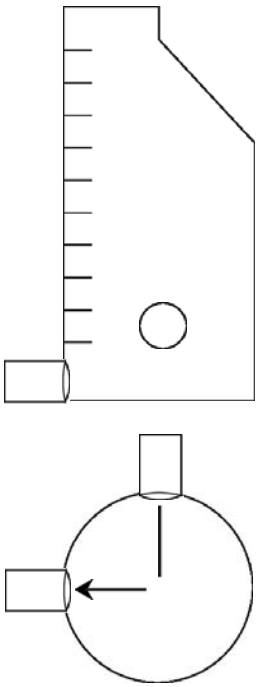
Manhole Inspection Form for Structure:

58

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.67
Corbel Type:	None
Corbel Condition:	DNR
Corbel Centricity:	Eccentric
Corbel Depth (ft):	0.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.67
Corbel Depth (ft):	0.00
Pipe Invert Depth(s) (ft):	10.55 10.60
Max Manhole Depth (ft):	10.60

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	10.55
8	Clay	W	10.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.89**	**5.11**	**61.33**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$3,552.50**
Storage Construction Costs:	**$1,479.66**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$2,450.00
25% Engineering and Legal:	612.50
20% Contingency:	$490.00
TOTAL COST:	**$3,552.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

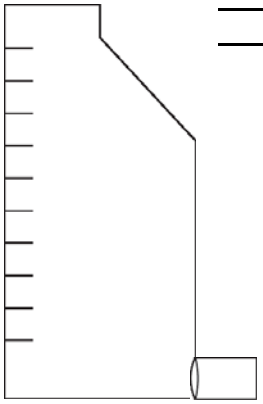
Manhole Inspection Form for Structure:

59

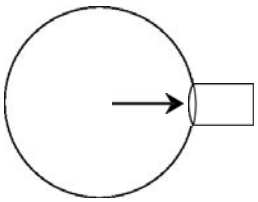
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.50
Max Manhole Depth (ft):	9.50



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	9.50

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.65**	**3.72**	**44.70**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$3,552.50**
Storage Construction Costs:	**$1,078.40**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$2,450.00
25% Engineering and Legal:	612.50
20% Contingency:	$490.00
TOTAL COST:	**$3,552.50**

This is a Category 4 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

Manhole Inspection Form for Structure:

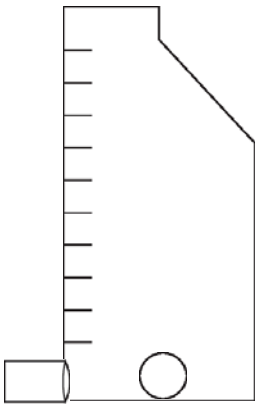
6

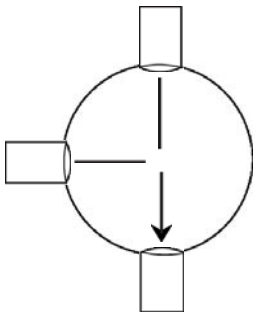
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Poor
Adjusting Ring Type:	Brick
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	0.33
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
broken frame

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.33
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.40
	10.40
	10.40
Max Manhole Depth (ft):	10.40

Pipe Size (in)	Material	Direction	Drop
8		N	10.40
8		S	10.40
8	PVC	W	10.40

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Drive Way
Manhole Surcharge:	DNR
Flooding/Ponding:	No
Flow Type:	DNR
Flow Clarity:	DNR
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.69	3.97	47.64
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.69**	**3.97**	**47.64**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Replace Frame (Pavement)	$1,000.00
2. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$3,915.00**
Storage Construction Costs:	**$1,149.46**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$2,700.00
25% Engineering and Legal:	675.00
20% Contingency:	$540.00
TOTAL COST:	**$3,915.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

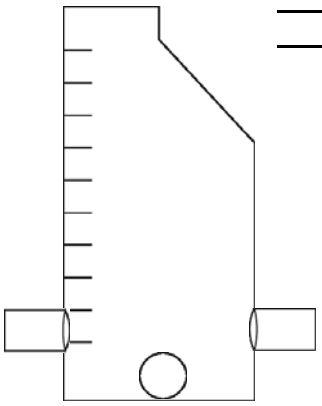
Manhole Inspection Form for Structure:

60

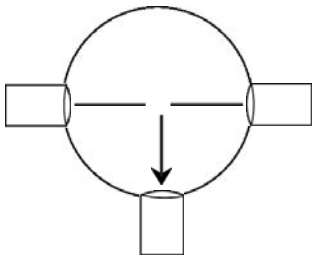
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	2.30
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	2.30
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.40 11.10 11.40
Max Manhole Depth (ft):	11.40



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	10.40
8	Clay	W	11.10
8	Clay	S	11.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$1,228.88**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

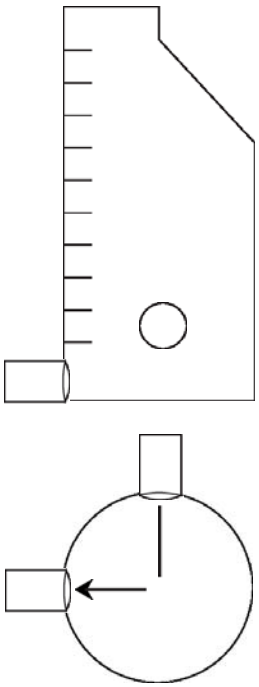
Manhole Inspection Form for Structure:

61

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.67
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.67
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.80
	7.90
Max Manhole Depth (ft):	7.90

Pipe Size (in)	Material	Direction	Drop
8	Clay	N	7.80
8	Clay	W	7.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.72**	**4.14**	**49.72**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Adjust Elevation (< 2 ft.)	$530.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,928.50**
Storage Construction Costs:	**$1,199.62**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,330.00
25% Engineering and Legal:	332.50
20% Contingency:	$266.00
TOTAL COST:	**$1,928.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

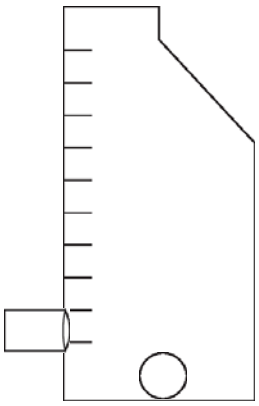
Manhole Inspection Form for Structure:

62

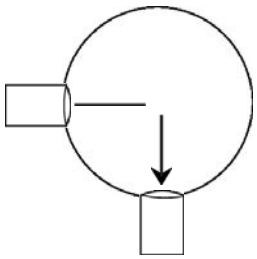
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	2.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	2.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.10 9.20
Max Manhole Depth (ft):	9.20



Pipe Size (in)	Material	Direction	Drop
8	Clay	W	9.10
8	Clay	S	9.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Field
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.60**	**3.45**	**41.40**

Recommended I/I Rehabilitation	**Cost**
1. Adjust Elevation (< 2 ft.)	$530.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$768.50**
Storage Construction Costs:	**$998.99**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$530.00
25% Engineering and Legal:	132.50
20% Contingency:	$106.00
TOTAL COST:	**$768.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

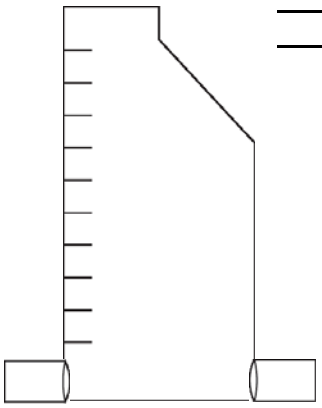
Manhole Inspection Form for Structure:

63

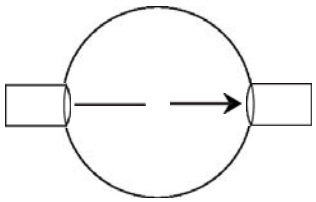
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Fair
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	7.20
	7.20
Max Manhole Depth (ft):	7.20



Pipe Size (in)	Material	Direction	Drop
8	Clay	W	7.20
8	PVC	E	7.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**3.51**	**20.27**	**243.23**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$5,867.80**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

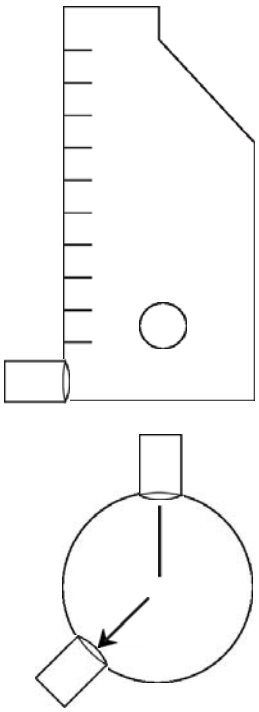
Manhole Inspection Form for Structure:

64

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.67
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Fair
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.67
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	5.20
	5.90
Max Manhole Depth (ft):	5.90

Pipe Size (in)	Material	Direction	Drop
8	PVC	N	5.20
8		SW	5.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-3
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.21	1.23	14.73
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**0.36**	**2.06**	**24.77**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$597.73**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 3 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

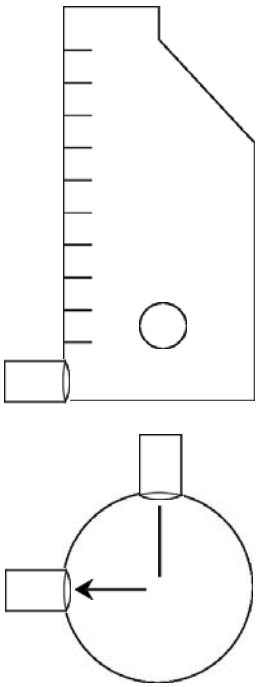
Manhole Inspection Form for Structure:

67

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.33
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.33
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.70
	11.80
Max Manhole Depth (ft):	11.80

Pipe Size (in)	Material	Direction	Drop
6	Clay	N	11.70
8	Clay	W	11.80

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Debris
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,522.50**
Storage Construction Costs:	**$1,228.88**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,050.00
25% Engineering and Legal:	262.50
20% Contingency:	$210.00
TOTAL COST:	**$1,522.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

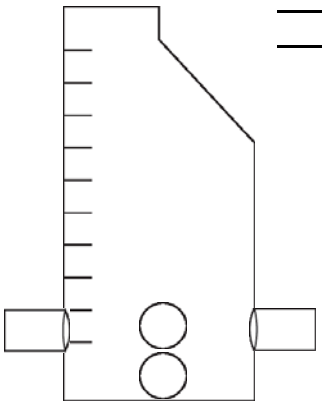
Manhole Inspection Form for Structure:

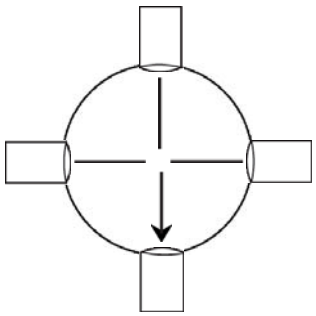
68

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.15
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.10
	11.20
	11.20
	11.30
Max Manhole Depth (ft):	11.30

Pipe Size (in)	Material	Direction	Drop
8		W	11.10
8		E	11.20
8		N	11.20
8		S	11.30

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.08	0.43	5.20
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.46**	**2.66**	**31.88**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$769.10**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

Manhole Inspection Form for Structure:

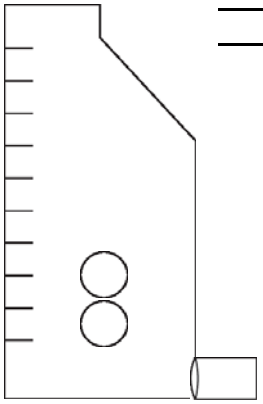
69

Structural Information

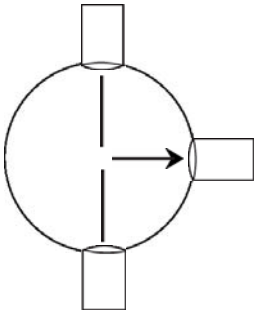
Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
o ring dry rotted

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.20
	9.90
	10.00
Max Manhole Depth (ft):	10.00



Pipe Size (in)	Material	Direction	Drop
8		N	9.20
8		S	9.90
8		E	10.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Side Walk
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-7

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.63	3.61	43.31
Total I/I:	**3.75**	**21.65**	**259.86**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Rehab Cost:	**$2,827.50**
Storage Construction Costs:	**$6,268.95**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,950.00
25% Engineering and Legal:	487.50
20% Contingency:	$390.00
TOTAL COST:	**$2,827.50**

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

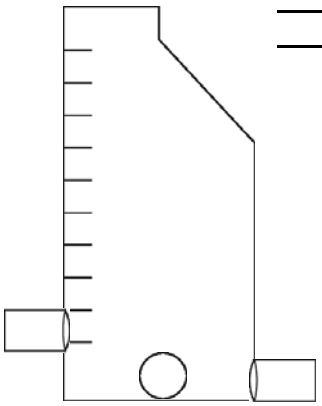
Manhole Inspection Form for Structure:

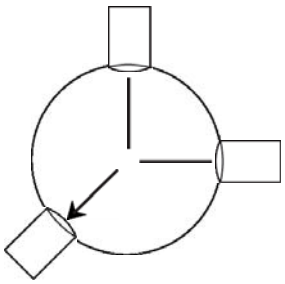
7

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Brick
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.10 10.20 10.20
Max Manhole Depth (ft):	10.20

Pipe Size (in)	Material	Direction	Drop
15		SW	10.10
8		N	10.20
12		E	10.20

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.50**	**2.89**	**34.65**

Recommended I/I Rehabilitation **Cost**

1.
2.
3.
4.
5.
6.
7.

Total Rehab Cost:	**$0.00**
Storage Construction Costs:	**$835.98**

Cost-effective to Rehab?: YES

Total Construction Cost:	$0.00
25% Engineering and Legal:	0.00
20% Contingency:	$0.00
TOTAL COST:	**$0.00**

This is a Category 4 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

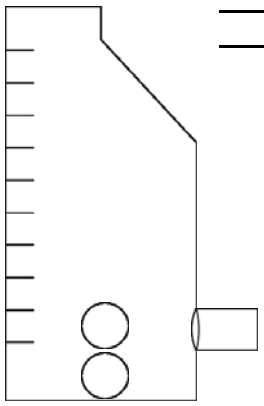
Manhole Inspection Form for Structure:

71

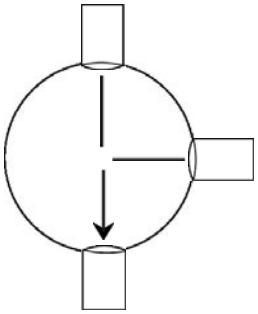
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Fair
Step Material:	DNR
Structure Notes:	
steps offset	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.60
	8.85
	8.95
Max Manhole Depth (ft):	8.95



Pipe Size (in)	Material	Direction	Drop
8		E	8.60
8		N	8.85
8		S	8.95

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Bituminous
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.69	3.97	47.64
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**1.19**	**6.89**	**82.64**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Rehab Cost:	**$2,827.50**
Storage Construction Costs:	**$1,993.75**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,950.00
25% Engineering and Legal:	487.50
20% Contingency:	$390.00
TOTAL COST:	**$2,827.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

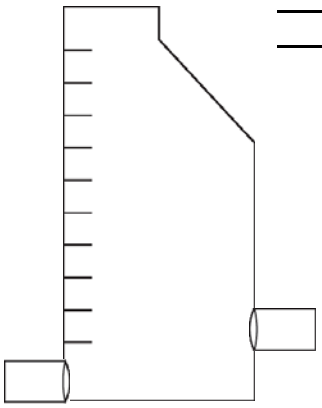
Manhole Inspection Form for Structure:

72

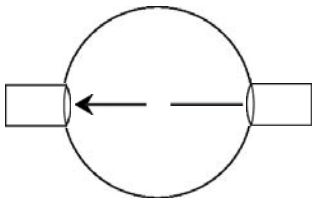
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.17
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.17
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	6.20
	6.30
Max Manhole Depth (ft):	6.30



Pipe Size (in)	Material	Direction	Drop
8		E	6.20
8		W	6.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Drive Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**3.63**	**20.96**	**251.54**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5.	
6.	
7.	

Total Construction Cost:	$2,900.00
25% Engineering and Legal:	725.00
20% Contingency:	$580.00
TOTAL COST:	**$4,205.00**

Total Rehab Cost:	**$4,205.00**
Storage Construction Costs:	**$6,068.37**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

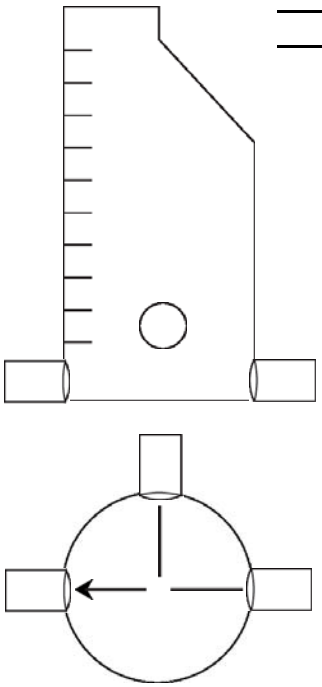
Manhole Inspection Form for Structure:

73

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.70 9.00 9.00
Max Manhole Depth (ft):	9.00

Pipe Size (in)	Material	Direction	Drop
6	Clay	N	8.70
8	Clay	E	9.00
8	Clay	W	9.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.63**	**3.62**	**43.48**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Veg./Gravel)	$350.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$507.50**
Storage Construction Costs:	**$1,049.15**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$350.00
25% Engineering and Legal:	87.50
20% Contingency:	$70.00
TOTAL COST:	**$507.50**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

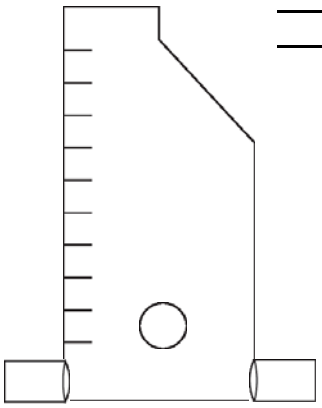
Manhole Inspection Form for Structure:

75

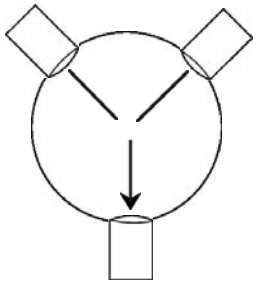
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.20 9.30 9.30
Max Manhole Depth (ft):	9.30



Pipe Size (in)	Material	Direction	Drop
8	Clay	S	9.20
8		NW	9.30
8		NE	9.30

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.36	2.09	25.12
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.63**	**3.62**	**43.48**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,015.00**
Storage Construction Costs:	**$1,049.15**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$700.00
25% Engineering and Legal:	175.00
20% Contingency:	$140.00
TOTAL COST:	**$1,015.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/10/2001

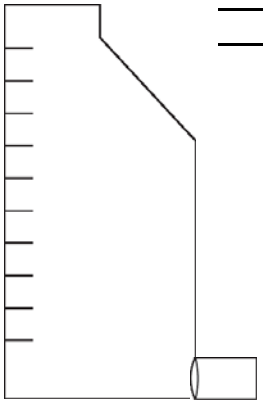
Manhole Inspection Form for Structure:

76

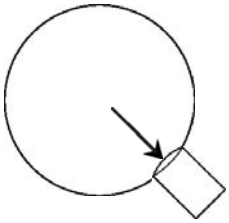
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.67
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.02
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.67
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.90
Max Manhole Depth (ft):	8.90



Pipe Size (in)	Material	Direction	Drop
8		SE	8.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Gravel
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**1.38**	**7.97**	**95.63**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,015.00**
Storage Construction Costs:	**$2,307.21**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$700.00
25% Engineering and Legal:	175.00
20% Contingency:	$140.00
TOTAL COST:	**$1,015.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

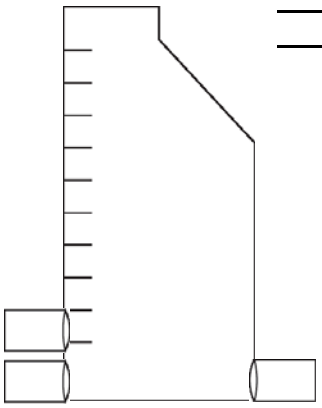
Manhole Inspection Form for Structure:

8

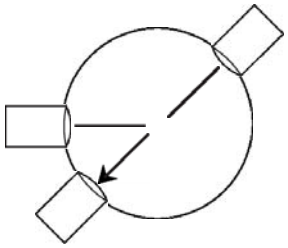
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Fair
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	0.17
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.17
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	8.50 9.90 9.90
Max Manhole Depth (ft):	9.90



Pipe Size (in)	Material	Direction	Drop
12	Clay	W	8.50
15	Conc	SW	9.90
15	Conc	NE	9.90

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.89**	**5.11**	**61.33**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$580.00**
Storage Construction Costs:	**$1,479.66**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$400.00
25% Engineering and Legal:	100.00
20% Contingency:	$80.00
TOTAL COST:	**$580.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

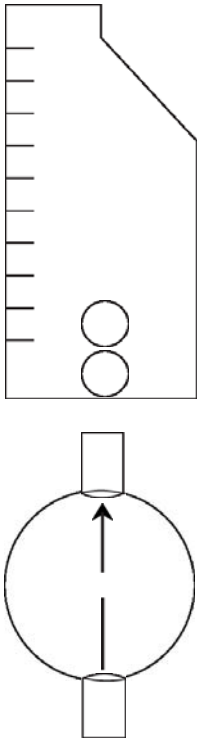
Manhole Inspection Form for Structure:

81

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Brick
Adjusting Ring Condition:	Broken
Adjusting Ring Depth (ft):	1.20
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.20
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	16.90
	16.95
Max Manhole Depth (ft):	16.95

Pipe Size (in)	Material	Direction	Drop
8	Clay	S	16.90
8		N	16.95

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Side Walk
Manhole Surcharge:	Yes
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**3.51**	**20.27**	**243.23**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4.	
5.	
6.	
7.	

Total Construction Cost:	$2,500.00
25% Engineering and Legal:	625.00
20% Contingency:	$500.00
TOTAL COST:	**$3,625.00**

Total Rehab Cost: **$3,625.00**
Storage Construction Costs: **$5,867.80**

Cost-effective to Rehab?: YES

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

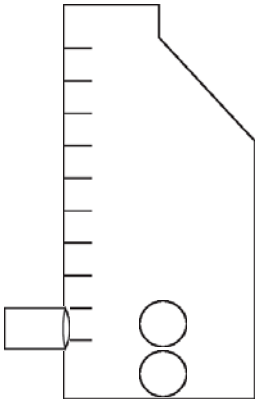
Manhole Inspection Form for Structure:

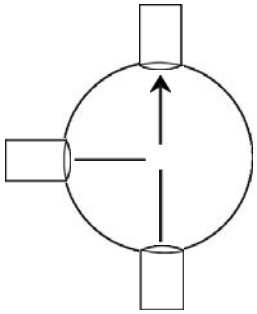
82

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.90
	13.05
	13.10
Max Manhole Depth (ft):	13.10

Pipe Size (in)	Material	Direction	Drop
8	Clay	W	12.90
8	Clay	S	13.05
8	Clay	N	13.10

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Side Walk
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-2
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.13	0.72	8.66
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.63**	**3.64**	**43.66**

Recommended I/I Rehabilitation	**Cost**
1. Seal Leaks with Mortar	$400.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5. Seal Leaks with Mortar	$400.00
6. Seal Leaks with Mortar	$400.00
7. Seal Leaks with Mortar	$400.00

Total Rehab Cost:	**$4,060.00**
Storage Construction Costs:	**$1,053.33**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$2,800.00
25% Engineering and Legal:	700.00
20% Contingency:	$560.00
TOTAL COST:	**$4,060.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

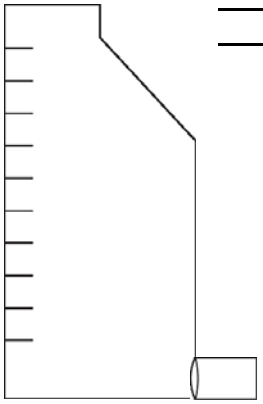
Manhole Inspection Form for Structure:

85

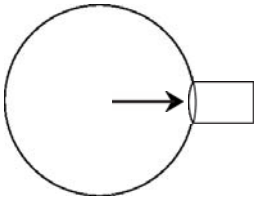
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	DNR
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.40
Max Manhole Depth (ft):	11.40



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	11.40

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	Yes
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

no good seal between adj & cone, bad frame seal

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (> 2 ft. Veg./Gravel)	$1,200.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$1,228.88**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

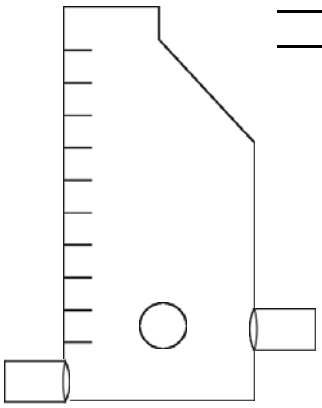
Manhole Inspection Form for Structure:

89

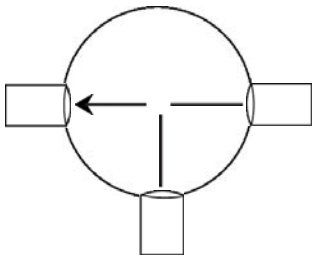
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	8.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	2.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	DNR
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	8.00
Corbel Depth (ft):	2.00
Pipe Invert Depth(s) (ft):	14.25 15.55 15.60
Max Manhole Depth (ft):	15.60



Pipe Size (in)	Material	Direction	Drop
10	Clay	S	14.25
18		E	15.55
18		W	15.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Shoulder
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.74**	**4.24**	**50.93**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (> 2 ft. Veg./Gravel)	$1,200.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$1,228.88**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/09/2001

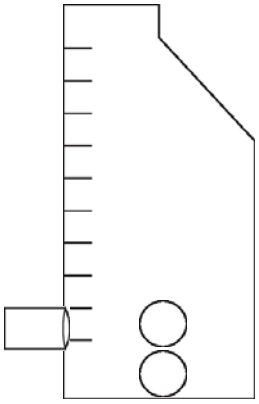
Manhole Inspection Form for Structure:

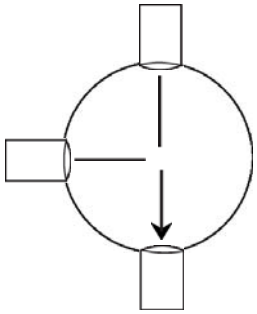
9

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	0.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.90
	11.40
	11.50
Max Manhole Depth (ft):	11.50

Pipe Size (in)	Material	Direction	Drop
8	Clay	W	10.90
15	Conc	N	11.40
18		S	11.50

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-1

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.69	3.97	47.64
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.00	0.00	0.00
Total I/I:	**0.69**	**3.97**	**47.64**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$1,149.46**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

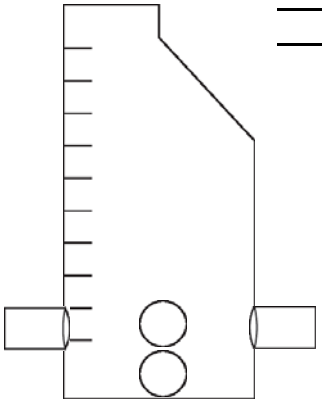
Manhole Inspection Form for Structure:

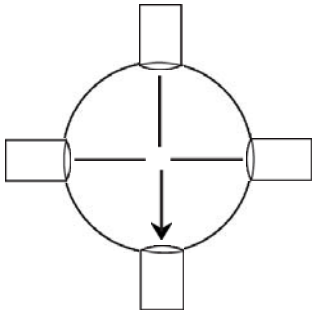
90

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	6.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	Yes
Cover Bolted:	No
Frame Condition:	Fair
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	2.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Fair
Flow Depth (ft):	0.70
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	2.00
Pipe Invert Depth(s) (ft):	12.60
	12.60
	15.50
	16.50
Max Manhole Depth (ft):	16.50

Pipe Size (in)	Material	Direction	Drop
18	PVC	E	12.60
18	PVC	W	12.60
42		N	15.50
42		S	16.50

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Fast
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**1.01**	**5.80**	**69.64**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,667.50**
Storage Construction Costs:	**$1,680.28**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,150.00
25% Engineering and Legal:	287.50
20% Contingency:	$230.00
TOTAL COST:	**$1,667.50**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

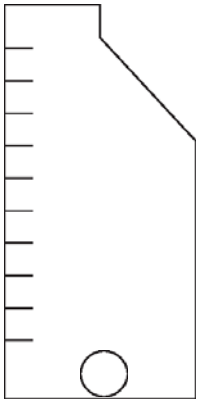
Manhole Inspection Form for Structure:

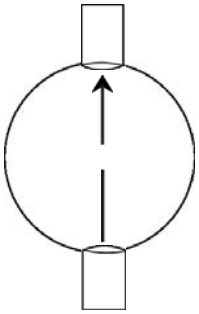
91

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	2.50
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.30
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	2.50
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	16.10
	16.10
Max Manhole Depth (ft):	16.10

Pipe Size (in)	Material	Direction	Drop
10	Clay	S	16.10
10	Clay	N	16.10

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Parking Lot
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	2.50	14.44	173.24
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**2.77**	**15.97**	**191.60**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (> 2 ft. Veg./Gravel)	$1,200.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,740.00**
Storage Construction Costs:	**$4,622.50**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,200.00
25% Engineering and Legal:	300.00
20% Contingency:	$240.00
TOTAL COST:	**$1,740.00**

This is a Category 7 Manhole
Monitor Again in 10 Years

*DNR = Did Not Record

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

Manhole Inspection Form for Structure:

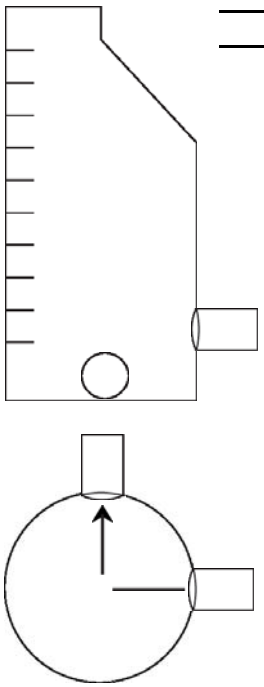
92

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	None
Adjusting Ring Condition:	DNR
Adjusting Ring Depth (ft):	0.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.20
Steps Condition:	Good
Step Material:	DNR

Structure Notes:
channel needs clraning

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	0.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	15.50
	15.60
Max Manhole Depth (ft):	15.60

Pipe Size (in)	Material	Direction	Drop
8		E	15.50
10		N	15.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Gravel
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.50	2.89	34.65
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**0.89**	**5.11**	**61.33**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,015.00**
Storage Construction Costs:	**$1,479.66**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$700.00
25% Engineering and Legal:	175.00
20% Contingency:	$140.00
TOTAL COST:	**$1,015.00**

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

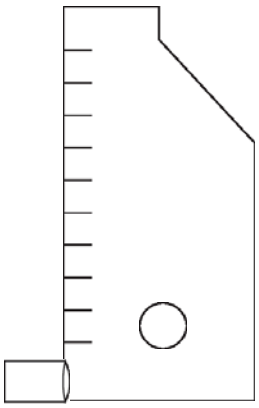
Manhole Inspection Form for Structure:

93

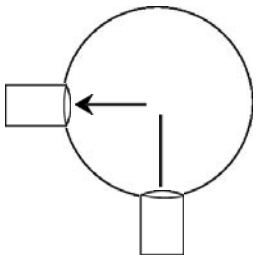
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.55 12.60
Max Manhole Depth (ft):	12.60



Pipe Size (in)	Material	Direction	Drop
8		S	12.55
8		W	12.60

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**3.51**	**20.27**	**243.23**

Recommended I/I Rehabilitation	**Cost**
1. Remove and Reset Frame (Pavement)	$750.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,087.50**
Storage Construction Costs:	**$5,867.80**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$750.00
25% Engineering and Legal:	187.50
20% Contingency:	$150.00
TOTAL COST:	**$1,087.50**

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

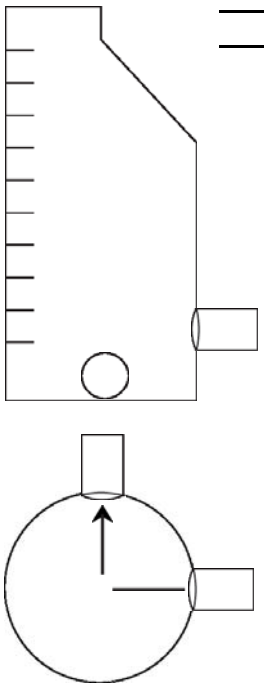
Manhole Inspection Form for Structure:

94

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	11.30 11.35
Max Manhole Depth (ft):	11.35

Pipe Size (in)	Material	Direction	Drop
8		E	11.30
8	Clay	N	11.35

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-3

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	3.13	18.04	216.55
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.15	0.84	10.05
Total I/I:	**3.27**	**18.88**	**226.60**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$5,466.64**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 7 Manhole
Plan to Repair in 0-5 Years

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

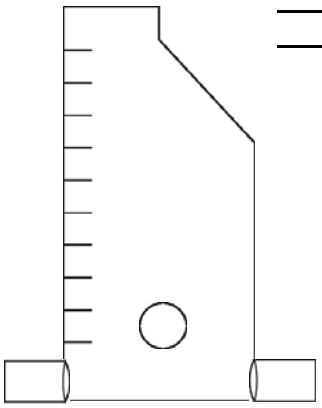
Manhole Inspection Form for Structure:

95

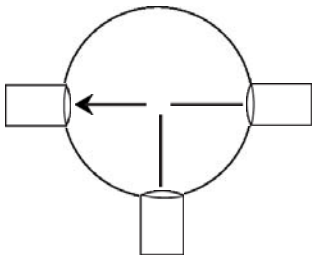
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.10
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	1.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	10.90
	11.10
	11.10
Max Manhole Depth (ft):	11.10



Pipe Size (in)	Material	Direction	Drop
8	Clay	S	10.90
8	Clay	E	11.10
8	Clay	W	11.10

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-5
Infiltration Rating:	F-4

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.69	3.97	47.64
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.27	1.53	18.36
Total I/I:	**0.95**	**5.50**	**66.00**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2. Seal Leaks with Mortar	$400.00
3.	
4.	
5.	
6.	
7.	

Total Construction Cost:	$2,100.00
25% Engineering and Legal:	525.00
20% Contingency:	$420.00
TOTAL COST:	**$3,045.00**

Total Rehab Cost: **$3,045.00**
Storage Construction Costs: **$1,592.51**

Cost-effective to Rehab?: NO

This is a Category 5 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report
print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

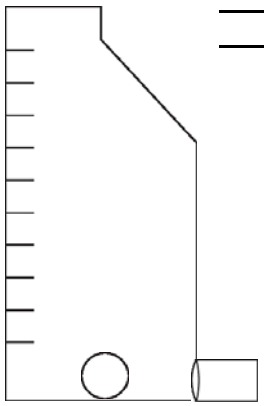
Manhole Inspection Form for Structure:

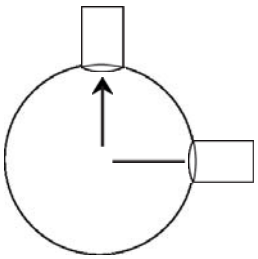
96

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Good
Adjusting Ring Depth (ft):	4.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





Rim Depth (ft):	NA
Ring Depth (ft):	4.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	12.00
	12.00
Max Manhole Depth (ft):	12.00

Pipe Size (in)	Material	Direction	Drop
8		E	12.00
8		N	12.00

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Steady
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-4
Infiltration Rating:	F-6

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.35	2.02	24.25
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.51	2.92	34.99
Total I/I:	**0.86**	**4.94**	**59.25**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2. Seal Leaks with Mortar	$400.00
3. Seal Leaks with Mortar	$400.00
4. Seal Leaks with Mortar	$400.00
5. Seal Leaks with Mortar	$400.00
6. Seal Leaks with Mortar	$400.00
7.	

Total Rehab Cost:	**$3,915.00**
Storage Construction Costs:	**$1,429.50**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$2,700.00
25% Engineering and Legal:	675.00
20% Contingency:	$540.00
TOTAL COST:	**$3,915.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

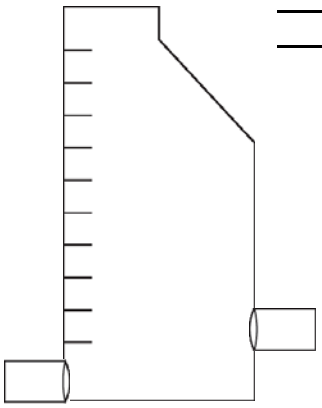
Manhole Inspection Form for Structure:

98

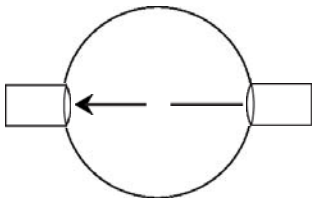
Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Poor
Adjusting Ring Depth (ft):	8.00
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping



Rim Depth (ft):	NA
Ring Depth (ft):	8.00
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.70 9.80
Max Manhole Depth (ft):	9.80



Pipe Size (in)	Material	Direction	Drop
8	Clay	E	9.70
8	Clay	W	9.80

(Diagrams not to scale - For pipe direction only)

Hydraulic Inspection

Surface Material:	Vegetation
Surface Setting:	Lawn Area
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Stagnant
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-7
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	2.50	14.44	173.24
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**2.89**	**16.66**	**199.92**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Veg./Gravel)	$700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$1,015.00**
Storage Construction Costs:	**$4,823.09**
Cost-effective to Rehab?:	**YES**

Total Construction Cost:	$700.00
25% Engineering and Legal:	175.00
20% Contingency:	$140.00
TOTAL COST:	**$1,015.00**

This is a Category 7 Manhole
Priority Repair in less than 1 Year

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

City of Bloomington
SSES
67110011
Inspection Date: 07/30/2001

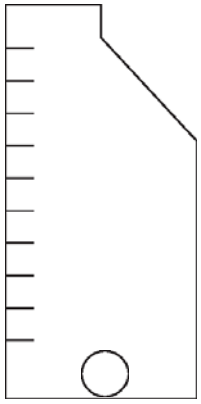
Manhole Inspection Form for Structure:

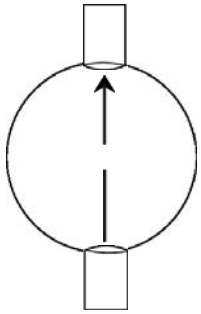
99

Structural Information

Structure Type:	San MH
Structure Diameter (ft):	4.00
Cover Type (# = Holes):	Solid
Cover Condition:	Good
Cover Manufacturer:	DNR
Bolt Down Cover:	No
Cover Bolted:	No
Frame Condition:	Good
Adjusting Ring Type:	Precast
Adjusting Ring Condition:	Fair
Adjusting Ring Depth (ft):	1.80
Corbel Type:	Precast
Corbel Condition:	Good
Corbel Centricity:	Eccentric
Corbel Depth (ft):	3.00
Wall Type:	Precast
Wall Condition:	Good
Channel/Bench Condition:	Good
Flow Depth (ft):	0.05
Steps Condition:	Good
Step Material:	DNR
Structure Notes:	

Connections/Piping





(Diagrams not to scale - For pipe direction only)

Rim Depth (ft):	NA
Ring Depth (ft):	1.80
Corbel Depth (ft):	3.00
Pipe Invert Depth(s) (ft):	9.50
	9.50
Max Manhole Depth (ft):	9.50

Pipe Size (in)	Material	Direction	Drop
8		S	9.50
8		N	9.50

Hydraulic Inspection

Surface Material:	Concrete
Surface Setting:	Road Way
Manhole Surcharge:	No
Flooding/Ponding:	No
Flow Type:	Slow
Flow Clarity:	Normal
Structure Rating:	S-1
Inflow Rating:	I-6
Infiltration Rating:	F-5

Hydraulic Inspection Notes

Structure Notes:

Inflow Notes:

Infiltration Notes:

Analysis: Infiltration/Inflow and Repairs

Miscellaneous Manhole Improvements:

1. Debris build up in manhole; cleaning is recommended.
2.
3.
4.
5.

	Average Day (gpm)	Average Month (MCF)	Average Year (MCF)
Inflow Rating:	0.88	5.05	60.63
Structure Rating:	0.00	0.00	0.00
Infiltration Rating:	0.39	2.22	26.68
Total I/I:	**1.26**	**7.28**	**87.31**

Recommended I/I Rehabilitation	**Cost**
1. Replace Adjusting Rings (< 2 ft. Pavement)	$1,700.00
2.	
3.	
4.	
5.	
6.	
7.	

Total Rehab Cost:	**$2,465.00**
Storage Construction Costs:	**$2,106.59**
Cost-effective to Rehab?:	**NO**

Total Construction Cost:	$1,700.00
25% Engineering and Legal:	425.00
20% Contingency:	$340.00
TOTAL COST:	**$2,465.00**

This is a Category 6 Manhole
Immediate Priority Repair

*DNR = Did Not Record

Manhole Report

print date: 12/20/2013

Appendix G

Manhole Rating System


Infiltration 1


Infiltration 2


Infiltration 3


Infiltration 4


Infiltration 5


Infiltration 6


Infiltration 7


Structure 1


Structure 2


Structure 3


Structure 4

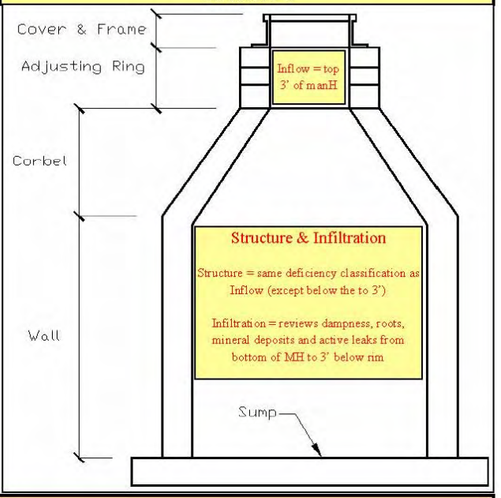
Infiltration/Inflow and Structure Rating

I/I Source	Location	Deficiency	Scale 1 (No Work)	2	3	4 (Minor Work)	5	6	7 (Major Work)
Infiltration **F**	Presence of water from bottom of manhole to 3' below Top of Casting	Dampness	No Dampness	Bottom 1'	Bottom 2'	Bottom 3-4'	Entire MH Wet	Entire MH Wet + Minor Mineral Deposits	Active Leak + Major Mineral Deposits
		Roots	No Roots	1% - 5% Roots	6% - 10% Roots	11 - 25% Roots	26% - 50% Roots	51% - 75% Roots	76% - 100% Roots
Inflow **I**	Potential for Inflow **within** the top 3' of manhole (i.e from Top of Casting to 3' below Top of Casting)	Brick Cover	No Work	Can see 1% - 5% Brick	Can see 6% - 25% Brick	Can see 11% - 25% Brick	Can see 26% - 50% Brick	Can see 51% - 75% Brick	Can see 76% - 100% Brick
		Mortar	No Mortar Missing	1% - 5% Mortar Missing	6% - 25% Mortar Missing	11% - 25% Mortar Missing	26% - 50% Mortar Missing	51% - 75% Mortar Missing	76% - 100% Mortar Missing
		Brick/Block Pieces and Cracks	No Brick/Block Missing and/or No Cracks	1% - 5% Brick/Block Missing and/or Hairline Cracks	6% - 25% Brick/Block Missing and/or 16th-inch Crack	11% - 25% Brick/Block Missing and/or 8th-inch Crack	26% - 50% Brick/Block Missing and/or 4th-inch Crack	51% - 75% Brick/Block Missing and/or 0.5-1" Crack/Gap	76% - 100% Brick/Block Missing and/or greater than 1" Crack/Gap
		Frame/Ring Condition	Good		Fair		Broken to Poor		
Structure **S**	Structural Deficiency **below** the top 3' of manhole (i.e from bottom of manhole to 3' below Top of Casting)	Brick Cover	No Work	Can see 1% - 5% Brick	Can see 6% - 25% Brick	Can see 11% - 25% Brick	Can see 26% - 50% Brick	Can see 51% - 75% Brick	Can see 76% - 100% Brick
		Mortar	No Mortar Missing	1% - 5% Mortar Missing	6% - 25% Mortar Missing	11% - 25% Mortar Missing	26% - 50% Mortar Missing	51% - 75% Mortar Missing	76% - 100% Mortar Missing
		Brick/Block Pieces	No Brick/Block Missing and/or No Cracks	1% - 5% Brick/Block Missing and/or Hairline Cracks	6% - 25% Brick/Block Missing and/or 16th-inch Crack	11% - 25% Brick/Block Missing and/or 8th-inch Crack	26% - 50% Brick/Block Missing and/or 4th-inch Crack	51% - 75% Brick/Block Missing and/or 0.5-1" Crack/Gap	76% - 100% Brick/Block Missing and/or greater than 1" Crack/Gap
		Corbel/Wall Condition	Good		Fair		Broken to Poor		

* Missing, crumbling or spalding


Structure 5


Structure 6




Inflow 1


Inflow 2


Inflow 3


Inflow 4


Inflow 5


Inflow 6


Inflow 7

Sanitary Sewer Technical Memoranda

SAN4 - WET WEATHER ALTERNATIVES EAST SIDE INTERCEPTOR SYSTEM

Wet Weather Alternatives
East Side Interceptor System

Executive Summary

The East Side Interceptor sewer, which conveys wastewater flows from the east side of the City of Bloomington to Southeast Wastewater Treatment Plant (SEWWTP), experiences elevated flows during wet weather due to inflow and infiltration into the pipes. Although this is not uncommon for wastewater collection systems, it creates problems for the Bloomington-Normal Water Reclamation District (BNWRD), as the SEWWTP does not have adequate treatment capacity to handle wet weather flows. To manage this, BNWRD currently diverts a portion of the East Side Interceptor system wet weather flow to the City's older sewer system on the west side. This is undesirable to both the City and BNWRD.

In the near term, the City will need to address excess peak flows and flow volumes resulting from wet weather, and implement a continuous inflow/infiltration evaluation and removal program that is modeled after the EPA's Capacity, Management, Operations and Maintenance (CMOM) regulations.

Key Findings

- The most cost-efficient method to address wet weather flows is through storage (via tank or holding pond).
- Increasing the treatment capacity at the SEWWTP is the least cost-efficient method to address wet weather flows.
- Footing drain removals can help to reduce excess flows, although it is uncertain how many footing drains are still connected to the sanitary sewer system.
- Preliminary estimates indicate that approximately 10% of I/I may be removed from areas within the target sewer districts as part of the proposed pilot program efforts.

Recommendations

- Perform additional smoke testing and manhole inspections in the high priority meter districts.
- Clean and televise sewers within the high priority meter districts.
- Perform a pilot inflow/infiltration removal program in the Arcadia meter district. Pre-rehabilitation flow meter data should be compared to post-rehabilitation to determine cost-effectiveness.
- Evaluate the prevalence of footing drains connected to the sewer system and disconnect those footing drains. This effort will focus on the Broadmoor meter district. Pre-rehabilitation flow meter data should be compared to post-rehabilitation to determine the cost-effectiveness of footing drain removal.
- Update City policies on footing drain removals and sewer lateral replacement.
- Install a partially-buried wet weather storage tank near the Little Kickapoo Pump Station.

Cost Summary	
Wet Weather Storage near Little Kickapoo Pump Station	$ 12,160,000
Inflow/Infiltration Evaluation and Source Removal Program	$ 2,288,000
TOTAL	**$ 14,448,000**

ARCHITECTS. ENGINEERS. PLANNERS.

OHM Advancing Communities

technical memorandum

Date: December 11, 2013

To: Ryan Otto, City of Bloomington

From: Greg Kacvinsky, OHM Advisors
Robert Czachorski, OHM Advisors

Re: Wet Weather Alternatives – Eastside Interceptor System

Project Summary

The City of Bloomington has performed flow metering, SSES, system modeling, I/I Analysis and an evaluation of available options for addressing excess peak flows. From these efforts, several short-term I/I removal opportunities have been identified and a long-term program for management of the peak wet weather flows has been developed. This program consists of the following components:

1. Perform I/I removal of the target districts identified as having I/I that is cost-effective to remove from the SSES.
2. Extend the I/I removal program to comprehensively address the sources of I/I in a pilot district. A review of other programs across the nation has shown that a comprehensive approach is necessary to achieve meaningful I/I removal.
3. Preliminary estimates indicate that approximately 10% of I/I may be removed from areas within the target sewer districts as part of the proposed pilot program efforts.
4. Measure the effectiveness of the I/I removal efforts and perform a cost-effectiveness analysis of further I/I reductions.
5. Proceed with either additional I/I removal or construct system storage to address the long-term needs for the City's peak flow management.
6. Implement a continuous I/I evaluation and removal program that is modeled after the EPA's CMOM program of regular system flow metering and targeted I/I removal when cost effective.

To provide a preliminary indication of the likely cost-effective project, we have evaluated alternatives that consider source removal, transport and treat, and storage as the primary long-term management approach. Each alternative includes the following components:

- Removal of the first 10% of the I/I flow from activities identified in the SSES.
- Total cost of capital projects and I/I removal
- 20-year present worth of operations and maintenance cost for new facilities
- 20-year present worth of reductions in treatment cost from I/I removal

The results of the evaluation are described in detail in this report and summarized in Table 1.

Table 1:
Preliminary Costs for Wet Weather Management Strategies

Item	Wet Weather Management Strategy		
	Source Removal	**Partial Source Removal and Transport & Treat**	**Partial Source Removal and Storage**
Capital Cost	$ 42,980,000	$ 75,550,000	$10,670,000
20-Year O&M	$0	$20,530,000	$2,900,000
20-Year Treatment Cost Reduction	($ 8,620,000)	($ 1,200,000)	($ 1,200,000)
Total 20-Year Life Cycle Cost	**$ 34,400,000**	**$ 94,900,000**	**$12,400,000**

Based on the preliminary evaluation of alternatives, the transport & treatment option is excessively costly and does not warrant further evaluation. With the assumptions made for this analysis, storage is the most cost-effective option. The pilot I/I removal program will evaluate the cost-effectiveness of the further I/I reduction and storage. The assumptions that need to be verified through the pilot I/I removal program are:

1. The cost for the I/I removal activities identified in the SSES.
2. The amount of I/I removed from the pilot I/I removal program.
3. The cost effectiveness of additional I/I removal beyond the pilot.
4. The cost savings resulting from reduced treatment disposal from reduced flows to the SEWWTP.

The source removal option has the advantages of permanently removing I/I flows from the system and avoiding a new satellite facility (i.e. storage tank) in the collection system to maintain. The disadvantages are the potentially high capital costs, the risks of achieving the high I/I removal rates required, and that no additional capacity would be available in the SEWWTP for additional growth without further expansion at the plant.

The storage option has the advantages of relatively low capital costs, several potential options available for a tank site, and the storage tank could be used for daily flow equalization by the SEWWTP. The disadvantages are that it results in a new satellite facility in the collection system to maintain and it requires the ongoing collection and treatment of wet weather flows.

The advantages, disadvantages and cost-effectiveness of these options should be reevaluated after the completion of the pilot I/I removal project. At that time, the assumptions made in this analysis can be verified or modified, and a final decision on the long-term plan can be made based on the results of actual observations and measurements in the Bloomington system.

Background

Portions of the East Side Interceptor sewer, which is owned by the Bloomington Normal Water Reclamation District (BNWRD), have been previously reported to have elevated base flows and inflow and infiltration (I&I) during wet weather events (see Figures 1a and 1b). Flows from the East Side Interceptor discharge to BNWRD's Southeast Wastewater Treatment Plant (SEWWTP). During significant wet weather events (generally exceeding 2-3 inches of rainfall), the SEWWTP influent approaches the plant's treatment capacity, which requires flow diversions to the City's west sewer system in order to avoid any overflows or flow bypasses at the SEWWTP. These diversions include an overflow pipe at the GE Valley Pump Station (GEVPS) wet well and a pumped diversion at the Little Kickapoo Pump Station (LKPS). Both diversions send wet weather flows to the City's older combined sewer collection system that ultimately discharges to BNWRD's West Wastewater Treatment Plant (WWWTP) on the City's west side. These diversions are not desired by BNWRD, as the older (west) components of the City's collection system include combined sewers. Additional flows to the combined system will make it more difficult for the City to meet its CSO Permit obligations with the Illinois Environmental Protection Agency (IEPA).

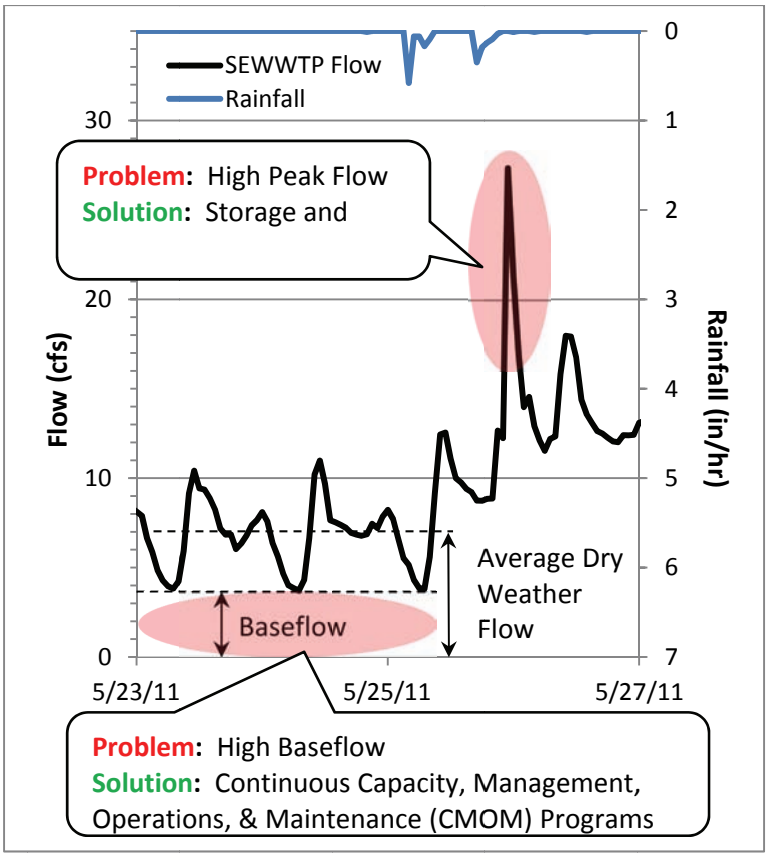


Figure 1a
Baseflow and Peak Flow Components of I&I

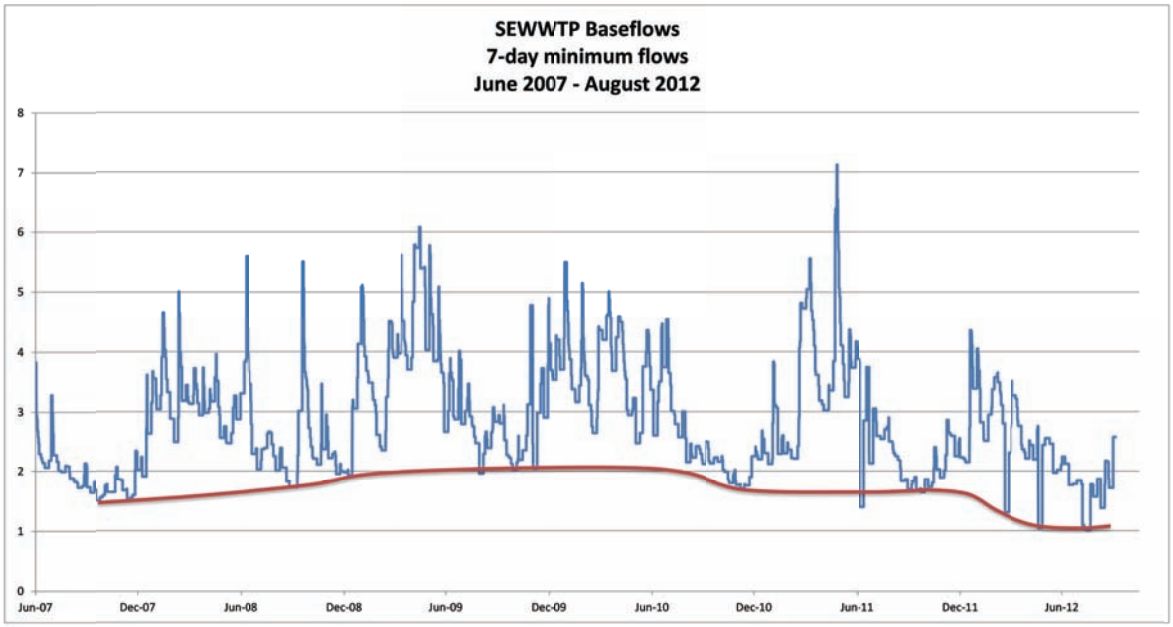


Figure 1b
Baseflow Observed at SEWWTP

This document builds upon previous work presented in the East Side Interceptor Hydrologic Analysis; East Side Interceptor / GE Valley Collector - System Capacity Assessment; and East Side Interceptor – Sanitary Sewer Evaluation Survey (SSES) documents. Whereas the previous analyses focus on the system design flows; hydraulic capacity of the system; and evaluation of I/I sources in the system, this technical memorandum uses the previous analyses to evaluate and recommend alternatives for a cost-effective program to reduce wet weather flows in the East Side Interceptor System. An assessment of base flow has also been incorporated into this analysis such that the proposed program to reduce wet weather flows considers the cost of treating non-wastewater base flow.

Approach for Alternative Evaluation

The SSES Memorandum relied on general assumptions on the effectiveness of various I/I removal activities to assess cost-effective options to reduce wet weather flows. The SSES Memorandum recommended an initial program of targeted manhole rehabilitation and direct inflow source removal (i.e. “low-hanging fruit”) based on typical levels of I/I removal effectiveness for these types of improvements. Prior to performing a cost-effectiveness analysis to select a long-term solution to manage system flows, we recommend a short-term (pilot) program to measure and verify the effectiveness of various I/I removal activities. Data on the effectiveness of short-term I/I removal activities will provide an objective basis for selecting those system improvements that will provide the most cost-effective long-term solution to reduce wet weather flows.

Given the current discrepancy between projected (future) wet weather peak flows and the current flow capacity at the SEWWTP, the I/I removal activities that are deemed “cost-efficient” will likely only result in a partial solution to the total system wet weather needs. Ultimately, it will likely be necessary to consider a set of capital improvements that address the regional needs of the East Side Interceptor and the SEWWTP, beyond I/I removal alone. In order to provide the City and BNWRD with a sense of long term capital expenditures, we offer specific recommendations for long term alternatives to manage system flows. These recommendations are based on the assumed level of I/I reduction that can be accomplished through cost-effective means. However, it will be necessary to re-evaluate the sizing of the long term alternatives to manage wet weather flows once more information on I/I removal effectiveness is confirmed after the conclusion of the short term program.

Short Term Program to Verify I/I Removal Effectiveness

The goal of the short term program is to perform removal of the I/I sources identified as cost-effective in the July 2012 SSES and expand the initial SSES to cover the remaining components of the high-priority meter districts. Upon the completion of I/I reduction activities from the expanded SSES effort, post-system rehabilitation flow monitoring should be performed to evaluate the effectiveness of the I/I removal. Figure 1 illustrates the cost-effectiveness of different I/I removal activities versus system storage of excess wet weather flows.

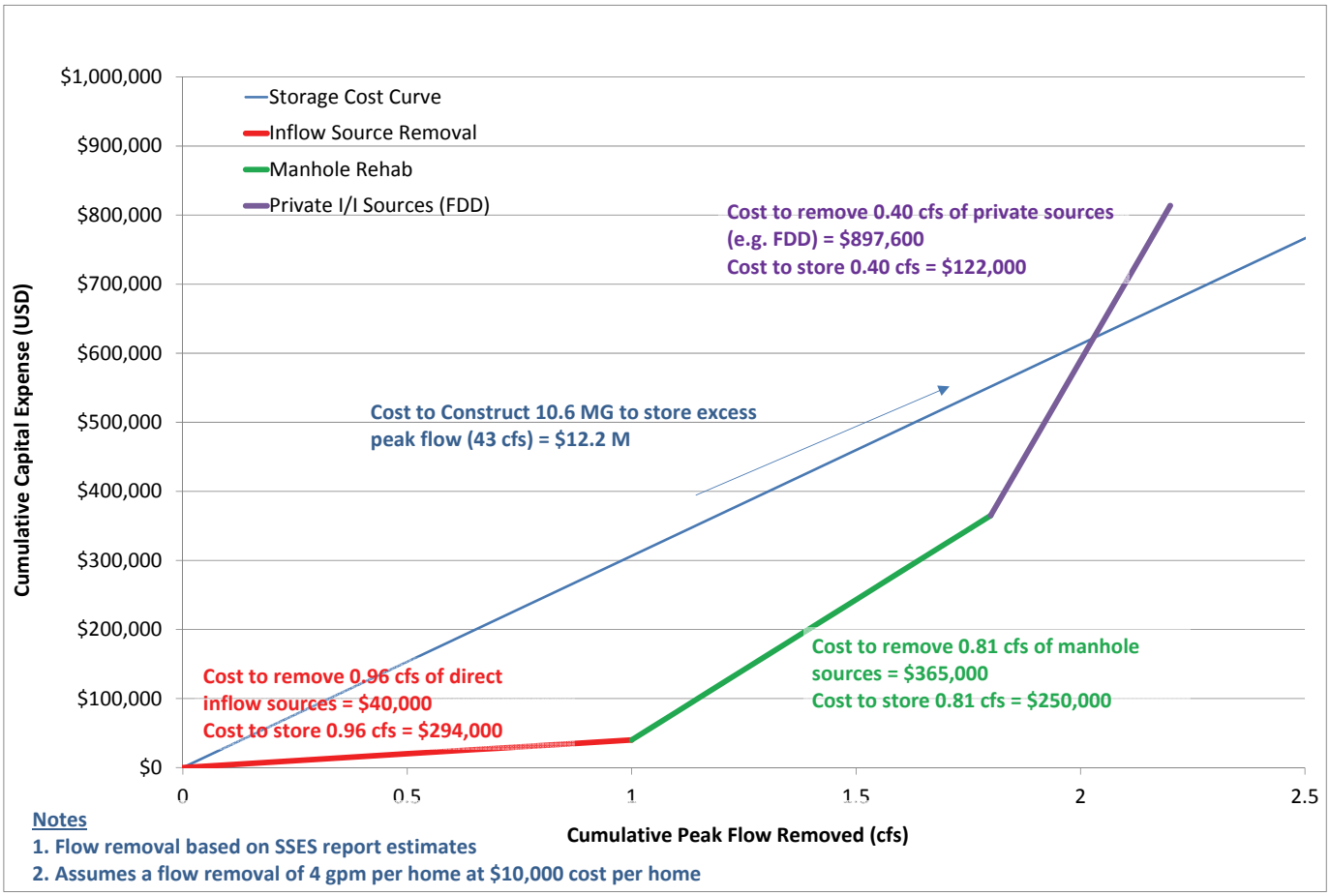


Figure 2
Summary of I/I Removal versus Storage Alternatives
Capital Costs Only

In Figure 2, the cumulative capital cost versus cumulative flow removed is plotted for system storage and various I/I removal activities. If the curve for a particular I/I removal activity is flatter than the storage cost curve, this means that more flow can be removed than can be stored on a per dollar basis; thus, the I/I removal activity is deemed cost-effective. This relationship is apparent with direct inflow reduction; however, the curve for sewer lining, manhole rehabilitation, and private source removal (i.e. footing drain disconnection and lateral lining) may be steeper than the storage cost curve. If the initial I/I removal activities reveal that it is more expensive to remove private I/I source flows than to store these flows, the City can use this information to prioritize future capital improvement funds towards regional improvements such as wet weather storage.

As a next step, the cost of base flow treatment was also incorporated in the cost curve plots and the result is illustrated in Figure 3. For this analysis, it was assumed that the base flow removal was proportionate to the peak flow removal shown on the plot.

The cost of base flow treatment was also incorporated within the cost curve plots. A detailed break-down of the base flow treatment cost computation is provided in Appendix Table A-1. For this analysis, it was assumed that the base infiltration flow removal was proportionate to the peak I/I flow removal. For example, if peak flows were reduced by 10%, then it was assumed that base infiltration flows were reduced by 10%. It was then assumed that the estimated base flow removal would occur 24 hours a day for 365 days a year to estimate a total base flow volume for the year. The yearly estimated base flow volume was then multiplied by a treatment cost of $1.70 per 1,000 gallons to come up with a yearly cost

to treat the base flow that would be removed. The yearly cost of base flow treatment was then converted to a 20-year present worth cost using an interest rate of 4%. Based on this analysis, it was estimated that for every cfs of peak I/I flow removed, the 20-year present worth cost to treat the associated base infiltration flow is approximately $200,000. The present worth value of $200,000 of treatment costs per cfs of peak I/I was used to evaluate alternatives and life cycle costs.

The present value of base flow reduction was then incorporated in the cost-effectiveness plots as shown in Figure 2 by subtracting the savings from base flow reductions from the capital costs to complete a particular I/I removal activity. The modified cost curves for the I/I removal activities, which incorporate savings from base flow reductions are presented as dashed lines on the figure. Incorporating base flow reduction into the curves has the effect of flattening the I/I removal curves; thus demonstrating that I/I removal is more cost-effective. In this case, the benefits of base flow reduction indicate that manhole rehabilitation would also be cost effective in comparison to system storage.

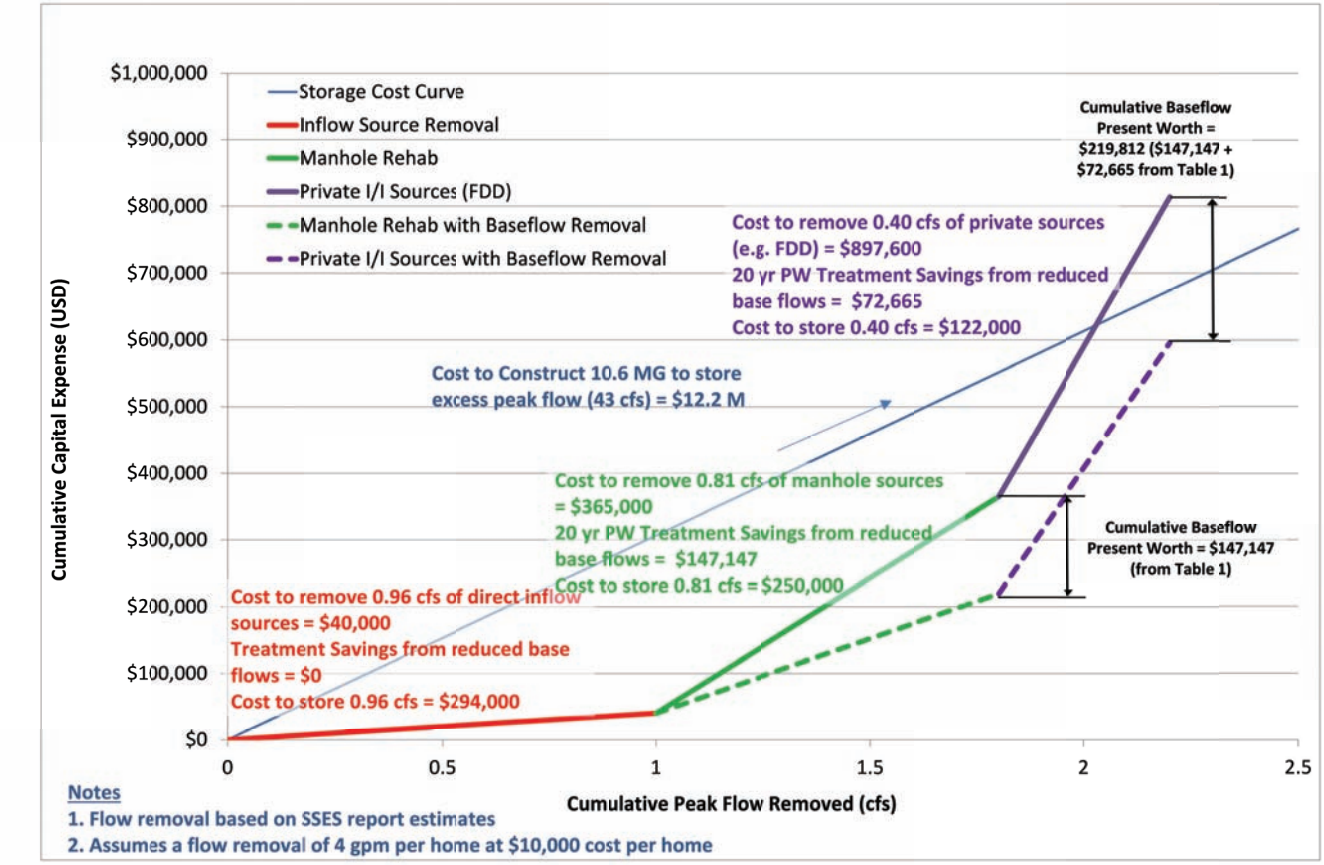


Figure 3
Summary of I/I Removal versus Storage Alternatives with Base Flow Reduction

The guidelines for determining cost effectiveness presented in Figures 1 and 2 are based on assumed values of I/I removal for base flow and peak flows as estimated from the experience of other communities' I/I removal efforts. These values indicate that direct source disconnection and manhole rehabilitation should be cost-effective as compared to wet weather storage; however, these values for I/I removal should be verified through the implementation of a pilot I/I removal program within the Arcadia and Broadmoor metering districts, as actual I/I removal rates can vary dramatically. The Arcadia and Broadmoor districts are good pilot areas as these two districts have the highest groundwater infiltration levels in the system. The recommended pilot study would be an extension of the efforts completed as part of this Master Planning effort.

The wet weather analysis in each district began in 2012 and involved initial flow metering to quantify current I/I levels, followed by a Sanitary Sewer Evaluation Survey (SSES) of selected portions of those sewer districts where higher wet weather response was observed. The SSES included manhole inspections and smoke testing to locate specific system defects. As the next step in the pilot process, SSES activities should be completed for the remainder of the priority meter districts; system defects should be corrected through targeted repairs/retrofits to the collection system where significant inflow sources are identified; and the effectiveness of the targeted repairs can be measured with ongoing flow metering. An overview of the recommend wet weather management process is shown in Figure 3, which is modeled after the EPA's Capacity, Management, Operation & Maintenance (CMOM) process.

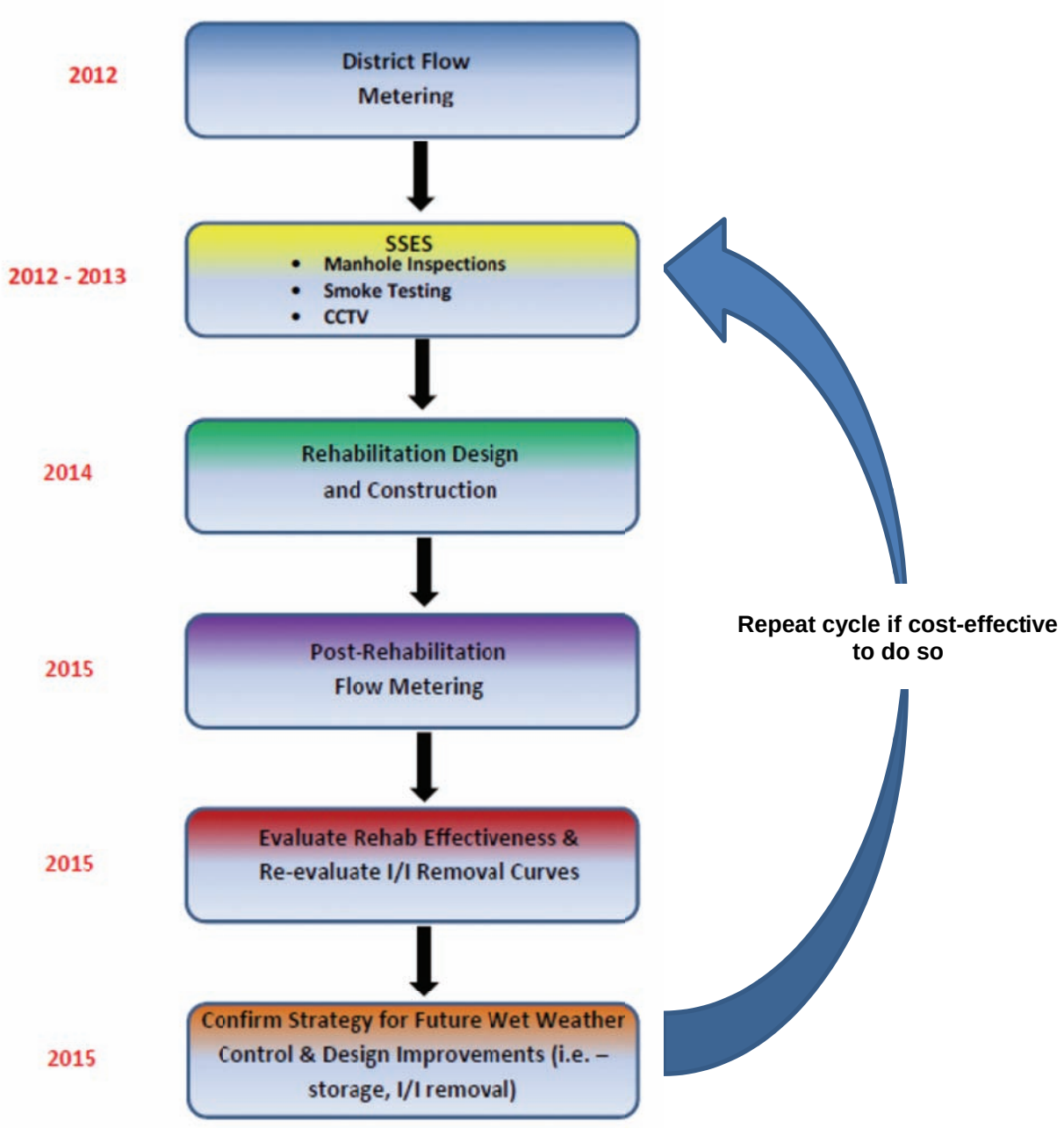


Figure 4
Overview of Pilot Evaluation Process (CMOM Process)

Long Term Program for Managing Wet Weather Flows

The rehabilitation effectiveness evaluation will allow for a better estimate of the magnitude of possible I/I removal system-wide. Based on the improved estimates for I/I removal completed in the short-term program, approaches for the long-term management of wet weather flows should be assessed to evaluate the most cost-effective solution.

Upon the completion of the first four components of Figure 4 (through post-rehabilitation flow metering), a

decision will need to be made on how to efficiently invest the City's sanitary sewer revenues to address the long-term capacity issues of the SEWWTP. The basic question to ask is:

> *Is it better to continue with I/I source removal (system rehabilitation) or invest in a regional solution (treatment capacity or wet weather storage)?*

This section serves to provide the City and BNWRD with an initial sense of what long-term wet weather control approach appears to be the most cost effective. Once the short-term pilot program is completed, the long-term wet weather control alternatives should be re-visited to assess the best alternative moving forward.

Transport and Treatment of Excess Peak Flows versus I/I Removal

Transport and treatment of excess peak flows involves conveyance of all peak flows to the BNWRD SEWWTP for treatment. The East Side Interceptor / GE Valley Collector - System Capacity Assessment indicated that the East Side Interceptor System has sufficient capacity to convey the future design flows 69 cfs) to the SEWWTP. However, the SEWWTP has a limiting treatment capacity of 26.1 cfs (16.875 MGD), thus the capacity of the WWTP would have to be upgraded if a transport and treat approach to wet weather control were adopted. The cost curve for upgrades to the WWTP capacity in relation to I/I removal is presented in Figure 5.

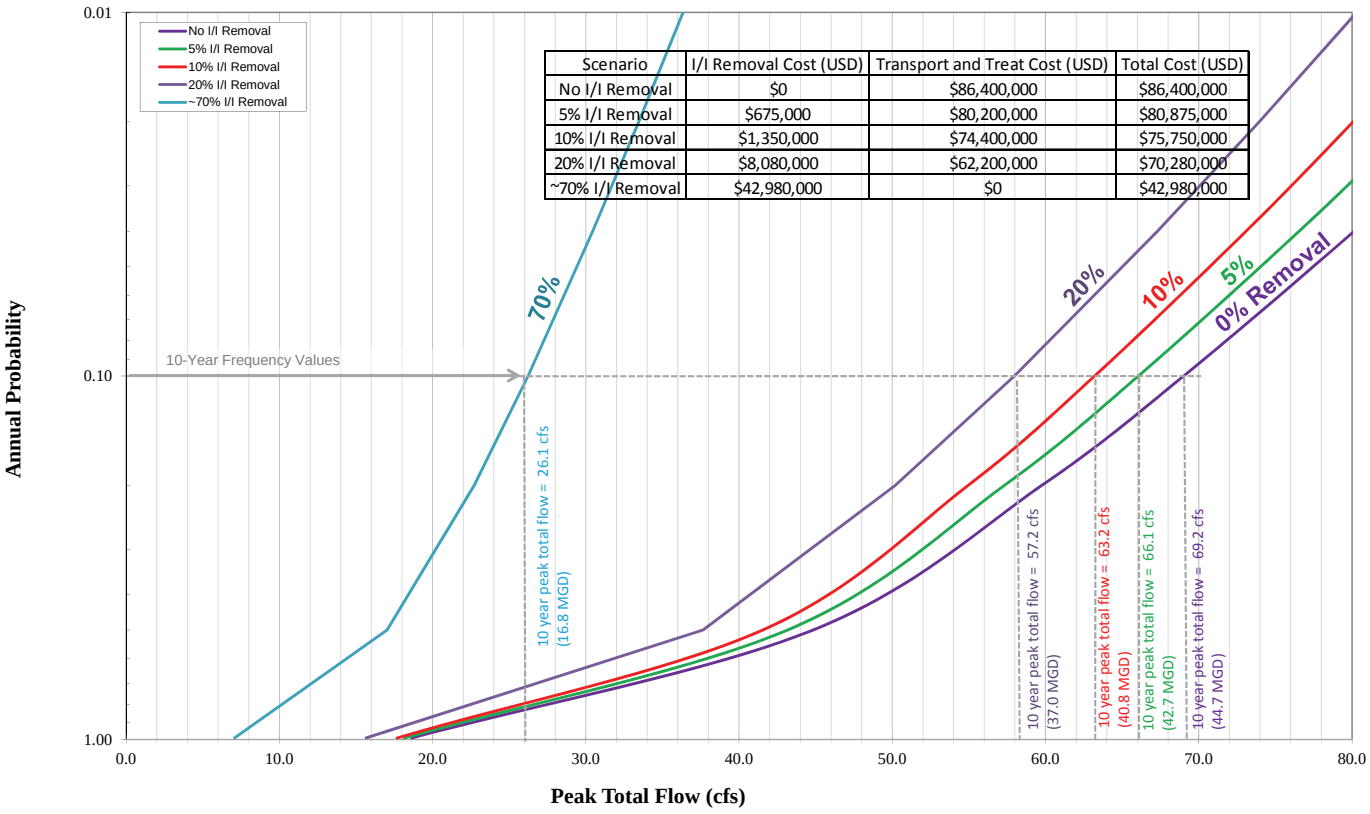


Figure 5
Transport and Treatment Cost Curve in Relation to I/I Removal

The transport and treatment cost curve presented in Figure 5 assumes a cost of $2 million per cfs of peak treatment capacity, based on experience with similar collection systems. The cost curve indicates that the cost of the transport and treat option is between $75 million and $86 million with total project costs decreasing as the amount of I/I removal increases. It should be noted that the I/I removal costs on a per cfs basis are based on the removal rates and costs presented in the SSES. The I/I removal activities

proposed in the SSES are generally considered to be the most cost-effective of I/I removal activities and that I/I removal will have decreasing marginal returns as more I/I removal is performed. We have made assumptions and used these assumptions to extend the curves in order to determine the point at which the most cost-effective approach would be revealed.

Storage of Excess Peak Flows versus I/I Removal

Storage of excess peak flows involves detention of peak flow volumes in a constructed basin facility such that the detained peak flows can be returned to the collection and treatment system once the peak wet weather flows have subsided. Since the East Side Interceptor System has capacity to convey the design flows and the WWTP has a limiting capacity of 26.1 cfs, a peak flow storage facility could be located at any location between the City boundaries and the WWTP to detain peak flows in excess of the WWTP capacity (26.1 cfs). The cost curve for storage upgrades in relation to I/I removal is presented in Figure 6.

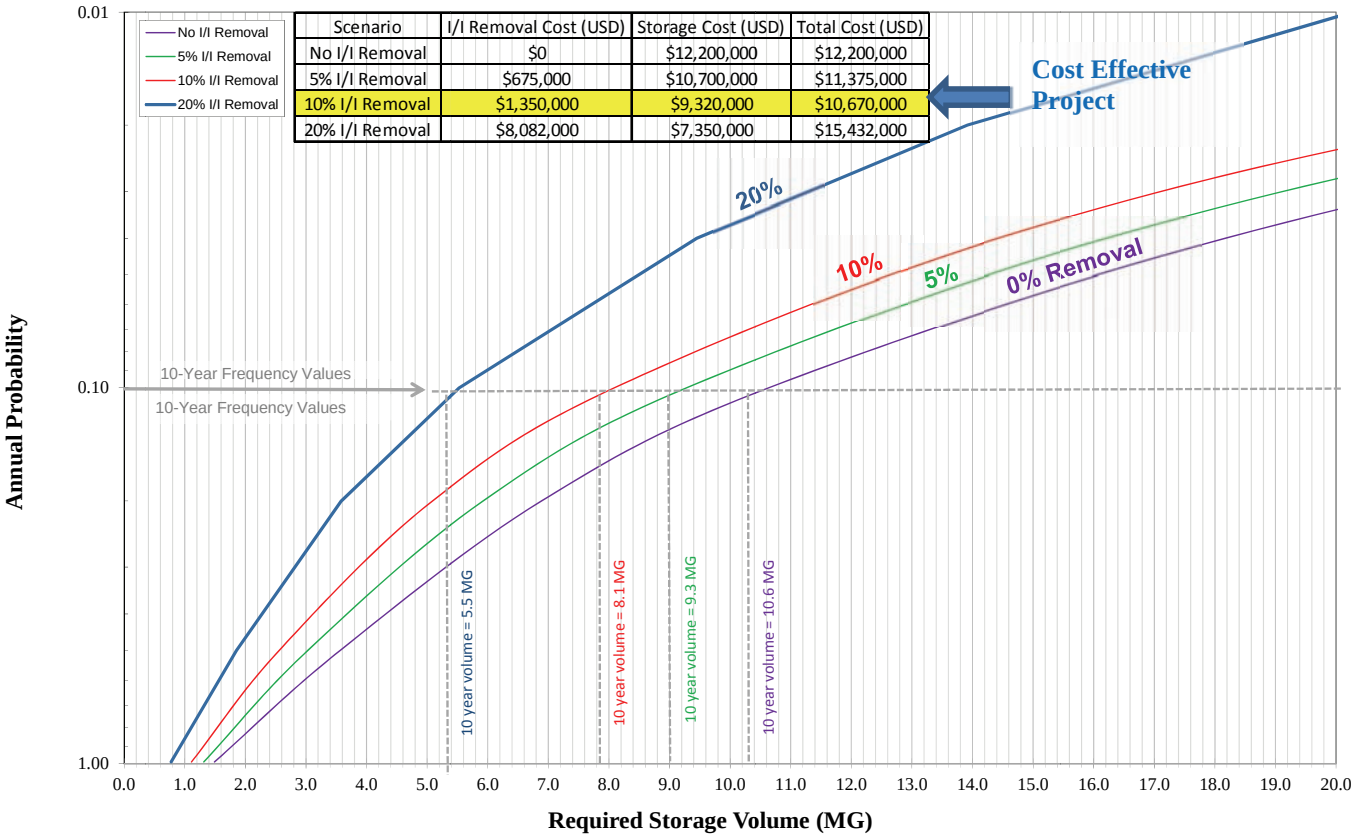


Figure 6
Peak Flow Storage Cost Curve in Relation to I/I Removal

The peak flow storage cost curve presented in Figure 6 represents our planning-level cost estimates for wet weather storage (as detailed in the Appendix). The cost curve indicates that the cost of the wet weather storage reaches a minimum at or around 10% I/I removal, with total project costs increasing again as the amount of I/I removal increases. It should be noted that the I/I removal costs on a per cfs basis are based on the removal rates and costs outlined in the SSES Memorandum. The I/I removal activities proposed in the SSES are generally considered to be the most cost-effective of I/I removal activities and that I/I removal will have decreasing marginal returns as more I/I removal is performed. We have made assumptions and used these assumptions to extend the curves in order to determine the point at which the most cost-effective approach would be revealed.

Because system storage appears to be promising as a cost-effective approach in managing wet weather flows, site schematics and planning level cost estimates were developed for two storage alternatives to

provide the City with a sense of the capital investment that may be required, such that the City can proactively plan for future capital expenditures.

The two options that were evaluated for system storage were an open top storage facility and an enclosed storage facility. The schematics for these options are presented in Figures 7 and 8.

Cost estimates for the storage alternatives are located in the Appendix.

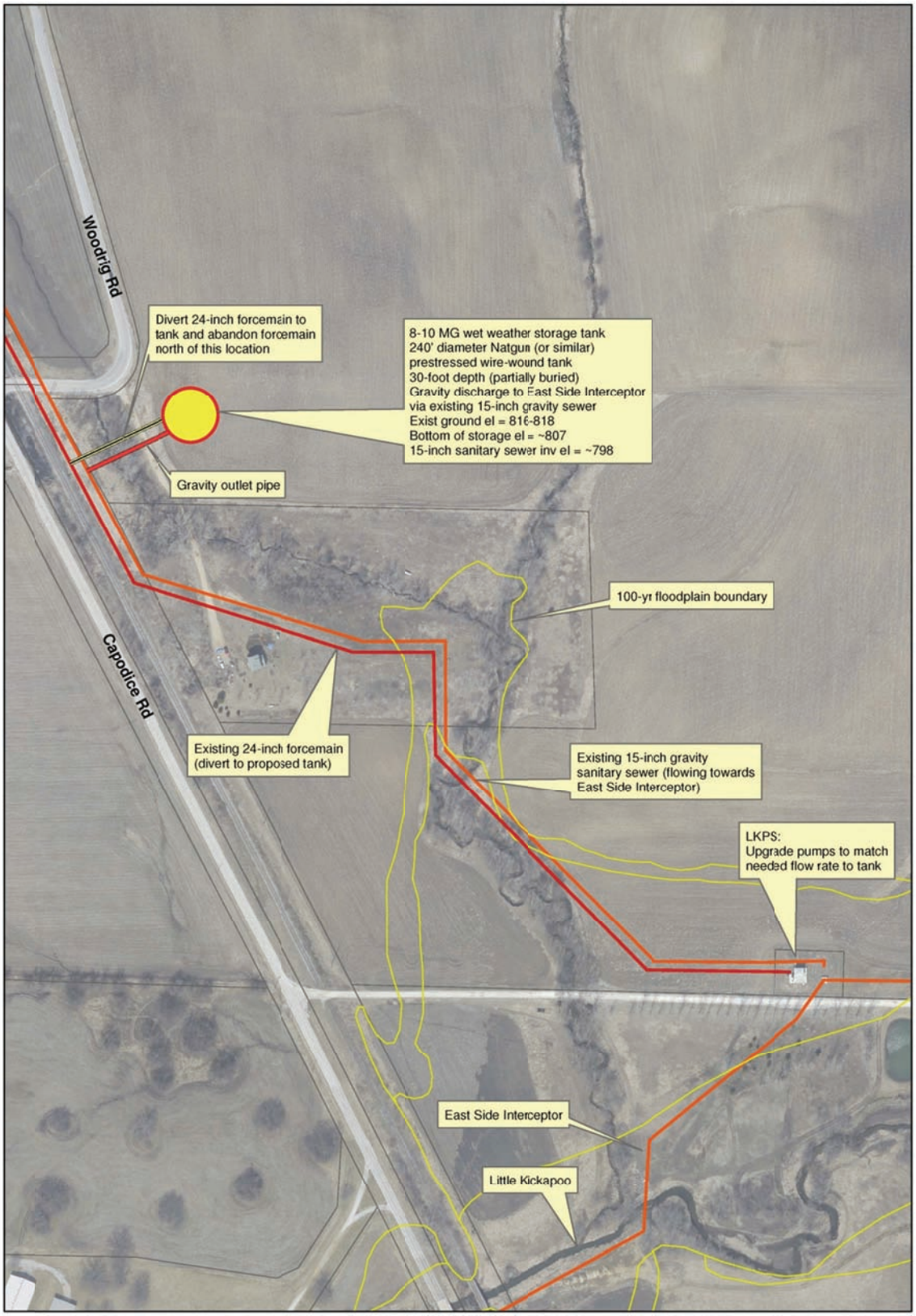


Figure 7
Wet Weather Storage: Partially-Buried Tank Scenario

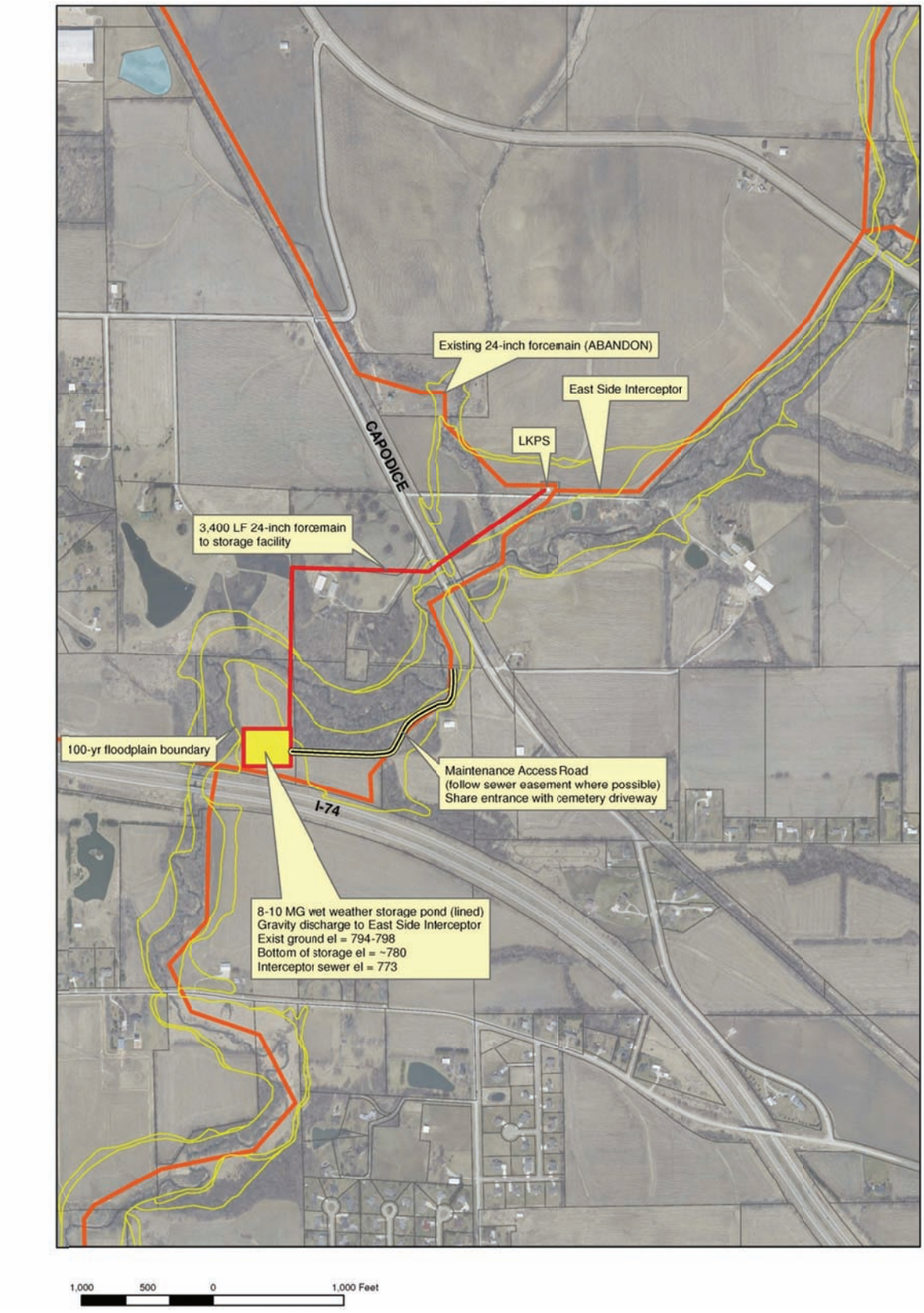


Figure 8
Wet Weather Storage: Open Pond Scenario

Life Cycle Cost Evaluation of Alternatives

Operations, maintenance, and treatment costs should also be considered in evaluating alternatives as these factors can impact which alternative is ultimately the most cost-effective. The required capital improvements to eliminate the capacity issues were summarized for all alternatives including I/I removal, transport/treatment, and system storage. Each alternative included the "pilot" I/I removal program and it was assumed that the I/I removal program would be successful in removing 6 cfs (10%) of the I/I in the system. It was assumed that the yearly O&M cost for any facility construction project would be equal to 2% of the capital cost to construct that facility. Base flow treatment costs were also incorporated into the life cycle cost analysis and it was assumed that for every cfs of peak I/I flow removed, the 20-year present worth cost to treat the associated base infiltration flow is approximately $200,000, as calculated in the previous section of this report. Tables 2, 3, and 4 summarize the life cycle cost analysis for each of the alternatives.

Table 2
Life Cycle Cost Analysis for Source Removal

Option 1: Source Removal

Description of Capacity	Capacity Value	
WWTP Capacity	26.1	cfs
Projected 10-Year Peak Flow	69.2	cfs
Removal Required	43.1	cfs

Life Cycle Cost Analysis	Cost	
Pilot I/I Program (10% I/I Removal; 6 cfs removal total)[2]	$1,350,000	
Footing Drain Disconnections (4 gpm each at $10k per home; 37.1 cfs removal total)[2]	$41,630,000	
Total Capital Costs	$42,980,000	
Plus 20-Year Present Worth Operations and Maintencance Costs[1]	$0	
Less 20-Year Present Worth Treatment Costs[1,2]	($8,620,000)	
20-Year Life Cycle Costs	$34,360,000	

Advantages
- No new facilities to operate and maintain in the collection system
- Flow is permanently removed from the system

Disadvatanges
- High capital cost
- I/I removal rate may not be acheivable (Are there 4,200 homes with FD connected to the sewer?)

Notes/Assumptions
1. Assumes cost of capital at 4% and compounding period of 20 years.
2. Assumed value to be verified during pilot I/I removal project

Table 3
Life Cycle Cost Analysis for Transport/Treat

Option 2: Transport and Treat

Description of Capacity	Capacity Value	
WWTP Capacity	26.1	cfs
Base I/I Removal (Pilot I/I Removal Project)[2]	6.0	cfs
Projected 10-Year Peak Flow	69.2	cfs
WWTP Expansion Required	37.1	cfs

Life Cycle Cost Analysis	Cost	
Pilot I/I Program (10% I/I Removal; 6 cfs removal total)[2]	$1,350,000	
WWTP Expansion[3]	$74,200,000	
Total Capital Costs	$75,550,000	
Plus 20-Year Present Worth Operations and Maintencance Costs[1,4]	$20,530,000	
Less 20-Year Present Worth Treatment Costs[1,2]	($1,200,000)	
20-Year Life Cycle Costs	$94,880,000	

Advantages

- No new satellite facilities to operate and maintain in the collection system

Disadvatanges

- High capital cost
- High O&M costs

Notes/Assumptions

1. Assumes cost of capital at 4% and compounding period of 20 years.
2. Assumed value to be verified during pilot I/I removal project
3. Assumes $2M per cfs of expansion
4. Assumes annual O&M equals 2% of capital costs

Table 4
Life Cycle Cost Analysis for System Storage

Option 3: Storage

Description of Capacity	Capacity Value	
WWTP Capacity	26.1	cfs
Base I/I Removal (Pilot I/I Removal Project)[2]	6.0	cfs
Projected 10-Year Peak Flow	69.2	cfs
Storage Required Assuming 10% I/I Removal	9.3	MG

Life Cycle Cost Analysis	Cost	
Pilot I/I Program (10% I/I Removal; 6 cfs removal total)[2]	$1,350,000	
Storage Tank	$9,320,000	
Total Capital Costs	$10,670,000	
Plus 20-Year Present Worth Operations and Maintencance Costs[1,4]	$2,900,000	
Less 20-Year Present Worth Treatment Costs[1,2]	($1,200,000)	
20-Year Life Cycle Costs	$12,370,000	

Advantages
- Low Capital Costs
- Readily Available Sites
- Opportunity to provide daily flow smoothing for SEWWTP

Disadvatanges
- O&M required for new satellite facility in collection system
- Requires permanent collection and treatment of wet weather flows

Notes/Assumptions
1. Assumes cost of capital at 4% and compounding period of 20 years.
2. Assumed value to be verified during pilot I/I removal project
3. Assumes $2M per cfs of expansion
4. Assumes annual O&M equals 2% of capital costs

The life cycle cost analysis for the alternatives indicates that the system storage alternative has the lowest life-cycle cost of $12.4 million. The source removal option has the second-lowest life cycle cost of $34.4 million and the transport/treat option is the most expensive with a life cycle cost of $94.9 million.

Recommendations

Based on the evaluation of alternatives and resulting key findings, we offer the following recommendations.

Items 1-2 focus on continued smoke testing, manhole inspections and CCTV inspections throughout the sewer districts identified as having elevated wet weather flows and volumes. This expansion of the inspection program is necessary in order to identify additional cost-efficient methods to reduce wet weather inflow and thus increase the likelihood of achieving the partial I/I removal goals established in the life cycle cost analyses (Tables 2-4).

Items 3-6 focus on a smaller pilot study area (Arcadia and Broadmoor). The pilot study area will include a more aggressive approach to remove I/I, and those efforts will result in more refined estimates for evaluating future wet weather control strategies.

The estimated costs for the recommendations are included in the Appendix (Table A-4).

1. The City should perform smoke testing and manhole inspections in the Broadmoor, Arcadia, Ireland Grove West, Ireland Grove East, Arrowhead/Holiday, and Stern meter districts to

identify additional I/I sources. This testing would be supplemental to the smoke testing already performed in 2012 and would help to complete this field investigation throughout the targeted sewer districts.

2. The City should perform CCTV inspections and PACP-based ratings of the collection systems in the Broadmoor, Ireland Grove West, Ireland Grove East, Arrowhead/Holiday, and Stern meter districts. The documentation of pipe condition should be consistent with the recommendations in the Asset Management Plan. The CCTV of the collection system in the Arcadia meter district will be completed as part of the system rehabilitation within this area.

3. The City should perform a pilot I/I removal program in the Arcadia meter district (see Figure 9). The extent of rehabilitation efforts should be determined by the CCTV efforts in this meter district. The costs in this document are based on the assumption that the pilot program will include cured in place piping (CIPP) rehab of the entire piping system (6,100 linear feet); rehab of all manholes (23 manholes); and CIPP rehab of private laterals (65 laterals). Actual quantities will be confirmed after the CCTV effort. *It is assumed that lateral lining would consist of only the component of the lateral within the public right-of-way (average of 30-35 lineal feet per lateral).*



Figure 9
Arcadia District: Full System Rehabilitation Pilot Study

4. The City should perform a survey of footing drains within the Broadmoor meter district (see Figure 10) to estimate the number of homes within the district that have footing drains connected to the sanitary collection system. The survey should include approximately 50 homes within the district as a representative sample of the total number of homes.

5. Assuming 25% of the 278 homes within the Broadmoor meter district have footing drains connected to the sanitary collection system, this would result in approximately 70 homes identified as part of the footing drain survey. The City should perform a pilot footing drain disconnection program on these 70 homes. This effort would require a verification of footing drain connection status for the remaining homes not initially surveyed.



Figure 10
Broadmoor District: Footing Drain Survey and Disconnection Pilot Study Area

6. BNWRD should redeploy their in-house flow meters to measure flows at the outlet of the Broadmoor and Arcadia sub-districts. Pre-rehabilitation data for these areas was collected during the years of 2008 to 2011 and this data was used as a basis for the hydrologic model development as part of East Side Interceptor Hydrologic Analysis. It will be important to validate the hydrologic models for pre-rehabilitation conditions; therefore collection of additional data is necessary at these locations.

7. Once the pilot programs in Arcadia and Broadmoor are completed, the City should perform post-rehabilitation metering in these meter districts to evaluate the effectiveness of the I/I

removal activities. The findings from this analysis will be used to guide the program for long-term I/I control.

8. Sanitary sewer trenches typically convey infiltrated surface water prior to infiltrating into the sanitary sewer or manholes. Providing outlets from the sanitary sewer trenches to adjacent drainageways may help to relieve hydraulic pressure in sanitary sewer trenches and can promote discharge of this water to the stormwater collection system, thereby reducing base flows in the sanitary sewer system. *The primary drawback of this solution is the potential occasional dry weather exfiltration from the sanitary sewer into a trench outlet, resulting in an illegal surface water discharge.*

   Sanitary sewer trench dewatering is not a likely candidate for the East Side Interceptor system, as the invert elevation of the City's sanitary sewer system is typically 4 feet (+/-) below the nearby channel bottom elevation (this scenario is true in the Broadmoor/Arcadia sewer district areas. A gravity outlet for the sanitary sewer trenches in this area would likely be at least 4 feet above the top of sewer and would do little to remove saturated soils along (or above) the pipe cross section.

   In some cases, the sanitary sewer system may be at or slightly above the elevation of the stormwater system. None of those cases was observed in the study area. However, if such a scenario were discovered, the City could install a hydraulic relief from a sanitary sewer trench to a receiving storm sewer or open channel, provided that the City observe the following protocol:

   a. Any installed trench outlet should be located where frequent inspection will be possible and flow rates can be estimated by simple means (this would typically be along an open channel with an unobstructed streambank).
   b. City staff should inspect the outlet during dry weather to determine whether exfiltration is occurring. Water quality testing will help establish if fecal bacteria are present. If exfiltration is suspected, the dewatering pipe should be plugged.
   c. City staff should inspect the outlet immediately after a wet weather event to estimate the flow rate from the dewatering pipe. In lieu of a flow meter, simple measurements should be used, such as timing the fill of a 5-gallon bucket.

9. Citywide Recommendation: Implement the following policy changes to address I/I sources:

   a. Require a point-of-sale inspection for the presence of footing drain connections to the sanitary sewer. If a direct connection is confirmed, the seller will need to install a separate sump pump that discharges the footing drain piping to the surface or to an available storm sewer connection point.
      i. Based on typical residential turnover data in the City of Bloomington, this would require up to 3,200 inspections per year. This would likely require about 4 full-time inspectors. Alternatively, this inspection could be performed by contractors pre-approved by the City.
      ii. The cost of the inspection should be borne by the seller. This will create a self-funded program. It is assumed that the City would make this a self-funded program and, therefore, no additional costs are identified.
      iii. As an alternative to a self-funding program, the City could subsidize the cost of the footing drain disconnection in order to reduce the burden on property owners and facilitate ownership transfer.
         1. Assuming that 5% of homes are found to have a footing drain connection to the sanitary sewer, this would result in approximately 160 footing drain disconnections per year. ***If the City covers 50% of the cost, the annual cost to the City would be about $800,000 (assuming a cost share of $5,000 per disconnection).***
         2. The annual cost would likely diminish as footing drains are identified

and disconnected and the overall percentage of homes with connected footing drains decreases.

b. Implement a cost-share program for private lateral replacement. This will encourage the replacement of the entire lateral (from wye to foundation) for property owners who are concerned about potential sewer backups due to lateral failure. This program should have two components: voluntary and mandatory.
    i. Voluntary: Private laterals in need of replacement due to clogging, root intrusion, or structural failure, initiated by the property owner.
    ii. Mandatory: All private laterals should be required to be replaced along a roadway replacement project if they meet the following criteria:
        1. The home is at least 40 years old, and;
        2. The lateral has not previously been replaced since the original home construction.
    iii. Approximate program costs:
        1. VOLUNTARY: Assume 0.2% of laterals (about 50-60) per year. Assuming each lateral replacement is about $6,000 and a 50% cost share, ***the annual cost to the City would be $165,000.***
        2. MANDATORY: Based on the City's anticipated roadway budget, about 50,000 lineal feet of roadway resurfacing will occur per year. At 30 sanitary lateral connections per 1,000 lineal feet of roadway, this translates to 1,500 laterals per year at a cost of $3,000-$4,000 per lateral (reduced cost due to roadway reconstruction mobilization and efficiencies of scale). ***With a 50% cost share, the annual cost to the City would be about $2.5 - $2.7 million.***
        3. ***Given the magnitude of costs associated with lateral replacement, these programs should be considered optional***. However, these costs should provide additional insight on the actual costs of maintaining a well-functioning wastewater collection system.

Review of Other I/I Reduction Programs

In order to review our conclusions and recommendations through a more objective lens, we have prepared a summary of I/I reduction efforts in other communities. This analysis was performed to provide the City of Bloomington with a more global perspective on the efficacy of I/I source removal efforts. The levels of success achieved by different communities vary, although there is a consistent theme that the City of Bloomington can learn from in order to optimize the allocation of future sewer funds. The following sources of information were used in this analysis:

1. Urbana-Champaign Sanitary District (UCSD): conversations with Mark Radi of the UCSD regarding wet weather flow management on the City of Champaign's west side, served by their Southwest WWTP.

2. Preliminary I/I Surcharge Program, Metropolitan Council of Environmental Services ["MCES Report", Minneapolis, MN], 2005.

3. City of Naperville, IL: conversations with Tony Conn regarding their I/I source reduction program between 2000 and 2011 (including review of pre- vs. post-rehabilitation flow metrics).

4. *The Status of Municipal Wastewater Treatment* (technical report), Concord, Massachusetts, 2007.

5. *Spatial Classification Methods for Efficient Infiltration Measurements and Transfer of Measuring Results* (technical report), Dresden University of Technology, 2007.

6. Waterford Township (Michigan): results of sewer rehabilitation program (2007-2011).

7. City of Auburn Hills (Michigan): results of footing drain disconnection program (2001-2005).

8. West Bloomfield Township (Michigan): results of sewer rehabilitation program (2007-2013).

The information from this data gathering effort should provide the City and BNWRD with additional perspective on the typical operating characteristics of wastewater collection systems and what is generally possible (and cost-effective). Our recommendations in this document reflect both our hydrologic/hydraulic findings within the East Side Interceptor system ***and*** the body of evidence as extracted by the sources listed above.

The key takeaways from this analysis are:

- Spot-treatment for sewer rehabilitation is generally ineffective.
- A comprehensive rehabilitation focus is needed to significantly impact system flows.
- Footing drain disconnection programs can be successful at reducing flows, provided there are large numbers of homes to be disconnected.
- Cost-effectiveness of system rehabilitation varies widely, depending on local constraints, cost of land, interceptor sewer capacity, and feasibility of other options.

Information Source	**Characteristics of Project/Study/Program**	**Impact on East Side Interceptor (or "Lessons Learned")**
UCSD	• Similar service area and land uses as East Side Interceptor service area. • Wet weather peaking factors similar to those of SEWWTP. • UCSD and City of Champaign have attempted I/I reduction through sewer rehabilitation, but have had little success in reducing I/I. • UCSD installed a wet weather treatment system at their SW WWTP to manage wet weather flows.	• I/I reduction efforts achieved through sewer rehab in individual sewer districts may have a limited impact when measured at the treatment plant. • The most cost-efficient and least disruptive options may include projects other than collection system rehabilitation, such as storage and/or wet weather treatment.
MCES Report	• I/I source removal programs can be cost-effective, especially in a built-out urban environment where land values are very high. • I/I source removal is critical in areas where the collector/interceptor sewer is undersized and where SSOs are likely. • The MCES report contains cost-effectiveness recommendations based on I/I removal costs (i.e. footing drain disconnections) that are well below the prevailing bid range for such work.	• The MCES report does not apply well to the City of Bloomington for the following reasons: o The City of Bloomington has rural areas where storage is more cost-effective and can be centralized to a single location. o The East Side Interceptor is hydraulically adequate with no known hydraulic restrictions, surcharging, or SSO potential. o I/I reduction efforts are likely significantly more expensive than detailed in the MCES report.

Information Source	Characteristics of Project/Study/Program	Impact on East Side Interceptor (or "Lessons Learned")
City of Naperville	• I/I reduction consists of total sewer system rehabilitation in selected districts, where all sewers, manholes, and service leads are lined. • The City spends $2.2M per year on the program. This covers 15,000 lineal feet of sewers, 150 service leads, and 35 manholes per year. • Flow reduction data provided is inconclusive (pre-rehab and post-rehab storm comparisons were under varying antecedent moisture conditions). • Annual flows to the WWTP have been reduced by just over 10%, when adjusting for the impacts of population increase.	• Complete system rehabilitation can be an effective tool in reducing I/I. However, the total potential I/I flow reduction is typically limited to 5% to 10% based on the collective experience of other communities (see the Concord, MA entry below) • $2.2M per year is a significant investment. A key concern is whether the investment was cost-effective compared to alternatives. • Naperville is a built-out community with high land values. This may have altered the cost-effectiveness of alternative projects such as wet weather storage.
Concord, MA	• Direct quote from study: *"Generally on the order of 5% to 10% of total inflow and infiltration can be cost-effectively removed."*	• This confirms our base assumption that some I/I reduction can be achieved through source reduction, but that the rest will likely need to be managed through regional (i.e. storage) solutions.
Dresden University of Technology	• Key findings cited in this report include: o Non-sanitary flows in United Kingdom (UK) collection systems (I/I) typically range between 15% to 50% of dry weather flow. o Non-sanitary flows in collection systems in Switzerland average nearly 50% above the base dry weather (sanitary-only) flow. o A study of German wastewater collection systems revealed that most regions within the country experience a non-sanitary flow of more than 30% of the base dry weather flow.	• In the East Side Interceptor, the non-sanitary flow surcharge (primarily due to infiltration) is 30%, which falls well within the range of the numerous systems studied in the Dresden report.
Waterford Township (Michigan)	• Multi-year sewer and manhole rehabilitation program, spanning from 2007 – 2011. • 75,000 lineal feet of sanitary sewer rehabilitated through lining (55,000 LF) or grouting (20,000 LF). • 592 private sanitary sewer laterals lined. • 140 manholes rehabilitated (various measures, including internal seals, frame adjustments, chimney liners). • System repairs to inflows identified during smoke testing of the collection system. • Efforts resulted in no measureable reduction in wet weather flows or flow volumes.	• System rehabilitation through sewer/lateral lining and manhole rehabilitation has a limited benefit that is often difficult to demonstrate through flow meter data. • Targeted rehabilitation in older neighborhoods helps to solve structural problems, but may have a smaller (or negligible) impact on I/I peak flows and flow volumes.

Information Source	Characteristics of Project/Study/Program	Impact on East Side Interceptor (or "Lessons Learned")
City of Auburn Hills (Michigan)	• Multi-year footing drain disconnection program (532 disconnections between 2001 and 2005) within a 460-acre sewershed • Pre- vs. post-rehabilitation was measured for the neighborhood undergoing the program. • Efforts resulted in measureable reductions in peak flow and flow volumes, especially during large wet weather events.	• Footing drain disconnections is one of the more effective methods of reducing I/I. • The City of Bloomington should determine, through a sampling of residences, the percentage of homes that have footing drains connected to the sanitary sewer. This will help determine how much potential there is for wet weather flow reduction through footing drain disconnections.
West Bloomfield Township (Michigan)	• Invested over $16 million over a 3-year period to repair and rehabilitate sewer pipes, manholes, and laterals. • Analysis of post-rehabilitation flow meter data indicates little to no reduction in wet weather flows. • Baseflows decreased in 2012, but drought conditions had the same general impact in adjacent non-rehabilitated meter districts. Baseflows increased back to normal levels in 2013.	• System rehabilitation through sewer/lateral lining and manhole rehabilitation has a limited benefit that is often difficult to demonstrate through flow meter data. • Targeted rehabilitation in older neighborhoods helps to solve structural problems, but may have a smaller (or negligible) impact on I/I peak flows and flow volumes.

APPENDIX

I/I Source Removal Calculations
Cost Estimates

Table A-1: Proportional Baseflow Removal Computations

Total SSES Area Flows (Arcadia/Broadmoor/Stern)

Item	Description	(Arcadia/Broadmoor/Stern)	Formula for Calculations
A	Total Average Baseflow	0.35	Metered
B	10-year Frequency Peak Flow Rate	10.5	Per Hydrology Statistics
C	Baseflow as Percentage of 10-year Frequency Flow Rate	3.3%	A / B

10-Year Peak Flow Removal by I/I Removal Activity

Item	Description	Peak Flow Removal	Formula for Calculations
D	Direct Source Removal	0.96	Per SSES Estimates
E	Manhole Rehabilitation	0.81	Per SSES Estimates
F	Footing Drain Disconnections	0.40	Per SSES Estimates

Base Flow Removal by I/I Removal Activity

Item	Description	Base Flow Removal	Formula for Calculations
G	Direct Source Removal	0.00	Set to zero; assume no impact to infiltration
H	Manhole Rehabilitation	0.03	C * E
I	Footing Drain Disconnections	0.01	C * F

Per Year Treatment Savings Resulting from Baseflow Removal

Item	Description	Treatment Savings per year at $1.70 per 1000 gallons (USD)	Formula for Calculations
J	Direct Source Removal	$0	G * 7.48 * 3600 * 24 * 365 / 1000 * 1.70
K	Manhole Rehabilitation	$10,827	H * 7.48 * 3600 * 24 * 365 / 1000 * 1.70
L	Footing Drain Disconnections	$5,347	I * 7.48 * 3600 * 24 * 365 / 1000 * 1.70

20-year Present Worth (PW) Treatment Savings Resulting from Baseflow Removal

Item	Description	20 Year PW of Treatment Savings (USD)	Formula for Calculations
M	Direct Source Removal	$0	$J * \frac{(1+i)^n - 1}{i(1+i)^n}$
N	Manhole Rehabilitation	$147,147	$K * \frac{(1+i)^n - 1}{i(1+i)^n}$
O	Footing Drain Disconnections	$72,665	$L * \frac{(1+i)^n - 1}{i(1+i)^n}$

20-year Present Worth (PW) Treatment Savings per cfs of Peak Flow Removed

P	Manhole Peak Flow Removal	0.81	**E**
Q	20-year Present Worth (PW) Treatment Savings for Manhole Removal	$147,147	N
R	20-year Present Worth (PW) Treatment Savings on a per cfs basis	$181,663	N * (1/E)
S	**20-year Present Worth (PW) Treatment Savings on a per cfs basis (rounded)**	**$200,000**	ROUND(R,-5)

Notes:

PW computations assume cost of capital = 4% and compounding periods (n) = 20

All flows in cfs

Table A-2
East Side Interceptor - Capacity Improvements
Planning-Level Cost Opinions

Owner:	**City of Bloomigton, Illinois**	**Date:**	**3/8/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**Wet Weather Storage Alternative**	**Prepared By:**	**TDK**
	Open Top Storage Option	**Reviewer:**	**GPK**

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	Furnish and install four (4) 6,500 gpm pumps and motors	1	LS	$400,000.00	$400,000.00
2	Furnish and install pump controls and piping	1	LS	$60,000.00	$60,000.00
3	10 MG Wet Weather Storage Pond	1	LS	$3,000,000.00	$3,000,000.00
4	24-inch force main	3,400	LF	$225.00	$765,000.00
5	Little Kickapoo Creek Crossings (Bore and Jack)	2	EA	$50,000.00	$100,000.00
6	5-foot Diameter Sanitary Manholes, 12-14 foot depth	8	EA	$6,000.00	$48,000.00
7	Maintenance Access Road	1	LS	$100,000.00	$100,000.00
8	Bypass Pumping	1	LS	$40,000.00	$40,000.00
9	Restoration	1	LS	$200,000.00	$200,000.00
10	Land Acquisition	1	LS	$250,000.00	$250,000.00
11	Pump hatch retrofits	1	LS	$150,000.00	$150,000.00
12	Structural modifications to inlet channel of LKPS	1	LS	$250,000.00	$250,000.00
13	Gen-set upgrades to LKPS	1	LS	$250,000.00	$250,000.00
14	Electrical upgrades to LKPS	1	LS	$150,000.00	$150,000.00
15	Controls upgrades to LKPS	1	LS	$85,000.00	$85,000.00
				SUBTOTAL	**$5,848,000.00**
	Contingencies	30%			$1,754,000.00
				SUBTOTAL (w/CONTINGENCIES)	**$7,602,000.00**
	PROJECT COSTS				
	Design/Admin/Const. Engr. Costs	25%			$1,462,000.00
	Inflation to Year 2016 (4% for 3 years)	12.5%			$730,204.67
TOTAL PLANNING-LEVEL COST OPINION (2016 DOLLARS)					**$9,800,000.00**

Table A-3
East Side Interceptor - Capacity Improvements
Planning-Level Cost Opinions

Owner:	**City of Bloomigton, Illinois**	**Date:**	**3/8/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**Wet Weather Storage Alternative**	**Prepared By:**	**TDK**
	Partially-Buried Tank Option	**Reviewer:**	**GPK**

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	Furnish and install four (4) 6,500 gpm pumps and motors	1	LS	$400,000.00	$400,000.00
2	Furnish and install pump controls and piping	1	LS	$60,000.00	$60,000.00
3	10 MG Wire Wound Tank	1	LS	$5,100,000.00	$5,100,000.00
4	Tank Flushing system	1	LS	$500,000.00	$500,000.00
5	24-inch force main	250	LF	$250.00	$63,000.00
6	24-inch gravity outlet pipe	250	LF	$275.00	$69,000.00
7	5-foot Diameter Sanitary Manholes, 12-14 foot depth	2	EA	$6,000.00	$12,000.00
8	Maintenance Access Road	1	LS	$5,000.00	$5,000.00
9	Bypass Pumping	1	LS	$15,000.00	$15,000.00
10	Restoration	1	LS	$50,000.00	$50,000.00
11	Land Acquisition	1	LS	$100,000.00	$100,000.00
12	Pump hatch retrofits	1	LS	$150,000.00	$150,000.00
13	Structural modifications to inlet channel of LKPS	1	LS	$250,000.00	$250,000.00
14	Gen-set upgrades to LKPS	1	LS	$250,000.00	$250,000.00
15	Electrical upgrades to LKPS	1	LS	$150,000.00	$150,000.00
16	Controls upgrades to LKPS	1	LS	$85,000.00	$85,000.00
				SUBTOTAL	**$7,259,000.00**
	Contingencies	30%			$2,178,000.00
				SUBTOTAL (w/CONTINGENCIES)	**$9,437,000.00**
	PROJECT COSTS				
	Design/Admin/Const. Engr. Costs	25%			$1,814,750.00
	Inflation to Year 2016 (4% for 3 years)	12.5%			$906,387.78
TOTAL PLANNING-LEVEL COST OPINION (2016 DOLLARS)					**$12,160,000.00**

Table A-4
East Side Interceptor - SSES and I/I Removal
Planning-Level Cost Opinions

Owner:	**City of Bloomigton, Illinois**	**Date:**	**3/8/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**SSES and I/I Removal**	**Prepared By:**	**TDK**
		Reviewer:	**GPK**

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	SSES in remaining target areas	130,000	LF	$1.45	$189,000.00
2	Sewer cleaning and CCTV inspection in remaining target areas	170,000	LF	$2.00	$340,000.00
3	Arcadia Rehab - CIPP lining of sewer mains	6,100	LF	$35.00	$214,000.00
4	Arcadia Rehab - Manhole rehab	23	EA	$2,000.00	$46,000.00
5	Arcadia Rehab - CIPP lining of sewer laterals	65	EA	$4,000.00	$260,000.00
6	Broadmoor - footing drain field verification	278	EA	$350.00	$98,000.00
7	Broadmoor - implement footing drain disconnection	70	EA	$10,000.00	$700,000.00
8	Post rehabilitation metering and evaluation of effectiveness	1	LS	$60,000.00	$60,000.00
				SUBTOTAL	**$1,907,000.00**
	Contingencies	20%			$381,000.00
				TOTAL (w/CONTINGENCIES)	**$2,288,000.00**

Costs do not include optional programs for City-wide footing drain disconnection and lateral replacement programs (Item 9 in the Recommendations section). These programs, if implemented, would likely add about $3.5 million per year to the City's sewer budget.

Sanitary Sewer Technical Memoranda

SAN5 - SANITARY PUMP STATION SCADA (Supervisory Control and Data Aquisition) SYSTEM

Sanitary Pump Station SCADA
(Supervisory Control And Data Acquisition) system

EXECUTIVE SUMMARY

This summary serves as a companion document to the Sanitary Pump Station SCADA system Technical Memorandum dated December 11, 2013, prepared by Foth for the City of Bloomington.

This memorandum was prepared to:

1. Study and evaluates the control, monitoring and alarm systems for the City's sanitary sewage pump stations
2. Outline actions necessary to improve the reliability and efficiency of these systems.

Key Findings

1. The pump stations are not supervised by on-site staff.
2. Each pump station has a unique control, monitoring and alarm system.
3. Recorded operational data is limited, varies from station to station, and severely limits the ability to perform comprehensive station performance evaluations.
4. Remote alarms give limited information to the operators, requiring immediate site visits for any station alarm condition.
5. Reliable and efficient remote control, monitoring and alarm systems are necessary to improve system reliability and reduce operating costs.

Recommendations

1. Create and adopt standards for monitoring, control and alarm hardware.
2. Create and adopt standards for a SCADA (Supervisory Control And Data Acquisition) system.
3. Upgrade, remove and replace pump station hardware to comply with the adopted standards.
4. Implement a fully integrated and upgradeable SCADA system to monitor and control the pump station, improve system reliability and increase the City's operational efficiency.

The estimated project cost to implement the recommendations in this memorandum is $583,000.

Technical Memorandum

Date: December 11, 2013

To: Ryan Otto, PE, City of Bloomington, Illinois

From: Dirk Rannebarger, PE, Foth Infrastructure & Environment, LLC.
John A. Dabrowski, PE, Foth Infrastructure & Environment, LLC.

Re: Sanitary Pump Station SCADA

INTRODUCTION

SCADA is an acronym that means **S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition. The meaning and usage of this has broadened since its first use and has generally come to stand for any method of communication between an automatic control system and humans. This communication can be one-way, such as alarm notification, or two-way with a person initiating control actions remotely. The communication can take place entirely within a facility, such as a water treatment plant, or an entire community, or even across the country or planet.

Numerous technologies are available for SCADA remote communication. Licensed radio, unlicensed low-power radio, cellular telephone, dial-up telephone and the Internet are available. Hardware and software has been developed and service providers are available to create, implement and support a remote monitoring, alarming and control system to fulfill the needs of the City.

The City is responsible for the operation and maintenance of 8 sanitary pump stations. The pumps operate automatically and do not require staff to be present for normal operation. Staff is present only for routine station checks and when notified of an operational problem.

Since pump stations are not supervised by staff on-site, a means of notification is needed to alert any abnormal conditions. A system that provides this function is commonly referred to as a SCADA system. This memorandum describes the methods used by the City to operate the sewage pumping systems, including the remote communication for abnormal conditions. Recommendations are included to provide guidance for improving remote notification of pump station status and alarms. In addition, the recommendations include overall control upgrades necessary to implement a pump station SCADA system that provides more data that the staff will use to make informed decisions and improve the effectiveness of their response.

KEY FINDINGS

General Observations - Sanitary Pump Stations

Sanitary pump stations are needed to pump sewage to the wastewater treatment facilities. The sewage flows in underground pipes by gravity to collection points throughout the City. The location of these collection points are the lowest elevation in the area served. The pump stations pump the sewage from these low collection points to the treatment plant. This method provides an economical means to transport the flow. If gravity flow was the only method used, the underground pipes would be buried deep to create the slope needed for flow to the treatment plant.

The pump stations become flow-stopping points in the collection system when the pumps are not able to run. When the pumps are not functioning due to equipment failure or electrical power loss, sewage will back up in the gravity lines and can overflow into homes and businesses. A means of notifying staff of problems at a pump station is needed to maintain pump station functioning.

Abnormal conditions at a pump station can be classified according to the urgency of response needed to keep the station operating. The most urgent conditions can be called Critical Alarms and require immediate attention. Pump equipment failures, whatever the cause are an example of a Critical Alarm.

Individual pump stations will have different response priorities. This is due to the location of the pump station, size of the wetwell, flow to the wetwell, pumping capacity, elevation of the wetwell relative to the gravity lines and other factors. These factors can be used to classify pump stations as High Priority and requires immediate attention. Eagle Crest East is an example of a high priority pump station. A pumping system failure at this station must be addressed within 1/2 hour, or sewage will begin to overflow in nearby homes. Other pump stations might serve a small area where flows are low and staff may have many hours and even days in some cases to respond. These locations may be considered a low response priority, however their priority rank will change and become more urgent the longer the problem is not addressed.

Pump operation is automatic. This allows the pump stations to be unattended and staff can perform other duties. The automatic control functions by pumping down the water in the wetwell to a lower level and stops the pumps when the level is lowered to the PUMPS OFF level. Sensors are used in the wetwell to detect the level of the water and determine when pumps should be on or off. Several different methods are commonly used to measure the water level. A float switch is used to provide on-off switching at one discrete level. This device is simple and reliable; however several switches are needed for duplex pump operation. Adjustments to the operating level can be accomplished by raising or lowering the float switch in the wetwell. These adjustments are not convenient to make.

Another method provides continuous measurement of the water level. This device combined with a solid state logic controller allows the operating level adjustment at the pump control panel. Since all level measurements are by a single device, reliability must be considered. A combination of float switches and a level sensor are commonly used

together. The float switches measure the extreme water levels. If these readings do not agree with the level sensor, an alarm is sounded and alternate pump control is used to keep the station functioning until repairs are made.

General Observations – Existing Electrical Systems

The pump stations operate on electrical energy that is supplied by the Electric Utility Company. Electrical system characteristics are common for all the pump stations - 277Y/480 Volt, 3-phase, 4-wire. The supply of electricity is high quality with very good reliability; however it is vulnerable to extreme weather and power pole knock-downs causing power outages. Since electric supply outages happen from time to time, alternate means to pump sewage is necessary. Using standby electric power generators to supply the pump station during an outage is an economical approach.

Standby electrical power for most of the pump stations is provided by permanent, on-site generating equipment. These standby power systems provide utility power loss detection, automatic starting and automatic power transfer from utility source. When the utility power source is reliably restored, the pump station will be automatically connected to utility power and the standby generator will be shut down.

The standby electrical power generator is driven by a diesel engine. This equipment is located outdoors and is housed in a weather-protected enclosure. An electric heater is used to keep the engine block warm so that engine starting is reliable and warm up time is reduced. Fuel for the engine is stored on-site in above ground tanks. These storage tanks typically provide fuel for 24 hours continuous operation. The generator control system provides warnings and alarms for various operating conditions and abnormalities, such as low fuel, failure to start, failure to transfer to standby power and additional conditions. These warnings and alarms can be used for remote notification to City Staff.

The electric motors that provide the mechanical power for the pumps are controlled by electromagnetic and solid-state devices. These devices connect and disconnect electrical power to the motors to start and stop the pumping. General terms for these devices are “Starters” and Variable Speed Motor Controllers referred to as “VFDs” and also “Drives”. The starters can be thought of as switches that provide monitoring and protection for the motors. The VFDs are solid-state devices that act like starters to start and stop the motor and can vary the speed of the motor, too. Changing the speed of the motor/pump will change the rate of the pumping and reducing the output will reduce the electrical power used. This is one benefit of the VFD.

General Observations – Existing Control Systems

All pump stations are equipped with automatic pump control. Although the control accomplishes the same result at all locations, how it is done varies. A few stations use float switches for water level sensing. Others use a level transducer that provides continuous measurement of the level throughout the wetwell level range. Some stations use electro-mechanical relays which are interlocked to provide the control logic needed to decide when pumps are turned on or off. Others use logic devices that can be programmed, programmable logic controllers (PLC), and display screens, human-machine interfaces (HMI), which provide visual communication to the operators.

Pump stations have been provided with equipment that measures the wastewater volume that is pumped out of the station. This data is recorded graphically on a circular chart recorder. A line is traced on a paper disc that rotates. The rotation is synchronized with time, so the resulting graph records the instantaneous flow against time. The collection of this data is not required by regulatory agencies and has limited value to operations. At present, the operations staff does not utilize this equipment.

General Observations – Existing Alarm Monitoring

The City utilizes a remote security monitoring company, TYCO Security Link (TSL), to monitor a limited number of alarms at each pump station. The fee charged to the City for this service is $130/month in addition to the cost for the telephone service. The charges for the telephone at each pump station are paid by the City. A pump station alarm is transmitted to the monitoring service facility across telephone lines. A call is placed by the monitoring service to City personnel. Presently, the City water department is the first called. The sewer department does not have staff working 24 hours a day, however the water department maintains staff around the clock. When notified of an alarm, the water operator on duty assesses the nature of the alarm and contacts the sewer department personnel for immediate response, if required. Land based telephones are used for automated communication from each pump station to the monitoring service facility.

Observations - Specific Locations

See Appendix A for a map of the pump station locations.

Sugar Creek Sanitary Pump Station

This is a submersible pump station with a ground level structure for the electrical/control equipment and a lower level containing the valves. The wetwell contains the two 125 HP submersible pumps. Standby electric power is provided by a diesel fueled generator located outside. It is protected by a weatherproof enclosure and contains a base mounted fuel tank. Inside the building is an automatic transfer switch. Site is secured with a fence and has building mounted security night light. The station alarms are monitored remotely by the TSL monitoring service. The pump motors are controlled with reduced voltage, solid-state soft-start. The level control is a bubbler system that utilizes an air compressor. Pump control is relay logic only (no programmable logic controller).

Wittenburg Woods Sanitary Pump Station

The pump station wetwell contains two 15 HP submersible pumps. The electrical panels are mounted outdoors. The station does not have a building or walk-in enclosure to protect the control equipment or service personnel. Standby electric power is provided by a diesel fueled generator that is connected to the utility with an automatic transfer switch. The generator is protected by a weatherproof enclosure and contains a base mounted fuel tank. The site is secured with a fence and has a security night light. The station alarms are monitored remotely by the TSL monitoring service. The pump control panel utilizes a Mitsubishi fixed I/O PLC and a level sensor monitors the wetwell level.

Fell Avenue Sanitary Pump Station

The pump station wetwell contains two 35 HP submersible pumps. The electrical panels are mounted outdoors. The station does not have a building or walk-in enclosure to protect the control equipment or service personnel. Standby electric power is provided by a diesel fueled generator that is connected to the utility with an automatic transfer switch. The generator is protected by a weatherproof enclosure and contains a base mounted fuel tank. The site is secured with a fence and has a security night light. The station alarms are monitored remotely by the TSL monitoring service. The pump control panel uses float switches for level monitoring and relay logic (not programmable) to control the pumps.

Regency Drive Sanitary Pump Station

This pump station has been recently refurbished and converted to submersible pumps. Two 18.2 HP submersible pumps are in the wetwell. The electrical panels are located inside a walk-in shelter protected from the weather. The pump controls utilize an Allen-Bradley Control Logix modular PLC with Ethernet connectivity. Wetwell level monitoring is by level sensor with float switches providing back-up level control. The site does not have a standby electric generator, however connections for a portable engine driven pump are installed. Pump station alarms are not remotely monitored. The wetwell is provided with an overflow and therefore backup electric power and remote alarming "station failure" is not required.

Holiday Drive Sanitary Pump Station

The pump station is a submersible pump type that has been converted from a packaged above ground type with a fiberglass tip-up enclosure protecting the equipment. Two 40 HP pumps are in the wetwell. The utility meter, service disconnect switch and manual transfer switch are mounted to a metal support rack located outdoors. The rack has a receptacle to connect a portable generator. The site is not fenced and does not have a security night light. The pump controls and motor starters are enclosed inside the fiberglass tip-up enclosure. Pump control is by relay logic only (no programmable logic controller) and float switches are used for the wetwell level. The station alarms are monitored remotely by the TSL monitoring service.

Eagle Crest East Sanitary Pump Station

This pump station utilizes two 40 HP submersible pumps in the wetwell. A ground level structure contains the electrical and control equipment with a lower level containing pump discharge piping and valves. The pump control panel uses a PLC Direct brand PLC and wetwell level is measured with a level sensor. The control panel is equipped with back-up pump control using float switches. Standby electric power is provided by a diesel fueled generator that is connected to the utility with an automatic transfer switch. The generator is protected by a weatherproof enclosure and contains a base mounted fuel tank. The automatic transfer switch is within the structure. Located at the site is a garage structure for storage of an engine driven portable bypass pump. The site is secured with a fence and has building mounted security night light. The station alarms are monitored remotely by the TSL monitoring service.

Kickapoo Main Branch Sanitary Pump Station

This new pump station utilizes two 105 HP submersible pumps in one of the two wetwells. The second wetwell has provisions for an additional two future pumps. A ground level structure contains the electrical and control equipment with a lower level containing pump discharge piping and valves. The existing pump control panel utilizes an Allen-Bradley Compact Logix modular PLC and is equipped with backup pump control using float switches. Variable speed drives control the pump motor speed, providing variable pumping capacity. The station has a standby power generator located outside in a weatherproof enclosure and a base mounted fuel tank. The automatic transfer switch for the standby power is located in the structure. The site is secured with a fence and has building mounted security night light. The station alarms are monitored remotely by the TSL monitoring service.

KEY RECOMMENDATIONS

Recommendations - General

Sewage pump stations have unique electrical and control requirements. Regulatory agencies, such as the Illinois EPA, require certain features for alarming, safety and reliability. The National Electrical Code has requirements that parallel the Illinois EPA and a few more. These requirements change over time. The local using agency can have their own requirements for operation and safety. A result of these factors is that pump station controls are typically custom designed and constructed. The hardware components that are used to build the control panels can come from various sources with the final decisions of what is used often left to the Consultant and builder of the panel. Often this results in panels that function as intended, however the components are not from the same manufacturer. This makes obtaining replacements cumbersome and maintaining a stock of spare parts expensive and requires larger space to store spare parts. A similar effect occurs with the control logic. Variations of the control will exist not just from the difference of the pump station function, but also from the Consultant specifications and control panel builder's practices. This can make troubleshooting, repairing and modifying more difficult and time consuming. Integrating the existing pump control panels into a single city-wide alarm and monitoring system (SCADA) will result in a system that has limited functionality. The recommendations that follow are not necessary to implement a SCADA system, however should be considered going forward. Standardizing the individual station controls will benefit operations and make integration of future pump stations and other facilities into a SCADA system less costly.

1. Replace existing alarm monitoring system with Autodialer

Replacing the existing alarm monitoring system with telephone automatic dialers at each pump station is recommended. This will replace the function of the Monitoring Service, making it no longer needed. Auto dialers are common place in municipal water and wastewater facilities. This equipment will automatically dial and place a telephone call when it is notified by the pump station controls. Voice messages for each alarm can be recorded and linked to specific dialer

inputs. This is similar to setting up voicemail messages. A telephone number list can be input and the dialer will call through this list until the call is answered and acknowledged. The call-out phone list is user programmable making changes easy. For example, the first called could be the Water Department. If the call is not answered and acknowledged, the police or fire department could be next. Then the pump station operator on call. This equipment can be accessed from any phone to check the status of the alarms and other equipment monitored by the dialer. These units are backed up by batteries to be functional in the event that all power is lost. In addition, they are expandable. A basic unit comes with 4 or 8 inputs and depending upon manufacturer, can be expanded to 32 or 40 inputs.

This recommendation would be an interim step and the remote alarm reporting function will be replaced with the SCADA system when it is fully implemented. The estimated costs for this item in the spreadsheet will show a simple payback of around 3 years from the monthly cost of the answering service alone. The cost of the implementation can be reduced if City staff installs the equipment instead of hiring a contractor. If the implementation of the SCADA system is planned to occur before the 3 year payback period, this improvement may not be justified.

2. Standardize the pump station control equipment.

The implementation of a city-wide SCADA system that integrates the sanitary pump stations will benefit from having uniformity of the controls at each location. Ideally, if all locations utilize identical control hardware, interconnecting the stations to a remote location will be easier to achieve and provide a higher level of data available. Standardization of hardware will reduce the number of different software packages that require routine and costly upgrades. Standardization will reduce the quantity of spare parts kept on-hand for emergency replacements. It will increase the effectiveness of the control system repair personnel by increasing the familiarity of fewer manufacturer's products and reducing the training needed.

A study is recommended to determine what equipment and software is in use now, preferences of the operating staff, support available from the equipment manufacturers, relative cost, availability (local supply firms), ease of use and other factors to determine which components of the control system will provide benefit from standardization. The results of this study will create guidelines for future control upgrades and additions. These guidelines will be provided to consultants and control panel fabricators during the design and construction/installation process to ensure uniformity of the pump station controls throughout the City.

3. Standardize the controls and controller programming at all pump stations.

This recommendation follows the same thinking of the first; standardizing the control equipment. The PLC control equipment is programmable. This provides flexibility in how the equipment is controlled and results in uniqueness to the logic written in the controller program. Every programming technician creating a PLC program will likely take a different approach to the same control problem.

The flexibility of the programming allows this to occur. Without guidelines, each PLC program will have differences that reflect the knowledge, training, level of experience and preferences of the programmer. Of course each pump station is different from the others. The differences between some are small. With others, the control is unique to that station due to the pumps, piping, valves, operation and other factors. However, one program will not be suitable for every pump station. A standard programming protocol and documentation criteria will reduce the time needed to become familiar with the program. This will result in improved efficiency for a technician to troubleshoot or modify an existing program. These guidelines will help the technician understand the structure of the program. Thorough program documentation will explain each logic path and provide cross references for associated logic in other subroutines.

Program standardization will also be a benefit when the pump stations communicate through the SCADA system.

4. Upgrade pump station PLC and HMI programs.

Two of the existing pump stations, Regency and Kickapoo Main Branch, have modular style PLC control panels with Ethernet capability. These panels should not require significant, if any hardware modifications to achieve compatibility with a standardized panel design. However it is very likely the programming of the existing PLCs and HMIs are not similar enough to consider those existing programs as the standardized programs. Replacing the existing programs with the standard program is recommended.

5. Upgrade wetwell level measurement to level sensors.

Level sensors, combined with a PLC and HMI provide a means to conveniently monitor the water levels in the wetwell. The pump start and stop water level setpoints can be easily adjusted from the operators terminal. With this capability, operations staff can make adjustments to the control to optimize operation of the station. The SCADA system can provide additional capability. Remote monitoring of the wetwell water levels can alert operators of a developing problem that steps can be made to resolve before equipment breakdown or pump station failure.

6. Replace existing control panel with standardized panel.

A few of the City's sanitary pump stations utilize control panels that do not have PLCs. Other pump station controls use PLCs of various manufacturers. Upgrading the panels to PLCs and replacement of PLCs with standardized hardware is recommended. The existing control panels can be modified by the addition of the PLC and HMI hardware, however disruption of the pump station control during the retrofit would create operational problems. The extensive modifications to these panels in the field will make it difficult to control the quality of the final product. Replacement of these existing panels is recommended to mitigate operational disruption and provide control panels that are consistent with the standardized design. This will also provide for a

7. Upgrade pump station controls to provide redundant level control of pumps.

Equipment failures do happen. If the failure results in the pumps not operating, sewage backups will result. Providing a redundant means to automatically operate the pumps is recommended. This can be accomplished with float switches and relays. This will have limited functionality (no alternation of pumps, for example); however it will keep the pumps in operation until repairs are made. The redundant control feature will be included with the standard control panel design and will be accomplished when Recommendation 6 is implemented. Existing control panels without redundant control can be modified to add this functionality if panel replacement is not the selected recommendation.

8. Create a City-wide SCADA system for the sanitary pump stations

A SCADA system will bring data from each pump station to one or multiple remote locations. This will increase the effectiveness of the operations staff to respond to alarm conditions, anticipate problems and evaluate the urgency of the pump station faults without travelling to the station. Implementing the recommendations above and combined with remote access (SCADA system) will provide the City with great flexibility in operation of the pump stations. Additional capabilities to the City-wide monitoring can be added in the future, such as remote setpoint changes, opening and closing valves, changing pump sequences and other control functions if the City desires.

Several existing technologies are available that a system can be built on. Today, Ethernet is the most common network protocol and has been proven to be robust and reliable. It is open and supported by many manufacturers' equipment. Ethernet is recommended for the control system network and communication to the remote monitoring location.

Communication between the pump stations and remote monitoring location can utilize several different existing technologies. Land-based telephone, cellular telephone, licensed radio, low-power unlicensed radio, fiber optics and the internet are all available. Control equipment manufacturers' have developed equipment that is in production which can use these media for communication. Low-power unlicensed radio, also known as "spread spectrum radio" is recommended. This communication is independent of a service provider and therefore does not have fees charged for its use.

A central monitoring location will provide a point of connection to the internet. With secure internet connectivity, the staff can have access to the SCADA system anywhere internet access is available. Notification of pump station alarms, faults and status can be accomplished with this access. Emails and text messages can alert staff of problems and access to the pump station control system can be through smart phones or tablets.

9. Relocate electrical equipment and provide a shelter for weather protection

Three pump stations, Wittenburg, Fell and Holiday, have electrical panels located outdoors and exposed to the weather. Electrical and control equipment located

outdoors is subject to temperature extremes, moisture condensing inside the enclosures and the possibility of rain water entering. This leads to the premature deterioration of the components within the panels. Panel hardware failures are often caused by bad weather. Troubleshooting and panel repairs can be required during these weather events and servicing electrical equipment in the rain is an obvious hazard. Servicing the electrical equipment during cold weather is difficult since warm clothes and gloves restrict the movements needed to hold tools, connect small wires and other detailed tasks. Locating the electrical and control equipment inside a shelter is recommended.

In addition, the locations of some panels are in violation of codes. The Standard NFPA 820 classifies physical areas in sewage works and collection systems according to the fire and explosion hazard present. Some electrical panels have been located in classified areas. The location of the Fell Avenue electric service disconnect switch does not provide the working clearance that is required by the National Electrical Code. Relocating the equipment to correct existing panel location problems in addition to providing a shelter is recommended.

Recommendations - Specific Locations

All Pump Stations

City staff in conjunction with a consultant and a controls specialist will work together to develop the guiding standards that will be used to prepare the existing facilities for interconnection through a SCADA system. This covers items 2 and 3 above. These standards will also guide the implementation of the SCADA and controls of any future pump stations.

- Create a standard for the pump station control equipment covering major components, such as PLCs, HMIs, and level sensors to minimize spare parts stocks.
- Create a standard for the software needed to program and maintain the programmable control equipment.
- Create a standard for control methodology so that all pump stations functions are as similar as practical and are suited to pump station operations.
- Create standard PLC program and control logic modules that are suited to pump station operations.
- Create standard HMI screens so that access and navigation at each station is similar.

Sugar Creek Sanitary Pump Station

- Replace the existing remote monitoring service with auto-dialer notification system. The existing dial-up phone line will be used.
- Replace existing control panel with a new panel that utilizes the standardized PLC/HMI and control logic.
- Replace the existing bubbler level control with a level transducer. Level signal will input to the PLC for the normal wetwell level control.

- Provide redundant level control using float switches to take over level control of the pumps if the level sensor or PLC fails.

Wittenberg Woods Sanitary Pump Station

- Replace the existing remote monitoring service with auto-dialer notification system. The existing dial-up telephone service would be utilized.
- Replace existing control panel with a new panel that utilizes the standardized PLC/HMI and control logic (note: the existing panel could be modified with a new PLC instead. This decision will be made when this recommendation is implemented).
- Provide shelter for the electrical panels to protect from the weather as well as providing a safe environment for staff servicing the electrical system. A shelter similar to Regency Pump Station is recommended.
- Relocate the electrical panels further away from the wetwell hatch. The installation now is in violation of the NFPA 820 requirements and the National Electrical Code for required clearance from the Class 1, Division 2 hazardous area around the wetwell.

Fell Avenue Sanitary Pump Station

- Replace the existing remote monitoring service with auto-dialer notification system. The existing dial-up telephone service would be utilized.
- Replace existing relay control panel with a new panel that utilizes the standardized PLC/HMI and control logic.
- Replace the existing float switch level control with a level transducer. Level signal will input to the PLC for the normal wetwell level control.
- Provide redundant level control using float switches to take over level control of the pumps if the level sensor or PLC fails.
- Provide shelter for the electrical panels to protect from the weather as well as providing a safe environment for staff servicing the electrical system. A shelter similar to Regency Pump Station is recommended.
- Relocate the electrical panels further away from the wetwell hatch. The installation now is in violation of the NFPA 820 requirements and the National Electrical Code for required clearance from the Class 1, Division 2 hazardous area around the wetwell.
- Relocate the electric service disconnect switch to a location that provides the National Electrical Code required clearance for safe working space. The existing switch is located too close to the site security fence.

Regency Drive Sanitary Pump Station

- Replace existing PLC program with new program that conforms to the standardized PLC control logic.

Holiday Drive Sanitary Pump Station

- Replace the existing remote monitoring service with auto-dialer notification system. The existing dial-up telephone service would be utilized.
- Replace existing relay control panel with a new panel that utilizes the standardized PLC/HMI and control logic.
- Replace the existing float switch level control with a level transducer. Level signal will input to the PLC for the normal wetwell level control.
- Provide redundant level control using float switches to take over level control of the pumps if the level sensor or PLC fails.
- Provide shelter for the electrical panels to protect from the weather as well as providing a safe environment for staff servicing the electrical system. A shelter similar to Regency Pump Station is recommended.

Eagle Crest East Sanitary Pump Station

- Replace the existing remote monitoring service with auto-dialer notification system. The existing dial-up telephone service would be utilized.
- Replace existing control panel with a new panel that utilizes the standardized PLC/HMI and control logic.

Kickapoo Main Branch Sanitary Pump Station

- Replace the existing remote monitoring service with auto-dialer notification system. The existing dial-up telephone service would be utilized.
- Replace existing PLC program with new program that conforms to the standardized PLC control logic.

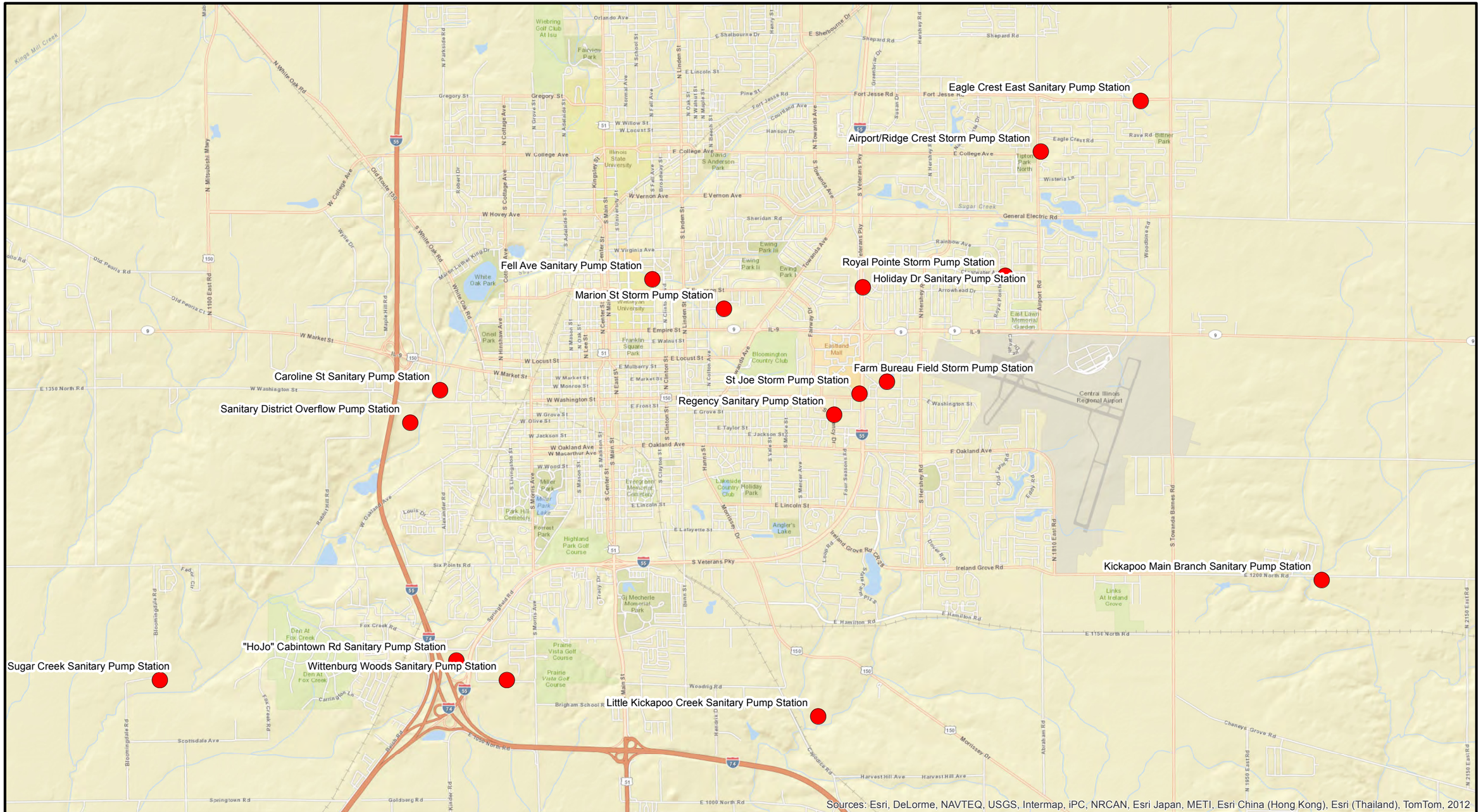
BUDGET COST OPINION

Table 1 tabulates the budget level cost opinions by station and in summary all work described in the recommendations.

Table 1 - Estimated Costs

		Centralized/ Common Work	Sugar Creek	Wittenburg	Fell Ave.	Regency	Holiday Dr.	Eagle Crest East	Kickapoo Main	Total
1	Replace existing alarm monitoring with autodialers	$ 1,000	$ 4,000	$ 4,000	$ 4,000		$ 4,000	$ 4,000	$ 4,000	$ 25,000
2	Create a standard for all pump station control equipment	12,000								12,000
3	Create a standard for pump station control logic and	15,000								15,000
4	Upgrade pump station PLC/HMI program					10,000			10,000	20,000
5	Upgrade wetwell level level measurement to level sensors		5,000		5,000		5,000			15,000
6	Replace existing control panel with standardized panel		25,000	25,000	25,000		25,000	25,000		125,000
7	Upgrade pump station controls to provide redundant level control of		4,000		4,000		4,000			12,000
8	Create a City-wide SCADA System for the pump stations	25,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	109,000
9	Relocate electrical equipment and provide shelter for weather			23,000	23,000		23,000			69,000
	Subtotal	$ 53,000	$ 50,000	$ 64,000	$ 73,000	$ 22,000	$ 73,000	$ 41,000	$ 26,000	$ 402,000
	Contingency (25%)	13,250	12,500	16,000	18,250	5,500	18,250	10,250	6,500	100,500
	Design & Construction Engineering (20%)	10,600	10,000	12,800	14,600	4,400	14,600	8,200	5,200	80,400
	Total Project Cost	$ 76,850	$ 72,500	$ 92,800	$ 105,850	$ 31,900	$ 105,850	$ 59,450	$ 37,700	$ 582,900

APPENDIX A – SANITARY PUMP STATION LOCATION MAP



Legend:

- Pump Station

N

Foth

0 5,000 Feet

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

CITY OF BLOOMINGTON

FIGURE 1

PUMP STATION LOCATIONS

Date: 11/12/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2013\13B030-00\GIS\Pump Stations.mxd Date: 11/13/2013

APPENDIX B – PUMP STATION DATA SUMMARY SHEETS

City of Bloomington, IL Sanitary Pump Station Summary
Data collected during site visit 11/26/2013

SUGAR CREEK SANITARY PUMP STATION				
Pump Station Type	Submersible	Packaged	Dry Pit	Notes
	YES	N/A	N/A	
Pumps	Quantity	HP		
	2	125 HP		
Site	Pump House	Controls Outside		
	YES	NO		
PLC	Mfr	Model	I/O Cards	
	NONE	N/A	N/A	RELAY LOGIC
HMI	Mfr	Model	Size (diagonal)	
	NONE	N/A	N/A	
Level Sensing	Sensor	Floats	Redundant	GAS DETECTION SYSTEM - NOT USED
	BUBBLER	HI LEVEL ALARM	NO	FLOWMETER - NO CONTROL
Station Alarms	Local	Remote	Remote Method	DIAL-UP TELE LINE
	PANEL MOUNTED	POWER FAIL EQUIPMENT FAIL HIGH LEVEL	TSL	TYCO SECURITY LINK (TSL) ANSWERING SERVICE
Motor Control	Across The Line	Reduced Voltage	Drive	
	NO	YES SOLID/STATE	NO	SQUARE D
Electric Service	Voltage	Amps	Phases	
	480 V	800 A	3	
Standby Power	Fixed Mount	Transfer Switch	Fuel	
	350 KW	AUTOMATIC ASCO	DIESEL	CATERPILLAR
Recommendations				
Replace Monitoring System		YES		
Upgrade to PLC		YES		
Upgrade to Standard PLC		N/A		
Upgrade Level Control		YES		
Add Redundant Control		YES		

WITTENBURG WOODS SANITARY PUMP STATION				
Pump Station Type	Submersible	Packaged	Dry Pit	Notes
	YES	N/A	N/A	
Pumps	Quantity	HP		
	2	15		
Site	Pump House	Controls Outside		
	NO	YES		
PLC	Mfr	Model	I/O Cards	
	MITSUBISHI	FX2N-32MR	FIXED IO	
HMI	Mfr	Model	Size (diagonal)	
	MITSUBISHI			
Level Sensing	Sensor	Floats	Redundant	
	TRANSDUCER	HIGH ALARM LOW ALARM	YES	
Station Alarms	Local	Remote	Remote Method	DIAL-UP TELE LINE
	PANEL MOUNTED	POWER FAIL EQUIPMENT FAIL HIGH LEVEL	TSL	TYCO SECURITY LINK (TSL) ANSWERING SERVICE
Motor Control	Across The Line	Reduced Voltage	Drive	
	YES	NO	NO	
Electric Service	Voltage	Amps	Phases	
	480 V	100 A	3	
Standby Power	Fixed Mount	Transfer Switch	Fuel	
	35 KW	AUTOMATIC	DIESEL	ONAN
Recommendations				
Replace Monitoring System		YES		
Upgrade to PLC		N/A		
Upgrade to Standard PLC		YES		
Upgrade Level Control		NO		
Add Redundant Control		NO		

City of Bloomington, IL Sanitary Pump Station Summary
Data collected during site visit 11/26/2013

FELL AVENUE SANITARY PUMP STATION				
Pump Station Type	Submersible	Packaged	Dry Pit	Notes
	YES	N/A	N/A	
Pumps	Quantity	HP		
	2	35 HP		
Site	Pump House	Controls Outside		SERVICE DISCONNECT IS TOO CLOSE
	NO	YES		TO SITE FENCE - NEC WORKING SPACE VIOLATION.
PLC	Mfr	Model	I/O Cards	
	NONE	N/A	N/A	
HMI	Mfr	Model	Size (diagonal)	
	NONE	N/A		
Level Sensing	Sensor	Floats	Redundant	LINDEN CO.
	NONE	FLOATS ONLY	NO	RELAY LOGIC ONLY
Station Alarms	Local	Remote	Remote Method	DIAL-UP TELE LINE
	PANEL MOUNTED	POWER FAIL EQUIPMENT FAIL HIGH LEVEL	TSL	TYCO SECURITY LINK (TSL) ANSWERING SERVICE
Motor Control	Across The Line	Reduced Voltage	Drive	
	YES	NO	NO	
Electric Service	Voltage	Amps	Phases	
	480 V	100 A	3	
Standby Power	Fixed Mount	Transfer Switch	Fuel	
	35 KW	AUTOMATIC	DIESEL	ONAN
Recommendations				
Replace Monitoring System		YES		
Upgrade to PLC		YES		
Upgrade to Standard PLC		N/A		
Upgrade Level Control		YES		
Add Redundant Control		YES		

City of Bloomington, IL Sanitary Pump Station Summary
Data collected during site visit 11/26/2013

REGENCY SANITARY PUMP STATION				
Pump Station Type	Submersible	Packaged	Dry Pit	Notes
	YES	N/A	N/A	
Pumps	Quantity	HP		
	2	18.2 HP		
Site	Pump House	Controls Outside		
	YES	NO		
PLC	Mfr	Model	I/O Cards	
	ALLEN-BRADLEY	CONTROL LOGIX	MODULAR	ETHERNET IP CARD
HMI	Mfr	Model	Size (diagonal)	Panel by TLC Controls
	ALLEN-BRADLEY	PANELVIEW + 600		
Level Sensing	Sensor	Floats	Redundant	
	TRANSDUCER	YES	BACKUP FLOATS	FLOWMETER - NO CONTROL
Station Alarms	Local	Remote	Remote Method	
	PANEL MOUNTED	NO	MODEM READY	
Motor Control	Across The Line	Reduced Voltage	Drive	
	NO	NO	YES	SQUARE D
Electric Service	Voltage	Amps	Phases	
	480 V	200 A	3	
Standby Power	Fixed Mount	Transfer Switch	Fuel	
	RECEPTACLE ONLY	MANUAL	N/A	Station has overflow - remote alarm and standby power not necessary
Recommendations				
Replace Monitoring System		NO		
Upgrade to PLC		NO		
Upgrade to Standard PLC		NO		
Upgrade Level Control		NO		
Add Redundant Control		NO		

HOLIDAY DRIVE SANITARY PUMP STATION				
Pump Station Type	Submersible	Packaged	Dry Pit	Notes
	YES	N/A	N/A	
Pumps	Quantity	HP		
	2	40 HP		
Site	Pump House	Controls Outside		
	NO	YES		
PLC	Mfr	Model	I/O Cards	
	NONE	N/A	N/A	RELAY LOGIC
HMI	Mfr	Model	Size (diagonal)	
	NONE	N/A	N/A	
Level Sensing	Sensor	Floats	Redundant	
	NONE	YES	NO	
Station Alarms	Local	Remote	Remote Method	DIAL-UP TELE LINE
	PANEL MOUNTED	POWER FAIL EQUIPMENT FAIL HIGH LEVEL	TSL	TYCO SECURITY LINK (TSL) ANSWERING SERVICE
Motor Control	Across The Line	Reduced Voltage	Drive	
	YES	N/A	N/A	
Electric Service	Voltage	Amps	Phases	
	480 V	200 A	3	
Standby Power	Fixed Mount	Transfer Switch	Fuel	
	RECEPTACLE	MANUAL	N/A	
Recommendations				
Replace Monitoring System		YES		
Upgrade to PLC		YES		
Upgrade to Standard PLC		N/A		
Upgrade Level Control		YES		
Add Redundant Control		YES		

EAGLE CREST EAST SANITARY PUMP STATION				
Pump Station Type	Submersible	Packaged	Dry Pit	Notes
	YES	N/A	N/A	
Pumps	Quantity	HP		
	2	40 HP		
Site	Pump House	Controls Outside		
	YES	NO		
PLC	Mfr	Model	I/O Cards	
	PLC DIRECT	DIRECT LOGIC	FIXED IO	
HMI	Mfr	Model	Size (diagonal)	
	AUTOMATION DIRECT	DP-C321		
Level Sensing	Sensor	Floats	Redundant	
	YES	YES	YES - FLOATS	FLOWMETER - NOT USED
Station Alarms	Local	Remote	Remote Method	DIAL-UP TELE LINE
	PANEL MOUNTED	POWER FAIL EQUIPMENT FAIL HIGH LEVEL	TSL	TYCO SECURITY LINK (TSL) ANSWERING SERVICE
Motor Control	Across The Line	Reduced Voltage	Drive	
	N/A	N/A	YES	EATON
Electric Service	Voltage	Amps	Phases	
	480 V	300 A	3	
Standby Power	Fixed Mount	Transfer Switch	Fuel	
	125 KW	AUTOMATIC IN MCC	DIESEL	ONAN
Recommendations				
Replace Monitoring System		YES		
Upgrade to PLC		N/A		
Upgrade to Standard PLC		YES		
Upgrade Level Control		NO		
Add Redundant Control		NO		

KICKAPOO MAIN BRANCH SANITARY PUMP STATION				
Pump Station Type	Submersible	Packaged	Dry Pit	Notes
	YES	N/A	N/A	
Pumps	Quantity	HP		
	2	105 HP		WETWELL CAN ACCOMMODATE AN ADDITIONAL 2 PUMPS
Site	Pump House	Controls Outside		
	YES	NO		
PLC	Mfr	Model	I/O Cards	
	ALLEN BRADLEY	COMPACT LOGIX L32E	MODULAR	UPS FOR CONTROL PANEL
HMI	Mfr	Model	Size (diagonal)	
	ALLEN BRADLEY	PANELVIEW + 700		
Level Sensing	Sensor	Floats	Redundant	
	YES IN EACH WETWELL (2)	HIGH-LOW ALARM	YES FLOATS	
Station Alarms	Local	Remote	Remote Method	DIAL-UP TELE LINE
	PANEL MOUNTED	POWER FAIL EQUIPMENT FAIL HIGH LEVEL	TSL	TYCO SECURITY LINK (TSL) ANSWERING SERVICE
Motor Control	Across The Line	Reduced Voltage	Drive	
	NO	NO	YES	SQUARE D
Electric Service	Voltage	Amps	Phases	
	480 V	1200 A	3	
Standby Power	Fixed Mount	Transfer Switch	Fuel	
	500 KW	AUTOMATIC	DIESEL	
Recommendations				
Replace Monitoring System		YES		
Upgrade to PLC		NO		
Upgrade to Standard PLC		N/A		
Upgrade Level Control		NO		
Add Redundant Control		NO		

Stormwater Technical Memoranda

ST1 - DELINEATION OF STORMWATER PROBLEM AREAS

DELINEATION OF STORMWATER PROBLEM AREAS

EXECUTIVE SUMMARY

This summary serves as a companion document to the Delineation of Stormwater Problem Areas Technical Memorandum dated December 11, 2013, prepared by Foth for the City of Bloomington.

This memorandum was prepared to:

1. Assist City staff with a general understanding of the extent of stormwater issues throughout the community.
2. Prioritize watershed(s) for further analysis based on the severity and density of the stormwater issues.

Questionnaires were distributed to City residences and businesses via City water bills. Over 2,300 questionnaire responses were received. All responses were reviewed, compiled and entered into the City's GIS database, together with other known stormwater issues documented by City staff.

Key Findings

1. Drainage issues are widespread throughout the City.
2. The frequency of flooding instances per acre, indicative of drainage issues, varies for each watershed in the City.
3. Based on questionnaire responses, the Oakland watershed, southeast of downtown, was found to have the highest density of reported surface flooding and basement flooding within the City.
4. City staff-reported issues in the Oakland watershed occurred at approximately eight times the average rate within the City.
5. Combined sewer overflows exist on Maizefield Avenue within the Oakland watershed.
6. Based on the above, the Oakland watershed was found to have the highest priority for further analysis.

Recommendations

The Oakland Avenue watershed is recommended for further study to identify potential solutions to the flooding problems in this watershed.

`

Date: December 11, 2013

To: Ryan Otto, PE, City of Bloomington, Illinois

From: John A. Dabrowski, PE, Foth Infrastructure & Environment, LLC.

Re: DELINEATION OF STORMWATER PROBLEM AREAS

INTRODUCTION

This technical memorandum was prepared to assist City staff with their overall understanding of where and to what extent the City is experiencing stormwater issues throughout the community. This memorandum has been prepared as part of the ongoing Stormwater Master Plan project. The scope of this part of the Master Plan is to review and analyze drainage issues throughout the community, and then identify and prioritize watershed(s) with the community, based on reported stormwater problems, for further analysis ultimately leading to the development of alternates to mitigate these drainage problems.

METHODOLOGY

Data was collected and compiled from three sources.

1. Existing GIS data from the City of Bloomington and McLean County.
2. A questionnaire issued to city residents via water bills.
3. Key City of Bloomington staff interviews.

Data from these sources was then entered into a GIS database for further assessment and nalysis.

GIS Data

"A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts." (www.esri.com/what-is-gis/overview.html)

Existing GIS data was collected from both the City of Bloomington and McLean County. The data, representing the city's infrastructureal physical proporities, were compiled into a single GIS system; data including surface contours, stream locations, and sewer locations (including types and sizes), manholes, streets, sidewalks, parking lots,

buildings, etc. The compiled GIS file allowed the ridges and valleys to be identified and the approximate limits of the watersheds delineated (see Exhibit 1).

These watersheds, totaling approximately 25 square miles, were then analyzed in reference to the physical properties including roads, storm sewers and combined sewer systems, as they commonly impact surface runnoff. This analysis identifies cross connections between watersheds via the underground conveyance networks, upon which the watersheds are remapped.

The mapped watersheds assist the understanding of primary storm and combined sewer networks in the City, and allow the analysis to proceed on a watershed basis.

Questionnaire

Beginning February and through April of 2012, the City forwarded a "Drainage/Flooding Survey" to each water user through the normal water billing cycle. This survey was created through a joint effort between City staff and the consultant team; a copy of the survey may be found in Exhibit 2. In general, survey questions focused on drainage and flooding issues designed to assist in problem area delineation and assessment. Additional questions were included to assist the City in tracking improper or non code-compliant sewer connections, including sump pump discharges.

By April 1, 2012, the collection cutoff date, 2,327 completed surveys had been returned; a compilation of these responses is included as Attachment 1. The City of Bloomington comprises of approximately 26,600 households. The response represents approximately 9% of the households within the city, a very reasonable response rate for surveys of this type. Furthermore, the responses were well dispersed throughout the city. These factors increase the confidence in the analyzed results.

City Staff

The final data collection aspect was interviewing key city personnel familiar with drainage issues within the city limits. Staff involved included personnel from within the Public Works Department representing both engineering and maintenance/operations.. This effort started with face to face conversations discussing what might constitute a problem, and what areas seemed to have some of the largest or most frequent issues. Following the meeting, a schematic depicting the specific areas or pipe segments with descriptons was prepared. This data is included as Exhibit 3 which includes both a map (part 1) depicting the areas and a table (part 2) defining the problems.

ANALYSIS

The initial effort involved sorting through the submitted questionnaires, categorizing the questions and reviewing each survey comments. These efforts provided the initial understanding of the data collected and assisted in the development of the analysis approach.

The data points were then entered into a GIS database so that they could be viewed together as a system rather than as individual and isolated points. Each survey response was referenced on a map based on the provided address.

The data was then sorted and mapped to illustrate specific reported issues. Figures were prepared as follows and can be found in Attachment 2:

Figure 1: Flooding Frequency
Figure 2: Flooding Duration
Figure 3: Stormwater Problems
Figure 4: Ditch Erosion
Figure 5: Ejector Pits
Figure 6: Sump Pump
Figure 7: Sump Pump Problems
Figure 8: Sewer Back-Ups

Where applicable, color gradients were used within the legend to illustrate the severity or frequency of an issue.

Review of the figures leads to two general findings:

- The survey responses are broadly distributed throughout the City.
- Stormwater issues appear to be distributed throughout the City with no obvious concentration in any specific neighborhood.

Generally, where surface flooding and sewer back-ups are found in high density, there is a high probability there is an underlying infrastructure limitation, be it inlet access, positive outfalls, undersized conveyance, etc. Therefore, to identify potential high priority areas, further analysis of the data was performed as follows. Two issues indicative of fundamental infrastructure limitations were selected:

- Surface Flooding (standing water, standing water in yard, flooding from channel)
- Water entering house through basement floor drain

Benefits are derived by analyzing data as an interconnected system rather than isolated individual points. This system analysis identifies trends and patterns that may not have been evident through individual assessments. Moreover, these trends and patterns may be quickly and visually compared to each other to determine priority areas.

Code was written to determine the density of these issues per acre for each watershed. The results are displayed in Exhibits 4 and 5 through the use of heat gradients. Watersheds with the highest densities are displayed with purple shading, then red and those with the lowest, a green shading.

Upon completion of the heat gradient density figures, variations amongst watersheds became evident. Most of the higher density areas are focused around the city's combined sewer network. The areas directly east of the downtown area present the highest occurrence density for both surface flooding and basement flooding, with the highest density in both flooding classes being that generally south of Washington St. and west of Mercer Ave., centered around Oakland Avenue. This drainage area, comprising approximately 405 acres, will be refereed to as the Oakland Watershed and is identified on Exhibit 1, Storm Watershed Areas herein.

Fifty-six (56) issues were reported by City Staff during the interview phase. Of these, twelve (12) issues, representing 20% of the total staff- reported issues, occurred in the Oakland Watershed. By comaparison, this 405 acre watershed represents only 2.5% of the area of all the watersheds analyzed within the City, therefore the rate of staff-reported issues is approximately 8x (= 20% / 2.5%). what might have been expected for this watershed.

CONCLUSION

City GIS data, questionnaires and city staff interview data were collected, reviewed, compiled and entered into the City's GIS database. Based on an initial assessment of the data, drainage issues appeared to be widespread throughout the City with no apparent concentration in specific areas. Further analysis was performed to analyze frequency of surface flooding and basement flooding, indicative drainage issues, on a per acre basis for each drainage basin. The results were presented using heat gradients within GIS. The Oakland watershed was found to have the highest density of both surface flooding and basement flooding within the City. City staff-reported issues in the Oakland watershed also occurred at approximately eight times the average rate within the City. In addition, combined sewer overflows exist on Maizefield Avenue within the Oakland watershed. Based on the high concentration of flooding, City staff reported issues and Combined Sewer Overflows, this watershed was identified for further study.

Exhibit 1
Storm Watershed Areas

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

SOURCE OR NOTES:

Legend

Oakland Watershed

Note: Watersheds are determined using a hybrid of topographic and sewer data

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 0.5 1
Miles

CITY OF BLOOMINGTON, ILLINOIS

EXHIBIT 1

STORM WATERSHED AREAS

Date: 2/14/2013	Revision Date: 12/9/2013	
Drawn By: JMS	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 11.mxd Date: 12/9/2013

Exhibit 2

Drainage / Flooding Survey Form

CITY OF BLOOMINGTON

PUBLIC WORKS DEPARTMENT

DRAINAGE / FLOODING SURVEY

February 2012

The City of Bloomington is performing a drainage survey and requests your participation. The results of this survey will be used to help identify locations where drainage problems exist and prioritize projects to address flooding and sewer backup issues throughout the City. Please answer the following questions about your home, property, or business.

This survey may be completed on-line at ***www.cityblm.org/sewermasterplan*** or by completing this form and returning it with your water bill payment. **Please return the survey by April 1, 2012.**

1. **Property Address (Required):** _____

2. **How often do you experience flooding problems?** (check one)
   - ☐ Never
   - ☐ Rarely (less than once every 5 years or so)
   - ☐ Infrequently (once every 1-2 years)
   - ☐ Several times per year
   - ☐ Every time it rains

3. **Where and how does the flooding occur?** (check all that apply)
   - ☐ Standing water outside the house, on the property
   - ☐ Standing water in the street
   - ☐ Flooding from adjacent creek, stream, or drainage ditch
   - ☐ Water entering the house from basement wall, door, window, crawl space, etc.
   - ☐ Water entering house through basement floor drain
   - ☐ N/A

4. **How long does the flooding last?** (check one)
   - ☐ Less than 30 minutes
   - ☐ 30 minutes to 1 hour
   - ☐ 1 to 2 hours
   - ☐ More than 2 hours
   - ☐ N/A

Post Office Box 3157
Bloomington, Illinois
61702-3157
309.434.2225 tel
309.434.2201 fax
For Hearing Impaired
TTY 309.829.5115
engineer@cityblm.org

an equal opportunity employer

5. **Is your property adjacent to an open drainage ditch?** (If "No," skip to question 8)
   - ☐ Yes ☐ No

6. **Do you have information on high water levels recorded (from the ditch next to your home) during a recent heavy rainfall? (information may include photos taken during flooding and/or reference marks showing the extent of flooding)**
   - ☐ Yes ☐ No ☐ N/A

7. **Does the drainage ditch next to your home show signs of erosion along its banks?**
   - ☐ Yes ☐ No ☐ N/A

8. **If there is erosion in the ditch next to your property, is the erosion bad enough to threaten the stability of any adjacent structure (such as house, shed, or driveway)?**
   - ☐ Yes ☐ No ☐ N/A

9. **Does your home have an ejector pump (a pump for basement sewage)?**
   - ☐ Yes ☐ No ☐ I don't know

10. **Does your home have a sump pump for foundation drainage?** (If "No," skip to question 14)
    - ☐ Yes ☐ No ☐ I don't know

(Continued on Back)

11. Where is your sump pump located?

- ☐ Basement
- ☐ Crawl Space
- ☐ Garage
- ☐ Outside pit
- ☐ Other (please specify) _____

12. How often does the sump pump run during wet weather?

- ☐ Several times per hour
- ☐ Several times per day
- ☐ Occasionally
- ☐ Never
- ☐ Unknown

13. Where does the sump pump discharge?

- ☐ Outside on the ground
- ☐ Rain garden or rain barrel
- ☐ Other (please specify)_____
- ☐ Connected to a storm sewer or sump pump drain line
- ☐ Unknown

14. Does the sump pump discharge cause problems with flooding or ice buildup?

☐ Yes ☐ No

15. Have you ever experienced sewer backups in your basement during periods of wet weather that resulted in sewage flooding a portion or all of your basement floor?

- ☐ Have never experienced a sewer backup into the basement
- ☐ Sewer backups are rare: sewage is contained to a small area of the basement
- ☐ Sewer backups are rare: sewage covers entire floor
- ☐ Sewer backups are frequent: sewer is contained to a small area of the basement
- ☐ Sewer backups are frequent: sewage covers entire floor

16. Do you have pictures and/or videos of your flooding problem?

☐ Yes ☐ No

17. Please use the space below to describe your flooding or sewer backup situation in more detail. If possible, please add references to specific dates and times when the flooding occurred, and, if you have photos or other evidence of flooding, be sure to fill out your contact information at the end of this survey so we may contact you to get copies of photos, sketches, etc. Photos and short video clips may also be e-mailed to engineer@cityblm.org; please include your property address and contact information in the e-mail.

18. It may be necessary to collect additional information on specific flooding problems. If the need arises, may City staff (or their representatives) contact you to discuss your flooding problem in more detail?

☐ Yes ☐ No

19. We appreciate your willingness to provide the location of your flooding problem, as the success of this survey depends on it. Your contact information is extremely important if you have photos or other evidence of flooding, as it will be necessary to contact you to retrieve this information.

Contact Information:

Name: _____

Mailing Address: _____

City/Town: _____

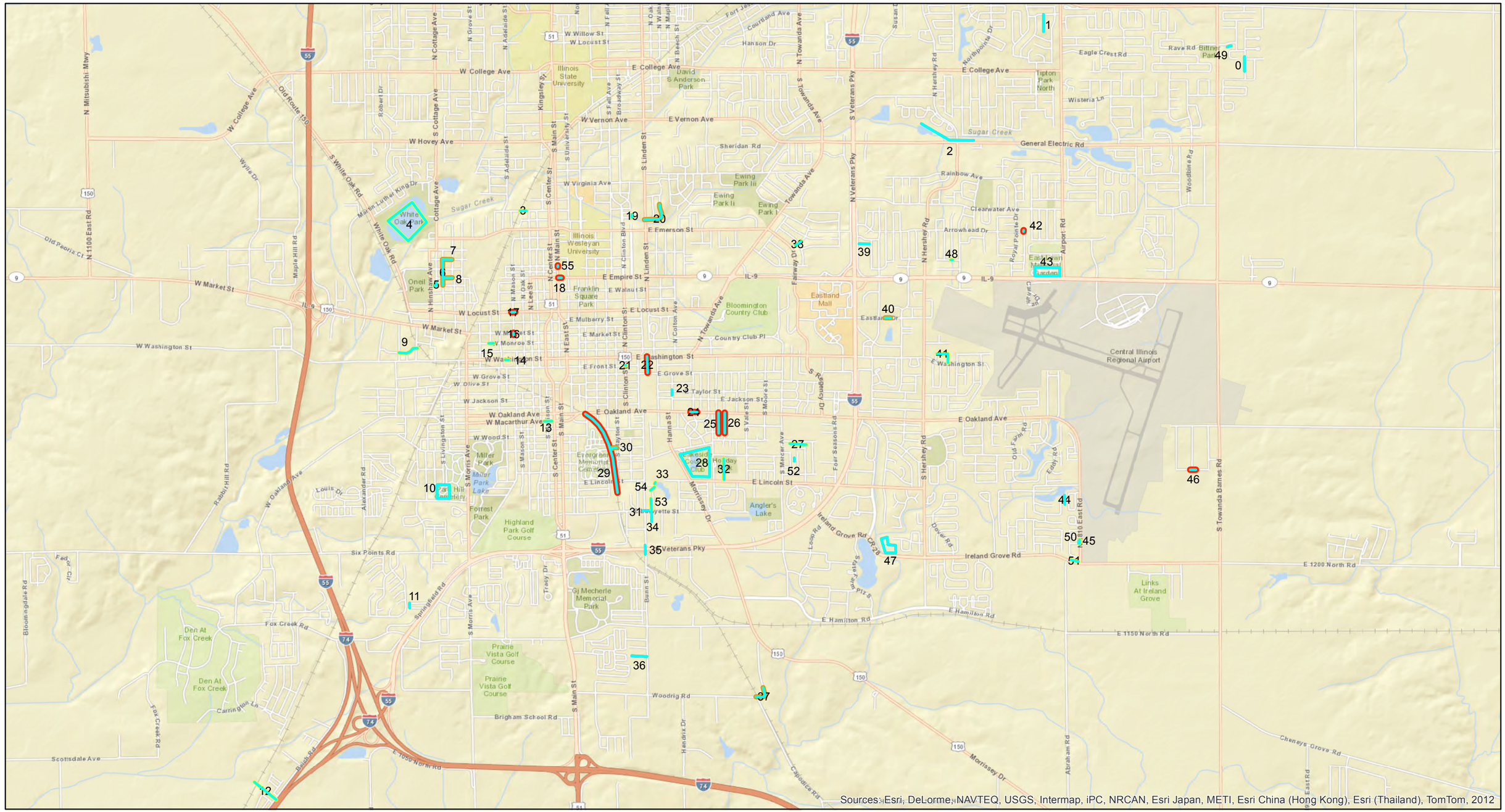
ZIP: _____

E-mail Address (we need this to follow up with you if you have flooding photos/evidence): _____

Phone Number: _____

Exhibit 3

Problem Areas Identified by City Staff



SOURCE OR NOTES:

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 0.5 Miles

CITY OF BLOOMINGTON, ILLINOIS

EXHIBIT 3 - PART 1

Problem Areas as Noted by City of Bloomington Staff

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure_COBissues.mxd Date: 2/22/2013

ID	COMMENT	TYPE	NOTES	PRIORITY
0	Sumps run continuously external sump (2213 Riverwoods Ln) in vacant lot- field tile issue?	Ground Water		None
1	Backyard flooding on Red Stone Ct	Ground Water / Yard		None
2	Constitution Trail floods	Park Flood	Works as designed.	None
3	Division Street Viaduct Floods	Street Flood		Low
4	No outlet for White Oak basin	Detention Basin Issue	Old gravel pit. Parks pumps this down.	Low
5	Intersection floods inlet issue	Street Flood		Low
6	Basement flooding along Livingston Street	Basement Flood		Medium
7	Basement flooding along Perry Street	Basement Flood		Medium
8	Basement flooding along Empire Street	Basement Flood		Medium
9	Street flooding along Circle Avenue	Street Flood		Low
10	Park Hill Cemetery floods in heavy rains- drain tile to interceptor issue	Yard Flood		None
11	Street flooding along Daddono Circle	Street Flood	Ditch needs Grading	None
12	Paved drainage way holds water filled with sedimentation in Prairie Place Sub	Ditch Issue	Ditch needs cleaned	Low
13	Intersection floods Madison @ MacArthur inlet issue	Street Flood		Low
14	Street flooding along Washington St South inlet plugs easily	Street Flood		Low
15	Intersection Floods Catherine @ Monroe Inlet Issue	Street Flood		Low
16	Street flooding on Mason Street southeast inlet needs work	Street Flood		High
17	Intersection floods Locust @ Mason - state route - inlet issue	Street Flood	IL 9 / US 150	High
18	Intersection floods Main @ Empire -(US 51 / US 150/ IL 9) - inlet issue	Street Flood		High
19	Street floods on James-Charles alley connection	Street Flood		Low
20	Street floods along Norbloom & Dawes Poor Access to line for cleaning minimal manholes	Street Flood	need to install new manholes and clean storm line	Medium
21	Street Flooding Front St @ Clinton St (US 150) debris related	Street Flood		Low
22	Alley Flooding possible storm line collapse	Street Flood		High
23	Street flooding when debris plugs line	Street Flood		None
24	Intersection Floods Oakland (Arterial) @ Meadows Inlets into Combined Sewer	Street Flood	Move Inlets into Storm Sewer	High
25	Basement flooding along Kreitzer	Basement Flood		High
26	Basement flooding along Florence	Basement Flood		High
27	Frequent backyard flooding- issue Pierce	Yard Flood		Low
28	No drainage- Lakeside Country Club Golf Course floods some	Drainage	Old clay pit outlets to northwest	None
29	Flooding along tracks	Ditch Issue		High
30	Inadequate drainage- yard floods 2-3 feet during prolong heavy rains	Yard Flood		Medium
31	Ditch line floods Bunn @ Lafayette	Ditch Issue		None
32	No known outlet for Holiday Park Lake	Drainage		Low
33	Basin outlet plugs easily - Baker-Ash Debris Issue	Detention Basin Issue		Low
34	Rear yard flooding along old RR alignment south of Lafayette east of Bunn	Yard Flood	Ditch line filled in, inadequate storm sewer, outside City limits	None
35	Street floods on Bunn St under Veterans Pkwy	Street Flood	Very flat rural section with inadequate ditches and drainage	None
36	High water table in this area	Ground Water		None
37	Street flooding on Woodrig Road at curve	Street Flood	Rural Section - Culvert too small ditch needs cleaned	Medium
38	Intersection flooding Delmar @ Mecherle	Street Flood	Works as designed	Low
39	Rear yard floods along Wildwood Road east of Holiday Dr	Yard Flood		None

ID	COMMENT	TYPE	NOTES	PRIORITY
40	Street flooding on Eastland Dr (Collector) During Moderate Rainfalls	Street Flood		Medium
41	Street flooding on Bayberry Ct @ Brunswick Dr	Street Flood	Works as designed - very flat no mid-block storm sewer	Low
42	Inlet to basin issue @ Royal Pointe Basin	Detention Basin Issue	Erosion around end section & grate broke	High
43	Eastlawn Cemetery floods due to internal piping issue	Yard Flood	Empire (IL 9) drains through this property See File	None
44	Backyard flooding- grading related	Yard Flood	Lawsuit - issue to be addressed by Breckenridge developer	None
45	Sewer back falls to north look at removing dead end manhole	Drainage		Low
46	Infiltration into sanitary via bad sewer joints under intersection	Ground Water		High
47	Brookridge Park floods in heavy rains	Park Flood	Park in Flood Plain works as designed	None
48	Intersection flooding Challis @ Slayton	Street Flood	Works as designed	Low
49	Yard flooding along Rave Rd	Yard Flood	See File	None
50	Basement flooding- field tile issue	Ground Water		None
51	Ditch Floods	Drainage		Low
52	Parking Lot below sewer level - drain by sump pump	Yard Flood		None
53	Ditch overgrown	Ditch Issue		Low
54	Proposed future line to basin to aid retention	Drainage		Low
55	street flooding - inlet issue	Drainage		High

Exhibit 4

Surface Flooding
Heat Gradient

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

SOURCE OR NOTES:

Legend

Surface Flooding

- Surface Flooding
- Combinded Sewer Boundary

Density

- 0 Points per 100 Acres
- 1 - 5 Points per 100 Acres
- 5 - 10 Points per 100 Acres
- 10 - 15 Points per 100 Acres

N

Foth

0 0.5 Miles

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

CITY OF BLOOMINGTON, ILLINOIS

EXHIBIT 4

SURFACE FLOODING
HEAT GRADIENT DENSITY

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\2013-02-14 Exhibits\Exhibit 4.mxd Date: 2/22/2013

Exhibit 5

Basement Flooding
Heat Gradient

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

SOURCE OR NOTES:

Legend

Flooding through Basement Drain

- Reported occourances
- Combined Sewer Boundary

Density

- 0
- 0 - 10 Points per 1000 Acres
- 10 - 20 Points per 1000 Acres
- 20 - 30 Points per 1000 Acres
- 30 - 40 Points per 1000 Acres
- 40 - 50 Points per 1000 Acres

N

Foth

0 0.5 1 Miles

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

CITY OF BLOOMINGTON, ILLINOIS

EXHIBIT 5

FLOODING FROM BASEMENT DRAIN
HEAT GRADIENT DENSITY

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\2013-02-14 Exhibits\Exhibit 5.mxd Date: 2/22/2013

Attachment 1

Questionnaire Response Tables

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
17400 E	2475 N Road	1						5	2	0	0	0	2	2	0	0	0	0	
0	Aberdeen Way	1						5	2	0	0	0	2	1	1	3	2	1	
0	Aberdeen Way	1						5	2	0	0	0	2	1	2	3	2	1	NA
0	Aberdeen Way	1						5	2	0	0	0	0	1	2	1	2	1	
1500	Airport Rd	1						5	2	3	3	3	2	2	0	0	0	1	
2500	Airport Rd	2	1					2	2	2	3	3	2	1	3	1	2	1	Q4: Water flow thru yard from higher ground - no problem.
2500	Airport Rd	2	1					3	2	0	0	0	2	1	1	3	2	1	
2600	Airport Rd	1						5	2	0	0	0	2	1	4	3	2	1	
2600	Airport Rd	1						5	2	3	3	3	2	1	4	3	2	1	
2700	Airport Rd	0						0	0	0	0	0	0	0	0	0	0	0	Weaver, & Jason Chambers about this. It is awful! Will you guys ever do anything to fix this issue?!? Smells like rotten eggs. Investigate it people!!!
2700	Airport Rd	0						0	2	0	0	0	3	2	0	0	0	1	The smell is our issue at this point. We are new to the area.We would like to have this issue addressed at the next council meeting. This has been brought up before.
	Airport Rd	1						5	1	2	0	2	2	1	1	4	2	1	In the past the association has had backups from discharge of detention basin.
0	Alder Ct	0						0	0	0	0	0	0	0	0	0	0	0	
0	Alder Ct	1						0	2	2	0	0	3	1	3	4	2	1	Q2: Only once in 10 years. Q17: Flooded once when screws at top of sump pump had not been tightened. Water spewed out the top (the plumber said) and flooded the basement. That was 3 yrs ago. Have lived here 9 1/2 yrs and that was the only episode.
0	Alder Ct	1						5	2	0	0	0	2	1	1	3	2	1	
0	Alder Ct	1						5	2	3	3	3	2	1	1	4	2	1	
0	Alder Ct	1						0	2	0	0	0	3	3	5	4	2	1	
300 N	Allin St	4		2				2	2	3	0	0	2	2	0	0	0	2	Q3: from stopped up sewers. Q15: once in 23 years. Q17: approximately 3 summers ago when we had much rain.
200 S	Allin St	1						0	2	0	0	0	2	2	0	0	0	1	
500 S	Allin St	3				4		4	2	3	3	3	2	1	5	3	2	1	Water seeps up through crack in basement floor and where the floor and walls meet.
600 S	Allin St	4		2				1	2	0	0	0	3	2	0	0	0	1	Storm drain located at the NE corner of Oakland and Allin is not able to keep up with moderate to heavy rain. Water flows across Oakland Avenue from the south side of the street to north side of the street just east of Allin St.
800 S	Allin St	1						0	2	0	0	0	2	2	0	0	0	1	
800 S	Allin St	5				4		3	2	2	2	2	2	0	0	0	0	2	Comes out of the drainage (sometimes - rarely) one area down on Allin & MacArthur (2 drainages) get backed up.
800 S	Allin St	4	1			4		4	2	0	0	0	2	2	0	0	0	1	ONLY happens during very heavy sustained rainfall. My house in is middle of the block. One end of block is high and other end of block is low. So water runs down the neighborhood and neighbors properties and hits one side of my house, and floods one room in my basement. Water depth in that room in never more than 3-4 inches. And if you let it sit for a few hours, it continues 'down stream' through that room and out through the otherside basement wall.
900 S	Allin St	3				4		4	2	0	0	0	3	2	0	0	0	1	Q10: not working. Q17: Water leaks in basement after a lot of heavy rain.
2300	Altoona	1						5	0	0	0	0	2	1	3	3	2	1	
3900	Anabelle Drive	2		2				1	2	0	0	0	2	1	3	4	2	1	
2300	Anchor Dr	1						5	2	0	0	0	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2300	Anchor Dr	1						5	2	0	0	0	3	1	2	4	2	1	We have only lived in this house for 8 months, so I don't know of all the details with flooding. I know that our basement is completely finished, so that has to be a good sign. Our house sits lower than our neighbors on either side and years ago, the gutter from a neighbor's house was running off onto our property and going into the basement. The previous owner's of our home put a plastic tube onto the neighbor's gutter which took the water to the front yards and there hasn't been a flooding problem since. Also the backyard slopes down towards the house and there has been some sort of system put it between the house and the yard that will collect all the water that runs down towards the house and carry it away. I don't know where it goes to, but I know it's not going into our house.
2300	Anchor Dr	1						5	0	3	3	3	2	1	4	1	2	1	
2400	Anchor Dr	1						5	2	0	0	0	3	1	3	1	2	1	
2400	Anchor Dr	3		2				2	2	3	3	3	3	1	5	4	2	1	
2400	Anchor Dr	1						5	2	0	0	0	2	1	3	1	2	1	Q12: if a lot of rain
1100	Andover St	1						5	2	0	0	0	2	2	0	0	0	1	
1100	Andover St	1						5	2	0	0	0	2	1	3	1	2	1	Q12: to hardly even unless lot of rain for several days.
1100	Andover St	1						5	2	0	0	0	2	1	3	1	2	1	
1100	Andover St	1						5	2	3	3	3	2	1	3	1	2	1	
0	Andy Ct	1						5	1	2	2	3	2	2	0	0	0	1	
0	Andy Ct	1						0	0	0	0	0	0	0	0	0	0	1	
0	Andy Ct	2	1			4		2	1	2	2	3	3	1	1	3	2	1	Sump pump runs dozens of times per day, even in dry weather. Have to have a backup pump because the basement flooded in matter of minutes during a power outage before tha backup was installed. The drainage ditch next to our house has never been a flood threat.
3000	Ann Dr.	2	1					4	2	0	0	0	3	1	1	1	1	1	
0	Arbor Ct	2				4		1	2	0	0	0	2	1	1	1	2	1	Water was forced up thru the drain in the window well and then thru the window into the basement.
0	Arbor Ct	1						5	2	0	0	0	3	1	3	4	2	1	
0	Arbor Ct	1						0	2	0	0	0	1	2	2	4	1	0	
0	Arbor Ct	1						5	2	0	0	0	2	1	4	4	2	1	n/a
0	Arbor Ct	1						0	1	2	1	2	2	1	5	1	2	1	
0	Arbor Ct	1						0	2	0	0	0	2	1	4	4	2	1	
0	Arbor Ct	1						5	2	0	0	0	3	1	2	4	2	1	
0	Arbor Ct	1						5	2	3	3	3	3	3	5	4	0	1	
0	Arbor Ct	1						5	2	0	0	0	2	1	2	1	2	1	
700	Arcadia Dr	1						5	2	0	0	0	3	3	0	0	0	1	
900	Arcadia Dr	1						0	1	0	2	2	2	1	1	1	2	1	
600	Arcadia Dr.	4	1	2				3	1	2	2	2	0	2	2	1	2	1	
800	Arcadia Dr.	2				4		4	1	2	2	3	2	2	0	0	0	2	
2700	Ark Drive	1						5	1	2	2	3	2	1	2	3	2	1	
900	Arlene Dr	1						5	2	3	3	3	2	2	0	0	0	0	
900	Arlene Dr	1						0	0	0	0	0	2	3	0	0	0	1	
900	Arlene Dr	1						0	2	0	0	0	2	2	0	0	0	1	
900	Arlene Dr	1						5	2	3	0	0	2	2	0	0	0	1	
3700	Armstrong Dr	1						5	2	0	0	0	2	1	1	3	2	1	
1700	Arrowhead Dr	1						5	1	2	2	2	2	2	0	0	0	1	n/a
1700	Arrowhead Dr	2	1			4	5	2	2	3	3	3	2	1	2	1	1	2	Roots from tree on property can cause blockage. I treated this with a solution to kill roots in drains.
2000	Arrowhead Dr	4		2				2	2	3	3	3	2	1	1	1	2	1	
2000	Arrowhead Dr	2	1				5	4	2	0	0	0	2	1	1	1	2	0	
2400	Arrowhead Dr	1						5	2	0	0	0	2	2	0	0	0	1	we are in a non flood area

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2800	Arrowhead Dr	5		2				4	2	0	0	0	2	1	1	1	2	1	Q3: along curb. Q17: Our home is at the SE corner of Arrowhead and Newcastle St. The standing water is along most of our property line on the Newcastle side and stays along the curb for weeks at a time, posing a mosquito breeding threat. It appears to be more of a street dept problem rather than a sewage problem. The concrete by the drainage opening at the corner is cracked and breaking down and needs repair.
2800	Arrowhead Dr	1						5	2	0	0	3	2	1	3	3	2	1	No flooding problems.
25300	Arrowhead Ln	1						5	2	3	3	3	1	2	0	0	0	1	
25400	Arrowhead Ln	1						5	2	0	0	0	1	2	0	0	0	1	NA
0	Ashling Ct	1						0	2	0	0	0	3	1	3	3	0	0	We have standing water near our back property line due to water coming from backyard receiving water from owner's basement - sump pump probably. We have thrown mosquito pellets in the puddles many tim3s. That part of yard is very swampy - riding mower leaves deep ruts.
0	Ashling Ct	1						5	2	0	0	0	2	1	1	3	2	1	
0	Ashling Ct	5	1					3	2	0	0	0	2	1	5	3	2	1	Water collects at 4 corners of yard - not graded off correctly when consruction was new.
0	Aspen Ct	2	1					2	2	0	0	0	3	1	1	4	2	1	
0	Aspen Ct	2				4		2	2	0	0	0	2	1	3	3	0	1	
0	Aspen Ct	1						5	2	5	3	3	3	1	1	3	0	1	
0	Astoria Way	2						2	1	2	1	1	3	1	2	4	2	1	I'm not sure that the survey recorded my answers, but we have been in this house less than 3 months and have very little knowledge of this topic
0	Astoria Way	1						5	2	2	3	3	3	1	1	4	2	1	
0	Astoria Way	1						5	2	0	0	0	3	1	2	4	2	1	
0	Astoria Way	1						5	1	2	1	2	2	1	3	1	2	1	
0	Astoria Way	1						5	2	3	3	3	2	1	3	3	2	1	
0	Astoria Way	1						5	2	3	3	3	3	1	4	4	0	1	Q2: no signs, have lived here 8 mos.
100	Astoria Way	1						5	1	2	2	2	3	1	2	3	2	1	
100	Astoria Way	2				4		4	2	0	0	0	3	1	1	3	2	2	Flooding happened in first week of July, 2003 when there was heavy rain in Bloomington/Normal area. Water entered in the basement of my house, houses adjacent to me and many more houses in the street.
100	Astoria Way	1						5	1	2	2	3	2	1	1	4	2	1	
100	Astoria Way	2	1					2	1	2	2	0	2	1	5	3	2	0	
3100	Auburn Rd	1						5	2	3	3	3	2	1	5	3	0	1	
3100	Auburn Rd	1						5	2	0	0	0	2	1	3	4	2	1	
0	Autumn Court	1						5	2	0	0	0	2	2	0	0	0	1	n/a
0	Bailey Ct	1						5	0	3	3	3	2	1	3	3	2	1	
300 E	Baker St	0	1					0	0	0	0	0	3	1	3	1	2	2	Q2: sometime when it rains, I am handicapped and live with my daughter in Kankakee. I'm home in Blm sometimes every 2 or 3 mos. For doctor visits. Q4: I have it mopped up. Q15: One time in many years.
300 E	Baker St	4	1	2				3	2	0	0	0	2	2	0	0	0	0	No basement, my house is on a slab, but I get nervous when the water floods my street and comes up my driveway.
300 E	Baker St	0						0	0	0	0	0	0	0	0	0	0	0	We have not had any problems so far.
900 E	Baker St	1						0	1	2	0	0	2	2	0	0	0	0	Q7: ?
3800	Baldocchi Dr	2						5	2	3	3	3	3	1	5	4	2	0	
1400	Bally Shannon Dr	1						5	2	2	3	3	3	1	1	3	2	1	
1400	Bally Shannon Dr	1						5	2	0	0	0	0	0	1	3	2	1	
3500	Ballyford Dr	1						5	2	0	0	3	2	1	2	3	2	1	
1200	Bancroft Dr	5	1	2				4	2	3	3	3	2	1	3	4	2	1	Flooding of the street (a moorhead) due to plugged drains flooding in back yard due to poor drainage (from yard behind) flooding in street due to plugged drains (neighbors put yard debrie in street).
0	Bandecon Way	1						5	1	2	2	3	1	1	4	3	2	1	
0	Bandecon Way	1						0	2	0	0	0	0	0	3	1	2	1	
1200	Banroft Dr	1						5	2	0	0	0	2	1	2	3	2	1	The smaller pump sump pipe goes into a larger drain and it blows the water out on the ground at this joint. I don't know where the drain pipe drains to, but it is plugged, and causes the water to come out at the joint.
0	Barclay Ct	1						5	2	3	3	3	2	1	3	3	2	1	
0	Barclay Ct	1						5	2	0	0	0	1	1	5	3	2	1	
2900	Bardwell Rd	1						5	2	0	0	0	3	1	5	3	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1100	Barker St	1						0	2	0	0	0	2	2	0	0	0	1	
1100 S	Barker St	1						5	2	0	0	0	2	2	0	0	0	1	
1200 S	Barker St	2					5	2	2	3	3	3	2	1	4	1	2	1	One time during rain day clear water came out of floor drain in basement, covering an area of 5'x8' with 8" to 10" standing water. I had to use plunger to get drain to work and get rid of water. Happened some time while we were sleeping so not sure how long water there.
0	Barley Circle	1						5	2	3	3	3	2	1	1	1	2	1	
3300	Barrington Road	1						5	2	0	0	0	2	1	1	4	2	1	
0	Bay pointe dr.	2	1					2	2	0	0	0	3	1	1	1	1	1	
100 S	Bayberry	0						0	0	0	0	0	0	0	0	0	0	0	Q2-Q4: behind me at 105 S. Sesame covering good part of their backyard, 2/3 - 3/4 from the fence. Has happened 2-3 times within the last 5 years in Jan.-Feb. when wehave had heavy rains. My concern is it eventually runs over onto my property (backyard). The last time this happened I was really concerned because the water covered at least 1/3 of my backyard. The water lasted about 2 days. I am on a slab and don't want water coming into my house.There is a drain in the back SE corner of my property. I am concerned about the water draining from their property onto my property. With other heavy rains, thus far other than winter, the standing water on the back protion of their yard has not overflowed into my yard.
100 S	Bayberry	4	1					3	2	0	0	0	3	1	5	1	2	1	
100 S	Bayberry Court	1						5	2	0	0	0	2	1	3	4	2	1	
100 S	Bayberry Court	2				4		1	2	0	0	0	2	1	2	1	1	1	The only "flooding" I have encountered is during very heavy rain, water will enter the basement through the basement window wells.
100 S	Bayberry Court	2	1	2				4	2	0	0	0	2	1	3	1	2	1	standing water in front of house causing sidewalk to sink and crack area. causes severe ice in street and area in cold wet times. area affected is directly over water shutoff valve for house. called city and nothing done. I am sure you have heard this before, but what the hell is my HIGH taxes I pay doing to help the situation. ??????????????????????????????
3900	Baywood Dr	1						0	2	0	0	0	3	1	3	1	2	1	
200	Beacon Cr	1						5	2	0	0	0	2	1	2	1	2	1	no problem
400	Beacon Cr	1						5	2	0	0	0	2	1	1	3	2	1	
400	Beacon Cr	3	1					3	0	0	0	0	2	1	2	1	2	1	
400	Beacon Cr	1						5	2	0	0	0	2	1	3	1	2	1	
500	Beaon CT	1						5	2	0	0	0	2	1	2	1	2	1	N/A
1500	Beckenham Dr	1						5	2	0	0	0	2	1	1	1	2	1	
1500	Beckenham Dr	2		2				2	2	0	0	0	2	1	1	5	2	1	Have had the street flood, extending slightly into the area between the front sidewalk and the street. Has occurred twice in 20 years. Not a problem.
1500	Beckenham Dr	1						0	2	0	0	0	2	1	1	3	2	1	
100	Beecher St	1				4		0	2	3	3	3	2	2	0	0	0	0	Q3: Seepage not flooding. Q4: As long as the rainstorm lasts. Q17: you could have sent a return envelope!
1100	Beechwood Ave	5	1					2	2	0	0	0	2	2	0	0	0	0	
100 N	Bellemont Rd	1						5	2	0	0	0	2	2	0	0	0	1	
100 S	Bellemont Rd	1						5	2	3	3	3	2	2	0	0	0	1	
100 S	Bellemont Rd	3				4	5	4	0	0	0	0	2	1	1	5	2	2	I have lived in my house for 1 year and have had 3 small backups. Normally it is the floor drain that backs up. I have had Rewesewer Co. check my line and everything looks ok.
100 S	Bellemont Rd.	2				4		5	2	0	0	0	2	2	0	0	0	1	Flooding has occurred once in 17 years and was due to a gutter malfunction
200	Benjamin Lane	4		2				1	2	2	3	3	2	1	2	1	2	1	
2000	Benjamin Lane	1						5	2	3	3	3	2	2	0	0	0	1	
2000	Benjamin Lane	1						0	2	0	0	0	2	0	0	0	0	1	
2100	Benjamin Lane	4		2				2	2	3	3	3	2	1	1	3	2	1	There are 3 sewers at Benjamin & Reinthaler with water running to the south from Reinthaler to Benjamin. People put leaves, sticks, grass and debris in the street, which then is moved by the water, clogging the 3 sewers causing the flooding. I'm the only one in the neighborhood who keeps those sewers clean to help eliminate so much flooding. I think they should pay a fine for doing what they do to cause the flooding. It doesn't last long but might not happen if they would be more considerate.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2200	Berry Ln	1						5	2	0	0	0	2	1	4	4	2	1	
1900	Berrywood Ln	1						5	2	0	0	0	2	1	1	4	2	1	
2000	Berrywood Ln	3	1			4		3	2	0	0	0	2	1	1	1	1	1	
2100	Berrywood Ln	1						5	2	0	0	0	2	2	0	0	0	1	
2100	Berrywood Ln	1						5	2	0	0	0	2	2	0	0	0	1	
1300	Beverly Ln	1						5	2	0	0	0	2	2	0	0	0	1	I have crawl space. I have a drain which runs through the back yard underground.
1300	Beverly Ln	2						3	2	3	0	0	2	1	3	1	2	1	
2200	Biasi Blvd	1						5	2	0	0	0	2	1	2	4	2	1	We've only lived here for 9 months- no problems to report.
2200	Biasis Blvd	1		2				1	2	0	0	0	2	1	1	4	2	1	
2600	Binghamton Lane	1						5	2	0	0	0	3	1	5	4	2	1	
2800	Binghamton Lane	2						0	2	0	0	0	2	1	1	3	2	1	
2800	Binghamton Lane	1						5	2	3	3	3	2	1	3	3	2	1	
900	Birchwood Ave	1						0	2	0	0	0	2	2	0	0	0	1	
900	Birchwood Ave	4	1					3	2	0	0	0	2	1	2	1	2	1	N/A
700 E	Bissell St	2					5	1	2	0	0	0	2	2	0	0	0	1	
700 E	Bissell St	1						5	2	0	0	0	2	2	0	0	0	1	
800 E	Bissell St	2		2				1	2	0	0	0	2	2	0	0	0	1	The only time we had a lot of flooding was years ago when it rained a lot and the street was flooded at Clinton and Bissell. Everyone had flooding at that time.
800 E	Bissell St	3				4		2	2	0	0	0	2	2	0	0	0	1	
400 W	Bissell St	2				4		2	2	2	2	2	1	1	1	1	2	4	Q13: Have two.
500 W	Bissell St	1						5	2	0	0	0	2	2	0	0	0	1	
500 W	Bissell St	1						5	2	2	3	3	2	2	0	0	0	1	
600 W	Bissell St	4					5	4	0	0	0	0	2	1	3	1	2	1	
200	Bittersweet Cr	1						5	2	3	3	3	2	1	3	1	2	1	Q2: Been here since 1986. Q17: Our home is located near the crest of the hill at the intersection of morris Ave and Hamilton Rd (about 100 yards west). The biggest rainfall occurred soon after we moved here in September 1986. There was flooding all over town that night, but not here.
2600	Blarney Stone	1						5	2	0	0	0	2	1	3	3	2	1	Q12 : rarely
2800	Blarney Stone	1						5	2	3	3	3	2	1	1	3	2	1	
100	Bloomington Hts Rd	1						5	2	3	3	3	1	1	2	1	1	2	Bad pump for sewer. Replaced Feb 2012.
1000	Blue Heron Way	1						5	2	2	2	2	0	2	5	4	2	1	I never have flood problem. We do not have any basement. So I am not sure where is our sump pump.
0	Blue Lake Court	2						5	2	0	0	0	2	1	2	3	2	1	We have only had water problems in the winter during rain/ice storms when the power goes out. Water comes in from the sump hole. We have had no problems since we installed a water powered backup sump pump.
0	Blue Lake Court	4	1	2				4	2	0	0	0	3	1	1	4	2	1	
0	Blue Lake Court	2				4		4	2	0	0	0	2	1	1	3	2	1	The only flooding we have experienced occurred during the December 1, 2006, ice storm that caused a power outage and prevented our sump pump from operating. We now have a back up sump pump.
0	Blue Lake Court	4	1					3	2	0	0	0	0	1	1	5	2	1	only flooding in basement when sump pump went out-new on put in!
3900	Bluebell Dr	1						5	1	2	2	2	2	1	3	5	2	1	
0	Boardwalk Cr	1						5	2	3	3	3	2	1	1	1	2	1	Q14: hose has frozen up but I fixed the problem before my basement flooded.
0	Boardwalk Cr	4	1					4	2	0	0	0	2	1	1	1	1	1	Surface water accumulates in both my back yard and my neighbors during wet periods or after heavy rains. Depending on soil moisture and frequency of rain, water will remain 1 day to weeks. Source of water is roof and sump pump drainage from homes in the area.
0	Boardwalk Cr	1						5	2	0	0	0	2	1	1	1	2	1	
0	Boardwalk Cr	1						5	2	0	0	0	3	1	2	1	2	1	
0	Boardwalk Cr	5	1					4	2	0	0	0	2	1	2	4	2	2	Flooding problem has gotten progressively worse over the last several years. Whenever it rains in excess of about an inch, that back yard of the property fills with water. Our lot is the lowest on the block, so everything ends up draining into our yard. Standing water has reached 3-4 inches deep during periods of heavy rain and remains for days making the bakyard unusable until it completely dries out. Often overflows into neighboring yards.
0	Boardwalk Ct	4	1					2	2	0	0	0	3	1	2	1	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1100	Bobolink Way	4						4	2	2	1	2	2	2	0	0	0	0	
2200	Brace Bridle	1						5	2	0	0	0	2	1	3	3	2	1	
2200	Bracebridge Road	1						5	2	0	0	0	2	1	4	3	2	1	
2200	Bracebridge Road	1						5	2	0	0	0	3	1	2	3	2	1	
700	Brad St	1						5	2	0	0	0	2	2	0	0	0	1	We don't have any flooding problems
700	Brad St	1						5	2	3	3	3	2	2	0	0	0	1	
700	Bradley Dr	4	1		3			4	1	2	0	0	3	1	3	1	2	3	Q7: unknown
700	Bradley Dr	3	1					4	2	2	2	2	2	1	0	4	2	1	Q1: Neighbor 705 Bradley Dr floods a lot worse. Neet to cut deeper and reslope ditch that is on east side of bradley dr lots to city big main ditch 1/2 block south Q2: run off from parking lots from Inlanta mortgage and country living apartments. Q5: It is half block south. Q12: seldom Q17: back yard standing water only.
0	Breckenwood Ct	1						5	2	0	0	0	2	1	5	4	2	1	Only lived here since Sept 2012
0	Breckenwood Ct	1						5	2	0	0	0	2	1	2	1	2	1	No flooding problems have been experienced at our property since we've owned it.
0	Breckenwood Ct.	4	1					4	2	0	0	0	3	1	1	3	2	1	During heavy or prolonged rains a puddle forms in our back yard near our propery line. Usually 30-40 feet long, 8-16 feet wide, and 6 10 inches deep. It usually subsides in a few hours, and has never caused any damage that we're aware of.
2900	Breezewood Blvd	1	1	2				2	2	3	3	3	2	1	3	1	2	1	Q3: With very hard rains but has not impaired my access to /from my home and has caused no damage and resolves quickly
2900	Breezewood Blvd	1						5	2	0	0	0	3	1	5	4	2	1	
3200	Brennan Ln	4				4		4	0	2	0	0	3	1	2	1	2	1	Neighbor changed grade and added pump to outside after that occurance we have flooded twice.
0	Briarwood Ave	1						5	2	0	0	0	2	2	0	0	0	1	
0	Briarwood Ave	1						5	2	3	3	3	2	2	0	0	0	1	
0	Briarwood Ave.	4					5	4	2	0	0	0	2	2	0	0	0	5	During hard/long rains, water comes up through our basement floor drains. I've installed some plugs to minimize the flow, but it still floods the basement floors. Flooding just re-occurred last night, March 31.
2700	Brighton Ln	1						5	1	2	2	2	1	1	1	1	2	1	I would like the drainage right in front of my house cleaned out. It's filled with dirt, leaves, etc. inside the drain.
2800	Brighton Ln	2					5	3	2	3	3	3	3	0	1	5	2	1	Sump pump failed in December 2007 and December 2008 during heavy rains. Neither occurrence was due to a power outage. I now have a batter-powered backup sump pump so this should not happen again.
3300	Brittany Cr	1						5	2	0	0	0	2	1	3	3	2	1	
3300	Brittany Cr	1						5	2	3	3	3	2	1	1	3	2	1	
1200	Broad Creek	1						5	2	0	0	0	2	1	1	3	2	1	
1200	Broad Creek	1						5	2	0	0	0	2	1	1	3	2	1	
1200	Broad Creek	1						5	2	0	0	0	2	1	1	4	2	1	There is a creek behind my house that was created in order to develop farm land into a subdivision. The water rises when it rains heavy and fast and I can see it inching it's way onto the grass. However, it has never come up anywhere near the house so I don't think it's a problem for us. I do know my neighbors have it worse as their property doesn't have the same grading.
1200	Broad Creek	1				4		3	0	0	0	0	3	1	1	4	2	1	Q2: have only lived here 4 years.
1300	Broad Creek	4			3			4	1	1	1	2	2	1	1	4	2	1	the easement behind us - about 40 feet across - is completely covered if we get 2"-3" of rain in a short period. The drainage ditch is filling with silt and reeds until part of it flows onto easement with just a little rain.
1300	Broad Creek	1						5	2	0	0	0	2	1	2	3	2	1	
1300	Broad Creek	4	1		3			3	1	1	3	3	3	1	1	3	2	1	Have not experienced any sewer problems, only high water levels when runoff ditches in back yard are overflowing to the adjacent ponds.
1400	Broad Creek	2	1			4		2	2	2	3	3	2	1	1	4	2	1	
600	Broadmoor Dr	2	1			4	5	2	2	0	0	0	2	1	1	3	2	1	Since the new additional line for sumps we have no problems.
600	Broadmoor Dr	2				4		4	1	2	2	2	3	1	2	3	2	1	Flooding occurs only if sump pump float sticks due to loose debris in pit, or if pump otherwise fails. I plan to get a battery-powered backup sump pump in the near future.
700	Broadmoor Dr	2						5	2	0	0	0	2	1	1	3	2	1	
900	Broadmoor Dr	1						5	1	2	2	2	2	1	2	1	2	1	
1000	Broadmoor Dr	2	1	2				3	2	0	0	0	2	1	1	3	2	1	
1200	Broadmoor Dr	1						5	1	2	1	2	2	1	1	1	2	1	Q7: West side.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
600	Broadmoor Dr.	1						5	1	1	1	2	2	1	2	3	2	1	
0	Brompton Ct	4	1		3			4	1	1	1	2	2	1	1	1	1	1	Mainly during heavy, hard rains or prolonged, multiple days of rain when ground is fairly saturated, the creek between the Brookeridge Subd and the Brookeridge II Subd overflows it's bank and water floods anywhere from 5-30 yards beyond the creek's banks. The water does eventually receed back into the creek depending upon the volume of rain. Some water will still remain for at least a few days even after the creek gets back to normal levels in various low parts of my yard.
0	Brompton Ct	1						5	2	3	3	3	2	1	2	1	2	1	No problem with discharge onto ground. Have tried in past to locate sump pump drain line to hook-up but have been unable to locate.
0	Brompton Ct	1						5	2	3	3	3	2	1	1	2	2	1	
0	Brookline Ct	1						5	2	0	0	2	2	1	1	4	2	1	
0	Brookline Ct	5	1		3			4	1	2	1	2	2	1	2	1	1	1	Brookline Ct dumps H2O onto our property causing problems! Engineers did not forsee erosion problems after builders complete builds in neighborhood!
3900	Brookline Ln	1						5	2	0	0	0	2	1	2	4	2	1	
0	Brookridge Ct	1						5	1	2	2	3	1	1	5	4	2	1	No problems that I am aware of. Again, we have lived in the house less than one year.
0	Brookridge Ct	1						5	2	3	3	3	2	1	3	1	2	1	
0	Brookshire Green	1						5	2	2	3	3	3	1	1	1	2	1	
0	Brookshire Green	2				4		5	2	0	0	0	2	1	1	1	2	1	
0	Brookshire Green	1						0	2	0	0	0	2	1	1	3	2	1	
0	Brookshire Green	1						5	2	0	0	0	2	1	1	4	2	1	Q10: two sump pumps. Q11: X2. One elective. One under pressure non elective. Q12: X2 - every few minutes. Q17: Both sump pumps run every few minutes. Sump pumps upgraded ~ eight years ago due to water leakage from side walls in basement.
0	Brookshire Green	2	1					2	2	0	0	0	2	1	1	1	2	1	
0	Brookshire Green	2						5	2	0	0	0	2	1	2	1	2	1	
0	Brookshire Green	1						5	2	0	0	0	2	1	3	1	2	1	
100	Brookshire Green	2	1			4		2	2	2	3	3	2	1	1	5	2	1	
100	Brookshire Green	2				4		5	2	0	0	0	3	1	1	1	2	1	sump pump backed up sometime prior to us buying the house
0 B	Brookshire Green	1						5	0	3	3	3	0	1	2	1	2	1	
0	Brownstone Ct	1						5	2	0	0	0	2	1	3	4	2	1	
2700	Brunswick Dr	1						5	2	3	3	3	3	1	3	1	2	1	
0	Brunton Ct	1						5	2	0	0	0	2	1	1	1	2	1	
0	Brunton Ct	1						5	2	0	0	0	2	1	1	3	2	1	
0	Brunton Ct	2				4		1	2	2	0	0	2	1	2	3	1	1	
2700	Bruswick Drive	3		2				3	1	2	2	3	2	2	0	0	0	2	We had sewer backup downstairs on one occasion and it was due to a plumbing problem.
800 E	Buchanan	1						5	0	0	0	0	2	2	0	0	0	0	
0	Buchhurst Circle	2			3			4	1	1	1	2	2	1	1	1	2	1	
0	Buckhurst Circle	1						5	2	0	0	0	3	1	1	4	2	1	
0	buckhurst circle	1						5	2	0	0	0	2	1	2	1	2	1	n/a
0	Buckhurst Court	1						5	2	0	0	0	2	1	3	4	2	1	
0	Buckhurst Ct	3				4		5	2	3	3	3	2	1	2	4	1	0	Current problem - see your records with Russel Waller, Engineering Dept. They have been working over a month in attempt to define problem.
0	Buckingham Ct	1						5	2	0	0	0	2	1	2	3	2	1	
1400	Bunn St	2				4		3	2	0	0	0	2	2	0	0	0	1	Our flooding problems were essentially solved when the retention basen was built behind the former rail road tracks.
1500	Bunn St	1						5	1	2	2	3	2	1	2	1	2	1	No problem
1500	Bunn St	0					5	4	2	0	0	0	2	1	1	1	2	1	Q2: only lived here 6 months and it flooded once. Q17:since I've lived here once and we had over 2 inches of rain that day.
900 S	Bunn St	1						5	2	0	0	0	2	1	5	4	2	1	
1500 S	Bunn St	4	1		3			4	1	2	2	2	2	1	2	1	2	1	Backyard pools water next to drainage ditch because drainage ditch doesn't keep maintained of grass and clear path for water to flow. During heavy rain front sewer drain can not handle flow and water will flood into front yard very badly.
1500 S	Bunn St.	1						5	1	3	3	3	2	2	0	0	0	1	
1200	Butchens Ln	1						5	2	3	3	3	2	1	3	1	2	1	never have issue. On top of hill.
1400	Butchers Ln	1						5	2	0	0	0	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1400	Butchers Ln	4				4	5	4	1	2	2	2	2	1	1	1	2	1	the basement floods because the backyard slopes toward the house causing water to enter through south basement windows. This is also helped because the roof gutters leak. Landlords…can't help but pity the mentally defective.
1200	Butler Ave	1						5	1	2	3	0	0	1	1	0	0	1	
1200	Butler Ave	1						5	2	0	0	0	1	1	0	0	0	0	
100	Buttercup Way	4	1					3	2	0	0	0	2	1	1	3	2	1	Ever since the completion of Hamilton Rd extension the land south of our property now all runs off to the area of our east lot (the old Nor House pasture) line so much it has changed ground grade. There is a now working storm drain in the back of the yard to the east but water does not flow that way anymore.
1200	Cadwell Drive	3	1			4		3	2	0	0	0	2	1	1	1	2	1	
1200	Cadwell Drive	1						5	2	0	0	0	2	1	1	1	2	1	
1200	Cadwell Drive	2	1	2				3	2	0	0	0	2	1	1	1	2	1	During hard rains, there will be standing water in the backyard and there will be standing water at the intersection of Cadwell and Arrowhead
1300	Cadwell Drive	4		2			5	2	2	3	3	3	2	1	1	4	2	1	I've lived here for 25 years. My sump pump runs all the time. I live in a duplex & the neighbor's next door runs all the time too. The street floods if a heavy rain. I've gone through many sump pumps - 3 in 5 months because they run so much. We have checked the drainage tile around the entire duplex but couldn't find any broken tiles.
1200	Caldwell Drive	2	1					3	2	0	0	0	2	1	1	1	2	1	
1600 N	Calhoun St	0						0	0	0	0	0	0	0	0	0	0	0	Private sewer along back of house to creek joins city sewer north of the end of street.
100	Camelot Dr	1						5	2	0	0	0	2	1	3	1	2	1	
100	Camelot Dr	4				4		0	2	0	0	0	3	1	1	1	2	1	I cringe whenever we are due to get a storm out of the West. I've had a claim rep till me my area is known for these problems. Q14 not anymore - I used to have a lake in my backyard. My handyman put an extension on the sump pump hose so it empties in the front yard now.
100	Camelot Dr	1						5	2	2	3	3	2	1	5	1	2	1	
0	Cameron Ct	1						5	2	0	0	0	2	1	2	3	2	1	
0	Canterbury Ct	1						0	1	3	3	3	0	0	0	0	0	1	
0	Canterbury Ct	1						5	2	0	0	0	3	1	1	1	2	1	
0	Canterbury Ct	2					5	2	2	3	3	3	3	1	1	3	2	3	I have slides with the year, but those slides are being put on a DVD and will not be available for several weeks, contact me if these would be helpful. Q2A2 has not occurred since a valve was replaced on Northcrest - in George Gildner's backyard.
0	Canterbury Ct	4		2			5	3	2	0	0	0	2	1	1	1	2	2	
0	Canterbury Ct	0					5	0	2	3	3	3	2	1	1	1	2	5	I have experienced backup for 28 years. The change which drains the main line on Country Club into the BCC lake seems to have cured the problem. The bridge at Kohls redriecting storm water into the sewage line caused sewage backup for years! Q2 Last correction in Country Club sewer seems to be working.
2800	Capen Dr	1						5	2	0	0	0	2	1	2	3	2	1	
2800	Capen Dr	3	1					4	2	0	0	0	2	1	1	3	2	1	In winter & early spring when the ground is still frozen sump pump run off from my neighbors collects at the back of our yard rather extensively. We have a number of photos showing the flooding.
2800	Capen Dr	1	1			4	5	4	2	3	3	3	2	1	2	1	2	1	
2900	Capen Dr	1						5	2	0	0	0	2	1	1	4	2	1	
2900	Capen Dr	1						5	2	0	0	0	2	1	2	1	2	1	
300	Carl Dr	1						0	2	0	0	0	2	1	3	3	2	1	
2900	Carlene Dr	1						5	2	0	0	0	3	1	1	1	1	1	Wet weather - sump pump pumps every few minutes. Lived at this address less than 3 years. Replaced original pump and a replacement.
3000	Carlene Dr	2	1					2	2	0	0	0	2	1	1	1	1	1	
3000	Carlene Dr	2	1					3	2	0	0	0	2	1	2	1	2	1	
3400	Carnelius Dr	1						5	2	3	0	0	1	1	2	3	2	1	
0	Carney Ct	5	1					4	1	1	3	3	3	3	5	4	0	1	pictures of backyard
17500	Carver Rd	1						5	2	2	3	3	2	1	2	1	2	1	
2100	Case Dr	2				4	5	2	2	0	0	0	2	1	1	4	2	1	
2100	Case Dr	1						5	2	0	0	0	2	1	2	3	2	1	
2200	Case Dr	4	1					2	0	0	0	0	2	1	1	3	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2200	Case Dr	4	1					4	1	2	2	2	1	1	5	4	2	1	Q3: in back corners of lot Q7: maybe - depends on how you define it Q9: I think so Q17: two corners in back yard have standing water regularly that does not drain well into the open drainage hole
0	Cashel Dr	1						5	2	0	0	0	1	1	5	4	2	1	
0	Cashel Dr	4	1					3	1	2	1	2	3	1	5	3	2	1	I have reported this numerous times. The drainage is underground along the property line. The ground along the property lien is dropping or sagging. My hard is no longer level. It is heavily sloped now. Water is constantly flowing through the colvert and into the lake/pond behind property.
1300	Cashel Dr	1						5	2	3	3	3	2	1	1	1	2	1	
2000	Castle Ave	3	1					3	0	0	0	0	2	2	0	0	0	1	Flooding occurs when an excesive amount of rain falls quickly. Old Farm tiles are broken, I think. I have put in french drains to carry water to side yard. A sump pump the city installed 15 years ago will carry water to street. Pump is actually in neighbors yard. An interesting drainage problem but doesn't affect my house now.
3300	Castlemain Dr	1						5	2	0	0	0	2	1	1	3	2	1	
3400	Castlemain Dr	1						5	2	0	0	0	2	1	1	3	2	1	
3500	Castlemain Dr	1						5	2	0	0	0	2	1	2	4	2	2	Occurred during the Fall of 2009 approximately
3500	Castlemain Dr	5	1				5	4	2	0	0	0	2	1	1	3	2	1	Our foundation sump pump runs very frequently, even in dry weather it will run every hour or so. During rain, the pump runs as frequently as every 5 seconds. Also in the rain, standing water build up in the back yard. It seem that ground water drainage in the area is poor. I have had several close calls with basement flooding and one full flood when the sump pump failed during a rainy day. I have had to get a larger capacity sump pump, and a backup generator to help prevent further floods. before these improvemnets i had several instances of needing to hand bail and pump the sump pit to prevent a basement flood. Some of my neighbors have expressed similar problems during. Observation indicates that much of the street is at a slight downward grade until you get to my property where it seems to level out. This is likely contributing to the problem.
3600	Castlemain Dr	2				4		4	2	0	0	3	3	1	5	4	2	1	Flooding happened with previous owners.
0	Cave Creek Court	2					5	2	2	0	0	0	2	1	1	3	2	1	
0	Cave Creek Court	3				4		1	2	0	0	0	3	1	2	4	2	1	
3200	Cave Creek Rd	3	1					3	2	0	0	0	2	1	1	3	2	1	This issue is not that concerning to me.
300	Ccourn Ct	1						0	2	3	3	3	2	1	3	1	2	1	
0	Cedar Ct	4		2				4	0	0	0	0	3	1	3	4	2	1	During heavy rains and thawing of snow, streets get covered in water.
200 N	Center St	1						0	2	2	0	0	2	1	4	4	2	1	
300 N	Center St	1						5	2	3	3	3	2	1	2	1	2	1	
400 N	Center St	1						0	0	0	0	0	0	0	0	0	0	1	
500 N	Center St	2		2				3	2	0	0	0	2	2	0	0	0	1	
300 S	Center St	3				4		3	2	2	0	0	2	1	2	1	2	0	
800 S	Center St	1						0	2	0	0	0	0	2	0	0	0	1	
1100 S	Center St	4		2		4		3	2	0	0	0	2	2	0	0	0	1	
1300 S	Center St	1						0	2	0	0	0	2	2	0	0	0	1	
1400 S	Center St	4	1	2		4	5	4	2	2	3	3	3	1	1	1	2	1	
1500 S	Center St	1						5	2	3	3	3	2	2	0	0	0	1	Q15: since the street improvements of new sewer lines
1600 S	Center St	1						0	2	2	0	0	2	2	0	0	0	1	
1600 S	Center St	5		2				2	0	0	0	0	0	0	0	0	0	0	
1700 S	Center St	5				4		4	2	3	0	0	2	1	1	1	2	2	Q2:in between-I wouldn't call it flooding but its som water in the basement. Q10: we have 2 sump pumps. Q17: We've completed several water mitigation projects including grading the land, waterproofing the wall, tiling and these have helped but we still get water almost every time it rains. It's not much and it's only along on wall.
1300	Challis Ct	4	1					2	2	0	0	0	3	2	0	0	0	1	Water stands in the SE corner of my lot after a HEAVY rain as well as a low spot in the opposite corner of the lots. However, nothing has entered the home in 25 years.
1300	Challis Ct	1						0	2	0	0	0	1	1	2	1	2	1	
1200	Challis Dr	1						5	2	0	0	0	2	1	1	3	2	1	
1200	Challis Dr	2				4		0	2	0	0	0	3	1	2	1	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1200	Challis Dr	2	1					3	2	0	0	0	2	1	1	3	2	1	
1200	Challis Dr	2	1					5	2	0	0	0	2	1	2	1	2	1	
0	Charles Place	4	1	2				2	2	0	0	0	2	2	0	0	0	1	After a significant amount of rain - water backs up across the street and comes into the front yard at the corner - it is there after it stops raining - but not for a terribly long time - it eventually drains away.
0	Charles Place	1						5	1	2	2	3	2	2	0	0	0	1	
0	Charles Place	1						5	2	0	0	0	2	2	0	0	0	0	No basement
1100	Chatham Lane	3	1					4	2	0	0	0	2	1	1	3	2	1	
1100	Chatham Lane	1						5	2	0	0	0	2	1	1	3	2	1	Flooding frequently occurs on EastLawn cemetery property behind our house but does not flow on to our property.
0	Chatsford CT	1						5	2	0	0	0	2	1	3	1	2	1	
0	Chatsford Ct	1						0	2	0	0	0	0	1	3	1	2	1	
0	Chatsford Ct.	4	1					4	2	0	0	0	2	1	1	1	1	1	Flooding tends to occur in our back yard after heavy rain.
0	Chatsford ct.	1						5	2	0	0	0	2	1	1	3	2	1	
400	Chelsea Dr	2				4		4	2	0	0	0	2	1	1	3	2	1	Q2A2 because sump pump keeps it from flooding more often.
500	Chelsea Dr	5	1					4	2	0	0	0	2	1	1	1	1	1	I have 2 areas in my backyard that holds water and takes days after a heavy rain to dry up. Even when there is no rain my sump pump runs 5 + times per day.
2800	Cherokee Lane	1						5	2	3	3	3	2	1	3	3	2	1	
24800	Cherokee Lane	1						0	2	0	0	0	2	2	0	0	0	0	
2800	Chesapeake Ln	3		2				2	2	3	3	3	3	1	1	3	2	1	Flooding issue with heavy rain - usually associated with snowfall. Heavy rain normally drains within 15-30 min. If there is snow followed by heavy rain, the rain stands. We have worked to make sure the drains and paths are clear. ___ poured hot water down to melt ice in drains. Water builds up onto our yards, over sidewalks. We have called law enforcement. I didn't have camera.
400	Cheshire Dr	0						0	0	2	2	2	0	0	0	0	0	0	
600	Cheshire Dr	1						5	2	0	0	0	2	1	1	1	2	1	
500 B	Cheshire Dr	1						5	2	0	0	0	2	1	1	1	2	1	
300 E	Chestnut St	1						5	2	0	0	0	2	2	0	0	0	1	
500 E	Chestnut St	1						5	2	0	0	0	2	2	0	0	0	0	
500 E	Chestnut St	2				4		1	2	0	0	0	3	2	0	0	0	1	Flooding ceased after we put plastic tents over the window wells several years ago!
500 E	Chestnut St	5		2				3	2	3	3	3	2	2	0	0	0	1	Every time it rains the one and only sewer drain on our block (Southside of the street), clogs and floods the entire street. Over the past years the flooding has continuously caused erosion on the street surface which has lead to an ongoing need to fill pot holes. Pleas fix the discharge, and resurface our street. Thanks.
600 E	Chestnut St	5		2			5	2	2	3	3	3	2	2	0	0	0	1	On Chestnut from Clinton Blvd east to Constitution Trail the sewer is both water and sewer and is ony a 12" sewer. Q2A5 heavy downpour, like 2 inches in 1 hr
600 E	Chestnut St	4				4	5	4	2	0	0	0	2	2	0	0	0	2	I get flooding during a hard rain. Most often it leaks through cracks in the walls and floors. A long, hard rain produces 1-4" from the floor drains. This is usually rain water. I have combination storm and sewer drains.
800 E	Chestnut St	1						5	2	0	0	0	2	2	0	0	0	1	
800 E	Chestnut St	4		2			5	1	2	0	0	0	2	2	0	0	0	4	In front of my house the street is the bottom of a saucer. When we get a very heavy rain the combination sewer isn't large enough to handle all the water. Then it backs up onto the lawns and backs up into my basement via floor drain.
900 E	Chestnut St	1						5	2	0	0	0	2	2	0	0	0	1	
400 W	Chestnut St	1						5	2	3	3	2	2	1	0	1	2	1	
1200 W	Chestnut St	1						5	2	0	0	0	2	2	0	0	0	1	
1200 W	Chestnut St	4		2			5	2	2	3	3	3	2	2	0	0	0	4	Sewer does not seem to take all the water when we have big rains or long rains.
1300 W	Chestnut St	2					5	2	0	0	0	0	2	2	0	0	0	2	
1300 W	Chestnut St	4					5	0	2	0	0	0	2	0	0	0	0	5	Several neighbors have backup problems too. When ours backsup we have 3-4 inches of sewage or more. Its sickening. We never thought to take pictures. We paid a lot of money twice to have our front yard dug up. It's a shame the city can't take care of this.
1400 W	Chestnut St	1						0	0	0	0	0	2	2	0	0	0	0	
1500 W	Chestnut St	1						0	2	0	0	0	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
600 E	Chestnut St.	1						5	2	0	0	0	2	2	0	0	0	1	
0	Cheviot Court	3	1			4		4	2	0	0	0	3	1	1	3	1	1	We had water in our basement from our sump pump failing several winters ago. The pump failed since the ground was frozen where the pump drained, and we received an unusual amount of rain in December. The pump failed; burning out I suspect; with no where for the water to go, since the drainage was frozen. We get standing water in our back yard with heavy rains. It seems like this water heads to our neighbors house towards Clearwater park retention basin. This is by way of gravity/slope I assume.
1000	Chicory Lane	2		2				2	2	0	0	0	2	1	2	1	2	1	In extremely hard rain the rain sewer backed up into the street at its lowest point. The water rose about three feet from the lowest point in the street. It lasted for an hour or so. This has happened twice in the 14 years we have lived here.
1000	Chicory Lane	2	1	2				3	2	0	0	0	2	1	1	1	0	1	never have problem in house, we have river between our house and house to east in heavy rains(100 year rain). Q4 center drain in street & storm drain on north and south side of street do handle standing water and catch up fairly quickly once downpour stops. Q14 the neighbors to the west have their drain line running onto sidewalk and our driveway, it can cause ice buildup in extreme cold weather.
1000	Chicory lane	1						5	2	0	0	0	2	1	2	1	1	1	
1000	Chicory Lane	5	1					4	2	0	0	0	3	1	1	1	1	1	The houses behind us build up their property so high we get all their run off in our yard. We have standing water, great erosion and cannot mow because it is so wet. Interns from the city surveyed several years ago. Runoff gets so bad it floods the sidewalks. Sometimes we don't use our backyard for months. We have algae and slime growing on our sidewalk from all the runoff.
1000	Chicory Lane	1						5	2	0	0	0	2	1	1	1	1	1	N/A
0	Chiswick Circle	1						5	2	0	0	0	2	1	1	1	2	1	
0	Chiswick Circle	1						5	2	0	0	0	2	1	2	1	2	1	
0	Chiswick Circle	1						5	2	0	0	0	2	1	1	1	2	1	
0	Chiswick Circle	1						5	2	3	3	3	2	1	1	1	2	1	
0	Chiswick Circle	3				4		4	2	0	0	0	2	1	1	1	2	0	
100	Christian Louis Court	1						5	2	3	3	3	2	1	5	4	2	1	
100	Christian Louis Court	1						5	2	0	0	0	2	1	2	3	2	1	Have never had any problems. I have moved and have the home up for sale.
0	Christian Louis Ct	1						5	2	3	3	3	1	1	3	3	2	1	
100	Christian Louis Ct	1						0	2	0	0	0	3	1	4	3	2	1	
2100	Citadel Dr	1						5	2	0	0	0	2	2	0	0	0	1	
2200	Citadel Dr	1						5	0	0	0	1	3	3	5	4	0	1	
3300	Clairbridge Dr	2				4		4	2	0	0	0	2	1	1	3	2	1	If my primarily electric sump pump is not working, I always get basement flooding during wet weather. I have a back-up water-driven sump pump to try to avoid basement flooding if I don't notice that my primary sump is out of service.
3300	Clairbridge Dr	1						5	2	0	0	0	3	1	1	4	2	1	
400 N	Clayton St	1						5	0	3	3	3	2	1	4	1	2	1	
200 S	Clayton St	4				4		4	1	2	0	2	2	2	0	0	0	1	Q2: between these 2 Q5: I think so. Q7: ? Q17: We're talking no more than an inch and NOT throughout the entire basement. After I identified a crack in the basement floor and filled it with concrete, the problem is much less frequent and the amount of wter is smaller. However, it does seem to come up through the brick floor in the northwest corner of my basement as the bricks are porus. I believe the problem is due to lack of drainange in the alley to the north of my house, as I NEVER see water on the south side of my basement.
500 S	Clayton St	2					5	4	2	0	0	0	2	1	2	1	2	2	Two years ago water was coming up through my basement floor. I had a company come and clean my sewer of roots. They replaced some pipe outside and put in a clean out in the sewer line. My house is approximately 160 years old and has no floor drain in the basement and my newer furnace drains into a sump hole and is discharged from the house. I have had no other water problems in my basement since the clean out was put in.
500 S	Clayton St	3				4		3	2	2	2	0	2	1	2	1	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
500 S	Clayton St	4				4		2	0	0	0	0	2	0	0	0	0	1	Water comes in thru windows in basement with excessive rain.
700 S	Clayton St	1						5	2	0	0	0	2	2	0	0	0	1	
700 S	Clayton St	1						0	0	0	0	0	2	1	3	1	2	1	
700 S	Clayton St	2	1		3			0	2	3	3	3	2	2	0	0	0	2	Q3: neighbor's sump pump soaks my yard.
700 S	Clayton St	4	1	2		4	5	4	2	0	0	0	1	1	3	1	1	5	July 2004?? When we received that 100 yr flood rain, we has 16" of backup in our basement. It took a good 24 hours for all the water to drain out. In 2005?? We installed an ejector pump. Q3A5 yes - until we installed ejector pump. Q4A3 depends on the amount of rain and how quickly it comes down. 1" of rain in 20 min vs 1" rec'd in a 24 hr peroid. Q15A5 before installation of ejector pump.
1100 S	Clayton St	2				4		1	2	3	3	3	2	1	1	4	2	2	
1100 S	Clayton St	1						0	2	0	0	0	2	2	0	0	0	0	Don't have basement
1700	Clearwater Ave	1						5	2	0	0	0	2	2	0	0	0	1	
1700	Clearwater Ave	1						5	2	0	0	0	3	3	0	0	0	0	no basement
2200	Clearwater Ave	4	1	2		4		4	2	0	0	0	1	0	1	1	1	0	Water comes off hill from Stevenson School nothing to catch water like retention basin or storm sewer.
2300	Clearwater Ave	1						5	2	0	0	0	3	0	5	1	2	1	
2400	Clearwater Ave	1						0	0	0	0	0	3	1	2	1	2	1	
2500	Clearwater Ave	1						5	0	0	0	0	3	1	5	4	0	1	
2600	Clearwater Ave	0						0	1	2	2	2	2	1	1	4	2	1	
2700	Clearwater Ave	1						5	2	0	0	0	3	1	1	4	2	1	
2800	Clearwater Ave	1						5	2	3	3	3	2	1	1	5	2	1	
500 N	Clinton Blvd	3		2		4		3	2	0	0	0	2	2	0	0	0	1	
1000 N	Clinton Blvd	5	1					4	2	0	0	0	3	3	0	0	0	1	Q4: for days! Q17: I rent from AB Rentals. The bsement floods in one area every rain. If it storms, water will be present for days until it drys naturally. Q18: Contact AB Rentals.
1200 N	Clinton Blvd	1						0	0	2	0	0	2	2	0	0	0	0	
1400 N	Clinton Blvd	4				4	5	1	2	0	0	0	2	2	0	0	0	3	Anytime roots grow up in the lines, starts backing up slightly, usually can use plunger to clear for a short while, eventually need to have line ran through to clear. Happens maybe 3 - 4 time per year, try to keep an eye on it so that it does not flood whole basement.
1400 N	Clinton Blvd	2				4		4	2	3	3	3	3	2	0	0	0	1	The only problem we had was when we had what people were cally a forty-year rain. It was not exactly flooding, but rather seepage from some fo the basement walls. It occurred some years ago.
1400 N	Clinton Blvd	1		2				4	2	2	3	3	2	2	0	0	0	1	
1500 N	Clinton Blvd	1						5	2	0	0	0	2	2	0	0	0	1	
1500 N	Clinton Blvd	2						3	2	2	2	2	2	2	0	0	0	0	No flooding since creek was paved in 1989.
1500 N	Clinton Blvd	2				4		2	1	2	2	2	2	2	0	0	0	1	Not really enough to talk about. Once in a while the floor of the basement gets wet from apparent seepage along the base of the foundation during very heavy rains. Wet basement walls, very seldom anything else.
1500 N	Clinton Blvd	4		2				4	2	0	0	0	2	2	0	0	0	1	
900 S	Clinton Blvd	3		2				1	2	0	0	0	3	1	1	5	2	1	We are the lowest corner in the neighborhood. We used to get standing water in the street corner all the time during every rain. I called and the city cleared the blockage and now we just have water that drains too slowly occasionally. The street in front of our house is full of pot holes, due to small standing water puddles.
1100 S	Clinton Blvd	5		2	3	4		3	2	0	0	0	2	1	1	1	2	1	When it rains hard and a lot it backs up into the basement. The stormdrain is constantly clogged and it is lower than the street, and it constantly is flooding.
1100 S	Clinton Blvd	1						5	2	0	0	0	2	1	1	1	1	1	Q12: if our home had several inches of rain Q14: ice buildup. Yes - only if its freezing outside
1400	Cloud St	0						0	0	0	0	0	0	0	0	0	0	2	Q15 The only time our basement floods is when someone on our private sewer line has blockage.
1800	Cloud St	4		2		4		2	2	0	0	0	2	1	1	1	2	2	
1900 E	Cloud St.	2					5	5	2	0	0	0	2	1	3	1	2	1	
300	Clover Court	1						5	2	0	0	0	2	1	1	1	1	1	In times of prolonged, heavy rain the back yard will have standing water in it. The property is located in a subdivision on a slight hill & homes uphill from me all discharge their sumps in their backyard. There can be a small "river" of water because of this.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
300	Clover Court	3					5	2	2	0	0	0	3	1	1	1	2	1	During times of heavy rain the sump pump runs often and discharges water onto the property. I have added a long hose to move water away from the house. As long as my sump pump doesn't fail, everything seems to be fine.
300	Clover Court	1						5	2	0	0	0	2	1	2	1	2	1	No flooding or sewer backup.
0	Cobblestone Ct	1						5	2	0	0	0	2	2	0	0	0	1	
1200	Colonial ave	1						5	2	0	0	0	3	1	2	4	2	2	
0	Colonial Plaza	1	1					5	0	0	0	0	0	0	0	0	0	0	Business in a shopping mall
500	Colton Ave	1						5	1	3	0	2	2	1	5	4	0	1	Q2: Only lived here since September 2011
1100	Colton Ave	1						0	1	2	2	2	2	2	0	0	0	1	Why am I being charged $4.35 for storm water charge? Q4: My far back yard sometimes get boggy in the spring. No problem. Q9: No basement. Q15: When I do laundry my washer drain is sluggish. Sewer goes out to the street which is on high ground.
1100	Colton Ave	1						5	1	2	2	2	2	2	0	0	0	1	No basement
1200	Colton Ave	1						0	2	0	0	0	2	2	0	0	0	1	
400 N	Colton Ave	2				4		3	2	0	0	0	2	2	0	0	0	1	Owned house since 1980. Building is quite a few feet above the street. Our problem is directing surface water away from the house, seepage from around the foundation is our problem.
1100 N	Colton Ave	1						5	2	0	0	0	2	2	0	0	0	1	
1100 N	Colton Ave	1						5	2	3	3	3	2	2	0	0	0	0	Q15: no basement
1200 N	Colton Ave	2				4		2	2	3	3	3	2	2	0	0	0	1	
1600	Commerce Pkwy	4		2	3			4	1	3	2	2	2	2	0	0	0	0	
100	Conley Cir	1						5	2	0	0	0	3	3	0	0	0	1	No flooding
100	Conley Circle	4					5	4	2	0	0	0	0	0	3	1	2	4	The main line to the street has been cleaned out. We notice when the City truck/workers do a clean out in the street there doesn't seem to be a problem, but if they just do a drive by or a stop and look down the hole the water will back up. We think if it was just cleaned out more often there would not be a problem.
100	Conley Cr	1						0	2	0	0	0	2	2	0	0	0	1	No Basement. No problems.
3500	Connie Kay Wy	1						5	2	0	0	0	2	1	1	1	2	1	
3700	Connie Kay Wy	1						5	2	0	0	0	3	1	3	4	2	1	
0	Continental Ct	1						5	2	0	0	0	2	2	0	0	0	1	We did have sewage backup on lower level due to tree roots clogging the sewer line going to street but not related to wet weather.
0	Conway Circle	3	1					3	2	0	0	0	2	1	3	3	2	1	The grade line for drainage between houses downstream of our house is too high due to too much fill when homes built. This causes surface drainage to back up onto our property at the northwest corner of our lot during higher-intensity storms. Water depth is approximately 4-6 inches and covers 500-750 square feet once a year or so.
3100	Copper Creek Rd	1						5	2	3	3	3	2	1	3	3	2	1	
3100	Copper Creek Rd	3	1					1	2	0	0	0	2	1	3	4	2	1	Low area in NE corner of lot floods when it rains heavily.
3100	Copper Creek Rd.	1						5	1	2	2	3	3	1	5	4	2	1	N/A
1600	Cottage Ave	1						5	2	0	0	0	3	3	0	0	0	1	Never had any issues.
1400 N	Cottage Ave	1						5	2	0	0	0	2	2	0	0	0	1	
0	Cottonwood	1						5	2	0	0	0	2	2	0	0	0	1	We don't have issues at our address, but notice nearby flooding at the intersection of Bunn and Lafayette (drainage ditch there too). Also drainage from house west of Nordines on Lafayette causes ice build up near intersection during cold wet conditions. Main and Lafayette intersection is better after road work, but drainage from Growing Gounds can still cause icy conditions at intersection.
0	Country Club Pl	2				4		2	0	0	0	0	2	0	0	0	0	1	
0	Country Club Pl	1						5	2	3	3	3	2	2	0	0	0	0	
0	Country Club Pl	0						0	2	0	0	0	1	1	3	1	2	4	Had problem with sewer back up for man years, put in backflow valve on outside pit in sewer line. Also put in ejector pum and put with a backflow elevated above sewer line level.
0	Country Club Pl	3				4	5	3	2	2	3	3	2	1	2	1	2	3	Only time flooding occurred when we had 100 year rain 5 years ago.
0	Country Club Pl	1						5	2	2	1	1	2	1	1	1	2	1	Q8: driveway Q11: 2 of them
100	Country Club Pl	4	1	2	3			4	1	2	2	2	1	1	1	1	1	1	Sump pump runs continuously because of water on my lot.
100	Country Club Pl	1						5	2	0	0	0	2	2	0	0	0	1	
700	Country Ln	1						5	2	0	0	0	2	1	3	1	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Cove Pointe Ct	2						2	2	0	0	0	2	1	1	5	2	1	Don't know if I would consider the water in my basement flooding, but more a sump pump issure when electricity goes out or sump pump fails.
0	Cove Pointe Ct	3	1					2	2	2	3	3	2	1	1	3	2	1	Surface drainage is slow durring heavy rains.
2800	Coventry Court	0						0	0	0	0	0	0	0	0	0	0	0	
2900	Coventry Court	1						0	2	0	0	0	2	1	2	4	2	1	
2900	Coventry Court	1						5	2	0	0	0	2	1	1	4	2	1	
2900	Coventry Ct	2				4		2	2	0	0	0	2	1	1	1	1	1	Rains seem to cause ground water level to rise enough that the sump pump will run every 3-5 minutes during saturating rainy times. This condition can last from 1-4 days depending on rain.
2900	Coventry Ct	1						0	2	0	0	0	0	0	0	0	0	1	
2900	Coventry Ct	1						5	2	0	0	0	2	1	3	1	2	1	
2800	Coventry ct.	1						5	2	0	0	0	2	2	0	0	0	1	
2800	Coventry Dr	4				4		3	2	3	3	3	2	1	5	3	2	1	
3100	Creek Side Rd	1						5	1	2	3	3	3	1	3	4	2	1	Q12: hardly ever
0	Crista Ann Ct	1						5	2	3	3	3	2	2	0	0	0	1	
0	Crista Ann Ct	1						5	2	3	3	3	2	1	4	3	2	1	
0	Crista Ann Ct	2						0	0	0	0	0	2	1	1	3	2	1	Only one time in six years did we have water come into the basement. Hydroponic pressure and no power was the cause. Back-up will solve with problem.
0	Crista Ann Ct	1						5	2	3	3	3	3	1	5	5	2	1	
0	Crista Ann Ct	1						0	2	0	0	0	2	1	5	3	2	1	
0	Crista Ann Ct	1						5	2	0	0	0	2	1	1	3	2	1	
0	Crista Ann Ct	3					5	4	2	0	0	0	1	1	1	3	2	2	Shortly after we moved into our newly built house in this Ireland Grove Development, we had 3-4 sewage backups during wet weather and it came out into our finished basement requiring extensive cleanup and carpet replacement. We contacted the City Sewer Department each time and were compensated by the City's Insurance carrier on 2 occasions. (This took place in the 2006-2008 timeframe). Following these occurences, the City Sewer Department came to our development periodically to ensure the sewer piping outside our home was clear. Susequently, the City sponsored the installation of an ejector pump and we have had no sewer back ups or flooding in our basement since that time (~ 2009 forward).
0	Crista Ann Ct	1						5	2	0	0	0	2	1	2	3	2	1	HAVE NO WATER PROBLEMS.
100	Crista Ann Ct	1						5	2	0	0	0	2	1	2	4	2	1	
100	Crista Ann Ct	1						5	2	0	0	0	2	1	1	4	2	1	
100	Crista Ann Ct	1						5	2	2	2	2	3	1	2	4	2	1	
100	Crista Ann Ct	1						5	2	0	0	0	2	1	3	3	2	1	
100	Crista Ann Ct	1						0	2	3	3	3	2	1	4	4	2	1	
100	Crista Ann Ct	2						5	2	0	0	0	2	1	1	4	2	1	
100	Crista Ann Ct	1						5	2	0	0	0	2	1	1	4	2	1	
0	Crooked Creek Ct	1						5	2	3	3	3	2	1	2	3	2	1	
2400	Crooked Creek Rd	0						0	0	0	0	0	0	0	0	0	0	0	
2500	Crooked Creek Rd	1						5	2	3	3	3	2	1	4	4	2	1	
2500	Crooked Creek Rd	1						5	2	3	3	0	3	1	4	4	2	1	
2700	Crooked Creek Rd	1						5	2	0	0	0	2	2	0	0	0	1	
2700	Crooked Creek Rd	1						5	2	3	3	3	2	1	2	3	2	1	
2700	Crooked Creek Rd	1						5	2	2	3	3	3	1	1	3	2	1	No issues
1300	Cross Creek Dr	5	1					4	1	2	2	2	2	2	0	0	0	1	
1300	Cross Creek Dr	5					5	4	1	2	2	2	2	2	0	0	0	1	
3200	Crossgate Dr	4	1					4	2	2	3	3	1	1	2	4	2	1	Q16: basement flooded twice not from sewer backup though. Where four houses converge, and in our back corner, standing water will occur after heavy rains for days. Very swampy for a long time.
0	Crosswinds Ct	1						5	2	0	0	0	2	2	0	0	0	1	
0	Crosswinds Ct	1						5	2	3	3	3	2	2	0	0	0	1	
0	Crosswinds ct.	1						5	2	0	0	0	2	2	0	0	0	1	N/A
0	Crosswinds Ct.	4	1	2				5	1	2	3	2	3	1	1	4	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Crosswinds Ct.	2				4		5	2	0	0	0	2	1	1	3	2	1	We were not home at the time when a very heavy rain, which caused runoff so fast that the drain close to our property could not handle it. Water built up behind our unit to the point where it ran into a window well, clogging the drain in the bottom of the window well. Water built up into the window well to the point where the pressure of the water broke the window, and the basement was flooded with 2 to 3 inches. Our sump pump was running and apparently kept water from going any deeper. Within a couple years after that, I personally put two-by-ten boards around the top of the window wells. Sometime later,some regarding was done behind, and on one side of our unit, so that during a similar downpour, water would supposedly drain into the street before it got above the level of the window well.
1300	Crown Court	1						5	1	2	1	2	2	1	3	1	2	1	
1300	Crown Court	1						5	1	2	1	2	1	1	1	1	2	1	
1300	Crown Court	1						5	2	0	0	0	2	1	1	3	2	1	
1300	Crown Court	1						0	1	2	1	1	3	1	3	1	2	1	
1300	Crown Court	4			3			3	1	2	2	2	2	1	3	1	2	1	Kickapoo creek runs behind our house. Flooding has never reached our yard. Rises & drains very fast. Our sump pump runs very little in the 22 years we lived here. There is some errosion around the drain pipe outlet that runs from the street between houses to the creek. Needs to be fixed.
1300	Crown Court	1						5	2	0	0	0	2	1	2	3	1	1	
1800 E	Croxton Ave	1						5	2	3	3	3	2	1	3	3	2	1	
1000	Croxton Ave	1						5	2	0	0	0	2	2	0	0	0	1	
1300	Croxton Ave	1						5	2	2	3	3	2	2	0	0	0	1	
1900	Croxton Ave	2					5	1	2	2	3	3	2	1	1	1	2	2	My flooding is usually due to roots in the main drain to the street. I have these removed annually.
1900	Croxton Ave	3	1			4	5	2	2	3	3	3	2	2	0	0	0	2	
1900	Croxton Ave	3				4		2	2	0	0	0	3	2	0	0	0	2	Flooding - back 1/3 of property during heavy rains will result in standing water in that area of the yard. Have heard a stream may have originally run thru the area. It's course may have been modified during construction of the town. Water during heavy rains will run from the backyard along the east side of the house to the street.
1900	Croxton Ave	1						0	2	2	0	0	2	1	1	1	2	1	
1900 E	Croxton Ave	1						0	2	3	3	2	2	2	0	0	0	1	no sump
1900	Croxton Ave.	1				4		5	2	0	0	0	2	1	2	1	2	1	N/A
1900	Croxton St	2	1					4	2	0	0	0	2	1	1	2	2	1	It didn't flood much but ground was damp.
0	Crystal Court	1						5	2	0	0	0	2	1	5	4	2	1	
0	Crystal Court	2	1					2	2	2	2	2	2	1	1	1	2	1	
0	Crystal Ct	2						0	2	3	3	3	3	3	5	4	0	0	
0	Crystal Ct	1						5	2	0	0	0	2	1	1	3	2	1	
0	Crystal Ct	1						0	2	0	0	0	3	1	2	4	2	1	
3100	Cumbria Dr	1						0	0	0	0	0	0	0	0	0	0	0	also no gravity flow drain in basement sump pump not plugged in
3300	Cumbria Dr	1						5	2	3	3	3	2	1	1	4	2	1	
3300	Cumbria Dr	1	1					5	2	0	0	0	2	1	1	3	2	1	
2100	Currant Ct	2	1					2	2	0	0	0	2	1	3	3	2	1	
0	Cygnet Crossing	1						5	2	0	0	0	2	1	1	3	2	1	No problems...our sump pump runs every time it rains.
0	Cygnet Crossing	0						0	0	0	0	0	0	0	0	0	0	0	
3600	Daffodil dr	1						5	1	2	2	3	2	2	0	0	0	1	
0	Daves Pl	5	1	2				1	2	3	3	3	2	2	0	0	0	1	Street drains near my house (in front of 9 Dawes Pl) clog and backup frequently, causing significant flooding into the street. During heavy storms, water fills the street and also comes up into my front yard (and I live two houses over from the drain). Drains are not able to handle all the water coming arount the corner and down the hill.
2800	Degarmo Dr	1						5	2	0	0	0	2	1	1	3	2	1	
2900	Degarmo Dr	1						5	2	0	0	0	2	1	2	3	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
400	Denver St	4		2				3	2	0	0	0	2	2	0	0	0	1	25 yards north of my property is a storm drain that is the lowest point on the four blocks of Denver St. This storm drain is consistently blocked with leaves and other debris when we have heavy rains. It is common to have 4" to 12" of standing water flooding the street when this happens. Question #4 - I'm not sure how long the water takes to drain. When I see it, I can usually get it to drain in 15 minutes by shoveling open the storm drain. If someone doesn't clear the debris, it seems to drain pretty slow.
0	Derby Way	5	1	2				4	2	0	0	0	3	2	0	0	0	1	Our back yard floods every time it rains. The entire street is graded into our yard. We are the second house on the street. Unfortunately, the house next to us where the water is supposed to drain through and into the street is approximately18 to 24 inches above graded so there is no where for the water to go so it sits in our yard for days depending on the amount of rainfall.
0	Derby Way	4	1					4	2	2	2	2	0	1	3	0	1	1	
0	Devon Rd	1						5	2	0	0	0	1	3	1	1	1	1	Q14: Occasionally ice.
0	Devon Rd	3	1					3	2	0	0	0	3	1	2	1	2	1	
0	Devon Rd	0						0	2	3	3	3	3	1	5	1	2	0	Have only lived here 6 mos.
100 S	Devonshire	1						5	2	3	3	3	2	1	1	5	2	1	
1200	Dianne Dr	2	1					2	2	0	0	0	2	1	1	1	1	1	
1200	Dianne Dr	2	1					2	2	0	0	0	2	1	1	4	2	1	
1200	Dianne Dr	3					5	2	1	2	2	2	3	1	2	1	2	1	The flooding has been caused by a sump pump that failed. My new sump pump has worked wonderfully since I installed it.
1200	Dianne Dr	1						5	2	0	0	0	2	1	2	1	2	1	lived in residence for 3 years, have never had any flooding problems. no indication on basement studs or drywall of prior water damage
1200	Dianne Dr	1						5	2	0	0	0	2	1	1	1	2	1	
1200	Dianne Dr	1						5	2	0	0	0	0	1	3	1	2	1	
1200	Dianne Dr	2	1					2	2	0	0	0	2	1	1	1	1	1	
1300	Dianne Dr	3				4		2	2	2	3	3	1	1	2	1	1	1	Basement flooded about a month ago 2/20/12 from sump pump, covered my basement floor. Had to have basement cleaned by Service Master. Water mitigation services for over 100,000.
1900	Dimmitt Ct	1						5	2	3	3	3	2	1	3	3	2	1	N/A
700 W	Division	1						5	2	3	3	3	2	1	3	3	2	1	
2800	Dodge	3	1					4	2	0	0	0	2	1	1	1	2	1	When our flooding was severe in the 1980's Jesse Smart met with us homeowners. We agreed to additional sewer near our yards and paid for the labor. We maintain the sewer and keep limbs and leaves from blocking it. It seem to help us 100%.
2800	Dodge	2	1					3	2	0	0	0	2	1	5	4	2	1	The sump pump failed and we didn't know it.
1200	Dogwood	1						5	2	0	0	0	2	2	0	0	0	0	Q10: It's on a slab!
1200	Dogwood Lane	5				4		4	2	0	0	0	2	2	0	0	0	0	I am on a slab. I get water in my registers, eat & cooling registers.
1200	Dogwood Ln	1						5	2	3	3	3	2	2	0	0	0	1	Q15: no basement Q17: so far, no problem
1200	Dogwood Ln	1						0	0	0	0	0	2	2	0	0	0	0	
1200	Dogwood Ln	1						5	2	0	0	0	0	0	0	0	0	0	
1200	Dogwood Ln	4	1			4		2	2	0	0	0	2	1	1	1	1	2	My neighbor to the West on Arrowhead had to install an extensive draining system to his backyard to try & reduce flooding to his slab home. The entire block to the south drains to his & my backyards. There is a storm sewer a few houses up in their backyard between Dogwood Lane & Mt. Vernon. I think it's between 1238 - 1240 Dogwood Lane. It is located under the power line easement. I believe it is plugged and my request to the city to check it has been ignored. I discovered the Storm Sewer when my neighbor at about 1238 Dogwood Lane drained his pool into it. It overflowed and sent water into the yards of 1240, 1242 & 1244 Dogwood. It also filled my neighbors yard on Arrowhead with water. My yard is small & I have no where to pump all this water except to the North of my home. This results in water overflowing the North Yard and overflowing the sidewalk. I am frustrated by this massive amount of water during storms and resulting damage it has caused. Gary Ofenloch 309-663-9932, Cell 309-310-6746, Work 309-268-5774 (BroMenn). I took some pictures over the years. I am not sure where they are at, but I could try & find them if necessary.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1200	Dogwood Ln	4	1					1	2	0	0	0	2	2	0	0	0	1	
1300	Dogwood Ln	1						5	2	0	0	0	2	3	5	4	2	0	
1300	Dogwood Ln	4	1					4	2	0	0	0	2	2	0	0	0	0	
1100	Doral Dr	4		2				2	2	0	0	0	1	1	3	3	2	5	May still have photos I will look one of street. Q15A5 64 inches, thanks to you and city know more. Q18A1 Yes, but only problem now is the street.
3100	Dorset Ct	2				4		1	2	3	3	3	2	1	2	3	2	1	one time in 10 years during 100 year rain, basement window well filled up and leaked into basement.
3100	Dorset Ct	1						0	0	0	0	0	0	1	4	1	2	1	
3200	Dorset Ct	1						5	2	0	0	0	3	1	3	1	2	1	
600 E	Douglas	3				4	5	3	2	0	0	0	2	2	0	0	0	2	Q2: Large amounts of rain Q17: All year long we get real bad gas smells from the basement drain. Smells the whole house up. Don't know what to do. Pleas call if any idas. It's getting worse. Thanks.
700 E	Douglas	1						5	2	0	0	0	2	2	0	0	0	1	
800 E	Douglas	1						5	2	0	0	0	2	1	3	1	2	1	Q2: since installing sump pump
800 E	Douglas	1						0	0	0	0	0	0	0	0	0	0	0	
400 E	Douglas St	3				4		4	2	0	0	0	2	2	0	0	0	1	
600 E	Douglas St	1						5	2	0	0	0	3	2	0	0	0	1	None, there is no flooding problem!!!
1200	Dover Rd	1						0	1	2	1	2	2	1	3	1	2	1	
1500	Dover Rd	1						0	0	0	0	0	0	0	2	1	2	1	
1500	Dover Rd	4	1					4	2	2	3	3	2	1	1	3	2	1	Have standing water in backyard during long or hard rain. Could be from neighbors sump pump. In some situations water remains standing for several days.
1400	Dover Road	1						5	2	0	0	0	3	1	2	1	2	1	
0	Downing Circle	1						5	2	0	0	0	3	1	2	3	2	1	
0	Downing Circle	4	1			4		4	2	0	0	0	2	1	1	1	1	1	
0	Downing Circle	1						5	2	3	3	3	2	1	1	1	1	1	
0	Drake Court	0						0	0	2	0	0	3	1	1	4	1	0	I do not know how to answer questions 1-10. I do not have flooding in my yard. And I do not have a drainage ditch (I don't think). However some properties do. I am good unless I have sump pump failure.
0	Drake Court	4	1					4	2	0	0	0	2	1	1	3	2	1	Flooding is more prevalent in the spring, but occurs with any significant rainfall. Water stands on the back 1/3 of the property for several hours, up to several days sometimes. Seems to be caused by lack of proper drainage flow from the surrounding properties.
0	Drake Court	1						5	2	0	0	0	2	1	1	3	2	1	The only flooding I've had in 18+ years in the home are 2 instances where the sump pump did not work. The flooding came from the sump pump hole overflow.
0	Drake Court	4	1					3	2	0	0	0	2	1	1	3	2	1	
0	Drake Court	1						5	0	0	0	0	1	0	4	4	2	0	
0	Drake Court	2		2				1	2	2	3	3	3	1	3	4	2	1	
2500	Driftwood	3		2	3			4	1	0	1	1	2	1	1	1	2	1	
1700	Dunraven Rd	4	1					3	2	0	0	0	2	1	1	4	2	1	
1700	Dunraven Rd	1						5	2	0	0	0	2	1	3	4	2	1	n/a
800	Durham Dr	1						5	2	0	0	0	2	2	0	0	0	1	
900	Durham Dr	1						5	2	3	3	3	3	1	4	1	2	1	We Have a gravity flow drainage system around our foundation that seems to work well.
1000	Durham Dr	1						5	2	3	3	3	2	1	2	1	2	1	
3100	Eagle Creek Drive	3					5	4	2	0	0	0	2	1	1	3	2	5	The sewer backup was reported to the city by our insurance company, our plumber and possibly Serv-Pro who spent 2 cleaning up and sanitizing what they could. Would you like to come and check for mold in our basement walls from the feces and urine creeping up and through the drywall?. It has happened twice and both times were sewer feces and urine, etc. The insurance company told us not to hold our breath waiting for the city to fess-up and pay for any of the damages. You did come out later the next day and spent quite a bit of time trying to locate where the problem was. I believe it was 1/4 mile down the road. I hope you don't think we believe you will really do anything about the sewer backing up...we don't!
3100	Eagle Crest Rd	1						0	2	0	0	0	3	1	1	4	2	1	Neighbors 2 doors to west did.
3200	Eagle Crest Rd	1						5	2	0	0	0	2	1	1	3	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
3300	Eagle Crest Rd	1						5	2	0	0	0	3	1	5	4	2	1	There was flood in basement one time after many inches of snow - blizzard January 1999
3100	Eagle Crest Rd.	1						5	2	0	0	0	2	1	1	3	2	1	
25100	Eagle Pt	1						5	1	3	2	2	1	1	3	5	2	1	
0	Earls Ct	1						5	2	2	3	3	1	1	1	3	2	1	
0	Earls Ct	2	1					4	2	0	0	0	2	1	1	3	2	1	No flooding since city installed storm sewer access.
2100	East Gate Place	1						5	2	0	0	0	2	2	0	0	0	1	
900 N	East St	3					5	4	2	0	0	0	2	2	0	0	0	5	Couple years ago, neighbors had same problem - was blockage. City of Blm paid for my clean up the 2nd time it occurred. Ist time was several years earlier.
800 S	East St	1						0	2	2	2	2	2	2	0	0	0	1	
900 S	East St	1						5	2	0	0	0	2	2	0	0	0	1	
900 S	East St	1						5	2	0	0	0	2	2	0	0	0	1	
1000 S	East St	1						0	0	0	0	0	0	1	3	3	2	0	
2100	Eastgate Place	2		2		4		3	2	0	0	0	2	2	0	0	0	1	Some flooding in street because of no storm drains on our block. Very little drop for water to move. Only water through cracks in floor of basement, mainly only mop up.
1200	Eastholme Ave	1						5	2	0	0	0	0	1	3	3	2	1	Have no flooding problems
1300	EastHolme Ave	4				4		4	2	0	0	0	2	2	0	0	0	1	
1400	Eastholme Ave	2		2				1	2	0	0	0	2	2	0	0	0	1	
1400	Eastholme Ave	3		2				1	1	2	2	2	2	2	0	0	0	1	sewre drain in the street next to our driveway was installed incorrectly (not level with the street and seems to hold water on our drive during heavy rains ,also strong sewer odor from the storm sewer. A question we have is whether the city is going to close in our drainage ditch like they have done on the country club golf course and the high school property?
1700	Eastland Dr	1						5	2	0	0	0	2	2	0	0	0	1	
2200	Eastland Dr Suite 204	1						5	2	3	3	3	2	2	0	0	0	1	
2200	Eastland Drive, Suite	1						5	2	0	0	0	3	3	0	0	0	1	This is a business. We do not have a basement and to my knowledge we have never had a backup or flooding issue. I have been here 5 years and have never experienced a problem.
1100	Eastport Dr	2						5	1	2	0	2	2	2	0	0	0	1	
1200	Eastport Dr	1						5	2	2	3	3	3	1	1	1	2	1	
1300	Eastport Dr	1						5	2	0	0	0	2	1	5	3	2	1	
1300	Eastport Dr	1						5	2	0	0	0	3	1	5	4	2	1	
12200	Eastport Dr	1						0	2	0	0	0	0	1	0	0	2	1	
1200	Eastport Dr	5						4	2	3	3	3	1	1	1	1	1	1	Q3: Water flowing from apartemtn complex to the south floods rear of my yard. Q17: Rain water is discharged, for entire apartment complex, out of single opening at end of building. There is a French Drain to rear, but it isn't effective anymore. As a result water rushes down the rear of my yard at about height of 6 inches. The ground remains soaked for a week at a time.
0	Eaton boulevard	0						0	0	0	0	0	0	0	0	0	0	0	
2000	ebo lane	1						5	2	0	0	0	3	1	4	4	2	1	
800	Eddy Road	4	1					3	2	3	3	3	1	1	4	0	0	1	Standing water at western edge of our lot following heavy rain.
900	Eddy Road	2	1					1	2	0	0	0	2	1	3	5	2	1	Resident since July, 2007
0	Edgewood Ct	2				4		5	2	3	3	3	3	1	3	1	2	1	
0	Edvardinsh Way	2		2				2	2	2	3	3	2	1	3	1	2	1	
0	Edvardinsh Way	3		2				1	2	0	0	0	2	1	2	1	2	1	
0	Edvardinsh Way	1						0	0	0	0	0	0	1	3	3	2	1	
0	Edvardinsh Way	1						5	2	0	0	0	3	1	2	4	1	1	no problem with flooding.
1700	Eide Rd	3	1					3	2	0	0	0	2	1	5	3	2	1	A low spot in the back yard has had standing water after heavy rains. The undeveloped lots behind us allow water to flow towards our house. At time the window wells become water falls but nothing gets into the house during this.
200	Eisenhower De	4		2				2	2	0	0	0	2	2	0	0	0	1	Flooding occurs in the middle of the block during heavy rain. Will usually reach a foot deep, then receed about an hour after rain ceases. Has occassionally made the road impassable, and as Eisenhower is a dead end street, there is no exit for those of us living at the end of the block.
200	Eisenhower Dr	1						5	2	0	0	0	3	3	0	0	0	1	
1100	Ekstam Dr.	1						5	2	0	0	0	3	1	3	4	2	1	
900	Elder	2				4		3	2	0	0	0	2	2	0	0	0	1	Q1: actually 2 times in 30 years Q17: I have owned this property for 30 years. Have had water in wouthwest area of basement 2 times - each after heavy spring rains. No photos

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
200 S	Eldorado	1						5	2	3	3	3	2	1	2	1	2	1	
800 S	Eldorado	1						5	2	3	3	2	2	2	0	0	0	0	
200 S	Eldorado A-2	1						5	2	0	0	0	2	3	0	0	0	1	
800 E	Elm St	1						0	2	0	0	0	2	2	0	0	0	1	
800 E	Elm St	2	1					0	2	0	0	2	2	2	0	0	0	1	
800 W	Elm St	2					5	5	0	0	0	0	2	1	3	1	2	3	
800 W	Elm St	2					5	1	0	3	3	3	2	2	0	0	0	1	
1200 W	Elm St	2				4		2	2	2	0	0	2	2	0	0	0	2	When rain is heavy, 1 1/2 to 2 in. Basement toilet has water bubbles and turns brown or sediment in bottom of the bowl. Drain in floor backs up with fast
1300 W	Elm St	3				4		2	2	0	0	0	2	2	0	0	0	1	
1400 W	Elm St	2					5	5	2	2	0	0	2	2	0	0	0	0	
1100	Elmwood Rd	1						5	2	0	0	0	2	2	0	0	0	2	Occurred once in 2003 about 4 feet in diameter around drain. Will take photos next time.
1100	Elmwood Rd	2					5	1	2	3	3	0	2	2	0	0	0	2	
1200	Elmwood Rd	1						0	2	0	0	0	2	2	0	0	0	1	
1000 E	Emerson St	1						0	2	0	0	0	2	2	0	0	0	0	
1000 E	Emerson St	1						5	1	2	2	2	2	2	0	0	0	1	
1500 E	Emerson St	1						0	2	0	0	0	2	2	0	0	0	1	
400 W	Emerson St	1						5	2	0	0	0	2	2	0	0	0	1	
1600 E	Emerson St.	1						5	2	0	0	0	1	1	2	3	2	1	This address is for St. John's Lutheran Church. As you know we are rather unique as we are not a residence. We have our own retention basin which handles any flooding matters. For other questions, call Roger at church, 827-6121 or my cell phone, 309-531-1040.
700 E	Empire	1						5	2	0	0	0	2	2	0	0	0	1	
1200 E	Empire	2				4		3	2	0	0	0	2	1	2	2	2	1	
600 E	Empire St	1						5	2	0	0	0	2	2	0	0	0	1	
600 E	Empire St	1						5	2	0	0	0	2	2	0	0	0	1	
700 E	Empire St	1						5	2	0	0	0	2	2	0	0	0	1	
700 E	Empire St	1						0	0	0	0	0	0	0	0	0	0	0	
800 E	Empire St	2				4		5	2	0	0	0	2	2	0	0	0	1	seepage due to severe rain.
1200 E	Empire St	1						5	2	0	0	0	3	1	1	1	2	1	
1200 E	Empire St	2	1			4		5	0	3	3	3	2	0	0	0	0	1	
1500 E	Empire St	1						5	2	3	3	3	0	0	0	0	0	0	
1700 E	Empire St	1						5	2	0	0	0	2	2	0	0	0	1	
2100 E	Empire St	1						5	2	0	0	0	2	2	0	0	0	1	
2300 E	Empire St	1						5	1	0	2	2	2	2	0	0	0	1	
2000	Escalade Rd	1						0	2	0	0	0	2	1	4	0	0	1	We have only lived her e since February 2012 - not a good witner to judge since no snow or rain.
1500	Espen Dr	1						5	2	0	0	0	2	1	2	1	2	1	
1800	Espey Dr	3	1					4	2	0	0	0	3	1	1	1	2	1	In periods of heavy rain a lake forms at the back of our backyard adjacent to neighbors backyard with no fences
1800	Espey Dr	1						5	2	0	0	0	2	1	4	3	2	1	
2700	Essington St	1						5	2	0	0	0	0	1	2	3	2	1	
2700	Essington St	1						5	2	0	0	0	3	1	1	3	2	1	
2700	Essington St	3	1					3	2	0	0	0	2	1	1	3	2	1	Our flooding is very minimal-only in one corner of our backyard and only in the spring with a lot of rain in a short period of time or a lot of rain over a serveral day period. We don't have any photos.
2800	Essington St	1						5	2	0	0	0	2	1	1	3	2	1	
2800	Essington St	2	1					3	2	0	0	0	2	1	1	4	2	1	My house at 2814 Essington is located at the point where all the water in the area drains into my backyard where there is a big sewer drain opening. When the rain is heavy it cannot handle the volume and a small pond develops in my back yard for a few hours. However it does not come close to the house. If I had know this I would not have purchased this property.
2900	Essington St	2	1			4		3	2	0	0	0	2	1	1	4	2	1	The only time we've had flooding in our basement was when our sump pump died. Flooding in our side yard occurs during heavy rain and lasts only an hour or so.
2900	Essington Street	1						5	2	0	0	0	2	1	1	3	2	1	
0	Ethell Parkway	1						5	2	2	2	2	2	2	4	0	2	1	
0	Ethell Parkway	5	1			4		4	0	0	0	0	2	1	1	4	2	1	
1000 N	Eugene St	4	1	2				3	0	0	0	0	0	0	0	0	0	0	Q2: Recently storm sewer crushed by some heavy truck

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
500 N	Evans	4				4		4	2	0	0	0	2	2	0	0	0	1	The flooding issues I have consist of water leaking in through cracks in the foundation and windows. The house is very old and has a brick foundation. I never have standing water. Only places where the floor is wet.
1000 N	Evans	1	1					5	2	3	3	3	2	2	0	0	0	1	
300 N	Evans St	1						5	2	0	0	0	2	2	0	0	0	1	
500 N	Evans St	1						2	2	0	0	0	3	3	0	0	0	1	
900 N	Evans St	2				4		4	2	3	3	3	2	2	0	0	0	1	I have lived at this address since 1990. Only small amounts of wter come in through basement walls from time to time, except one year - May 2007 I believe - when we had 6-7" of water in the basement and we had to call a service to pump it out.
1000 N	Evans St	1						0	2	0	0	0	2	2	0	0	0	1	
1100 N	Evans St	4				4		1	2	0	0	0	2	2	0	0	0	1	When it rains hard a lot water comes in and goes down the drain mostly. Minor water stands in side yard since large garages built next door. Comes in walls and around basement windows only when saturation is severe. At the SE corner of Evans and Empire large amounts of water always stand. Other corners in neighborhood have some standing water.
500 S	Evans St	5	1					4	2	0	0	0	3	1	2	1	2	1	Our main flooding problem is in our garage from the alley. The alley goes downhill and all the water flows directly into our garage and sits there for several days until it finally dries. Several times a year, we must scoop mud out of our garage that was brought in from the flooding from the alley.
0	Everett Ct	1						5	2	3	3	3	2	1	3	3	2	1	
0	Everett Ct	1						5	2	2	3	3	2	1	3	4	2	1	
100 S	Evergreen Lane	1						5	2	0	0	0	2	1	1	1	2	1	June 2010 we had the sewer line between the house and the street collapse. We had a new line installed and have had no further problems to this time. The collapse was det4ected before and major indorr problems occurred. The only other problem we had was when we lost power nad the sump pump wont work, we now have a generator.
100 S	Evergreen Lane	1						0	2	0	0	0	0	1	3	1	2	1	
100 S	Evergreen Lane	3	1	2				4	2	0	0	0	3	1	1	4	2	1	
200 S	Evergreen Lane	1						5	2	3	3	3	2	1	3	1	2	1	
200 S	Evergreen Lane	4	1	2				4	2	0	0	0	2	1	1	1	1	1	First I want to clarify that my belief is we don't have a flooding "problem". However we have had enough issues with the basement floor getting wet that we have not finished out our basement. To qualify basement flooding -- it means the basement floor is wet and the rugs are soaked. Our basmement only floods when the power goes out or from sump pump failure. The water has never been more than 1/4 inch deep on the floor. Since 1985 the scenario of a power outage and heavy rain has probably happened 5 - 8 times. Sump pump failure has happened twice and once a couple of years ago the pump failed to keep up and water backed up onto the basment floor. A larger pump was installed to solve the problem. Flooding in the backyard means we have standing water at the rear easment and it can be a 4 to 6 inch pond primarily caused by natural rainfall and all the sump pumps discharging into the backyards. The ponding has never grown large enough to get within 12ft of the rear of my house's foundation.
100	Fairview Ave	2						5	2	0	0	0	2	2	0	0	0	1	
200	Fairway Dr	4	1					4	2	0	0	0	2	1	2	3	2	1	Q4: Depends on the amount of rain.
200	Fairway Dr	0						0	2	0	0	0	2	2	0	0	0	0	
200	Fairway Dr	1		2				1	2	0	0	0	2	2	0	0	0	1	
200	Fairway Dr	1						5	2	0	0	0	2	2	0	0	0	1	
300	Fairway Dr	1		2				2	2	3	3	3	2	3	0	0	0	1	
300	Fairway Dr	1						0	0	0	0	0	0	1	2	4	2	2	The only time we have any trouble is when the electric power is off for several hours.
300	Fairway Dr	5	1					2	2	0	0	0	2	1	1	1	2	2	Water always pools on the north end of the property between houses next to our patio.
300	Fairway Dr	1						5	2	0	0	0	2	1	2	1	2	1	
2000	Fallen Oak Rd	1						5	2	3	3	3	2	1	2	1	2	1	
2000	Fallen Oak Rd	4	1					0	2	0	0	0	3	1	1	4	2	1	Q2: after heavy rain. Q3: backyard. Q4: not sure. Q17: looks lie a small creek running through the backyard.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2000	Fallen Oak Rd	2	1					1	2	0	0	0	2	1	1	1	2	1	
2000	Fallen Oak Rd	4	1					4	2	0	0	0	2	1	1	1	1	1	during wet weather our sump pump runs constantly and we pump to the yard. We then get standing water and some of it drains to the neighbor's house compounding their water problem. Neighbor had a city engineer come out and he suggested digging a trench between our houses and installing a drain barrel underground. It did not work and now water accumulates between the houses. Other neighbors drain toward the street which causes ice on sidewalks and in the street.. Since we drain to the yard, in the winter ice forms and we have burned out several sump pumps. We drain above ground so that we can move the hose so standing water does not continually go to one spot. We are at 2015 Fallen Oak Rd.
100	Fedor Circle	1						5	1	3	3	3	2	1	4	3	2	1	
1600	Fell Ave	2		2				3	2	0	0	0	2	2	0	0	0	2	Sewer backup through floor drain in 2008 when Hurricane Ike came through. Added/installed backwater valve shortly after. No problems since. Address provided is just north of Sugar Creek on Fell.
1600	Fell Ave	5		2			5	4	2	0	0	0	3	1	5	4	2	1	Any time there is a significant amount of rain, Division street floods with standing water. It can remain for days.
1400 N	Fell Ave	1						0	2	0	0	0	2	2	0	0	0	1	
1500 N	Fell Ave	1						5	2	3	3	3	2	2	0	0	0	1	
0	Fetzer Ct	1						5	2	0	0	0	3	3	0	0	0	1	
0	Fetzer Ct	1						5	2	0	0	0	2	2	0	0	0	1	
0	Fetzer Ct	3			3			1	1	2	2	2	2	3	0	0	0	1	There is standing water in the drainage ditch , in summer is a cess pool, mosquito breeding ground. When the water table gets too high water seeps in to my downstairs bathroom around the base of the toilet where the floor meets the wall. There are water stains from this. It has happened several times since I have lived here 8 years. This is a townhouse built on a slab. No basement. Probably a good thing because it would flood. The ditch is off of Ireland Grove Rd.
0	Fetzer Ct	2			3			5	2	0	0	0	2	1	1	1	1	1	I have only lived her 1 1/2 years but I was told when one sump pump broke that there was water damage in a few units.
0	Fetzer Dr	1						5	2	0	0	2	2	3	5	4	2	0	Q16: no basement
0	Fisher Dr	0						0	1	2	3	3	2	2	0	0	0	0	Please note: When we moved to this address in 1974, we had a heavy rain in April. It resulted in our receiving three feet of water in our basement in less than an hour. This happened several times after this, and each time we complained to the city. Several neighbors also had water in their basements also. We wrote letters to the city (Mayor Smart) and come ___this, the city installed a bypass sewer from Sunset Rd, down Fisher Dr, where it overloaded our sewer and caused the water to back up through our floor drains and flooding the basemetn. This flooding problem happened until 1982, when after upgrading part of Sugar Creek, and installign the bypass, we have not had a flooding problem since. I have copies of the letters sent to the city in case you need to see them. This property is now for sale, and is presently unoccupied.
200	Fleetwood Dr	1						5	2	3	3	3	3	1	5	1	2	2	
200	Fleetwood Dr	2				4		5	2	0	0	0	2	2	0	0	0	0	
200	Fleetwood Dr	1						5	2	3	3	3	2	1	1	1	2	1	
5100	Fleming Ln	4	1					2	2	0	0	0	3	1	2	3	2	1	When moderate rain occurs, there will be standing water around the edge of the property. I believe it is designed to do this, but our lot appears to be the only one on our street that has the visible standing water. It never gets up close to the house, but again we haven't had a really terrible rain out here. No water problems within the house, just the standing water all the way around the property.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
200	Florence Ave	4	1	2		4		3	2	0	0	0	2	1	2	5	2	2	Basement flooding with water seeping in walls was very frequent and varied in level depending on hard/long/frequent the rain was. Attempts with water proofing walls were unsuccessful. Then about 5 years ago, had an expensive basemeny dewatering system put thru out the basement but still had water come in at door & walls. Then we tore out entire driveway and door area & poured a pitched new surface. Also put up water resistent wall board.
200	Florence Ave	2	1					3	2	0	0	0	2	2	0	0	0	1	Low area in the backyard floods with heavy rain.
200 S	Florence Ave	5					5	4	2	0	0	0	2	2	0	0	0	0	Had to call plumber for flooding in basement. I had this problem corrected in Dec 2011. New sewer frommy basement to the city line across the street.
200 S	Florence Ave	1			3			4	2	3	3	3	0	1	1	1	2	1	We used to have a wet basement almost all of the time. We had the floor dug up around the basement walls and drain tile installed feeding into two sump pumps.
500 S	Florence Ave	3		2		4		4	2	0	0	0	3	2	0	0	0	1	Water comes into basement where floor meets wall and in certain areas through the baseement floor. We bought the house in 2007. Worse years: Spring & Summer 2007 & I believe 2009
500 S	Florence Ave	4	1			4		4	2	3	3	3	1	1	5	1	0	0	
500 S	Florence Ave	2				4		1	2	0	0	0	3	3	0	0	0	2	Sewer back up was not related to storm/flooding
200 S	Florence Ave.	4	1	2				4	2	0	0	0	2	1	1	1	2	1	Our flooding in the house was from hydrostatic pressure when the ground was saturated. We put in a sump pump and haven't flooded in house since. When it rains hard, water stands in our side yard. Our house is about 87 years old, and many of our neighbors a few houses away have had to have their sewers dug up in the past year. That is very worrisome for us.
600 S	Florence Ave.	2	1	2				5	2	0	0	0	2	1	3	1	2	1	
1000	Folsom St	3				4		3	2	0	0	0	2	2	0	0	0	1	When it rains really hard for a long period of time, water seeps up through the basement floor and walls.
1000	Folsom St	4	1					3	2	0	0	0	2	2	0	0	0	0	Heavy rains create a large "puddle" in the center of our back yard.
1000	Folsom St	1						5	2	0	0	0	2	2	0	0	0	1	
1000	Folsom St.	1						5	2	0	0	0	3	1	4	1	2	1	
1500 W	Forrest	1						0	2	0	0	0	2	0	0	0	0	1	
0	Fountain Lake Court	2	1				5	4	2	0	0	0	2	1	1	3	1	2	Any time there is a heavy rain, backyards flood between Fountain Lake Court and Old Farm Road due to grading & a storm sewer inlet in a backyard two houses to the south. Even in a moderate rain, the sump pump runs constantly due to an apparent high water table in this neighborhood.
0	Fountain Lake Court	3	1					5	2	0	0	0	2	1	2	3	2	1	
0	Fountain Lake Court	1						5	2	0	0	0	2	1	1	3	2	1	
0	Fountain Lake Court	5						5	2	3	3	3	2	1	1	4	2	1	
3400	Fountain Lake Dr.	1						5	2	0	0	0	3	1	1	3	2	1	
800	Four Seasons Rd	1						5	2	0	0	0	3	3	0	0	0	1	
2000	Fox Creek Rd	1						5	0	1	2	2	2	2	0	0	0	0	
2100	Fox Creek Rd	2				4	5	2	2	0	0	0	2	1	3	5	2	1	
2500	Fox Trot Trail	1						5	2	0	0	0	3	1	5	4	1	1	
2600	Fox Trot Trail	1	1					1	0	2	0	0	0	3	5	4	0	1	Q3: Heavy rains might cause standing water backyard for a bit, but it does drain out, house next door not built, there this affect it. Q5: don't know Q7: don't know Q8: don't know Q9: no basement Q17: Have not had flooding problem - am here almost 3 years. Backyard has had standing water for 15-20 minutes with very heavy rains a couple of times. I think the empty lot next door might have an effect on water drainage.
2000	Foxtail Rd	1					5	1	2	3	3	3	2	1	2	1	2	1	
2100	Foxtail Rd	1						5	2	0	0	0	3	1	1	3	2	1	N/A
2200	Foxtail Rd	1						5	2	0	0	0	2	1	3	1	2	1	Never experience flooding in my area or home.
5000	Francesco Lane	1						5	2	0	0	0	3	1	4	3	2	1	
5000	Francesco Lane	5	1					2	2	0	0	0	2	1	1	1	2	1	Poor drainage in the yard causes standing water in several locations. Ground in spots never fully dry's due to lack of drainage paths.
5100	Francesco Lane	2		2				2	2	0	0	0	2	1	2	3	2	1	
5100	Francesco Lane	1						5	2	2	2	2	2	1	3	3	2	1	
800	Fremont St	1						5	1	2	2	2	1	1	3	1	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1000 E	Front St	3		2				2	2	0	0	0	2	1	1	1	2	1	
1000 E	Front St	3				4	5	5	0	0	0	0	2	2	0	0	0	2	
1000 E	Front St	4					5	4	2	0	0	0	2	1	2	3	2	3	Q2: 3-4 per yr. Q12: Several times per hour - during heavy rains and several times per day - regular rainfall. Q17: Worst time was June 2006. We had just pruchased our home and did not know the sump pump didn't work. The basement flooded from both drains roughly 3-4 inches w/sewage (super heavy rains). During heavy rains we sometimes get an inch or more of standing water. My grandparents owned tis same house more than 30 years ago. They had problems with flooding and sometimes sewage as sell. According to them, one fo the houses directly behind us (Grove St) had their house drains from the gutters placed directly into the storm drains. I guess Front & Grove were & maybe still are on the same storm drains??
1000 W	Front St	1						5	2	3	3	3	2	1	2	1	2	1	
1000 W	Front St	1						5	2	0	0	0	2	2	0	0	0	1	
4000	Fullerton Rd	1	1					5	2	3	3	3	2	1	4	3	2	1	
3600	Gabby Drive	1						5	2	0	0	0	2	1	3	3	2	1	
1900	Gailey Ln	3				4		2	2	3	3	3	2	1	1	3	2	1	
300	Garfield Dr	0				4		4	2	0	0	0	2	1	1	1	1	1	Water seeps in next to wall and sreads. If the sump pump runs it keeps water away from the foundation so there is no seepage.
300	Garfield Dr	3		2				1	1	1	1	2	2	2	0	0	0	3	July,1992 only. Sewer backed up through drain. I was at work so the water filled the entire basement floor with the deepest part in the lundary room where the drain was. City of Bloomington reimbursed me for some of the damage.
300	Garfield Dr	4	1					4	2	3	3	3	2	1	4	1	2	0	Flooding may be too severe a description, Vista Dr is much higher than Garfield so we get downhill runoff. My backyard is flat and water stands for 3-7 days after a heavy rain across the full E-W width of the yard. Makes a sloshy bag that can't be mowed well when wet.
300	Garfield Dr	1						0	1	2	1	2	2	2	0	0	0	1	
1900	Garling Dr	1						0	2	0	0	0	2	0	0	0	0	1	
1900	Garling Dr	1						5	0	0	0	0	3	3	5	4	2	1	
1900	Garling Dr	4		2		4		4	2	3	3	3	2	2	0	0	0	2	When ground is frozen and heavy rains - even with water channels along walls water comes under garage floor door stairwell, around door and floods 1/2 floor. Also have had water in downstairs bath within three walls or window wells. Property is lower than lots to south. I plan to get a sump pump in the basement, dehumidifier sysetm when I can afford it.
1900	Garling Dr	1						0	2	2	2	2	2	2	0	0	0	1	
2500	Garlington Ln	1						5	2	3	3	3	2	1	1	3	2	1	
2100 E	Gate Pl	1						5	2	0	0	0	2	2	0	0	0	1	
2100 E	Gate Pl	1						0	2	0	0	0	2	2	0	0	0	1	
1700	GE Rd	1						5	2	0	0	0	1	1	1	1	2	1	
2500	GE Rd	1						0	1	2	2	2	2	2	0	0	0	1	No basement
0	Geneva Ct	1						5	2	0	0	0	2	2	0	0	0	1	
0	Geneva Ct.	1						5	2	0	0	0	2	1	1	3	2	1	
900	Gerike Way	1						5	2	3	3	3	2	1	4	1	2	1	
900	Gerike Way	4	1					4	0	0	0	0	0	0	0	0	0	0	Has standing water because it needs to be leveled and graded. It breeds bugs & weeds. Would appreciate if you would look into it.
1000	Gerike Way	1						5	2	0	0	0	2	1	2	3	2	1	
1000	Gerike Way	4	1					4	2	0	0	0	2	1	2	3	2	1	When it rains heavily, water will flow from east to west across the back yards of 1009-1013 Gerike Way, forming a "river" that will remain for several hours or even a day. The water level in my backyard at 1011 Gerike remains so high that a new planting of trees last year died from too much moisture.
1200	Gettysburg Dr	0						5	2	0	0	0	2	1	1	1	2	0	
1200	Gettysburg Dr	3				4		2	2	0	0	0	2	1	2	1	2	2	
1200	Gettysburg Dr	1						0	2	0	0	0	3	1	1	5	2	1	
2800	Gill St	1						5	2	0	0	0	3	3	2	3	2	1	
2900	Gill St	1						5	2	5	3	3	2	1	2	1	2	1	
3000	Gill St	1						5	1	2	2	2	2	2	0	0	0	1	
3700	Gina Drive	4	1					2	2	0	0	0	3	1	2	4	2	1	
100	Ginger Creek Court	0						0	0	0	0	0	0	0	0	0	0	0	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
100	Ginger Creek Court	1						5	2	3	3	3	2	1	0	0	2	1	
1700	Glenbridge Rd	4				4		5	1	3	0	2	1	1	2	1	2	2	Q7: not sure Q15: rain thru cracks in basement wall foundation Q17: Rain/ wetness appearing alongside cracks in basement wall, heavy near enters thru front and hall, even with addition of stormdrain.
1800	Glenbridge Rd	1						5	2	0	0	0	2	1	5	3	2	1	
3600	Glenmore Dr	1						5	2	0	0	0	3	1	5	4	2	1	
3600	Glenmore Dr	2					5	4	2	0	0	0	2	1	1	3	2	1	
3500	Glenmore Rd	2				4		5	2	0	0	0	2	1	1	3	2	1	
1200	Glenwood Rd	2					5	4	2	2	2	2	2	1	3	1	2	2	
1200	Glenwood Rd	5		2				4	2	0	0	0	2	2	0	0	0	1	There is an area by my mailbox that floods every time it rains. It does not drain, but eventually evaporates. I've tried to fix the problem myself by filling it up with rock, but that really hasn't done much.
1300	Glenwood Rd	1						5	2	3	3	3	2	2	0	0	0	0	I don not have a basement, so have not experienced that type of flooding/backup. I have had water backup when flushing the toilet, where water overflowed over the toilet. I was told this is due to tree roots too large in the neighborhood getting into pipes. City came and cut down a coupel trees after that.
1300	Glenwood Rd	1						5	2	0	0	0	2	2	0	0	0	1	
1300	Glenwood Rd	0						0	0	0	0	0	0	0	0	1	2	0	
0	Gloucester Cir	2					5	4	2	2	0	0	2	1	1	1	2	1	
0	Gloucester Cir	1						5	2	3	3	3	2	1	1	1	2	1	
0	Gloucester Cir	1						5	2	0	0	0	2	1	1	1	1	1	
0	Gloucester Cir	1						5	2	0	0	2	3	1	5	4	2	1	We have owned the property about 6 months, so I don't know much yet,
0	Gloucester Cir	1						0	0	0	0	0	2	1	2	4	2	1	
0	Gloucester Cir	4	1					4	2	0	0	0	2	1	1	1	2	1	Standing and running water during heavy rain periods in backyard.
1900	Golden Dr	1						0	2	0	0	0	2	2	0	0	0	0	
200	Golden Eagle Rd	1						5	2	3	3	3	2	2	0	0	0	0	
3300	Golden Eagle Rd	1						0	2	0	0	0	2	1	2	1	2	1	
3300	Golden Eagle Rd	1						5	2	0	0	0	2	1	2	3	2	1	Flooding occurred one time. Sump pump stopped working. It happened about 7 years ago.
3300	Golden Eagle Rd	1						5	2	0	0	0	3	1	4	3	2	1	Q12: that I've noticed
300 W	Graham St	2					5	2	2	0	0	0	2	2	0	0	0	1	One time 7 or 8 years ago storm sewer back up
500 W	Graham St	1						0	0	0	0	0	0	0	0	0	0	0	
700 W	Graham St	1						5	2	0	0	0	2	2	0	0	0	1	
1500 W	Graham St	1						5	2	2	2	2	2	0	0	0	0	1	
1500 W	Graham St	2				4		4	2	3	3	3	1	2	3	1	2	1	Q10: portable sump pump
300	Granada Rd	1						5	2	3	3	3	2	1	1	5	2	0	We had back up once about five years ago and we paid a plumber to install a check valve. City workers also gegan cleaning out sewer on street more frequently and we have not experienced additional problems.
300	Granada Rd	1						5	2	0	0	0	2	2	0	0	0	1	
2800	Grandview Dr	2					5	3	2	0	0	0	2	1	1	3	2	1	
2800	Grandview Dr	1						5	2	3	3	3	2	1	1	3	2	1	
2800	Grandview Dr	2					5	4	2	3	3	3	2	1	1	3	2	1	Q3: Water enters house through basement sump pit. Q4: Basement flooded when power outage for 2 days used up sump pump battery back up. Property has no sanitary sewer. Q15: Property has a septic tank. Q16: Ins. Co. has them. Q17: No problems as long as we have reliable electric service. Are you planning on a sanitary sewer for the S side of the 2800 block of Grandview?
2800	Grandview Dr	3	1			4		3	2	0	0	0	2	1	1	1	2	1	Our sump pump only runs after periods of extended heavy rain.
2800	Grandview Dr	1						0	2	0	0	0	2	1	3	1	2	1	
2900	Grandview Dr	3	1			4		4	2	0	0	0	3	1	2	4	2	1	
2900	Grandview Dr	1						5	2	0	0	0	2	1	1	3	2	1	
300	Grant Rd	1						5	2	0	0	0	3	1	2	1	2	1	
400	Grant Rd	5	1				5	4	2	0	0	0	2	2	0	0	0	3	Q3:back of property;2 times until I replaed valve to sewer line cost $1100. Q9:told once could not be put in, neighbors on both sides have pumps, see above replaced valve check valve to hold sewer water from entering house.Q15:2 times prior to new valve. Q16:no, but have homowner policy info for repair job.
0	Grape Vine Ln	1						5	2	5	3	3	2	1	3	4	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Grape Vine Ln	1						5	2	0	0	0	2	2	0	0	0	1	
2200	Gravenhurst Dr	4	1					3	2	0	0	0	3	1	1	4	2	1	Flooding and standing water occurs along our rear fence line with property adjacent to our neighbors backyard on two sides. Seems to be a grading problem. Generally occurs durning heavy rainfall periods. Water table in our area is high, especially during heavy rainfall periods, due to the pond and creek nearyby.
0	Graystone court	2				4		4	2	0	0	0	2	1	1	4	2	1	Not sure this even applies, but when raining hard, the sump pump couldn't keep up and the basement flooded. This happened once.
0	Graystone court	1						5	2	0	0	0	2	1	1	4	2	1	
0	Graystone court	1						5	2	0	0	0	3	1	1	1	2	1	
0	Graystone court	1						5	2	3	3	3	2	1	1	3	2	1	
2800	Greenfield Rd	1						5	2	3	3	3	2	1	3	1	2	1	
2800	Greenfield road	1						5	2	0	0	0	2	1	1	3	2	1	
1200	Greenlawn Dr	1						5	1	2	2	3	1	1	5	4	2	1	
100	Greenleaf Dr	2		2				1	0	0	0	0	2	1	1	1	2	1	
100	Greenleaf Dr	1						2	2	2	0	0	2	1	3	1	2	1	Q2: not anymore - installed dewatering system 2009. Q3: Previous. Q17: I had water on several occassions. Had a dewatering system installed on the inside of lower level and in the crawl space. Have not had any problem since.
200	Greenleaf Drive	4	1					4	2	0	0	0	3	1	5	1	2	1	During heavy or large amounts of rain water stands on our back property line where the fence is. It also mainly stays in the area of the back corner where the pine tree is and is on our neighbor's property also. When rain stops it will eventually go away.
200	Greenwood Ave.	2	1			4		4	2	0	0	0	2	1	1	1	2	2	This property is Radio station WJBC and is on a septic system. Several years ago before the system was reworked we had a back up that was not storm related. We did have a storm related basement flooding, I believe in the winter of 2002, when the sump pumps could not keep up with the ground water.
2400	Grey Fox Trail	1						5	2	0	0	0	3	1	5	4	2	1	n/a
2400	Grey Fox Trail	1						5	2	0	0	0	2	1	1	3	2	1	
0	Greythorne Circle	1						5	2	0	0	0	2	1	2	3	2	1	
400 N	Gridley	1						5	2	0	0	0	2	2	0	0	0	1	N/A
600 S	Gridley	1						5	2	3	3	3	2	2	0	0	0	0	
700 S	Gridley	4	1	2	3			4	1	2	2	2	2	2	0	0	0	0	The water comes from Rail Road tracks. It floods the road and my yard.
500 S	Gridley Street	4	1					4	2	0	0	0	2	2	0	0	0	1	for the last 3 months, we have had a constant puddle/stream on the side of our driveway. We do not have any water in the basement, do not know where this water is coming from.
300 E	Grove	1						5	2	3	3	3	2	2	0	0	2	0	
1200 E	Grove	5		2				4	2	0	0	0	2	2	0	0	0	1	Street floods on north side of Grove just opposite our property at 1207 E. Grove. This has been the case for years. During very heavy rains the flooding will reach the middle of the street and sometimes stretch across the street.
1400 E	Grove	1						5	2	0	0	0	2	2	0	0	0	1	
1000	Grove St	1						5	2	3	3	3	2	2	5	5	2	1	
300 E	Grove St	1						5	2	0	0	0	2	2	0	0	0	2	
400 E	Grove St	4		2				3	2	0	0	0	2	1	2	1	2	1	Storm drain on northeast side of Grove/Gridley intersection seems inadequate to handle volume of runoff on Grove St. During heavier rainfalls. Water is often standing in the street covering a large percentage of the intersection for several minutes after rain has stopped. Water frequently covers the parkway area in front of 402 Grove near the intersection.
400 E	Grove St	1						0	2	0	0	0	2	2	0	0	0	1	
500 E	Grove St	1						5	2	0	0	0	2	2	0	0	0	1	
500 E	Grove St	2				4		4	0	0	0	0	2	2	0	0	0	1	
600 E	Grove St	4		2				1	2	0	0	0	2	2	0	0	0	1	The inlet on my corner was replaced a few years ago and the elevation is to high. The grate also has no overflow and gets plugged up everytime it rains. It used to work just fine before you changed it. The street floods during heavy rains several times a year.
700 E	Grove St	1						5	2	0	0	0	2	2	0	0	0	1	
800 E	Grove St	1						5	2	3	3	3	2	2	0	0	0	1	
800 E	Grove St	1						5	0	2	0	0	3	0	0	0	0	1	
800 E	Grove St	5				4		4	2	2	0	0	2	2	0	0	0	2	Q2 Heavy rains only

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1100 E	Grove St	1						5	2	0	0	0	2	2	0	0	0	1	no flooding
1200 E	Grove St	0						0	0	0	0	0	0	0	0	0	0	0	Q1: Vacant Lot
1300 E	Grove St	4	1					2	2	0	0	0	2	2	0	0	0	2	Sewer backup caused by MY broken sewer pipe between my house and the street. Backyard flooding occurs as I have a low spot in the yard and the water flow is to my backyard.
1300 E	Grove St	2				4		1	2	2	2	3	2	1	3	1	2	1	
1300 E	Grove St	3				4		5	2	2	0	0	2	2	0	0	0	0	
1300 E	Grove St	2		2		4		4	2	0	0	0	3	1	2	1	2	1	Q11: X2
1400 E	Grove St	2						5	1	2	2	2	2	1	3	5	2	1	Q2: 10 years. Not for many years. No problem.
1400 E	Grove St	2				4		5	2	2	3	3	2	2	0	0	0	1	
1500 E	Grove St	3	1					2	2	0	0	0	2	2	0	0	0	1	The water than drains from the paved alley onto our adjoining driveway is the only problem.
1500 E	Grove St	1						5	2	0	0	0	2	2	0	0	0	1	
1500 E	Grove St	2						5	2	3	3	3	2	2	0	0	0	1	Q2: Never since the city resurfaced Grove St. over 10 years ago Q10: House built in 1910 Q17: No problems
1500 E	Grove St	3	1			4		4	2	0	0	0	3	1	2	2	2	1	Several times over the years when a Flood Warning was in effect, I've had water come through the basement walls and floor. The toilet in the basement frequently has difficulty flushing.
500 W	Grove St	1						5	2	3	3	3	0	0	0	0	0	1	
500 W	Grove St	1						5	2	2	3	0	2	2	0	0	0	1	
500 W	Grove St	5		2				2	2	2	3	3	2	2	0	0	0	1	
500 W	Grove St	4	1	2		4		4	1	0	0	0	2	2	0	0	0	2	Q2: Street floods up thru drive way/yard. No drain in basement, but some water on walls. Q4: The whole time there is rain. Q17: Everytime there is a hard rain and water stands in street and yard - our floor is damp (no drain in basement).
800 W	Grove St	4				4		2	2	0	0	0	2	2	0	0	0	1	
900 W	Grove St	1						5	2	0	0	0	2	2	5	4	2	1	
1100 W	Grove St	1						5	0	0	0	0	2	2	0	0	0	1	
1400 W	Grove St	4		2				4	2	2	3	3	2	2	0	0	0	2	Street curb drains get clogged frequently. Street cleaner does not clean street well.
500	Guido Circle	2						5	2	2	2	2	2	2	0	0	0	0	
1400	Guiness Dr	1						5	2	0	0	0	3	1	4	4	2	1	
1900	Hackberry Rd	4	1			4		3	2	3	3	3	2	1	3	1	2	1	
1900	Hackberry Rd	2	1					3	2	2	3	3	2	2	0	0	0	1	
1900	Hackberry Rd	1						0	0	0	0	0	0	0	0	0	0	0	
2100	Hackberry Rd	2		2				4	2	0	0	0	2	2	0	0	0	1	Street floods if get very heavy rain
2100	hackberry road	1						5	2	0	0	0	2	1	3	1	2	1	NA
2600	Hall Court	3						5	0	0	0	0	3	1	2	3	2	1	
2600	Hall Court	4	1					2	2	0	0	0	2	1	2	1	2	1	It involves a small amount of ponding in the rear yard after very heavy rainfall.
2600	Hall Court	1						5	2	0	0	0	2	1	5	1	2	1	
2600	Hall Court	2	1					3	2	0	0	0	2	1	3	4	2	1	
2600	Hall Court	4	1					4	2	0	0	0	2	1	2	1	2	1	Q2: during heavy rains
1700	Hamilton Rd	1						5	2	0	0	0	2	1	3	4	2	1	
400 W	Hamilton Rd	1						5	2	0	0	0	2	1	1	4	2	1	We hooked up to the city sewer in the fall of 2011. we are at one of the highest points in B/N so flooding is not a problem.
700 W	Hamilton Rd	1						5	2	3	3	3	2	2	0	0	0	1	
1700 E	Hamilton Rd.	1						5	2	0	0	0	2	2	0	0	0	1	
200	Hampton Dr	1						5	2	0	0	0	2	2	0	0	0	2	The city frequently maintains the sewer as we see the trucks regularly.
200	Hampton Dr	2	1	2				3	2	0	0	0	2	1	1	1	2	1	
600 S	Hannah St	5	1			4	5	4	2	0	0	0	1	1	3	1	2	3	Have standing water outside of house on north side when it rains. It come into the basement from north wall and drains out floor drains. When it rains hard, the water comes up from floor drains. That's why I put in a sump pump a few years ago after I moved here. My new furnace down in the basement got flooded out, from drains backing up.
600	Hannah St.	4					5	2	1	2	3	3	2	2	0	0	0	4	When there is a hard fast rain, the street floods bad and then enters the basement through the drains. When the St. clears the water and or sewage subsides within the hour. Someone from the City was here last year & said it was our problem, even though all the neighbors have said they have the same problem..
600	Hannah St.	4					5	1	2	0	0	0	2	2	0	0	0	3	Occurs during heavy rain
0	Harbor Point Ct	1						5	0	3	3	3	2	1	1	5	2	1	My sump pump seems to run much more than my very close neighbors.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Harbor Pointe Cr	2	1					4	2	0	0	0	3	1	5	3	2	1	Back yard has flooded a couple of times when the drain gets covered with debris.
0	Harbor Pointe Cr	1						5	1	3	2	2	2	1	2	1	2	1	
0	Harbor Pointe Cr	2				4		2	2	2	2	2	2	1	1	1	2	1	All That happens is that the area about one foot from the basement wall may get wet. All of the occurrences seem to be linked to a sump pump problem (float valve got stuck in off position, sump pump died, etc.)
0	Harbor Pointe Cr	5						5	1	2	2	2	0	1	1	1	1	1	Q5: retention basin Q14: rarely
0	Harbord Dr	3	1	2				2	2	0	0	0	3	1	2	1	2	1	Q4: during very heavy or rapid rainfall Q11: at front of home Q17: Durning havy rain, water accumulates outside backdoor of home. (Low area/ High clay soil) There is standing water also along the curbs on harbord Drive fom time to time. I believe some work was done recently on sewer at Maizefield and Harbord, which may have fixed this.
0	Harbord Dr	1						0	2	3	3	3	2	2	0	0	0	1	
0	Harbord Dr	4		2		4		5	2	2	2	2	3	1	5	1	2	1	Basement would have water through cement block. Installed dewatering/sump pump system in basement because of frequent water.
0	Harrison Court	1						5	2	0	0	0	2	1	3	4	2	1	I don't have any problems.
0	Harrison Ct	2				4		4	2	3	3	3	3	1	1	4	2	1	
0	Harrison Ct	5		2				5	2	2	3	3	3	1	2	3	2	1	
0	Harvest Ct	1						5	0	2	3	3	2	1	1	1	2	1	
0	Harwood Pl	1						5	2	3	3	3	2	2	0	0	0	1	No flooding problem but info furnished if it will be helpful to you.
0	Harwood Pl	1						2	2	2	2	2	2	2	0	0	0	1	
0	Harwood Pl	1						5	2	0	0	0	2	2	0	0	0	1	
0	Harwood Pl	2				4		3	2	0	0	0	2	2	0	0	0	1	
900	Hastings Dr	1						0	2	2	0	0	2	2	0	0	0	1	none
900	Hastings Dr	1						5	2	3	3	3	2	2	0	0	0	1	no basement
900	Hastings Dr	1						5	2	3	3	3	2	1	0	1	2	0	
100	Hawthorne Lake Dr	1						5	2	3	3	3	3	2	0	0	0	1	No Sewer back-up problems. Did want to mention that we do have drainage isssue when it rains in the back yard. The ground stays very wet until ti drains into the ground permanently.
100	Hawthorne Lake Dr	2	1					3	2	0	0	0	2	2	0	0	0	1	
100	Hawthorne Lake Dr.	1						5	2	0	0	0	2	2	0	0	0	1	N/A
100	Hawthorne Lake Driv	4	1					4	2	0	0	0	2	2	0	0	0	1	We only have about two inches of black dirt under the grass and then there is hard clay. This makes it impossible to have good drainage when there is a heavy rain. Some years ago greedy contractors scaped off most of the black dirt so they could sell it to others.
2600	Hayes Ln	1						5	2	0	0	0	2	1	1	4	2	1	
0	Hayloft Rd	1						5	2	0	0	0	2	1	3	3	2	1	
0	Hayloft Rd	1						5	1	2	2	2	2	1	2	5	2	1	No flooding or sewer backups.
0	Hayloft Rd	4	1					3	2	0	0	0	2	1	2	3	2	1	Flooding occurs at the back of the lot in the "interior of the block" so to speak. The standing water during moderate rainstorms has increased in the last 10 years. We are the original property owners, homes on block are all 19 years old. For the first nearly 10 years the sump pump in our home never ran, regardless of the amount of rain. Now it does run several times a day during rain storms.
300	Hazel St	4	1					4	1	2	3	2	2	2	0	0	0	0	The ditch in front of the property needs to be graded and seeded.
0	Hearthstone Ct.	1						5	2	0	0	0	2	1	1	3	2	1	
700	Heather Hill Rd	3					5	1	2	2	2	2	2	1	2	5	2	1	
700	Heatherhill Rd	1						5	2	0	0	0	2	1	2	1	2	1	
1900	Hedgewood Dr	2	1	2				4	2	0	0	0	2	1	1	4	2	1	2. No flooding inside house. Possible over ten years ago some occured. 3. Surface water from other yards comes into our yard because of debris and lay of land...but does not cause problem. 4. Water outside in street due to patch work done on street. Not flooding but bad design. Major problem: Our subdivision was built with a gravity flow storm water drainage system. The connection of our house to this drainage appears to be disconnected or stopped up. We do not know where the connection is. We would like to be able to connect it. This would stop much of the sump pump action.
2000	Hedgewood Dr	1						5	2	0	0	0	2	2	0	0	0	1	
2000	Hedgewood Dr	1						0	0	0	0	0	2	1	4	1	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2100	Hedgewood Dr	2	1					4	2	0	0	0	2	1	1	3	2	1	Basement flooded one time about 4 years ago when sump pump stuck. Otherwise, only thing is puddles in back yard with rain - better now because dirt was added to low areas of yard.
2200	Hedgewood Dr	1						0	0	0	0	0	0	0	0	0	0	1	
2200	Hedgewood Dr	1						5	2	0	0	0	2	1	1	1	2	1	
2200	Hedgewood Dr	1						5	2	3	3	3	2	2	0	0	0	1	
3700	Helen dr	4	1					2	2	0	0	0	3	1	1	1	2	1	Every time we have a heavy rain, the NW corner of my property floods. I have put in a drainage system and a water garden in that corner and it has helped manage the problem.
17600	Hepatica Ln	1						5	2	0	0	0	1	1	2	3	2	1	n/a - No flooding problems.
400 N	Hershey Rd	0						0	0	0	0	0	0	0	0	0	0	0	
1200 N	Hershey Rd	3			3		5	0	1	2	0	2	1	3	0	0	0	1	
1200 N	Hershey Rd	1						5	2	0	0	0	2	1	3	3	2	1	
1500 N	Hershey Rd	3	1			4	5	3	2	0	0	0	2	1	1	1	2	2	Several years ago water spewed up at least a foot in the air from sewer drain. Entire basement flooded with at least 6 inches of water. A couple of times too much rain at once caused sump pump not being able to keep up.
100 S	Hershey Rd	1						5	2	0	0	0	2	1	2	1	2	1	
100 S	Hershey Rd	1						0	0	0	0	0	0	1	4	1	2	1	
200 S	Hershey Rd	1						5	2	0	0	0	2	1	3	1	2	1	
200 S	Hershey Rd	1						0	2	0	0	0	2	1	3	3	2	1	
200 S	Hershey Rd	1	1					5	2	0	0	0	2	1	2	1	1	1	
200 S	Hershey Rd	1						0	2	0	0	0	2	1	1	1	2	1	
300 S	Hershey Rd	2		2				2	2	3	3	3	2	1	1	3	2	0	
300 S	Hershey Rd	1						5	2	3	3	3	2	1	1	1	2	1	
1300 S	Hershey Rd	1						0	1	2	1	2	2	1	1	1	2	1	Creek erosion is on the north side of creek where a drain pipe has broken off and is laying next to creek.
200 S	Hershey Road	4	1				5	4	2	0	0	0	2	1	1	1	2	3	During rainy periods, the backyard floods in low areas abutting the Utility Easement and often takes several days to percolate/evaporate. The basement floor drain erupted with backflow during heavy rains (1986 or 1987) and filled the entire basement with 4 inches of water. Have not had a re-occurence since then.
18300	Hiawatha Ln	1						5	2	0	0	0	1	1	1	1	2	1	
25300	Hiawatha Ln	1						0	2	2	3	3	1	2	0	0	0	1	
2000	Hidden Lake	1						5	2	0	0	0	3	1	5	4	2	1	
2000	Hidden Lake	1						5	2	0	0	0	2	1	3	1	2	1	
0	Hidden Lake Ct	1						5	2	0	0	0	2	1	1	1	1	1	
0	Hidden Lake Ct	1						0	2	0	0	0	2	1	3	1	2	1	
2000	Hidden Lake Dr	1						0	2	0	0	0	2	1	2	1	2	1	
2000	Hidden Lake Rd	1						5	2	3	3	3	3	1	1	1	2	1	
300	Hillside Court	1						5	2	0	0	0	2	1	1	1	2	1	Although we haven't had an actual sewer backup, there was one occasion a few years ago when our toilets wouldn't flush and the city found a clogged sewer line down the line from us.
200	Hillside Ln	1						5	2	0	0	0	2	2	0	0	0	0	Q15: no basement
200	Hillside Ln	1						5	2	0	0	0	2	2	0	0	0	1	Q15: tri-level house
300	Hillside Ln	3	1					0	2	2	2	2	2	1	0	1	1	1	Q4: after end of rain Q12: durning/ after heavy rains Q14: end of driveway and in street Q17: Our probery address is 307 Hilside Ln. Atp building at 310 and 312 Riley Dr have their drains spouts directed downhill into our backyard. During heavy down pours their drainage comes into our yard. This is legal but I would like wome alternate route for this water.
300	Hillside Ln	4		2				1	0	0	0	0	2	2	5	1	0	2	
300	Hillside Ln	1						5	2	3	3	3	2	1	2	1	2	2	Sever backup has only occurred when we had claytile. After replacing the clay tile with PVC we have not had any more backups.
300	Hillside Ln	4	1					4	2	2	0	0	2	1	2	1	2	1	
100	Hilltop Rd	1						5	2	0	0	0	2	2	0	0	0	1	No problem
1100 N	Hinshaw Ave	2					5	0	0	0	0	0	2	2	0	0	0	3	
1100 N	Hinshaw Ave	2				4		1	2	0	0	0	2	2	0	0	0	1	
800 S	Hinshaw Ave	3				4		0	2	3	3	3	2	1	1	1	2	1	Ours is more water seepage into the 1/2 basement when the ground is extremely saturated. We have a sump pump that takes care of most of the water, but occasionally we have had to use a water vacuum and a fan to dry the basement. We have never had ar extreme amount of water in the basement.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1000 S	Hinshaw Ave	1						5	2	0	0	0	2	2	0	0	0	1	
1200 S	Hinshaw Ave	1						5	2	3	3	3	2	1	2	1	0	1	
1200 S	Hinshaw Ave	1						5	2	0	0	0	2	2	0	0	0	1	I live at the top of a hill. My basement does not flood.
1300 S	Hinshaw Ave	2	1		3			2	1	2	1	1	2	1	3	1	2	1	Flooding is rare now. Erosion is problem here. It has gotten extremely bad since the draining of Miller park which the water level was very high but did not come out of the banks but has bared tree roots and the creek is a lot wider then it has ever been (family /myself has owned property since the 1950's) It is beginning to erode into other lots.
1300 S	Hinshaw Ave	1						5	1	2	1	2	2	2	0	0	0	1	
1300 S	Hinshaw Ave	2	1		3			2	1	2	1	1	2	2	0	0	0	1	Was raised in the property and own it now. The creek has came out of banks in past years but hasnt recently but there is now extreme erosion on both sides of creek at 1311 and 1305 as i own both properties and the erosion is starting to enter another lot other then the lot the creek is located on.
1300 S	Hinshaw Ave	1						5	2	3	3	3	2	2	0	0	0	1	
1100 W	Hinshaw Ave	2	1					2	2	0	0	0	2	2	0	0	0	2	They were doing sewage clean out with the vactor truck that day - later that night a very heavy rain came trhough and we had a litte back up in the basement floor drains.
0	Hodgehaven Cir	1						5	2	0	0	0	2	1	1	3	2	1	
0	Hodgehaven Cr	2						5	2	3	3	3	2	1	1	3	2	1	I have lived in this house for 13 years. Twice during that time the float on the sump pump got stuck and caused minor flooding in part of the basement. There was no property damage either time. I believe this occurred in 2005 and 2010.
0	Hodgehaven Cr	1						0	2	0	0	0	3	3	5	4	2	1	
0	holder way	1						5	2	0	0	0	2	1	1	4	2	1	
1300	Holiday Dr	1						5	2	0	0	0	3	1	2	1	2	1	
1400	Hollycrest Dr	4				4		2	2	0	0	0	3	1	0	4	2	1	
1400	Hollycrest Dr	1						5	2	3	3	3	2	1	3	3	2	1	
1100	Hollyridge Cr	1						5	2	0	0	0	2	1	3	3	2	1	
1100	Hollyridge Cr	1						0	2	0	0	0	2	1	1	1	2	1	
1100	Holyridge Cr	1						0	2	0	0	0	2	1	3	1	2	1	
0	Humanity Ln	4		2		4		3	2	0	0	0	3	1	2	1	2	1	
2800	Huntington Rd	2					5	4	2	2	3	3	1	1	2	4	2	2	
2800	Huntington Rd	4	1					4	2	0	0	0	2	1	3	5	2	1	Since we built back in 93, the subdivision has had ongoing flooding issues in the back yards. The build came back and put in a sewer line with drains every other house through the back yard and connected it to the storm sewer. On heavy rains, it seems the Storm sewer is overwelmed adn the yards backup.
3000	Hyacinth Dr	1						5	2	0	0	0	2	0	0	0	0	1	
700	IAA Dr	1						5	2	2	3	3	2	2	0	0	0	0	
500	IAA Dr Ste 6A	1						0	2	0	0	0	1	2	0	0	0	1	
600	IAA Drive	3	1					4	1	2	1	2	2	2	4	5	2	1	NE Corner of parking lot drains into open ditch which sometimes backs up with heavy rain.
1600 W	Illinois	1						5	2	3	3	3	2	2	0	0	0	1	
0	Independence Sq	1						5	2	3	3	3	2	1	2	1	2	1	
0	Independence Sq	1						5	0	0	0	0	2	1	1	1	2	1	
0	Independence Sq	1	1					1	2	0	0	0	2	1	1	4	2	1	
1700	Indiana St	2						1	2	3	3	3	3	3	0	0	0	0	2007 or 2008 tree roots broke tiles in sewer causing back up ino shower.
1600 W	Indiana St	1						5	0	0	0	0	2	2	0	0	0	0	
1700 W	Indiana St	2	1		3	4		3	2	0	0	0	2	1	3	1	2	1	Q2: (3 yrs) on SO. Q3:Next door neighbor. Q4: depends. Q17: It has to rain steady for a couple days. I talked to Tornquist as they were digging foundation next door (to the east) But what's new, Habitat for Humanity does as they please and has no regard for outcome of their action and then lie about it. Q18: I don't know why, since Habitat and Tonquist created the problem.
1300	Inglewood Cr	1						5	2	3	3	3	2	2	0	0	0	1	Q17: Although I have not had flooding at my address, there is a poor drainage issue at the NE corner of our condo association. Along GE Rd. Please be aware of the need for addional drainage immediately South of GE rd/East of 1417 Inglewood Cr. Thanks!
1300	Inglewood Cr	1						5	2	0	0	0	2	2	0	0	0	1	no problems
0	Inglewood Ln	1						5	2	3	3	3	2	2	0	0	0	1	
0	Inglewood Ln	1						5	2	3	3	3	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Inglewood Ln	1						5	2	0	0	0	2	2	0	0	0	1	
0	Inglewood Ln	1						5	2	0	0	0	2	2	0	0	0	1	Never experienced any flooding at this location.
0	Inglewood Ln	5	1					4	2	0	0	0	2	2	0	0	0	1	I have drainage problems from the property behind me.The swail to allow adequate drainage is not effective. The property behind me sits higher than my property and heavy rains continually create a flooding issue in my back yard. The water lays in my back yard and does not drain. I have continual issues with replacement of landscaping due to standing water.
0	Inverness Dr	4	1					3	2	0	0	0	2	1	1	3	2	1	After serious rains and especially in the spring, water will stand around the back and two sides of our house. Often the ground stays so soggy we have to wait a few weeks before we can mow the grass in those areas. The lot behind us is higher than our lot so the rain washes down toward us; also their sump pump empties into their yard which then flows onto our lot adding more water.
0	Inverness Dr	1						5	2	0	0	0	2	1	1	3	2	1	Problem began to get worse 3-4 years ago. Years ago pump only ran after rain. It now runs almost continuously. We really need resolution to this.
2000	Ireland Grove Rd	5			3			4	2	2	1	2	2	2	0	0	0	0	Q3: My wonderful neighbors put all their water on me plus. Ireland Grove Road and Brickyard Drive. Q5: Near Q7: near business
2900	Ireland Grove Rd	4	1		3			4	2	0	0	0	2	0	3	1	2	1	
3300	Ireland Grove Rd	1						5	2	3	3	3	3	3	0	0	0	1	n/a
2000 E	Ireland Grove Rd	4	1	2				3	2	0	0	0	2	2	0	0	0	5	When it rains the sewer right in front of building can't handle all the water it backs up and comes right in store. We have been having this problem for years.
3000	Iris Way	1						5	2	0	0	0	2	2	0	0	0	1	
200	Ivanhoe Way	1						0	2	0	0	0	0	2	0	0	0	1	
200	Ivanhoe Way	2				4		4	2	0	0	0	1	1	5	1	2	2	
200	Ivanhoe Way	2	1			4		4	2	2	3	3	2	2	0	0	0	2	
0	Ivey Ct.	1						5	2	0	0	0	2	1	1	1	2	1	NONE
#VALUE!	Jackson St	0						0	2	0	0	0	2	1	3	1	2	1	I have installed a basement dewatering system. Also installed larger gutters and down spouts.
500 E	Jackson St	3					5	4	2	0	0	0	2	2	0	0	0	4	Q5: our property is nt even adjacent to a sewer. Q17: The city has known about our sewer issues since sping 2008, and refuses to do anything about it. This would require them to install a sewer in the 500 block of E Jackson, so I can run a new line. This project is shovel ready, but never makes the budget. (but the Country Club gets a new water line). My sewer is 92 years old, is attached to my neighbors, and exits at Evans and Mill. My patience is running out.
1100 E	Jackson St	1						0	0	0	0	0	0	0	0	0	0	0	
1100 E	Jackson St	0		2				4	2	3	3	3	2	2	0	0	0	1	Q4: sometimes Q17: The flooding is at the inlets. They were not properly installed. The inlet pans are too shallow which causes the grates to clog up.
1100 E	Jackson St	1						5	2	0	0	0	2	2	0	0	0	1	
1400 E	Jackson St	3	1			4		4	2	0	0	0	2	2	0	0	0	2	
1500 E	Jackson St	1						5	2	3	3	3	3	2	0	0	0	1	
2000 E	Jackson St	3	1					4	2	0	0	0	2	2	0	0	0	2	It occurred 2 years ago on a Sunday morning. I believe it was the after effect of a hurricane. It rained a lot the night before.
2000 E	Jackson St	3	1	2		4	5	4	2	0	0	2	2	1	0	5	2	4	If we have heavy rains everyone on our block floods and Lowes, Menards and Best Buy sell out of o sump pumps. This is a citywide issue. Put tax money towards addressing this issue instead of pensions
2000 E	Jackson St	4				4		3	2	2	3	3	3	1	3	4	2	1	When it rains heavily I often experience flooding / water puddles on the west and south side of my basement. This happen sduring med-heavy rains.
2100 E	Jackson St	1						5	2	3	3	3	2	2	0	0	0	2	The sewer backup happened because of the gutters running into the sewer line. When that was changed many years ago, the problem was solved.
2100 E	Jackson St	1						5	2	0	0	0	2	2	0	0	0	1	
2100 E	Jackson St	1						5	2	3	3	3	2	2	0	0	0	0	no basement
2200 E	Jackson St	3					5	2	2	0	0	0	2	1	1	1	2	2	We get sewer backup when it rains hard (over 1 1/2 inches) and it comes up thru our basement shower and floor drains.
2200 E	Jackson St	1						5	2	3	3	3	2	2	0	0	0	0	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2300 E	Jackson St	1						5	2	3	3	3	2	1	3	1	2	1	Never had flooding in last 50 years
800 W	Jackson St	1						5	2	0	0	0	2	2	0	0	0	1	
800 W	Jackson St	2					5	5	2	0	0	0	3	1	5	4	2	1	
1100 W	Jackson St	1						5	2	2	3	3	2	1	3	0	2	1	
1300 W	Jackson St	1						5	2	0	0	0	2	2	0	0	0	0	
0	James Pl	1						0	2	0	0	0	0	2	0	0	0	1	
0	James Pl	1	1					1	2	0	0	0	2	2	0	0	0	0	No basement. I own on our corner on James and Clinton Blvd need to be fixed always flooding here.
1200	Janet Drive	1						5	1	2	2	2	2	1	1	3	2	1	
1300	Janet Drive	4	1					4	1	2	1	2	2	2	0	0	0	1	I live on Sapphire Lake and the lake bed is eroding. My lawn is constantly flooded in the summer due to poor drainage or sloping. I have had several people look at the situation and no one can figure out the source of the water. I think it is coming from the lake.
1000	JC Pkwy	1						5	2	0	0	0	2	2	0	0	0	1	
900	Jefferson St	5		2				4	2	2	0	0	2	2	0	0	0	1	This is at the Corner of Allin and Jefferson every time it rains the street drain does not drain for seveal hours.
800 E	Jefferson St	1						0	2	0	0	0	2	2	0	0	0	1	
1000 E	Jefferson St	0				4		0	2	0	0	0	2	1	2	1	2	1	Doesn't flood, just get water. Water in one room in basement in opposite corner to the existing sump pump. Put on new gutters, waiting to see if they (gutters) fix the problem. Basement dewatering person says gutters will not fix the problem. He says it is the water table. Water in blocks in south wall. Waiting for rain sufficient to prove problem cause. Sorry to ramble. - Dorothy
1000 E	Jefferson St	1						5	2	0	0	0	2	2	0	0	0	1	
1100 E	Jefferson St	1						5	2	3	3	3	2	2	0	0	0	0	
1200 E	Jefferson St	1						0	2	0	0	0	0	2	0	0	0	0	
1200 E	Jefferson St	1						5	0	3	3	3	2	2	0	0	0	1	
1200 E	Jefferson St	0						0	2	3	3	3	2	2	0	0	0	0	
1200 E	Jefferson St	4	1	2		4	5	4	2	0	0	0	3	1	2	4	1	1	i get water in the basement when there are heavy rains or if the ground is already saturated and we get rain. Standing water in the street by the curb occurs as well.
1200 E	Jefferson St	3	1			4		3	2	0	0	0	3	1	3	3	2	2	Mostly problems with water entering basement through the seam between walls and floor. Sump pumps in basement do a pretty good job. Most problems resolved when realized second sump pump wasn't working and was fixed. Worst flooding nearby we've noticed is Washington St. in the 1200 block, sometimes becomes impassable.
100 W	Jefferson St	1						5	2	0	0	0	2	2	0	0	0	1	
200 W	Jefferson St	1						5	2	3	3	3	2	2	0	0	0	2	
800 W	Jefferson St	1						0	2	0	0	0	2	2	0	0	0	0	
800 W	Jefferson St	1	1					5	2	0	0	0	2	2	0	0	0	1	
800 W	Jefferson St	5					5	4	2	3	3	3	2	2	0	0	0	1	The flooding is on the south and east side of the basement in the laundry room. It comes through the wall and floor meet when the rain is heavy.
900 W	Jefferson St	1						0	2	0	0	0	2	2	0	0	0	1	
1100 E	Jefferson St.	5		2				4	2	0	0	0	1	2	0	0	0	1	the flooding occurs in the street because the asphalt ends at the brick but after the drain. This results in the end of the asphalt acting as a dam and not allowing the water to drain. Also, the drains get clogged with debris on a regular basis.
2200	Jessamine Rd	1						5	2	0	0	0	2	1	3	3	2	1	Q16: N/A Q18: N/A
0	Jill Ct	5				4		4	1	2	2	2	2	1	1	1	2	1	Any time it rains the sump pump runs for days after the rain stops. If I didn't have a sump pump basement would flood after every rain. Basement flooded once in very heavy rain because the sump couldn't keep up.
0	Jodi Ln	2						5	2	0	0	0	1	1	2	1	2	3	Q3: sump pump failure.
1300	Jolene	1						5	2	0	0	0	0	1	2	3	2	1	Q12: maybe several times per hour
3000	Joseph St	1						5	2	0	0	0	2	2	0	0	0	1	
0	Joslin Court	1						5	2	0	0	0	2	1	2	1	2	1	No flooding/backup experienced as of yet.
0	Joslin Ct	4	1					4	2	0	0	0	2	1	1	4	2	0	when we receive heavy rains there is standing water in the backyard & side yard.
0	Joslin Ct	1						5	2	0	0	0	2	1	2	3	2	1	I've only had water in my basement once in the 16 years I've lived here and that was due to a stuck float on my sump pump.
1500	Julie Dr	1						5	2	3	3	3	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1500	Julie Dr	2					5	5	2	0	0	0	3	1	5	1	2	2	
1500	Julie Dr	2				4		0	2	0	0	0	2	2	0	0	0	1	
1500	Julie Dr	1						5	2	3	3	3	2	2	0	0	0	1	
1500	Julie Dr	3		2				3	2	0	0	0	3	1	2	1	2	1	Q3: along the curb only
2000	Juniper Lane	1						5	0	1	2	3	1	1	1	1	2	1	
2000	Juniper Lane	1						5	2	0	0	0	2	2	0	0	0	1	
2700	Kaisner Dr	1						5	2	3	3	3	2	1	2	3	2	1	
2500	Kara Xing	1						5	2	0	0	0	2	1	1	4	2	1	We have lived at this address since June 2010 and have not experienced any flooding during that time.
0	Keisha Dr	1						5	2	3	3	3	2	2	0	0	0	1	I have no flooding problems
1500	Kell Ave	4	1					2	1	1	2	3	2	1	4	4	0	1	When we moved to The Grove we had flooding problems in 2008-2009-2010. Water ran off field to west of our home and gathered around one drain and stood in the ditch between our neighbors house and ours. An additional drain was put in our neighbor's yard. The problem seems to be under control
1500	Kell Ave	1						5	2	0	0	0	2	1	4	3	2	1	
100 E	Kelsey	1						5	2	0	0	0	2	2	0	0	0	1	
300 W	Kelsey	1						0	2	0	0	0	2	1	0	1	2	1	I have a basement dewatering system. Water pools at the end of the driveway and does not drain into sewer. Grade is bad!
400 W	Kelsey	1						5	2	3	3	3	2	2	0	0	0	1	
200 W	Kelsey St	1						5	2	3	3	3	2	1	5	2	2	1	
500 W	Kelsey St	1						5	2	0	0	0	2	2	0	0	0	1	
300 W	Kelsey St.	1						5	2	0	0	0	2	2	0	0	0	2	I only have backup if I don't have tree roots removed so it is not a real flooding problem.
0	Kenfield Cr	4	1			4		4	2	2	0	0	2	1	4	4	2	1	Standing Water in low areas of yard. Frequent drainage to street sloppy areas between yards.
0	Kenfield Cr	1						5	2	0	0	0	3	1	4	1	2	1	no flooding problem
0	Kenfield Cr	2	1	2	3			2	1	2	1	2	2	2	0	0	0	1	
0	Kenfield Cr	4		2				3	2	0	0	0	2	1	1	1	2	1	
0	Kenfield Cr	1						5	2	0	0	0	0	1	1	1	2	1	If I ever do have a flooding problem after this survey, I will hold "you" responsible. Because in 26 years-never flooding here!!!
0	Kenfield Cr	3	1					3	2	0	0	0	2	1	1	4	2	2	Backup occurred December 2010 and was only in basement back room. Had to have a new sewer line dug and installed from house to city sewer hookup.
1300	Kenneth Dr	1						5	2	0	0	0	2	1	1	1	2	1	
1300	Kenneth Dr	1						5	2	3	3	3	2	1	1	1	1	1	
1300	Kenneth Dr	1						5	2	0	0	0	3	1	2	1	2	1	
1300	Kenneth Dr	2		2				1	2	0	0	0	2	1	1	1	2	1	On rare occasions when it rains very heavily, the storm sewer at the corner of Kenneth and Ann will back up and water will get to be maybe a foot deep at deepest on the street at the corner. It has happened about twice in the last 15 years
0	Kensignton Cr	1						5	1	2	2	3	2	1	3	1	2	1	
0	Kensington Cr	1						1	2	0	2	2	2	1	3	1	2	1	
0	Kenyon Court	1						5	2	3	3	3	2	2	0	0	0	1	
0	Kenyon Court	4		2				2	2	2	2	2	2	2	0	0	0	1	
1600	Keybridge Way	1						5	2	0	0	0	3	1	1	1	2	1	Q2: I have lived here for 4.5 years.
1600	Keybridge Way	1						5	2	3	3	3	2	1	3	3	2	1	
2700	Keystone Rd	4	1					2	2	0	0	0	2	1	1	3	2	1	Flooding occurs on our back property line almost every time it rains. The water is supposed to flow between the property lines behind the houses and onto the street, but it doesn't work as designed.
2800	Keystone Rd	5	1					4	2	0	0	0	2	1	1	1	2	1	There was no drainage tile install on the property line between our house and the houses behind us. Our yard will flood anywhere from about 5 feet into our yard to 30/40 feet during a heavy rain. The depth of the water is anywhere from about 1/2 inch to 3 or 4 inches during a heavy rain. The yard also floods every time the neighbors drain their pools or back-flush their pools.
#VALUE!	Keystone Rd	1						5	2	3	3	3	2	1	2	3	2	1	
2800	Keystone Road	4	1					4	2	0	0	0	2	1	1	3	2	1	We have had a persistent flooding problem (3-8 inches) in our backyard when heavy rains hit. This is because there is not proper drain installed at the bottom of our slope. Approximately 5 homes are affected by this water with our house being most heavily affected because of how flat the back of our yard is. A simple drain would fix this persistent problem.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1300	Kickapoo Creek Rd	1						5	2	0	0	0	3	3	5	4	2	1	
18300	Kickapoo Ln	5			3	4		2	2	0	0	0	2	1	1	1	2	1	Q2: if heavy rain Q3: water drains on my property from homwe to west and across the street. Q11: two Q13: and drains to lake Q17: no photos or videos. Surface drainage from houses across the street. We have terraced area infront of house to try to slow it down. Also installed drain in front of garage and new footing tiles down west of house. No luck!
18400	Kickapoo Ln	2					5	5	2	0	0	0	3	1	5	4	2	1	
1200	Kim Dr	1	1					4	2	3	3	3	2	1	1	1	2	1	
1200	Kim Dr.	2				4		4	2	0	0	0	2	1	1	1	2	1	A crack in our driveway funneled rainwater into our basement. We had about 11 inches of rain that day. We have replaced our driveway and have had no flooding since.
1200	Kim Dr.	4	1			4		4	2	0	0	0	2	1	1	1	1	2	My sump pump will run every 30 seconds for many days after a few inches of rain. My back yard also collects water after several inches of rain.
1200	Kim Dr.	0						0	0	0	0	0	0	0	0	0	0	0	
1300	Kim Dr.	5	1					4	2	0	0	0	1	1	1	1	2	1	
2900	Kingsbury Court	1						5	2	0	0	0	2	1	4	1	2	1	
3200	Kirkwood Rd	1		2				4	2	0	0	0	3	1	2	4	2	1	The flooding occurs on the street (Hallsferry Rd) to the side of my house.
0	Kleggstone Circle	1						0	2	0	0	0	2	1	1	4	2	1	
0	Kleggstone Circle	2					5	0	2	2	3	2	2	1	1	3	2	2	Q2: As long as the sump pump works we all fine. If it did not, we would be flooded when we had a huge down pore. Q4: Don't know, we've kept sump pump in working order. Q10: 1 for everyday use and 2 backups. Q17: the sump pump is absolutely sessential during rainy season. Each pump is 2 1/2 gallon.
0	Kleggstone Cr	1						5	2	3	3	3	2	1	1	3	2	1	
0	KNOLLBROOK CT	1						5	2	0	0	0	2	1	3	4	2	1	
0	KNOLLBROOK CT	2	1					3	2	0	0	0	2	1	3	3	2	1	
2200	Knollbrook Way	1						0	2	0	0	0	2	1	2	5	2	1	
2200	Knollbrook Way	2						5	2	0	0	0	2	1	1	5	2	1	Sump pump takes care of things until the power goes out. basement flooded once in 5 years. But the sump does run nearly continuesly when it rains.
1600	Koch	1						5	2	3	3	3	2	2	0	0	0	1	
1200 S	Kock	2	1					2	2	0	0	0	2	2	0	0	0	0	I do not have any flooding problem.
2600	Kolby Ct.	1						5	2	2	3	3	2	1	2	3	2	1	
100	Kreitzer Ave	1						5	2	3	3	3	2	1	4	1	2	1	
200	Kreitzer Ave	1						0	2	0	0	2	2	2	0	0	0	1	
200	Kreitzer Ave	0				4		2	0	0	0	0	2	0	0	0	0	1	Water seepage through old basement brickwall
400	Kreitzer Ave	1						5	0	3	3	3	2	2	0	0	0	3	Had sewer back up once in the 27 years I've lived here.
400	Kreitzer Ave	2				4		0	2	0	0	0	3	1	5	1	2	0	Q4:don't know Q15:don't know
500	Kreitzer Ave	0		2		4		0	2	3	3	3	2	1	2	1	2	1	Q3: standing in street if sewers clogged, did enter house but no longer since installed a sump pump in 2008. Q10: put one in in 2008 3 months after I bought the hosue due to water in basement.
100 S	Kreitzer Ave	3				4		1	2	0	0	0	2	2	0	0	0	1	
500 S	Kreitzer Ave	3				4		1	2	2	3	3	2	2	0	0	0	1	During heavy rains - small trickles of water thru cracks in sidewalk at or around back door/foundation of house. Homeowner needs to have it repaired.
500 S	Kreitzer Ave	5				4		4	2	0	0	0	2	2	0	0	0	1	
0	Kylemore Rd	1						5	2	2	2	2	2	1	1	3	2	1	
1000	Laesch Ave	1						5	2	0	0	0	2	1	1	3	2	1	
1000	Laesch Ave	1						5	2	3	2	3	2	1	2	1	2	1	
1000	Laesch Ave	2						5	2	0	0	0	2	2	0	0	0	0	Wen we have excessive rains - we have noticed rain in crawl space
1000	Laesch Ave	1						0	0	0	0	0	2	2	0	0	0	1	Q15: No basement
1000	Laesch Ave	4	1					4	2	0	0	0	2	2	0	0	0	1	Q15: no basement Q17: sketch drawn on paper
1000	Laesch Ave	2	1					1	2	0	0	0	2	2	0	0	0	0	
1000	Laesch Ave	1						5	2	0	0	0	2	2	0	0	0	1	
1000	Laesch Ave	1						5	2	0	0	0	3	1	2	3	2	1	
0	Lafayette Ct	1						5	1	3	1	2	2	2	0	0	0	1	
0	Lafayette Ct	1						5	1	2	2	2	2	2	0	0	0	1	
700 E	Lafayette St	4	1					3	2	2	3	3	2	1	1	1	2	1	
1000 E	Lafayette St	1						5	2	0	0	0	2	2	0	0	0	1	
1100 E	Lafayette St	1						5	2	3	2	3	2	2	0	0	0	1	Q2: Commercial building - no basement Q11: no sump pump

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Lake Bluff Ct	1						5	2	0	0	0	3	1	1	4	2	1	
0	Lake Bluff Ct	1						5	2	3	3	3	2	1	4	3	2	1	
2000	Lake Bluff Rd	1						5	2	0	0	0	2	2	0	0	0	1	
2000	Lake Bluff Rd	1						5	2	0	0	0	2	1	1	1	2	1	na
2000	Lake Bluff Rd	1						5	2	0	0	0	2	1	3	1	2	1	
0	Lake Point Ct	1						5	2	3	3	3	2	1	2	5	2	1	
0	Lake Pointe Ct	1						5	2	0	0	0	3	1	2	5	2	1	
0	Lake Pointe Ct	1						5	2	3	3	3	0	1	3	3	2	1	
0	Lake Pointe Ct	1						0	2	0	0	0	2	1	1	3	2	1	
0	Lake Ridge Ct	2				4		2	2	2	3	3	2	1	4	1	2	1	
0	Lake Ridge Ct	1						5	2	0	0	0	1	2	0	0	0	1	
0	Lake Ridge Ct	1				4		5	2	0	0	0	2	1	5	4	2	1	
100	Lake St	1						0	2	0	0	0	2	2	0	0	0	1	
100 W	Lake St	1						5	2	0	0	0	2	2	0	0	0	1	We have never experienced flooding in our basement but we live on a hill and don't expect any
0	Lake View Pt	2	1		3			2	1	2	0	2	3	1	3	1	2	1	Q7: Unsure
0	Lake View Pt	4	1		3	4		4	1	2	1	2	2	2	0	0	0	1	Q2: 2-3 per year. Q17: When we moved here in ___(left blank) there was very little evidence of a drainage ditch behind our house. Now there is standing water in it all year. Heavy rains causes it to creep towards our property. I have seen the water level enter our yard a couple times.
0	LakeRidge Court	4	1					4	2	0	0	0	2	1	2	5	2	1	The only flooding I experience is at the back of my back yard, which is at the bottom of a hill.
2100	Lamon Dr	3				4		2	2	2	3	3	2	1	1	1	2	1	Q3: Slight. Q4: depends on amt of rain.
2300	Lamon Dr	4	1		3			4	0	0	0	0	2	1	1	3	2	1	Our yard is lower than the yards next to & behind us. We end up with a lake when it rains a lot. Q3: parking lot, other yards.
2200 E	Lamon Dr	1						5	2	0	0	0	2	1	4	4	0	1	
0	Laurel Wood Dr	1						0	2	3	3	2	2	1	1	3	2	1	
0	Laurel Wood Dr	1						5	1	2	1	2	2	1	3	4	2	1	
0	Laurel Wood Dr	1						5	2	0	0	0	2	1	4	3	2	1	
0	Laurel Wood Dr	1						5	2	0	0	0	2	1	1	3	2	1	Q1: Springridge
0	Laurel Wood Dr	2	1		3			2	2	0	0	0	3	1	1	3	2	1	Only during heavy rainstorms do I see standing water around the Condo. The sump pump runs almost constantly during heavy rain storms and continues to run a day or so after the rain storm is over. As long as the sump pump continues to run like it has been I can't consider this a serious problem. Not sure anything will change the situation because it only happens in the heaviest of rain storms. It does fine in just a normal situationl
0	Laurel Wood Dr	1						5	2	0	0	0	3	1	2	4	2	1	
1700	Lawndale Wy	5	1					2	2	0	0	0	2	1	2	1	2	0	Q2: if heavy rian fall, not justsmall amount of rainfall. Q15: the year we had a down pour 1 time since living here lost power, sump couldn't run - slight issue as we borrowed a generator then purchased a generator.
3900	Lay Ln	1						5	2	0	0	0	2	1	1	3	2	1	
600 N	Lee St	2					5	2	2	0	0	0	2	2	0	0	0	1	I am on a shared tile system at the end of a hill and when the line gets full or backed up I'm the one that gets the water in the basement. Also I live next to a rental property and was having issues with them flushing paper towels, diapers, etc and with the shared drain I always ended up with the mess.
600 N	Lee St	4				4		2	2	0	0	0	2	2	0	0	0	2	We live on a hill and water comes through the 100+ year old foundation.
600 N	Lee St	1						5	2	3	3	3	2	2	0	0	0	1	
800 N	Lee St	2				4		4	2	0	0	0	2	2	0	0	0	1	Only after a couple of extremely intense rains over about 12 1/2 years have I had flooding thru one west basement window at the basement level of a small unfinished space
900 N	Lee St	3				4		3	2	0	0	0	2	2	0	0	0	1	
1200 N	Lee St	1						5	2	3	3	3	2	2	0	0	0	1	
1200 N	Lee St	4		2				3	2	0	0	0	2	2	0	0	0	1	Q4: Depends on how much rain we get and if I go open the drain of leaves, etc. Q17: Because the curbside drains are often full of leaves, twigs and dirt and no one seems to ever clean the, everytime we get a good rain, the drains don't drain casuing flooding at corners.
1200 N	Lee St	1						5	2	0	0	0	2	2	0	0	0	1	
1200 N	Lee St	1						5	2	0	0	0	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1500 N	Lee St	3				4		5	2	2	3	3	2	1	3	1	2	2	Q15: 2 times in 25 years. Q17: The back up was from tree roots growing in the tile.
1600 N	Lee St	1						5	2	0	0	0	2	2	0	0	0	2	Q15: from tree roots, only not wet weather.
1600 N	Lee St	1						0	2	3	3	3	3	2	0	0	0	1	
1000 S	Lee St	2					5	3	2	0	0	0	2	2	0	0	0	1	
1100 S	Lee St	4					5	4	2	0	0	0	2	2	0	0	0	5	
1100 S	Lee St	5					5	4	2	0	0	0	3	2	0	0	0	5	Q15: depends on rain. Q17: My basement has one floor drain and every time it rains I can depend on it backing up into the basement. It takes a few days to go down.
200	Leland St	4	1			4		3	2	2	2	2	2	2	0	0	0	1	
200	Leland St	1						5	2	0	0	0	3	2	0	0	0	1	
300	Leland St	1						5	2	0	0	0	2	2	0	0	0	1	
300	Leland St	4		2				3	2	0	0	0	2	2	0	0	0	1	n/a.
400	Leland St	0				4		0	2	0	0	2	2	2	0	0	0	1	Q2: If gutters are not cleaned out it will flood if we have a hard rain. Q4: depends on rain fall
400	Leland St	1						0	2	3	3	3	2	2	5	0	0	1	I have lived her 10 years and have never had a problem
0	Lexis Ct	2				4		0	2	0	0	0	2	1	3	4	2	1	Not actually flooding problem. More just moisture seeping in where basement wall (concrete block) meet the floor. Need very heavy rainfall for this to occur.
0	Lexis Ct	1						0	2	0	0	0	2	1	5	1	2	1	
0	Lexis Ct	1						5	2	0	0	0	2	1	2	3	2	1	
0	Lexis Ct	2	1	2				4	2	0	0	0	2	1	2	3	0	1	Q4: in yard between houses. Q13: I presume.
0	Lexis Ct	4			3			3	1	2	3	2	3	1	3	4	0	0	Q3: drainage ditch
700 E	Lincoln St	1						5	2	3	3	3	3	2	0	0	0	1	
700 E	Lincoln St	4		2			5	2	2	0	0	0	2	2	0	0	0	3	4-5 years ago street drain was plugged, water backed up into my basement $7000-8000 damage
1800 E	Lincoln St	1						5	2	0	0	0	2	2	0	0	0	1	
2200 E	Lincoln St	3		2				0	0	0	0	0	0	1	3	5	0	1	Q13: When I plug it in. Q14: Bad winters or if your drain is plugged.
2700 E	Lincoln St	1						0	2	0	0	0	2	2	0	0	0	1	
300 W	Lincoln St	2		2				4	2	0	0	0	2	2	0	0	0	1	Only floods when curb drain is blocked
400 N	Linden St	4		2				1	2	0	0	0	2	2	0	0	0	1	
400 N	Linden St	2				4	5	5	2	0	0	0	2	1	2	1	2	1	Water entered trhough the walls and up from the drains in May 2004 and continued to seep through foundation in wet weather until we installed a drainage system in the perimeter of the basement that collects in a sump pump.
1100 N	Linden St	5					5	0	2	0	0	0	2	2	0	0	0	2	Q4: depends on amount of rainfall Q17: It tends to flood when it rains really hard, will go back dwon, time frame depends on amount of rainfall.
1200 N	Linden St	0						0	0	0	0	0	2	0	0	0	0	1	Do not have any flooding since the city installed the sewage injector system a few years ago. Also the old factory has mostly been removed.
1300 N	Linden St	2					5	3	2	2	0	0	2	2	0	0	0	1	
1300 N	Linden St	1						5	2	3	3	3	2	2	0	0	0	0	no basement
1500 N	Linden St	4	1	2				3	2	0	0	0	2	2	0	0	0	0	
1500 N	Linden St	1						5	2	0	0	0	2	2	0	0	0	1	
0	Linnwood St	3				4		4	1	2	1	2	2	2	0	0	0	1	Our house is on the corner of Linwood & LaFayette Streets. The laFayette Street improvement between Morrissey and maple scheduled for 2012 will eliminate the open ditch.
3000	Lisa Dr	2				4		2	2	0	0	0	2	1	1	1	2	1	During heavy rains and very wet weather my foundation cement blocks in bsement will be damp and sweat and water does come in at the floor level adjacent to the foundation. I am a renter and the property belongs to Highland Properties.
3000	Lisa Dr	4				4		4	1	2	2	2	2	2	0	0	0	1	When it rains where the ground is saturated, water seeps through the wall. I bought several tons of dirt and built up the ground around my front and this has helped a bit
1000 N	Livingston St	4					5	0	2	0	0	0	1	2	0	0	0	4	Q4: Depends on the amount of rain. Q9: Drains were removed in 2011 & pump installed. Q17: Because of our location we flooded every hard rain. We began to keep drains plugged. We were then told about Carry Sneeden & got on list to have drains removed. We do not expect anymore flood problems.
1000 N	Livingston St	1						5	2	3	3	3	2	1	2	3	2	1	
1100 N	Livingston St	3				4		4	2	0	0	0	2	2	0	0	0	2	Heavy, Heavy rain cause? That freak flood. Live low area bottom of two hills.
1300 N	Livingston St	1						0	2	0	0	0	0	0	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1300 N	Livingston St	2	1					4	2	3	3	3	2	2	0	0	0	0	Q4: ?
800 S	Livingston St	5		2				4	2	0	0	0	2	2	0	0	0	1	Flooding in the street occurs during a hard rain. The large puddle extends across Livingston and at the curb in front of my house is about 4 inches deep. The storm drain at the corner (Elm and Livingston North-East) is always completely coverd with debris. Water backsup until it flows west across Livingston.
900 S	Livingston St	1						5	2	0	0	0	2	1	4	1	2	1	
1000 S	Livingston St	1						0	2	0	0	0	2	2	0	0	0	1	
1100 S	Livingston St	1						5	2	0	0	0	2	1	2	3	2	1	
1100 S	Livingston St	5					5	4	2	0	3	3	3	1	1	1	2	1	Supposely there is an old farm drainage tile that butts up to my foundation, when we get heavy rainfall, my sump pump runs all day and water starts to come in through cracks in floor. This has been going on for 20+ years.
1200 S	Livingston St	2						0	0	0	0	0	2	0	0	0	0	0	Q15: no basement
1100	Lockenvitz Ln	0						0	1	2	1	1	3	1	5	4	2	1	The open drainage ditch behind my townhouse gets high during heavy rains. There are utility boxes on the north side of it, where there is erosion taking place. The workers have to walk through the ditch to access the boxes.
200 E	Locust St	1						5	2	3	0	0	3	2	0	0	0	1	Q9: building not home
300 E	Locust St	1						5	0	3	3	3	2	2	0	0	0	1	
500 E	Locust St	1		2				1	2	0	0	0	2	2	0	0	0	1	
600 E	Locust St	1						5	2	3	3	3	2	2	0	0	0	1	
800 E	Locust St	1						5	2	3	3	3	3	2	0	0	0	1	
900 E	Locust St	4				4	5	4	2	0	0	0	2	2	0	0	0	1	I never had a problem until the house west of me became a rental property. According to Roto-Rooter their waste goes out to the street from my house. I also have a lot of mature roots. I have to have roto-rooter out every 12-18 mo. So my basrement doesn't flood again.
900 E	Locust St	2				4		2	2	3	3	3	3	3	0	0	0	2	Q2: Heavy rainfall. Q9: Rental. Q15: Since I've been here, 10/2005, no backups. Q17: Not really a problem here. On another note, flushing the toilet seems a little weak at times, been here since 10/2005. Landlord's name: Ron Gruber 309-310-9896.
400 W	Locust St	1						0	0	0	0	0	2	2	0	0	0	1	
800 W	Locust St	1						5	2	3	3	3	2	2	0	0	0	1	
1300 W	Locust St	1						5	2	2	3	3	2	2	0	0	0	2	
1400 W	Locust St	1						5	2	0	0	0	2	2	0	0	0	1	
1500 W	Locust St	1						5	2	3	3	3	2	2	0	0	0	0	Q15: Never
0	London Court	1		1				4	2	3	3	3	2	1	3	1	2	1	we live on a cul de sac. After heavy rain there is standing water, not a lot, in the curve where our house sits. The water may stay for several days as there is not a drain nearby. It must drain through an opening between the street and curb or evaporate. We don't consider it a big problem.
0	London Court	4	1					4	2	5	3	0	2	1	2	1	2	1	Flooding in east end of property inside fence. Live on downhill slope but drainage is blocked by landscaping in adjacent yard which prohibits flow of water onward.
0	London Court	0						5	2	0	0	0	2	1	1	0	2	1	When we moved to this house 6 years ago we did have some basement water issues. We have since put two tons of dirt at strategic points around the foundation of our home and put a dewatering system in around the base of our basement. We have three sumps. We also added a hydro back up sump.
0	London Court	1						5	2	3	3	3	2	1	3	1	2	1	
5100	Londonderry Rd	1						0	0	0	0	0	0	0	0	0	0	0	
5100	Londonderry Rd	1						5	2	0	0	0	2	1	3	3	2	1	
5000	Londonderry Rd.	1						5	2	0	0	0	2	1	3	3	2	1	
0	Lone Oak Ct	1						5	2	3	3	3	2	2	0	0	0	1	
0	Lone Oak Ct	1						5	2	3	3	3	2	1	5	4	2	1	
0	Lone Oak Ct	1						5	2	3	3	3	3	1	4	4	2	1	
0	Lone Oak Ct	1						5	2	0	0	0	3	1	5	4	2	1	
0	Lone Oak Ct	1						5	2	0	0	0	3	1	1	3	2	1	
0	Long Cove Court	3	1					2	2	0	0	0	2	1	2	3	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1600	Longden Ave	4		2				4	2	0	0	0	2	1	2	1	2	1	There has always been flooding in the street where our driveway meets the street. The "pool" occurs when there is a prolonged, heavy rain. We recently (last fall) put in a drainage pape along the driveway to help with drainage on the north side of our garage. This is NOT the cause of the flooding of the last 25 years. There has been flooding and sewer gas problems throughout our neighborhood for 25+ years. Flooding on Buthers Lane is very severe as well as on Gongden and Welling.
1700	Longden Ave	1						5	2	0	0	0	3	3	0	0	0	1	
1700	Longden Ave	1						4	2	0	0	0	2	1	3	4	2	1	
1800	Longden Ave	1						0	2	0	0	0	2	1	1	3	2	1	
1800	Longden Ave	5	1					4	1	2	2	2	3	1	1	3	2	1	Q1: we have only lived at this address since August 2010.Q2:hard-in lower back yard caused because drain cannot get all excess water.Q4:Depends on the amount of hard rain-mostly it's a couple of hours. Q6:I can take pictures.Q7:to much dirt is in culvert that goes under Six Points Road-it needs to be cleaned out, so debris does not collect on top of outlet drain, as I have cleaned it off many times.Q11:we have a battery back up to sump pump.Q12:if bad rain only.Q16:I will take pictures now that I know to do that.Q17:Too much rain causes water not to be taken by the drainage outlet. Water has caused our basement no problems yet. House is on top of hill-water runs in lower part of back yard into neighbors yards. It might help if the culvert under Six Points Road had extra dirt taken away. I have leaned so much debris off top of drainage outlet-there is no place for debris to go and collect on top of outlet, stopping water flow.
5000	Longfield Road	1						5	1	3	2	2	2	1	4	3	2	1	
1200	Longford Ln	1						5	1	2	2	2	3	1	2	4	2	1	
1300	Longford Ln	1						5	1	3	3	2	3	1	1	3	2	1	
1300	Longford Ln	1						5	2	0	0	0	2	1	1	3	2	1	
2800	Longmeadow Lane	1						5	2	0	0	0	2	1	1	3	2	1	Not applicable - no flooding or sewer backup problems (knock on wood!)
1000	Low St	1						5	2	3	3	3	2	2	0	0	0	1	
1100	Low St	1						0	2	0	0	0	3	3	0	0	0	1	
1100	Low St	1						5	2	0	0	0	2	1	3	1	2	1	
1100	low st	1						5	2	0	0	0	2	1	5	1	2	1	
1200	Low St	4				4		4	2	0	0	0	2	2	0	0	0	1	
1300	Low St	3		2				3	2	0	0	0	3	3	0	0	0	0	
900 S	Low St	2				4		5	2	0	0	0	2	2	0	0	0	1	One remembered water incident many years ago. No real details remembered. Occasional slight moisture in one basement corner - rarely happens.
1100 S	Low St	1						5	2	3	3	3	2	1	3	1	2	1	
100	Lucern Dr	1						5	2	5	3	3	3	1	3	4	2	1	
800 E	MacArthur Ave	5		2				4	2	2	3	2	2	2	0	0	0	0	Q15: We have no basement on any houses in this block. Q17: The street curbshold water and does not run off to Bunn unless I push it myself. It is not really a flooding problem, owever the water doesn't run off and the mosquitos are bad in the summer and it smells in time.
800 E	MacArthur Ave	5	1	2				4	2	0	0	0	2	2	0	0	0	0	We live on a concrete slab foundation. We have no drainage on our street what so ever. The houses on E Elm St to the South of us have property levels much higher than ours. Every time it rains, their water run off comes into our backyards. Then has no where to go!! It stands around our house and on our property.
800 E	MacArthur Ave	1						5	2	3	3	3	3	2	4	4	0	1	
800 E	MacArthur Ave	1						5	2	2	3	3	2	2	0	0	0	0	
500 W	MacArthur Ave	1						5	2	0	0	0	2	3	0	0	0	1	
600 W	MacArthur Ave	1						5	2	3	3	3	2	2	0	0	0	2	
700 W	MacArthur Ave	4		2				4	2	3	3	3	2	2	0	0	0	2	The street floods when we have heavy rains. The sewer grates get plugged up with debris and keep water from going into sewers. If the homeowners keep grass and leaves out of drains, flooding in my basement is minimum or non-existant but that rarely happens. They have been told how to eliminate water in the basements but are to damn lazy to help keep gutters cleaned.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
800 W	MacArthur Ave	4		2				4	2	0	0	0	3	2	0	0	0	1	The drains along my street often clog with debris during times of heavy rain, leading to flooding as deep as a foot over an area as long as 2 blocks, starting in front of my house and going east. My driveway is often blocked by water when this happens, and the water remains until a city crew or resident comes along and clears the debris from the drain.
900 W	MacArthur Ave	1						0	2	0	0	0	2	2	0	0	0	1	
900 N	Madison St	1						0	2	0	0	0	2	2	0	0	0	1	
1200 S	Madison St	3		2			5	4	2	3	3	3	2	2	0	0	0	2	Q3: Street drain blocked. My sewer blocked tree roots (once). Q17: I replaced tile with pvc to street.
1300 S	Madison St	1						5	2	0	0	0	2	2	0	0	0	0	Only sewer backup was when pipe from house to street came apart and we had to have a portion of pipe replaced at our expense.
1400 S	Madison St	1						0	2	2	2	0	2	2	0	0	0	1	
1400 S	Madison St	3				4		2	2	0	0	0	2	2	0	0	0	3	
1600 S	Madison St	0						0	2	2	2	2	2	2	0	0	0	0	
1600 S	Madison St	1						5	2	3	3	3	2	2	0	0	0	1	
200	Magnolia Dr	1						0	2	2	0	0	2	2	0	0	0	0	
200	Magnolia Dr	3			3			3	2	0	0	0	2	2	0	0	0	1	
200	Magnolia Dr	1						0	2	0	0	0	2	2	0	0	0	1	
200	Magnolia Dr	1						5	2	0	0	0	2	2	0	0	0	1	
100	Magnolia Drive	1						5	2	0	0	0	2	2	0	0	0	1	Q15: Don't have a basement.
200	Magnolia Drive	4	1	2				3	2	0	0	0	2	2	0	0	0	1	We have a storm drain directly in front of our house which can only accomodate so much of the rain, especially during a heavy rain. Debris is also carried to it during the raining, which clogs up the drain and contributes to the flooding. The street in front of our house and neighbors' houses are almost always flooded during a heavy rain, which comes up into the yard as well as surrounding parked cars on the street. When the street and curb were repaired in front of our home a few years ago, the workers made the curb sloping instead of a definite curb, which allows the rain to more easily flood our yard as well as wash away the soil from the curb side lawn (city owned). This also allows vehicles pulling in front of our home to easily pull over the curb, creating tire tracks on the lawn. Anything you could do to alleviate the flooding, including fixing the infrastructure would be much appreciated!
100	Magoun	2				4		1	0	0	0	0	3	2	0	0	0	0	
100	Magoun	1						5	2	0	0	0	3	3	0	0	0	1	
300 N	Main St	1						5	2	0	0	0	2	2	0	0	0	1	
400 N	Main St	2				4		5	2	0	0	0	2	2	0	0	0	0	
600 N	Main St	1						5	2	0	0	0	2	2	0	0	0	1	
700 N	Main St	1					5	5	2	0	0	0	2	2	0	0	0	1	NO FLOODING PROBLEMS
1500 N	Main St	1						0	2	0	0	0	2	2	0	0	0	1	
1500 N	Main St	1						0	2	0	0	0	2	2	0	0	0	1	
300 S	Main St	1						5	2	3	3	3	2	2	4	0	0	1	
1500 S	Main St	1		2				4	2	5	3	2	2	2	0	0	2	1	Q3: Sidewalk
2400 S	Main St	1						5	2	0	0	0	2	2	0	0	0	1	
2400 S	Main St	1						5	1	2	2	2	2	2	0	0	0	1	This is a business.
100	Maizefield Ave	3				4	5	2	2	2	2	2	0	1	1	1	2	2	
100	Maizefield Ave	2				4		5	2	0	0	0	2	1	0	0	0	1	
100	Maizefield Ave	1						5	2	0	0	0	3	2	0	0	0	1	
100	Maizefield Ave	4				4	5	2	2	0	0	0	2	1	2	1	2	2	
200	Maizefield Ave	1						5	0	0	0	0	3	2	0	0	0	1	
400	Maizefield Ave	5		2				4	2	0	0	0	2	2	0	0	0	1	
100	Manor Cir	5	1					3	1	2	1	2	3	1	2	1	2	1	Q2: every time it rains hard. Q7: possibly some but I really don't know.
100	Manor Cir	1						0	0	0	0	2	0	1	1	5	2	1	
100	Manor Cir	1						5	2	5	3	3	2	1	1	3	2	1	
100	Manor Cir	1						5	1	2	1	3	2	1	5	1	2	1	
100	Manor Cir	1						5	2	0	0	0	2	1	3	1	2	1	
200	Manor Cir	1						5	0	3	3	3	1	1	3	1	2	0	
200	Manor Cir	1	1					1	2	0	0	2	2	1	2	1	2	1	
200	Manor Cir	1						0	2	0	0	0	3	1	1	0	2	1	
1100 S	Maple	1						5	2	0	0	0	0	1	3	1	2	0	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
900	Maple Hill Rd	5			3			3	1	1	1	1	1	1	1	5	2	0	Flood driveway
1000	Maple Hill Rd	0						0	2	0	0	0	2	1	3	1	2	1	Questions 2-4 are not answered because we had a foundation drainage system installed this past fall. It appears that this has taken care of the problem of water enterring the house through the basement walls but we have not had the system in place to know for sure.
800	Maple St	0						0	0	0	0	0	0	0	0	0	0	0	
600 S	Maple St	0		2		4		4	2	0	0	0	2	2	0	0	0	3	During the July flood of 20??, I got about 2 inche of clear backup water from storm/sanitary sewr. A sump pump would probably solve the seepage problem. Q3A4 seepage around newer furance pad and floor cracks. Q15A3 once in July years ago - 8 inch rain over 2 days.
1000 S	Maple St	5	1			4		3	2	3	3	3	1	2	0	0	0	1	
1000 S	Maple St	1						5	1	3	1	3	1	1	2	3	2	2	sewer bcaked up years ago. Problem was taken care of.
1000 S	Maple St	1						0	1	1	1	2	2	2	0	0	0	1	
500 E	Market St	4		2				1	2	0	0	0	2	2	0	0	0	1	drainage @ the corner of the 500 block of E Market & McLean backs up flooding the street.
700 E	Market St	5				4		4	2	0	0	0	2	2	0	0	0	2	Q2: Heavy rain or sustained Q11: No sump pump Q17: I get seapage through basemnet walls that accumulates on the basement floor. I usually wait until it stops before vaccuming it and it takes several days to evaporate.
700 E	Market St	4				4		4	2	0	0	0	2	1	1	1	2	1	Water enters several places, depending on amount of rain, some goes out the drain, sump pump or evaporates
700 E	Market St	4				4		4	2	2	3	3	2	2	0	0	0	1	
800 E	Market St	1		2				5	0	0	0	0	2	0	0	0	0	1	
800 E	Market St	1						5	2	0	0	0	2	2	0	0	0	1	
800 E	Market St	5						5	2	0	0	0	2	2	0	0	0	1	
800 E	Market St	1						5	2	5	3	3	2	2	0	0	0	0	
100 W	Market St	1						5	2	2	3	2	2	3	5	4	0	1	Never had problem
800 W	Market St	1						5	2	2	3	3	0	1	3	3	2	1	
1200 W	Market St	1						5	2	0	0	0	2	2	0	0	0	1	
1200 W	Market St	1						5	2	0	0	0	2	2	0	0	0	1	Can only remember one backup and that was over 40 years ago.
1300 W	Market St	1						5	2	0	0	0	2	2	0	0	0	0	
1300 W	Market St	1						5	2	0	0	0	2	2	0	0	0	1	
1300 W	Market St	1						5	2	0	0	0	2	2	4	5	2	1	N/A
1400 W	Market St	1						5	2	0	0	0	2	2	0	0	0	0	
1700 W	Market St	1						5	2	0	0	0	2	2	0	0	0	0	Don't have a basement
1900 W	Market St	1						5	2	0	0	0	2	2	0	0	0	1	
2500 W	Market St	2				4		3	0	1	0	0	3	2	0	0	0	1	Q6: It wasn't much. Just enough to make a mess. Q17: It seeped into the walls & foundation. We used a shop vac. Just enough to make a mess. This was about 3 years ago. Never had a problem before that.
700	Marshall Ln	2			3			5	2	0	0	0	2	1	3	1	2	1	Q4: A long time Q17: Worse flooding 20 years ago!
1000	Martin Luther King D	2	1					3	2	0	0	0	2	2	0	0	0	1	
1500	Martin Luther King D	5	1					0	2	0	0	0	2	2	0	0	0	1	Q4:non of the lots in the 1500 block of MLK are graded so the water can drain out until back yard drys out.
1500	Martin Luther King D	1						5	2	3	3	3	2	2	0	0	0	1	
1600	Martin Luther King D	5	1	2				4	2	0	0	0	3	3	0	0	0	1	Every time it rains the water pools at the end of my driveway in the street. It remains there for as long as it takes to evaporate.
0	Marvin Gdns	1						5	2	0	0	0	2	1	1	1	2	1	
0	Mary Ellen Way	5		2				0	2	0	0	0	2	2	0	0	0	0	Q2: every time it rains hard. Q17: Water pools in the street for a very long time. Getting through the intersection is a little difficult.
600 N	Mason St	3				4	5	4	2	0	0	0	2	2	0	0	0	2	Most times of heavy or prolonged rainfall results in water entering the basement through the walls and up through the basement floor. This often coincides with flooding at the intersection of Locust and Mason. The City has just done substantial work to the storm sewer at the southwest corner of that intersection, we will see if that helps.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
800 N	Mason St	2				4	5	3	2	0	0	0	3	2	0	0	0	2	we had a problem with sewage coming up in one area of our basement--plumber couldn't break the clog--had to have sewer specialist ream the pipes to the street. I think this occurred the end of September, 2012. once in a while there is (like TODAY) a sewer smell coming up from the basement. we carry buckets of HOT water down to the basement and flush the drain on the west side. this sort of works
800 N	Mason St	1						5	2	0	0	0	2	2	0	0	0	1	
1300 N	Mason St	1						5	2	0	0	0	2	2	0	0	0	0	No Basement, no flooding
1200 S	Mason St	1						5	0	0	0	0	2	0	0	0	0	1	
800 N	Mason Street	3				4	5	3	2	0	0	0	2	2	0	0	0	2	
800	Matlock Drive	1						5	2	0	0	0	2	1	2	4	2	1	
3600	Matthew Drive	2	1					2	2	0	0	0	2	1	2	3	2	1	
3600	Matthew Drive	4	1					3	2	0	0	0	3	1	1	3	2	1	Twice sump pump failed resulting in saturated carpet/water damage in basement --- servicemaster called. A few times per year in heavy rains a "pond" develops in backyard and a "river" between our houses forms leading to sidewalk/street area.
0	Mayapple	4	1					2	2	0	0	0	2	1	2	3	2	1	The drainage is strictly in the contour in the easement that was created by the city and the developer. The contour of the land when it rains, our backyard floods in this area.
900	Mayflower Ave	4		2				4	2	0	0	0	2	2	0	0	0	1	
900	Mayflower Ave	5		2				3	2	0	0	0	3	1	3	1	2	1	There is one inlet on Mayflower and it is near Pierce St. If we get 1/10 rain the street floods. This has happened since they put in new sewers and the street must have a low spot. The city overlaid this with asphalt and it still floods. There is no inlet at this end of Mayflower.
900	Mayflower Ave	1	1	2				3	2	0	0	0	1	3	0	0	0	1	When we have a hard rain, we have standing water in the city street in front of house. It can be there for a couple of hours. The water stretches across the width of the street and is about 5 to 7 feet long. The road has a dip after it was resurfaced a few years ago and there's no drainage flow or inlet. In our back yard and in the adjoining Owens property (vacant lot off 4 Seasons Rd), water stands for 2 or 3 hours during a hard rain along our fenceline on both sides of the property. So far it hasn't been a big problem except for mosquito/swamp potential. I mention it because if the property is ever developed, storm water management will be an issue that will need to be addressed. We can take pictures during a rain the next time we have standing water if it is necessary and will help.
200	Mays Dr	1						5	2	0	0	0	2	1	2	1	2	1	
200	Mays Dr	2					5	1	2	2	2	2	2	1	4	4	2	2	Flooding has never been a problem - only a few times and then nothing disasterous!
2300	Maysel St	1						5	2	0	0	0	2	2	0	0	0	1	
2300	Maysel St	1						5	2	0	0	0	2	2	0	0	0	1	We don't have a basement.
1100 W	McArthur	1						0	0	2	2	2	3	3	0	0	0	1	
200 S	McClun Street	4		2		4		3	2	0	0	0	2	2	0	0	0	1	Almost any time that there is a heavy or prolonged rain fall, about a quarter of my basement floods and can take days to drain/dry up. Also, about two blocks south of my house, the street will somewhat flood during heavy rain. However, it use to be worse before some work was done around 2-3 years ago. I can take photos the next time either occurances happen again.
400 S	McClun Street	3	1					2	2	0	0	0	2	2	0	0	0	1	My property is on the corner of McClun and Taylor St. Water flows north from Oakland and South from Grove St and the low point is McClun and Taylor. When it rains we have a lake several feet deep. The 2 corner drains can't keep up and get blocked easily and often. Also after resurfacing Taylor St the water can flow down my driveway into the garage and into the basement.
2700	McGraw Dr.	1						5	2	0	0	0	2	1	1	4	2	1	
500	McGregor St	1	1					5	2	0	0	0	2	2	0	0	0	1	
500	McGregor St	1						5	2	3	3	3	2	2	0	0	0	1	
500	McGregor St	2						0	2	2	2	0	2	0	0	0	0	2	Q15:had sewer break in street
500	McGregor St	4	1			4	5	3	2	3	3	3	3	1	5	1	2	1	We have had water come in thru basement windows, walls and thru the floor. It happens pretty frequently when there is rainfall and or large amount of snow melting. Water tends to collect on our sidewalk and base of driveway/sidewalk during rainfall.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
800	McGregor St	1						5	2	3	3	3	2	2	0	0	0	1	
1000	McGregor St	1						0	0	0	0	0	0	0	0	0	0	1	
500 S	McGregor St	2				4		4	2	0	0	0	2	1	4	1	2	1	Q2: during extremely heavy rain. Q4: depending on lengtj of rainstorm.
1800	McKay Drive	5			3			1	1	1	1	2	2	1	2	5	2	1	The drainage ditch in our backyard has a constant, low flow of water running thru it. If it rains even moderately, the drainage ditch will swell beyond its banks and flood our backyard and even flood into the street during heavier downpours. We have only owned this property for 3 years, but I have already noticed an increase in the slope of the backyard as floods have diminished the integrity of the ditch banks. The most recent flooding incident happened this morning (4/1/12 at about 4:30am) with about 1/2" of rainfall. The water was well outside of the banks, and it was also flowing over the top of our neighbors' culvert/driveway. We have video footage that shows flooding from the last 2 years or so.
1800	McKay Drive	4			3			2	1	2	1	1	3	1	1	1	1	1	There is a drainage ditch that floods with heavy rain. It is located behind my property. The soil has eroded to the point I may lose my fence posts on the rear fence. When I called the city about it, an engineer from the the city(bloomington) came out and looked at the ditch, and told me to MOVE MY FENCE, and that would fix the problem! With all the new construction around six points road and morris ave, I fear this will get worse
300 N	McLean St	1						5	2	3	3	3	2	2	0	0	0	2	
1200 N	McLean St	2			3			1	1	3	2	2	3	2	0	0	0	1	
300 S	McLean St	1						5	2	3	3	3	2	2	0	0	0	1	
400 S	McLean St	3				4		2	2	0	0	0	2	2	0	0	0	1	
100 S	McLean Street	4					5	4	2	2	3	3	2	2	0	0	0	2	Capodice, Anaconda, Nichols, approx $2000 per year
3400	McNiff Dr	2						5	2	0	0	0	3	1	1	4	2	1	Q16: Maybe? Q17: Dec 2010? Front, sump pump issue.
3400	McNiff Dr	2						4	0	0	0	0	2	1	2	5	2	0	My basement flooded 1st time when the pump quit 5 years ago. 2nd time when we had an ice storm and had no electricity 4 months after the 1st time.
100	Meadow Ridge Dr	1						5	2	2	0	0	2	1	5	3	2	1	
100	Meadow Ridge Dr	2	1					2	2	0	0	0	2	1	5	3	2	1	It is so rare, not sure it is a problem. I've never had any flooding in the basement or even any standing water that was too close to my home. 103A Meadow Ridge Drive, Bloomington, IL 309-829-8417
#VALUE!	Meadow Ridge Dr	2	1					4	2	0	0	0	3	1	2	1	2	1	Q5: "They" ran it under ground. Q17: The problem is not "flooding" - It is standing water because there is too much water underground because of (#5) that the sump pump picks up too much water.
100	Meadowbrook Dr	2				4		1	2	0	0	0	2	1	3	1	2	1	Very minor flooding only occurs when there are long, heavy rains. Some water comes up through floor - exits drain.
200	Meadowbrook Dr	4	1	2				4	2	0	0	0	2	2	0	0	0	0	Q15: Have no basement Q17: I get flooding in my back yard and street when it rains really hard. It takes a long time for the water to drain from the backyard.
200	Mecherle Dr	2				4		5	2	0	0	0	1	1	5	1	2	2	Outside pump failed - only once in the last 15 years - was repaired about 5 years ago.
200	Mecherle Dr	4		2				2	2	0	0	0	0	0	0	0	0	0	
200	Mecherle Dr	3					5	0	2	0	0	0	2	2	0	0	0	3	Q2: sewer in street is completely blocked Q4: Depends on how quick I notice flooding and how quick you get out here to unblock sewer Q17: Three times in the last 8-9 years out once in 1991 - often enough my insurance (Sate Farm) may start to disallow claims
300	Mecherle Dr	1						5	2	2	3	3	2	2	0	0	0	1	
300	Mecherle Dr	3	1			4		3	0	2	3	3	2	1	3	1	2	1	The water would come up thu floor crack and next to the wall and floor. I had a de-watering system put in April 2011 and so far this year we havent had the rain. Also put in sump pump in April 2011.
100 N	Mercer Ave	1						0	2	0	0	0	2	1	1	1	2	1	
100 S	Mercer Ave	3					5	4	2	0	0	0	2	2	0	0	0	1	Q4: have to call a plumber
200 S	Mercer Ave	3					5	1	2	0	0	0	3	3	0	0	0	2	Our biggest concert is the odor of sewer gas that significantly permiates when ther is any backup (monthly). As it is very strong, noxious smell.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
300 S	Mercer Ave	1	1					5	2	0	0	0	3	3	0	0	0	1	
400 S	Mercer Ave	2				4		4	2	0	0	0	2	1	1	3	2	1	
400 S	Mercer Ave	2						5	2	3	3	3	2	2	0	0	0	1	
500 S	Mercer Ave	2				4	5	2	2	0	0	0	2	2	0	0	0	3	Have lived here 40 yeasrs. Had 2 or 3 storm water backups but none in past 5 years. I believe a storm water relief sewer was added to alley along side our house within past 5 years. Connects to Mercer main drainage.
700 S	Mercer Ave	4	1					4	2	0	0	0	1	1	1	1	1	2	Flooding is in 1/3 of my back yard and floods almost all the back yards of the three adjoining properties north of mine on Castle Ave. Water will stand for 2 to 3 days and mosquito's are a serious issue as the area remains very wet for up to a week. The mosquitoes are so bad, that my wife and I and our two kids cannot go outside most of the summer in the evening. This is also killing the grass, plants and shrubs in the yard.
800 S	Mercer Ave	3					5	1	2	2	2	2	0	1	1	1	2	3	
800 S	Mercer Ave	1						5	0	0	0	0	2	2	0	0	0	1	
900 S	Mercer Ave	1		2				1	2	3	3	3	2	2	0	0	0	0	
900 S	Mercer Ave	1						5	2	3	3	3	2	2	0	0	0	1	
900 S	Mercer Ave	5				4		5	2	2	3	3	2	1	1	1	2	3	Q2: Every time it rains hard. Q3: enters from the south -hard rain. Rarely through basement floor drain. Q4: more than 2 hours from storm sewer backup as long as it is raining really hard from the south. Q14: - Storm sewer backup. Q17: The storm sewer wter backed up through the floor drain July 8-9,2003. It reached 23 inches in the basement that night and the next day or two. No photos or videos. Maxed out our insurance coverage.
1100 S	Mercer Ave	1						5	2	3	3	3	2	2	0	0	0	0	
1300	Mill Creek Rd	5	1					4	2	0	0	0	3	1	1	1	2	1	1304 Mill Creek Rd - 309-212-2017 each rain results in standing water in the backyard lasting up to to 24 hours. sump pump will run consistantly for 2-3 days after rain, we have gone through 4-5 pumps in the last 13 years. Someone did come out and review the yard and agreed that grading was not ideal for our lot, neighboring yard drains water into ours. Suggested installing drainage tile in the backyard, at our expense of course. Spring and Fall are the worst.
1400	Mill Creek Rd	1						5	2	0	0	0	2	1	2	3	2	1	
1400	Mill Creek Rd	4	1	2				3	2	0	0	0	2	1	1	1	2	1	Q13: It was connected until water in basement due to an illegal tile issue by mechanical devices. Q17: There must be problems as street shows distress - when getting mailbox the ground (even a foot down) holds water - curb is also breaking away.
700 W	Mill St	1						5	2	3	3	3	2	2	0	0	0	1	
800 W	Mill St	2				4		4	2	0	0	0	2	2	0	0	0	1	
800 W	Mill St	1						5	2	0	0	0	2	1	5	4	2	1	
800 W	Mill St	4				4	5	4	2	3	3	3	3	1	3	1	0	3	Q19: had new sewage system installed 5 years ago.
1000 W	Mill St	1						5	2	3	3	3	2	2	0	0	0	0	Don't have flooding problem or seven back up situation
1100 W	Mill St	1						5	2	2	2	2	2	1	3	1	2	1	
1100 W	Mill St	1						5	2	0	0	0	2	1	3	1	2	1	
700 E	Miller	0						0	0	0	0	0	0	0	0	0	0	0	Since you built the water retention base on Ash & Lincoln, I have had no flooding. Thank you.
200 W	Miller	1						5	2	3	3	3	2	2	0	0	0	1	
300 W	Miller	4				4		2	2	0	0	0	2	2	0	0	0	1	Gutter over flow from leaves during heavy rain. If gutters are clean there's not much trouble. Some come up thru bricks but doesn't last long. Drain takes care of it mostly.
300 E	Miller St	1						5	2	0	0	0	2	1	3	4	2	1	N/A
800 E	Miller St	2						5	2	3	3	3	3	1	2	1	2	1	
500 W	Miller St	1						5	2	0	0	0	2	2	0	0	0	1	PLEASE give me a call!
500 W	Miller St	1						5	2	0	0	0	2	2	0	0	0	1	
3000	Mirium Dr	1						5	2	3	3	3	2	1	1	1	1	1	
3000	Mirium Dr	2	1			4		3	2	3	3	3	2	1	1	3	2	1	Don't recall having any problem since Airport Rd was widened. We may have some brief stainding water in the yard if rain is very heavy for a long period of time.
2900	Mockingbird Lane	3	1					4	2	3	3	3	2	1	1	1	1	1	
2900	Mockingbird Lane	2						5	2	3	3	2	1	3	3	1	2	0	
0	Monarch Dr	2				4		3	2	0	0	3	2	1	1	3	2	0	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Monarch Dr	1						5	1	2	1	2	2	1	4	3	2	1	We live in Spring Ridge PUD along the south edge of the development which borders Sugar Creek. There is significant erosion which needs repaired.
0	Monarch Dr	1						5	2	0	0	0	2	1	5	2	2	1	
0	Monarch Dr	1						5	2	0	0	0	2	1	2	3	2	1	
2500	Monica Ln	1						5	2	0	0	0	2	1	3	3	2	1	
2500	Monica Ln	1						5	2	0	0	0	3	1	3	4	2	1	
1000	Monroe Dr	0						0	0	0	0	0	0	0	0	0	0	0	Just purchased the home in December 2011. Not sure of these questions.
1000	Monroe Dr	1						0	2	0	0	0	2	2	0	0	0	1	
1000	Monroe Dr	4				4		4	2	3	3	3	3	1	5	3	2	1	Q4: very slow build up
400 E	Monroe Dr	1						5	2	3	3	3	2	2	0	0	0	2	
600 E	Monroe Dr	4		2				4	2	0	0	0	2	2	0	0	0	1	corner of E Monroe and S. Clayton streets there is flooding over the road due to small storm drain. The water continues over Clayton and westward down monroe. Due to old brick streets, water stands for several hours, sometimes days, on the sides of the street. Dean Kladder - 609 E Monroe - Bloomington
600 E	Monroe Dr	1						5	2	0	0	0	2	2	0	0	0	1	
700 E	Monroe Dr	5		2	3			3	1	2	2	2	3	3	5	4	2	1	Q1: corner of clayton Q17: The drainage areas on both corners (north & south) on clayton st and monroe flood with every rainstorm. The south side needs new grates and the flow from the alley on the north sides need to be stopeed or slowed in some way.
700 E	Monroe Dr	5		2				4	2	0	0	0	2	2	0	0	0	1	On the corner of East Monroe and Clayton Streets, the stormwater drains always clog up when it rains. We get huge puddles of water at least six inches deep that flood our street. It's mostly due to overgrown grass and mud that clog the drain opening.
700 E	Monroe Dr	1						5	2	0	0	0	3	1	2	4	2	1	
800 E	Monroe Dr	2						2	0	3	0	0	3	0	0	0	0	2	Q15: I had back up two yrs ago. Rotor Rooter took care of it.
800 E	Monroe Dr	1						5	2	3	3	3	2	3	0	0	0	1	
800 E	Monroe Dr	2				4	5	5	0	0	0	0	2	1	5	1	2	2	
1000 E	Monroe Dr	1						5	2	3	3	2	2	2	0	0	0	1	
1100 E	Monroe Dr	1						5	2	2	2	2	3	3	0	0	0	1	
1100 E	Monroe Dr	1						5	2	0	0	0	2	2	0	0	0	1	never a problem
1100 E	Monroe Dr	3				4		2	2	0	0	0	2	2	0	0	0	1	It is my problem. The city is not responsible.
1100 E	Monroe Dr	1						5	2	2	2	2	2	2	0	0	0	1	
100 W	Monroe Dr	1						5	2	3	3	3	2	2	0	0	1	0	Rental Q15: had one incident caused by a water-line problem (vault cave in).
700 W	Monroe Dr	2						5	2	3	3	3	0	3	5	4	0	1	
1000 W	Monroe Dr	3					5	3	1	2	2	2	2	2	0	0	0	3	
3100	Monterey Rd	1						5	2	0	0	0	2	1	3	3	2	1	Q18: We haven't had a flooding problem.
3100	Monterey Rd	1						5	2	3	3	3	2	1	3	3	2	1	
3300	Monterey Rd	3			3			4	1	2	1	2	0	1	1	3	2	1	Q4: depends on rainfall. Q17: All I think needs attention by us is due to wind blowign out of west going east, the ground has wshed away, under cement at creeks entrance to lake behind us. Since stream water is heading NW there is a continual errosion on dirt and rocks. Children have thrown most of our rocks in lake. Need more stones at lake edge. More dirt under cement at water's edge. People stand on cement to fish all the time. Rock area looks nasty and is hard to maintain.
3200	Monticello Rd	1						5	2	0	0	0	2	1	1	3	2	1	
3200	Monticello Rd	2				4		0	0	2	3	3	3	1	1	4	2	1	Q4: ? Q5: ?
3300	Monticello Rd	1						5	2	0	0	0	2	1	3	4	2	1	
3300	Monticello Rd	1						5	2	0	0	0	2	1	3	1	2	1	
100	Moore St	2				4		4	2	0	0	0	0	1	3	4	0	2	
100 S	Moore St	1						0	2	0	0	0	2	2	0	0	0	1	
100 S	Moore St	1						5	2	3	3	3	2	2	0	0	0	0	None
100 S	Moore St	5		2				4	2	0	0	0	2	2	0	0	0	1	Water gathers at low spot where alley, curb, and street meet every time there is rain. Dirt also washes here and stands and utility pole leans as result of water.
500 S	Moore St	4				4	5	4	2	2	2	2	2	2	0	0	0	3	Typically water comes up through basement floor/join to wall. Rarely but one indiced of sewer back up, which covered entire basement

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
700 S	Moore St	4	1					4	2	0	0	0	2	1	1	3	2	1	Backyard floods along W property line with nearly every rain. Front yard floods similarly near Moore street covering front walkway.
2800	Morningside Dr	2	1					4	2	0	0	0	3	1	2	1	2	2	I think any sewage return that brought water and debris up into the laundry wall tub - it was more a clogged pipe or whatever and plumber reamed it out.
2900	Morningside Dr	1						5	2	3	3	3	2	1	2	1	2	1	Q12: depending on rain
2900	Morningside Drive	1						5	2	0	0	0	2	1	4	1	2	3	Q15: One occurance, approx 1980? Q17: Heavy rain caused backup of city facility and flooded our entire basement, 3-4 inches. We were gone at the time and sumpp pump was countinually running but unable to handle water flow (see Q15).
300 N	Morris Ave	1						5	2	3	3	3	2	2	0	0	0	0	
800 N	Morris Ave	2					5	2	2	3	3	3	2	2	0	0	0	2	
1300 N	Morris Ave	3				4		3	2	3	3	3	2	2	0	0	0	2	Tree Roots
1500 N	Morris Ave	4	1			4		2	2	2	3	3	1	3	2	4	2	1	
1500 N	Morris Ave	1		2				2	2	0	0	0	2	2	0	0	0	1	I live at the end of N. Morris in a cul-de-sac. The street sewer drain which is the only one at bottom of hill is always plugged and covered with depbris. I clean it whenever I can.
300 S	Morris Ave	1						0	2	2	0	0	2	2	0	0	0	1	
900 S	Morris Ave	1						5	2	0	0	0	2	2	0	5	0	1	Q12: none Q14: none Q17: no flooding here
1000 S	Morris Ave	1						5	2	2	3	2	2	2	4	5	2	0	
2100 S	Morris Ave	1						0	2	0	0	0	1	1	2	3	2	0	
2200 S	Morris Ave	2				4		5	2	0	0	2	2	1	2	1	2	1	Answer to #2 and #3 - This problem was solved with a change in landscaping.
1200	Morrissey Dr	1						5	2	3	3	3	2	2	0	0	0	1	Q9: no basement
1300	Morrissey Dr	2				4	5	2	2	2	2	2	0	1	1	3	2	1	
1400	Morrissey Dr	2	1					2	2	0	0	0	2	2	0	0	0	1	Low spot in yard will hold water after heavy rains. I wouln't call this flooding but it is one of the options you offer.
1400	Morrissey Dr	1						5	2	2	3	3	2	2	0	0	0	1	
1500	Morrissey Dr	5					5	4	2	0	0	0	2	1	1	1	2	1	
1600	Morrissey Dr	1						5	2	3	3	3	2	2	0	0	0	1	
1200	Moss Creek Rd	1						5	2	0	0	0	2	1	3	3	2	1	No flooding issues.
1300	Moss Creek Rd	1						5	2	3	3	3	2	1	1	4	2	1	
2800	Mowrey Rd	1						5	2	3	3	3	2	1	1	3	2	1	
300 E	Mulberry St	1	1					3	2	0	0	0	2	2	0	0	0	1	Q2: If it rains real hard. Q15: One time several years ago. Q17: Water backed up coming from laundry room. Plumber put in an above the floor drain to the sewer. No problem since.
500 E	Mulberry St	1						5	2	0	0	0	2	1	3	1	2	1	
600 E	Mulberry St	1						0	2	5	3	0	2	2	0	0	0	0	
600 E	Mulberry St	1						5	2	0	0	0	2	2	0	0	0	1	
300 W	Mulberry St	1						5	2	2	2	2	2	2	5	0	2	1	
900 W	Mulberry St	2						1	2	3	3	3	3	2	0	0	0	1	
1300 W	Mulberry St	1						5	2	2	2	2	2	2	0	0	0	1	
1400 W	Mulberry St	1						5	2	2	2	2	2	2	0	0	0	1	
1600	Myra Ln	1						5	2	2	3	2	3	1	2	3	2	1	
1600	Myra Ln	1						5	2	0	0	0	2	1	4	3	2	1	
18600	Navajo Ln	1						0	2	0	0	0	2	2	0	0	0	1	
3000	Neaves Dr	1						5	2	0	0	0	2	1	2	3	2	1	
3000	Neaves Dr.	1						5	2	0	0	0	2	1	1	5	2	1	No flooding issues.
1200	Newcastle Dr	1						5	2	2	3	3	2	1	1	4	1	1	
2500	Newport Dr	1						5	2	3	3	3	2	1	1	1	2	1	
2500	Newport Dr	2						4	2	0	0	0	2	1	1	4	2	1	
2500	Newport Dr	1						0	0	0	0	0	0	1	3	4	0	0	
1200	Nicki Dr	1						5	2	3	3	3	2	1	1	1	2	1	
1300	Nicki Dr	2					5	1	2	0	0	0	2	1	2	1	2	1	Lived at address for 34 yrs. And only once did water flood room where sump pump installed.
1300	Nicki Dr	1						5	2	0	0	0	2	2	0	0	0	1	
1200	Nicki Dr.	2	1					3	2	0	0	0	2	1	3	1	2	1	Storm water drain in backyard. Floods along property line to drain.
1200	Nicki Dr.	1						5	2	0	0	0	2	1	1	5	2	1	
0	Nicole Ct	1						5	1	3	2	2	2	1	4	1	2	1	Q1: note : when we tried to do online it always went to survey monkey??
24900	Nighthawk Rd	1						5	1	2	2	2	2	1	3	1	2	1	
0	Norbloom Ave	3				4	5	4	2	3	3	3	3	1	1	1	2	2	
0	Norbloom Ave	3				4		4	2	0	0	0	2	1	2	1	2	2	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Norbloom Ave.	1						0	2	0	0	0	2	2	0	0	0	1	
1000	Norma Dr	1						5	2	0	0	0	2	1	5	4	2	1	
1200	Norma Dr	2			3			4	1	2	2	2	3	1	1	4	2	1	
1200	Norma Dr	1						5	2	0	0	0	2	1	4	3	2	1	Only lived here for 9 months....no problems during that timeframe
1300	Norma Dr	1						5	2	0	0	0	2	1	3	3	2	1	
1300	Norma Dr.	1						5	2	0	0	0	2	1	3	3	2	1	
1400	Norma Dr.	4	1					4	2	0	0	0	2	1	1	3	2	1	During periods of heavy rain, we will get standing water in the back of the backyard. We butt up again farm land which I presume results in some runoff into our yard.
0	Northcrest Court	4				4		3	2	0	0	0	2	1	1	1	2	1	
0	Northcrest Court	3				4		4	1	2	2	2	1	1	2	1	2	5	I bought the house 1989, flooded x4 so state farm cancelled my policy
0	Northcrest Ct	2				4	5	2	2	3	3	3	2	1	1	1	2	2	
2600	Northpointe Dr	1						5	2	3	3	3	2	1	3	1	2	1	
600	Northway Lane	1						5	1	2	1	1	2	2	0	0	0	1	Q8: Possibly dangerous to children who occasionally play in the ditch by a wooden structure that is falling down.
700	Northway Lane	2					5	1	2	2	2	2	2	1	5	1	2	1	
0	Northwest Ct	4				4		4	2	2	3	3	2	2	0	0	0	1	We bought home 10/2011 - Previous homeowner had problems. During rainy season we have seepage. Former homeowner had all kinds of issues. City had paid him for water damage - (Robert Reardon)
2500	Norton Rd	1						5	2	0	0	0	2	1	1	3	2	1	
0	Oak Park Rd	1						5	2	5	3	3	2	2	0	5	0	1	
0	Oak Park Rd	1						5	2	0	0	0	2	1	1	4	0	1	
0	Oak Park Rd	1			3			3	2	5	3	3	2	1	2	3	2	1	
0	Oak Park Rd	4	1					3	2	0	0	0	2	2	0	0	0	1	
100	Oak Park Rd	1						5	2	3	3	3	3	1	2	3	2	1	
600 N	Oak St	1						5	2	0	0	0	2	2	0	0	0	1	
900 N	Oak St	1						0	2	2	0	2	2	2	0	0	0	1	
900 N	Oak St	3				4		4	2	2	2	2	2	2	0	0	0	0	
900 N	Oak St	1						0	2	0	0	0	2	1	5	1	2	1	
1000 N	Oak St	1						0	0	0	0	0	2	2	0	0	0	1	
1100 N	Oak St	3		2				2	2	0	0	0	2	1	1	3	2	1	i believe the main problem is the sewer drains on or st. are not cleaned on a regular basis,i try to keep the sewer drain on my corner clean from debri but some time's this is not enough
700 S	Oak St	2	1					3	2	2	0	2	1	1	3	1	2	1	
800 S	Oak St	1						5	2	0	0	0	2	2	0	0	0	1	
900 S	Oak St	1						5	2	3	3	3	2	1	2	1	2	1	
1200 S	Oak St	3				4		3	0	0	0	0	2	2	0	0	0	1	When it's been dry then rains heavy or when it rains a lot over time or in a short period of time. Water will seap through cracks in floor and or wall cracks. Not up from the sewer.
1200 S	Oak St	4		2				2	2	0	0	0	2	2	0	0	0	2	Once a year occurs and we have our basement drains snaked. This is very expensive.
1300 S	Oak St	1						5	2	0	0	0	2	2	0	0	0	0	
1500	Oakbrook Dr	5	1					4	2	2	3	3	2	1	1	1	2	1	Flooding occurs on the lot line with the park behind property.
1400	Oakbrook Dr.	1						5	2	0	0	0	2	1	2	1	2	1	
400 E	Oakland Ave	5				4		4	2	0	0	2	2	2	0	0	0	1	Water comes in thru the brick walls. Every time it rains and runs into a floor drain.
600 E	Oakland Ave	1						5	2	3	3	3	3	2	0	0	0	1	
700 E	Oakland Ave	5		2				4	2	0	0	0	2	2	0	0	0	1	Corner of oakland and evans has standing water every time it rains, had a rain last night 2am and it's 10:20 am now and there is still plenty of standing water in the road. Happens at both corners on the north side of the street.
900 E	Oakland Ave	5			3			4	1	2	1	1	2	1	1	3	2	1	The city has been aware of this problem for more than 7 hears. They've never done anything about it and the back wall is unsafe.
900 E	Oakland Ave	1						0	2	2	2	2	2	2	0	0	0	0	
1100 E	Oakland Ave	1		2	3			4	1	2	3	3	2	1	5	4	2	1	Q2: In our building only in front of builing on the street and sidewalk. Q17: We only have standing water in front of building and sidewalk.
1200 E	Oakland Ave	1						5	2	0	0	0	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1200 E	Oakland Ave	3		2		4		4	2	0	0	0	2	2	0	0	0	1	1.) Storm drains in road on corner of Oakland & Meadows gets clogged during heavy rains. Causes serious traffic problems. 2.) Storm/sewer drain on Meadows Avenue in front of driveway for 1227 East Oakland Avenue doesn't drain well, causing discharge smell in neighborhood. My email address is bushwaq@gmail.com
1300 E	Oakland Ave	2				4		4	2	0	0	0	2	2	0	0	0	1	Occasionally, water comes into the basement at the south (highest grade) wall and runs across the floor to the drain.
1300 E	Oakland Ave	4		2				2	2	0	0	0	2	2	0	0	0	0	When there is a hard fast rain or it rains for a long period the street in front of house floods. Usually floods on south side but north side will flood reducing street to one lane. Corner of Meadows/State; Oakland floods regularly.
1300 E	Oakland Ave	3		2				2	2	0	0	0	2	1	4	1	2	1	
1500 E	Oakland Ave	1						5	2	0	0	0	2	2	0	0	0	1	
1500 E	Oakland Ave	2		2			5	2	2	0	0	0	2	2	0	0	0	2	If we have a heavy rain basement floor gets wet (just a little).
1600 E	Oakland Ave	1						5	2	0	0	0	2	2	0	0	0	3	
1900 E	Oakland Ave	4	1					4	2	0	0	0	2	2	0	0	0	1	The backyard floods anytime there is a heavier rainfall. Sometimes the water will stand for days if the ground is saturated. It just drains slow. Please don't do anything to make it worse. I will send a photo. drslcsorensen@aol.com
1900 E	Oakland Ave	1						5	1	2	2	2	3	3	0	0	0	1	
1900 E	Oakland Ave	1						5	2	0	0	0	2	1	4	1	2	1	
2800 E	Oakland Ave	1						0	0	0	0	0	2	1	4	1	2	1	
2900 E	Oakland Ave	1						5	2	0	0	0	2	1	3	1	2	1	
3000 E	Oakland Ave	1						5	2	3	3	3	1	1	1	1	2	0	Q15. On Septic Tank
3000 E	Oakland Ave	1						5	2	0	0	0	1	1	1	3	2	1	
3000 E	Oakland Ave	1						5	0	3	3	3	2	1	2	4	2	1	
4100 E	Oakland Ave	1						5	1	1	2	3	2	2	0	0	2	1	
200 W	Oakland Ave	3				4		3	2	2	0	0	1	2	0	0	0	1	
500 W	Oakland Ave	1						5	2	3	3	3	2	2	4	0	0	1	
600 W	Oakland Ave	1						5	2	0	0	0	2	2	0	0	0	1	
600 W	Oakland Ave	2				4		4	2	0	0	0	3	2	0	0	0	1	
800 W	Oakland Ave	2				4		1	2	0	0	0	2	2	0	0	0	1	When we get a heavy rain with ground still froze, we get some water in the basement. It is quite rare, though.
800 W	Oakland Ave	4				4		3	2	0	0	0	3	2	0	0	0	4	It seems to occur when raining a few days.
800 W	Oakland Ave	0						0	0	0	0	0	0	0	0	0	0	0	
900 W	Oakland Ave	1						5	2	3	3	3	2	2	0	0	2	0	
1100 W	Oakland Ave	1						5	2	3	3	3	2	2	0	0	0	1	
1400 W	Oakland Ave	1						5	2	0	0	0	2	2	0	0	0	1	
0	Oakland Ct	1						5	2	3	3	3	2	2	0	0	0	1	
1900	Oakwood Ave	1						0	2	2	3	3	2	1	5	1	2	1	
2000	Oakwood Ave	3	1					3	2	3	3	3	2	1	4	1	2	1	Q2: never in house; infrequently in yard Q3: side yard: to north at property line; backyard: to east along property line
2200	Oakwood Ave	4	1					3	2	0	0	0	2	1	1	5	2	1	During heavy rains we have runoff coming through our yard towards the street. It only happens during heavy rains of 2 or more inches and because we are the low house in the area our side yard is the natural flow for this water. It has never been a problem other than during the rain.
600	Old Farm Rd	4	1	2				4	2	0	0	0	2	1	1	3	2	1	Q2: if heavier rainfall amounts - usually if 2+ inches of rain. Q4: Depends on amount of rain; If 2"-3" rain, then 2+ hours.
1000	Old Farm Rd	1						5	2	3	3	3	2	1	3	5	2	1	Q5: but live on old farm law
3100	Old Jamestown Rd	1						5	2	0	0	0	2	1	1	3	2	1	
3100	Old Jamestown Rd	1						5	2	3	3	3	1	1	2	4	2	1	
3100	Old Jamestown Rd	1						5	2	3	3	3	2	1	1	3	2	1	
3100	Old Jamestown Rd	1						5	2	0	0	0	2	1	4	4	0	1	
400 E	Olive St	1						5	2	0	0	0	2	2	0	0	0	1	
600 E	Olive St	1						5	2	0	0	0	2	2	0	0	0	1	
700 E	Olive St	2		2		4		3	2	0	0	0	2	2	0	0	0	1	
800 E	Olive St	4		2		4	5	2	2	0	0	0	2	1	1	5	2	2	The flooding problem is based on how hard it rains; how long it rains; how frequently it rains.
1000 E	Olive St	1						0	2	0	0	0	2	2	0	0	0	1	
1000 E	Olive St	4	1			4		4	2	3	3	3	2	2	0	0	0	1	City alley behind our house has a large water runoff intake. Most of the time that intake is full of depbris. When full of debris and heavy rain water run-off from apartment parking lot floods over yard and eventually basement and always our garage.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1400 E	Olive St	1						5	2	0	0	0	2	2	0	0	0	1	
1400 E	Olive St	4	1	2		4	5	2	2	3	3	3	2	1	1	3	2	1	The water in our street doesn't drain. It just sets there. 1421 is replacing their foundation, 1423 has some problems. I have had to take out carpeting and throw it out. I have rugs now. These have also been soaked and I've paid to have the largest one cleaned several times. Seems like a neighborhood problem.
1400 E	Olive St	2		2				2	2	0	0	0	3	2	0	0	0	1	Street floods only when we get a heavy rain.
1500 E	Olive St	1						5	2	0	0	0	2	2	0	0	0	1	
1500 E	Olive St	4				4		4	2	3	3	3	2	2	0	0	0	1	
2200 E	OLIVE ST	1						0	1	2	2	2	2	2	0	0	0	1	
2200 E	Olive St	1						0	2	0	0	0	2	1	2	3	2	0	
600 W	Olive St	4					5	2	2	0	0	0	2	2	0	0	0	2	Q2: 1 or 2 a year.
800 W	Olive St	4		2			5	4	1	2	3	3	2	2	0	0	0	5	
1000 W	Olive St	4				4		0	2	2	0	2	2	2	0	0	0	1	Minor flooding depends on which direction the rain comes from. Probably a sump pump would take care of it.
1300 W	Olive St	2				4		5	2	3	3	3	2	1	5	5	2	1	
1400 W	Olive St	1						5	2	0	0	0	2	2	0	0	0	1	
1400 W	Olive St	1						0	0	0	0	0	2	2	0	0	0	1	
1400 W	Olive St	2					5	0	2	3	3	3	2	1	2	1	2	1	When we had 2-3" of rain it would up thru crack in floor and depends on rain we had to use dump and vaccum pump 24 hr and more. We put in sump pump where the crack was and have not had a problem. Been 4-5 yrs when we put in pump.
400	Olympia Dr	1						0	2	3	3	3	2	2	0	0	0	0	
200	Orleans Dr	3	1	2		4		2	2	0	0	0	2	2	0	0	0	1	Q3: our lower level is a walkout Q17: Flooding occurs when rain fall si excessively heavy and street drain cannot handle the flooded street. It then flows down the east side of our home to area patio that is low paint of property and can seep into our den.
200	Orleans Dr	2		2		4		0	2	0	0	0	2	2	0	0	0	1	1. Standing water in the street is when we have huge rains - it appears the storm drain in the street can't handle it fast enough. 2. On occassion we have gotten water in the basement at the two front (SE & SW) corners of the house. Typically this is after a large rain and we failed to have our gutters extended far enough into the yard.
200	Orleans Dr	2				4		1	2	3	3	3	2	2	0	0	0	1	Q3: amount of water after a heavy rain is 2 cups - not a problem.
200	Orleans Dr	1						5	2	3	3	3	2	1	3	1	2	1	
1900	Owens Dr	1						5	2	0	0	0	2	2	0	0	0	2	
1900	Owens Dr	1						5	2	3	3	3	2	2	0	0	0	1	
1900	Owens Dr	1						5	2	3	3	3	2	2	0	0	0	1	
1900	Owens Dr	3	1	2				3	2	0	0	0	1	1	0	0	0	1	
1900	Owens Dr.	2					5	3	2	0	0	0	2	1	2	1	2	3	Only once in the 11 years we have lived here, no photos, had dirty water in all rooms of the basement., have had the man hole in our yard pumped out once.
0	Oxford Ct	1						0	2	0	0	0	2	1	1	1	2	1	
100	Packard St	1						5	2	0	0	0	2	2	0	0	0	1	
100	Packard St	3				4		2	0	0	0	0	2	2	0	0	0	1	
200	Packard St	1						5	2	3	3	3	0	1	3	1	2	1	
1500	Paddington Dr	1						5	2	0	0	0	2	1	1	1	2	1	Never had flooding but the sump runs alot after a rain.
1500	Paddington Dr	1						5	2	3	3	3	2	1	1	1	2	1	
1500	Paddington Dr	4	1			4	5	3	2	0	0	0	3	1	1	1	1	1	
0	Paige Place	1						5	2	0	0	0	3	1	5	4	2	1	
0	Paige Place	3				4		2	2	0	0	0	2	1	1	4	2	1	
0	Palm Ct	1						5	2	0	0	0	2	1	4	3	2	1	Q5: But next to a detention basin Q17: No flooding problems here so no reason for cntact.
0	Palm Ct	2	1	2				3	2	0	0	0	3	1	1	1	2	1	
3600	Pamela Dr	3						5	2	0	3	0	2	1	1	4	2	1	
3600	Pamela Dr	4	1					4	2	0	0	0	2	1	2	3	2	1	Low spot in back yard drainage channel fills with up to 6-8 inches of water during heavy rains. Water typically stands for 12-18 hours.
2200	Park Place Dr	1						5	0	0	0	0	2	1	1	1	2	1	
2600	Park Place Dr	4	1					4	2	0	0	0	2	1	1	3	2	1	Backyard accumulates runoff from neighbors and is slow to drain via surface runoff
2700	Park Place Dr	1						5	2	3	3	3	2	1	1	3	2	1	
2700	Park Place Dr	1						0	2	0	0	0	2	1	3	3	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1000 N	Park St	3				4		4	2	0	0	0	3	3	0	0	0	1	Not a major problem - usually about 1/4-1/2 inch deep covering about an 8-10 foot area in basement - when a big rain occurs (2-3 inches).
2100	Parker Ave	4	1					3	2	0	0	0	2	1	2	4	2	1	Just a low-lying spot in the backyard where water collects after a heavy rain or long period of rain. Not a big problem, just soggier than the rest of the yard.
2100	Parker Ave	1						5	2	0	0	0	0	1	1	1	2	1	
0	Parkshores Dr	1						5	2	3	3	3	2	2	0	0	0	1	
0	Parkshores Dr	1						0	2	0	0	0	2	2	0	0	0	1	
0	Parkshores Dr	1						5	1	3	2	2	2	2	0	0	0	1	
100	Parkview Dr	1		2				1	1	2	2	2	2	2	0	0	0	1	
200	Parkview Dr	1						0	1	2	1	2	2	2	0	0	0	1	
200	Parkview Dr	2				4		0	2	0	0	0	3	1	0	0	2	0	
200	Parkview Dr	1						5	2	0	0	0	2	2	0	0	0	1	
200	Parkview Dr	1						0	2	0	0	0	2	2	0	0	0	1	
800	Parmon Rd	1						5	2	0	0	0	2	2	0	0	0	1	
800	Parmon Rd	1						0	0	0	0	0	1	1	1	3	2	1	
800	Parmon Rd	3					5	2	2	0	0	0	2	1	2	1	2	3	Sewer kick back hasn't happened in about a year. It is much better. It used to happen with every heavy rain. It is still a concern and something should be done.
900	Parmon Rd	3	1					4	2	0	0	0	2	2	0	0	0	1	
900	Parmon Rd	4	1					4	2	0	0	0	2	1	5	1	2	1	There was backup in toilet in bathroom once but it was due to tree roots in line from house to street. Problem solved by clean out. I know have it cleaned annually to avoid that problem.
0	Partner Place	2	1					4	2	3	3	3	2	1	3	1	2	1	
500	Patterson Dr	1	1					5	2	0	0	0	2	2	0	0	0	1	
500	Patterson Dr	2				4		0	2	0	0	0	2	2	0	0	0	2	Q4:on occasion it has happened the duration of a driving rain with winds directing the water.Q11:n/aQ12:n/aQ13:n/aQ14:n/aQ15: once over 20 years ago during an extremely heavy rain in a short time period.Q17:we have been pretty fortunate not to experience any major problems.
0	Pebblebrook Ct	1						5	2	0	0	0	2	1	1	3	2	1	
0	Pebblebrook Ct	4	1					3	2	0	0	0	2	1	2	1	2	1	In periods of steady rainfuall, water will back up into the loest zone in my back yard. After the rain stops there is a small pool that slowly drains away over time (usually in a few hours). Afterwards though, the ground in that area remains soggy and wet for days.
0	Pebblebrook Ct	4	1					4	2	0	0	0	2	1	1	3	2	1	Even with the little rain and snow we have had this year our yard and the next door neighbors yards are soggy.
100	Pebblebrook Ct	1						5	2	0	0	0	0	1	1	3	2	1	
100	Pebblebrook Ct	1						5	2	0	0	0	2	1	2	4	2	1	N/A
100	Pebblebrook Ct	1						5	2	0	0	0	2	1	5	4	2	1	
2100	Peirce Ave	4	1					4	2	0	0	2	2	2	0	0	0	0	Sent to Mayor Jesse Smart years ago, not sure where copies are. Floods my entire backyard the the two houes to the east and west on each side of my house plus the house to the south of me. January 14, 2005 Kurt Haas was here, the fall of 2006 Mr. Haas and another man were here. 10/30/09 Kurt Haas and another man here. Fifteen years before that talked to Mayer Smart - sent pictures. City Engineer came out and promised something would be done. That was 37 years ago. Mr. Haas has been terrific. I know if he had the power he'd fix my yard himself! I do realise there is a major drainage problem that concerns the eningeers.
2200	Peirce Ave	1	1					4	2	5	3	3	2	1	1	1	1	1	Q2: sump pump handles it. Q3: I need tiling. Q13. sump pump can run for days on end. Q14: no one has ever been hurt. Q18: I don't have a flooding problem
2200	Peirce Avenue	2	1					2	2	0	0	0	2	2	0	0	0	1	Q2: Run-off from State Farm Oakland Avenue parking lot during extremely heavy rain, into NE corner of yard. Q4: Goes down quickly. Would not consider to be a problem.
0	Pembrook Cr	1						5	2	2	3	3	2	1	1	1	2	1	
0	Pembrook Cr	2				4	5	4	2	0	0	0	2	1	2	4	2	1	Q2: We've lived here 2 yrs & experienced flooding once when our sump pump existing to house that was very old failed. Q9: The one time we had flooding the sump pump had failed.
0	Pembrook Cr	1						5	2	0	0	0	2	2	0	0	0	1	Q18 : Whatever is useful

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Pembrook Cr	1						5	2	0	0	0	2	1	3	1	2	1	Q12: it depends on how much rainfall and in what period of time.
0	Pembrook Cr	1						5	2	3	3	3	3	1	3	1	2	1	
0	Pembrook Cr	1						0	2	0	0	0	3	1	3	3	2	1	
0	Pendleton Way	1						5	2	3	3	3	2	1	3	1	2	1	
0	Pendleton Way	3	1			4		4	1	2	2	2	2	1	1	1	2	1	
0	Pendleton Way	1						5	1	1	2	3	2	1	3	1	2	1	
0	pendleton way	1						5	1	2	2	2	3	1	3	3	2	1	
0	Pendleton Way	1						5	1	1	1	2	2	1	3	1	2	1	There is no problem flooding
0	Pendleton Way	4	1	2				4	2	0	0	0	3	1	2	3	2	1	When there is heavy rain or snow melt, standing water occurs in back side yard along property line-usually stays there for two to several days.
0	Pendleton Way	2						2	1	2	2	2	2	1	3	1	2	0	Q15 One time when lift station was flooded SE of subdivison.
3300	Peppertree Ln	1						5	2	0	0	0	2	1	3	3	2	1	
3300	Peppertree Ln	2					5	3	2	0	0	0	3	1	5	4	2	1	Basement flooding occurred aproximately 5 years ago during a heavy rain. The sump pump had stopped working without my knowledge. After flooding , new sump pump replaced. No recurrent flooding since.
2600	Persimmon Pl	4		2		4		2	2	0	0	0	2	1	1	1	2	1	
2700	Persimmon Pl	2		2			5	2	2	0	0	0	2	1	1	1	2	1	Main problem is flooding through roughout in basement. Now has a dedecated sump pump in that hole. Have not had a problem since.
2800	Pheasant Run	2	1					2	2	0	0	0	2	1	1	3	1	1	Q12 during wet weather it cycles every 90 seconds.
2800	Pheasant Run	3	1					4	2	0	0	0	2	2	1	3	2	1	The backyard floods to within 3 feet of my patio. The church behind me has helped the problem with their new landscaping. Q12A1 every 15 - 20 seconds
2900	Pheasant Run	3	1					4	2	0	0	0	2	1	1	3	2	1	Water comes up from back property line and approaches house.
2800	Phillip Place	1						0	2	0	0	0	2	1	1	1	2	1	
2800	Phillip Place	1						5	2	0	0	0	2	1	4	1	2	1	
400 E	Phoenix Ave	1						5	2	3	3	3	2	2	0	0	0	1	
1300	Pinehurst Dr	2						0	2	0	0	0	0	0	0	0	0	0	
1300	Pinehurst Dr	2					5	4	2	0	0	0	0	1	2	1	2	2	Backup caused by blockage in storm drain in street.
1300	Pinehurst Dr	4				4		3	2	0	0	0	2	1	3	1	2	2	
2500	Piney Run	1						5	2	3	3	3	1	1	3	3	2	1	
2500	Piney Run	1						5	2	0	0	0	2	1	3	3	2	1	
2700	Piney Run	1						5	2	0	0	0	2	1	2	4	2	1	
2700	Piney Run	1						5	2	0	0	0	2	1	2	4	2	1	
2700	Piney Run	1						5	2	0	0	0	3	1	3	1	2	1	
2600	Pipeline Rd	4	1		3		5	4	2	0	0	0	1	1	1	0	2	1	
0	Plantation Ct	5	1					3	1	2	1	2	2	1	1	3	2	1	Standing water on east side of house and along back fence. There is a large storm sewer drain 100' from house but water doesn't drain to into it.
1500	Plantation Ln	2	1					3	2	3	3	3	3	1	1	3	2	1	
2800	Polo Rd	1						0	0	0	0	0	0	1	2	3	2	0	
2800	Powell Drive	2	1					1	2	0	0	0	2	1	3	3	2	1	
100	Powers Dr	1				4		0	0	0	0	0	3	1	1	3	2	1	Q2:none since install water pressure back up sump pump. Q4:within 3 hours of no electric. Q17:4 year ago without electricity, seepage all around basement foundatiod to, none since back up sump pump installed.
100	Powers Drive	2			3			2	1	2	2	2	2	1	1	4	2	1	
800 N	Prairie St	1						5	2	0	0	0	2	2	0	0	0	1	
900 N	Prairie St	1						5	1	0	0	0	2	2	0	0	0	1	
1000 N	Prairie St	1						5	2	3	3	3	2	2	0	0	0	1	
1000 N	Prairie St	1						5	2	0	0	0	2	2	0	0	0	1	
300 S	Prairie St	1						5	2	5	3	3	2	2	4	5	0	1	
0	Prairie Vista Ct	1						0	2	0	0	0	3	3	0	0	0	1	
0	Prairie Vista Ct	1						0	2	0	0	0	3	1	5	4	2	1	
0	Prenzler Dr	4	1					4	2	0	0	0	2	1	1	3	2	1	
0	Prenzler Dr	2	1					4	1	2	2	2	2	1	3	3	2	1	
100	Prenzler Dr	2				4		4	2	0	0	0	2	1	5	1	2	1	N/A
3400	Prescher Pointe	1						5	2	0	0	0	3	1	3	3	2	1	
3400	Prescher Pointe	1						5	2	3	3	3	2	1	3	3	2	0	
3500	Prescher Pointe	1						5	2	2	3	3	3	1	5	4	2	1	Moving out 4/11/12, new home owners moving in that date.
1900	Princess Ct	1	1		3		5	3	2	2	2	2	2	2	0	0	2	0	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
200 N	Prospect	4	1					4	2	0	0	0	3	3	0	0	0	1	The flooding that occurs at this location is located on the back side of the building near the dumpster. One days of heavy rain, there will be standing water that covers 4-5 parking spaces and reaches half way across the lot. Again, only occurs during heavy rains.
500 S	Prospect	2					5	3	2	0	0	0	2	1	1	3	2	1	
3000	Providence Dr	1						5	2	0	0	0	2	1	3	3	2	1	
2800	Raad Rd	1						5	2	2	2	2	2	1	1	1	2	1	
0	Rachel Ct	1						5	2	3	3	3	2	1	3	3	2	1	
0	Rachel Ct.	1						5	2	0	0	0	3	1	5	4	2	1	
0	Rachel Ct.	1						5	2	3	3	3	2	1	3	4	2	1	
2700	Radbourne Dr.	1						5	2	0	0	0	2	1	2	1	2	1	
1100	Rader Run	1						5	2	3	3	3	2	1	2	4	2	1	
200	Radliff Rd	2					5	4	2	0	0	0	2	2	0	0	0	3	The drain backup happened when the once every 10 years or so rain hit the Bloomington area.
300	Radliff Rd	1						5	2	0	0	0	3	1	5	4	2	1	
300	Radliff Rd	1						5	2	0	0	0	2	1	1	1	2	1	
500	Radliff Rd	1	1					3	2	3	3	0	2	2	4	0	0	0	no basement
600	Radliff Rd	1						5	2	0	0	0	2	1	3	5	2	1	
600	Radliff Rd	1						0	2	0	0	0	2	2	0	0	0	5	Q15: Sewer backups were frequetn: sewage covered entire floor to a depth of several inches. Q17: Sewer backups occurred between 1973 and 1979 totalling 16 occurances. Only Mayor Buchanon listened and helped us - after NO help from City Staff over 6 years!
2300	Rainbow Ave	2				4	5	3	2	3	3	3	3	1	1	3	0	1	Flooding has recurred when we've had extremely wet conditions and flooding of creeks/rivers occurs.
2400	Rainbow Ave	1						5	2	3	3	3	2	2	0	0	0	0	No basement. It's a slab floor home.
2400	Rainbow Ave	1						5	2	0	0	0	2	2	0	0	0	1	My House is on a slab - no basement
2600	Rainbow Ave	1						5	2	0	0	0	3	1	1	3	2	1	
2700	Rainbow Ave	1						5	2	0	0	0	3	2	0	0	0	0	
0	Ranney Ct	1						5	2	0	0	0	3	1	2	4	2	1	
3900	Rave Rd	0	1					0	2	3	3	0	2	1	1	3	2	1	Q1: Purchased a home that had previous. Q3: Constant flow of water under basement floor. Constant flow even without rain. Q6: lake across the street from our home. Q12: Runs every 3-5 minutes without wet weather. Q17: High water table - surrounding losts drain to our property. We have put in drainage tiles, outdoor sump pump and stand alone generator.
3900	Rave Rd	4	1					4	2	0	0	0	2	1	1	4	2	1	It appears that the drainage plan for my home and the home to the west of me is not correct. We have both experienced flooding, errosion of land, standing water, sump pumps that run continously. We have incurred expenses to mitigate the situation whether that be back up systems, landscaping, replacing primary sump pump, etc.
0	Ravenwood Cr	1						5	2	0	0	0	2	1	1	3	2	1	
0	Ravenwood Cr	5	1					4	2	0	0	0	2	1	3	4	2	1	We have had a history of flooding in the back of our yard along the fence line and into the back of our yards along with our immediate neighbors. If it rains we have a major drainage problem where water flows toward a drain two houses down but never gets there and water is standing typicially in all of our yards. My neighbor who has the drain in the back of his yard has complained in the past that the drain is too high and it will take a lot of water for it to effectively work. The city came in 3-4 years ago to check the tiling/drainage and took pictures but nothing was ever done. The city employee's comment was that it appeared to be caused by a fence/garden. However the flooding problem was there long before the fence was built and garden started on the other side of the fence. There is a tiling issue that was never checked into. We never heard back. There may be pictures and a report on file. I'll have to look for it in our records.
0	Ravenwood Cr	2		2			5	2	2	0	0	0	2	1	1	3	2	1	
0	Ravenwood Cr	3				4		1	1	2	2	2	2	1	2	3	2	1	
0	Ravenwood Cr	2				4	5	2	2	0	0	0	2	1	1	4	2	1	
0	Ravenwood Cr	1						5	2	0	0	0	2	1	4	3	2	1	
100	Ravenwood Cr	1						5	2	0	0	0	2	1	3	4	2	1	Have flooding in our backyard after significant rain.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Reading Rd	1						5	2	3	3	3	0	1	3	1	2	1	
0	Reading Rd.	2	1	2				1	2	0	0	0	2	1	1	3	2	1	Poor drainage in the backyard - standing water if it rains heavily.
0	Red Stone Ct	2					5	4	2	3	3	0	2	1	1	3	2	1	Q3: Sump pump failure only. Q4: Til pump fixed. Q17: sump pump failure: ping pong ball caught end of drain, hung up on side wall, broken.
0	Red Stone Ct	2		2				5	2	0	0	0	3	1	1	5	2	1	
0	Red Stone Ct	0	1					4	2	1	2	2	2	1	1	3	2	1	Q3: It's a huge problem for us. Our basement has flooded 5 times. Q5: There is no drainage ditch but water runs along our property line as if there were a ditch. Q6: We've paid over $10,000 to have our yard graded to expedite water to drain. Several properties drain to the drain on our property. It's too much water draining into one drain. Q10: Runs up too 100 times per day when it rains heavily. Q17: Several houses to the sides of our house and behind it drain into one sewer drain. This drain sits right in the corner of our yard. During a heavy rain, there's a creek that develops along our property line. It eventually backs up. Our basement has flooded 5 times since 2003 - when we purchased our house. It's cost us thousands of dollars. The previous owner's experinece was similar. Another drain is essential. It isn't fair that our yard takes on water drainage for over 10 houses.
0	Red Stone Ct	3	1					2	2	0	0	0	2	1	1	1	2	1	In heavy extended rains, water pools in the southeast corner of lot - back yard - where 4 yards come together. We're very near the high point in the neighborhood, so this seems strange, but believe it's the drainage design in the neighborhood to have water run to back of lots. No sewer issues though.
0	Red Stone Ct	3	1					3	2	0	0	0	2	1	1	3	2	1	minimal standing water between our's and neighbor's property line when heavy rain...eventually soaks into ground
2800	Reed Rd	1						5	2	0	0	0	2	1	1	1	2	1	
2300	Reeline Dr	2				4	5	5	2	3	3	3	2	1	1	1	2	1	Q3: Due to improper grating and sump pump
100 N	Regency Dr	1						5	2	0	0	0	2	2	0	0	0	2	This is a business address, no basement, no flooding ever
100 N	Regency Dr	1						5	2	0	0	0	2	2	0	0	0	1	
100 N	Regency Dr	1						5	2	3	3	3	2	2	0	0	0	0	No basement
100 N	Regency Dr	3				4		2	2	2	0	0	2	1	1	1	2	1	
100 S	Regency Dr	2				4		4	1	1	2	2	2	1	2	2	2	1	
200 S	Regency Dr	1	1	2				2	2	0	0	0	3	3	0	0	0	1	
100 N	Regency Dr	4		2				3	2	0	0	0	3	1	2	1	2	1	
100 S	Regency Drive	2				4		3	2	0	0	0	2	1	1	1	2	1	If sump pump works, have no problem
800	Reinthaler Rd	1						5	2	3	3	3	2	2	0	0	0	0	
900	Reinthaler Rd	4	1					4	2	0	0	0	2	2	0	0	0	0	Reinthaler Condo's have had several floods, we think this is because we sit low and the other houses drain spouts run off onto are property . The back drain backs up and floods water onto our property, we have tried to contact the COB engineering department to see were are back drain goes but no one can give us an answer. It would be very helpful if we could determind were the water is backing up so we could fix this problem. Thank you for conducting this survey our part of town has got a lot of drainage issues.
900	Reinthaler Rd	3		2				3	2	0	0	0	2	1	2	1	2	1	The crawlspace was flooded when I bought the home in 2006, but since then I have sealed the crawlspace, installed drain and exterior pit sump pump. No problems of water in the crawlspace since 2006.
900	Reinthaler Rd	0		2				0	2	0	0	0	2	1	2	1	2	0	
0	Remi Ct	4	1					2	2	0	0	0	2	1	3	3	2	1	During rainstorms, we have a concrete walkway between Remi Ct and Clearwater Avenue where water runs down into our yard. It often causes flooding in our front yard near the sidewalk due to the erosion of soil and I have noticed that the sidewalk itself has sunken down in the spot where the water pools. Also, during heavy rainstorms, water is present in our back yard that takes approximately 30 - 60 minutes to subside. During these rainstorms, our sump pump runs consistently every 2-3 minutes. Pictures can be sent upon request to document the flooding issues.
2300	Revere Rd	1						5	2	0	0	0	0	0	4	4	0	1	
2800	Richard Rd	1						5	2	0	0	0	2	1	3	1	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2800	Richard Rd	3	1					2	2	0	0	0	2	1	1	1	2	1	
2800	Richard Rd	2				4		2	2	0	0	0	2	1	2	1	2	1	5-7 years ago - sump pump was not keeping up and basement floor flooded.
2800	Richard Rd	2					5	4	2	3	3	3	2	1	2	3	2	3	Last flood was 2003 after 9 inches of rain. Sump pump could not keep up. No pics but had to completely remodel basement. Not covered by insurance. Minor floods since then but can't remember specific dates, usually after 4" + of rain.
2800	Richard Rd	1						5	2	0	0	0	2	1	2	1	2	1	
2800	Richard Rd	1						5	2	3	3	3	2	1	2	1	2	1	
0	Richwood Trail	1						5	2	2	3	3	3	1	5	4	0	1	The biggest concern is all the water that comes from the property up the road (back yards) when it rains. I had friends help put a drainage in to keep the erosion problem from cintinuing. But when it does rain for a long period the water comes down and fills up then starts to over fill the holding area. When it does stop raining it takes a bit for all to drain out.
2200	Ridge Creek Dr	1						5	2	0	0	0	2	1	2	3	2	1	not an issue for us
2200	Ridge Creek Dr	1						5	2	0	0	0	2	1	4	3	2	1	
3000	Ridge Creek Dr	1						5	0	0	0	0	2	2	0	0	0	1	
3000	Ridge Creek Dr	1						5	2	3	3	3	3	2	0	0	0	1	
3100	Ridge Creek Dr	1						0	2	0	0	0	2	1	1	3	2	1	
2600	Ridge Rd	0						0	0	0	0	0	0	0	0	0	0	0	
2600	Ridge Rd	1						5	2	3	3	3	2	1	3	3	2	1	Q16: Do not have flooding problem
2600	Ridge Rd	1						5	2	3	3	3	2	1	3	4	0	1	
2700	Ridge Rd	1						5	2	0	0	0	2	1	1	1	2	1	
2100	Ridgecreek Dr	1						5	2	3	3	3	2	1	2	3	2	1	
1400	Ridgeport Ave	1						5	2	0	0	0	2	1	5	1	2	1	
1400	Ridgeport Ave	2	1				5	3	2	0	0	0	3	1	1	1	2	1	In very heavy storms, water will come up in the basement thru a floor drain.
0	Ridgewood Drive	2		2				0	2	3	3	3	3	3	5	4	2	0	
300	Riley Dr	5		2				1	2	2	0	2	3	1	2	1	2	0	
0	Riser Ave	1						5	2	3	3	3	2	2	0	0	0	1	
2200	Riverwoods Ln	1						5	2	3	3	3	3	1	1	1	2	1	
1200	Riviera	1						5	2	0	0	0	2	1	2	3	2	1	
200	Robinhood Ln	1						0	2	0	0	0	3	0	5	1	2	1	
300	Robinhood Ln	1						5	0	0	0	0	3	2	0	0	0	1	
400 S	Robinson	4	1	2				3	2	0	0	0	2	2	0	0	0	0	
0	Rock Garden Ct	1						5	2	0	0	0	1	1	1	3	2	1	
0	Rock Garden Ct	0						0	0	0	0	0	0	0	0	0	0	0	
0	Rock Garden Ct	1						5	2	0	0	0	1	1	2	4	2	1	
0	Rock Garden Ct	1						5	1	2	2	2	1	1	2	1	2	1	
3900	Rockledge Rd	5	1					2	2	0	0	0	3	1	1	4	2	1	A "river" forms covering 1/3 of our back yard, it flows to a drain which is in the corner of our yard. The drain has an iron grill top that looks like the ones in a street. All the yards are graded to drain toward the drain but over time soil has built up around it. No one maintains it, it just might be clogged.
4000	Rockledge Rd	4	1					3	2	2	3	3	2	1	3	3	2	1	
4000	Rockledge Rd	1						5	2	0	0	0	2	1	1	3	2	1	
2700	Rocksbury Dr	1						5	2	0	0	0	2	1	3	3	2	1	
2800	Rocksbury Dr	2						3	2	0	0	0	2	1	2	3	2	2	In 18 years at this house, one time sewer backed up.
2800	Rocksbury Dr	4	1					4	2	3	3	3	2	1	1	3	2	1	Standing water in back yard.
2800	Rocksbury Dr	1						5	2	3	3	3	2	1	1	3	2	1	
2800	Rocksbury Dr	1						5	2	0	0	0	2	1	4	1	2	1	
1000	Rocky Ford Rd	2			3			2	1	2	1	2	2	2	0	0	0	1	Q5: Over Flow Creek Q7: Minor Q17: Over flow creek flooding does NOT impact our residence.
1400	Rodney Ave	1						5	2	3	3	3	2	2	0	0	0	1	
2800	Roksbury Dr	1						5	2	0	0	0	2	1	2	3	2	1	
24400	Ron Smith Memorial	1						5	1	2	2	3	2	1	3	5	2	1	
25100	Ron Smith Memorial	1						5	2	0	0	0	1	1	3	3	2	1	
24400	RonSmith Memorial I	1						5	2	0	0	0	1	2	0	0	0	1	Q1: Lake Bloomington
400 N	Roosevelt	1						5	2	2	3	3	2	2	5	4	0	2	
600 N	Roosevelt	5				4		0	2	0	0	0	2	2	0	0	0	1	The basement takes in water every time it rains. My basement floor is graded pretty well - so as the water comes in it makes its way to the foor drain. I don't usually have too much standing water at any given time. However, if my floor drain ever did back up I would have a serious problem

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
700 N	Roosevelt	1						5	2	0	0	0	2	2	0	0	0	1	
1200 N	Roosevelt	4		2				2	2	0	0	0	2	2	0	0	0	2	Most of the flooding now is only in the street. The sewer can't handle downpours. I used to get sewer in the basement through the drains, but since the Division Street sewer was redone, I don't have problems. Neighbors on N. Madison had major problems when the old brick sewer collapsed and flooded up to four feet in their basements a few years back. I have standpipes in all of my drains which has also helped in the past.
1300 N	Roosevelt	1		2				5	2	0	0	0	3	1	3	4	2	1	Q6: water sometimes standing near drains @ corner of Roosevelt & union during heavy rains (sometimes several hrs). Q18: I have no pictures but have lived here 20 yrs.
1500 S	Roosevelt	5				4		4	2	3	3	3	2	2	0	0	0	2	Water Running across floor during heavy rains, no sump pump, rare backup through floor drains
800	Roosevelt	1						5	2	0	0	0	3	3	0	0	0	1	
1600 N	Roosevelt Ave	1						0	2	0	0	0	2	2	0	0	0	2	Sewer backup maybe 1 time a year, have sewer pipe cleaned out at least once a year.
1600 N	Roosevelt Ave	5				4		3	2	0	0	0	2	2	0	0	0	2	Believe toilet paper gets caught in roots of a tree, or trees, so I discard all toilet paper in trash.
500 S	Roosevelt Ave	4				4		2	2	0	0	0	2	2	0	0	0	1	The main problem is street flooding. I live on a corner lot. The new curbless corners allow fast moving rain water to travel and completely cover my front sidewalk. I have erosion and block settling because water comes down Oakland Ave form the east and west. The storm drain to the south fill quickly and the water comes across the street and goes down our sidewalk.
1500 S	Roosevelt Ave	1						0	2	0	0	2	2	2	0	0	0	1	
1600 S	Roosevelt Ave	1						5	2	3	3	3	2	2	0	0	0	0	
1600 S	Roosevelt Ave	1						5	1	2	2	0	2	1	5	0	2	1	
1000 N	Roosevelt Ave.	2				4		3	2	0	0	0	2	2	0	0	0	1	
0	Rosewood Ct	5	1					4	2	0	0	0	1	1	2	5	2	1	
0	Rosewood Ct	4	1					0	2	0	0	0	2	1	3	4	2	1	Water stands across the lot line of our backyard. The end of our lot line and continues for 2-3 houses next to us. Standing water has killed our bushes at least 3 times.
0	Rosewood Ct	1						5	2	0	2	0	1	1	2	1	2	1	
0	Rosewood Ct	1						0	2	0	0	0	1	1	1	3	0	0	
0	Rosewood Ct	2	1					2	2	0	0	0	2	1	1	3	2	1	water around foundation at fireplace comes into basement wall. just a little bit .
0	Rosewood Ct.	1						5	2	0	0	0	1	1	1	3	2	1	N/A
1100	Rosney Ave	3					5	4	2	0	0	0	2	1	1	1	2	2	When the rains are heavy and constant, we have an occasional flooding issue with the basement floor drain. Usually water covers an area within a ten foot radius of the drain. The water level does not decrease on its own over a lengthy period of time, so we usually have to mop up the water. We have had our drainage Roto-rooted for possible tree roots or other obstructions, but we still experience flooding and have had sewage backup into our basement once or twice over the past two years. We have a sump pump and a basement de-watering system and still experience flooding regardless.
1300	Rosney Ave	1						5	2	3	0	0	2	2	0	0	0	1	
1200 N	Rosney Ave	2		2			5	3	1	2	2	2	2	2	0	0	0	1	
0	Ross Dr	1						5	2	0	0	2	3	1	2	4	2	1	
0	Ross Dr	1						5	2	3	2	2	3	1	2	4	2	1	
0	Ross Dr	5		2				4	0	0	0	0	2	2	0	0	0	0	The drainage problem is a the intersction of Ross Drive and 4 Seasons Road
0	Ross Dr	2						3	2	0	0	0	3	2	0	0	0	1	One time during the severe winter a frozen pipe burst(looks like) and the water was flooded in the laundry room. Informed Property Management maintainance and was fixed.
0	Ross Dr	4		2				4	2	0	0	0	3	3	0	0	0	1	There is waterlog on the intersection on Fourseasons Rd and Ross Drive. The drainage won't drain out the rain wanter.
900	Roundhouse Dr.	1						5	2	0	0	0	2	2	0	0	0	1	
0	Rounds Rd.	3	1					3	2	0	0	0	2	1	1	3	2	1	
0	Rounds Rd.	4	1	2		4		4	2	0	0	0	2	1	1	4	2	1	House on slight hill and back yard seems to have clay soil base and catches drainage from up hill. Pooling continues to occur despite landscaping and grading, though work seems to have reduced occurrence of water in basement. Basement water and standing water in street is infrequent.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
200	Rowe Dr	4	1					4	1	2	1	0	2	2	0	0	0	0	Backyard collects water as I am on the downhill side of my neighborhood. It does not drain around the house as it should. Also, at the corner of Rowe & Radliff, the drain gets clogged and backs up the street. Q4: Depends on how long it rains.
200	Rowe Dr	2	1					1	0	2	2	2	2	2	0	0	0	0	Q3: Rarely Q5: across the street - actually - no problem Q8: no need Q11: none Q15: no Q18: no problem
200	Rowe Dr	1						3	1	0	1	2	2	2	0	0	1	0	Q2: house is about 25 feoot higher than creek that floods. No basement
300	Rowe Dr	1						5	2	0	0	0	2	2	0	0	0	1	
300	Rowe Dr	1						5	1	3	1	2	2	2	0	0	0	1	
300	Rowe Dr	1						5	1	2	2	2	2	2	0	0	0	0	Q15: Slab House
300	Rowe Dr	5		2				4	2	3	3	3	2	1	2	1	2	1	Q2: every time it rains hard. Q3: Standing water in the street up by the curb. Q4: More than 2 hours (if it rains hard). Q12: If it rains a lot, and the ground is already soaked. Q17: The problem with the flooding at the curb is because the street needs to be redone so it will flow down to the drain in front of our house.
300	Rowe Dr	0						0	0	0	0	0	0	0	0	0	0	0	Q2: In heavy rains, wash-off from neighbor behind.
300	Rowe Dr	3	1					3	2	3	3	3	2	2	0	0	0	0	
300	Rowe Dr	2						5	0	0	0	0	2	1	3	1	2	1	
300	Rowe Dr	1						5	1	3	1	3	2	2	0	0	0	0	
1200	Royal Poinie Dr	4						4	2	2	2	2	2	1	1	1	2	1	
1200	Royal Poinie Dr	1						5	2	0	0	0	2	1	2	4	2	1	NA
1200	Royal Poinie Dr	1						5	2	3	3	3	2	2	0	0	0	1	No problems due to flooding, however our sewer line needs frequent servicing (cleaned out aproximately every 2 years) because of an inadequet slope profile in the sewer drain. Where the hell was city inspector(s)?? During construction?? Fire em all!!!
1200	Royal Poinie Dr	1						5	1	2	2	2	2	1	3	3	2	1	
1200	Royal Poinie Dr	1						5	2	3	3	3	0	3	4	3	0	1	
1400	Royal Poinie Dr	1	1					5	2	0	0	0	3	1	3	4	2	1	Q2: standing water when rains hard for awhile if keep raining otherwise 2 day right side in back not bad.
1600	Royal Poinie Dr	1						5	2	3	3	3	2	1	1	4	2	1	
1600	Royal Poinie Dr	2	1					4	2	0	0	0	2	1	1	5	2	1	The city took steps to alleviate the b____(sp?) 25 or so years ago, since then floodign has been tolerable.
1700	Royal Poinie Dr	3					5	4	2	0	0	0	2	1	1	3	2	0	Q12: several times every few minutes
3000	Rusty Ln	1						5	2	0	0	0	2	2	0	0	0	1	
3100	Rusty Ln	3	1			4		3	2	0	0	0	2	2	0	0	0	1	
0	Ruth Rd	1						0	2	0	0	0	3	2	0	0	0	1	
100	Ruth Rd	1				4		5	2	0	0	0	2	1	1	1	2	1	
0	Rutherford Ct	1	1					4	2	0	0	0	0	1	2	3	2	1	Q3: Once when ground was frozen, had a heavy snow fall then it rained. Q11: crawlspace in basement of bilevel. Q12: Depending on severity of rain.
0	Rutherford Ct	3	1					1	2	0	0	0	3	1	2	3	1	1	
2800	Rutherford Dr	1						0	2	0	0	0	2	1	4	4	2	1	
2800	Rutherford Dr	1						5	2	3	2	2	2	1	3	3	2	1	
1200	Rutledge Rd	1						5	2	0	0	0	2	2	0	0	0	1	N/A
1200	Rutledge Rd	1						5	0	0	0	0	2	2	0	0	0	1	
1300	Rutledge Rd	1						0	0	0	0	0	0	1	3	4	0	4	A sewer pipe was broken in our front yard and it has all been replaced and works very well now!
0	Ryan Dr	1						5	2	0	0	0	2	2	0	0	0	1	No flooding issues
0	Ryan Dr	1						5	2	0	3	3	2	2	0	0	0	0	We live on Ryan Dr the street goes down hill from Croxton. At the corner of Ryan and Cloud we have a flooding problem. If we have a good rain that end of the street is always flooded.
0	Sable Oaks Ct	1						5	1	1	0	0	2	1	2	3	2	1	Q5:White Eagle detention basin. Q7:most residents have put in gravel/rock along the bank. However at Streid/White Eagle there is on going ersion towards the street. Over a long time there will be an issue one lane filled with drainage pipe is completely exposed. Also concerned about silt buildup from the erosion on level of detention basin in the future.
3000	Sable Oaks Ct	1						5	2	0	0	0	2	1	1	3	2	1	
1000 S	Sable Oaks Ct	2					5	2	2	0	0	0	2	2	0	0	0	1	
3100	Sable Oaks Road	2			3			1	1	2	1	2	2	1	2	3	2	1	
1000	Saddlebrook Dr	1						5	1	2	1	1	2	1	3	3	2	1	
1000	Saddlebrook Dr	1						5	1	2	1	1	2	1	3	4	2	1	The problem is erosion of the drainage ditch adjacent to the south edge of my property.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1000	Saddlebrook Dr	3	1			4		4	1	2	1	2	3	1	1	1	2	1	Primary sump failure extended power outage during winter storm
1200	Sandburg Dr	1						5	2	0	0	0	2	1	3	1	2	1	
1200	Sandburg Dr	4	1					2	2	0	0	0	2	1	2	1	1	2	Q2: Several times per year (heavy rains). Q3: Water enterign house thru basement floor drain - this has happened a couple of times. Q14: Discharge line froze once and caused backup into basement. Q17: My house sits higher than the back of the property. During heavy rains, I get 1/2" or so of water, alon geast side and along north side where sump pump discharges. Doesn't last too long (Have had sewer line back up twice.)
2400	Sarah Anne	1						5	2	0	0	0	2	1	2	4	2	1	No problems
0	Sarlight Ct	4	1					3	2	0	0	0	2	1	1	1	2	1	The only tiem I've had flooding in the house it was caused by rainfall so heavy the sump pump couldn't keep up - July 2003. A low area in the backyard always floods when rainfall exceeds 2 inches.
2400	Savanna Rd	1						5	2	3	2	2	2	2	0	0	0	1	
2400	Scarborough St	3	1					2	2	0	0	0	2	1	1	3	2	1	We don't really have a significant flooding problem, though we have ponding of water in the yard when heavy rains occur. Also, our sump pump runs regularly most of the year, and very frequently during wet weather. Our water problems may the result of a poorly graded yard as much as anything else.
2800	Scarborough St	1						5	2	0	0	0	2	1	2	3	2	1	
2800	Scarborough St	1						5	2	0	0	0	2	1	5	4	2	1	
2800	Scarborough St	1	1					3	2	0	0	0	2	1	1	1	2	1	Q3: along property line Q4: again depending on heavy rain Q12: Depens on amount of heavy rain or less
2800	Scarborough St	3	1			4		2	2	0	0	0	2	1	1	3	2	1	The worst one was several years ago when the ground was frozen and we had a big rainstorm. Sump couldn't keep up with whaat was coming in. Other than that once in a a great while, window on back of house fills up and water comes in.
2900	Scarborough St	1						5	1	2	2	2	3	1	5	3	2	1	
2900	Scarborough St	1						0	2	0	0	2	2	1	3	3	1	1	
0	Scenic Pt	1						5	2	0	0	0	2	1	2	1	2	1	
0	Scenic Pt	1						5	2	0	0	0	2	1	2	1	2	1	NA
1800	Scogin Creek Rd	3			3			5	1	2	2	3	3	1	1	4	2	1	Q12: Sometime constantly to the point it burned out in less than 3 years. Q17: In Dec 2011 often hevy rain, my sump pump burned out. This was the first time I had water in the basement. The drainage ditch often looks like a lake after a rain - it usually takes a day to go down. During most rains, my sump pump runs constantly.
600	Scott st	1						5	2	0	0	0	2	1	2	4	2	1	no problems
1300	Seminary Ave	4	1			4	5	4	2	0	0	0	2	2	0	0	0	1	Anytime the ground is saturated I get water in the basement. I tried to make the basement usable, but it has never happened b/c it gets flooded at least twice a year. I have tried banking dirt and rocks around the foundation and that didn't help.
1300	Seminary Ave	2	1					1	2	0	0	0	3	2	0	0	0	1	A prior owner (not the previous but owners before whome I bought the property from several years ago) had a garage where part of my driveway is now. During heavy rainfall water will pool in that area for awhile due to the lower level of that area and from constant use of using that area to turn vehicle around and neighbors use that are to turn vehicle around as well.
600 W	Seminary Ave	3	1	2		4		4	0	0	0	0	2	2	0	0	0	2	In heavy rain, water soaks basement floor. Never any standing water. Its just wet only bad a few times in 18 years. Couple times a year it does get wet. Standing water in street (Oak) very deep. Debris covers the sewar grates.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
1300 W	Seminary Ave	3			3		5	3	2	0	0	0	2	2	0	0	0	3	My wife and I have lived here 50 yers. My children played ball in the street. We are proud of Bltn. We have a nice new street in the 1300 block. Garbage pickup excellent. Police protection is good. Ambulance service is good. No robberies, no mugging. The mggers now go to the East side. Our problem - after 50 years we are starting to have sewer backup in our basement. About 2 years ago after a 4" rain we had 4" of sewer water in our basement. Four months later, same thing. Engineering Dept. came out. Said it was a surge. What in the hell is a surge? (Just kidding) Our combination sewer-storm flows into the creek. Creek is so full from storm water our sewer water cannot enter. When you build a new bridge on Cottage put a 45 or 90 degree on our sewer outlet and the current of the creek will let our sewer enter. Simple. I've invested $1500 with Lysowski who installd sewer backup stopper in basement. I think this will help. Maybe the 45 degree will help my neighbors who had the same problem. Thank you, L.J.C.
100 N	Sesame Street	1						5	2	0	0	0	3	3	0	0	0	0	
200 S	Sesame Street	1						0	2	0	0	0	2	1	3	1	2	1	
500	Seville Ave	5	1					4	0	0	0	0	3	3	0	0	0	0	A large area at the back of parking lot floods due to: grade of parking lot, rise of adjacent properties, possible inadequecy of the storm drain at the rear of parknig lot. Q15 Unknown: I have lived in rental apartment for only 2 months.
300	Seville Rd	1						5	2	0	0	0	2	2	0	0	0	1	
300	Seville Rd	2				4		2	2	0	0	0	2	1	2	3	2	1	
300	Seville Rd	2					5	2	2	0	0	0	1	2	0	0	0	1	
300	Seville Rd	3	1					1	2	0	0	0	2	1	2	1	2	1	We have lived at this address for about 30 years & have had no real problem. Prior to our ownership there was a problem once but some work was done to alevate the problem. Keeping all the drains along the streets open and free of debris should be a priority by the city.
500	Seville Rd	2					5	3	2	3	3	3	2	2	0	0	0	2	
3900	Shasta Dr	1						5	2	0	0	0	2	1	3	1	2	1	
3900	Shasta Dr	1						5	2	0	0	0	2	1	3	4	2	1	
1400	Sheridan St	3		2				4	2	0	0	0	2	2	0	0	0	2	
1300 N	Sherman St	4				4		1	2	0	0	0	2	2	0	0	0	2	
200	Sherwood Way	3				4		0	2	5	3	3	3	1	5	1	2	1	Q4: depending on the rain Q13: underground Q17: others in the block have had problems
200	Sherwood Way	4		2				4	2	0	0	0	2	2	0	0	0	1	Stopped up street drains. Has not backed up into house yet.
200 S	Sherwood Way	3					5	2	2	0	0	0	2	1	3	1	2	2	Have an 8" combination storm & seage system have an interceting 8" line between 205 Sherwood & 203 Sherwood that come from Robinhood Lane - any idiot should realize that 2-8" lines emptying into 1-8" line it s going to cause sewer to backup in basements "DUH". Comment on Q#18 - They all know about it - they said pump truck to inspect the man hole every 17 days in front of 205 Sherwood. It has been going on since Rowe built Fairway Knolls and Dale Balluber was the engineer who sold out to Delmak Rowe, I have put up with it for 34 years! Every big storm - intersection Radliff & Robin Hood lane floods to be totally impassable.
0	Shire Court	3	1					4	2	0	0	0	2	2	0	0	0	1	water accumulates in ditch/low area between my backyard and the house just behine me.
0	Shire Court	2	1					3	2	0	0	0	2	1	3	1	1	1	Standing water in backyard after lots of rain.
0	Shire Court	1						5	2	0	0	0	2	2	0	0	0	1	
100	Shorewood Drive	2				4		2	2	0	0	0	2	1	1	3	2	1	
100	Shorewood Drive	1						5	2	0	0	0	2	1	2	3	2	1	
100	Shorewood Drive	2	1					4	2	0	0	0	2	1	1	1	1	1	
1100	Sidney St	3	1					2	2	0	0	0	2	2	0	0	0	1	
1100	Sidney St	1						0	2	0	0	0	2	2	0	0	0	1	
0	Silverberry	1						0	2	0	0	0	2	1	4	1	2	1	
2000	Sinclair Ct	1						5	2	0	0	0	3	1	3	4	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2100	Sinclair Ct.	5			3			4	2	0	0	0	2	1	5	4	2	1	Every time it rains, there is flooding along the back of my property line. The most recent flooding occurred on 4/14/2012. It has worsening since the city added a path connecting my street to the Tipton Trails Park. I have several photos of the flooding available. Please contact me if you need them.
1600	Six points rd	4	1		3			4	2	0	0	0	1	1	3	4	2	1	We have flooding in our adjacent lot. and we have a creek like water feature that is run off that runs through our property. At periods of heavy rain the small "creek" turns into a large "lake" on our property.
2700	Slayton Drive	1						5	2	0	0	0	2	1	1	1	2	1	
0	Smoerset Ct	1						5	1	2	2	2	2	1	3	1	2	1	Q5: Retention basin directly behind us. Q12: Rarely.
0	Smokey Court	1						5	2	0	0	0	2	1	3	1	2	1	n/a
0	Smokey Court	5		2				4	2	0	0	0	2	2	0	0	0	1	Ineffective design of the road/drainage of Smokey Court as well as the road's decline causes large puddles of water to accumulate and, in the winter, freeze. This accumulation caused further decline in the condition of the road and dangerous and unsafe conditions - especially when the water freezes.
800	Snyder Dr	1						0	2	0	0	0	2	2	0	0	0	1	
900	Snyder Dr.	1						5	2	0	0	0	2	2	0	0	0	0	We have a crawl space.
0	Somerset Ct	1						0	2	2	3	3	2	1	3	3	2	1	
0	Somerset Ct	1						5	1	2	2	2	0	0	3	1	2	1	
0	Somerset Ct	3	1			4		3	1	2	2	2	2	1	1	1	2	1	
2900	Southfork Rd	4	1					4	1	1	2	2	1	1	2	3	2	1	Q2: Never in home, serveral times per year in yard. Q17: Flooding in yard during rainy spring. Have picture of ducks swimming in standing water!
2900	Southfork Rd	4	1					4	1	2	2	2	2	1	1	3	1	1	Q3: Seaping between wall and floor, also water pressure beneath floor has cracked my concrete. Q5: Sidewalk along utilities easement. Q14: I am the last house on the drain line prior to its discharge into the storm sewer. I installed a second pump because during periods of heavy rain or melting I have not been able to empty my sump pit.
2800	Southfork Road	4	1					4	2	0	0	0	3	1	2	3	2	1	being at the bottom of a graded "hill" our back yard is typically wet. As a result we have constant divets from mower tires, even after fillling rows, they still come back. We have lived in this home for 20 years. We are thankful Bob Tolan escavated the way he did or we would have water in the basement as all the neighbors have. The natural flow of water comes down across our neighbors, through our yard and across the next 1 or 2 neighbors. We have had drainage work done 3 times (at our expense to alieviate the problem) - it is better, but not corrected.
2900	Southfork Road	2		2				1	2	0	0	0	2	1	3	4	2	1	We are at the bottom of a hill. It only happens when there is too much rain too fast. The drains usually catch up within 30 minutes or less.
3200	Spahn Lane	3		2				2	2	0	0	0	2	1	1	3	2	1	Under heavy rain conditions the street floods over the curbs.
3200	Spahn Lane	2					5	2	2	0	0	0	2	1	1	1	2	1	The last time we had flooding in the basement was about 4-5 years ago in December when the power was off and the sump pump didn't drain. We have since installed a back-up sump pump.
3300	Spahn Lane	1						5	2	3	3	3	3	1	5	4	2	1	
2800	Spangle Rd	4	1					3	2	2	3	3	1	1	2	3	2	1	When it rains we get 4-8 inches of standing water in back yard. We back up to empty lots.
0	Spiria Court	1						0	2	0	0	0	3	1	1	3	2	1	
0	Spiria Court	1						5	2	3	0	0	2	1	1	1	2	1	
0	Spring Ridge Circle	1						5	2	0	0	0	2	1	3	3	2	1	
0	Spring Ridge Circle	2			3			4	1	2	1	2	2	1	1	3	2	1	January ice dams blocked rain water creating water behind us.
200	Spring Ridge Dr	1						5	2	3	3	3	0	1	3	3	2	1	
200	Spring Ridge Dr	1						5	2	0	0	0	2	1	1	4	2	1	
300	Spring Ridge Dr	1						5	2	0	0	0	2	1	1	3	2	1	
300	Spring Ridge Dr	1						5	2	0	0	0	2	1	5	3	2	1	
300	Spring Ridge Dr	1						5	2	3	3	3	1	1	5	4	2	1	
400	Spring Ridge Dr	2				4		3	2	0	0	0	2	1	2	4	2	1	
1800	Springfield Rd	4	1					4	2	2	3	2	2	1	2	3	2	1	
2200	Springfield Rd.	1						5	1	2	2	3	2	2	0	0	0	1	
0	Spruce Ct	1						5	2	0	0	0	2	1	2	3	2	1	
1300	Staghorne Way	1						5	2	0	0	0	2	1	2	3	2	1	n/a

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
300 S	State	1						5	2	0	0	0	3	2	0	0	2	1	
1100 N	State St	1						5	2	0	0	0	2	2	0	0	0	3	About 10 years ago some roots of a large tree in our front yard blocked our sewer line. In the 20 years we have lived in this house this was the only time we have ever experienced this problem as the tree causing the trouble was removed. Since we live near the top of a hill in our neighborhood I never thought we would ever have a problem. Although we did. After our sewer back up experience we installed an outside sewer line 'clean-out' but as the offending tree was removed and a new tree to replace it was planted 15-20 feet FURTHER away from the sewer line I do not anticipate there ever being a problem again. If there should be, there is now an access to the sewer line for better root eradication.
1100 N	State St	1						5	2	0	0	0	2	2	0	0	0	1	
1100 N	State St	1						5	2	3	3	3	2	2	0	0	0	0	Do not have a basement.
1100 N	State St	1						5	1	2	2	2	2	2	4	4	2	1	
1200 N	State St	1						5	0	0	0	0	2	2	0	0	0	0	
1200 N	State St	1						5	2	0	0	0	2	2	0	0	0	1	
200 S	State St	3				4		4	2	2	2	2	2	1	1	1	2	1	
500 S	State St	3				4		3	2	0	0	0	2	2	0	0	0	1	If we receive several inches of rain in a short period of time, there may be a trickle of water come through the wall in the basement SE corner. Usually a plugged downspout is the culprit. It's more annoying than a real problem. A wet vacuum takes care of it.
500 S	State St.	2				4		5	2	0	0	0	2	2	0	0	0	1	Periods of heavy rain may result in water seepage through the walls and floor. Don't know if related to any drainage problem, but I am noting. The intersection of Oakland Ave. and State St. is prone to flooding in high rain situations. At times -- rather rare -- the waters have backed up in the street as far as my house (100 yards). The city is probably aware of this, but I thought I would report anyway.
1400	Steeplechase Dr	1						5	2	0	0	0	2	2	0	0	0	1	n/a
1400	Steeplechase Dr	1						5	2	0	0	0	2	1	3	3	2	1	
1500	Steeplechase Dr	4	1			4		0	2	0	0	0	3	1	1	3	2	1	Woodland Ridge Subdivision is built on a hill. We have runoff from our neighbors to the west whose elevation is higher than ours. We also have a lot of runoff from the woods behind our house, especially since the Timbers Subdivison was built and something was irrevocably changed in the woods. We are very unhappy with the situation.
2300	Stern Dr	2					5	1	2	0	0	3	2	1	3	3	2	1	
0	Stetson Dr	1						5	2	3	3	3	2	1	1	1	2	1	
400 E	Stewart St	2						5	1	2	2	2	2	1	3	1	2	1	Just once year ago when the bldg across put a mess (___?) down her toilet.
500 W	Stewart St	1						5	2	3	3	3	2	2	0	0	0	1	
200	Stillwell st	1						5	2	0	0	0	0	0	0	0	0	1	
100	Stockholm	1						0	2	3	3	3	2	2	0	0	0	1	
2000	Stone Mountain Blvd	4	1	2				2	1	2	2	2	3	1	3	4	2	1	Corner of Stone Mountain & Hubbard floods severely (well over curbs onto property) 3-5x per year during intense and/or prolonged rainfall. Cars frequently attempt to navigate, pushing water up almost into garage. Candidly, the drainages at the intersection was very poorly enteneered - at least several more storm drains would be required. We worry about ability of emergency vehicles to navigate in emergency, we may have photos and would be happy to record video.
3200	Stonebridge Dr	2					5	1	2	2	3	3	3	1	1	1	2	1	
3200	Stonebridge Dr	1						5	2	0	0	0	3	1	3	4	2	1	
3200	Stonebridge Dr	3	1					2	0	0	0	0	2	1	1	4	2	1	
3300	Stonebridge Dr	1						5	2	0	0	0	2	1	1	3	2	1	
3300	Stonebridge Dr	1						5	2	3	3	3	1	1	1	4	2	1	N/A
0	Stonebrook Court	3	1					3	2	0	0	0	2	1	2	3	2	1	Side yard swale not graded correctly and backyard water can't flow to the street.
0	Stonebrook Court	1			3			4	1	2	3	3	2	1	0	4	2	1	
0	Stonebrook Court	1						5	0	0	0	0	0	1	5	4	2	1	Q2: so far
0	Stonebrook Court	1						5	1	2	2	2	2	1	4	4	2	1	
100	Stonebrook Court	5	1					4	2	0	0	0	3	1	5	4	2	1	pooling of water accumulates in my backyard after heavy rain

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Stonehedges Ct	1						5	2	3	3	3	2	1	1	4	2	1	
0	Stonehedges Ct	1						5	2	3	3	3	2	1	1	4	2	1	
0	Stonehedges Ct	1						5	2	0	0	0	3	1	4	1	2	1	Q9: We have a bathroom in basement - house built in 1998 w/basement bath. Not sure if an ejector pump is always needed for basement bath so marked - Don't know. Pls change if basement bathroom always have ejector pumps.
0	Stonehedges Ct	1						5	0	3	3	3	2	1	5	1	2	1	
0	Stoney Court	1						5	2	0	0	0	2	2	0	0	0	1	
0	Stortz Dr.	4	1					2	2	2	2	0	2	2	0	0	0	1	
2800	Stratford Ct	1						5	2	3	3	3	3	3	2	2	0	1	
0	Strawberry Rd.	1						5	2	0	0	0	2	2	0	0	0	1	
2700	Stretmoor Dr	1						5	2	3	3	3	2	1	5	4	2	0	We live near the top of a hill in Heartland Hills subdivision. The nearest creek is dawhire about 1/2 - 3/4 miles away on Six Points Rd.
3200	Suffolk Way	1						5	2	0	0	0	2	1	5	4	2	1	
3200	Suffolk Way	1						5	2	0	0	0	3	1	5	4	2	1	
3200	Suffolk Way	1						5	2	0	0	0	2	1	4	1	2	1	
3200	Suffolk Way	1						5	2	0	0	0	3	1	4	1	2	1	
3300	Summer View Ln	1						5	2	3	3	3	2	1	3	1	2	1	
2100	Summerfield Blvd	3				4		0	2	3	3	3	3	1	2	4	2	1	
1000	Summit St	1						5	2	0	0	0	0	2	0	0	0	1	
800 S	Summit St	2		2		4		2	2	3	3	3	2	2	0	0	0	0	
900 S	Summit St	2				4		0	2	0	0	0	2	1	2	1	2	1	Q2: flooding rarely, seapage frequently. Q14: rarely Q15: no but we experience occasional sewer odor.
0	Sun Pointe Ct	1						5	2	3	3	3	3	1	1	4	2	1	
0	Sun Pointe Ct	1						0	2	0	0	0	2	1	5	5	2	1	
0	Sun Pointe Ct	1						0	2	0	0	0	2	2	0	0	0	1	
0	Sun Pointe Ct	1						0	2	0	0	0	2	1	5	5	2	1	
0	Sunset Rd	0				4	5	0	2	0	0	0	2	1	2	1	2	0	Note on Question 2 & 4 - It depends on the length and severity of the rain. Note on Question 9: We are NOT connected to the sanitary sewer. Note on Question 12: Depending on rain as mentioned in questio #2. Note on Question 15: We have no sewer connection. During heavy or extended rains I OCCASIONALY have some problems in basement. Have had quite a lot of work done to solve it, and it is much better. If one of the sump pumps quits working of course that is a problem! If the lone field tile that is in this area gets stopped up then there is a problem!
0	Sunset Rd	2	1					4	2	0	0	0	2	3	3	5	2	1	
0	Sunset Rd	2		2				2	2	0	0	0	3	1	1	3	2	1	
0	Sunset Rd	1						5	2	0	0	0	2	1	1	1	2	1	Q16: N/A
0	Sunshine Ct	1						5	2	0	0	0	2	2	0	0	0	1	
0	Sunshine Ct	2	1			4		2	2	0	0	0	1	1	1	1	2	2	When sump pump is not working
0	Swan lake road	3	1	2		4		4	1	2	2	3	2	1	1	3	2	1	In December, 2007 water came into basement through foundation walls and damaged drywall and flooring. Sump pump could not keep up. Only time that has happened since we moved here in 1997. Retention pond level got close to top after four days of continual rain. That was the highest it ever rose.
0	Swarthmore Dr	1						5	2	0	0	0	3	1	5	4	2	1	
0	Swarthmore Dr	1						5	2	3	3	3	2	1	1	3	2	1	
0	Swarthmore Dr	5	1					4	2	0	0	0	2	1	1	3	2	1	Standing water in backyard due to poor drainage.... Stays wet for several days after any amount of rain.
0	Swayze Ct.	1						5	2	0	0	0	1	1	4	3	2	1	Our backyard is graded so rainwater goes to the sides of our house. Our sump pump has not run, or had enough water in it to run, in the 4 years we have been in this house.
1500	Sweetbriar Dr	4	1					0	2	0	0	0	2	1	1	5	1	1	Q4: Varies. Q17: I am the recipient of neighbors water to my backyard which causes standing water. In hard rains it is difficult to get the wter to drain to the street because of the large volume of water.
1700	Sweetbriar Dr	2					5	1	2	3	3	3	2	1	3	1	2	1	
0	Sylvan Ln	1						0	0	0	0	0	0	0	0	0	0	1	
0	Sylvan Ln	1						5	2	0	0	0	0	0	0	0	0	1	
0	Sylvan Ln	1						5	2	0	0	0	2	2	0	0	0	1	
0	Sylvan Ln	1						5	2	0	0	0	2	2	0	0	0	1	
0	Sylvan Ln	1						5	2	3	3	3	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Sylvan Ln	1		2				2	2	0	0	0	2	2	0	0	0	1	Flooding in road when it rains in front of our home
0	Szarek Dr	1			3			4	2	0	2	2	1	1	3	1	2	1	
0	Tami Ct	2						5	2	3	3	3	2	1	1	1	2	1	Q3: Sump pump failure
0	Tami Ct	2				4		0	2	3	3	3	2	1	2	1	2	1	
100	Tanner St	2		2				2	2	0	0	0	2	2	0	0	0	1	Drainage is generally good - extreme conditions have been the only time I'm aware of any problem.
100	Tanner St	1	1					5	2	3	3	3	2	2	0	0	0	1	
100	Tanner St	1						5	2	0	0	0	2	1	1	1	2	1	
0	Tatiana Ct	1						5	2	3	3	3	3	1	1	1	2	1	
1600 E	Taylor	3		2			5	3	2	0	0	0	2	2	0	0	0	2	
1900 E	Taylor	3		2		4	5	4	2	0	0	0	2	1	1	1	2	3	
500 E	Taylor St	0						0	0	0	0	0	3	1	3	1	2	1	Q2: been here two years. Can't answer 2, 3, 4
700 E	Taylor St	3				4		2	2	0	0	0	3	1	4	4	2	1	
800 E	Taylor St	1						5	2	3	3	3	2	2	0	0	0	2	I experience foul odor from sewers in street. Can not sit on f ront porch at times because odor is so strong. I hae called about this before and they said ti was drainage and sewer line both in one place. I would appreciate this checked out as I have lived here 20 years and it doesn't get better. At times it is so bad it makes you feel sick.
800 E	Taylor St	1						0	2	2	3	3	2	2	0	0	0	1	
1000 E	Taylor St	2	1					3	2	0	0	0	2	2	3	1	2	1	
1000 E	Taylor St	2				4		2	2	0	0	0	2	2	0	0	0	1	
1100 E	Taylor St	1						5	2	0	0	0	2	2	0	0	0	1	
1100 E	Taylor St	1						5	2	0	0	0	2	2	0	0	0	1	
1900 E	Taylor St	1						5	2	0	0	0	2	2	0	0	0	1	
2000 E	Taylor St	5				4	5	0	2	3	3	3	2	2	0	0	0	2	Q2:every time it rains very hard for an extended period of time. Q4:it depends upon how long it is raining.Q17:ours mostly seems to be a problem of water backing up throught the drains. Whenever there is a substantial rainfall. We do get a little water through basement floor sometimes.
2000 E	Taylor St	1						5	2	0	0	0	2	2	0	0	0	1	
2000 e	Taylor St	2				4		1	2	0	0	0	2	2	0	0	0	1	
2000 E	Taylor St	2		2				4	0	0	0	0	2	2	0	0	0	0	
2100 E	Taylor St	2	1					2	2	2	3	3	2	2	0	0	0	0	
2100 E	Taylor St	5		2		4	5	4	2	3	3	3	1	2	0	0	0	1	Q2: hard-more than 3" of rain. Q3: floor cracks. Q17: flooding started in 1970's when state farm corporate paved acre of land on corner of Washington/Veteran's Parkway - no storm sewers in our streets. Flooding from back up of sewer water - no place for water to drain to until sewage system catches up with storm run-off.
900 W	Taylor St	1						5	2	0	0	0	2	2	0	0	0	1	
900 W	Taylor St	1						5	2	3	3	3	1	1	0	0	0	0	
1000 W	Taylor St	3			3			1	2	2	0	0	2	2	0	0	0	0	
1300	Tearose Ln.	1						5	1	1	2	3	2	1	3	3	2	3	Most of our problems started in 2003 with the 100 year flood. Our sewage system was comprised and caused sewage backup in several homes including ours. In addition there was occasionally flooding into our yard and others because of the storm cap in my yard. August 2003 water actually streamed between my and my neighbor's house. The city corrected both problems so at this point we get occasional flooding in backyards, but nothing close to the house.
18300	Teepee Trail	4						0	2	0	0	0	0	2	0	0	0	0	
18300	Teepee Trail	1						5	2	0	0	0	2	2	0	0	0	1	this is a lake bloomington addtress. no sewer. on septic
0	Tees Court	1						5	2	0	0	0	2	1	1	1	2	1	
0	Tees Ct	4		2				4	2	2	2	3	2	1	1	1	1	1	The area between my house and the neighbor's fill with water after rain or melting snow and ususally puddles for quite a while. It wouldn't be bad if that wasn't the area where my mailbox is located.
3000	Thornwood Lane	1						5	2	0	0	0	3	3	0	0	0	1	N/A
2100	Timber View Drive	4	1					4	2	3	3	3	2	1	1	3	2	1	The city put in a drain behind our property in the common area which helped a great deal. Now we get some water near the back of our property when it rains ver much. When we get extremely heavy rains, water will fill the back yard on both sides of the house.
0	Timbergate Court	4	1					4	2	0	0	0	2	1	1	3	2	1	During heavy rains in the backyard only

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
0	Timbergate Court	1						0	1	3	3	3	2	1	4	4	2	1	
0	Timbergate Court	3	1					3	2	0	0	0	2	1	2	3	2	1	Lived in the house approx. 8 years and have had major flooding issue once. I believe it was a heavy rain at Christmas/New Years approx. 2-3 years ago. Sump pump failed and flooding was very bad, entire basement. Have since put in back up systems so this won't happen again. During heavy rains we will have standing water for a few hours in back yard and side yards. Sump pump runs frequently during heavy rains or long rains.
0	Timbergate Court	1						5	2	0	0	0	2	1	2	3	2	1	
0	Timberlake Rd	1	1		3			2	2	0	0	0	2	2	0	0	0	1	We have run off because the water does not enter the storm drain and runs across our property like a creek when it rains.
0	Timberlake Rd	1						5	2	3	3	3	1	1	5	1	2	0	
0	Timberlake Rd	3	1					1	2	0	0	0	2	1	4	4	2	1	heavy rainfall causes rapid flow down slope near house, eroding ground. Note: sewer only operational since May 2011 so no real experience with sewer problems. Has alarm
0	Timbers Ct.	1						5	0	0	0	0	2	1	5	4	2	1	
0	Timberview Dr	1						5	2	3	3	3	2	1	3	1	0	1	
2300	Timberview Dr	3	1					3	2	0	0	0	3	1	1	3	2	1	
0	Toms Dr	1						5	2	0	0	0	2	2	0	0	0	1	
2200	Tori Ann Ln	4	1					3	2	3	3	3	3	1	1	4	2	0	Our sump pump runs constantly in wet weather to keep up. We have standing water over large areasof our yard afterheavy rainfall.
700	Towanda Ave	1						5	2	0	0	0	2	1	3	3	2	1	
800	Towanda Ave	1						5	2	0	0	0	2	2	0	0	0	1	
1200	Towanda Ave	4		2				3	2	0	0	0	2	1	1	1	2	1	
1300	Towanda Ave	1						5	2	0	0	0	2	2	0	0	0	1	Had standing water at the back and front of property many years ago. Problem seems to be fixed by city adding drainage.
1300	Towanda Ave	2				4		0	2	0	0	0	3	1	5	1	2	1	
1400	Towanda Ave	4				4		4	2	3	3	3	2	1	2	1	2	1	Never had any problems until Towanda Ave was redone a few years ago. Ground tiles were not replaced by city wen driveway was replaced.
1200 N	Towanda Ave	1						5	2	3	3	3	2	2	0	0	0	0	
500 S	Towanda Barnes Rd	1						5	1	2	2	2	2	2	5	0	2	1	
1200	Townley Dr	2	1					4	2	0	0	0	2	1	2	1	2	1	
1200	Townley Dr	1						5	2	0	0	0	2	1	4	1	2	1	
1300	Townley Dr	3	1					4	2	0	0	0	2	1	3	1	2	1	During periods of heavy rain and over a couple of days we will have water sitting along our back fence line. It stays until the rain stops. It has happened in the fall and spring. Our sump has run only once because of this.
1300	Townley Dr	5		2				3	2	0	0	0	2	1	1	1	1	2	
0	Tracy Dr	2			3			1	2	0	0	0	3	3	0	0	0	0	Q15: not applicable Q17: Water tastes contaminated and water builds up outside the house in/near the drain.
1900	Tracy Dr	1						5	2	0	0	0	3	3	0	0	0	0	
2000	Tracy Dr	1						5	2	0	0	0	2	2	0	0	0	1	
2000	Tracy Dr	1						5	2	3	3	3	2	2	0	0	0	1	I have no problem
2000	Tracy Dr	3	1					4	1	2	1	3	3	3	0	0	0	0	
2400	Treeline Dr	1						5	2	0	0	0	2	1	2	3	2	1	
0	Treyburn Ct	1						0	1	2	2	3	2	1	1	3	2	1	No problems to report
1800	Tullamore Ave	1						5	1	2	1	2	3	3	0	0	0	1	
800	Twin Lake Rd	1						5	2	3	3	3	2	1	1	1	0	1	Q14: ice buildup? Sometimes. I just sold the house.
1000	Twin Lake Rd	1						5	2	0	0	0	2	1	2	3	2	1	
100	Urban St	1						5	2	0	0	0	2	1	2	1	2	3	
100	Vale St	1						5	2	0	0	0	3	2	0	0	0	1	
100	Vale St	3					5	4	2	1	3	3	2	1	1	1	1	4	I have sent copies of phot per Karen Schmidts Request.
100	Vale St	4		2		4	5	4	2	0	0	0	2	1	2	1	1	2	Every spring and summer during wet weather I have sewage and water in the basement. Each year I have the pipes snaked but that does not seem to fix the problem, but helps some. The city has come out at least twice to dig up and fix the line that runs between 101 and 103 S. Vale Street. About 5 years ago I had 12" of water/sewage in the basement and had to rip out and remodel the entire cellar.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
500	Vale St	2	1			4		4	2	0	0	0	2	1	2	1	1	3	We had a major sewage backup winter of 2010-2011. We were told that it was our responsibility to fix. $5000 later we now have a trap on ouside lawn. No one could give us a reason. It happened suddenly & fix was not covered by our "Cadillac" homeowners insurance.I do not have photos but insurance company or Servepro may have them.
600	Vale St	2					5	3	2	0	0	0	2	2	0	0	0	1	Spring of 2009, basement flooded thru floor drain, about 5" of water, took several days to remove by drain.
800	Vale St	5	1					4	2	2	3	3	2	2	0	0	0	1	Flooding extremely all along the low spot in the bak yard and all the property us are above our yard. I will try to get photo's. Thank you!
900	Vale St	1						5	2	3	3	3	2	2	0	0	0	0	
500 S	Vale St	1						5	2	0	0	0	2	2	0	0	0	1	
700 S	Vale St	3				4		4	2	2	3	3	2	2	0	0	0	1	
0	Valley Brook Ct	1						5	2	3	2	2	1	1	2	1	2	1	
900	Valley View Circle	1						5	2	0	0	0	2	2	0	0	0	0	No Basement
100	Van Schoick	1						5	2	0	0	0	0	1	2	1	2	1	Q14: crawl space
100	Van Schoick	1						5	2	0	0	0	2	1	1	1	2	1	Q11: 2 pumps Q12: Depens on how much rain Q17: 2 pumps - 1 at NE corner of house and 1 at SE corner of house. Seem to take care of excess rain water Q18: no flood problem
0	Vermont Ave	1						5	2	0	0	0	2	1	1	3	2	1	
0	Vermont Ave	1						0	2	0	0	0	2	1	1	1	2	1	
0	Vermont Ave	1						5	2	0	0	0	2	1	0	0	0	0	Q10: with battery backup
0	Vermont Ave	3				4		4	2	0	0	0	3	2	0	0	0	1	flooding generally occurs when the ground has been saturated for more than a day. Late winter, when the ground is still covered in snow, the temp increases and we experience heavy rain or when we have several days of heavy rains.
1500 E	VERNON	1						5	2	0	0	0	2	2	0	0	0	1	NO FLOODING PROBLEMS
300	Vista Dr	2	1					3	2	0	0	0	2	1	2	1	2	1	Rain water is slow to drain from low point of rear yard in a heavy rain, or in a period of sustained frequent rain.
300	Vista Dr.	1						5	2	0	0	0	0	0	0	0	0	1	
300	Vista Drive	4	1					4	2	0	0	0	2	1	2	4	2	1	A heavy rain, especially when the ground is frozen, (Jan/Feb), will cause standing water in the yard.
1800	Vladimir Dr	1						5	2	0	0	0	3	1	5	4	2	1	I said no flooding problems
1800	Vladimir Dr	1						5	2	0	0	0	3	3	0	0	0	1	
2800	Vrooman Ct	1						0	0	0	0	0	0	1	3	3	0	1	
1900	Wakefield Ln	1						5	2	0	0	0	2	1	2	3	2	1	
1900	Wakefield Ln	1						5	2	0	0	0	2	1	2	4	2	1	N/A
0	Walker Dr	1						0	2	0	0	0	2	1	2	3	2	1	
0	Walker Dr	2	1					1	2	0	0	0	3	2	0	0	0	1	
0	Walker Dr	1						5	2	0	0	0	2	2	0	0	0	2	
0	Walker Dr	1						5	0	0	0	0	3	2	0	0	0	1	
0	Walker Dr	2				4		5	2	0	0	0	2	2	0	0	0	1	We have a garage "under" the house, so the driveway slopes towards the house. There is a drain a few feet in front of the garage door (which leads to the garage under the house and to the basement) If the drain is not kept clean/cleared of debris, we have had water backup'ed in front of the garage door about 2' high. If the garage door is opened, the water goes into the garage/basement.
0	Walker Dr	1						5	2	0	0	0	2	1	3	3	2	1	
0	Walker Dr	1						5	2	2	2	3	2	2	0	0	0	2	notes from question 15: Roots
600 E	Walnut St	1						5	2	3	3	3	2	2	0	0	0	1	
800 E	Walnut St	2						5	2	3	3	3	2	2	0	0	0	1	
800 E	Walnut St	1						0	0	0	0	0	2	2	0	0	0	1	Q18: I have no problem
900 E	Walnut St	1						5	2	0	0	0	2	2	0	0	0	1	
600 W	Walnut St	1						5	2	0	0	0	0	2	0	0	0	1	
1200 W	Walnut St	1						5	2	0	0	0	2	2	0	0	0	1	
1300 W	Walnut St	4		2				3	2	3	2	2	2	1	3	1	2	1	1304 W Walnut sHs at the low point and both street drains s and n hold steady water 3-6 inches deep for several days
1300 W	Walnut St	1						5	2	2	3	3	0	2	4	5	2	0	
1100	Wanda Way	1						5	2	0	0	0	3	1	5	4	2	1	
100	Warmer	5	1	2				4	2	0	0	0	3	2	0	0	0	0	Flooding occurs from the paved alley (we think). Lasat sprign we had a pair of ducks paddling around our backyard. We have no pond or other water feature.
1300 W	Warner	3				4		3	2	0	0	0	2	1	3	1	2	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
900	Wartburg Dr	1						5	2	0	0	0	2	3	0	0	0	1	Have not had problems to date. House approximately 6 yr. old
900	Wartburg Dr	1						5	1	2	2	2	2	2	0	0	0	1	none
1000	Wartburg Dr	1						5	2	0	0	0	0	0	5	4	2	1	
1000	Wartburg Dr	1						5	0	2	3	3	3	1	1	3	2	1	
1300 E	Wasghington St	1						5	2	0	0	0	2	2	0	0	0	1	
1500 E	Wasghington St	4	1			4		4	2	0	0	0	3	1	5	1	2	1	Driveway in back of house on property always backs up to become a pond whenever it rains hard or long.
2700 E	Wasghington St	1						5	2	0	0	0	2	1	2	1	2	1	
300 E	Washington St	2				4		1	0	0	0	0	0	1	3	3	2	2	
600 E	Washington St	2						5	0	3	3	3	3	3	5	4	0	0	
600 E	Washington St	1						0	0	0	0	0	2	2	4	0	2	1	Q10: Don't need one Q12: not needed
800 E	Washington St	1						5	2	2	2	2	2	2	0	0	0	1	
800 E	Washington St	1						0	2	0	0	0	2	0	0	0	0	0	
1000 E	Washington St	3				4		3	2	0	0	0	2	2	0	0	0	1	
1000 E	Washington St	1						5	2	0	0	0	1	1	1	1	1	1	
1100 E	Washington St	4				4		4	2	0	0	0	0	2	0	0	0	1	Q4: Until I take care of it.
1100 E	Washington St	1						0	2	3	3	3	2	2	0	0	0	1	
1200 E	Washington St	2				4		4	2	0	0	0	2	2	0	0	0	1	
1200 E	Washington St	2					5	4	2	0	0	0	2	1	2	1	2	1	Q4: pump of sub-pump not working part replaced. Water was gone.
1400 E	Washington St	1						5	2	0	0	0	2	2	0	0	0	1	
1400 E	Washington St	3					5	4	2	0	0	0	3	3	5	5	0	2	
1400 E	Washington St	1						5	2	0	0	0	2	2	0	0	0	1	
1500 E	Washington St	2		2				3	2	2	3	3	2	2	0	0	0	1	Standing water in streets after heavy rain, water drains in hour or two.
1500 E	Washington St	1						4	2	0	0	0	3	1	2	1	2	1	
1600 E	Washington St	1						5	2	0	0	0	2	2	0	0	0	1	
2500 E	Washington St	2					5	3	0	0	0	0	2	1	5	4	2	1	
2700 E	Washington St	1						5	2	2	3	2	2	1	2	4	2	1	
2900 E	Washington St	4				4		4	2	0	0	0	2	1	1	1	2	1	In rainy wet session waer seeps in basement wall & sump pump runs often. No real flooding but water does seep in and is a concern.
3100 E	Washington St	1						0	0	0	0	0	0	0	0	0	0	0	
800 W	Washington St	1						5	2	0	0	0	2	2	0	0	0	1	
800 W	Washington St	1						5	2	2	2	3	2	2	5	4	2	1	
1300 W	Washington St	1						5	2	0	0	0	2	2	0	0	0	1	
500	Waterford	1						5	2	3	3	3	2	1	0	3	2	1	Q12: It depends on the amount of rain.
300	Waterford Estates Dr	2				4		1	2	0	0	0	2	1	1	4	2	1	During rain and high wind, water seeps through basement window
1300	Watersound Wy	1						5	2	3	3	3	1	1	5	3	2	1	Q2: been in house since August 19, 2011 - new construction
3900	Watertown Ln	1						5	2	3	3	3	3	1	5	4	2	1	
3900	Watertown Ln.	1						5	2	0	0	0	2	1	3	4	2	1	
700	Watford Dr	1						5	2	0	0	0	2	1	2	1	2	1	
2500	WEDGEWOOD RD	1						5	2	0	0	0	2	1	3	1	2	1	N/A
3500	Wegeng Dr	2						5	2	0	0	0	1	1	5	1	2	1	
3500	Wegeng Dr	1						5	2	0	0	0	3	1	2	4	2	1	
100	Weldon St	1						5	2	0	0	0	3	2	0	0	0	1	Water enters the basement walls but not to a point of flooding. Just little wet spots every once in awhile
100	Weldon St	3				4		2	2	2	2	2	2	2	0	0	0	1	
1300	Welling	1						5	0	0	0	0	0	2	0	0	0	1	none
2600	Wellington Way	1						0	2	3	3	3	2	1	2	1	2	1	
2700	Wellington Way	1						4	0	2	2	2	2	1	2	4	2	1	
2800	Wellington Way	5		2				4	2	0	0	0	2	1	2	1	2	1	Road does not slope towards drain in front of house resulting in a large pool of water that stands on street and driveway for days.
2800	Wellington Way	4	1					4	2	0	0	0	2	1	1	1	1	1	heavy rains causes a lake in bak corner of yard - can last over 24 hours
2800	Wellington Way	2	1			4		4	2	0	0	0	2	1	2	1	1	1	During very wet weather our backyard floods, as do all the neighbors.

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2800	Wellington Way	5	1					3	2	0	0	0	2	1	1	1	2	1	Water pools in our backyard each time it rains. I believe it happens because the natural drainage is to the west and has become slowed/blocked due to storage sheds, flower boxes, etc. that have been built by neighbors to the west. An additional factor is that several houses have changed their sump pump discharge to the back yard instead of the street, further slowing drainage.
3000	Wembley Way	1						5	2	3	3	0	2	1	1	1	2	1	
3000	Wembley Way	3						0	2	2	0	0	0	1	3	3	2	0	Q3: Sump pump. Q4: Don't know. Q17: Water comes from the sump pump or not working and I have had a sump put in within 4 years.
3000	Wembley Way	1						5	2	3	3	3	2	1	1	3	2	1	
2600	Westbrook Dr	1						5	2	0	0	0	2	1	3	3	2	1	
2700	Westbrook Dr	1						5	2	0	0	0	2	1	1	4	2	1	
2700	Westbrook Dr	1						0	0	0	0	0	0	1	1	5	2	1	When the sup pump runs we get a small amount of water through the basement wall near the discharge pipe.
1100 N	Western Ave	3		2				3	2	2	2	2	2	1	2	1	2	2	
300 S	Western Ave	2				3		1	2	0	0	0	2	2	0	0	0	2	
3500	White Eagle Drive	1						5	1	2	2	2	2	1	3	3	2	1	
25200	White Owl Ln	1						5	2	0	0	0	3	3	0	0	0	1	
0	White Pl	1						0	2	2	0	0	2	2	0	0	0	1	
0	White Pl	2		2				3	2	0	0	0	2	2	0	0	0	1	
0	White Pl	3	1			4		3	2	0	0	0	2	2	0	0	0	1	Q3: on concrete driveway behind our house Q17: Water stands on concrete driveway to our garage off the alley. The alley has multiple layers of asphalt and the water has no place to drain. I don't consider it a big problem.
0	White Pl	1						5	2	0	0	0	2	2	0	0	0	1	
0	White Pl	4	1	2		4		4	2	0	0	0	3	1	1	1	2	1	Never had flooding problems in house until several years ago when we had record rains. Installed sump pump and now pump runs whenever it rains.
0	White Pl	1						5	1	2	2	2	2	2	0	0	0	1	
0	White Pl	4	1			4		3	2	0	0	0	2	1	1	1	2	3	
100	White Pl	1						5	2	0	0	0	0	2	0	0	0	1	No flooding problems
1700	Whitmer Ct	1						5	0	0	0	0	1	1	1	5	2	1	
1700	Whitmer Ct	1						5	2	3	0	0	1	1	3	3	2	1	
1600	Whitmer Ct.	1						0	2	0	0	0	0	0	2	3	2	1	
4100	Wicker Rd	1						5	2	2	3	3	2	2	0	0	0	0	
200	Wild Flower Pl	1						0	2	0	0	0	2	2	0	0	0	1	
3500	Wilder Dr	2			3			4	2	3	3	3	3	1	2	4	2	1	During periods of heavy rain a big puddle develops next to our property - big enough for birds (ducks) to paddle in. It takes days to weeks for it to dry up. I believe this is the church's property since we had our lot surveyed last year.
3500	Wilder Drive	1						5	1	3	3	3	1	3	0	0	0	1	
200	Wildflower Pl	1						5	2	3	3	3	2	1	2	1	2	1	
1600	Wildwood Rd	2		2				5	2	0	0	0	2	1	1	1	2	1	No photos, mostly wet carpet and bottoms of panelling.
1700	Wildwood Rd	3				4	5	3	2	0	0	0	2	1	2	1	2	1	We had the drain in the basment floor that would shoot water up 6 - 18 inches up, 2 to 3 times a year until I completely covered it with cement. The drian looked like some misplaced garden water feature in my basement. We had to run 2 sump pumps constantly and had to monitor and with our wet vac to keep up with the water coming in this drain or the basement would have several inches of water in as little as an hour. Since I closed off the drain, we have had only minor sepage in very rainy weather when the street is flooded and the street drains are clogged with debris. The street drains seem to clog very quickly. My neighbors and I have all been out in the street in rainy weather with our rakes or shovels to remove debris from the drains so our homes do not flood.
200 S	Willamsburg	4	1					1	2	0	0	0	2	1	1	1	2	1	We get run-off from the neighbors on both sides. If there is a large amount of rain quickly, the Arbors' (apartments behind us) parking lot also floods.
200	Willard Ave	2	1			4		4	2	0	0	0	2	2	0	0	0	1	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
200	Willard Ave	2				4		4	0	2	3	3	3	3	5	4	0	2	Q5: ? Q14: ? Q15: 3 times in 6 months Q17: My roomates were present when sewage came out of the kitchen sink onto the floor and went on to the basement floor. I don't know if this issue was directly related to flooding.
400	Willard Ave	1						5	2	0	0	0	2	2	0	0	0	1	
400	Willard Ave	1						5	2	3	3	3	2	1	3	1	2	1	
0	Willedrob Road	4		2		4		4	2	0	0	0	2	1	5	1	2	1	Flooding occurs in the street at the entrance to the property. Water does not drain from here or drains at a very slow rate.
100 N	Williamsburg Dr	1						5	2	0	0	3	2	3	0	0	0	0	Q15: No basement
100 S	Williamsburg Dr	1						5	2	0	0	0	2	1	3	3	2	1	
100 S	Williamsburg Dr	5	1			4	5	4	2	0	0	0	1	1	1	1	2	4	The corner of Williamsburg and Washington floods every time it rains and the cars that drive by through flood my yard and leave behind rock and asphalt.
100 S	Williamsburg Dr	5	1	2		4	5	4	2	0	0	0	1	1	0	0	0	0	
100 S	Williamsburg Dr	1						5	2	0	0	0	2	1	2	1	2	1	
200 S	Williamsburg Dr	2	1					3	2	2	0	0	2	1	2	1	2	1	
0	Willowbend Ct	4			3			1	1	1	2	3	2	1	1	4	2	1	The creek along the back of our property gets backed up due to blockages on the adjacent vacant lot to our North (8 Tangle Oaks Rd). The creek will overflow its banks and overflow onto our property (we have even found dead fish in our yard after heavy flooding). Half the vacant lot at 8 Tangle Oaks and the street itself is often flooded as well. We're puzzled as to where the creek is supposed to be flowing, it appears to be going into the storm drain over on Tangle Oaks.
0	Wilshire Ct	1						0	2	0	0	0	2	1	2	5	2	1	
1500	Wilson St	3					5	4	2	0	0	0	2	2	0	0	0	5	
1500	Wilson St	1						5	2	0	0	0	3	3	0	0	0	1	
1500	Wilson St	4	1					2	2	3	3	3	2	2	0	0	0	4	
2900	Winchester Dr	4	1					4	2	0	0	0	2	1	1	1	1	1	Each house on the south side of the street near us has a standing "lake" that forms in the back part of the yard when it rains heavy or for long periods of time. It takes several days for the water to disappear, and then the back of the yard remains muddy for several days after that.
3000	Winchester Dr	2	1					4	1	1	1	2	2	1	1	1	2	1	Drainage ditch behind my house that carries away water from the retention spots in the airport property and Airport Park erodes away and holds water such that I am concerned it may run onto my property. Would like to see a cement water way from the road culvert to the storm drain to replace the eroding soft ditch. Also during dry periods water is retained in the ditch promoting mosquistoes and child nuisance.
3000	Winchester Dr	1						5	2	0	0	0	3	1	5	1	2	1	
3100	Winchester Dr	2	1		3			4	1	2	1	2	3	1	1	1	2	1	Q4: Depends on rain.
3200	Winchester Dr	3	1					2	2	0	0	0	2	1	3	1	2	1	Slope in backyard and poor drainage/sump discharge from neighbors contribute to standing water occasionally.
1300	Windham Hill Rd	1						5	2	0	0	0	2	2	0	0	0	0	For Your Awareness: South Windham Hill Rd: seepage at curb and along edge of street on East side of street. Seems to be at lot line between 1307 Windham Hill Rd and a corner property on WineWay and Windham Hill Rd. Occurs mostly after rainfall. Causes no flooding to my property.
1500	Windham Hill Rd	1						5	2	2	3	3	2	1	3	3	2	1	
1500	Windham Hill Rd	1						5	2	0	0	0	1	1	4	3	2	1	
3400	Windmill Rd	1						5	2	0	0	0	2	2	0	0	0	1	
0	Windsong Way	5	1					4	2	0	0	0	2	2	0	0	0	1	
3700	Wine Wy	0						0	0	0	0	0	0	0	0	0	0	0	Just moved into condo with no basement.
3700	Wine Wy	1						5	2	3	3	3	2	2	0	0	0	0	
3700	Wine Wy	1						5	2	3	3	3	2	2	0	0	0	0	
3700	Wine wy	1						5	2	0	0	0	2	2	0	0	0	1	
3100	Wisteria Ln	1						5	2	0	0	0	2	2	0	0	0	1	
1900	Withers Lane	1						0	2	3	3	3	2	1	2	1	2	1	
2000	Withers Lane	1						5	0	0	0	0	1	1	5	4	2	1	
800	Witten Woods Drive	1						5	2	3	3	3	3	1	5	1	2	1	
800	Witten Woods Drive	1						5	2	0	0	0	2	1	3	3	2	1	
900	Witten Woods Drive	1						5	2	0	0	0	2	1	1	3	2	1	n/a
1000	Witten Woods Drive	1						5	2	2	2	2	2	1	3	1	2	1	Don't have flooding.

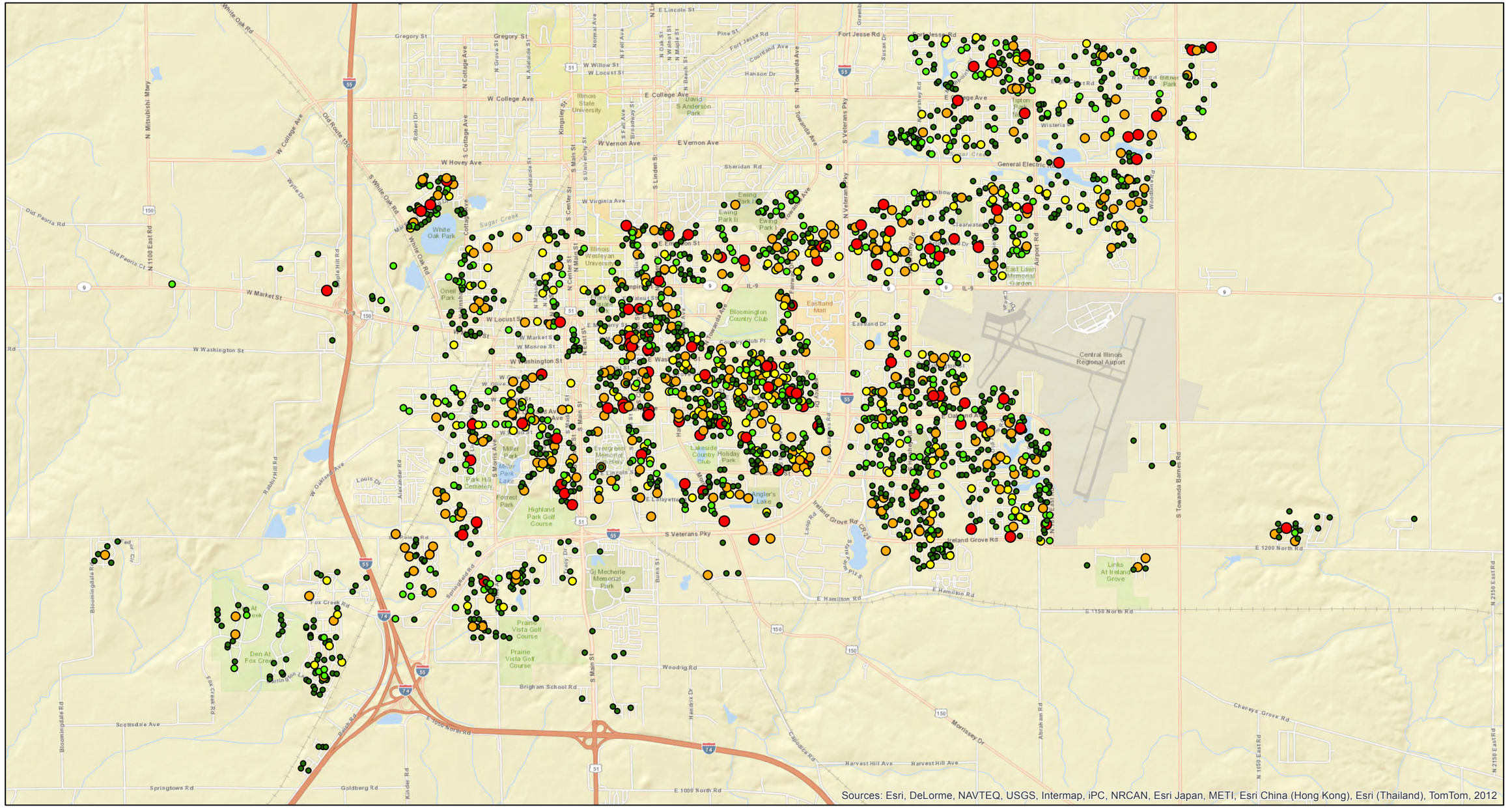
Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
2300	Wood Havens Dr	2						5	2	2	3	3	1	1	3	5	2	1	Q14: There are some in our neighborhood that casue water in street, ice in cold months.
25000	Wood St	1						5	2	0	0	0	1	3	5	5	2	1	
300 E	Wood St	4				4		4	2	3	3	3	2	2	0	0	0	1	Whenever there is a medium to heavy rain, I get water in my basement. Mostly on the East and South side of the basement. I have had puddles lasting for a few days. There are two areas that stay damp.
700 E	Wood St	1						0	2	0	0	0	2	2	0	0	0	1	
900 W	Wood St	3	1			4		4	2	0	0	0	2	2	0	0	0	1	wHEN IT RAINS TOOLONG AND WATER STARTS SEEPING INTO WALLS. nOT REALLY BAD FLOODING , JUST WET SPOTS AND DAMP AT FLOOR/ WALL JUNCTION
1100 W	Wood St	1						5	2	2	3	3	2	2	0	0	0	1	
1100 W	Wood St	0				4		2	2	2	3	3	2	2	0	0	0	2	
1400 W	Wood St	1						5	2	0	0	0	0	2	0	0	0	1	
25000	Wood Thrush Cr	1						5	2	0	0	0	1	1	3	5	2	1	
1400	Woodbine Rd	1						5	2	2	3	3	3	1	3	4	2	1	
1900	Woodbine Rd	1						0	0	0	0	0	2	2	0	0	0	1	
1900	Woodbine Rd	4	1					4	2	2	3	2	3	2	0	0	0	1	Standign water behind back yard and between my house and the house south of me.
0	Woodbridge	1						5	2	0	0	0	2	1	1	1	2	1	
1100	Woodbury Pl	1						5	2	0	0	0	3	1	1	3	2	1	
2200	Woodfield Rd	5		2				2	2	0	0	0	2	1	1	1	2	1	No basement flooding, but frequent street flooding at intersection of East College Ave & Hedgewood Dr. Storm sewer openings on the south and north sides of this intersection flood with standing water in street. NOTE, a lot of water is collected from Northpoint Subdivision flowing into this intersection.
2200	Woodfield Rd.	1						5	2	0	0	0	2	1	1	1	2	1	
2000	Woodhavens Drive	4			3			2	1	2	2	2	2	2	0	0	0	1	Problem is caused by improper grading of lots in subdivision to get water to run into drainage system.
2000	Woodhavens Drive	2				4	5	2	2	2	3	3	2	1	1	3	2	1	
2100	Woodhavens Drive	1						5	2	2	2	0	2	1	2	1	2	1	No Flooding at all!
200	Woodland Ave	4		2				3	2	0	0	0	2	1	1	1	2	1	Flooding in street started when street was paved by city. There are also broken curbs. The new level of the city street prevents proper draining of street. This is at the NE corner of Woodland Ave and Taylor Ave.
300	Woodland Ave	4				4		3	2	0	0	0	2	1	3	5	2	2	Some of the problem was associated with downspouts, however heavy rains will push water up though cracks in basement floor which is concrete floor. Sewage problem is rare but has happened twice about 5 years ago. Sump was installed afterthat.
400	Woodland Ave	1						5	2	0	0	0	2	2	0	0	0	1	
400	Woodland Ave	5		2		4		1	2	2	3	3	2	2	0	0	0	1	The street in front o the house has basically no curb and rain always results in a large puddle in the street. There is nothing to help divert water to a drain.
400	Woodland Ave	2					5	2	2	3	3	3	2	2	0	0	0	1	Over 5 years ago, water came up through floor drain in basement. Q18 Call my daughter , work 664-9253 or her home 661-8341, I can not hear on phone
400	Woodland Ave	3	1					4	2	3	3	3	3	2	0	0	0	2	
400	Woodland Ave	1						5	2	0	0	0	0	0	0	0	0	0	
400	Woodland Ave	4	1	2		4		4	2	3	3	3	2	2	0	0	0	1	Flooding in our basement has decreased greatly since we had our roof and gutters replaced. Flooding in the backyard only happens after large snowmelt, a long and heavy rain or both. Flooding n the street is commong but not severe
400	Woodland Ave	1						5	2	0	0	0	2	2	0	0	0	1	no flooding
0	Woodruff Dr	1						5	0	0	0	0	3	1	3	1	2	1	
0	Woodruff Dr	1						5	2	3	3	3	2	2	4	0	2	1	
0	Woodruff Dr	1						5	0	3	3	3	2	2	0	0	0	0	
0	Woodruff Dr	1						5	2	3	3	3	2	1	2	3	2	1	
0	Worthington Ct	4	1					3	2	0	0	0	3	2	0	0	0	1	Q4: my backyard Q17: During heavy or lng rains, water runs along the backyard of my house, then into neighbors, and then to next neighbors. It is like a stream that runs along the back of our yards. There is ALWAYS standing water in the yard north of me, everytime it rains.
1200	Wright St	1						5	2	0	0	0	2	2	0	0	0	1	N/A
800 S	Wright St	1						5	0	3	2	0	3	1	2	0	2	1	
1300 S	Wright St	2				4		1	0	0	0	0	0	0	0	0	0	0	

Block	Street	Q2 Flooding Frequency	Q3-1 Standing Water Outside House	Q3-2 Standing Water in Street	Q3-3 Flooding from Adjacent Open Channel	Q3-4 Water from Basement Wall, Door, Etc.	Q3-5 Water Entering House Through Drain	Q4 Flooding Duration	Q5 Property Adjacent to Drainage Ditch	Q6 Information on Water Levels Recorded	Q7 Drainage Ditch Erosion	Q8 Ditch Erosion Threatening Stability	Q9 Ejector Pump	Q10 Sump Pump	Q12 Frequency of Sump Pump Running	Q13 Sump Pump Discharge	Q14 Sump Pump Dishcarge Problems	Q15 Sewage Flooding due to Sewer Backups	Comments
600	Wulbrun Dr	1						5	2	0	0	0	2	1	1	4	2	1	
500	Wylie Dr	1						5	2	0	0	0	2	2	0	0	0	1	
2200	Yarrow St	2				4		1	2	0	0	0	2	1	1	4	2	1	N/A
0	Yew Ct	1						5	2	0	0	0	2	2	0	0	0	0	This home is a one-story, built on a slab in "Oakwoods" subdivision on Six Points Road.
0	Yew Ct	1						5	2	0	0	0	2	1	2	1	2	1	
0	Yew Ct	4	1					1	2	2	0	0	3	1	5	1	2	1	
3100	Yorkshire Court	1						5	2	0	0	0	2	1	2	5	2	1	
3100	Yorkshire Court	1						5	2	3	3	3	2	1	3	1	2	0	
3200	Yorkshire Court	2	1					4	2	2	2	0	2	1	1	1	2	1	No action needed in my immediate vicinity, no problems even during heavy rains/snows.
3200	Yorkshire Court	2	1					2	2	0	0	0	3	1	1	1	1	1	only lived here 6 months. need question box for this situation
3200	Yorkshire Court	1						5	2	0	0	0	2	1	1	1	2	1	NA
2500	Yorktown Dr	2					5	1	2	0	0	0	2	1	1	1	2	2	Sewer backup - was told it was due to tree roots in main drain in front yard. Had Rewesewer snake out line and problem was solved. Also yard has sunk where pipe goes to street and sidewalk has broken and sunk. Also much standing water there.
2500	Yorktown Dr.	4	1					4	2	0	0	0	2	1	2	1	2	1	neighboring properties on 3 sides drain into my yard. Due to the poor grading when subdivision was developed, causes the water to pool in my back yard. It drains out slowly, even though I have taken steps to put in drainage strips with a sod cutter... I have had basement water problems because of this, but by adding fill around the house this has been corrected... it is just standing water after each rain of more than 1/2 inch... Can you do any thing???? not without involving neighbors
0	Yotzonot Dr.	1						5	2	0	0	0	3	3	0	0	0	1	
0	Yukon Circle	1						5	2	0	0	0	3	1	3	4	2	1	
0	Yukon Circle	1						5	2	0	0	0	2	1	3	4	0	0	
0	Yukon Circle	3	1					2	2	0	0	0	2	1	1	3	2	1	Backyard has about 2 inches of standing water for a few hours after a period of heavy rains. Probably due to improper swail
100	Yukon Circle	1						5	2	0	0	0	3	1	5	4	0	1	
0	zNo_address	1						5	2	0	0	0	2	1	2	1	2	1	
0	zNo_address	1						0	0	0	0	0	2	2	0	0	0	0	
0	zNo_address	1						0	0	0	0	0	0	0	0	0	0	0	
0	zNo_address	1						0	2	0	0	0	3	1	2	1	2	1	
0	zNo_address	1						5	2	0	0	0	3	1	4	4	2	1	
0	zNo_address	1						5	2	0	0	0	0	0	0	0	0	0	
0	zNo_address	0	1					5	0	2	3	3	2	2	0	0	0	1	Flooding areo at back of home. Started 5-6 years ago - alleviated by digging a channed in yard to divert water.
0	zNo_address	0		2				2	2	0	2	2	2	1	2	1	2	1	Q16: But the lady mayor came out once to the corner @ Arrowhead & Holiday & had to be carried from car.
0	zNo_address	0						0	2	0	0	0	2	2	0	0	0	0	
0	zNo_address	2				4		0	2	5	3	3	2	1	1	1	2	1	We have never "flooded", but there is significant seepage of ground water into the basement, which is severd by a sump pump.

.

Attachment 2

Questionnaire Responses
Figures 1 thru 8



SOURCE OR NOTES:

Legend

Q2 - Flooding Frequency

- Never
- Rarely (<5 years)
- Infrequently (1-2 years)
- Several times per year
- Every time it rains

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

Foth

0 0.95
Miles

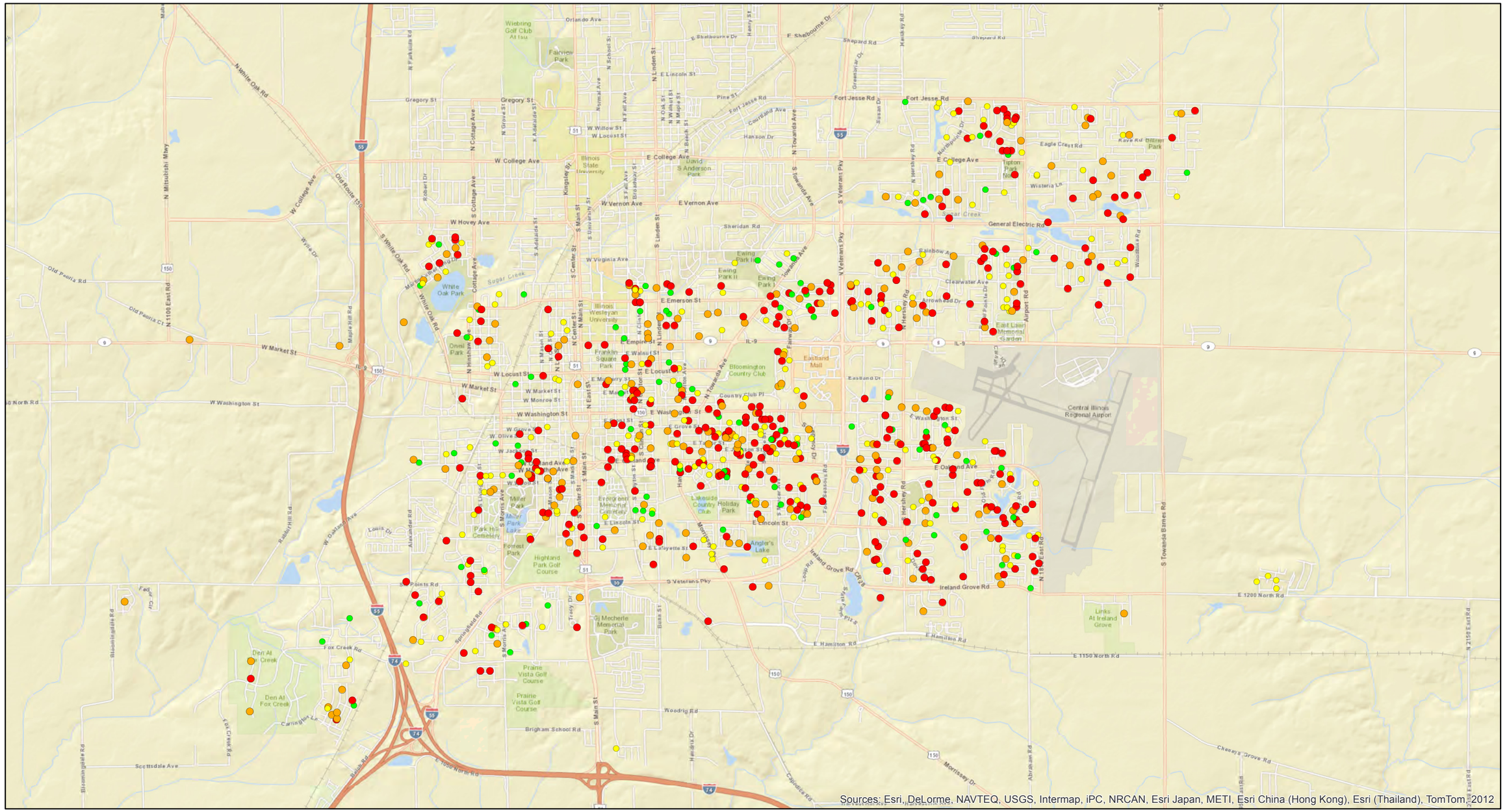
CITY OF BLOOMINGTON, ILLINOIS

ATTACHMENT 2 - FIGURE 1

FLOODING FREQUENCY

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 1.mxd Date: 2/14/2013



SOURCE OR NOTES:

Legend

Q4 - Flooding Duration

- Less than 30 minutes
- 30 minutes to 1 hour
- 1 to 2 hours
- More than 2 hours

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 0.5 1 Miles

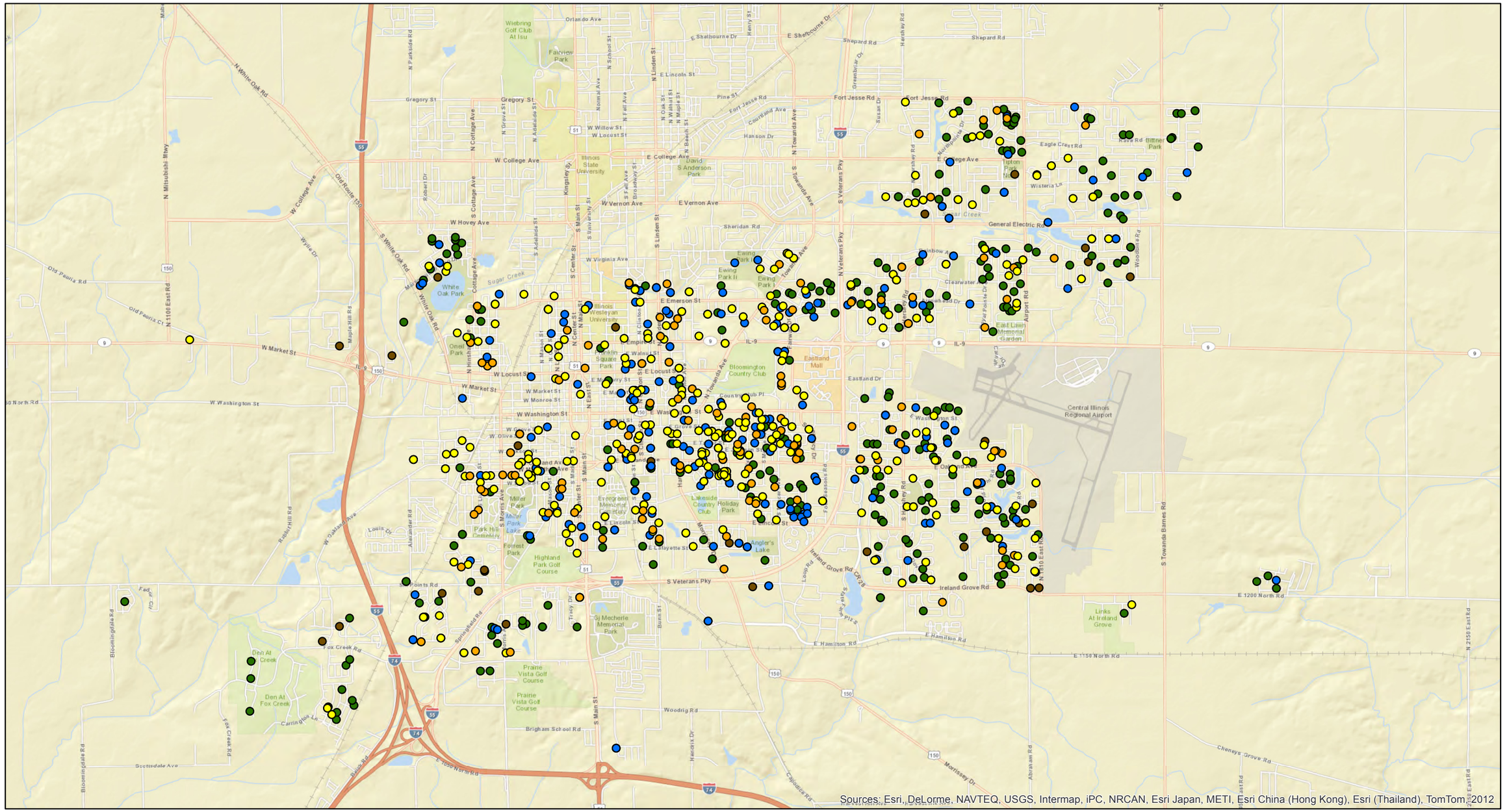
CITY OF BLOOMINGTON, ILLINOIS

ATTACHMENT 2 - FIGURE 2

FLOODING DURATION

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 2.mxd Date: 2/14/2013



SOURCE OR NOTES:

Legend

- Standing Water in Street
- Standing Water in Yard
- Flooding from Channel
- Water Entering Basement Drain
- Water Seeping into Basement

N

Foth

0 0.5 1 Miles

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

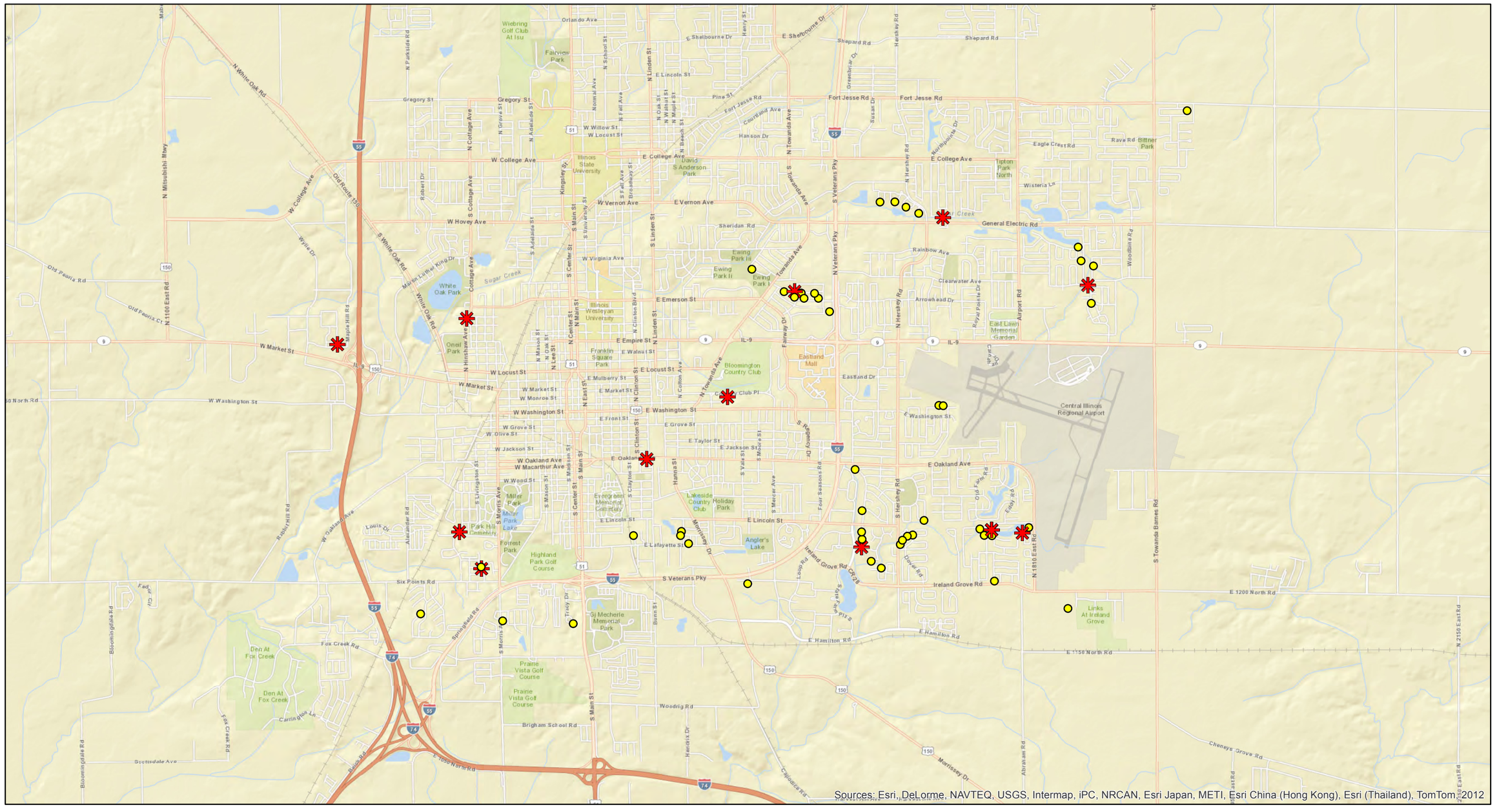
CITY OF BLOOMINGTON, ILLINOIS

ATTACHMENT 2 - FIGURE 3

STORMWATER PROBLEMS

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 3.mxd Date: 2/14/2013



SOURCE OR NOTES:

Legend

Severe Ditch Erosion

- Ditch Erosion
- Ditch Erosion Threatening Structure

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

Foth

0 0.5 1 Miles

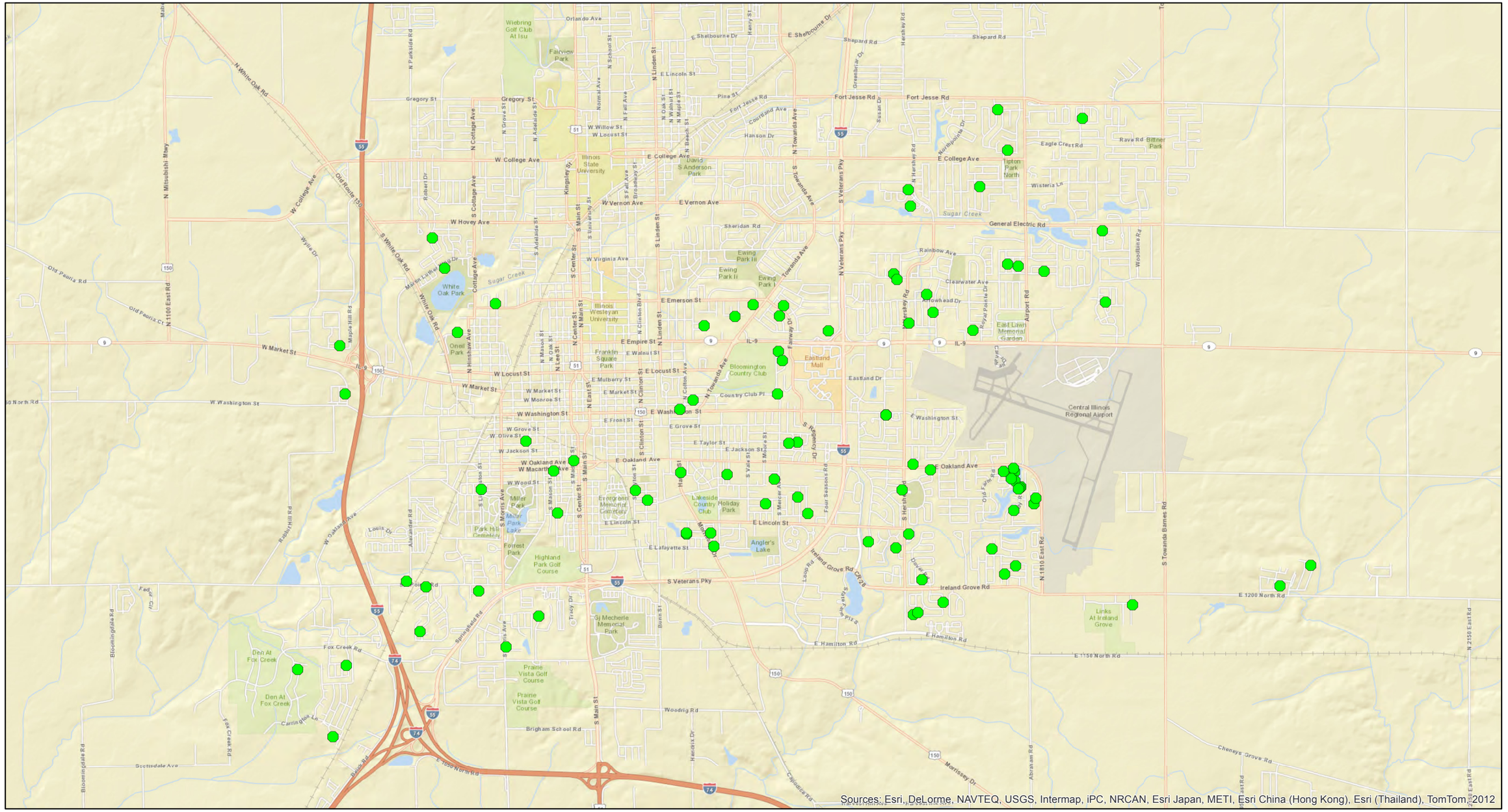
CITY OF BLOOMINGTON, ILLINOIS

ATTACHMENT 2 - FIGURE 4

DITCH EROSION

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 4.mxd Date: 2/14/2013



SOURCE OR NOTES:

Legend

Q9 - Ejector Pumps

Ejector Pump

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 0.5 1 Miles

CITY OF BLOOMINGTON, ILLINOIS

ATTACHMENT 2 - FIGURE 5

EJECTOR PITS

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 5.mxd Date: 2/14/2013

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

SOURCE OR NOTES:

Legend

Q13 - Sump Pump Discharge

- Outside on the ground
- Rain garden or rain barrel
- Connected to a storm sewer or sump pump drain line
- Unknown
- Other

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 0.5 1 Miles

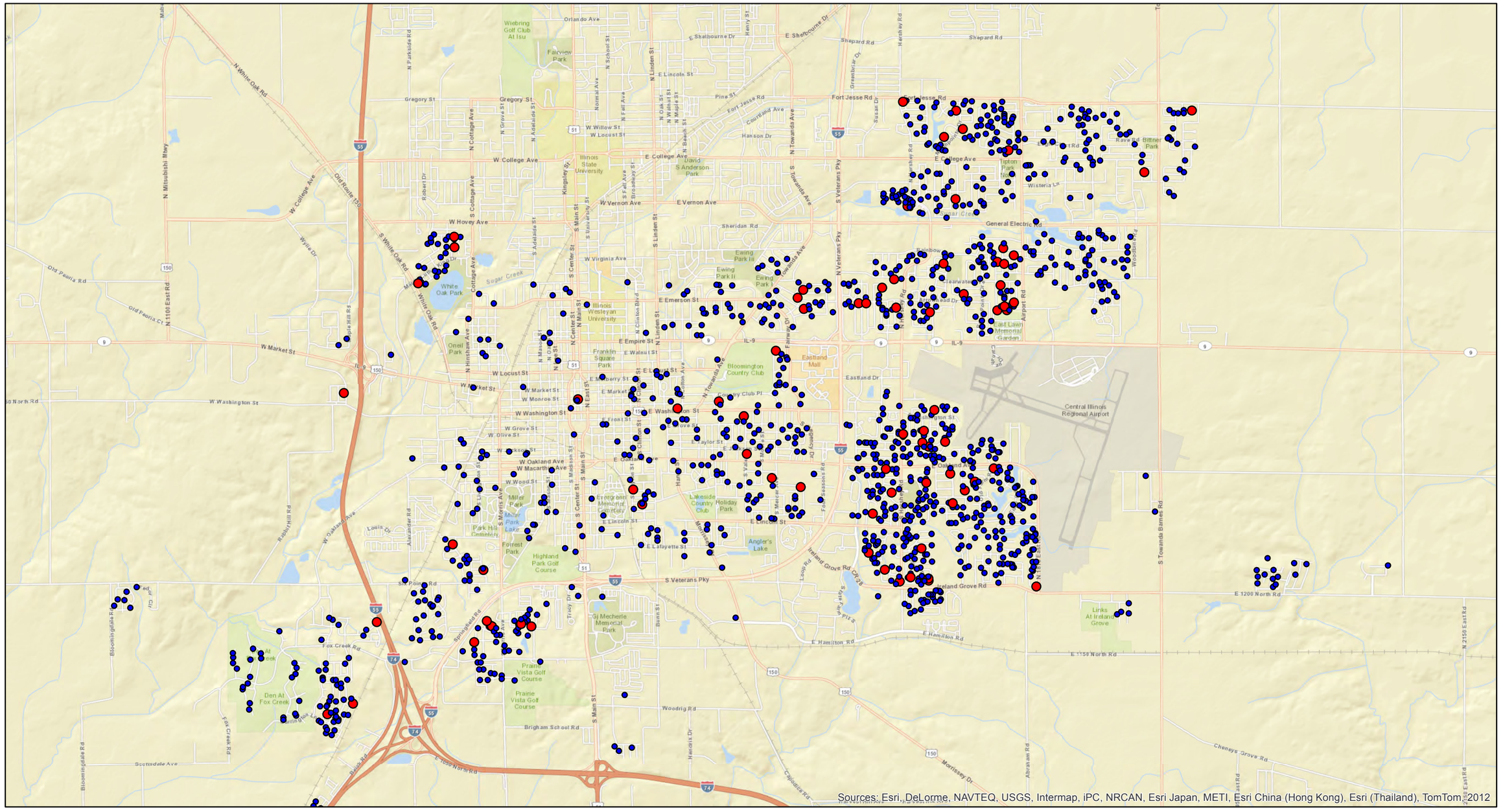
CITY OF BLOOMINGTON, ILLINOIS

ATTACHMENT 2 - FIGURE 6

SUMP PUMP DISCHARGE

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 6.mxd Date: 2/14/2013



SOURCE OR NOTES:

Legend

Q14 - Sump Discharge Problems

- Sump Discharge Problems
- No Problems

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 0.5 1 Miles

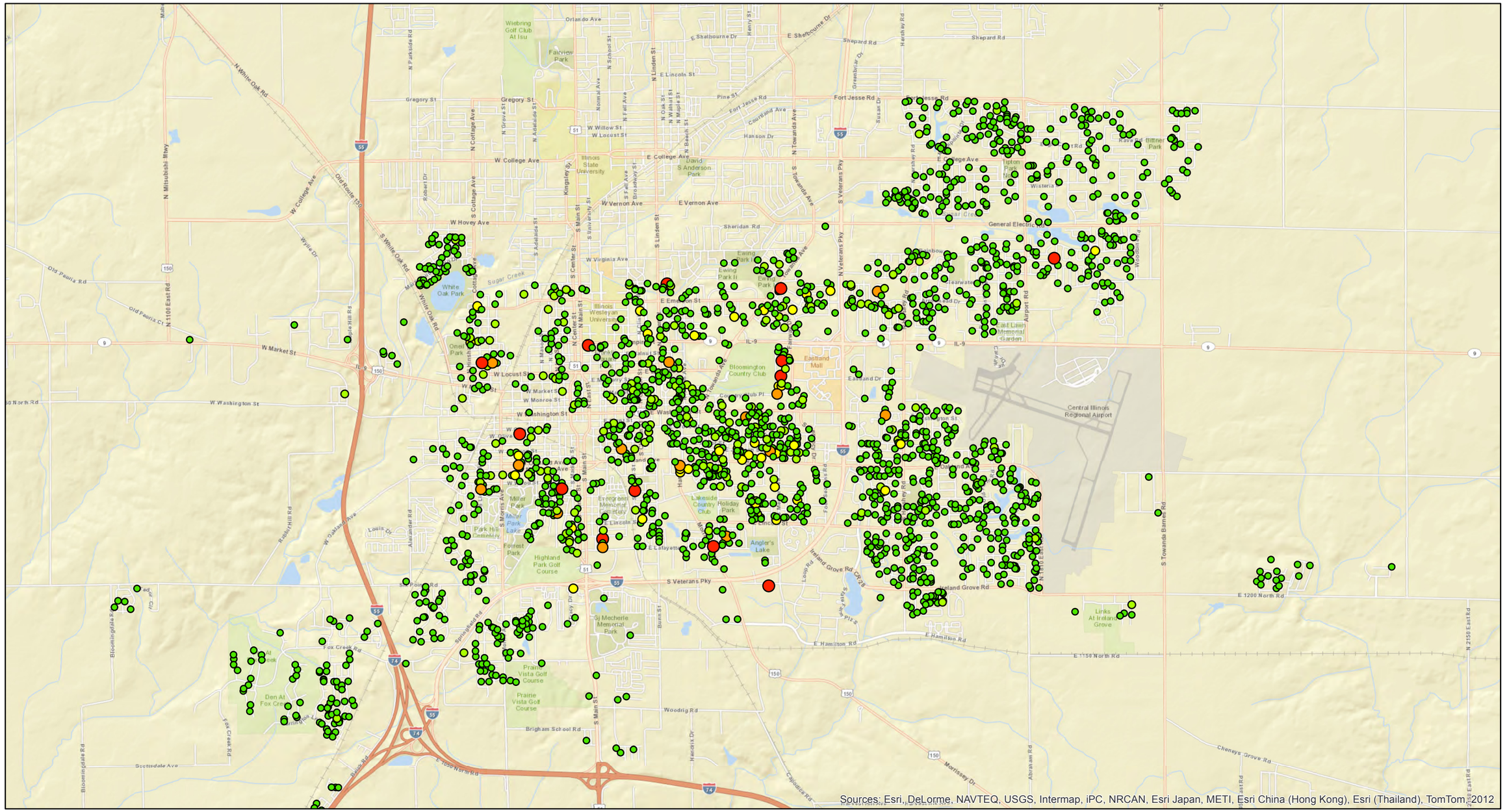
CITY OF BLOOMINGTON, ILLINOIS

ATTACHMENT 2 - FIGURE 7

SUMP PUMP PROBLEMS

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 7.mxd Date: 2/14/2013



SOURCE OR NOTES:

Legend

Q15 - Frequency and Intensity of Sewer Backups

- Never
- Rare, contained to small area
- Rare, covers large area
- Frequent, contained to small area
- Frequent, covers large area

N

Foth

0 0.5 1 Miles

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

CITY OF BLOOMINGTON, ILLINOIS

ATTACHMENT 2 - FIGURE 8

SEWER BACK-UPS

Date: 2/14/2013	Revision Date:	
Drawn By: MJM	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Exhibits_MXD\Figure 8.mxd Date: 2/14/2013

Stormwater Technical Memoranda

ST2 - HYDROLOGIC/HYDRAULIC MODELING IN PRIORITY WATERSHEDS, OAKLAND AVENUE WATERSHED STORMWATER MODEL, COMBINDED SEWER SEPARATION OPPORTUNITIES

HYDROLOGIC/HYDRAULIC MODELING IN PRIORITY WATERSHEDS
OAKLAND AVENUE WATERSHED STORMWATER MODEL
COMBINED SEWER SEPARATION OPPORTUNITIES

EXECUTIVE SUMMARY

This executive summary is for the above Technical Memorandum dated December 11, 2013, prepared by Foth for the City of Bloomington as part of the Sewer Master Plan.

Introduction

The Oakland Avenue watershed was found to have the highest density of stormwater issues in the City (See companion Technical Memorandum - Delineation of Stormwater Problem Areas) and was recommended for further analysis. A computer Hydrologic/ Hydraulic (H/H) model using XP-SWMM was created for the watershed. Findings and recommendations based on computer modeling are presented including confirmation of system deficiencies and identification of potential system improvements.

Potential improvements included in the analysis, requested by City staff, are:

1) Separation of combined sewers in the Oakland Avenue watershed
2) Construction of a stormwater outlet from the Oakland Avenue watershed to Sugar Creek
3) Construction of two detention basins along the stormwater outlet.

Planning level cost estimates for the improvements are prepared to assist with the development of a Capital Improvement Plan (CIP).

Key Findings

Widespread surcharging occurs in the Oakland Avenue watershed combined sewer system, resulting in periodic basement flooding, street flooding and system overflows. Separating sanitary and storm flows can mitigate flooding and system overflows. Based on the H/H model analysis, sewer separation centered on reconfiguring the original combined sewer into a sanitary sewer and reconfiguring the 1946 relief combined sewer into a storm sewer is technically feasible and has merit. A phased improvement plan based on this reconfiguration was modeled and planning level cost estimates prepared.

Recommendations

A 4-phase improvement plan is recommended as follows:

Phase 1 - small scale, localized improvements to the combined sewer system. These improvements include modifications to a weir junction chamber along Taylor Street, installation of storm sewers along McGregor Avenue, additional study of flooding at the intersection of Oakland Avenue and Meadows Avenue, and elimination of the CSOs

along Maizefield Avenue at Kreitzer Avenue and Florence Avenue. Phase 1 estimated cost is $742,000.

Phase 2 - initiates sewer separation in the Oakland Avenue watershed. Reconfiguration of the 1946 parallel relief sewer system into a dedicated storm sewer system is proposed. The H/H model indicated that the 1946 relief sewers, if disconnected from the original combined sewers, would have reasonable capacity to convey stormwater. Supplemental new downstream storm sewers are requires. Following separation, the original combined sewer would function as a sanitary sewer, greatly reducing basement sewer backups and combined sewer overflows. Phase 2 estimated cost is $3,354,000.

Phase 3 - construction of a storm sewer outlet and a stormwater detention basin for the Phase 2 sewer separation improvements. The detention basin, Pond 1, is located at the site of the City's public works facility on the south side of the downtown area. These improvements will decrease upstream flooding and reduce the peak discharge into the undersized downstream combined sewers. Phase 3 estimated cost is $2,115,000.

Phase 4 - construction of a second detention basin, Pond 2, at the current Nicor Gas facility and a conveyance network along Constitution Trail from the Phase 3 improvements (Pond 1) to Pond 2 and then on to Sugar Creek. This complete stormwater separation will divert an estimated 200 million gallons of stormwater per year from the treatment facility by discharging separated stormwater directly to Sugar Creek. Phase 4 estimated cost is $2,855,000.

Summary of Planning Level Costs for Phases 1 - 4	
Phase 1	$742,000
Phase 2	$3,354,000
Phase 3	$2,115,000
Phase 4	$2,855,000
Total	$9,066,000

Summary

Implementation of the four-phase sewer separation improvement plan outlined herein will reduce peak flows in the system, reduce peak discharges to Sugar Creek, mitigate basement flooding caused by sewer backups and reduce system flooding. Stormwater flows from the Oakland Avenue watershed, currently discharging to the sewage treatment facility, would be diverted away from the plant directly to Sugar Creek. Estimated total project cost is $9.1 million

Technical Memorandum

Date: December 11, 2013

To: Ryan Otto, PE, City of Bloomington, Illinois

From: John A. Dabrowski, PE, Foth Infrastructure & Environment, LLC.

Re: HYDROLOGIC/HYDRAULIC MODELING IN PRIORITY WATERSHEDS
OAKLAND AVENUE WATERSHED STORMWATER MODEL
COMBINED SEWER SEPARATION OPPORTUNITIES

INTRODUCTION

This technical memorandum presents the findings and recommendations of the stormwater modeling effort performed as part of the ongoing Stormwater Master Plan project. XP-SWMM is used to develop a hydrologic and hydraulic model to confirm system deficiencies and identify improvement possibilities, assisting with the development of a Capital Improvement Plan (CIP).

The hydrologic and hydraulic modeling focuses on the following components:

Infrastructure Components Modeled	**Key Attributes Modeled and Summarized**
Large-diameter (24" and up) storm sewer	Hydraulic grade line, peak flow, flow velocity, system surcharge locations, manhole overtopping locations
Open channels	Hydraulic grade line, peak flow, flow velocity, floodplain geometry, flow obstructions, vulnerable structures
Flood routing	Location and depth of flood storage and flood routing
Detention ponds (storage and outlet hydraulics)	High water levels, total storage available, additional storage, outlet hydraulics, freeboard, emergency overflow characteristics

Upon completion of the watershed delineation and problem area analysis (see Delineation of Stormwater Problem Areas Technical Memorandum), the project team met with City staff to review the findings and determine the limits of the area to study in more detail. The deliberation resulted in the selection of the 434 acre Oakland Avenue watershed for additional study. This watershed has the highest reported incidences of flooding and stormwater issues, per acre, in the City.

The limits of the Oakland Avenue watershed are roughly defined on the north by East Grove Street, on the east by South Mercer Avenue, on the south by East Lincoln Street, and on the west by South Gridley Street. The watershed is further divided into 41 sub-watersheds.

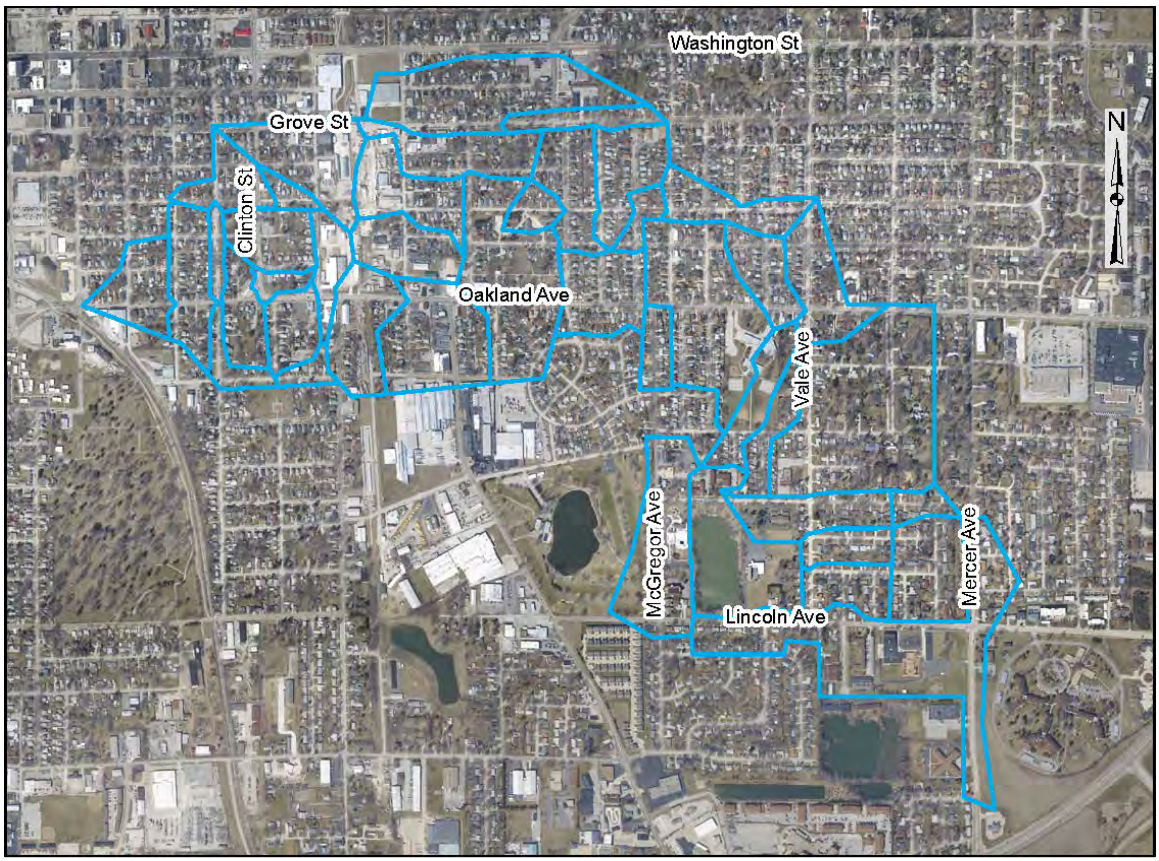


Figure 1 - Study Area

Several conceptual improvement alternates are considered. These alternates are in series, that is they build off each other, each adding to the last, to mitigate the existing flooding. The conceptual analysis begins by assessing the current sewer network and identifying potential sections for storm and sanitary sewer separation. These potential sections generally consist of reaches of parallel sewer pipe where a relief sewer has been installed alongside an older, combined sewer.

The assessment then reviews potential storage and outlet conveyance options based on two interconnected detention ponds and a conveyance network. The first potential pond (upstream) is located at the site of the City's public works facility at the northwest quadrant of East Oakland Avenue and Gridley Street. The second potential pond (downstream) is located at the current Nicor Gas facility on Gas Avenue north of East Washington Street. A proposed conveyance along Constitution Trail linking the two ponds, with a storm sewer outlet from the downstream pond to Sugar Creek is modeled and assessed.

This memorandum summarizes the hydrologic and hydraulic analysis and illustrates system deficiencies. Recommended system improvements are illustrated together with planning level cost estimates.

METHODOLOGY

WATERSHED DEFINITION

The findings in the Delineation of Stormwater Problem Areas technical memorandum were reviewed. This memorandum identifies the location of the major problem areas in the city on a watershed basis. The project team used ArcGIS to determine problems per acre within each watershed and created a heat density map of reported problems.

Figure 2 portrays a density map for reported surface flooding occurrences; the color gradient depicts the density of reported flooding issues. Green represents a low density of issues while purple represents the highest; with yellow, orange, and red respectively in between. The surface flooding issues assessed include reports of both street flooding and yard flooding. These reported instances may be ambiguous due to the variety of respondents; however, the fact that a respondent took the time to make the report suggests that there is likely an issue.

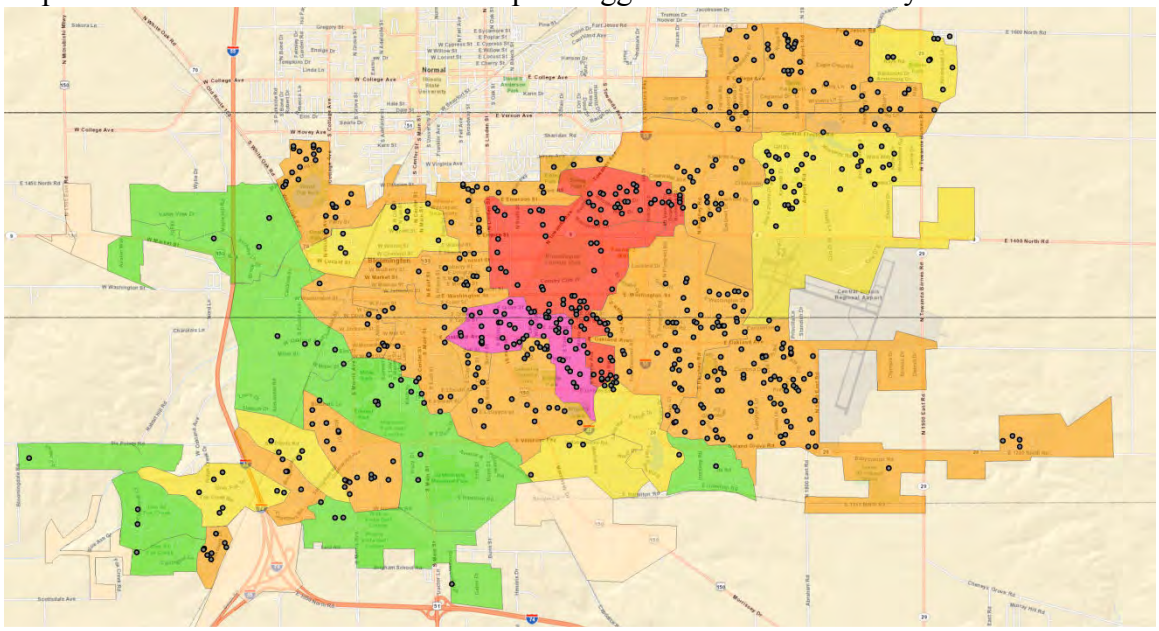


Figure 2 - Surface Water Flooding Density Map

Figure 3 portrays the same for basement sewer backups. This map will be less ambiguous regarding the definition of flooding; however, there may still be some discrepancies, possibly as a result of not having a basement, or having installed mitigation methods (e.g., ejector pits and overhead sewers).

These potential ambiguities and discrepancies are thought to apply to each watershed similarly and are therefore dismissed. However, it remains quite apparent where the worse problem areas are, as experienced by the residents. The area of greatest problem density is the Oakland Avenue watershed area, followed by the Locus/Colton watershed area, which has already been studied and is currently being mitigated.

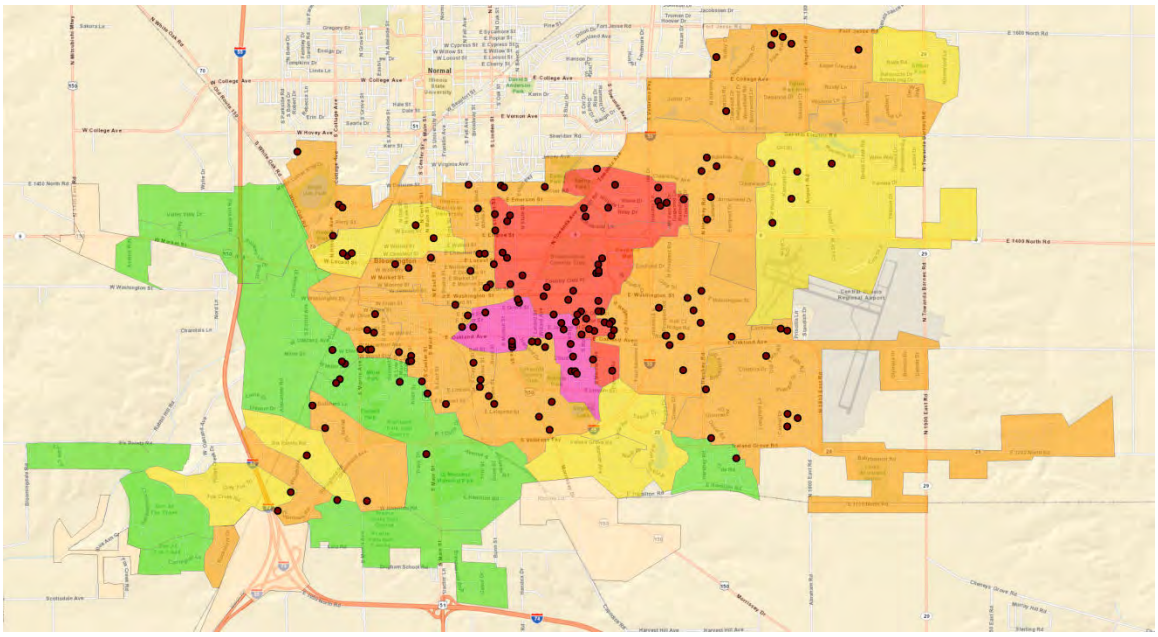


Figure 3 - Basement Drain Backup Density Map

In addition to assessing the questionnaire responses, comments from city staff were included in the analysis. These comments included areas of known problems and suspected causes. The Oakland Avenue watershed has also the highest density and the most known problem areas per city staff.

Two primary factors were key to choosing this watershed for further analysis. First, it has the greatest density of both questionnaire respondent complaints and city comments. Second, the Oakland Avenue watershed resides in an older area of town with combined sewers and is located directly in between two previous studies – the Locust/Colton study and the Lafayette Street study. The ability to fill in the gap between these two studied watersheds was an attractive benefit to the City staff.

Upon determining the final area to be studied, additional data was collected to build an accurate model of the watershed. A more detailed delineation effort ensued. This effort considered the boundaries of the aforementioned watersheds, the 2 foot topographic contours, aerial imagery to determine land use, and historical record drawings. This data was combined to redefine the watershed boundaries and to delineate both stormwater and sanitary sub-watershed; in most cases the two differed as shown in Figure 4 – the blue lines depict the stormwater sub-watersheds and the brown lines depict the sanitary sub-watersheds.

Once the sub-watersheds were determined, the sewer network was verified. All sewers 24 inches in diameter and larger were analyzed. Due to the complexity of the system, and to be able to model some of the specific problem areas, some sewers smaller than 24 inches in diameter were also included in the network for a more accurate depiction of the system in specific areas. The sewers were assessed in GIS; for every sewer that was to be analyzed, the record drawings were reviewed to verify location, connections, size, and inverts. Sewers that had missing or contradicting data were field verified.

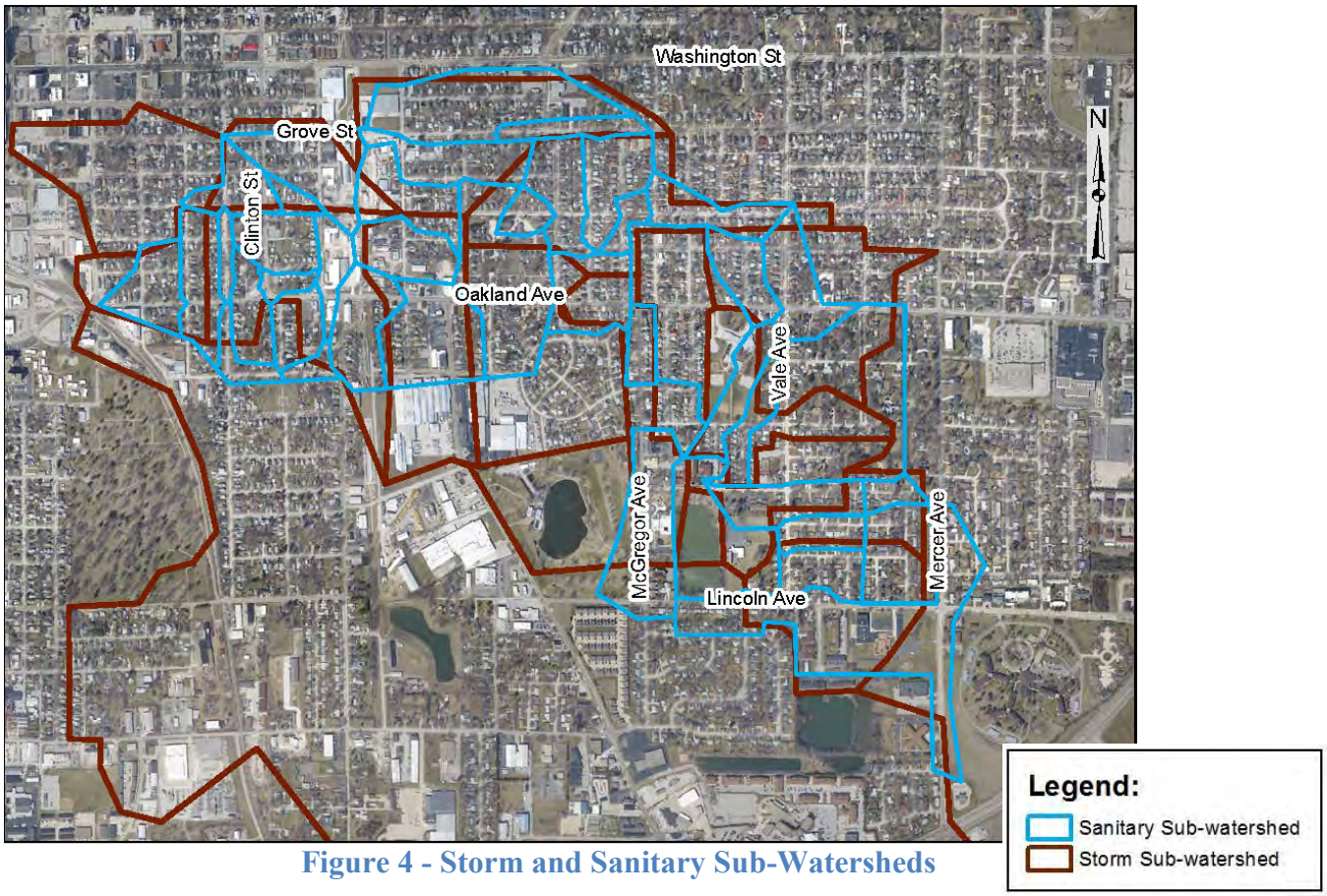


Figure 4 - Storm and Sanitary Sub-Watersheds

XP-SWMM MODEL

Following the standard set forth by other aspects of this project and preceding projects, XP-SWMM was used to model this watershed. All trunkline sewers 24 inches in diameter and larger within the watershed were modeled. Both stormwater and sanitary effluent were routed through the trunklines. Multiple duration precipitation events were modeled to determine the critical rainfall duration.

Runoff Calculations

The Runoff Curve Number (RCN) method was used to calculate the runoff response from the individual subbasins in the XP-SWMM model. This method was used elsewhere in this master plan project and on previous models. Curve Numbers were selected based on land use observed from aerial photography. The NRCS Soil Type was assumed to be Type C for developed areas, assuming a compacted "urban" soil type. Actual subbasin data including the Curve Number used are included in Attachment 1.

Rainfall Statistics

NOAA Atlas 14 rainfall depths were used for multiple rainfall durations and reoccurrence events. The NOAA Atlas 14 data represent up-to-date statistical data set for rainfall in central Illinois. Bulletin 71, widely referenced in Illinois, uses rainfall data through 1986. The NOAA data include approximately 20 years of additional rainfall statistics and is therefore assumed more representative of current climate conditions. Rainfall depths used in the XP-SWMM model are based on the NOAA Atlas 14. The 10 year (10%) event is shown below:

Critical Duration Rainfall Depths
NOAA Atlas 14

10% Event							
Duration [hrs]	24	12	6	3	2	1	0.5
Distribution [Huff quartile]	3	2	1	1	1	1	1
Depth [in]	4.63	4.03	3.47	2.77	2.58	2.17	1.71

Critical Duration Analysis

The critical duration storm is that which presents the highest peak runoff rate at the downstream end of the system. The 10 year (10%) event was chosen to find the critical duration and as can be seen in Figure 5, the 1-hour rain event produces the highest peak flow.

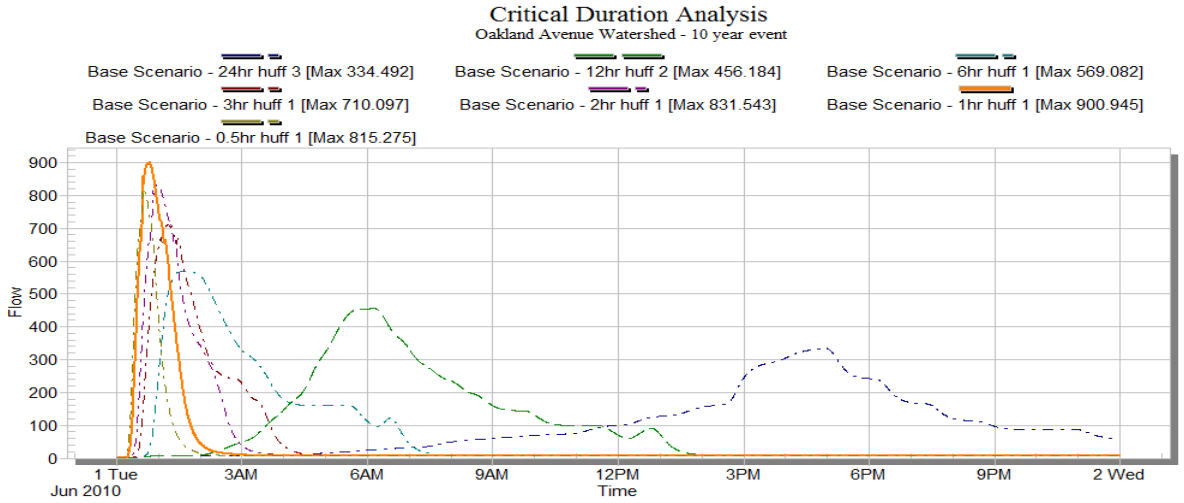


Figure 5 - Critical Duration Analysis

The 1-hour duration storm was determined as the critical duration; therefore, this duration is applied to various sized storm events (events of different reoccurrence frequency).

Modeled Rainfall Depths (1-Hour Critical Duration)
NOAA Atlas 14

Reoccurrence	1%	2%	10%	20%	50%	100%
Depth [in]	3.17	2.86	2.17	1.89	1.52	1.26

EXISTING CONDITIONS ANALYSIS

The XP-SWMM model was used to an identify and analyze sewer surcharging in the system. A surcharged sewer is herein defined as a pipe at full capacity with the hydraulic grade line (HGL) above the top of the pipe. Street flooding occurs when the HGL increases above adjacent inlets and the effluent surcharges onto the ground surface. Likewise, if the HGL increases above an adjacent property's basement floor level, and the basement has gravity flow floor drains, the effluent will likely flood into the basement. The model results were compared to reported flooding.

SEPARATION OPTIONS ASSESSMENT

The sewer network was studied to determine separation possibilities. Much of the current trunkline system has a parallel relief system built in the 1940's. The hypothesis was that these parallel combined sewer systems could be eventually divided into a separate storm sewer system and a sanitary sewer system. Separation of the existing combined sewer system was assessed only at the trunkline level. Upstream inlets, connections, and pipes (smaller than 24 inches in diameter) were not included in the modeling.

PROPOSED CONVEYANCE NETWORK AND DETENTION PONDS

In addition to analysis of the Oakland Avenue watershed, a new stormwater sewer conveyance network with detention ponds was considered. The City wished to complete a high-level analysis to explore what benefits could be derived from this concept. A conveyance network was simulated from the downstream end of the Oakland Avenue watershed all the way to Sugar Creek; two detention ponds were included along this reach. Additionally, adjacent combined sewer watersheds were assessed and included in the model to take into account future separation projects.

By separating the stormwater from the sanitary sewer, millions of gallons of stormwater can be diverted from the sanitary treatment facility annually. This diversion will reduce treatment costs and capacity needs. The inclusion of the two ponds adds many other benefits; they include flood reduction, peak discharge reduction, downstream flow rate reduction, scour reduction, allowance for pollutant settlement and/or filtration, and groundwater recharge.

ANALYSIS

The majority of the sewer network within this watershed is comprised of a combined sewer system that is one which conveys both sanitary flow and stormwater runoff in the same pipe. This often leads to problems during wet weather periods. During large precipitation events, increased stormwater runoff entering the system can cause the surcharge and flooding. As surcharge increases, combined stormwater and sanitary effluent can back up into basements, flood into streets, and sometimes overflow into local streams.

By City standards, storm sewers are to be designed to handle the 5 year precipitation event (or 20% event) without surcharging. As combined sewers include stormwater runoff, this 20% event is applied as the design event. This design event is the accepted threshold for preventing surcharge while installing reasonably sized sewer pipes. Design and installation of a sewer system capable of conveying less frequent events (i.e. larger storms) quickly becomes cost prohibitive.

Three primary data sources are reviewed as follows:

1. The impacts of a 20% storm event as modeled in XP-SWMM.
2. Recurring problematic areas as documented by City staff.
3. Recurring problematic areas as reported in the questionnaire.

PROBLEMS DETERMINED VIA XP-SWMM MODEL RESULTS

The model of the existing combined sewer trunk line portrays some moderate surcharging. A color-coded rating system using a four level scale was developed to present each pipe's surcharge rating. The surcharge rating assesses a pipe's capacity based on the location of the HGL relative to the top of the pipe. Level one (Green) represents an HGL within the pipe, i.e. below the top of the pipe. Level two (Yellow) represents an HGL exceeding the top of the pipe by no more than 50% of the distance from the top of the pipe to the surface elevation. Level three (Orange) represents an HGL higher than 50% of the distance from the top of the pipe to the surface (generally approaching the ground surface); this level is more likely to surcharge basement drains. Finally, level four (Red) represents an HGL above the rim elevation, resulting in a direct discharge onto the surface. Figure 6 displays a typical profile with two different pipe sizes, a smaller diameter pipe on the right (or upstream) side and a larger diameter pipe on the left (or downstream) side. The HGL on the left side of the profile rises above the top of the pipe and above the 50% line; this results in a pipe rating of Level 3 (Orange).The HGL on the right side of the profile rises above the smaller diameter pipe but stays below the 50% line; this results in a pipe rating of Level 2 (Yellow).

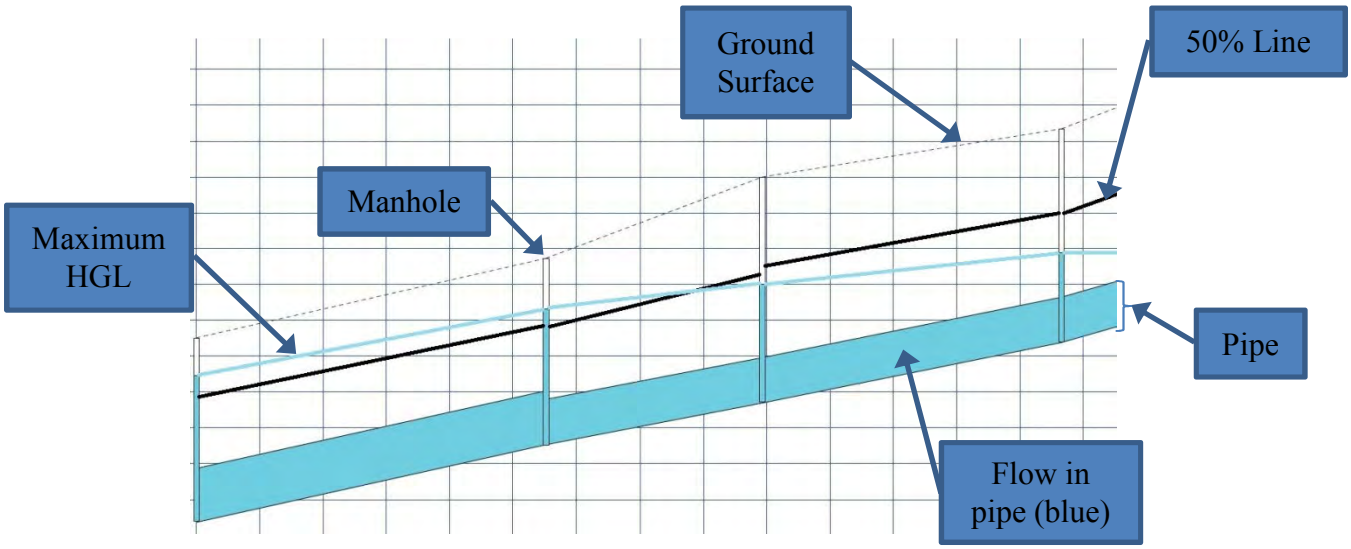


Figure 6 – Typical Sewer Profile Illustrating Surcharge Rating System

A complete map and profile of all sewers modeled may be found in Attachment 2.

Figure 7 shows the trunk line in this color-coded surcharge rating system for the 20% event.

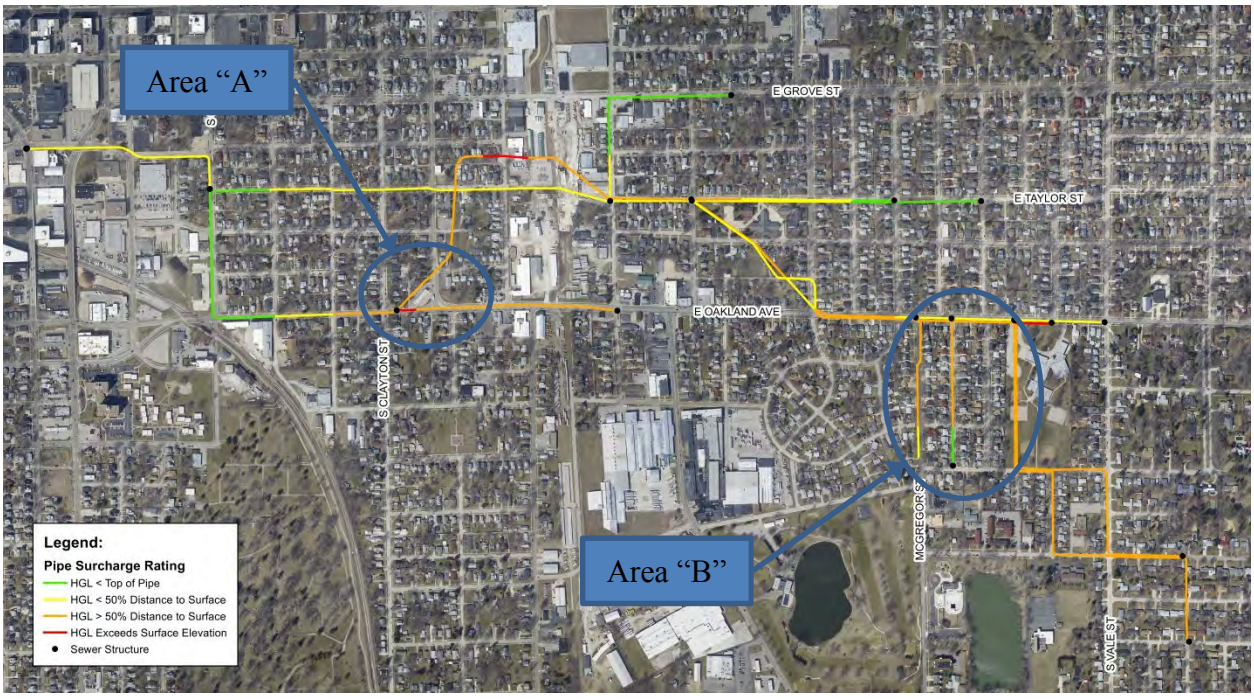


Figure 7 - Pipe Surcharge Rating for 20% Event

Rating the sewer segments in this manner is beneficial to identify areas with undersized sewers. Figure 7 depicts two such areas in this watershed. Problem Area "A," is in the western portion of the watershed, mostly along Oakland Avenue. Problem Area "B," is in the eastern portion, south of Oakland Avenue along McGregor Avenue, Kreitzer Avenue, and Florence Avenue.

- Problem Area "A" has an elevated HGL along Oakland Avenue from Clayton Street to McClun Street and along Clinton Street from Oakland Avenue to Jackson Street. This surcharge is a result of several factors. The primary cause is the merging of two separate sewers into a single sewer on Oakland Avenue just east of Clayton Street. Additionally, the size and the slope of all of the sewers in this area are inadequate.

- Problem Area "B" references combined sewers along McGregor Avenue, Krietzer Avenue, and Florence Avenue flowing north to Oakland Avenue. The McGregor Avenue sewer extends from south of Holiday Park. The Kreitzer and Florence Avenue sewers are bounded by Cloud Street on the upstream end. These combined sewers are overloaded. Additionally, the HGL for downstream receiving sewer on Oakland Avenue is well above the top of the three contributing sewers. This creates additional backup in the contributing sewers causing backups for upstream users and inlets.

PROBLEMS DEPICTED BY THE CITY OF BLOOMINGTON STAFF

City staff compiled a list of known problem areas. These problem areas are based on historical complaints and issues that the staff has dealt with in the past. Upon running the existing conditions model, an analysis of these areas was performed to determine possible cause. The noted problems are as follows:

- Area #1 (Figure 8) - Flooding at the intersection of Oakland and Meadows Avenue. This area is labeled a high priority due to the amount of traffic at the intersection. The combined sewer trunklines passing under this intersection have available capacity during the design event. This suggests that there may be problems with the inlet system including too few, too small and blocked by debris.

- Area #2 (Figure 8) – Basement Backups along Kreitzer and Florence Avenues. This is another high priority problem area designated by city staff. The GIS data and the as-built data indicate that these two sewer lines are very similar and receive both sanitary effluent and storm runoff. The XP-SWMM model predicts sewer surcharge (Problem area "B") during the design event. Figure 8 displays the profile for Kreitzer Avenue.

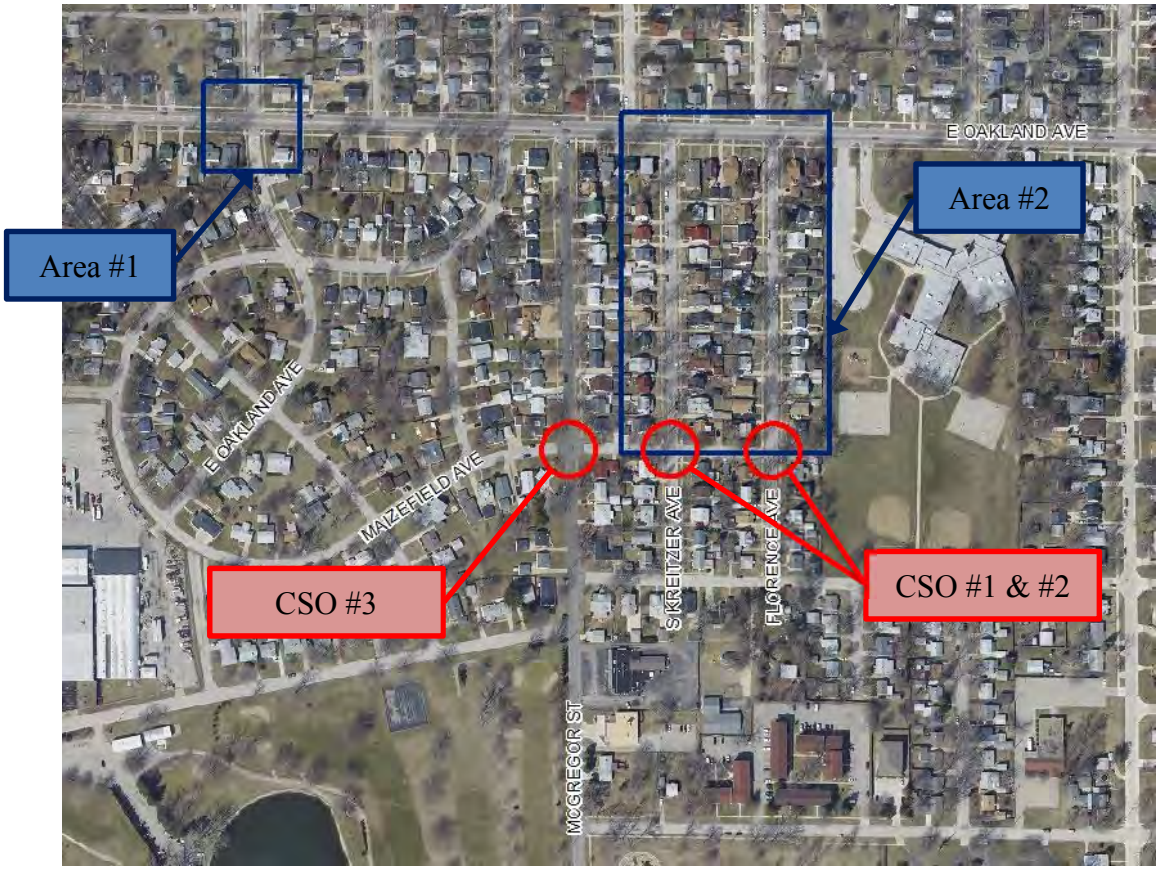


Figure 8 – Problem Areas Depicted by City Staff

- CSO #1 and #2 (Figure 8) – There are three combined sewer overflows (CSOs) along Maizefield Avenue. CSO #1 and #2 are at Florence Avenue and Kreitzer Avenue. The model predicts a maximum CSO overflow rate of 2 cfs for the 20% design event. The Kreitzer Avenue sewer profile is shown on Figure 9.

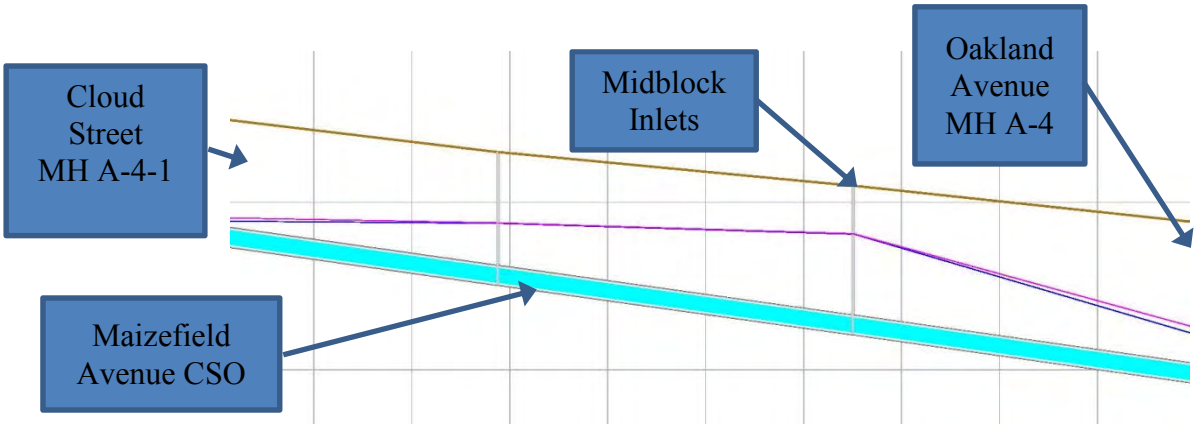


Figure 9 – Kreitzer Avenue from Cloud Street to Oakland Avenue (A-4-1 to A-4)

- CSO #3 (Figure 8) is located at the intersection of Maizefield and McGregor Avenues on the McGregor Avenue sewer. The XP-SWMM model predicts significant surcharging for this sewer during the design event. The questionnaire responses also noted flooding and basement backups in this area. The McGregor Avenue sewer profile is shown on Figure 10.

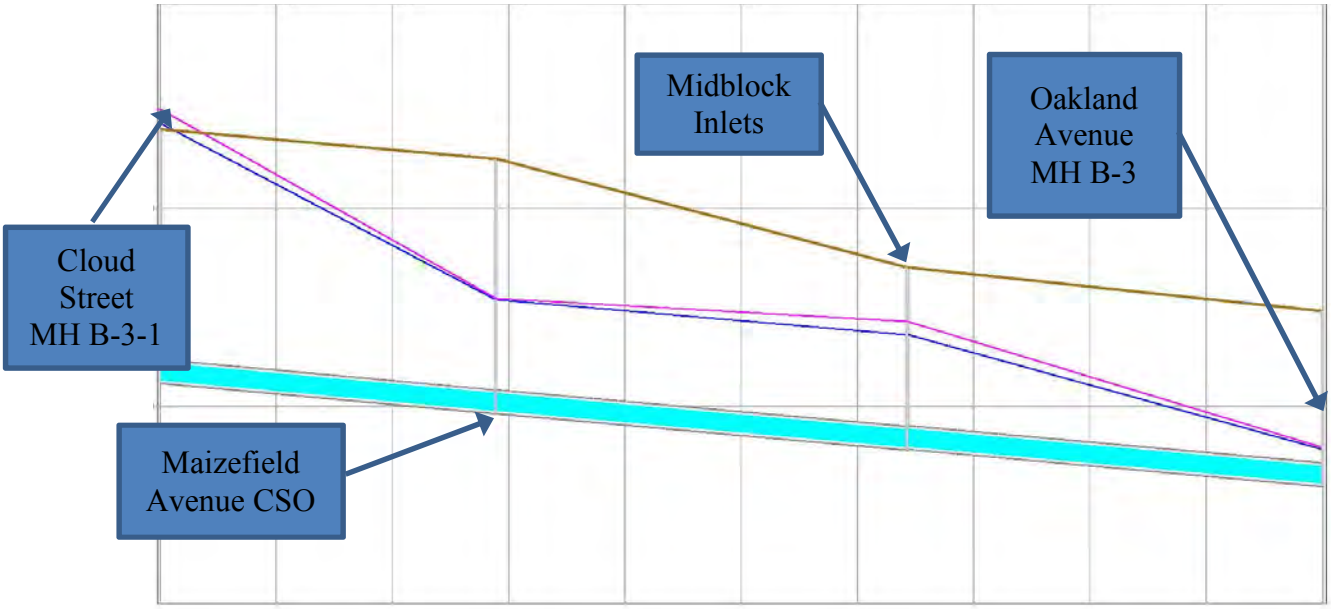


Figure 10 – McGregor Avenue Profile from Cloud Street to Oakland Avenue (B-3-1 to B-3)

Currently surcharging is frequently relieved by the CSO from this sewer into the storm sewer system. During the design event, the CSO peak flow is estimated at 4 CFS for over an hour; this equates to over 100,000 gallons of combined effluent entering the storm sewer and eventually the stream during a design event.

PROBLEMS DEPICTED VIA QUESTIONNAIRE

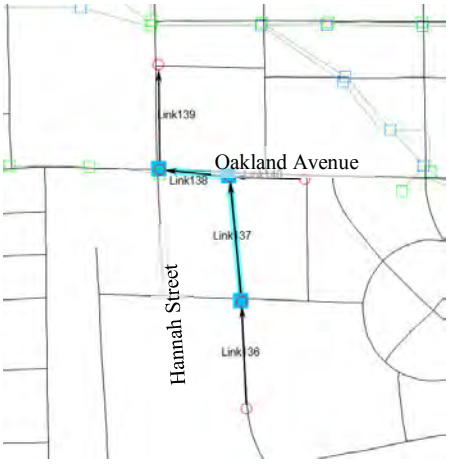
The questionnaire responses suggest that the majority of reported problems appear to be either a result of poor lot grading or combined sewer back-ups into basements. Residential lot grading is not a major infrastructure problem affecting the entire community and is therefore not a primary focus of this study. Basement backups noted by residents are assessed in more detail when they occur in clusters, as they could be indicative of combined sewer surcharging. The following areas were assessed in more detail:

- Hannah Street
  The locations of three reports of basement sewer backups on Hannah Street south of Oakland Avenue are shown on Figure 11. The combined sewer serving Hannah Street is 15 inch diameter. As the threshold for inclusion in the base model was 24 inch diameter, the Hannah sewer was not included in the original existing conditions model. This 15 inch diameter sewer pipe was subsequently added to the model. The results show that the

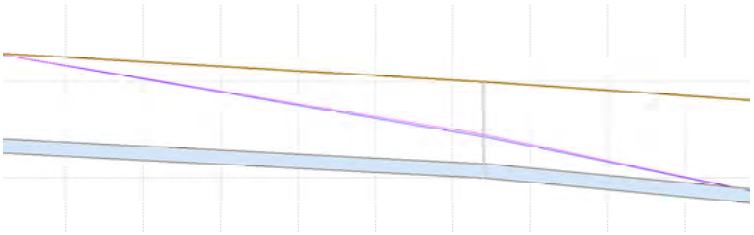
HGL on Hannah Street rises well above the top of the pipe, even reaching the surface. This high HGL suggests undersized sewer pipes and the potential for basement backups.



Location of reported Basement backups



15" sewer added to the model



Profile View of Hannah Street Sewer to Oakland Avenue

Figure 6 - Hannah Street Problem Area

❖ McGregor Street

Figure 12 shows a reported occurrence of basement flooding along McGregor Street. Additionally, the dark blue dots represent two reports of street flooding. These reports verify earlier model findings of a high HGL along McGregor Street. (See Figure 10)

❖ Croxton Avenue

Figure 13 shows three reports of basement flooding along Croxton Avenue east of Vale Street. These reports verify earlier model findings of a high HGL along Croxton Avenue (see Attachment 2.2-Sewer reach A5 to A5-1)

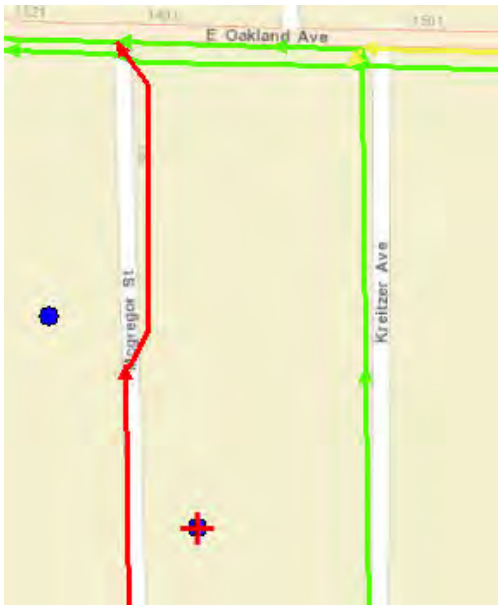


Figure 12 - McGregor Street Problem Area

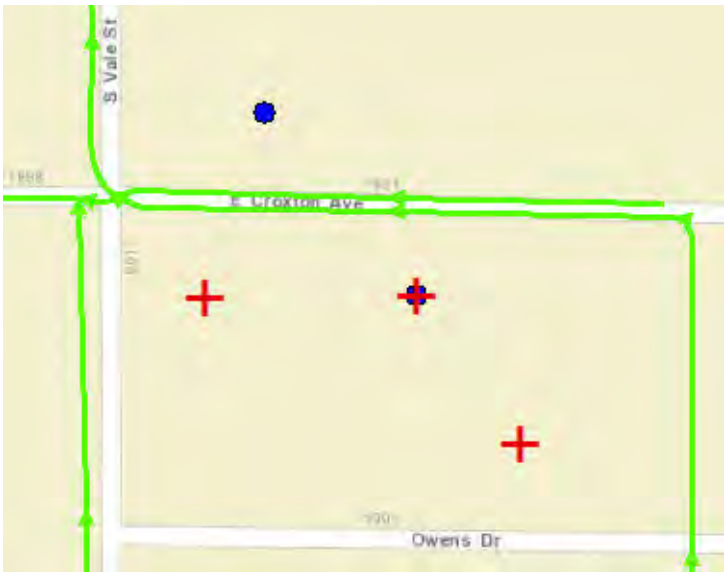


Figure 13 - Croxton Avenue Problem Area

RECOMMENDATIONS

The recommendations, which follow, consist of four phases of improvements. The analysis of the problem areas determined that flood mitigation via several smaller scale improvement projects was feasible. These projects are grouped together in Phase 1 – Localized Improvements.

Subsequent Phases 2, 3, and 4 improvements are based on a more holistic sewer separation approach for the watershed incorporating nested detention basins to reduce peak flows and associated conveyance costs. Phase 2 presents the possibility of separating the Oakland Avenue watershed into separate sanitary and storm sewers. Phase 3 discusses the option of constructing a detention facility, Pond 1, at the public works facility south of downtown. Phase 4 creates a second detention facility, Pond 2, at the current Nicor Gas site and a new stormwater conveyance route from Pond 1 to Pond 2 to Sugar Creek.

PHASE 1 – LOCALIZED IMPROVEMENTS

The localized improvements are split into four subprojects, Phase 1A thru 1D.

Phase 1A
Oakland Avenue sewer (Clayton St. to McClun St.) and Clinton Stet sewer (Oakland Ave. to Jackson Street):

> This system has a dedicated storm sewer system prior to discharging to the 66 inch diameter combined sewer along Oakland Avenue east of Clayton Street. The model suggests street significant surcharging and flooding during a 10% event, but only brief sewer surcharges during a 20% (design) event.

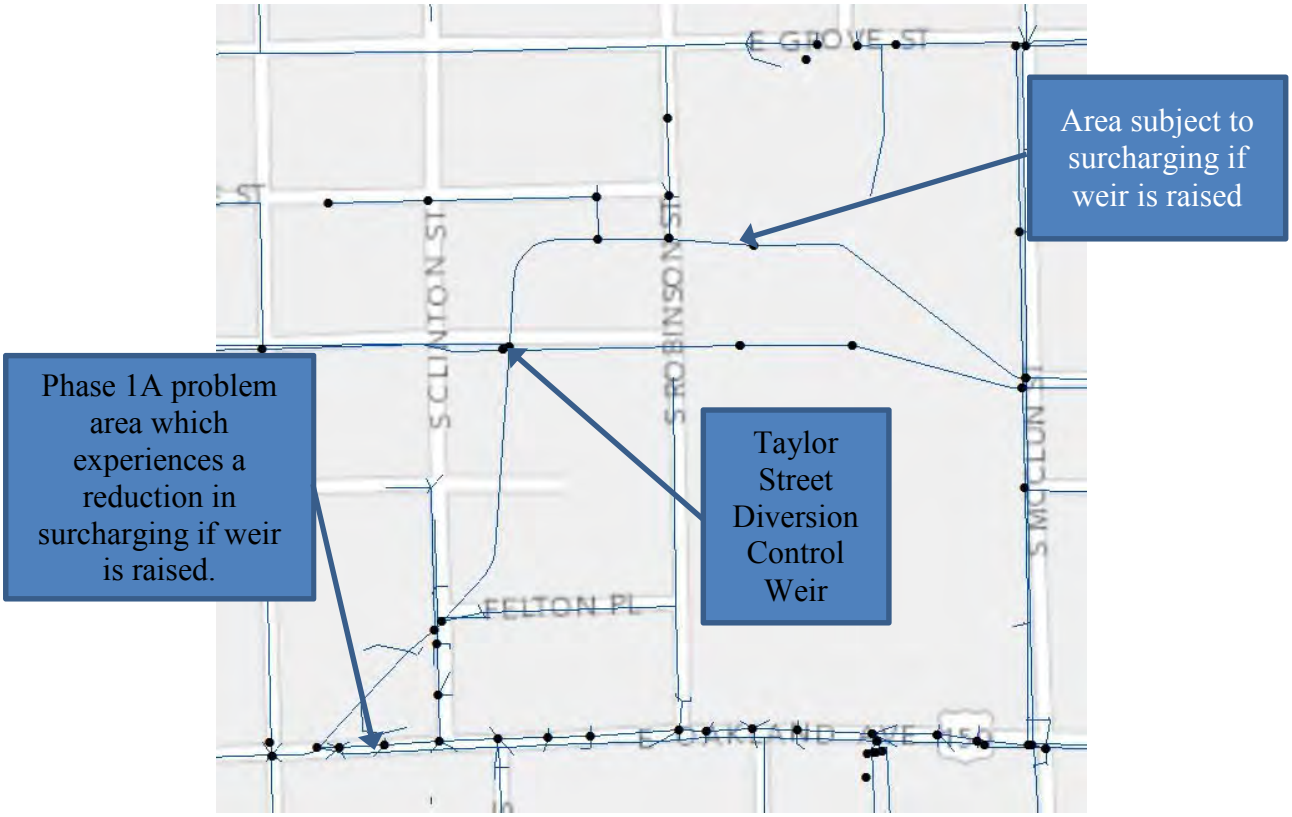


Figure 74 – Phase 1A problem area and upstream Diversion Control Weir

Part of the flow through the problem area is overflow from an upstream diversion control weir in the junction chamber along Taylor Street east of Clinton Street. If the weir was raised, less flow would pass through the problem area, alleviating some of the hydraulic pressure. Currently, the flow to the outlet pipe heading south to Oakland Avenue is controlled by an 18 inch tall weir. The impacts of raising this weir were modeled; a 30 inch weir height was found to better balance the flows through the existing sewer network resulting in an HGL at or within only a few feet of the top of pipe both upstream and downstream of the junction chamber. If the weir is raised, the sewer north of Taylor Street is projected to experience a slight increase in the HGL resulting in a surcharging of approximately 2.5 feet. Peak surcharging in the downstream sewer, currently estimated at 4 feet, is projected to decline to less than 2 feet.

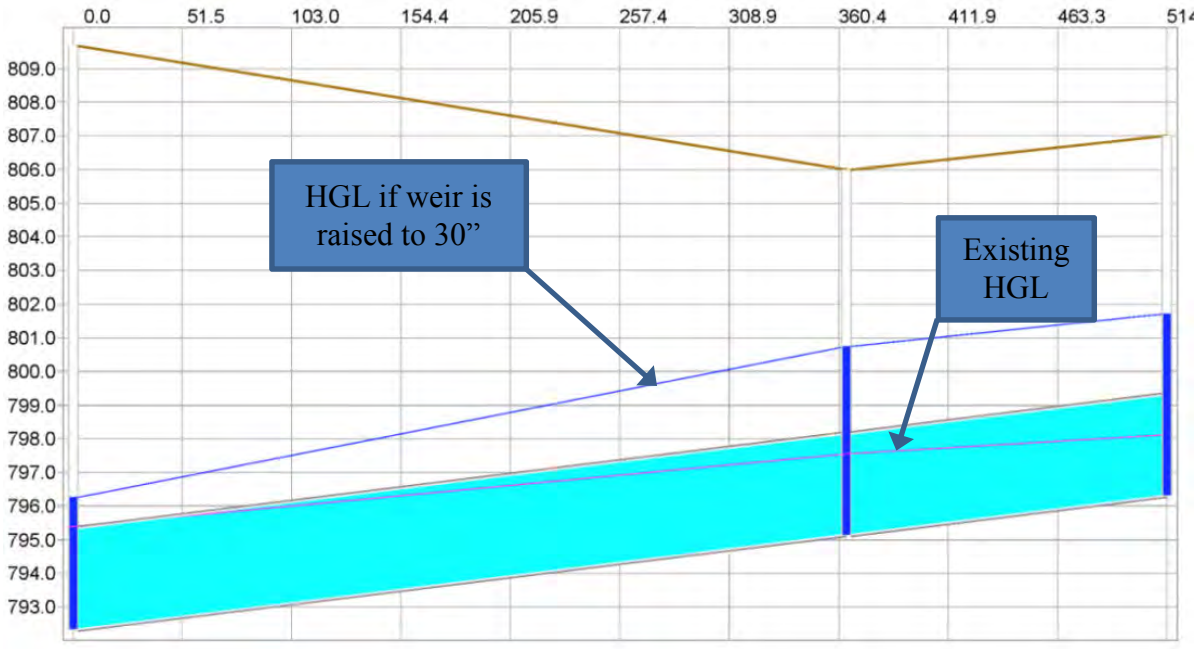


Figure 85 – HGL Upstream of Weir North of Taylor Street

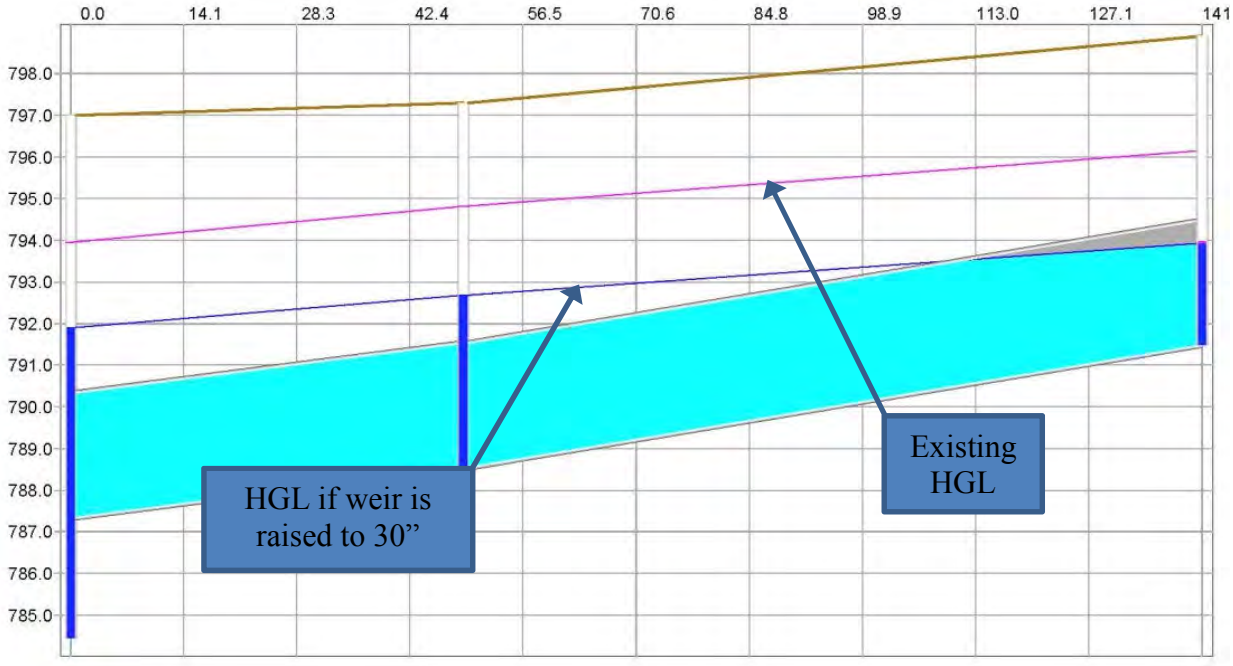


Figure 96 –HGL Downstream of Weir along Oakland Avenue

Other sewer sections in the vicinity of this weir would also experience minor changes to the HGL during the design event. However, as any modification to the weir height could increases the HGL in certain areas, it may adversely impact some users. Therefore, further study and additional field investigations are recommended before the overall benefits of this proposed improvement can be confirmed. Estimated project costs for modifications to the weir are $30,000.

Phase 1B – McGregor Avenue flowing north to Oakland Avenue:

This area has reported surcharge problems and includes one of the three CSOs on Maizefield Ave. Alternates are considered to reduce the surcharging and eliminate the CSO.

The initial recommended alternate, Phase 1B-1, is to install approximately 900 feet of 18 inch diameter storm sewer along McGregor Street from Croxton Avenue to Maizefield Avenue. This allows for separating the combined sewer into a dedicated storm sewer and dedicated sanitary sewer. This 18 inch storm sewer would connect the existing storm sewer south of Croxton Avenue to the Maizefield Avenue storm sewer system, replacing the combined sewer overflow. The capacity of the receiving sewer will need to be evaluated; however, based on the upstream sewer it appears to be a viable option.

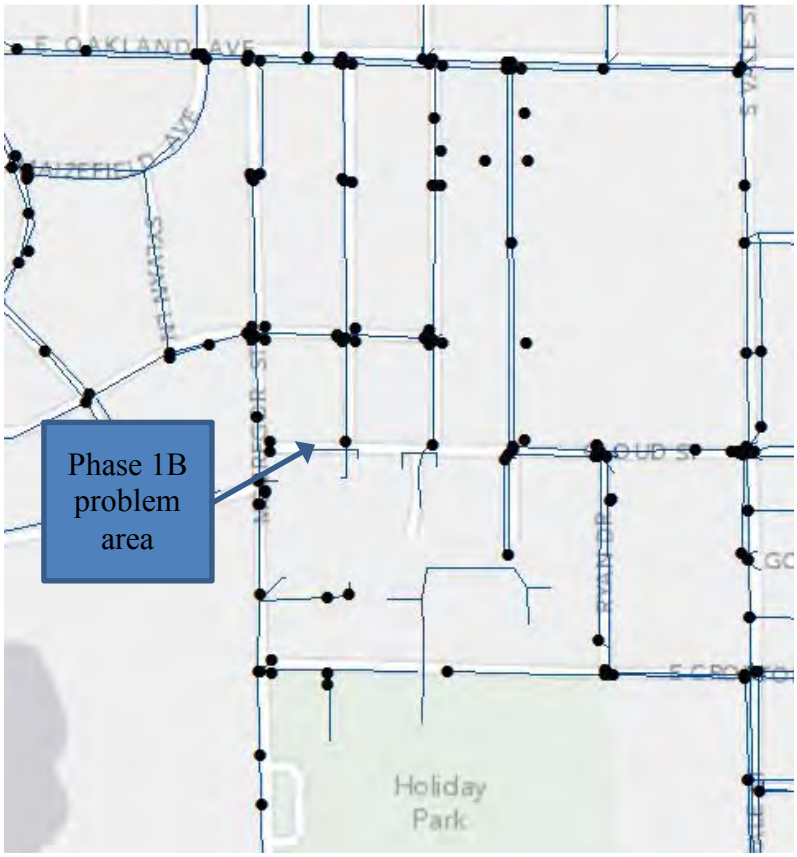


Figure 17 –Area Affected by CSO Elimination

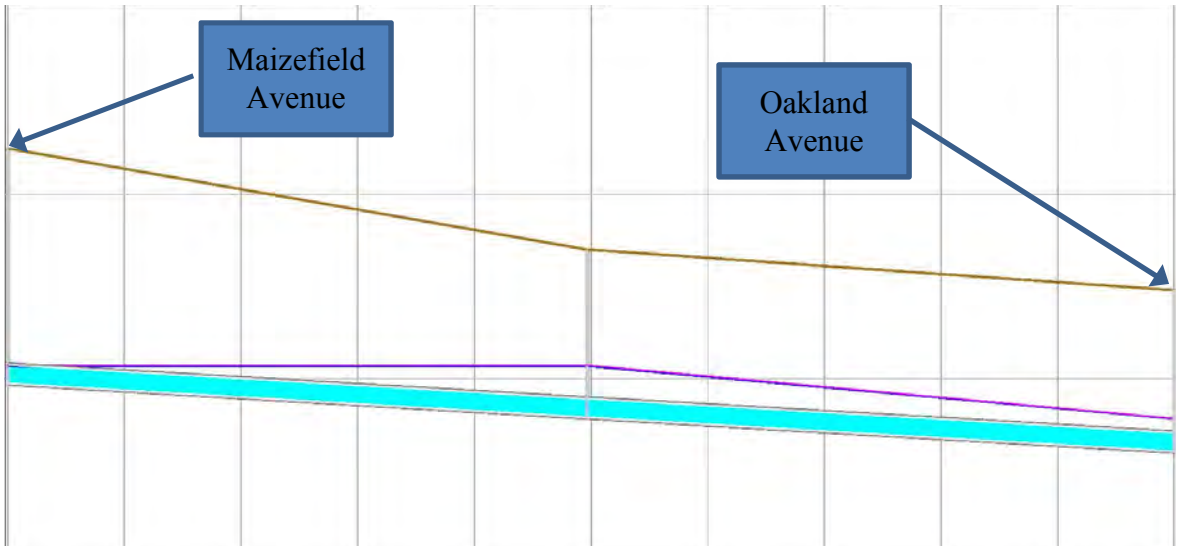


Figure 18 – McGregor Profile after Upstream Storm Removal

By separating out the upstream storm water runoff along McGregor Street, the HGL in the combined sewer between Maizefield Avenue and Oakland Avenue is reduced. (See Figure 10 for existing condition)

If a further in-depth study of the Maizefield Avenue storm sewer determines that the system does not have capacity to receive additional flow, the proposed 18 inch storm sewer should be extended an additional 750 feet to Oakland Avenue. This additional alternate, Phase 1B-2, would completely separate the storm and sanitary sewers along McGregor Street from Lincoln Street to Oakland Avenue. The extension of this line all the way to Oakland Avenue would eliminate the need to connect to the Maizefield Avenue storm sewer; additionally it would allow the two inlets between Maizefield Avenue and Oakland Avenue to be disconnected from the combined sewer and attached to the storm sewer. Estimated project costs are as follows:

Phase 1 B-1	$150,000
Phase 1 B-2 (if needed)	$175,000
Total	$325,000

Phase 1C – Basements backups along Kreitzer Avenue and Florence Avenue:

Similar to phase 1B, Kreitzer Avenue and Florence Avenue have reported combined sewer surcharging into adjacent basements; additionally, this area also has two CSOs located on Maizefield Avenue lying in the Oakland Avenue watershed. Similar to the McGregor Street problem area, the combined sewers along Kreitzer and Florence Avenues have inadequate capacity to convey the design storm flow. Unlike the McGregor Street problem, the most upstream storm runoff inlets are located at Maizefield Avenue.

The initial recommended alternate, Phase 1 C-1, is to reroute the inlets at the intersections of Maizefield and Kreitzer Avenue and Maizefield and Florence Avenue to the Maizefield Avenue storm sewer. By separating out the upstream storm water runoff along Kreitzer Avenue, the HGL between Maizefield Avenue and Oakland Avenue for the combined sewer is greatly reduced as shown in Figure 19 as compared to Figure 10. However, it will also be necessary to perform an additional feasibility study to determine if the receiving sewer system has capacity to make this alternate viable; initial evaluations appear that it does.

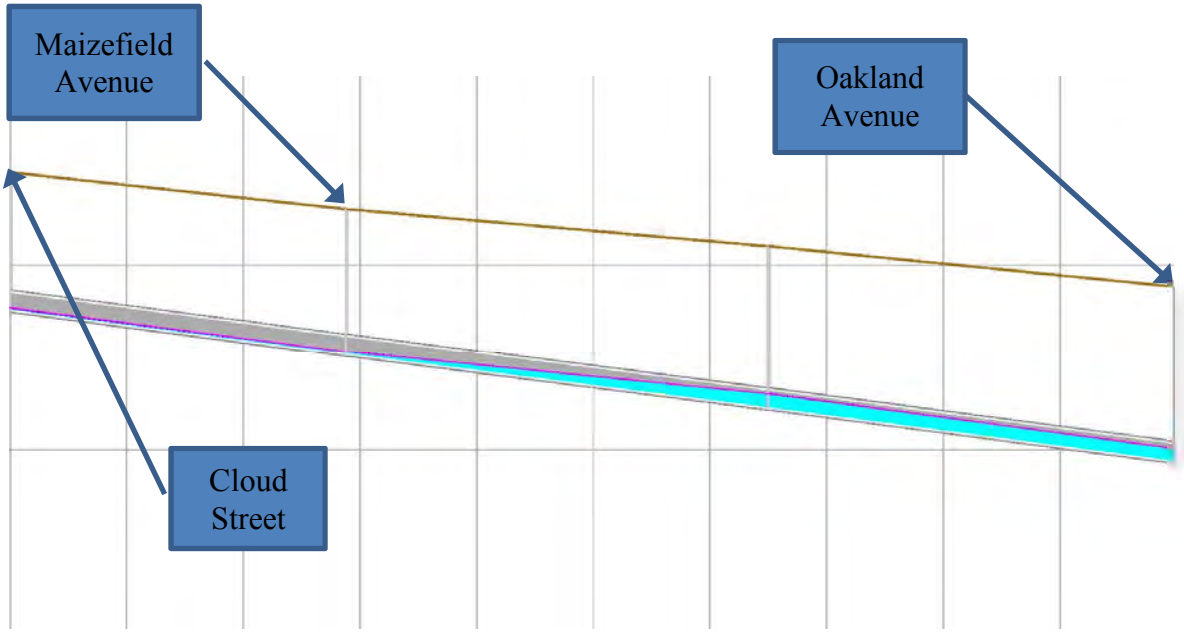


Figure 19 – Kreitzer Avenue Profile after Upstream Storm Removal

If the required feasibility study evaluating the available reserve capacity of the Maizefield Avenue storm sewer proves the system inadequate to receive additional flow, a proposed 12 inch diameter storm sewer would be extended 750 feet to convey the storm runoff all the way to Oakland Avenue. This second alternate, Phase 1 C-2, would completely separate the storm and sanitary sewers along the Kreitzer Avenue and Florence Avenue from Cloud Street to Oakland Avenue. The extension of this line all the way to Oakland Avenue would eliminate the need to connect to the Maizefield Avenue storm sewer; additionally it would allow the inlets between Maizefield Avenue and Oakland Avenue to be disconnected from the combined sewer and attached to the storm sewer. Estimated project costs are as follows:

Phase 1 C-1	$ 80,000
Phase 1 C-2 (if needed)	$130,000
Total	$210,000

Phase 1D – Flooding at the intersection of Oakland Avenue and Meadows Avenue:

Based on the model, the flow in the parallel combined sewers that serve this intersection appears to be within the pipes (non-surcharging) for the design event. This suggests that this there may be an inlet deficiency. It is possible that the inlets are either too few, too small or clogged and therefore unable to handle the design runoff flow. While upsizing these inlets should reduce flooding, and the local receiving sewer appears to have reserve capacity, this would still add additional flow to a system that has downstream conveyance issues. Therefore, the initial recommendation is to perform a thorough investigation of the inlets at this intersection.

As an alternate, there appears to be a separate storm sewer along Meadows Avenue which may be able to receive the stormwater from this intersection. Further investigation is required to determine if it has reserve capacity. This investigation also includes determining its exact location and size. If this investigation proves favorable, the potential solution is to disconnect the inlets from the combined sewer and direct this storm water runoff to the existing storm sewer. Prior to implementing these improvements, additional field investigations and an H/H model update are recommended to assess any potential negative impacts and to prepare an appropriate mitigation plan as necessary. Estimated project costs are $60,000.

Recap of estimated costs for Phase 1 improvements:

Phase I Planning Level Cost Estimate Summary	
1 A	$ 30,000
1 B-1	150,000
1 B-2 (if needed)	175,000
1 C-1	80,000
1 C-2 (if needed)	130,000
1D	60,000
Subtotal	$ 571,000
30% Contingency	171,000
ESTIMATED PHASE I TOTAL	$ 742,000

PHASE 2 - SEPARATE STORMWATER SYSTEM

The Phase 1 localized repairs mitigate some of the extreme surcharging and flooding in the system; however, widespread problem surcharging in the combined sewer system remains, particularly for events greater than the 20% (5 year) recurrence.

During a 10% recurrence (10 year) event, the majority of the larger trunk sewers are near full capacity and beginning to surcharge. Outlets for upstream sewers into these trunk sewers are restricted causing upstream sewers to surcharge. These surcharges contribute to combined sewage effluent backing up into basement drains, and in some cases all the way to the ground surface.

During a 2% recurrence (50 year) event, the larger trunk sewer pipes also become surcharged, further exacerbating upstream flooding. These surcharges impose potential health concerns for the community. Additionally, surcharges into a basement can cause structural and aesthetic damages to homes. A potential solution to these problems is separating the combined sewer network into individual sanitary sewer networks and stormwater sewer networks.

The Eastern Relief Sewer (Division C), designed in 1946 and built in the following years, parallels the original trunkline through much of the studied watershed. This relief sewer functions as a combined sewer. Under Phase 2 improvements, these parallel sewer relief trunk lines are reconfigured to function as a separate storm sewer system. Sanitary sewage flows only are routed through the original combined sewers, thus creating an independent storm and sanitary sewer systems. At the completion of Phase 2 improvements, the downstream end of the two separated sewer systems converges back into a combined sewer near the west end of the Oakland Avenue watershed until Phase 3 is completed. A schematic of the separated sewer networks is shown in Figures 20 and 21.

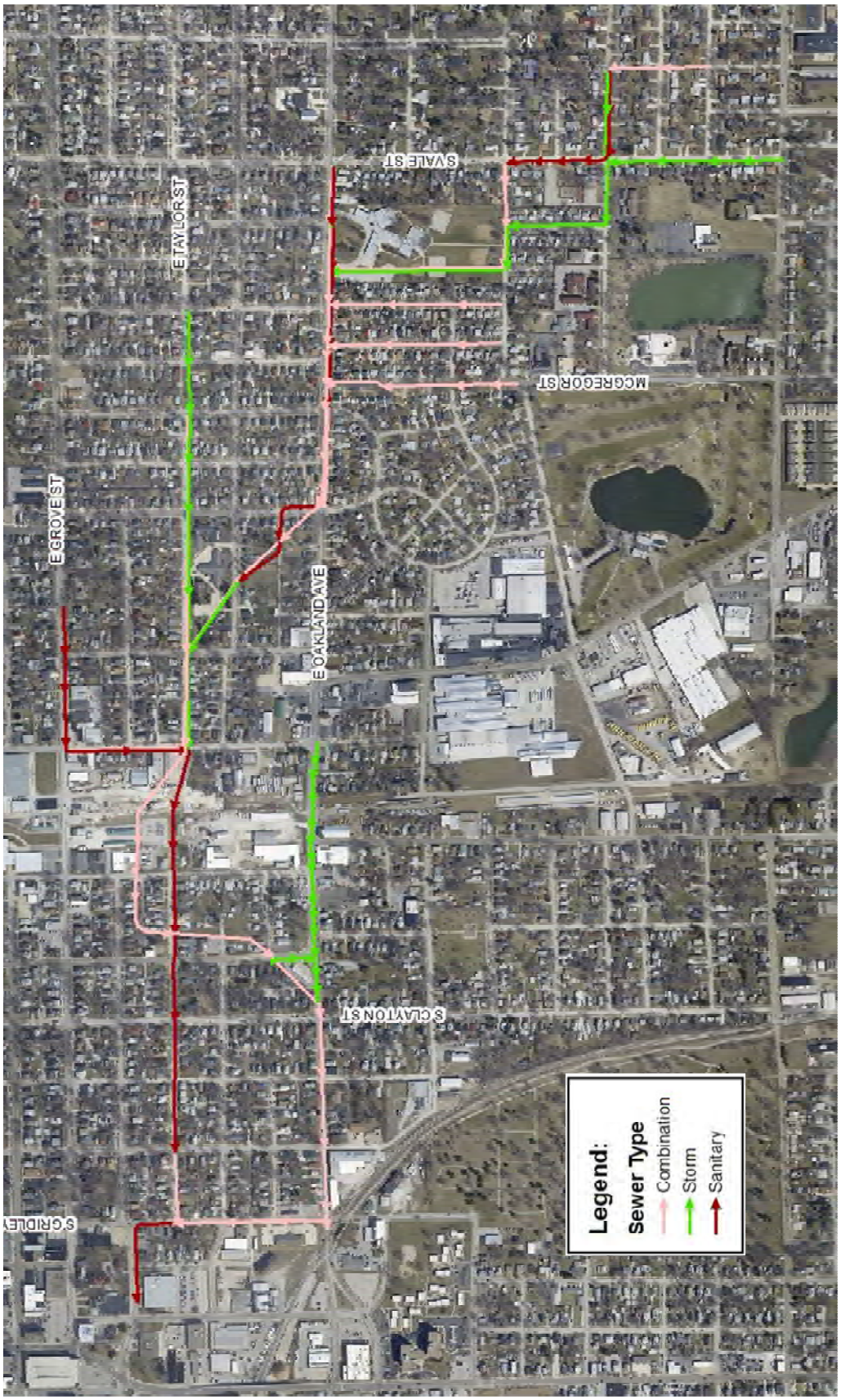


Figure 20 – Proposed Sewer System BEFORE Separation

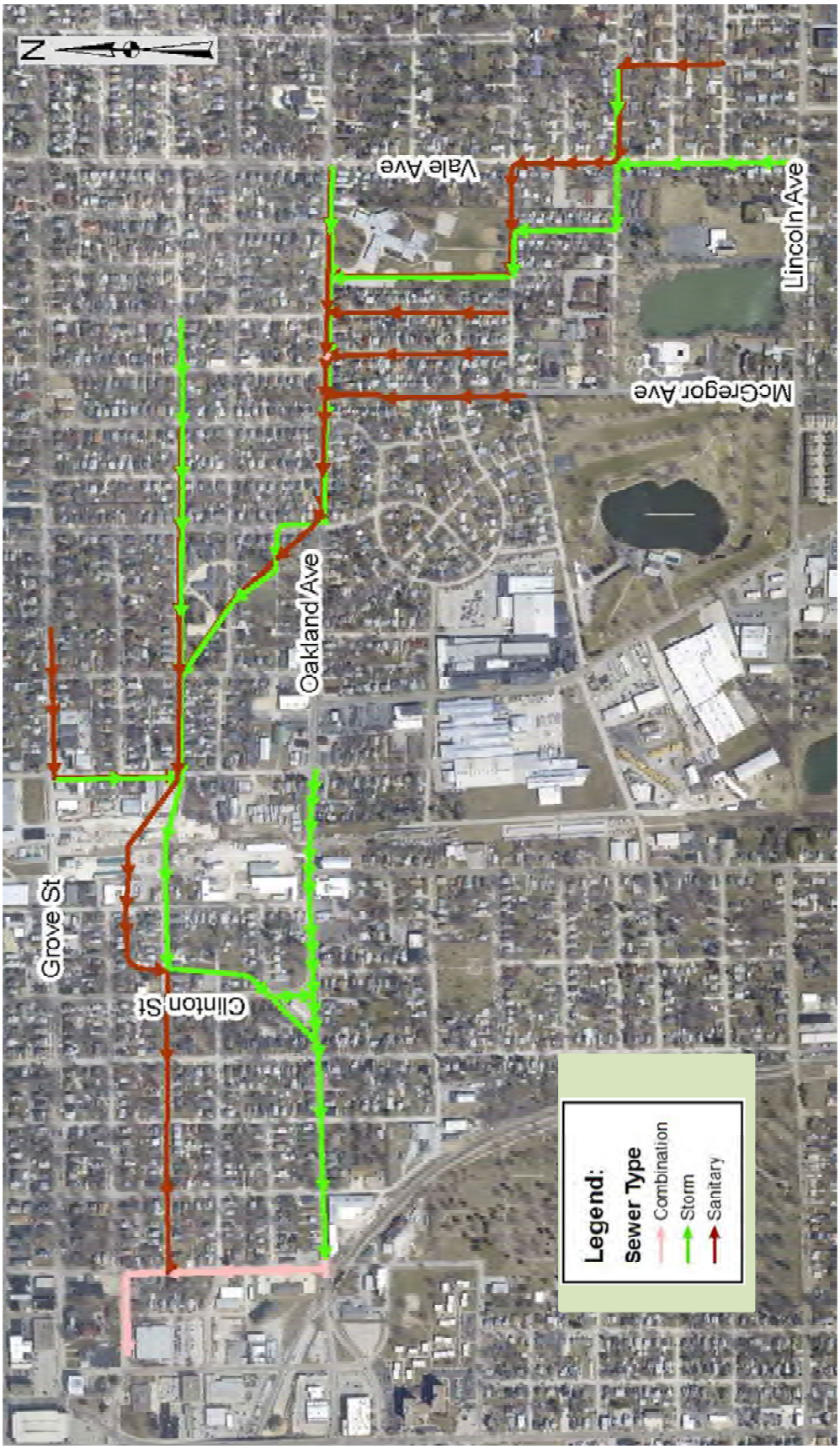


Figure 21 – Proposed Sewer System AFTER Separation

The following basic assumptions are necessary when considering the feasibility of combined sewer separation in this area:

All sanitary laterals are or will be connected to the original combined sewer.

In reviewing sewer GIS mapping and as-built drawings, it appears that the majority of the sanitary lateral lines feeding the trunkline are connected to the original combined sewer. In most sections where laterals are connected to the relief sewer, they are close to the original combined sewers and can be rerouted to the original combined sewer. The original combined sewer was designed to convey both sanitary flow and stormwater runoff. It is therefore assumed that the original combined sewer is capable of conveying all sanitary effluent in addition to some minor storm flows from upstream inlets that may not be separated initially.

All storm inlets are or will be connected to the new trunk storm sewer.

An XP-SWMM model was created to reflect separate storm and sanitary sewer networks. As before, the 20% (5 year) event was used as the design event. Resulting sanitary sewer trunk profiles and storm sewer trunk profile are shown in Figures 22 and 23.

Figure 22 shows the original combined sewer pipes are adequate to convey the sanitary flow. Additionally, the HGL from the surcharged storm sewer has minimal impact on the sanitary sewer at their point of merger, as can be seen on the downstream side of Figure 23.

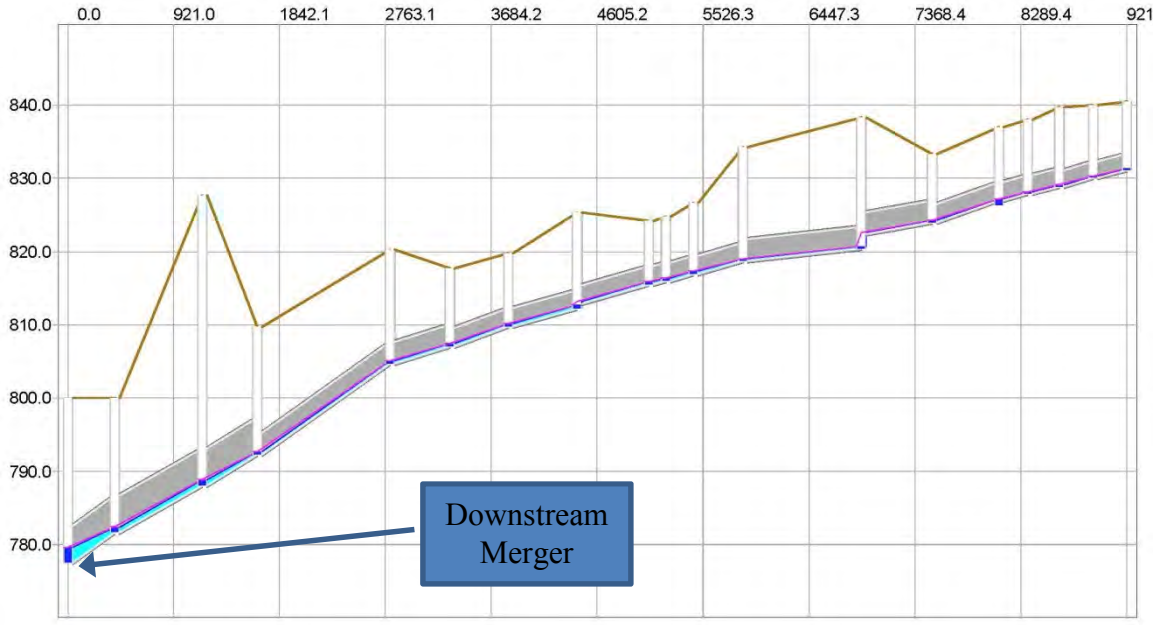


Figure 22 - Sanitary Sewer Trunk Profile

In order to provide adequate outlet capacity for the storm sewer system, it was necessary to add 1200 feet of new 72 inch storm sewer to the downstream storm conveyance

system. With this addition, Figure 23 shows that the storm trunk line has adequate downstream capacity. Surcharging may continue in some upstream reaches. Although this is in conflict to the general goal of containing the design storm within the capacity of a sewer, an exception may be justified in this situation given the benefits gained from the complete removal of the combined effluent surcharges and overflows. Additional study of the impacts of any storm sewer flooding should be performed as planning for Phase 2 improvements advance.



Figure 23 - Storm Sewer Trunk Profile

Planning level cost estimates are summarized below, They include costs for physical separation of the trunklines, modifying junction chambers, plugging parallel sewer manhole connections, new 6 foot diameter storm sewer to convey a major downstream portion of the separated sewer, short lengths of inlet pipes and connection reroutes, several blocks of new parallel sewer to reroute upstream sewers and minimal street restoration.

Phase 2 Planning Level Cost Summary

5	Junction Chambers	$50,000	Each	$250,000
30	Cross Connection Plugs	$3,000	Each	$90,000
20	Inlet/Connection Reroutes	$15,000	Per Intersection	$300,000
10	Parallel Sewer (d<18")	$30,000	Per Block(300')	$300,000
10	Street Restoration	$80,000	Per Block(300')	$800,000
1,200	6' RCP Storm Sewer	$700	LF	$840,000
	Subtotal			$2,580,000
	30% Contingency			$774,000
	PHASE 2 TOTAL			**$3,354,000**

PHASE 3 – DOWNTOWN DETENTION FACILITY

City staff identified a 3 acre site, currently occupied by the City's public works, as a potential site for a new stormwater detention facility. The limits of this facility are Main Street on the west, Constitution Trail on the south, East Street on the east and Jackson Street on the north. (See Figure 24) A pragmatic detention basin design incorporates the entire site. Assuming a ten foot wide ledge around the top, and sloping down fifteen feet at a four to one slope results in approximately 30 acre-feet of available storage.



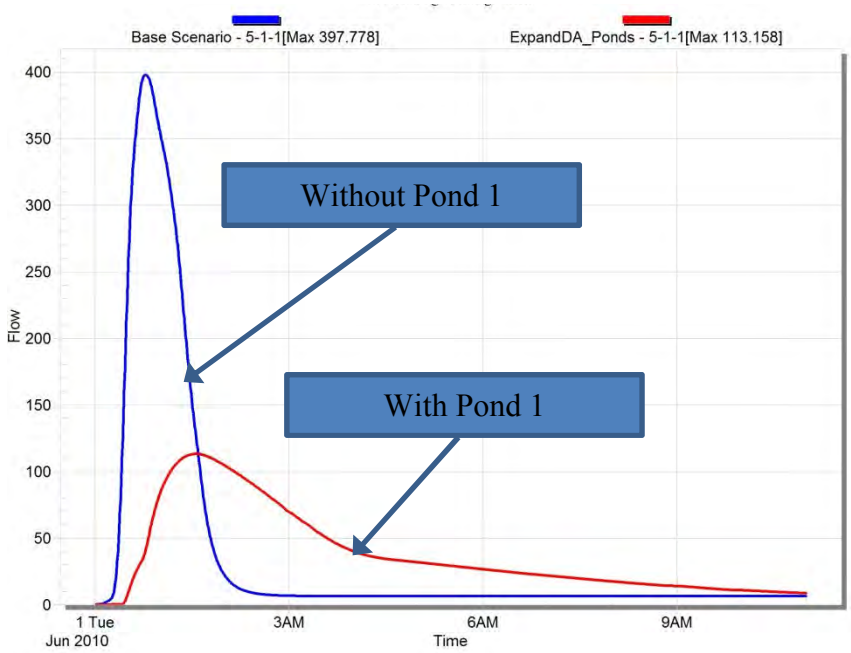
Figure 24 – Location of Proposed Pond 1

The concept of adding this detention facility, Pond 1, was developed with the intent of reducing upstream surcharge and downstream peak flows.

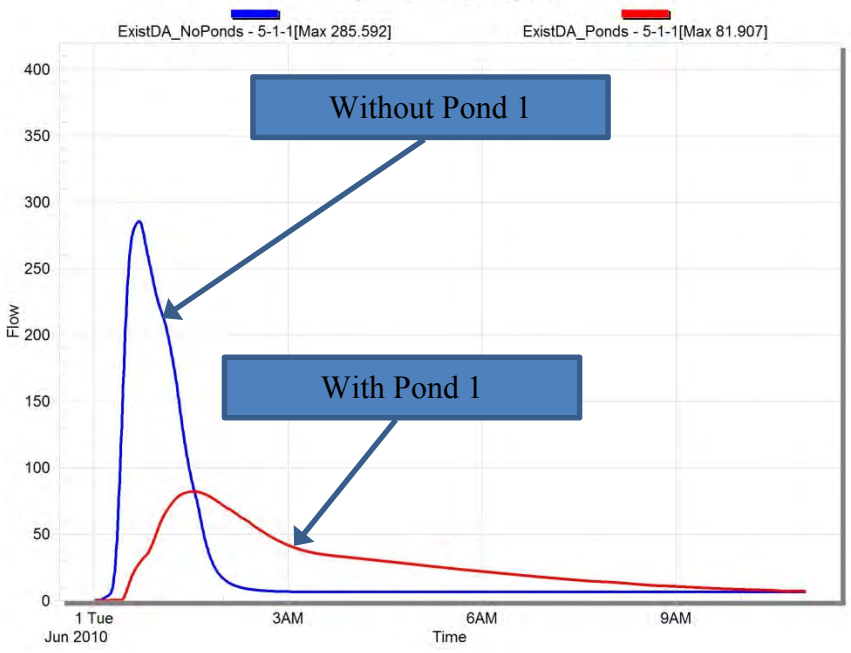
Through the use of an engineered outlet control, Pond 1 is able to reduce the peak discharge from the upstream drainage area to the existing and undersized downstream combined sewer system from 285 cubic feet per second (cfs) to 81 cfs.

In order to maintain inclusiveness of this study, adjacent combined sewer watersheds that have the potential to also be separated and directed to the ponds are included. For the proposed Pond 1, an adjacent 380 acre watershed was added to the existing drainage area representing this potential area. For this expanded "full potential" drainage area, Pond 1 is able to reduce the peak discharge from 398 cfs to 113 cfs.

Peak flow with and without Pond 1 for the existing watershed and, separately, for the greater "full potential" watershed are shown in Figure 25.



Existing Drainage Areas only



Including Expanded (Full Potential) Drainage Area

Figure 25 - System Flows downstream of Pond 1 location.

This feasibility level design assumes the availability of the land for the detention facility. Planning level costs assume the land for the detention facility has been acquired and cleared; additional assumptions include easements or rights of way are granted.

Approximately 1,000 feet of new 72 inch diameter storm will be required to convey stormwater to the detention facility from the previously Phase 2 separation improvements. Major work items for the 30 acre-foot basin are excavation, shoreline armoring and landscaping. An existing combined brick sewer which intersects the new pond will be rerouted around the new basin. Two junction chambers will be constructed to control the flow in and out of the detention basin.

Phase 3 Planning Level Cost Summary

1,000	72 inch Storm Sewer	$700	LF	$700,000
30	Basin Excavation	$20,000	ACRE-FEET	$600,000
1	Landscaping & Armoring	$125,000	LUMP SUM	$ 125,000
800	36 inch Sanitary Sewer	$125	LF	$100,000
2	Junction Chambers	$50,000	EACH	$100,000
	Subtotal			$1,625,000
	30% Contingency			$490,000
	PHASE 3 TOTAL			**$2,115,000**

PHASE 4 – NEW DETENTION POND AND STORMWATER TRUNKLINE TO SUGAR CREEK

Phase 4 creates a conveyance and storage network for Phase 3 improvements which discharges detained storm water from the Oakland Avenue watershed to Sugar Creek. Creating this link will divert approximately 200 Million Gallons of stormwater from the sanitary treatment facility annually. This link will also provide opportunities to intercept up to 1200 acres of other combined sewer watersheds downstream of the Oakland Avenue watershed. This creates potential for over 750 Million Gallons of stormwater that could be diverted from the sanitary treatment facility annually.

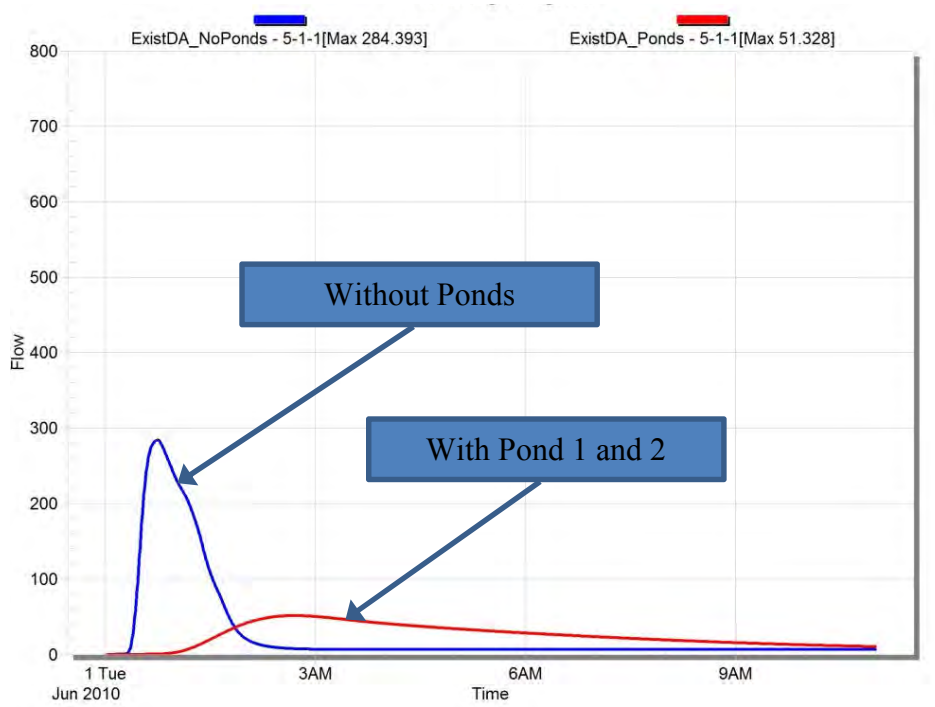
This new conveyance network outlets Pond 1 and follows along Constitution Trail to Pond 2 located at the current Nicor Gas site, currently undergoing remediation (see Figure 26). Pond 2 occupies approximately 9.2 acres, is 12 feet deep with a 5:1 side slope and provides approximately 51 acre-feet of storage. An engineered outlet control discharges the detained stormwater to the nearby triple 9 foot by 7 foot box culverts. One of the three box culverts will be converted to storm-sewer-only and flow directly to Sugar Creek.



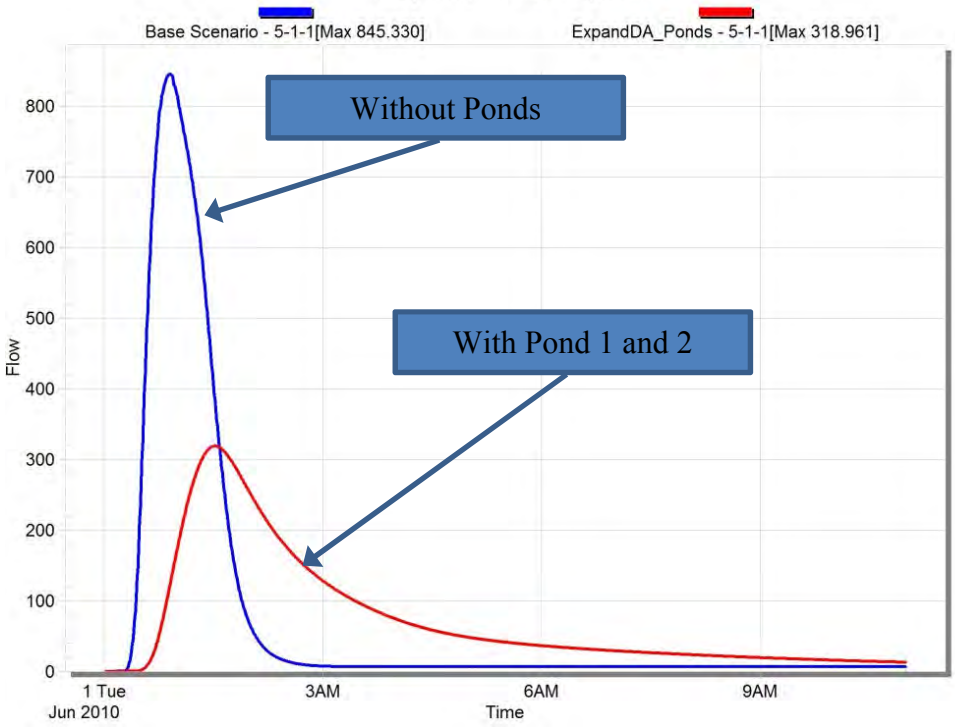
Figure 26 - Proposed Ponds and Conveyance Route

Phase 3 included accommodations for other upstream watersheds that could potentially enter Pond 1. Likewise, to plan for the future, Pond 2 includes accommodations for other city watersheds that naturally drain to it and could one day be separated and routed to and

through Pond 2. Figure 27 shows system discharge at the Pond 2 location with and without the ponds.



Existing Drainage Areas only



Expanded (Max. Potential) Drainage Area

Figure 27 - System Flows Adjacent to Sugar Creek

In addition to eliminating hundreds of millions of gallons of stormwater that would have passed through the sanitary treatment facility, the ponds greatly reduce the peak flows discharged to Sugar Creek.

Figure 27 illustrates the impact of peak flow reductions by the detention ponds. Through the use of an engineered outlet control, Pond 2 is able to reduce the peak discharge to Sugar Creek from the existing drainage areas from 284 cfs to 51 cfs.

If the additional potential watersheds are included, the peak flow to Sugar Creek is reduced from 845 CFS to 319 CFS.

Phase 4 Planning Level Cost Summary

6,000	48" RCP Storm Sewer	$150	LF	$900,000
51	Basin Excavation	$20,000	ACRE-FEET	$1,020,000
1	Landscaping and Armoring	$125,000	LUMP SUM	$125,000
3	Junction Chambers	$50,000	EACH	$150,000
	Subtotal			$2,195,000
	30% Contingency			$660,000
	PHASE 4 TOTAL			**$2,855,000**

SUMMARY

The Oakland Avenue watershed has the highest density of stormwater issues per acre in the City. The watershed was selected for further Hydraulic/Hydrologic analysis. XP-SWMM was used to build Hydraulic/Hydrologic models to facilitate this analysis. Problem areas identified in the model were compared to reported issues. Potential system improvements were modeled and analyzed. City staff requested the following potential improvements be included in the analysis:

1) Separation of combined sewers in the Oakland Avenue watershed
2) Construction of a stormwater outlet from the Oakland Avenue watershed to Sugar Creek
3) Construction of two detention basins along the stormwater outlet.

Phased improvements were identified and analyzed. The improvements are based on a series of four phases. Planning order costs for each improvement were prepared.

Phase 1 - smaller scale, localized improvements to the combined sewer system. These improvements include modifications to a weir junction chamber along Taylor Street, installation of storm sewers along McGregor Avenue, additional study of flooding at the intersection of Oakland Avenue and Meadows Avenue, and elimination of the CSOs along Maizefield Avenue at Kreitzer Avenue and Florence Avenue. These localized improvements are designed to mitigate current problems. Estimated cost of these improvements is $742,000.

Phase 2 - initiate sewer separation in the Oakland Avenue watershed. Reconfiguration of existing parallel relief combined sewers into dedicated storm sewers is proposed. The XP-SWMM model indicated that generally the existing relief sewers, if disconnected from the original combined sewer, would have capacity to adequately convey stormwater. The original combined sewer would then function as a sanitary sewer, greatly reducing basement sewer backups and combined sewer overflows. Phase 2 estimated cost to separate the trunklines (24” diameter and larger) is $3,354,000.

Phase 3 – construction of a storm sewer outlet and stormwater detention for the Phase 2 Oakland Avenue watershed sewer separation improvements. This detention basin, Pond 1, is to be located at the site of the City’s public works facility on the south side of the downtown area. These improvements will decrease upstream flooding and reduce the peak discharge from the Oakland Avenue watershed back into the undersized downstream combined sewers. Phase 3 estimated cost is $2,115,000.

Phase 4 – construction of a second detention basin, Pond 2, at the current Nicor Gas facility and a conveyance network along Constitution Trail from the Phase 3 detention basin (Pond 1) to Pond 2 and then on to Sugar Creek. This complete stormwater disconnection will divert an estimated 200 million gallons of stormwater per year from the treatment facility by discharging separated stormwater directly to Sugar Creek. Phase 4 estimated cost is $2,855,000.

Summary of Planning Level Costs for Phases 1 - 4	
Phase 1	$742,000
Phase 2	$3,354,000
Phase 3	$2,115,000
Phase 4	$2,855,000
Total	$9,066,000

Implementation of the four-phase sewer separation improvement plan outlined herein will reduce peak flows in the system, reduce peak discharges to Sugar Creek, mitigate basement flooding caused by sewer backups and reduce system flooding. Stormwater flows from the Oakland Avenue watershed, currently discharging to the sewage treatment facility, would be diverted away from the plant directly to Sugar Creek. Estimated total project cost is $9.1 million

ATTACHMENT 1

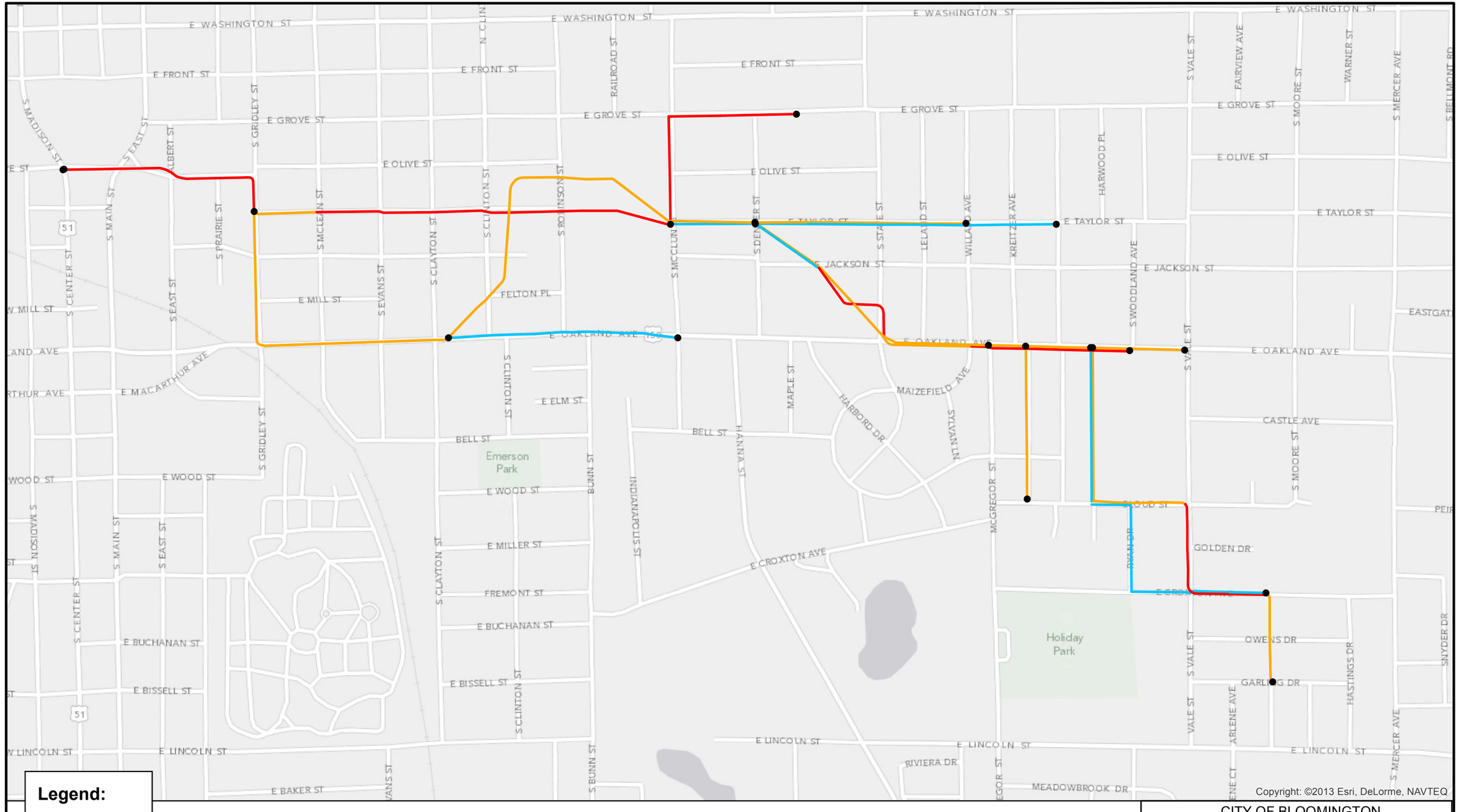
SUBWATERSHED DATA

Node Name	Area [ACRE]	Curve Number	Time of Concentration]min]	Max Flow [CFS]	Sanitary Inflow [CFS]
Node22	16.8	91	19.821	27.884	0
Node1	8.6	88	13.596	12.787	4.66
Node2	0	0	0	0	0
Node3	10	88	13.771	14.746	0
Node4	0	0	0	0	0
Node5	7.8	90	17.072	12.647	0.3
Node6	6.9	88	11.247	10.848	0
Node7	0	0	0	0	0
Node8	2.2	86	12.271	2.894	0
Node9	0	0	0	0	0
Node10	8.2	85	12.154	9.947	0
Node12	6.4	90	11.777	11.575	0
Node15	5.2	91	13.461	9.779	0
Node19	11.3	90	18.595	17.843	0
Node23	0	0	0	0	0
Node25	6.8	88	12.311	10.442	0
Node26	2	88	11.199	3.158	0
Node27	13.9	90	13.436	24.237	0.13
Node28	0	0	0	0	0
Node29	0	0	0	0	0
Node31	0	0	0	0	0
Node33	10.8	90	15.434	17.742	0
Node34	9.3	85	14.588	10.991	0.25
Node36	10.9	88	21.286	14.007	0
Node37	0	0	0	0	0
Node38	14.8	82	19.451	12.388	0
Node39	0	0	0	0	0
Node40	3.3	88	10.35	5.302	0
Node41	0	0	0	0	0
Node42	0	0	0	0	0
Node43	0	0	0	0	0
Node48	11.2	88	17.042	15.631	0.05
Node49	0	0	0	0	0
Node50	0	0	0	0	0
Oak_Mcgrg	4	88	14.887	5.845	0
Node52	4	88	16	5.687	0
Node53	0	0	0	0	0
Node54	0	0	0	0	0
Node57	0	0	0	0	0
Node58	0	0	0	0	0
Node59	7.4	78	34.579	3.507	0
Node61	5.8	80	27.189	3.637	0
Node63	0	0	0	0	0
Node64	40.5	83	24.266	33.897	0
Node69	0	0	0	0	0
Node71	10	81	18.064	7.862	0
Node72	0	0	0	0	0.15
Node73	0	0	0	0	0
Node74	0	0	0	0	0
Node75	2.8	81	17.318	2.236	0

Node Name	Area [ACRE]	Curve Number	Time of Concentration]min]	Max Flow [CFS]	Sanitary Inflow [CFS]
Node76	5.2	0.83	21.597	0	0
Node77	0	0	0	0	0
Node78	12.4	78	15	7.946	0.09
Node79	7	83	18.757	6.409	0
Node80	0	0	0	0	0.23
Node81	0	0	0	0	0
Node82	19.9	85	27.307	18.446	0
Node85	0	0	0	0	0
Node86	9.9	88	15.234	14.137	0
Node87	0	0	0	0	0
Node88	10.3	88	19.526	13.639	0
Node89	0	0	0	0	0
Node90	2.8	88	13.573	4.17	0.28
Node91	0	0	0	0	0
Node92	8.4	88	20.179	10.931	0
Node93	23.7	84	25.929	20.781	0
Node95	0	0	0	0	0
Node96	0	0	0	0	0.3
Node97	4.9	88	21.181	6.324	0
Node100	0	0	0	0	0
Node101	0	0	0	0	0.31
CSO-Mcgreg	0	80	22.62	6.952	0.1
Node105	7.3	83	19.324	6.603	0
Oak_Krtz	26	81	6.843	25.349	0.14
Node107	10.9	81	18.244	8.569	0.29
Node108	0	0	0	0	0
Node109	9.5	88	20.179	12.362	0
Node110	405.8	88	32.82	433.265	0
Node111	0	0	0	0	0.22
Node113	0	0	0	0	0
CSO-Kreitz	0	0	0	0	0
Node115	0	0	0	0	0.1
Node116	18.5	80	22.62	12.414	0.2
Node117	0	0	0	0	0
Node118	0	0	0	0	0
Node119	0	0	0	0	0
Node120	0	0	0	0	0
Node121	0	0	0	0	0

ATTACHMENT 2

EXISTING CONDITIONS – 20% EVENT



Legend:

Sewer Type

- Combination
- Sanitary
- Storm

NOTE: SEWER TYPES PER CITY DATABASE

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 200 400 600 800

Feet

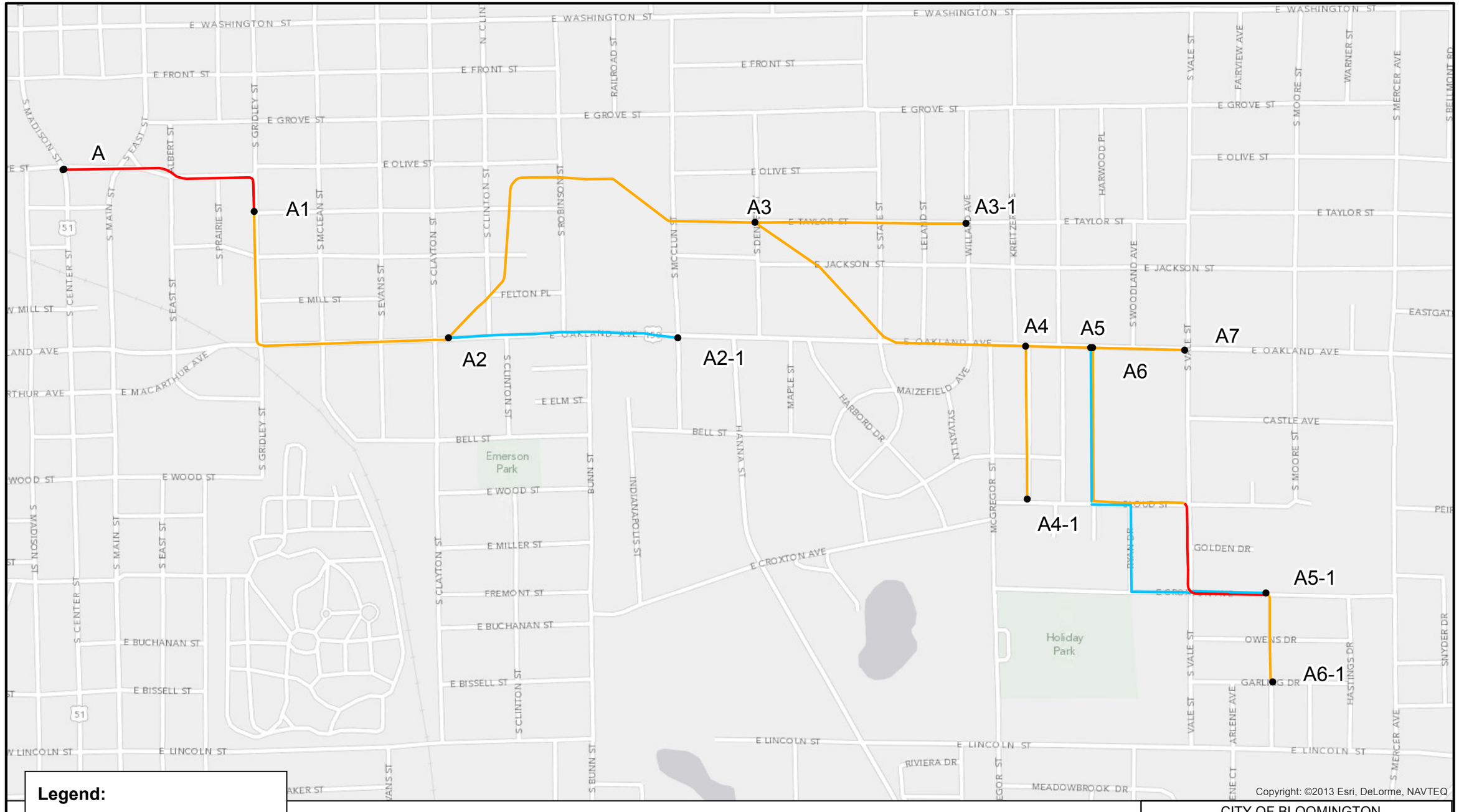
CITY OF BLOOMINGTON

ATTACHMENT 2.1

EXISTING SYSTEM
(ORIGINAL & RELIEF SEWERS)

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Attachment 2.mxd Date: 12/10/2013



Copyright: ©2013 Esri, DeLorme, NAVTEQ

Legend:

Sewer Type
- Combination
- Sanitary
- Storm

Structures
- Structure Name

NOTE: SEWER TYPES PER CITY DATABASE

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 200 400 600 800
Feet

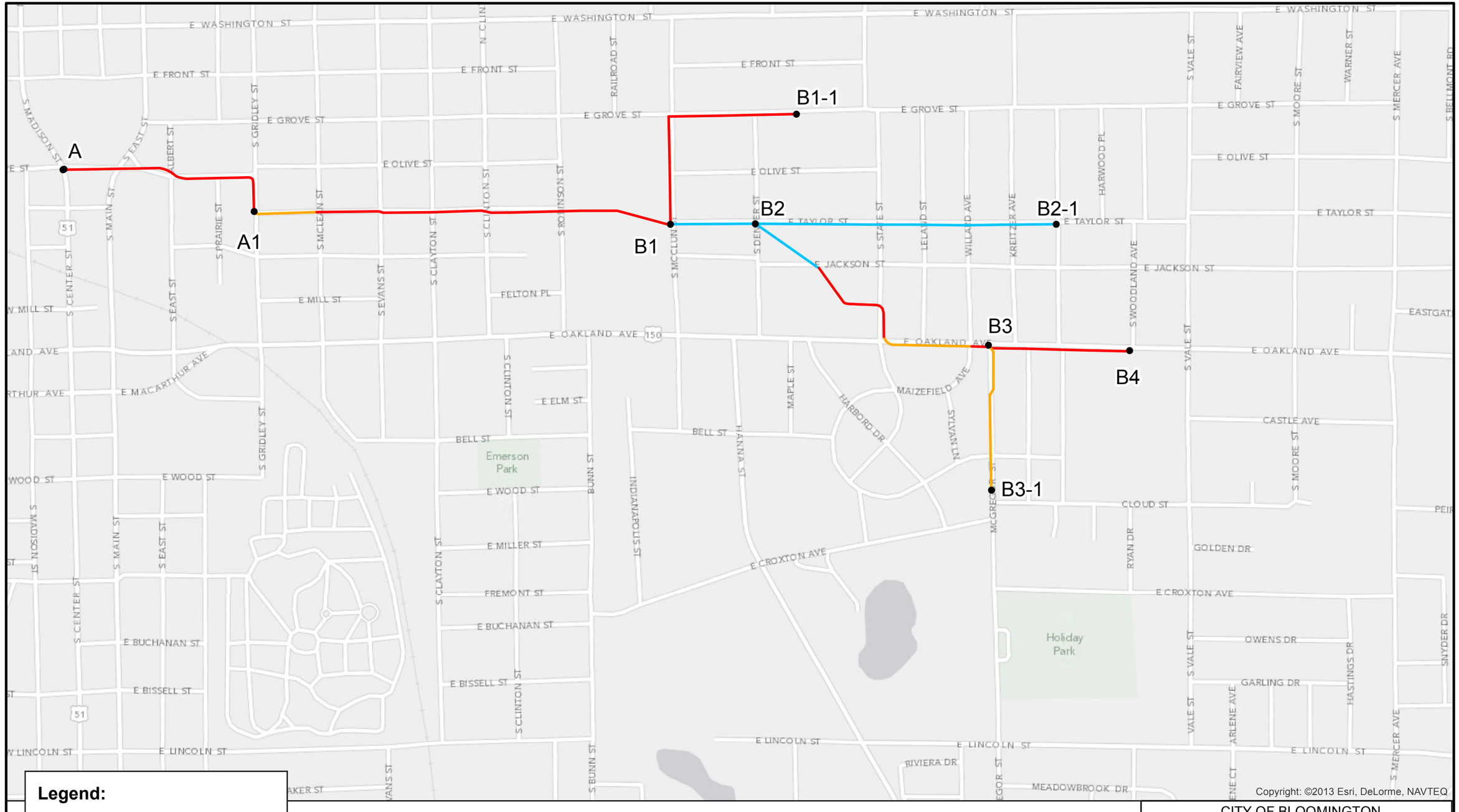
CITY OF BLOOMINGTON

ATTACHMENT 2.2

EXISTING SYSTEM
(ORIGINAL SEWERS)

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005

Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Attachment 2.mxd Date: 12/10/2013



Copyright: ©2013 Esri, DeLorme, NAVTEQ

Legend:

Sewer Type
- Storm
- Sanitary
- Combination

Structures
- Structure Name

NOTE: SEWER TYPES PER CITY DATABASE

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 200 400 600 800
Feet

CITY OF BLOOMINGTON

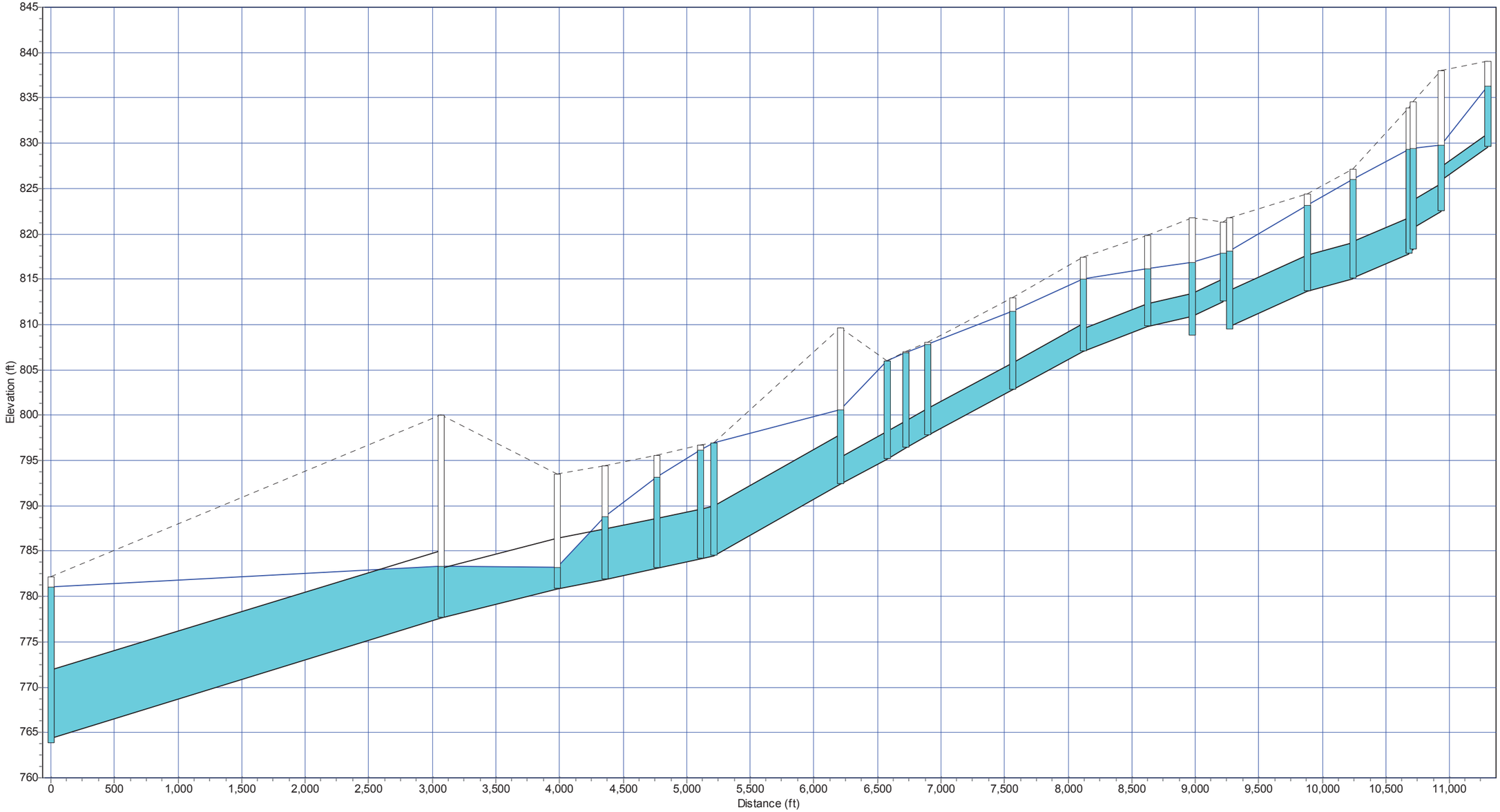
ATTACHMENT 2.3

EXISTING SYSTEM
(RELIEF SEWERS)

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005

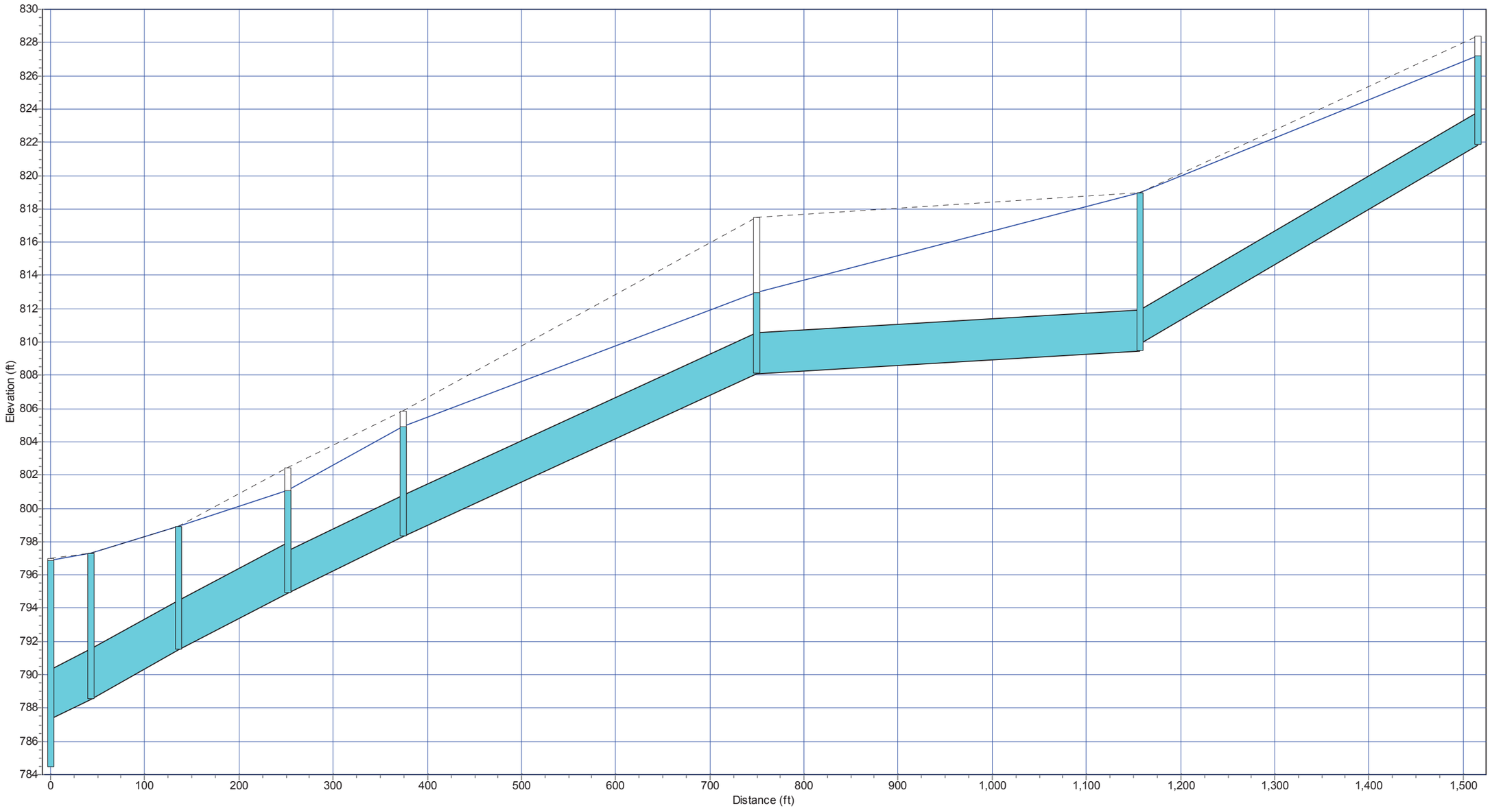
Path: X:\CH\IE\2012\12B005-00\GIS\MXD\Attachment 2.mxd Date: 12/10/2013

20% (5YR) HGL from A to A7



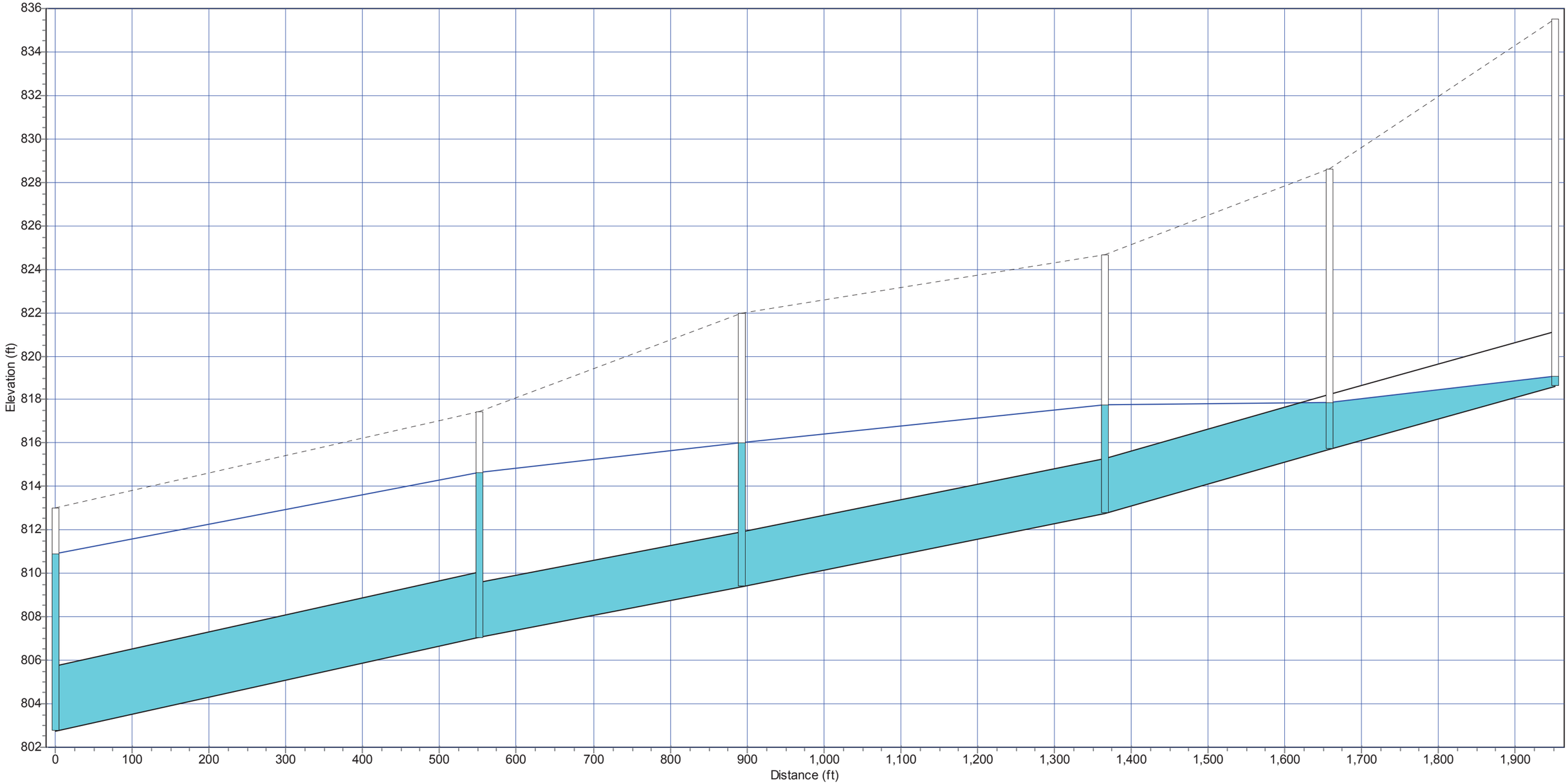
06/01/2010 00:29:40

20% (5YR) HGL from A2 to A2-1



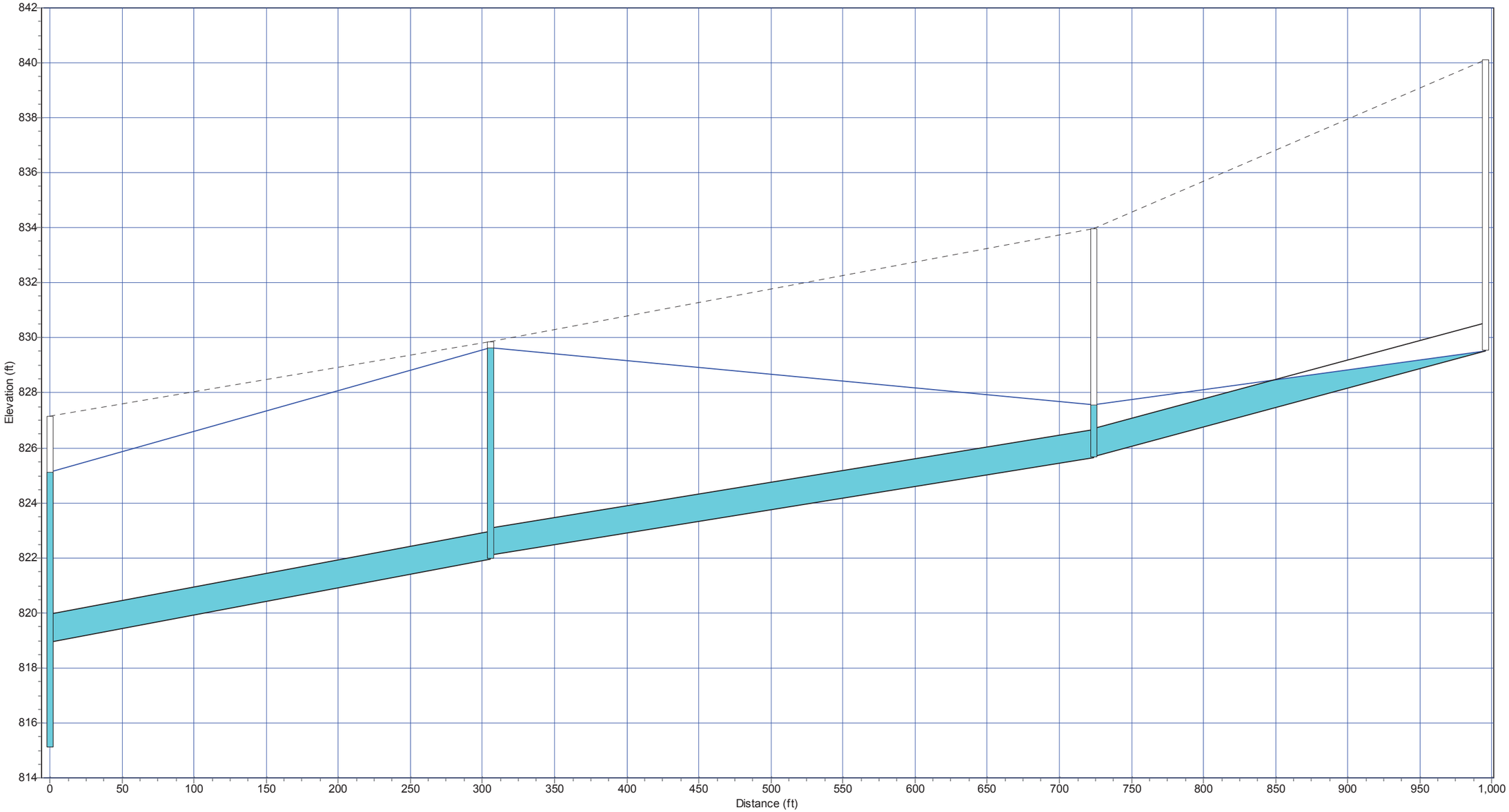
06/01/2010 00:32:40

20% (5YR) HGL from A3 to A3-1



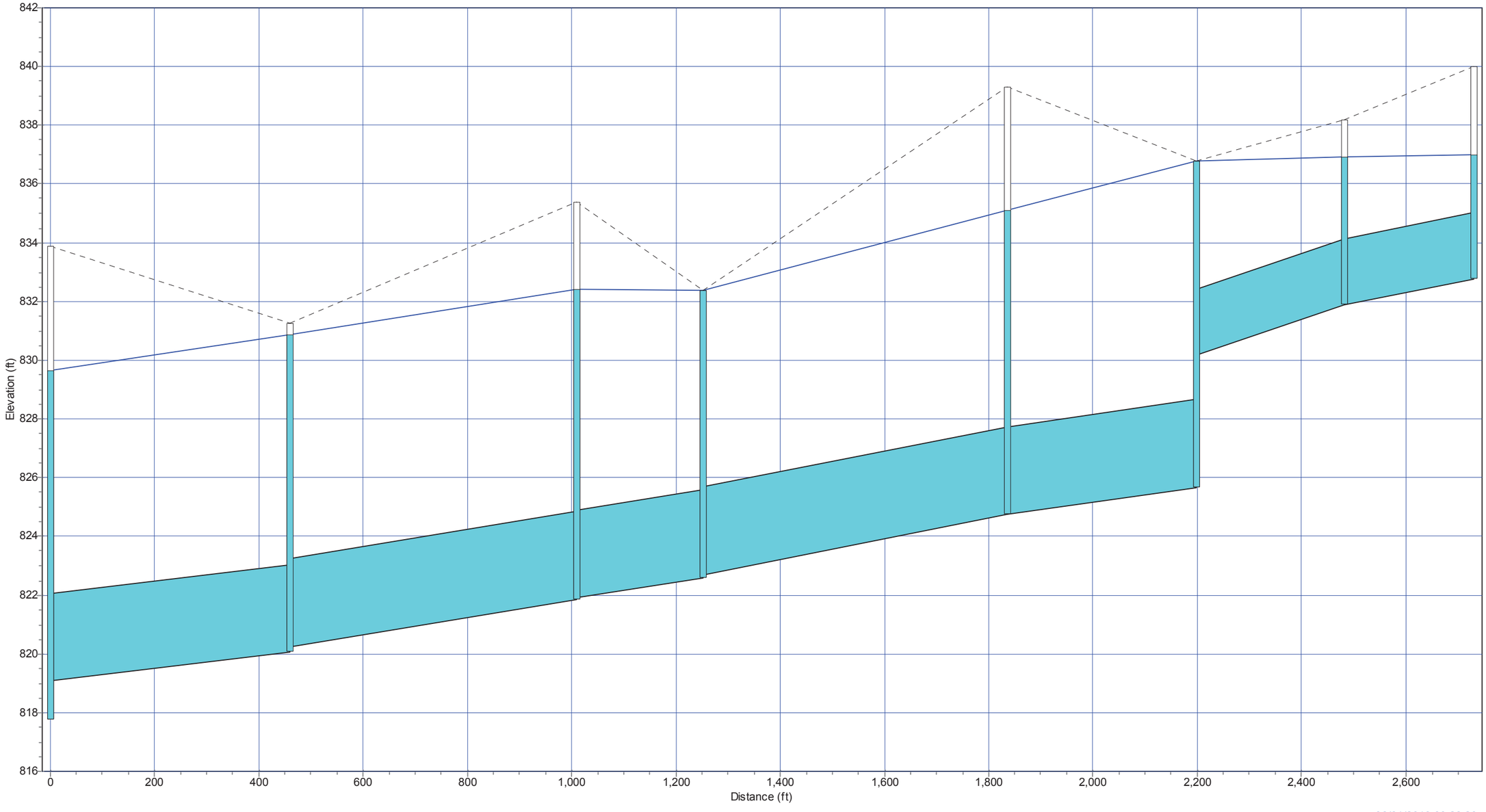
06/01/2010 00:23:40

20% (5YR) HGL from A4 to A4-1



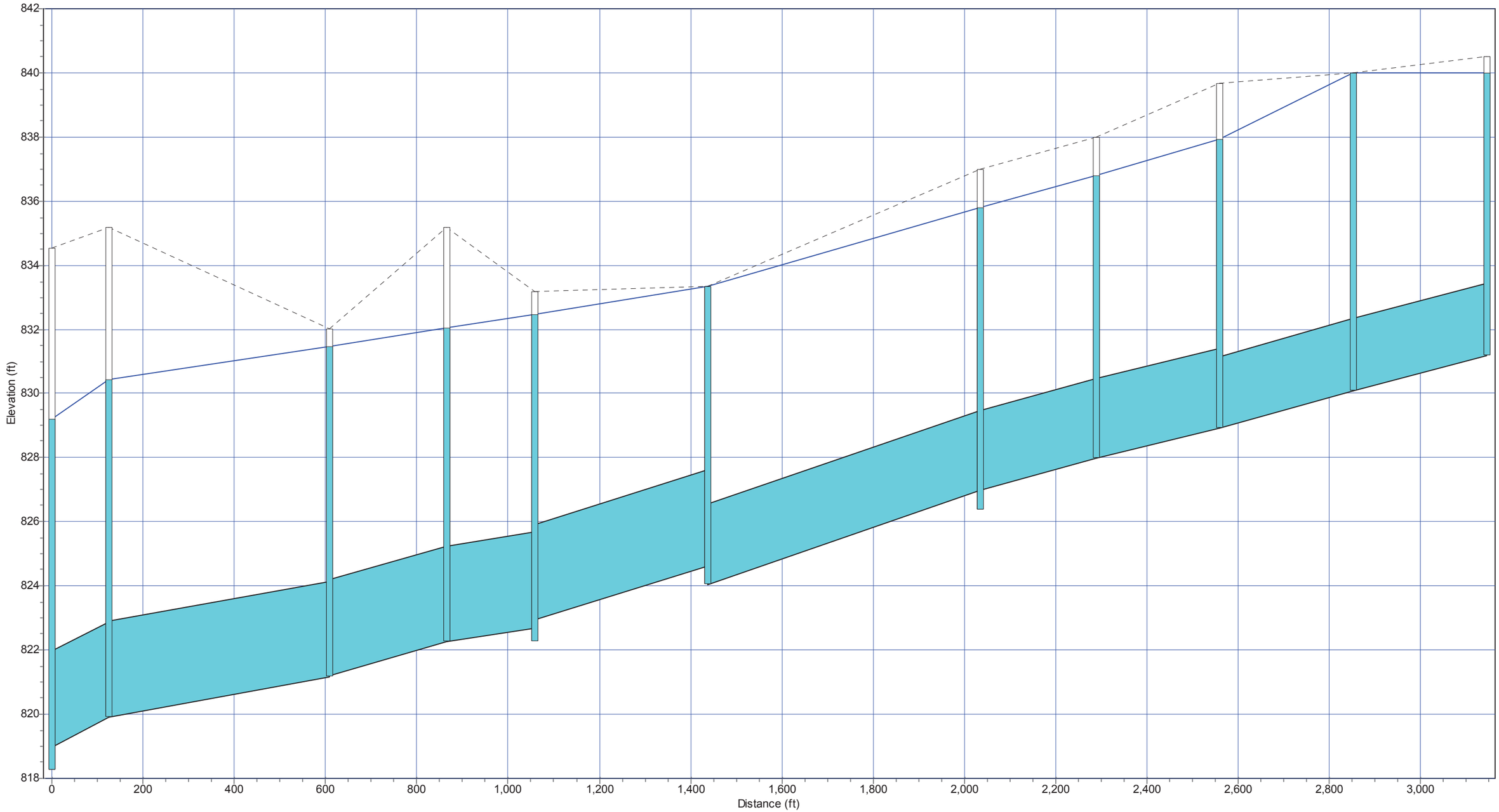
06/01/2010 00:17:00

20% (5YR) HGL from A5 to A5-1



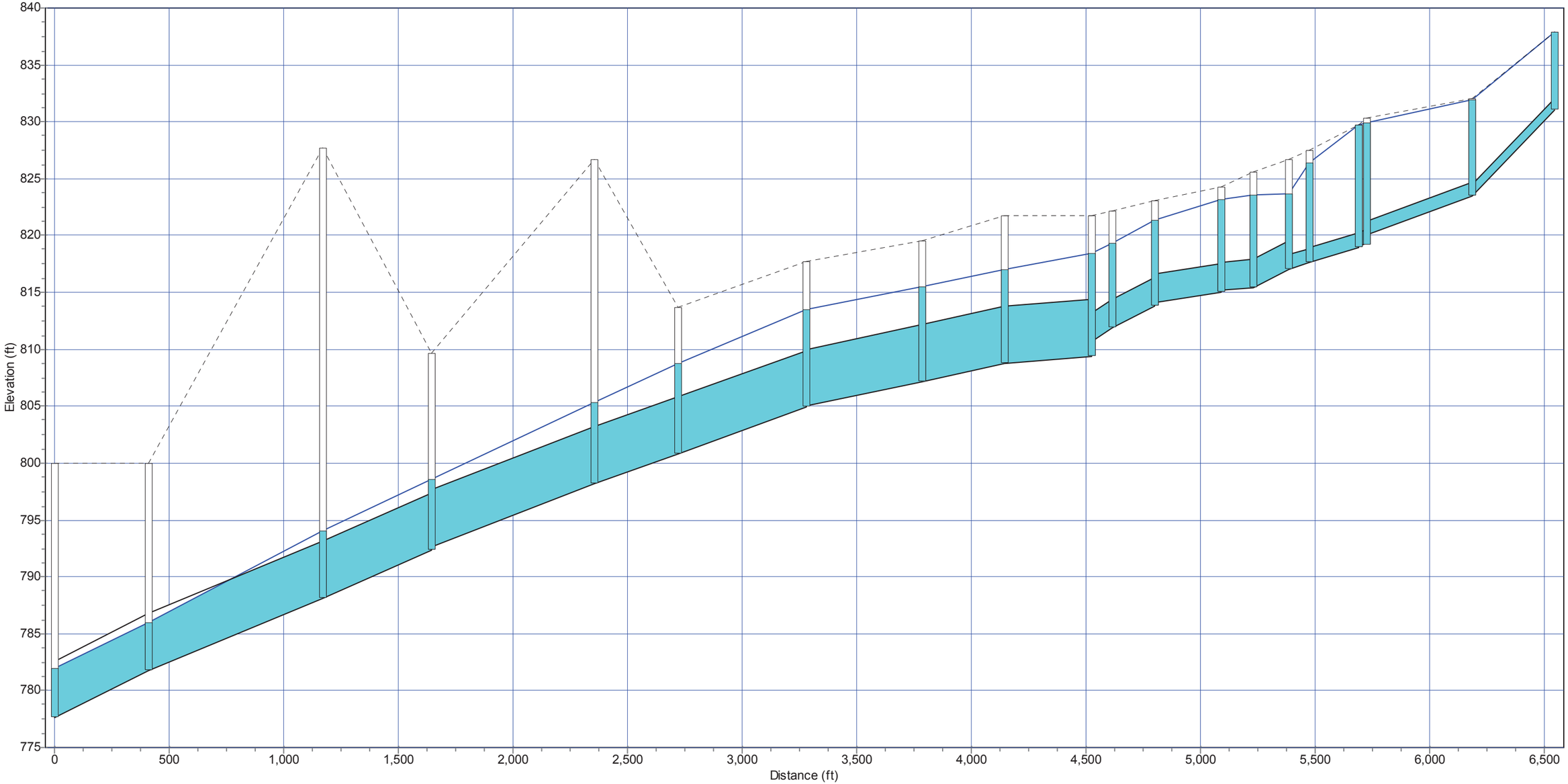
06/01/2010 00:23:20

20% (5YR) HGL from A6 to A6-1



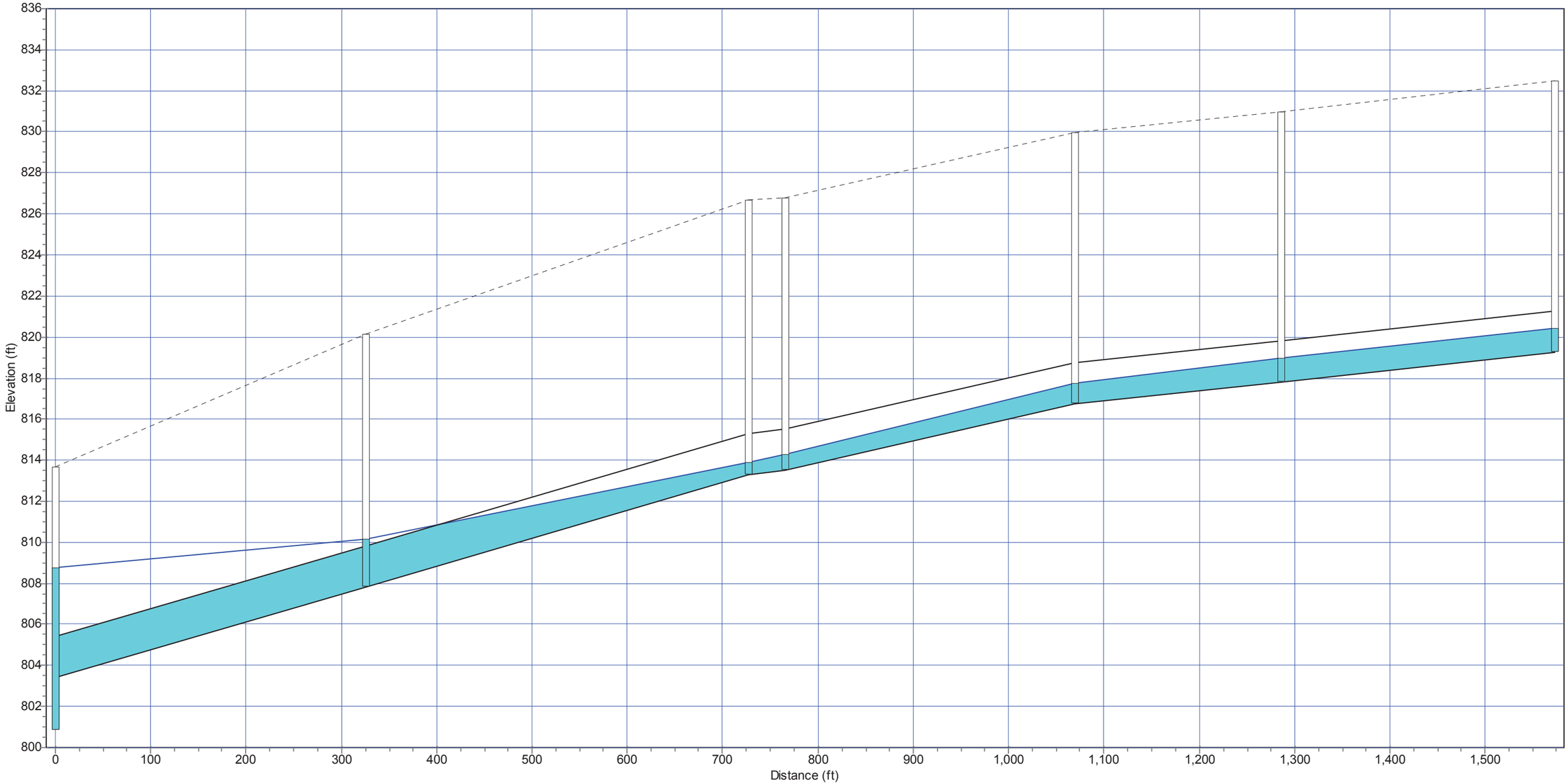
06/01/2010 00:16:50

20% (5YR) HGL from A1 to B4



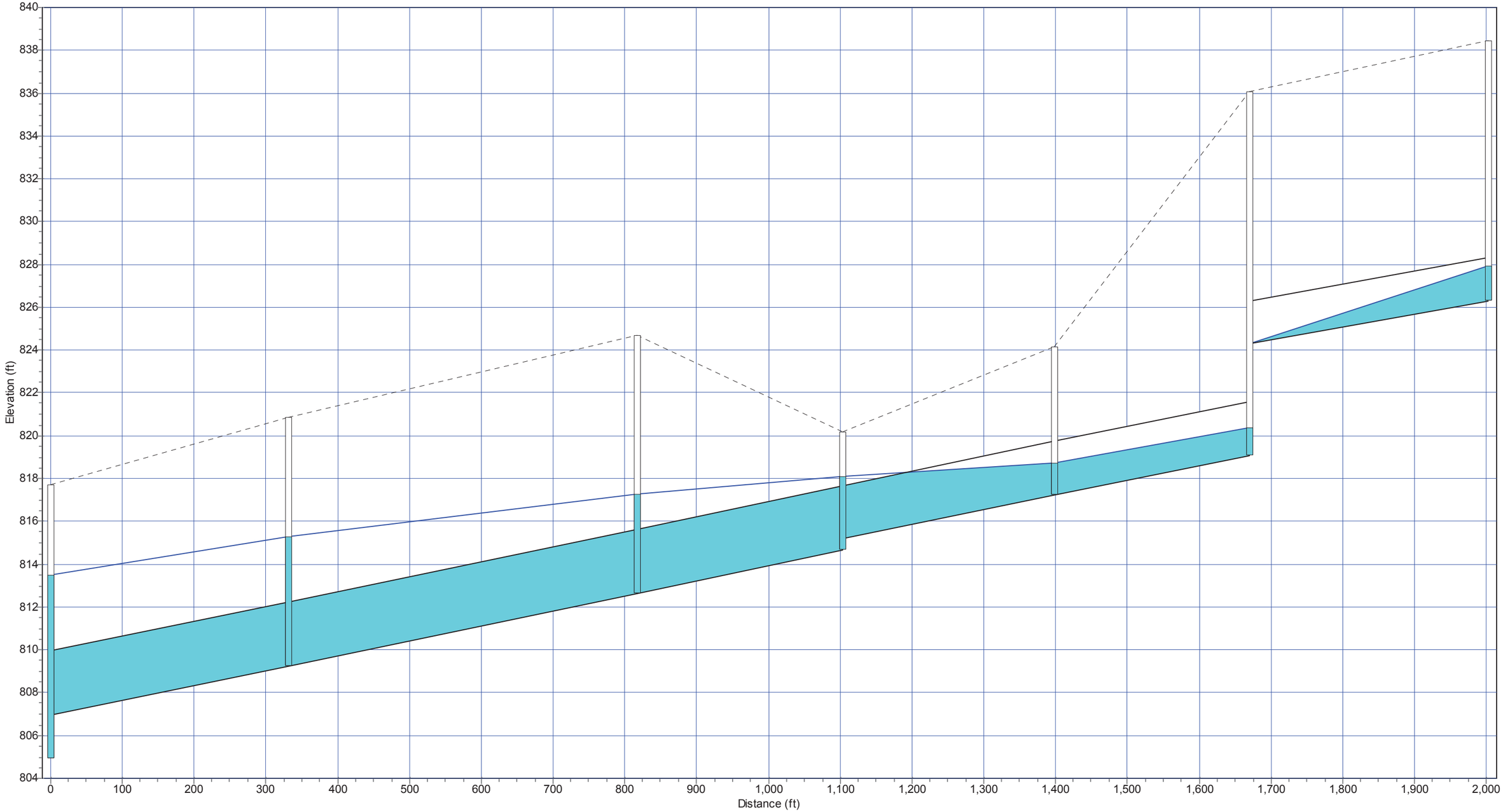
06/01/2010 00:26:00

20% (5YR) HGL from B1 to B1-1



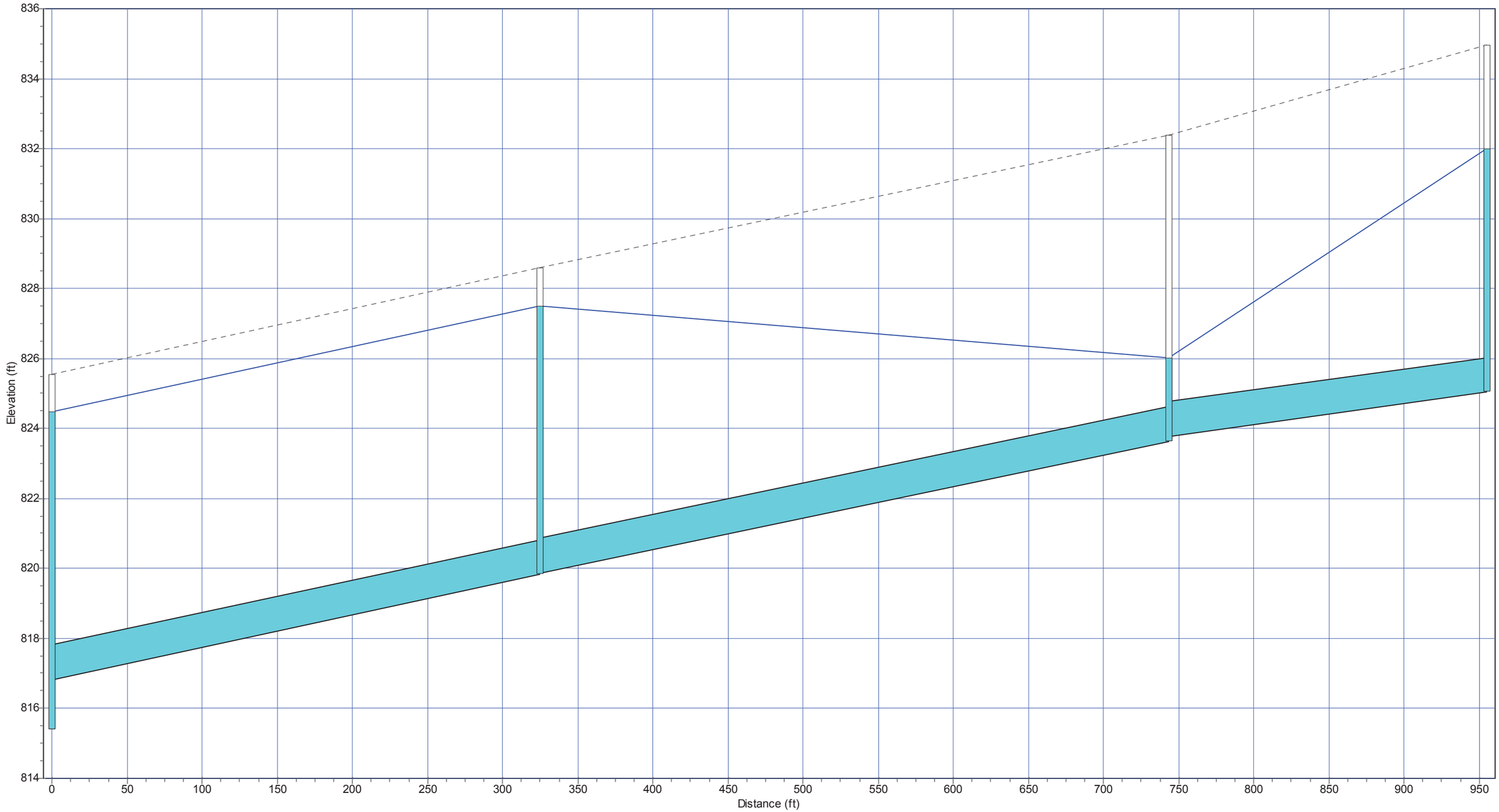
06/01/2010 00:26:00

20% (5YR) HGL from B2 to B2-1

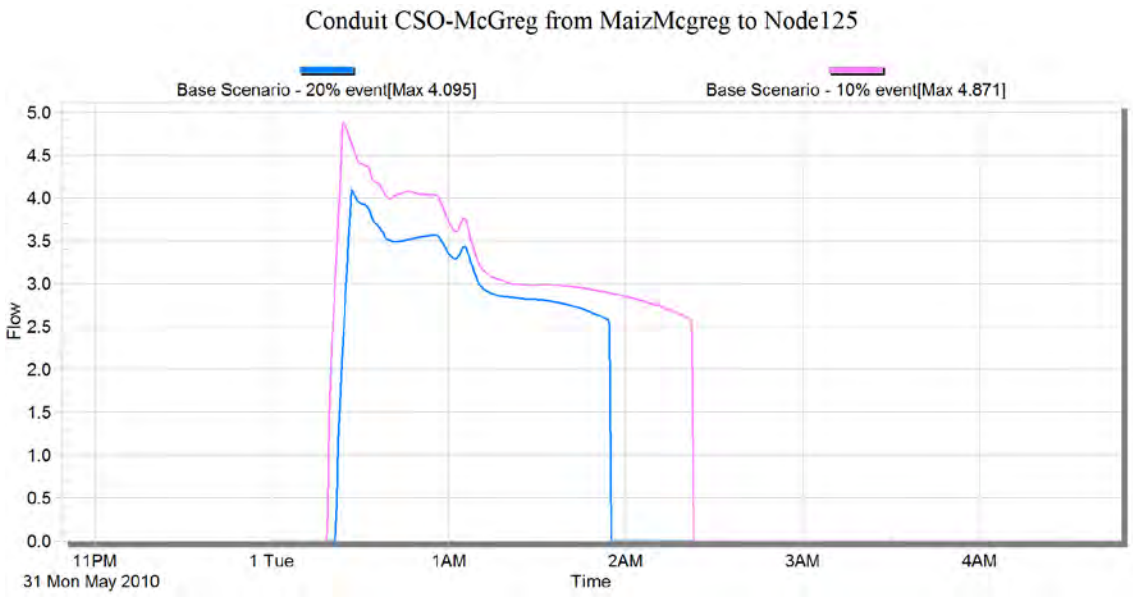


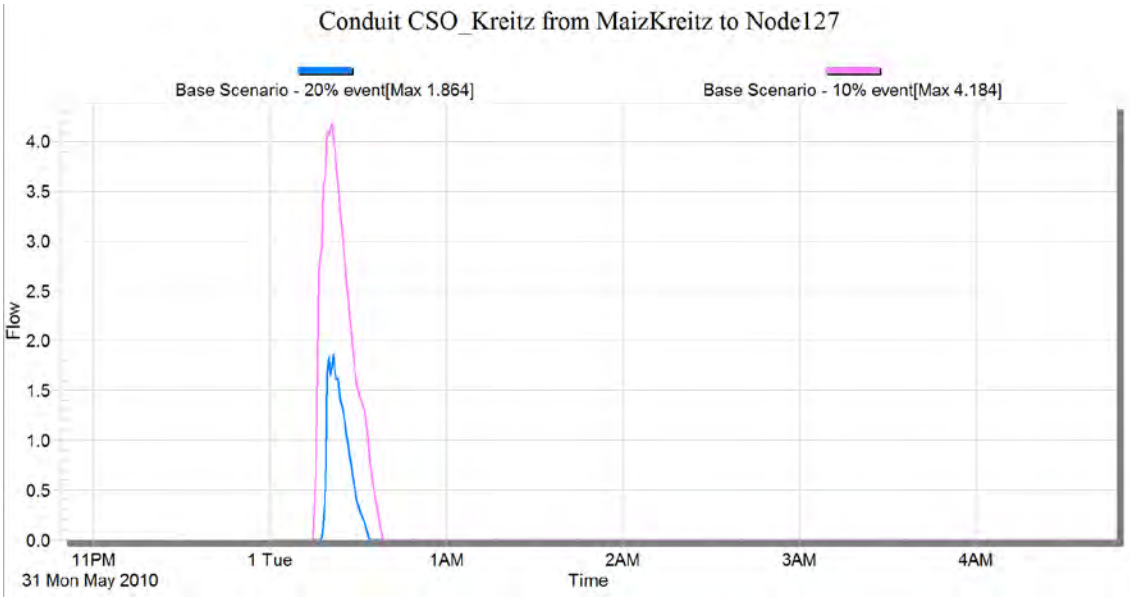
06/01/2010 00:25:30

20% (5YR) HGL from B3 to B3-1



06/01/2010 00:23:50





Attachment 2.19

CSO overflow rates at Maizefield Avenue

Stormwater Technical Memoranda

ST3 - STREAMBANK INVENTORY

STREAMBANK INVENTORY

EXECUTIVE SUMMARY

This summary serves as a companion document to the Streambank Inventory Technical Memorandum dated December 11, 2013, prepared by Foth for the City of Bloomington.

The South Branch Sugar Creek, Goose Creek, and Kickapoo Creek are major drainage ways within the City. These streams, together with other open channels, comprise approximately 59 miles. The City does not have an active inventory or assessment of these channels. Many channel reaches have received no maintenance, are experiencing moderate to severe erosion, and require rehabilitation.

This Memorandum summarizes findings from a pilot program undertaken to make an initial assessment of 4 miles of the City's channels using the Unified Stream Assessment (USA) method. Data collection and processing was streamlined using StreamSites, a proprietary web-based tablet application to store and analyze data in a GIS environment. Graphical and tabular summaries of channel ratings are presented. Recommended repairs and associated planning level cost estimates for two severely eroded channel reaches identified in the pilot program are outlined.

Key Findings

1. One-third (1/3) of channels assessed in the pilot program have eroded banks classified as "poor" or "severe" and are in need of rehabilitation.
2. In order to assess a variety of channels, some channel reaches with known problems were selected for the pilot program. The length of problem channel reaches selected for the pilot program may not be indicative of all problem channel reaches in the City. Therefore, extrapolation of data from the pilot program to all City channels may lead to erroneous estimates.

Recommendations

1. Expand the pilot program to create an initial assessment of all channels in the City. Use the assessment to prioritize channels requiring rehabilitation based on the severity of channel erosion.
2. Adopt a two trigger system (Static and Dynamic) to schedule periodic re-inspections.
3. Develop a Capital Improvement Plan for urban streams in the City based on a watershed approach. The Plan should include priorities based on the Unified Stream Assessment (USA) evaluations and include budgets based on incorporating the cost-effective rehabilitation options for each reach, including the evaluation of deploying BMP's in the contributing watershed.
4. Initiate early action repairs on two severely eroded channels identified in the Pilot Program along Sugar Creek and Little Kickapoo Creek (Brookridge Branch). Estimated rehabilitation cost is $2.5 million and $1 million respectively.

Date: December 11, 2013

To: Ryan Otto, PE, City of Bloomington, Illinois

From: J. Douglas Eppich, PhD, PE, Foth Infrastructure & Environment, LLC.
John Dabrowski, PE Foth Infrastructure & Environment, LLC.

Re: STREAMBANK INVENTORY

INTRODUCTION

The South Branch Sugar Creek, Goose Creek, and Kickapoo Creek flow through the City of Bloomington and serve as major drainage ways. Many reaches have not been subjected to a routine maintenance program. Some reaches are experiencing moderate to severe erosion and the City does not have an active inventory of the existing erosion.

The project team conducted a pilot program to make an objective assessment of selected reaches of the South Branch Sugar Creek, Goose Creek, and Kickapoo Creek. The Unified Stream Assessment Method (USA) is used for field reconnaissance; this method provides a template to assess a stream across eight separate components and compare sections based on individual components. StreamSites, a proprietary web-based computer tablet application, is used during the field survey assessment phase to streamline data collection and automate data processing.

By using the Unified Stream Assessment, a standardized base is set which allows streams throughout the City to be documented and compared to each other. This process is enhanced by entering field data into a georeferenced database and creating an active GIS based inventory. This inventory and unified assessment allows system conditions to be comprehensively analyzed and compared reach by reach. Priorities can then be established based on the assessments to assist prioritization of repairs and maintenance efforts.

Following the creation of a GIS based inventory, the project team makes recommendations for completion of the initial streambank assessment and ongoing inspection and documentation at pre-determined intervals. Additionally, a Capital Improvement Plan to repair those areas identified as experiencing severe erosion is prepared. This effort allows for integration of future inspection and maintenance needs with the City's CIP Planning and Maintenance Optimization.

METHODOLOGY

The Unified Stream Assessment (USA) Method was chosen with the understanding that the City intends to begin creating an inventory of its streams. This inventory allows the City staff to compare stream sections to determine stream sections (reaches) with the highest need for maintenance or repair. The USA method is the tenth manual in an eleven manual Urban Subwatershed Restoration Manual Series produced by the Center for Watershed Protection at the direction of the Office of Water Management U.S. Environmental Protection Agency.

The overall series was written to organize the vast amount of information needed to restore small urban watersheds. The contents of the eleven manuals are organized as follows:

- Manual 1: An Integrated Approach To Restore Small Urban Watersheds
- Manual 2: Methods To Develop Restoration Plans For Small Urban Watersheds
- Manual 3: Storm Water Retrofit Practices
- Manual 4: Urban Stream Repair Practices
- Manual 5: Riparian Management Practices
- Manual 6: Discharge Prevention Practices
- Manual 7: Watershed Forestry Practices
- Manual 8: Pollution Source Control Practices
- Manual 9: Municipal Practices And Programs
- **Manual 10: The Unified Stream Assessment (USA): A User's Manual**
- Manual 11: The Unified Subwatershed And Site Reconnaissance (USSR): A User's Manual

These manuals outline practices and approaches to complete and analyze assessments, and plan for restoration and maintenance to prevent urban stream degradation. This technical memorandum focuses on inventory and assessment of streams and therefore makes use of Manual 10. The USA is a rapid technique to locate and evaluate problems and restoration opportunities within the urban stream corridor. This user's guide describes means and methods to perform the assessment and interpret the data collected to determine the stream corridor restoration potential for the subwatershed.

To facilitate the analysis, he City's streams are divided into reaches. Each reach is assessed by the eight components below, which are then integrated into an overall reach assessment. Reaches throughout the City may then be compared by quantitative measures. The eight assessment components are:

1. Storm Water Outfalls
2. Severe Stream Erosion
3. Impacted Stream Buffers
4. Utilities in the Stream Corridor
5. Trash and Debris
6. Stream Crossings
7. Channel Modifications
8. Miscellaneous Features

Examples of these data assessment forms are found in Attachment 1.
StreamSites, a proprietary web-based computer tablet application based on the USA, was used to streamline data acquisition. Figures 1, 2 and 3 show typical screen shots of the application.

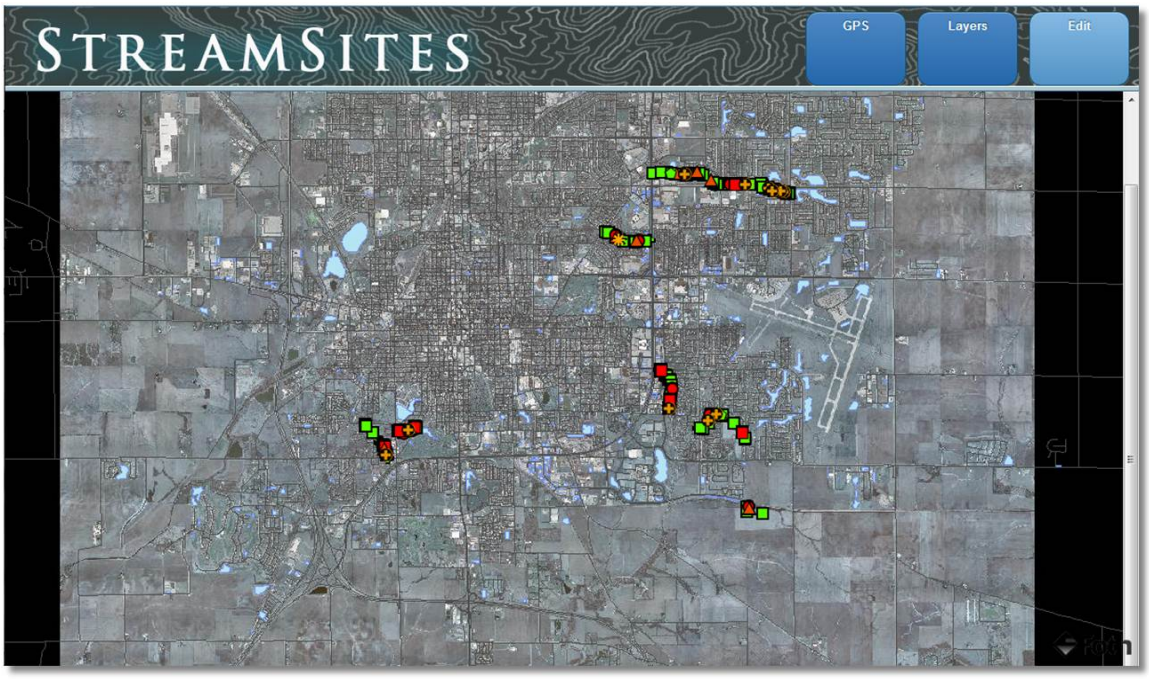


Figure 1 - StreamSites Main Screen

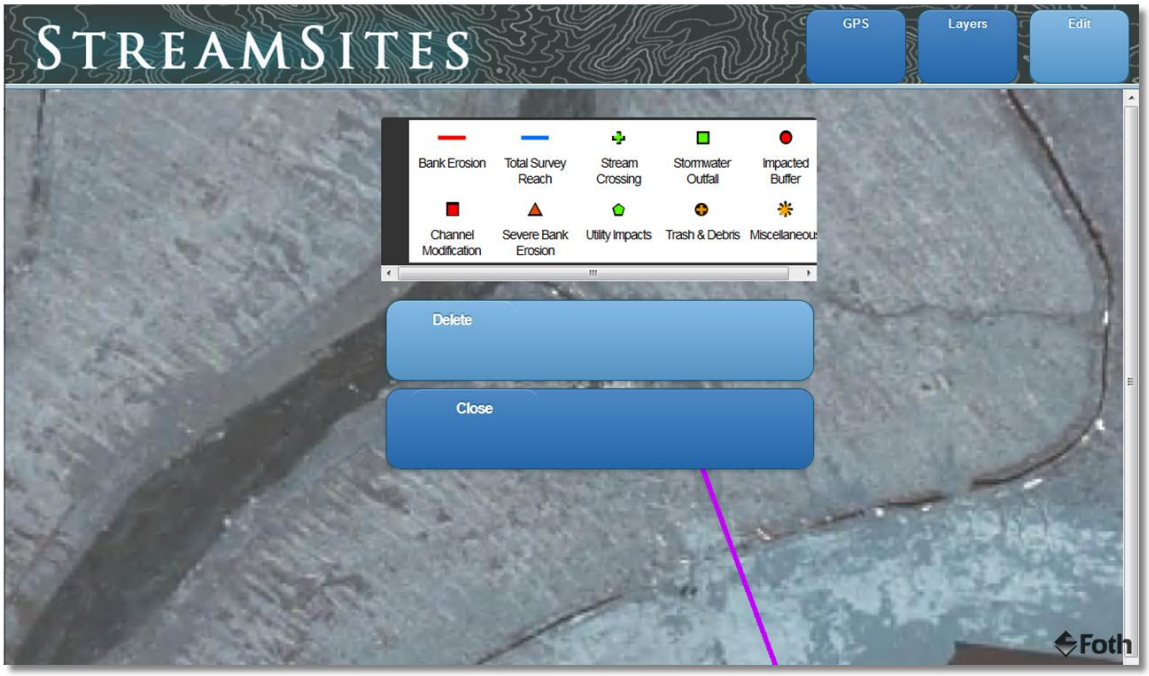


Figure 2 - Component Selection Screen

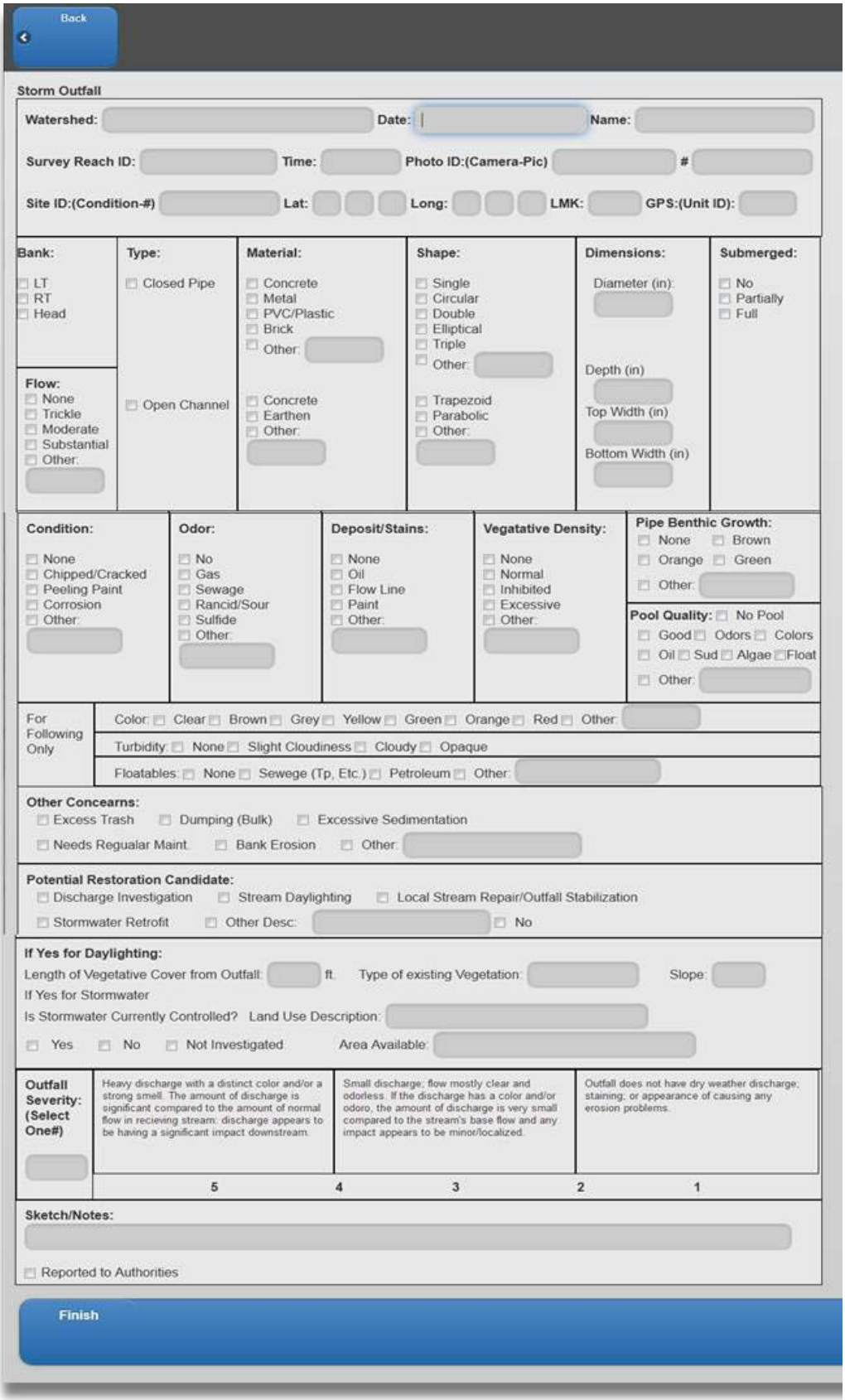


Figure 3 - Outfall Data Collection Sheet

Using StreamSites, the data is stored and processed on the web (cloud) in real-time, as it is collected, in a georeferenced database ready to be viewed in ArcGIS.

This georeferenced database is easily queried in ArcGIS by any collected attribute: size, status, rating, location, etc... This data can be viewed in graphical form to locate areas of severe need to assist with identifying and prioritizing where maintenance and repair funds are needed.

Each measured component is displayed in ArcGIS and color coded according to its scored rating. Figure 4 displays an example of a surveyed section, as seen in ArcGIS. The data can also be viewed and sorted in tabular form by rating or location to assist with the analysis.

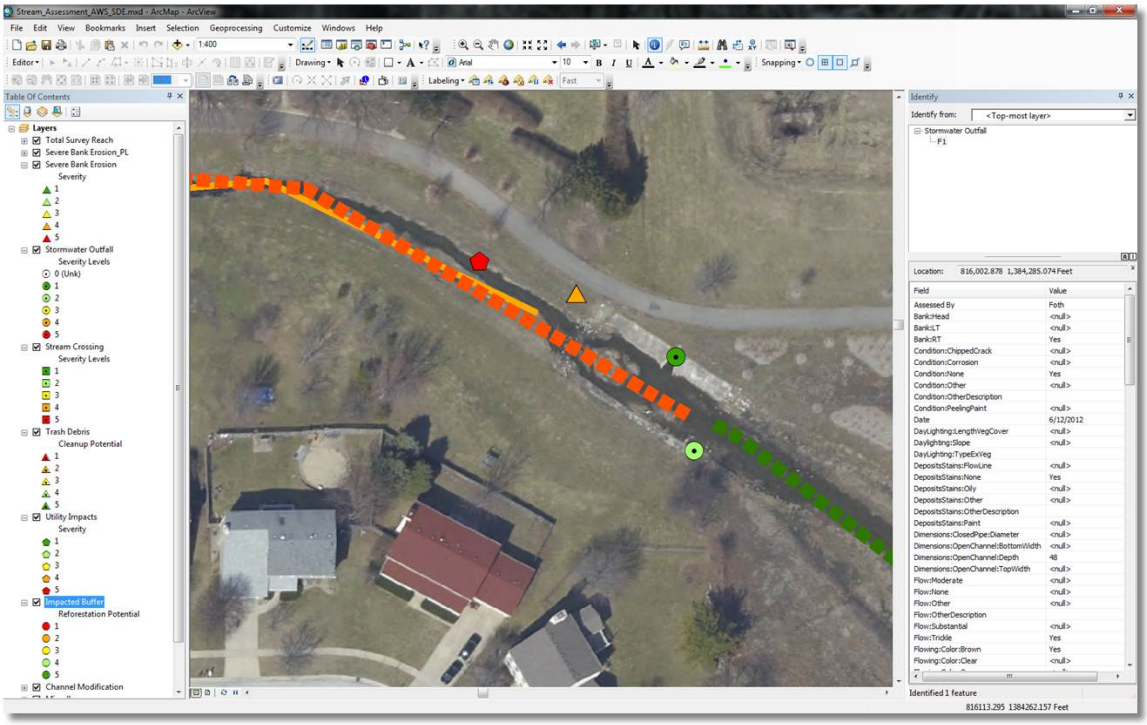


Figure 4 - View of Collected Data in ArcGIS

ANALYSIS

An initial evaluation and assessment of all streams within the City was beyond the scope of this project. City staff therefore identified and prioritized stream sections (reaches) for inclusion in a pilot study for initial assessment. These stream reaches are shown in Attachment 2. They include sections with known problems and a representative sample of other sections with the variety of conditions that are typically found within the City limits. These conditions included good quality prairie streams, highly eroded streams and concrete lined urban streams. The range of collected data is intended to serve as an example for future collections.

A complete Unified Stream Assessment was performed on the selected stream sections. Data for the eight components below was collected for each reach. Each section was divided into manageable reaches per the Unified Stream Assessment method. Bank erosion severity, number of severe outfalls and other severe components each reach are summarized below and in Attachment 2. Attachment 3 included examples of geo-referenced photos taken during the assessment.

Section/ *Reach*	Reach Length (ft.)	Reach Score	Erosion Severity	Length of Severe Erosion* (ft.)	Outfall Severity	Number of Severe Outfalls*	Other Severe Components*,**
1 *1*	670	143	0				
1 *2*	1260	142	0				
1 *3*	1970	37	4	1,800	5	2	4
2 *1*	2780	26	0				
3 *1*	410	105	0				3, 5
3 *2*	270	55	3				7
3 *3*	350	82	0		4	1	7
4 *1*	1460	53	2				3, 5, 6, 7
5 *1*	1550	69	3				5, 6
5 *2*	1210	59	3		5	1	3
6 *1*	1730	73	3				6
6 *2*	2540	53	5	2,210	5	1	7
6 *3*	2210	86	4	650			
6 *4*	2030	58	4	1,950	4	1	
Total	20440			6610			

* Severe is defined as receiving either a rating of “poor” or “extreme”
** 3-Impacted Buffers, 4-Utilities In The Stream Corridor, 5- Trash And Debris, 6-Stream Crossings, 7-Channel Modifications, 8-Miscellaneous Features

Watershed Section F6 Reach 2 and Watershed Section F1 Reach were found to have severe erosion problems. An interpretative analysis of each reach was made using the collected field data and model results to provide the City with indicator causes for the observed problems and to provide a basis for the recommend improvements to each reach discussed in the recommendations section of this report.

1. *Watershed F6 Reach 2*

This reach of Sugar Creek is located along the north side of General Electric Road from Hershey Road, extending upstream approximately 2,300 feet to a culvert that conveys the stream under General Electric Road. (See Figure 5) This reach exhibited severe bank erosion, the only reach with a five (severe) rating of the streams inventoried in the pilot study. The extreme bank erosion is threatening the integrity of the adjacent Constitution Trail.



Figure 5 - Sugar Creek Severe Erosion

This reach is experiencing limited down-cutting due to bed scour, since the channel bed is grade controlled by concrete bottom culverts at the upstream and downstream ends of the reach (crossing at Hershey Drive and at General Electric Road). In several locations along this reach, the shear bank resulting from erosion is beginning to undermine sections of the pedestrian/bike path (Constitutional Trail) along General Electric Road creating a safety hazard. The channel section was constructed as a trapezoidal channel with limited cross sectional area for the required conveyance and poor connectivity to the flood plain.

Hydraulic modeling of this reach showed typical peak water velocities in the range of 6 to 7 feet per second (fps) for significant floods from the 1-year event up to the 100-year flood. The tributary watershed is substantially developed with detention basins. The detention basins limit peak flows and prevent flooding of adjoining properties. However, they also extend the duration of the flood flows in the channel and do not reduce the flood flow velocities enough to prevent channel erosion and degradation.

The trapezoidal channel section in this reach is typically found in mountain stream reaches where the channel either erodes to bedrock or becomes bedded and lined with natural rock materials before becoming stable. The channel section in this reach is essentially bare earth and easily eroded.

The analysis showed insufficient area to engineer sustainable meanders in the channel. However, there is area available to widen the channel in order to provide the required conveyance with lower and less erosive velocities. The analysis also showed that, in addition to widening, armoring of the channel bed and banks would be required prevent future erosion problems. Channel improvements based on creating a two-stage channel is proposed and further discussed in the recommendations section.

2. *Watershed F1 Reach 3*

This reach of Little Kickapoo Creek (Brookridge Branch) extends east from Lincoln Avenue approximately 1,820 feet to the outlet of the Oakridge Subdivision Detention Basin. (See Figure 6) This reach is one of several that has a "poor" (4 out of 5) bank erosion ranking. The reach is easily accessed and highly visible along a popular park pathway.

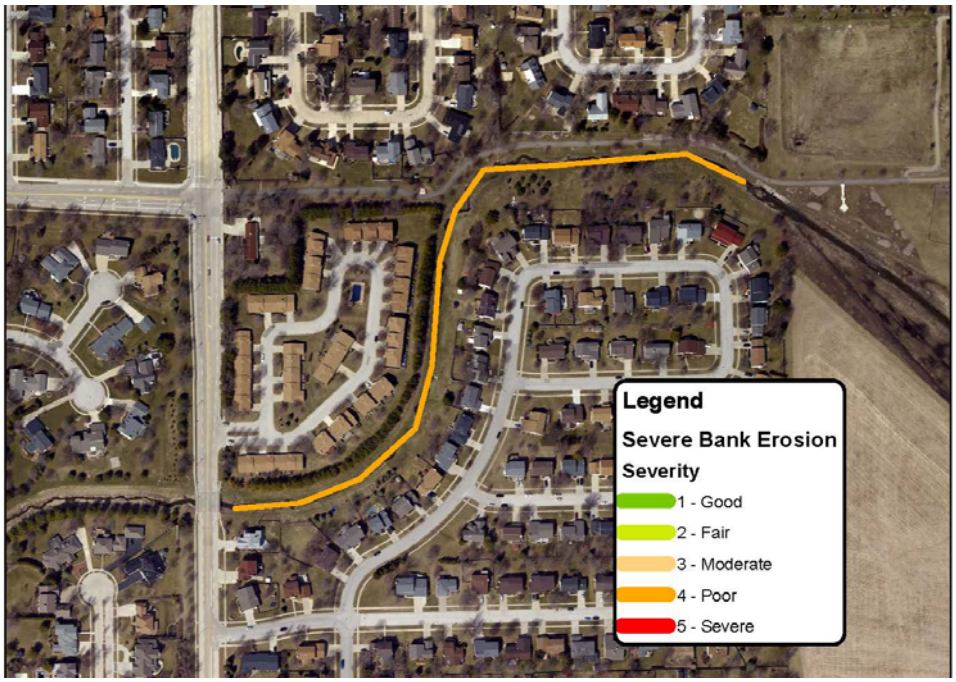


Figure 6 - Kickapoo Creek Severe Erosion

This reach appears to have been reconstructed into a straight to gradually curving channel to align with adjacent planned neighborhood development. The channel is attempting to reform into a meandering channel typical of Illinois prairie streams. However, the channel bed is incising due to bed scour. This incising has reduced the connectivity of the channel bed with its already limited flood plain, causing yet higher velocities and exacerbating the bank and bed erosion. The attempted re-meander process also increases bank erosion along the outer stretches of the meanders. Adjacent utilities, especially sanitary sewers, may be impacted if the erosion is allowed to continue.

Much of the tributary watershed is parkland or larger lot residential development and, as such, does not produce the higher peak flood flows that require more engineered structured stability improvements. The analysis indicates that a naturalized meandering stream channel could be stable in this reach. Re-establishing a natural stream meander pattern with appropriate geometry would reduce the tendency of the present stream to migrate. By raising the present incised channel bed to more closely approximate the historic channel bed profile, the channel could also be better connected to adjoining floodplain.

RECOMMENDATIONS

1. COMPLETE INITIAL ASSESSMENTS OF ALL OPEN CHANNELS

The pilot program to inventory and assess channels covered 4 miles of the City's 59 miles of channels. To identify and prioritize future channel remediation and repairs, it is recommended that the City complete the inventory and assessment for all 59 channel-miles within the City limits.

For safety and logistical reasons, the USA requires a minimum two-person crew. Crew members should be trained in using the USA, and be able to recognize impacted sites, assess average reach conditions, and envision the typical restoration techniques employed in those conditions. Specific knowledge of native flora, common invasive plants, and stream geomorphology are helpful, but not essential. The estimated time for an experienced two-person crew to complete this initial inventory is 60 crew-days.

2. RE-INSPECT CHANNELS AT PLANNED INTERVALS

Re-inspection is necessary to monitor stream health and condition changes. Waterways naturally morph overtime, especially when all the elements of an urban watershed are considered. These changes can be seen through re-inspection of the stream network at optimum intervals. The use of two triggers for re-inspections, a static trigger and a dynamic trigger, is recommended. If either trigger is activated for a reach, a full USA re-inspection of the reach is required.

The Static Inspection Trigger is based on the bank erosion rating score:

Bank Erosion Rating Score:	**1**	**2-3**	**4**	**5**
Re-Inspection Interval [years]:	**10**	**5**	**2**	**!**

! Immediate Improvements Recommended

These intervals are minimum inspection frequency; additional inspections can be beneficial, especially if new bank or bed erosion areas have been discovered.

The Dynamic Inspection Trigger is based on upstream development and/or diversions. The effects of alterations to the upstream watershed are often seen in the form of increased stream bank or bed erosion. Therefore, it is necessary to monitor streams after threshold projects.

A development or diversion project that affects 5% or more of its containing watershed will require a stream inspection prior to construction and again 5 years following completion of construction. This before and after inspection helps to identify responsible parties for mitigating negative effects to a stream due to urbanization and reduction in impervious surfaces.

3. DEVELOP A CAPITAL IMPROVEMENT PLAN

Frequently, poor conditions along stream reaches are attributable to poorly controlled upstream run-off conditions. The recommended approach for developing a capital improvement plan based on sustainable stream solutions is to first address the cause of the problem on a watershed or sub-watershed basis. To do so, it is recommended that the contributing drainage area first be evaluated to assess if structural Best Management Practices can be cost-effectively deployed to mitigate the stream problems. Examples of structural BMPs that can significantly impact runoff include detention basins, vegetated swales or ditches, catch basin inlet devices and ditch checks. While localized repairs to undermined outlet structures and culverts may be unavoidable, extensive stream rehabilitation should be initiated only when the addition of structural BMP's is considered not cost-effective.

The recommended actions proposed to develop a Capital Improvement Plan (CIP) for urban streams in the City are as follows:

1. Complete the stream assessment for all streams in the City's network using the Unified Stream Assessment Methodology rating system begun in the pilot program.
2. Prioritize remediation of stream reaches based on completed stream reach assessments.
3. Using the completed stream assessments to prepare planning level cost estimates for stream rehabilitation on a reach by reach basis for the identified higher priority streams.
4. Similarly, using the completed assessments for outfalls, prepare planning level cost estimates for outfall rehabilitation for the higher priority outfalls.
5. Using the planning level costs established for stream repairs, evaluate if structural Best Management Practices (BMP's), either alone or in combination with minor stream improvements, can be cost-effectively applied within the contributing watershed to mitigate the stream problems.
6. Prepare a Capital Improvement Plan incorporating priorities based on the completed Unified Stream Assessment. Include budgets based on incorporating the cost-effective rehabilitation options for each reach.

4. EARLY ACTION REPAIRS

1. Watershed F6 Reach 2

This channel has been previously engineered to be straight and deep section. While the naturalized channel as illustrated on Figure 6 of the *Greenways Plan and Sustainable Design Initiatives Technical Memorandum* is the desirable state for channels of this size, many factors specific to this reach greatly reduce remediation practice options at this

location. Detention basins with controlled outflows result in prolonged erosive flows after a significant event. The channel is confined on the south by a straight section of Constitutional Trail paralleling G.E. Road, and on the north by rear yards of residences. Insufficient area is available to add natural energy dissipaters, such as meanders or floodplain connections. Repairs must be designed to fit within the physical constraints of the stream.

Armored banks are required, especially the south bank adjacent to the trail. The near vertical slopes on this bank, which are over 10 feet high, require solutions based on structural retaining walls. Typical options include driven sheet piling, mechanically stabilized earth (MSE) walls using vegetated bags, and stacked gabion baskets. Gabion baskets will be used in this early action plan to establish planning level cost estimates. Gabion baskets are rock-filled wire mesh cages which are stacked to form a wall or steep slope. In addition to a semi-natural appearance, the gabion baskets are sustainable, more durable than vegetated bag MSE walls, and are historically cost-effective to construct and maintain.

Large stones or reinforced mattresses, such as concrete revetment mattresses, are placed to establish an armored base flow channel. The base flow channel is narrower than the overall channel width, reducing the quantity of bed armor necessary. A wider overflow flood channel is established above the base channel, creating a small floodplain. The flood channel is widened to the full width of the right of way, allowing for the slope to existing grade. The bed of the flood channel consists of vegetative growth. Figure 7 depicts a schematic cross section of the recommended channel.

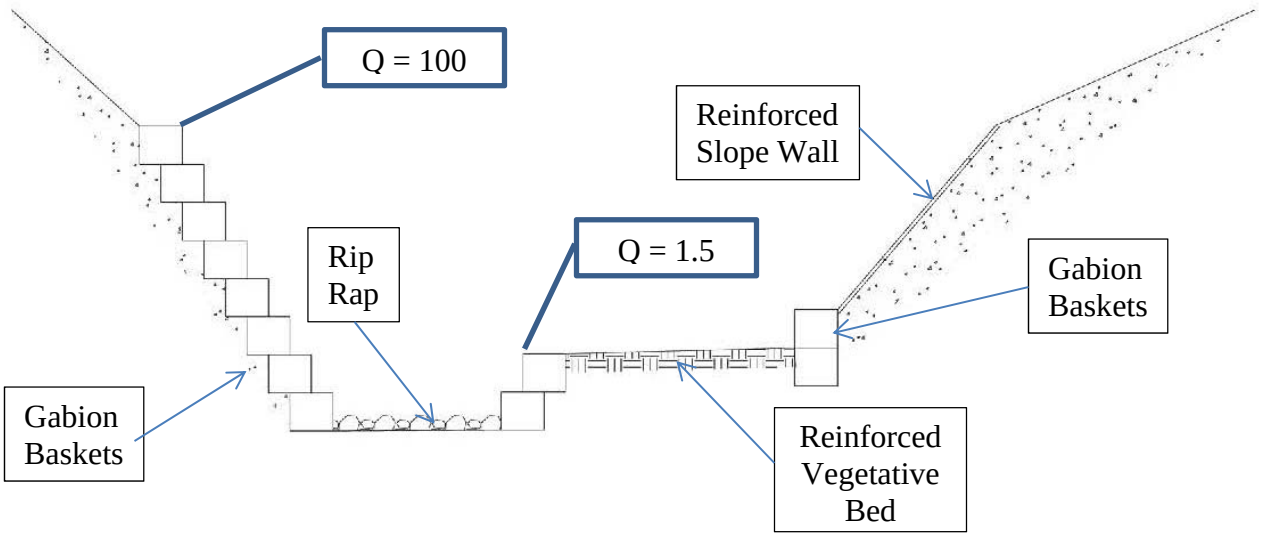


Figure 7 - Conceptual Sugar Creek Cross Section

Typical existing and proposed cross sections are used to calculate approximate quantities of the major construction items for this reach, resulting in estimated planning level costs as follows:

Planning Level Cost Estimate for Watershed F2-Reach 2 Improvements

2,200 L.F. @ $900 / L.F.	$1,980,000
30% Contingency	$594,000
Estimated Total	$2,574,000

2. Watershed F1 Reach 3

This stream reach, which has been previously modified into an engineered straight to gently curving channel, is incising. This channel is not as deep as Watershed F6-Reach 2 above. Also, the floodplain is not far removed, and land is available for alignment changes. A comprehensive rehabilitation based on a naturalized channel redesign is recommended.

Required work items include a channel realignment to create engineered meanders to mimic naturally meandering channels. These meanders decrease flow velocity, reduce the energy of the flow and thus decrease future erosion.

The channel improvements include creation of a lower base flow channel connected to a higher, wider, overflow channel to allow less frequent flood flows to spread out to dissipate energy.

Additional preventative standard measures recommended for inclusion in the design of this naturalized channel include:

- Soft bank stabilization practices in areas of high potential shear stresses, including, Streambank Shaping, Soil Lifts, Brush Mattresses and Vegetation Establishment
- Flow deflection practices including, Wing Deflectors and Rock or Log Vanes
- Grade control practices to reduce future incising including, Rock Vortex Weirs, Rock Cross Vanes, Step Pools and V-Log Drops

In addition to the preventative measures, habitat encouraging practices can be implemented. All these practices, plus an in-depth analysis of the upstream conditions, lead to a comprehensive stream design that becomes a sustained and healthy stream system for the City and community. Figure 8 displays an example typical cross section.

The selection of these techniques requires an in-depth study of the stream. In order to create a planning level cost estimate, actual construction cost for five similar naturalized stream projects were reviewed. The project costs were divided by the length of the

channel improvements to estimate the cost per foot of channel improved. Results are given below. The median cost for the five projects reviewed was $371. For planning purposes, a cost of $400 per foot will be used for this reach.

Scott Park – Champaign, IL	$ 533/LF
Cemetery Ravine – Lake Forest, IL	$ 371/LF
Rivershire Creek – Lincolnshire, IL	$ 179/LF
Rush Creek – Kansas City, MO	$ 424/LF
Flint Creek – Barrington, IL	$ 208/LF
Reach F1.2 – Bloomington, IL	**$ 400/LF**

Planning Level Cost Estimate for Watershed F1-Reach 3 Improvements

1,800 LF @ $400 / LF	$720,000
30% Contingency	$216,000
ESTIMATED TOTAL	**$936,000**

Figure 8 - Example Cross Section





MEET EXISTING

MEET EXISTING

WET PRAIRIE

WET PRAIRIE PLANTINGS

WET PRAIRIE PLANTINGS

FLOODPLAIN

3

1

3

1

3

1

GEOTEXTILE SURFACE NETTING, TYP.

6" TOPSOIL PLACEMENT

EMERGENT PLANTINGS, TYP.





BOTTOM OF BANK

GRAVEL

THALWEG

EMERGENT WET-MESIC PRAIRIE SEEDING

GEOTEXTILE SURFACE NETTING

TOPSOIL

ENKAMAT

TOPSOIL

TYPICAL SECTION



Figure 8
Typical Section

ATTACHMENT 1

UNIFIED STREAM ASSESSMENT DATA SHEETS

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): **OT-_____**	**LAT** ___°_____'_____" **LONG** ___°_____'_____"	**LMK**_____	**GPS:** (*Unit ID*)

BANK: ☐LT ☐RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter:_____(in)

SUBMERGED: ☐ No ☐ Partially ☐ Fully

☐ Open channel

☐ Concrete ☐ Earthen ☐ Other:

☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: _____(in)
Width (Top):_____(in)
" (Bottom):_____(in)

NOT APPLICABLE

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:
OTHER CONCERNS:		☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: _____ft Type of existing vegetation:_____ Slope: _____°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:_____

Area available:

OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4 3	2 1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH:	**TIME:**___:____AM/PM	**PHOTO ID** (CAMERA-PIC #):	/#
SITE ID: (*Condition-#*) **ER-**_____	*START* **LAT** ___°___'___" **LONG** ___°___'___" **LMK** _____		**GPS:** (*Unit ID*)
	END **LAT** ___°___'___" **LONG** ___°___'___" **LMK** _____		

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition

☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both *(looking downstream)*

LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length *(if no GPS)*	LT_____ft	and/or RT_____ft	Bottom width _____ft
Bank Ht	LT_____ft	and/or RT_____ft	Top width _____ft
Bank Angle	LT_____°	and/or RT_____°	Wetted Width _____ft

LAND OWNERSHIP: ☐ Private ☐ Public ☐ Unknown

LAND COVER: ☐ Forest ☐ Field/Ag ☐ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☐ Bank stabilization ☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	Good access: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair access: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult access. Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/#
SITE ID: (*Condition-#*) **IB-_____**	*START* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** _____		**GPS:** (*Unit ID*)
	END **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** _____		

IMPACTED BANK: ☐ LT ☐ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE:

(Facing downstream)	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☐ :
RT Bank	☐	☐	☐	☐	☐ :

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☐ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐Active reforestation ☐Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT BANK	RT
Length (ft):	_____	_____
Width (ft):	_____	_____

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

Stream Crossing **SC**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/#
SITE ID: (*Condition-#*) **SC-**_____	**LAT** ___°_____'_____" **LONG** ___°_____'_____" **LMK**_____		**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE:
☐ Arch ☐ Bottomless
☐ Box ☐ Elliptical
☐ Circular
☐ Other:

 # BARRELS:
☐ Single
☐ Double
☐ Triple
☐ Other:

MATERIAL:
☐ Concrete
☐ Metal
☐ Other:

ALIGNMENT:
☐ Flow-aligned
☐ Not flow-aligned
☐ Do not know

DIMENSIONS: (*if variable, sketch)*
Barrel diameter: _____(ft)
Height: _____(ft)
Culvert length: _____(ft)
Width: _____(ft)
Roadway elevation:_____(ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE:
☐ Flat
☐ Slight ($2^o - 5^0$)
☐ Obvious ($>5^o$)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: _____ (in)
☐ Flow too shallow Water Depth:_____ (in)
☐ Other:

BLOCKAGE SEVERITY: *(circle #)*

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5	4 3	2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Channel Modification **CM**

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#

SITE ID: (*Condition-#*) **CM-_____**

START **LAT** ___°___'___" **LONG** ___°___'___" **LMK** _____

END **LAT** ___°___'___" **LONG** ___°___'___" **LMK** _____

GPS: (*Unit ID*)

TYPE: ☐ Channelization ☐ Bank armoring ☐ concrete channel ☐ Floodplain encroachment ☐ Other:

MATERIAL:
☐ Concrete ☐ Gabion
☐ Rip Rap ☐ Earthen
☐ Metal
☐ Other:

Does channel have perennial flow?	☐ Yes ☐ No
Is there evidence of sediment deposition?	☐ Yes ☐ No
Is vegetation growing in channel?	☐ Yes ☐ No
Is channel connected to floodplain?	☐ Yes ☐ No

DIMENSIONS:
Height _____(ft)
Bottom Width _____(ft)
Top Width: _____(ft)
Length: _____(ft)

BASE FLOW CHANNEL
Depth of flow _____(in)
Defined low flow channel? ☐ Yes ☐ No
% of channel bottom _____%

ADJACENT STREAM CORRIDOR
Available width LT_____(ft) RT_____(ft)
Utilities Present? ☐ Yes ☐ No
Fill in floodplain? ☐Yes ☐ No

POTENTIAL RESTORATION CANDIDATE ☐ Structural repair ☐ Base flow channel creation ☐ Natural channel design ☐ Can't tell ☐ no ☐ De-channelization ☐ Fish barrier removal ☐ Bioengineering

CHANNELIZATION SEVERITY: (*Circle #*)	A long section of concrete stream (>500') channel where water is very shallow (<1" deep) with no natural sediments present in the channel.	A moderate length (> 200') ,but channel stabilized and beginning to function as a natural stream channel. Vegetated bars may have formed in channel.	An earthen channel less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5	4 3	2 1

NOTES:

Trash and Debris **TR**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**____:____AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/#
SITE ID: (*Condition-#*) **TR-**_____	**LAT** ___°_____'_____" **LONG** ___°_____'_____" **LMK** _____		**GPS:** (*Unit ID*)

TYPE: ☐ Industrial ☐ Commercial ☐ Residential	**MATERIAL:** ☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☐ Yard Waste ☐ Automotive ☐ Other:	**SOURCE:** ☐ Unknown ☐ Flooding ☐ Illegal dump ☐ Local outfall	**LOCATION:** ☐ Stream ☐ Riparian Area ☐ Lt bank ☐ Rt bank	**LAND OWNERSHIP:** ☐ Public ☐ Unknown ☐ Private **AMOUNT** (*# Pickup truck loads*):

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☐ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:** ☐ Yes ☐ No ☐ Unknown
	WHO CAN DO IT: ☐ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
	5	4	3	2 1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Utility Impacts **UT**

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **UT-**_____	**LAT**___°_____'_____" **LONG** ___°_____'_____" **LMK:** _____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**LOCATION:**	**POTENTIAL FISH BARRIER:**	**PIPE DIMENSIONS:**
☐ Leaking sewer ☐ Exposed pipe ☐ Exposed manhole ☐ Other:	☐ Concrete ☐ Corrugated metal ☐ Smooth metal ☐ PVC ☐ Other:	☐ Floodplain ☐ Stream bank ☐ Above stream ☐ Stream bottom ☐ Other:	☐ Yes ☐ No	Diameter: _____in Length exposed: _____ft
			CONDITION: ☐ Joint failure ☐ Pipe corrosion/cracking ☐ Protective covering broken ☐ Manhole cover absent ☐ Other:	

EVIDENCE OF DISCHARGE:		
	COLOR	☐ None ☐ Clear ☐ Dark Brown ☐ Lt Brown ☐ Yellowish ☐ Greenish ☐ Other:
	ODOR	☐ None ☐ Sewage ☐ Oily ☐ Sulfide ☐ Chlorine ☐ Other:
	DEPOSITS	☐ None ☐ Tampons/Toilet Paper ☐ Lime ☐ Surface oils ☐ Stains ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Structural repairs ☐ Pipe testing ☐ Citizen hotlines ☐ Dry weather sampling
☐ no ☐ Fish barrier removal ☐ Other:

If yes to fish barrier, Water Drop: _____ (in)

UTILITY IMPACT SEVERITY: (*Circle #*)				
	Section of pipe undermined by erosion and could collapse in the near future; a pipe running across the bed or suspended above the stream; a long section along the edge of the stream where nearly the entire side of the pipe is exposed; or a manhole stack that is located in the center of the stream channel and there is evidence of stack failure.	A moderately long section of pipe is partially exposed but there is no immediate threat that the pipe will be undermined and break in the immediate future. The primary concern is that the pipe may be punctured by large debris during a large storm event.	Small section of exposed pipe, stream bank near the pipe is stable; the pipe is across the bottom of the stream but only a small portion of the top of the pipe exposed; the pipe is exposed but is reinforced with concrete and it is not causing a blockage to upstream fish movement; a manhole stack that is at the edge of the stream and does not extend very far out into the active stream channel.	
Leaking= ☐ 5	5	4	3	2 1

NOTES:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

Miscellaneous **MI**

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**_____	**LAT**___°_____'_____" **LONG** ___°_____'_____" **LMK:** _____	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**_____	**LAT**___°_____'_____" **LONG** ___°_____'_____" **LMK:** _____	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**_____	**LAT**___°_____'_____" **LONG** ___°_____'_____" **LMK:** _____	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

Reach Level Assessment **RCH**

SURVEY REACH ID: _____	**WTRSHD/SUBSHD:**	**DATE:** ___/____/___	**ASSESSED BY:**

START **TIME:** ___:___AM/PM **LMK:** _____ **LAT** ___° _____' _____" **LONG** ___° _____' _____" **DESCRIPTION:**	*END* **TIME:** ___:___AM/PM **LMK:** _____ **LAT** ___° _____' _____" **LONG** ___° _____' _____" **DESCRIPTION:**	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☐ Clear ☐Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☐ some ☐ lots
Floating: ☐ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☐ Fish ☐ Beaver ☐ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS

☐ Unknown	☐ Downcutting	☐ Bed scour
	☐ Widening	☐ Bank failure
	☐ Headcutting	☐ Bank scour
	☐ Aggrading	☐ Slope failure
	☐ Sed. deposition	☐ Channelized

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank _____(ft)
RT bank _____(ft)
Width: Bottom _____(ft)
Top _____(ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5	4 3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow

NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACH-MENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

ATTACHMENT 2

STREAM REACH MAPS

F6

F5

F2

F1

F4

F3

Legend:

Watershed Name

Surveyed Reach

Future Surveys

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

Foth

N

0 0.5 1

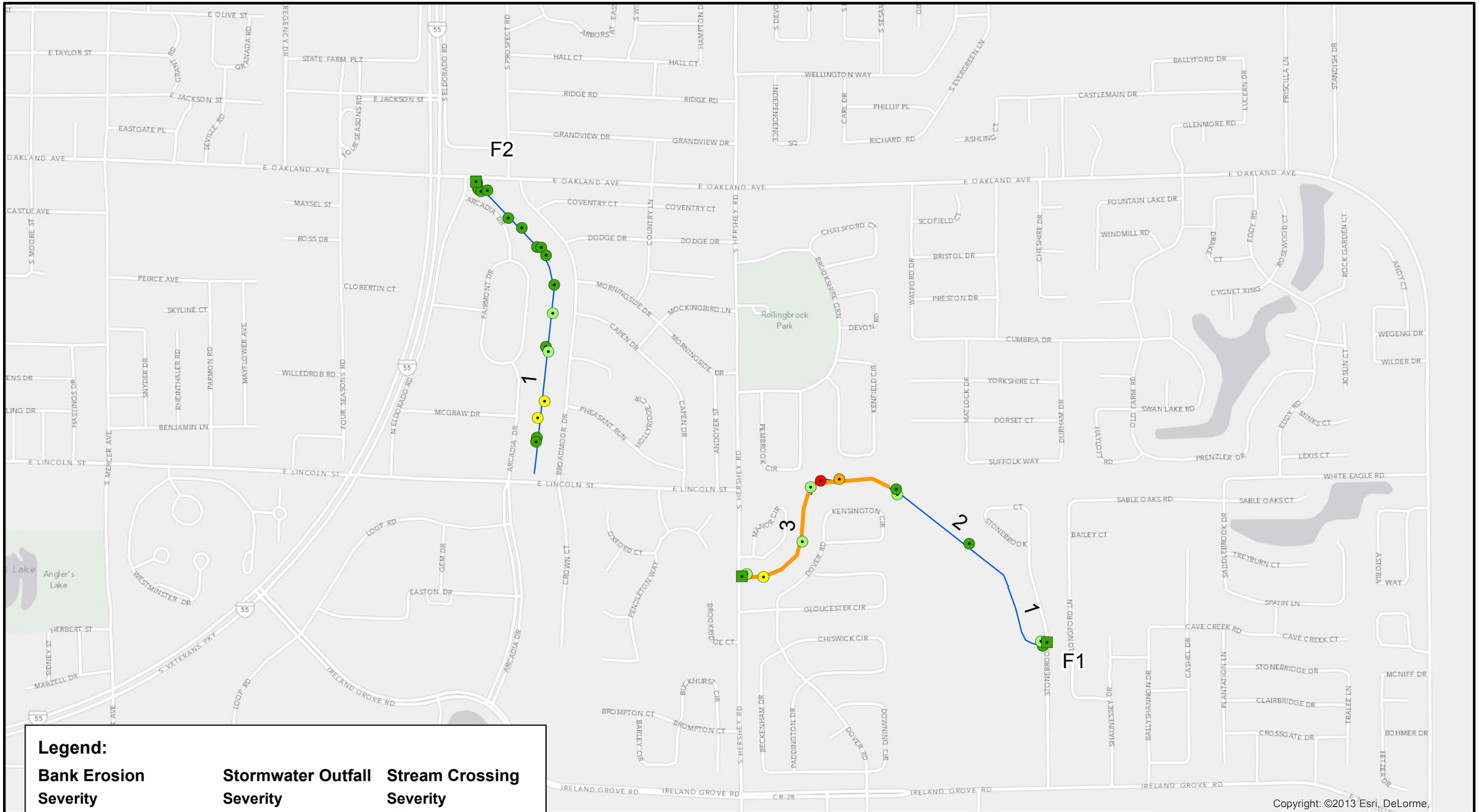
Miles

CITY OF BLOOMINGTON

STREAMBANK INVENTORY

SURVEYED STREAMS

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005



Legend:

Bank Erosion Severity	Stormwater Outfall Severity	Stream Crossing Severity
1 - No Bank Erosion	1 - No Problems	1 - No Blockage
2	2	2
3	3	3
4	4	4
5 - Severe Bank Erosion	5 - Severe Problems	5 - Severe Blockage

Copyright: ©2013 Esri, DeLorme,

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

Foth

N

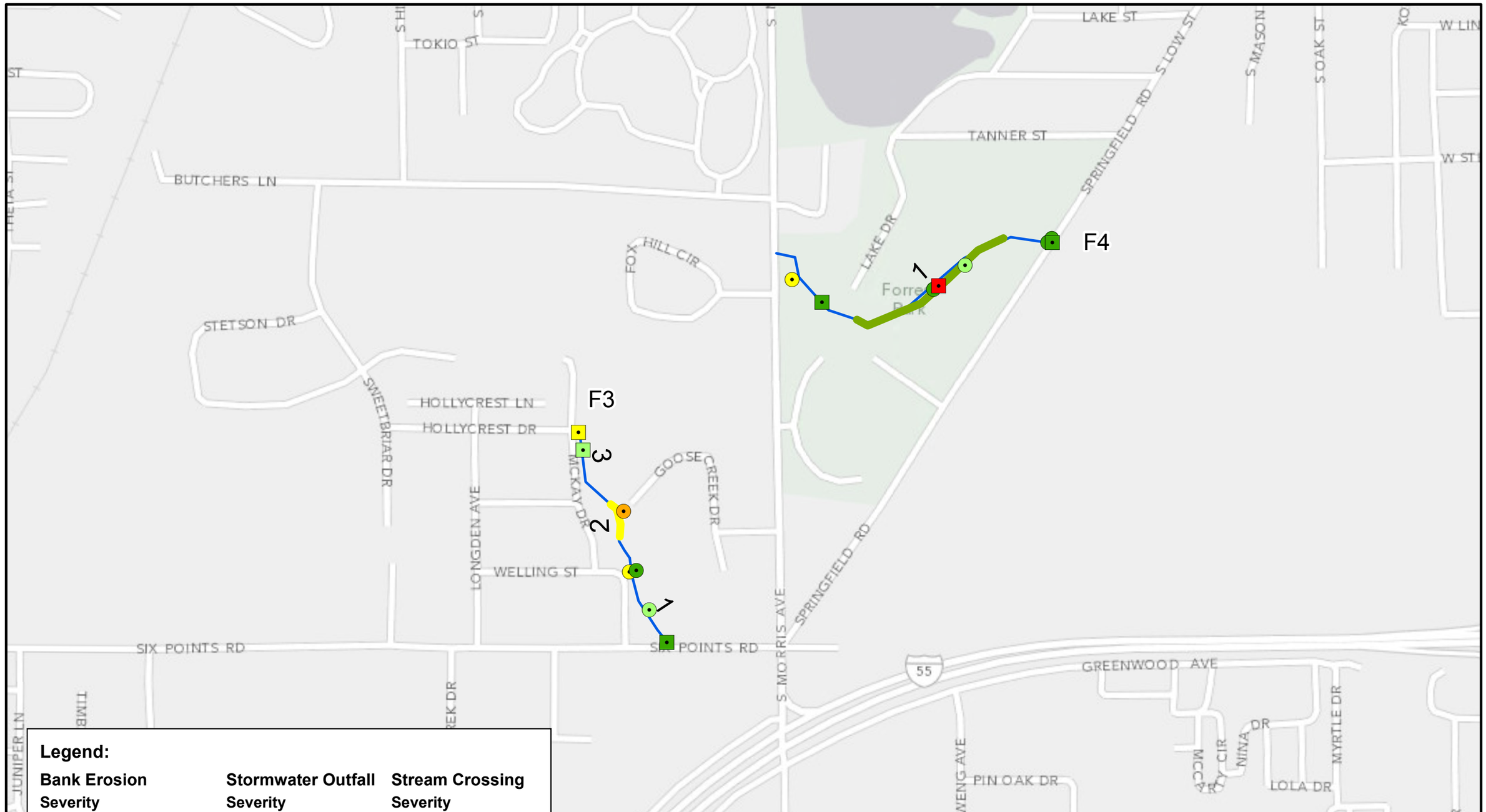
0 400 800
Feet

CITY OF BLOOMINGTON

STREAMBANK INVENTORY

GENERAL CONDITIONS OF SURVEYED REACHES - F1 & F2

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005



Legend:

Bank Erosion Severity	Stormwater Outfall Severity	Stream Crossing Severity
1 - No Bank Erosion	1 - No Problems	1 - No Blockage
2	2	2
3	3	3
4	4	4
5 - Severe Bank Erosion	5 - Severe Problems	5 - Severe Blockage

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

Foth

N

0 200 400
Feet

CITY OF BLOOMINGTON

STREAMBANK INVENTORY

GENERAL CONDITIONS OF SURVEYED REACHES - F3 & F4

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005

F6

F5

1

2

3

4

Legend:

Bank Erosion Severity	Stormwater Outfall Severity	Stream Crossing Severity
1 - No Bank Erosion	1 - No Problems	1 - No Blockage
2	2	2
3	3	3
4	4	4
5 - Severe Bank Erosion	5 - Severe Problems	5 - Severe Blockage

Copyright: ©2013 Esri, DeLorme,

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 400 800
Feet

CITY OF BLOOMINGTON

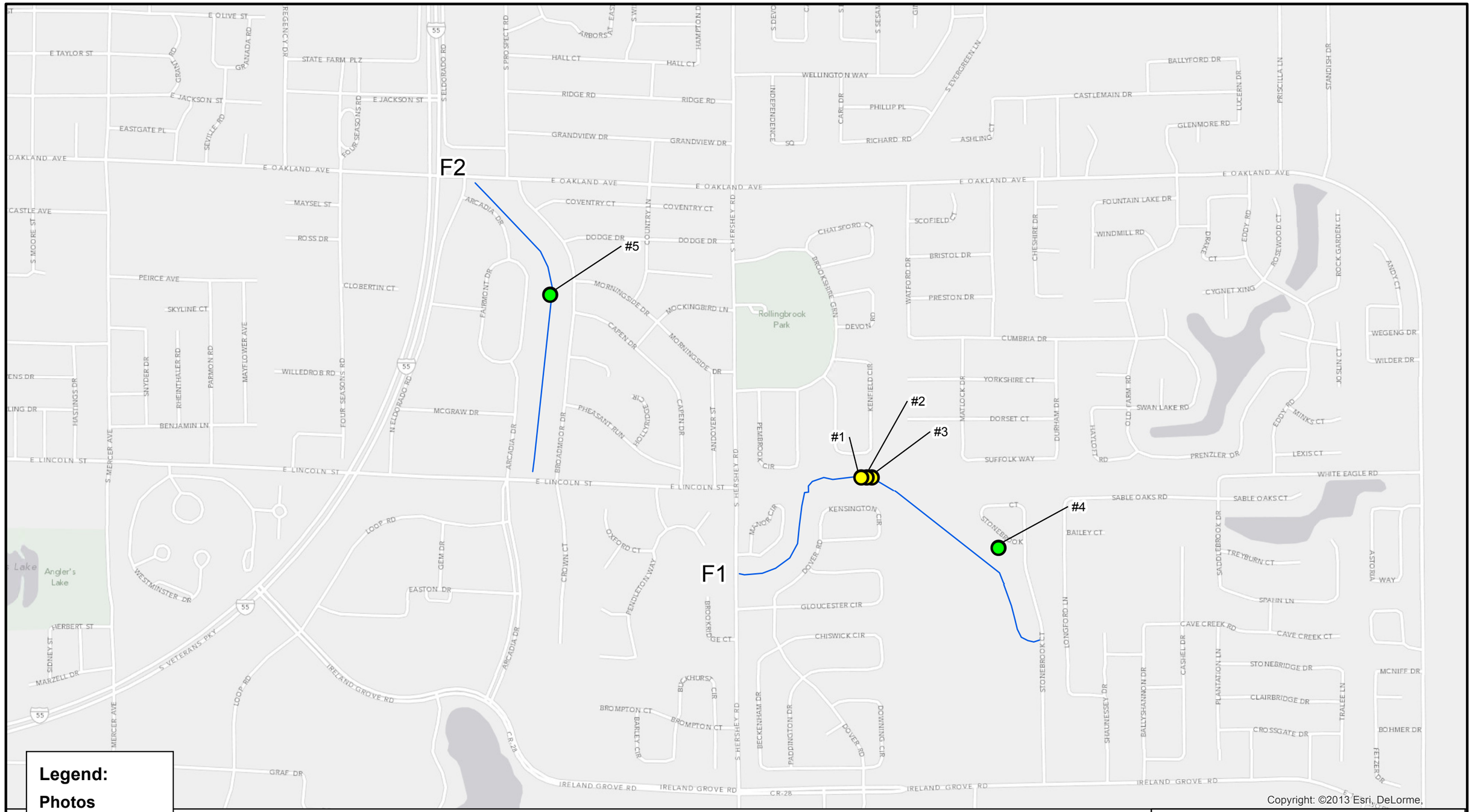
STREAMBANK INVENTORY

GENERAL CONDITIONS OF
SURVEYED REACHES - F5 & F6

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005

ATTACHMENT 3

STREAM REACH PHOTOS



Legend:

Photos

Reach Conditions

- Good
- Adequate
- Poor

Photo #

Copyright: ©2013 Esri, DeLorme,

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

0 200 400 600 800

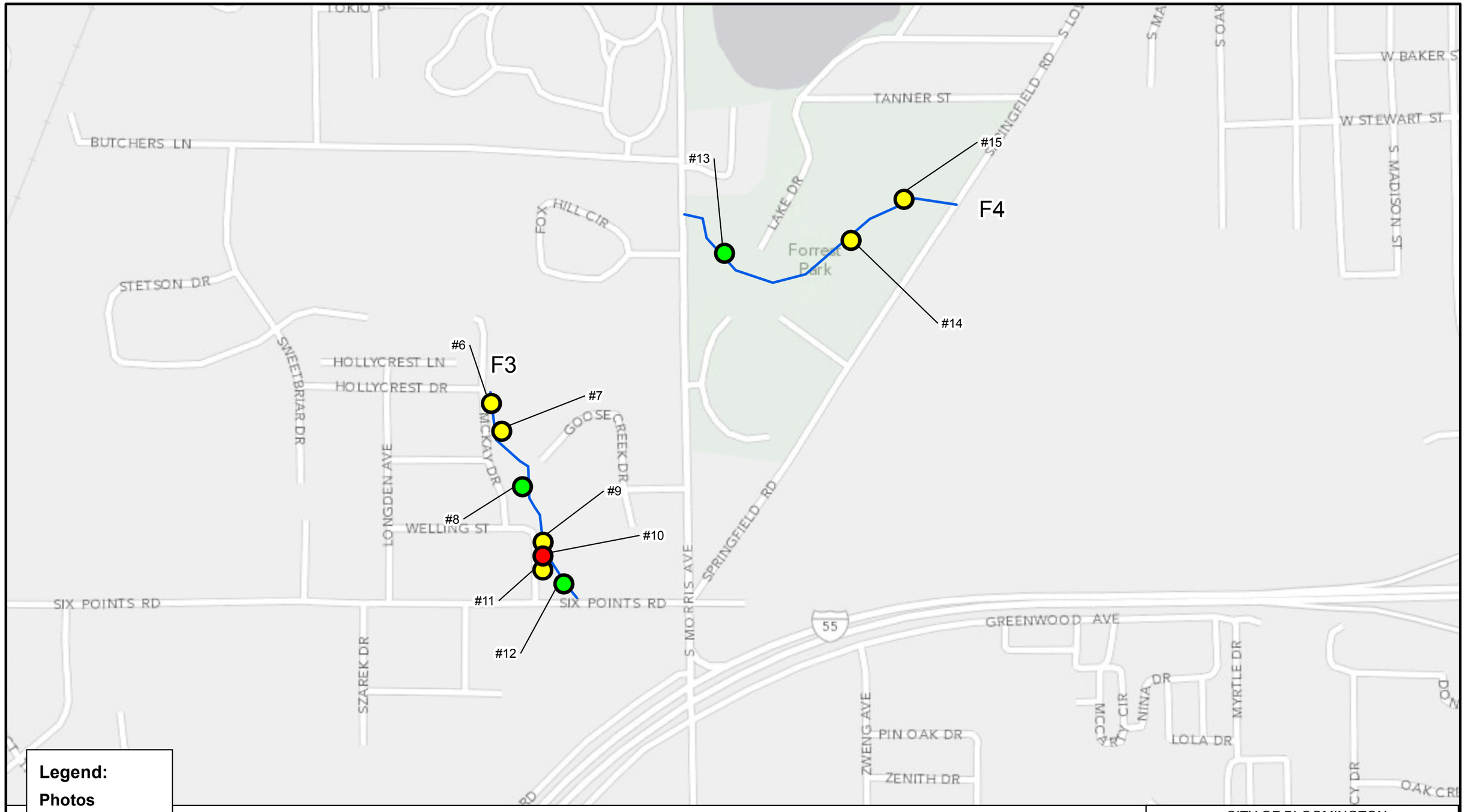
Feet

CITY OF BLOOMINGTON

STREAMBANK INVENTORY

PHOTO LOCATIONS
SURVEYED REACHES - F1 & F2

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005



Legend:

Photos

Reach Conditions

- Good
- Adequate
- Poor

Photo #

N

Foth

0 200 400

Feet

This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

CITY OF BLOOMINGTON

STREAMBANK INVENTORY

PHOTO LOCATIONS
SURVEYED REACHES - F3 & F4

Date: 12/9/2013	Revision Date:	
Drawn By: JMS	Checked By: JAD	Scope: 12B005

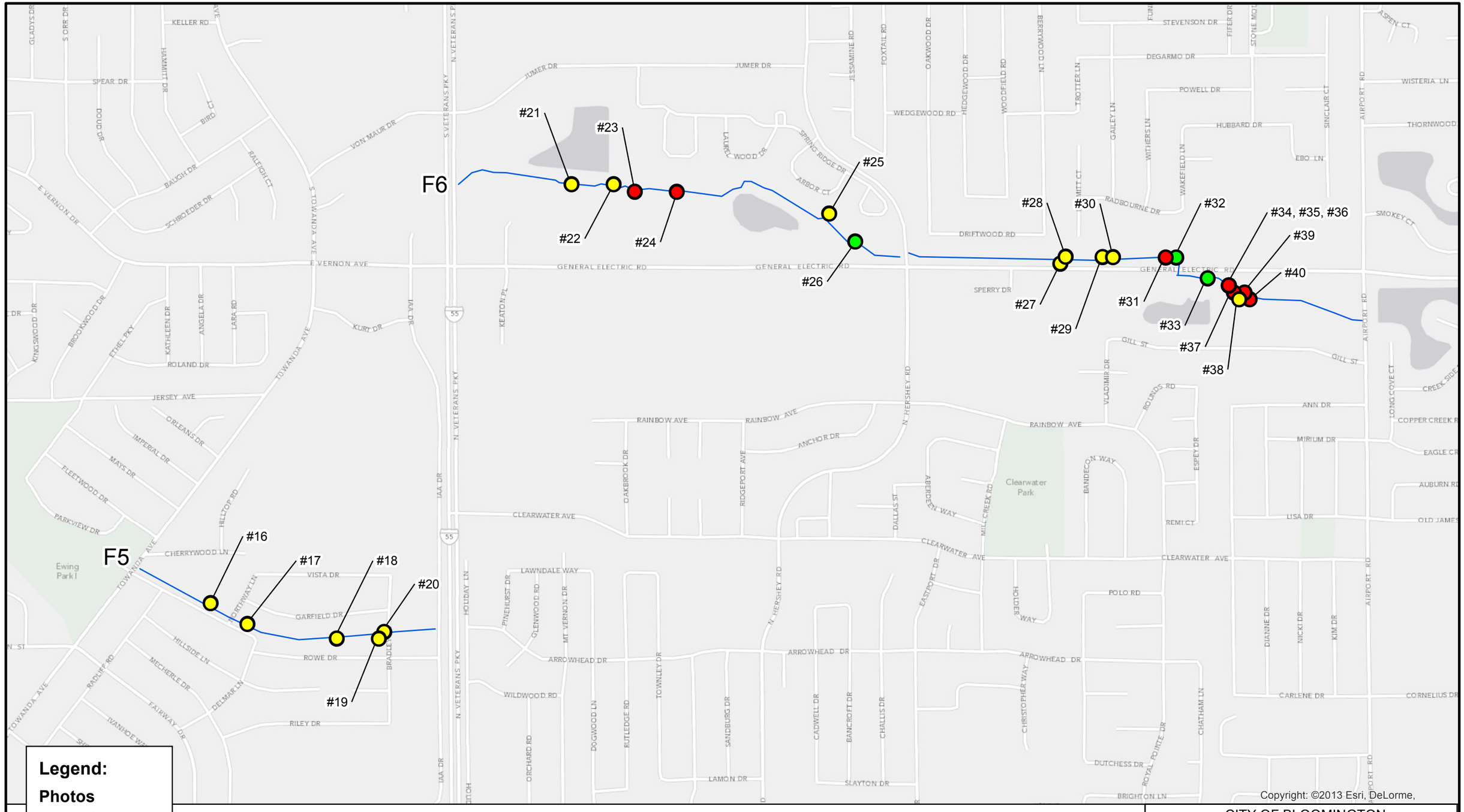

F6
#21
#22
#23
#24
#25
#26
#27
#28
#29
#30
#31
#32
#33
#34, #35, #36
#37
#38
#39
#40
F5
#16
#17
#18
#19
#20
Legend:
Photos
Reach Conditions
Good
Adequate
Poor
Photo #
KELLER RD
SPEAR DR
JUMER DR
VON MAUR DR
BAUGH DR
SCHROEDER DR
E VERNON DR
E VERNON AVE
S TOWANDA AVE
S VETERANS PKY
N VETERANS PKY
GENERAL ELECTRIC RD
KURT DR
ROLAND DR
JERSEY AVE
ORLEANS DR
IMPERIAL DR
MAYS DR
FLEETWOOD DR
PARKVIEW DR
HILLTOP RD
CHERRYWOOD LN
VISTA DR
GARFIELD DR
ROWE DR
HILLSIDE LN
MECHERLE DR
DELMAR LN
FAIRWAY DR
RILEY DR
RADCLIFF RD
IVANHOE WAY
Ewing Park I
WEDGEWOOD RD
LAUREL WOOD DR
SPRING RIDGE DR
ARBOR CT
DRIFTWOOD RD
RADBOURNE DR
SPERRY DR
STEVENSON DR
DEGARMO DR
POWELL DR
HUBBARD DR
EBO LN
WISTERIA LN
THORNWOOD
SMOKEY CT
ASPEN CT
GILL ST
RAINBOW AVE
ANCHOR DR
CLEARWATER AVE
LAWNDALE WAY
ARROWHEAD DR
WILDWOOD RD
LAMON DR
SLAYTON DR
POLO RD
DUTCHESS DR
BRIGHTON LN
CARLENE DR
CORNELIUS DR
ANN DR
MIRIUM DR
LISA DR
REMI CT
AUBURN RD
OLD JAMES
COPPER CREEK R
EAGLE CR
CREEK SIDE
Clearwater Park
ROLANDS RD
BANDECON WAY
ABERDEEN WAY
MILL CREEK RD
ESPEY DR
CHRISTOPHER WAY
ROYAL POINTE DR
CHATHAM LN
DIANNE DR
NICKI DR
KIM DR
HOLDEN WAY
VLADIMIR DR
N HERSHEY RD
EASTPORT DR
AIRPORT RD
ORCHARD RD
DOGWOOD LN
RUTLEDGE RD
TOWNLEY DR
SANDBURG DR
CADWELL DR
BANCROFT DR
CHALLIS DR
HOLIDAY LN
PINEHURST DR
GLENWOOD RD
MT VERNON DR
KEATON PL
IAA DR
OAKBROOK DR
RIDGEPORT AVE
DALLAS ST
JESSAMINE RD
FOXTAIL RD
OAKWOOD DR
HEDGEWOOD DR
WOODFIELD RD
BERKWOOD LN
TROTTER LN
GAILEY LN
WITHERS LN
WAKEFIELD LN
SINCLAIR CT
FIFER DR
STONE MOUNTAIN
FUNSTON
GLADYS DR
S ORR DR
HAMMITT DR
BIRD CT
DOUD DR
KINGSWOOD DR
BROOKWOOD DR
ETHEL PKY
KATHLEEN DR
ANGELA DR
LARA RD
TOWANDA AVE
55
Copyright: ©2013 Esri, DeLorme,
Foth
N
0 200 400 600 800
Feet
This drawing is neither a legally recorded map nor a survey and is ot intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.
CITY OF BLOOMINGTON
STREAMBANK INVENTORY
PHOTO LOCATIONS
SURVEYED REACHES - F5 & F6
Date: 12/9/2013
Revision Date:
Drawn By: JMS
Checked By: JAD
Scope: 12B005



Photo #1



Photo #2



Photo # 3



Photo # 4



Photo # 5



Photo # 6



Photo # 7



Photo # 8



Photo # 9



Photo # 10



Photo # 11



Photo # 12



Photo # 13



Photo # 14



Photo # 15



Photo # 16



Photo # 17



Photo # 18



Photo # 19



Photo # 20



Photo # 21



Photo # 22



Photo # 23



Photo # 24



Photo # 25



Photo # 26



Photo # 27



Photo # 28



Photo # 29



Photo # 30



Photo # 31



Photo # 32



Photo # 33



Photo # 34



Photo # 35



Photo # 36



Photo # 37



Photo # 38



Photo # 39



Photo # 40

Stormwater Technical Memoranda

ST4 - GREENWAYS PLAN - SUSTAINABLE DESIGN INTIATIVES

Greenways Plan
Sustainable Design Initiatives

Executive Summary

This plan provides a roadmap to address future development along waterways (riparian corridors) in order to protect the "backbone" of the City's existing and future stormwater infrastructure and identify policy changes that will help to provide a more sustainable framework for land development. This plan is critical to allow for both environmental and economic sustainability.

Key Findings

- Existing drainage channels are experiencing severe erosion and places private property at risk of damage.
- A lack of easements makes drainage channel maintenance difficult or impossible.
- 73 city-owned detention ponds and over 300 privately-owned detention ponds experience significant problems resulting from a lack of maintenance. This can increase flooding risk and pose a threat to surface water quality.
- Existing City staffing is not sufficient to inspect stormwater infrastructure and implement maintenance programs necessary to avoid future damage due to failed systems.

Recommendations

- Revise floodplain boundaries at key locations where development has occurred.
- Implement streambank restoration projects and modify existing drainage channels to better withstand urban runoff.
- Implement a City-wide detention pond inspection and maintenance program.
- Establish a Greenway standard for new developments to accommodate drainage channels, pedestrian access, and maintenance access.
- Identify locations for regional stormwater detention in the City's key Planning Areas.
- Update the City's Manual of Practice to address stormwater management in order to meet pending changes to federal and state rules.
- Increase the rate for fee-in-lieu for stormwater detention to match actual costs for stormwater management.

Planning-Level Cost Summary	
Detention Pond Inspection/Maintenance Program	$ 6,470,000
Drainage Channel Improvements and Related Studies	$ 12,380,000
TOTAL	$ 19,030,000

ARCHITECTS. ENGINEERS. PLANNERS.

OHM Advancing Communities

technical memorandum

Date: December 11, 2013

To: Ryan Otto, City of Bloomington
From: Greg Kacvinsky, OHM Advisors

Re: Stormwater Master Plan – Greenways Plan / Sustainable Design Initiatives

Summary

The City of Bloomington wishes to develop a plan to address future development along waterways (riparian corridors) in order to protect the "backbone" of future stormwater infrastructure and identify policy changes that will help to provide a more sustainable framework for land development.

The purpose of this plan is to explore existing problems associated with development along riparian corridors and develop reasonable policy changes that will:

- Provide healthy and visually-pleasing corridors for recreation, flood conveyance and water treatment/conveyance.
- Enhance the ability for City staff to maintain greenways and drainage channels.
- Connect neighborhoods and expand the Constitution Trail system.
- Repair and enhance waterways in existing urban areas to address public safety, aesthetic and maintenance concerns.
- Identify land use and design policy changes that will help promote sustainable growth, enhanced property values and reduced long-term costs for stormwater infrastructure.

Definition of Greenways

For the purpose of this report, the term *Greenways* will encompass the following characteristics that impact the City of Bloomington's existing and future stormwater infrastructure:

- Riparian corridor - provides a protected area for the conveyance of stormwater baseflows and flood routing while providing an adequate habitat for aquatic species.
- Floodplain / floodway - provides an adequate footprint for floodplain / floodway protection without any human-made encroachments such as structures, fences, or other features that would obstruct flow. Provides enough flow width to maintain reasonable and safe flow velocities during a 100-year recurrence interval event.
- Maintenance - allows for unencumbered access to the stream/creek corridor by City maintenance staff, including the ability for City equipment to travel along the waterway for regular inspections of the corridor.

- Pedestrian / bicycle linkages - allows for the connection of pathways between multiple subdivisions, maintaining a continuous path along a stream while minimizing roadway crossings.
- Regional stormwater detention - allows for the construction of regional detention ponds for flood control purposes.
- Wetlands and stormwater quality enhancement - provides an adequate footprint for wetland protection, wetland mitigation banks, and stormwater Best Management Practices (BMPs) that encourage deep infiltration and reduce the potential for non-point source pollution.

The development of the recommendations in this document is based on the multi-use needs as defined in the definition of greenways as described above. Recommendations are provided for:

1. Urbanized areas
    a. Fully-developed areas within the City that are currently constrained by the existence of structures within close proximity to drainage channels.
    b. Fully-developed areas that are experiencing problems with drainage channel deterioration, including bank erosion and down-cutting.
    c. Fully-developed areas that are experiencing problems with ongoing detention pond operation and maintenance.
2. Future development areas, focusing on the geographic regions:
    a. Bloomington West (west of I-74, south of Route 9, or *Planning Area 4* of the City's current Comprehensive Plan, dated October 2005)
    b. Bloomington East (east of Towanda-Barnes and north of Ireland Grove, or *Planning Area 7* of the City's current Comprehensive Plan)
    c. Bloomington South (south of Hamilton Road, east of U.S. 51, or *Planning Area 8* of the City's current Comprehensive Plan)

This memorandum references the City of Bloomington's *Manual of Practice for the Design of Public Improvements* (2005) ("Manual of Practice") for new subdivisions. Where our recommendations may impact the existing Manual of Practice, we provide guidance on which sections may need to be revised.

Cost estimates are provided for specific recommendations, and are included in Table 5 at the end of this document.

Existing Problems - Urbanized Areas

Existing Problems – Urbanized Greenways

Although the City has right-of-way or easements for most of the system of open drainage channels in developed areas, it is often difficult to maintain and/or repair channels due to erosion, encroachment of landscaping or accessory structures, and tree overgrowth.

Typical problems with urbanized greenways in the City of Bloomington are:

- Floodplain is not contained within the channel corridor (see Figure 1a).
- Land use changes and development have changed peak flow rates and floodplain elevations. Existing floodplain mapping does not necessarily reflect

the current risk levels along the City's drainage channels (see Sugar Creek modeling section for specific examples).

- Main buildings and accessory structures have been built within the stream corridor, and often within the right-of-way or easement (see Figures 2a and 2b)
- Natural channel meandering results in lateral movement of the channel (and streambank) to the edge or out of the existing easement boundary (see Figures 1a and 1b).
- Constant flow (from footing drain discharge, such as sump pumps) and slow release of stormwater volume from detention ponds after storms results in a highly erosive environment along the stream bottom. This results in undercutting and channel widening. This makes the channel banks steeper and the channel deeper, adding threats to public safety and private property (see Figure 3).
- Maintenance is difficult or impossible in constrained areas where only narrow easements exist (see Figure 2a).



Figure 1a - Floodplain Encroachment / Meander: Branch of Little Kickapoo

Homes and accessory structures encroach on the floodplain and floodway (just east of Ireland Grove / Arcadia intersection). Channel right-of-way does not include entire floodway. Natural stream meander is beginning to move beyond the main channel corridor.

This floodplain has not been remapped since development. Future land development policy should require Letters of Map Revision (LOMRs) be acquired for all development that will impact the floodplain geometry.



Figure 1b – Channel Cross Section Infringes on Private Property
1019 Maple Street (Outfall to Oak-Ash Basin)



Figure 2a - Typical Urban Greenway: Sugar Creek
Deep, narrow channel makes access difficult - parking lot and building encroachment prevents channel maintenance

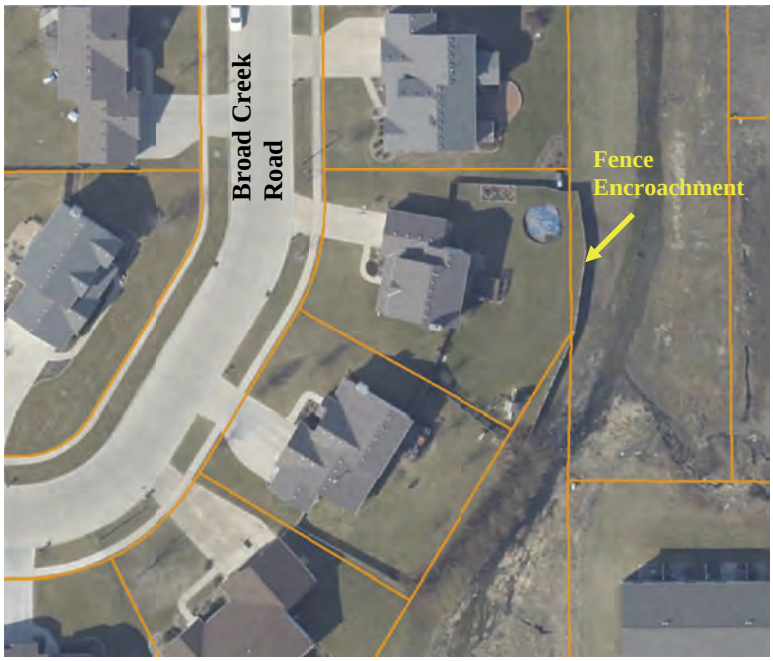


Figure 2b – Encroachment on Right-of-Way
Property owners often build fences and accessory structures within the corridor reserved for stormwater conveyance



Figure 3 – Streambank Erosion: Rowe Drive Drainage Channel
Decades of stormwater runoff from an urbanized watershed have widened and deepened this tributary of the Sugar Creek, creating public safety hazards. This drainage way was restored in the late 1970s after similar erosion problems.

Existing Problems – Publicly-Owned Detention Ponds

Maintenance of City-Owned Dry Detention Ponds

There are about 46 city-owned dry detention ponds, with a total combined footprint of 62 acres, according to GIS data. According to City staff, the bottoms of the dry ponds have become saturated and are difficult to maintain. This is largely due to accumulated sediment, lack of underdrains, clogged underdrains, and/or partially clogged outlet structures that prevent complete pond dewatering (see Figure 4), although the specific maintenance concerns vary for each detention pond.



Figure 4 – Dry Pond Sediment Accumulation and Saturation

Although the City prefers to mow the vegetation in the bottom of the dry detention ponds, the saturated conditions have forced maintenance crews to retreat away from the low points, where taller vegetation has taken over. This taller vegetation is generally not desired by adjacent property owners or City maintenance staff.

Generally, dry detention ponds require sediment cleanout and general maintenance every 5-10 years, depending on the sources of runoff and the relative concentrations of sediment (TSS) entering each pond. Given that many of the ponds referenced in this document are significantly older than 10-15 years and that most of them have not had sediment removed during this period, it is safe to assume that all existing dry ponds will require at least some sediment removal and other repairs to ensure they are working as originally designed.

Specific recommendations and cost estimates for dry detention pond maintenance are included in the *Key Recommendations* section of this document.

Maintenance of City-Owned Wet Detention Ponds

There are 27 city-owned wet detention ponds with a total combined footprint of nearly 159 acres and nearly 2.5 miles of shoreline. As these detention ponds age, the shorelines are subject to erosive forces from wave action and/or human interference (see Figure 5a). Over time, all shorelines (armored ***and*** unarmored) will require basic maintenance in order to prevent significant erosion and, potentially, damage to private property.



Figure 5a – Wet Pond Shoreline Erosion
White Eagle Lake (Before Maintenance)



Figure 5b – Wet Pond Shoreline Improvements
White Eagle Lake (After Maintenance)

Specific recommendations and cost estimates for wet detention pond maintenance are included in the *Key Recommendations* section of this document.

Existing Problems – Privately-Owned Detention Ponds

There are over 300 privately-owned detention ponds in the City of Bloomington. Most (about 75%) of these ponds are very small (less than 0.5 acre) and impact relatively small areas. About 25% of these ponds (81 ponds) range from 0.5 acre to over 20 acres. Many of these ponds are part of a Homeowners' Association (HOA) or other joint entity. These entities typically do not have adequate resources and/or proper motivations to maintain detention ponds. Key problems encountered by City staff include:

- Plugged outlet structures – detention ponds do not adequately drain out after storm event
- Erosion along shoreline (wet ponds only)
- Excessive sediment buildup in vicinity of outlet structure (dry ponds only)
- Nuisance vegetation (lack of regular mowing)
- Intentional removal of hydraulic restrictors or other outlet controls
- Structural failure of inlet/outlet pipes
- Placement of fill or other unapproved obstructions in pond area
- Potential for automobile inundation and cross-connection with hazardous materials (parking lot stormwater detention applications only)

This lack of maintenance results in an increased frequency of local flooding and, consequently, increased complaints to Public Works staff. However, as these ponds are privately-owned, the City does not have the authority to enter private property and implement needed repairs.

Key Recommendations

Recommendations – Urbanized Greenways

The key to improving the management of the City's network of open drainage channels is to better understand the flooding risk and to modify existing channels to enhance public safety and ease of maintenance. Specific recommendations include:

- Implement a floodplain remapping effort in areas where the official mapped floodplain is not representative of existing conditions. The Sugar Creek Analysis recommended a Letter of Map Revision (LOMR) along its upper reaches. Additionally, a LOMR should be completed for the branch of the Little Kickapoo through Ireland Grove (Figure 1a) from the Little Kickapoo upstream to Stonebrook Court. This will likely remove numerous properties from the flood zone and may help to open the potential for development in previously-undevelopable areas.

- Use the updated FEMA floodplain GIS shapefiles to identify floodway and floodplain encroachments using the latest-available aerial photography.

Encroachments include homes, accessory structures, fences, walls, and other features that could impede floodwaters. Develop a ***Structure Encroachment Database*** and work with individual property owners to relocate or retrofit structures. Provide a budget line item in the City's Stormwater Fund for a cost-share program to assist property owners in removing/retrofitting structures. This would be an ongoing program, as only a limited number of retrofits could be implemented in any given year. This program should need 0.25 FTE with the Engineering Department and an annual construction budget of $50,000 (total annual cost of approximately $75,000). The database should be prioritized as follows:

  - Top priority: floodway encroachments
  - Normal priority: floodplain encroachments

Chapter 18 of the City Code addresses floodway/floodplain development and is based on the State of Illinois' Model Floodplain Ordinance. This ordinance will help the City prevent future encroachments; however, Chapter 18 does not address enforcement of floodway/floodplain encroachment in neighborhoods that predate the ordinance. In these cases, City staff should use the ***Structure Encroachment Database*** to partner with property owners to eliminate encroachments where possible.

- Implement streambank restoration projects in areas of moderate to severe erosion as defined in the Streambank Inventory). 0.10 FTE (City Engineering Department) should be necessary, at a minimum, to administer this program.

- In areas where the channel is too constrained (or too deep) to maintain a natural pilot channel and floodplain, explore the feasibility of a dual open/closed conveyance system. Such a system would consist of a low flow pipe to convey baseflows and small (i.e. 1-year) rainfall events and a vegetated flood conveyance channel for larger events. This will reduce the depth of the open component of the channel, enhance public safety along the channel corridor, and will make the channel less vulnerable to ongoing erosive forces. 0.15 FTE (City Engineering Department) should be necessary, at a minimum, to administer this program. Based on currently-known erosion and access problems, potential channel reaches include (see Figure 6 for an example cross section):
  - Sugar Creek (Airport Road to GE Road): 1,500 lineal feet
  - Rowe Drive Drainage Channel (Tributary to Sugar Creek): 2,700 lineal feet between Towanda and Veterans Parkway
  - Open Channel north of 1019 Maple St. (outfall to Baker-Ash detention basin): 300 lineal feet (see Figure 1b)

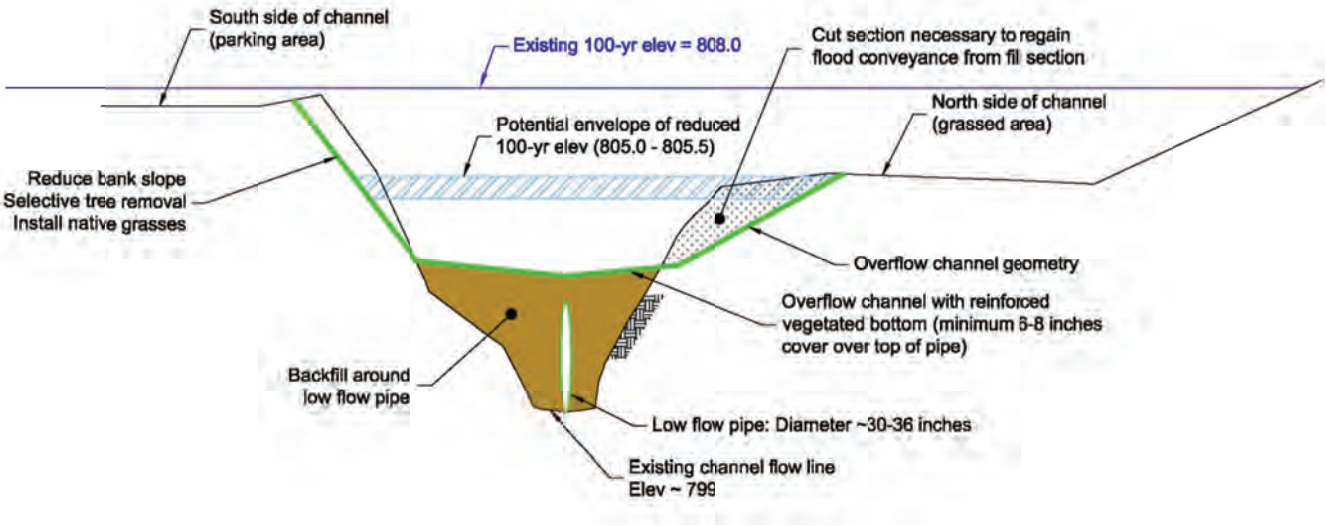


Figure 6
Representative Cross Section
Low Flow Pipe and Flood Channel Modification
Sugar Creek: Approximately 160 feet Downstream of Airport Road
Required Minimum Width: 65-70 feet

Recommendations – Publicly-Owned Detention Ponds

Implement a City-wide detention pond inspection and O&M program. This program will help to ensure the ongoing function of City-owned detention ponds and is part of a sustainable framework of stormwater management infrastructure. The program should consist of the following elements for City-owned detention ponds:

a. Annual inspection of detention ponds (dry and wet ponds)
    i. Visual inspection of outlet condition.
    ii. Visual inspection of shoreline for erosion and/or structural encroachment. Identify violations within the "no-mow" zone (wet ponds only).
    iii. Removal of debris/obstructions.
    iv. Report any unauthorized alterations and track inspection status in GIS.
    v. Inspect and document 73 publicly-owned detention ponds per year.
    vi. Assume 2.5 – 3.0 hours per pond for inspection and reporting (180-220 hours per year, or 0.15 FTE).
b. Sediment removal and outlet repair (dry ponds only)
    i. 62 acres of dry detention pond footprint (City-wide).
    ii. Using a 10-year cycle, address 6.2 acres of dry pond footprint per year.
    iii. Assume 20% of each pond bottom requires cleanout, regrading, and restoration.
    iv. Assume average sediment depth of 6 inches.
    v. 1,000 cubic yards of annual sediment removal (this quantity will likely decrease after the first complete cycle of sediment removal, as many ponds have 20 years or more of sediment accumulation).
    vi. 1.25 acres of annual restoration (seeding, mulching, and watering).
    vii. Repair and retrofit outlet structures on an as-needed basis (assume 2% of outlet structures require repairs each year).

viii. Underdrain repair, cleaning, and replacement (assume 6 ponds per year at $15,000 each, includes 0.10 FTE).
ix. Low-flow pump maintenance, repair, and replacement pump installation (assume one pump per year at $10,000 each, includes 0.05 FTE).

c. Shoreline stabilization (wet ponds only)
i. Based City GIS data, an approximation of the total wet pond footprint is about 12,000-13,000 lineal feet (about 2.5 miles of pond shoreline within the City's maintenance jurisdiction).
ii. Assume that shorelines will require maintenance on a 20-year cycle. This may consist of minor regrading, vegetation, rip rap, sediment removal, and/or similar measures.
iii. 650 lineal feet of shoreline maintenance per year, varying measures to be determined on a site-by-site basis.
iv. Encourage establishment of "naturalized" shorelines as recommended in the Greenways / Sustainability document in order to reduce maintenance frequency. Focus shoreline maintenance efforts on those that will create naturalized and sustainable shorelines (as opposed to turf grass pond edges).

The above recommendations translate to an ***annual funding need of approximately $265,000 (including 0.30 FTE in the Engineering Department) for basic inspection and administration of maintenance activities of publicly-owned detention ponds***. See Table 4 for a breakdown of individual cost components.

Given the City's ongoing permit requirements under the IEPA NPDES Phase II stormwater program, the City should consider, as an additional activity related to the City-owned detention ponds, targeted detention pond retrofits to address non-point source pollution and further enhance stormwater quality within and downstream of the City. These improvements are described as follows:

- Water quality retrofits: Implement detention pond retrofits at selected publicly-owned detention ponds to address frequent storm hydrology (i.e. 1-year / 2-year storms), similar to the recommendations in the Sugar Creek Analysis. These retrofits should not impact the flood control characteristics of each pond, but instead will help to further reduce the transport of stormwater pollutants to downstream areas. Retrofits can consist of the following, depending on the location and configuration of existing detention ponds:

    - Dry ponds:
        - Install a sediment forebay to trap sediment and create a point-of-maintenance for sediment removal on a 5-10 year cycle. Sediment forebays can accomplish water quality enhancement and ease of maintenance, as sedimentation is limited to a controlled area and outlet clogging is prevented.
            - As an alternative to sediment forebays, perforated underdrains can be installed where there is an outlet low enough to accept gravity discharge from the underdrain system. Although this does not address water quality, it can enhance ease of maintenance.
        - Modify the outlet structure to provide a 24-hour storage/release of the runoff from a 1-inch, 1-hour rainfall

event. ***The Center for Watershed Protection recommends this control to better protect receiving drainage channels.*** This can typically be accomplished using a manhole structure with a low flow orifice (restrictor). The top of manhole acts as a crest and allows larger storms to overflow into the main pond discharge pipe.

- Wet ponds:
  - Modify the outlet structure to provide 24-hour storage/release of the runoff from a 1-inch, 1-hour rainfall event.
  - Prohibit turf maintenance, fertilization and mowing activities within 10-15 feet (minimum) of the water's edge. Create a "no-mow" zone around the pond edge. Within this zone, mowing and fertilizer/chemical use should be prohibited by ordinance. If desired, signage can be installed along the perimeter of wet ponds to remind adjacent property owners of this restriction. Inspection and enforcement can be managed through the pond inspection program previously referenced. Encourage growth of deep-rooted native grasses, sedges, wildflowers, shrubs and trees. Where access is desired, rip rap could be used to protect the shoreline.
  - Where possible, integrate wetland shelves along the shoreline (see discussion under Sustainable Design Initiatives at the end of this document for examples and illustrations.)

- Of the City's 73 publicly-owned ponds, only a small fraction would be reasonable candidates for retrofit. Retrofits should be targeted to areas of higher potential for non-point source pollution, such as commercial/industrial areas. For cost estimation purposes, it is assumed that approximately 15% of the City-owned ponds (11 ponds) would be viable candidates for retrofit.

The Pennsylvania Environmental Council published a useful guidance document on detention pond retrofits that closely resemble the recommendations in this report. Specific examples are provided that demonstrate how retrofits can be designed and implemented. The following link references this document.

http://www.jrbp.missouristate.edu/rippleeffect/pdf/Improving_Stormwater_Basins_ForBetterStormwaterManagement.pdf

Recommendations – Privately-Owned Detention Ponds

There are over 300 privately-owned detention ponds in the City of Bloomington. Most (about 75%) of these ponds are very small (less than 0.5 acre) and impact relatively small areas. About 25% of these ponds (81 ponds) range from 0.5 acre to over 20 acres. Although the City is not financially responsible for private detention pond maintenance, City Public Works staff is currently burdened with complaints related to the function of these facilities.

Given that the combined footprint of all privately-owned detention ponds in the City of Bloomington (262 acres) exceeds the combined footprint of publicly-owned ponds (221

acres), it can be argued that the overall impact of privately-owned ponds on the City's stormwater infrastructure is somewhat higher than that of publicly-owned ponds. ***Proper inspection and enforcement of maintenance on privately-owned ponds is of critical importance to the City of Bloomington, as it has a direct impact on sediment discharge, flood control, and surface water quality***.

Implement a City-wide private detention pond inspection and enforcement program. This program will help to ensure the ongoing function of privately-owned detention ponds and is part of a sustainable framework of stormwater management infrastructure. The program should consist of the following elements:

a. Annual inspection of privately-owned detention ponds, including the following observations: (applies to dry and wet ponds)
    i. Visual inspection of outlet condition.
    ii. Visual inspection of shoreline for erosion and/or encroachment.
    iii. Report any unauthorized alterations (i.e. removal of restrictor, fill within pond area, placement of hazardous materials in pond footprint) and track inspection status in GIS.
    iv. Inspect and document 81 privately-owned detention ponds (25% largest privately-owned ponds) per year.
    v. Inspect the remaining 220 (+/-) privately-owned detention ponds on a 5-year cycle (~44 ponds per year). Many of these "ponds" are parking lot detention storage areas, so inspection will be limited to the outlet restrictor.

b. Privately-owned detention pond enforcement program
    i. Contact property owner or HOA when inspection reveals any significant problem that would impact detention pond operations.
    ii. Establish a reasonable timeframe for the owner to re-establish the detention pond function to the original design intent.
    iii. When the property owner or HOA does not comply and repairs/retrofits are necessary to ensure adequate function of the City's stormwater infrastructure and prevent downstream flooding, use existing legal tools at the City's disposal to implement and finance emergency repairs:
        a. Special Service Area (real estate tax applied to properties served by a given detention pond that requires maintenance/repair)
        b. Lien
        c. Removal of Stormwater User Fee Credit (if applicable)

c. Assume the following hourly commitment for pond inspection and enforcement:
    i. 60 ponds per year: 2.5 hours per pond for inspection and reporting
    ii. 20 ponds per year: 12 hours per pond for inspection, reporting and enforcement activities
    iii. 44 ponds per year (smaller basins inspected on 5-year cycle): 1.5 hours per pond for inspection and reporting
    iv. ~450 hours per year, or about 0.25 FTE

d. Zero capital costs to the City are assumed for private detention pond maintenance. It is assumed that any emergency repairs made to private detention ponds will be reimbursed to the City through direct owner reimbursement or legal means (i.e. Special Service Area assessments or Liens).

Cost estimates for all above recommendations are included at the end of this document in Table 4.

Including the anticipated City staff commitments for the recommendations under floodplain/floodway encroachment, streambank maintenance, publicly-owned detention ponds, and privately-owned detention ponds, the City should plan for the following increased staffing commitments (above existing levels, as these programs do not currently exist):

Floodplain / floodway encroachment program:	0.25 FTE
Urban channel modification:	0.15 FTE
Streambank maintenance/repair:	0.10 FTE
Public detention pond inspection:	0.30 FTE
Private detention pond inspection:	0.25 FTE
TOTAL	**1.05 FTE**

The above staffing covers administration of the programs only. Additional costs, such as consultant services, construction, materials/equipment, etc., are included in the line items in Table 4 and 5 (cost estimates).

Future Development Areas

Existing Issues / Problems – Future Development Areas

Although the City has right-of-way or easements in most locations for open drainage channels in developed areas, there is a specific need to evaluate the appropriate corridor width for drainage channels to meet the needs of greenways as defined in this document. As stated in the *Urbanized Areas* component of this document, drainage channel corridors in existing developed areas are generally not adequate to accommodate maintenance, pedestrian access, flood control and water quality needs.

As development continues along the west, south, and east fringes of the City, it will be necessary to evaluate the need to set aside land area for the purpose of stormwater management. As each growth area has unique characteristics, it would benefit the City (and developers) to provide some flexibility on establishing greenways. Key attributes in each growth area which will impact greenway layout include:

- Presence of large drainage channels versus small ditches
    - Planning Area 4 contains the Sugar Creek, a 30-40 square mile drainage area, while Planning Area 7 has smaller drainage channels with drainage areas less than 2-3 square miles)
- Presence of wetland/woodland areas
- Presence of existing (mapped) floodplains

The following physical characteristics of future greenways will be covered in the recommendations listed below. These recommendations are based on and coordinated with key findings in other sections of this report, including the Sugar Creek Analysis and the Streambank Assessment.

- Riparian corridor width to accommodate channel grading, floodplain, pedestrian

access, maintenance access and water quality goals
- Specific recommendations for existing drainage channels in Planning Areas 4, 7, and 8
- Regional detention basins, including a discussion of:
    - In-line versus off-line
    - Wet versus dry
    - Potential locations based on topography and expected growth patterns
    - Fee-in lieu rates
- Stormwater detention design guidelines and recommended policy changes for:
    - Publicly-owned ponds
    - Privately-owned ponds
- Future changes to stormwater quality regulations and their impact on local rules

Recommendations – Future Development Areas

A. Trigger Points for Establishment of Greenways

The point at which a Greenway is established should be determined at the staff level during the site plan review process, with appropriate flexibility for site-specific characteristics. Appropriate measures to determine when a greenway should be provided:

- Regardless of drainage area, greenways should be established at the point *an enclosed drainage system becomes an open channel system*. Typically, this occurs at or around ½ square mile (320 acres), as conveying larger drainage areas in a piped system is usually not economically feasible. An example is the area tributary to the Four Seasons detention pond. The drainage area tributary to the pond, 0.37 square mile (236 acres), is primarily piped. Downstream of this pond, open channels convey stormwater to the Sugar Creek (see Figure 7).

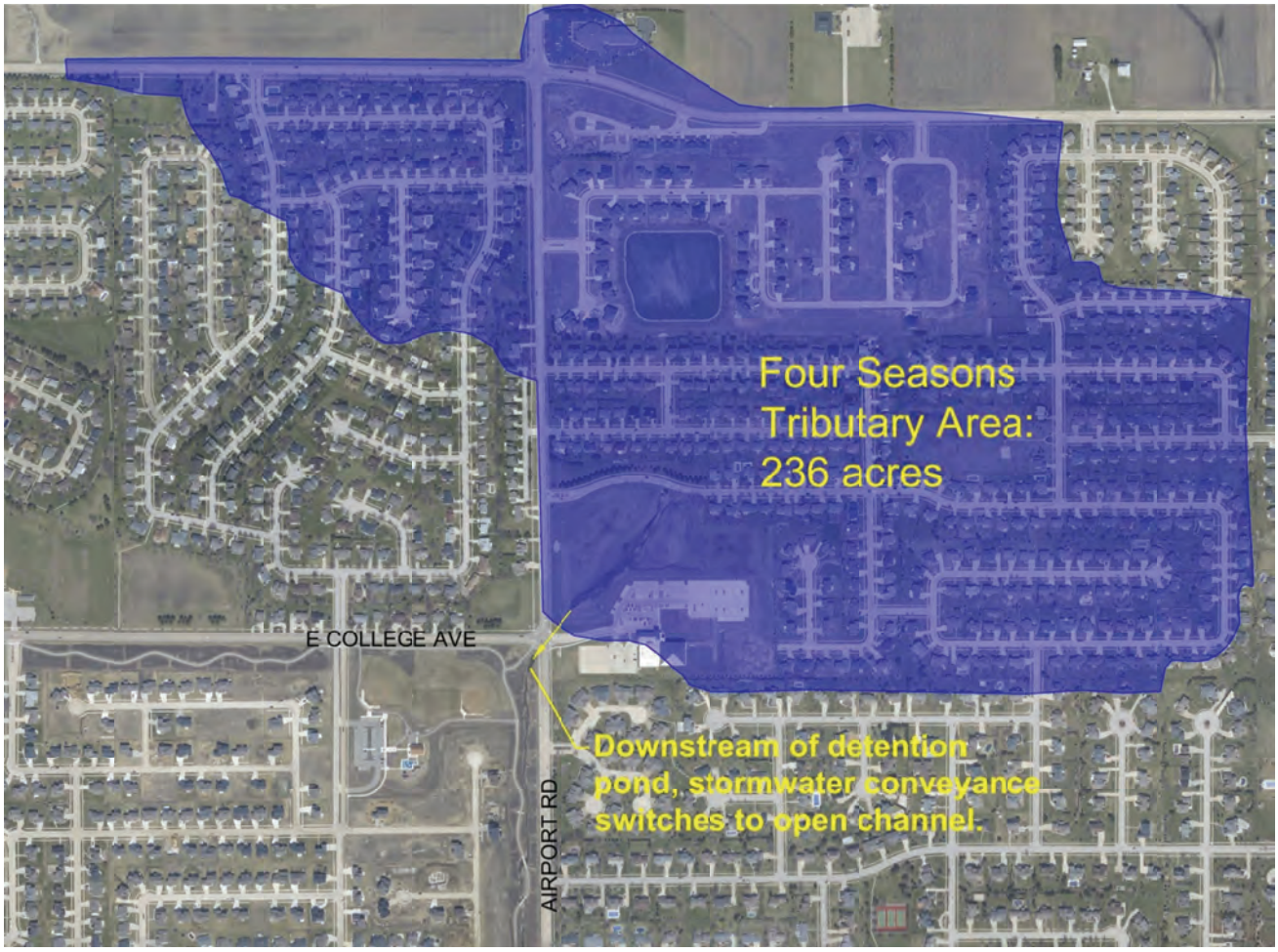


Figure 7
Four Seasons Tributary Area – Transition from Piped to Open Channel

- Other existing examples of conversion from piped to open channel systems in the Sugar Creek watershed include:
  - Tipton Subdivision: 0.5 square mile (322 acres)
  - Shirk Basin Area: 0.45 square mile (289 acres)
  - Hawthorne Subdivision: 0.55 square mile (349 acres)

- Although it is desirable to have a continuous system of greenways, it is generally difficult to regulate their establishment upstream of the point at which a drainage system becomes an open channel, as the drainage infrastructure is generally contained in pipes and is often located within the roadway right-of-way. Changes to the City code could be used to establish requirements for greenways connectivity.

- Any ditched or channelized system draining areas between 1/8 to 1/2 square mile (80 to 320 acres) should consist of a low-flow pipe to convey flows up to the 5-year event (as per current ordinance) with larger flows conveyed in a vegetated flood conveyance channel (consistent with Figure 6 in this document). This will prevent further maintenance issues that have evolved in

developed areas in the City where baseflows have downcut small drainage channels to the point where public safety has been compromised.

- For areas between ½ and 1 square mile (320 and 640 acres) that are drained with an enclosed system, it is necessary to demonstrate adequate flood conveyance for the 100-year storm. In these cases, the developer should provide:

    - Calculations showing that the 100-year peak flow is contained within the pipe without excessive surcharging above the surface along the alignment of the enclosed system, including documentation on flow velocities, junction losses, and the resultant hydraulic grade line.
    - In cases where the pipe is designed to overflow, provide a defined flood route with a right-of-way adequate for the computed flood.

- For areas exceeding 1 square mile (640 acres), require an open channel with greenway. ***Since urban areas exceeding 1 square mile (640 acres) are regulated by IDNR-OWR under floodplain/floodway rules, this is an appropriate trigger point for greenway establishment.*** At this watershed size, greenways should provide (at a minimum) adequate width to convey the 100-year peak flow while preventing any floodway or floodplain encroachment.

- For the purpose of establishing the difference between a natural drainage way (i.e. "lineal park") and an engineered solution (i.e. maintained ditch with or without low-flow pipe), the appropriate cutoff is a drainage area of 1 square mile (640 acres). Below this threshold, the City should expect engineered solutions intended to minimize maintenance concerns and provide efficient drainage. Above this threshold, the City should expect more natural solutions that integrate existing natural features while providing safe pedestrian access.

B. Appropriate Greenway Geometry

Greenway geometry will vary and will depend on the following factors:

1. Total drainage area
2. Existence of existing mapped floodway/floodplain
3. Existence of woodlands and/or wetlands
4. Need for pedestrian and/or linear parkway access (e.g. Constitution Trail)

The City should pursue the following changes to its planning and design policy with respect to establishing greenways:

- Update the City of Bloomington's technical guidance on determining right-of-way / greenway corridor cross section for areas up to 3 square miles (approximately 2,000 acres):

    - Amend Section 6.02(B)(2) of the Manual of Practice to encourage a double-trapezoidal channel design. A double-trapezoidal design

provides a smaller low-flow channel and a wider floodplain shelf to aid in channel maintenance and to reduce flow velocities. The smaller (main) channel should be designed to convey the "bank-full" event, which is widely-considered to be the approximate average of the 1-year and 2-year recurrence interval peak flows. The floodplain shelf (and larger channel) should be sized for the 100-year peak flow.

- Implement a drainage area-based guideline to determine appropriate right-of-way corridor width. Table 1 includes a list recommended corridor widths, adapted from guidance from the Ohio Department of Natural Resources (ODNR), which is based on several studies of watercourses in the eastern United States and includes a protection zone wide enough to include a stream meander belt and floodplain width:

Table 1: Recommended Channel Right-of-Way Widths

Drainage Area Tributary to Stream (ac)	**Minimum Right-of-Way Width (ft)***
< 80 **	50 (minimum width)
80-160 **	75
160-320 **	100
320-640	125
640-1,280	160
1,280-2,000	175
>2,000	200 (minimum) Actual width based on engineering analysis of floodplain width, existing wetlands and pedestrian corridor needs

* *Width = 117 (DA)* $^{0.43}$
DA = Drainage Area (in square miles)
Source: Ohio Department of Natural Resources

** *Provide flexibility on areas less than ½ square mile (320 acres) Appropriate width to be determined during site plan review, but with a minimum width of 50 feet*

Although easements could be considered for smaller drainage areas, dedicated right-of-way should be sought for all design scenarios that include a drainage channel, which typically occurs somewhere between 320 and 640 acres.

The City should work with developers to make greenways (i.e. drainage channels) a central component of a development, as opposed to a hidden afterthought (Figure 8). Instead of being bordered by fences and out-buildings, drainage channels should be bordered by wetlands, woodlands, pathways, and should have a "soft" edge that invites people to the corridor. The Kickapoo Creek improvements completed as part of the City's IEPA 319 Grant (The Grove Subdivision) is an excellent example of the type of corridor that should result from new land development.

Some of the larger streams within the City's planning areas (Sugar Creek and Little Kickapoo) have drainage areas well above the 2,000-acre threshold in Table 1. In these cases, the right-of-way width should be based on conditions unique to those watersheds. Specific recommendations for greenway width for the Sugar Creek and Little Kickapoo in Planning Areas 4, 7 and 8 are included in the following sections.



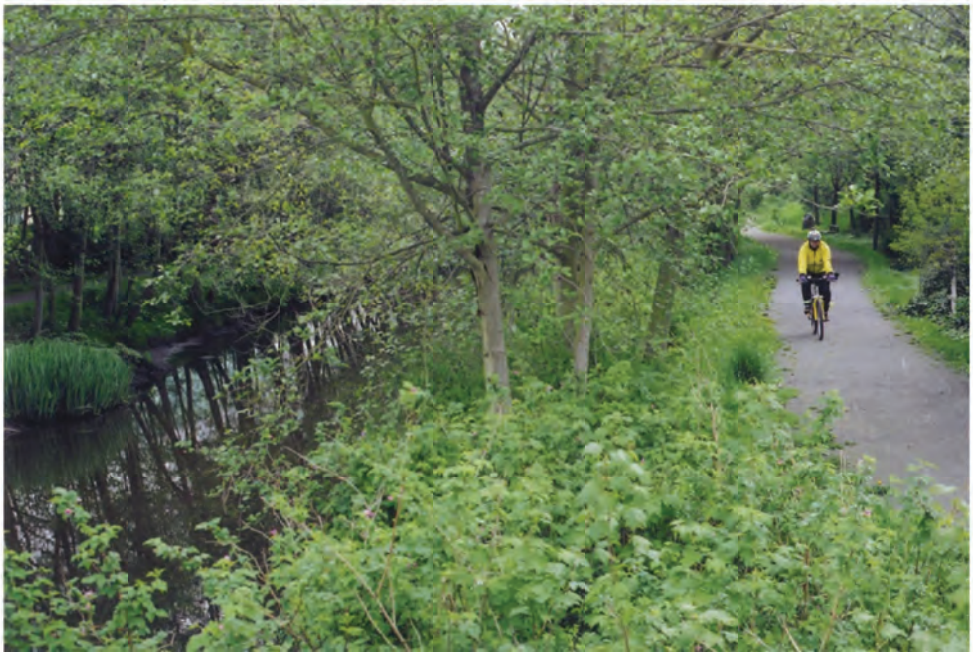


Figure 8
Greenway – Bad and Good Example

- Greenway Widths for Large Drainage Areas (Exceeding 2,000 acres)

  Drainage channel greenway corridor needs are generally straightforward for *First-Order* streams, as the drainage area is smaller and the need for channel cross section width is well-defined by site design and hydrologic/hydraulic analysis. However, the City of Bloomington has some *Second-* and *Third-Order* streams that will likely see land development within the current planning horizon. Each of the three Planning Areas studied as part of this document have unique riparian characteristics that need to be separately evaluated (see Appendix B for the official Planning Area Map).

Definition of 'Stream Order'

This document references stream order (e.g. first-order, second-order, etc.) based on the Strahler stream order, which uses a hierarchy of tributaries with first-order streams representing the most upstream branches, typically where a "blue line" starts on a USGS map. Second order streams occur where two first-order streams converge, and so on.

This definition is unrelated to the Town of Normal's definition of stream order, which is based on the McLean County Stream Order Map. The stream orders in that map are chosen based on local criteria that include micro-tributaries that are not typically counted in the stream order process. As such, a Third-Order stream defined in this document would likely be classified as a Fifth-Order stream in the McLean County Stream Order Map.

  - Planning Area 4: One of the streams that could be described as a Third-Order Stream in the study area is the Sugar Creek on the City's west side (in Planning Area 4, see Figure 9). Through this reach, the Sugar Creek has a drainage area ranging from 30 to 40 square miles. Downstream (west) of Interstate 74/55, there are over 3 miles of stream within Planning Area 4, and many opportunities for land development along this reach of the Sugar Creek. As development continues within this planning area, the Sugar Creek corridor should be addressed as follows:

    - The existing Flood Insurance Study establishes 100-year and 500-year flows ranging from 8,500 cfs - 12,000 cfs between Interstate 74/55 and the west edge of Planning Area 4. The existing floodplain width ranges from 1,200 feet to 2,200 feet between Six Points Road and CR 1025 E. The stream protection area should extend to include the entire floodplain, which will require a wide right-of-way. As development occurs, the Sugar Creek cross section should be allowed to achieve a more "naturalized" state and allow for future channel meandering within the floodplain. Key channel characteristics would be as follows:
      - Longitudinal slope: 0.14% (existing conditions)
      - Main channel: design to convey approximately 1,400 - 1,600 cfs (~ 1.5-year flow event, typical for a "bank-full" discharge). This would require a 40-foot bottom and a minimum depth of 4 to 5 feet.

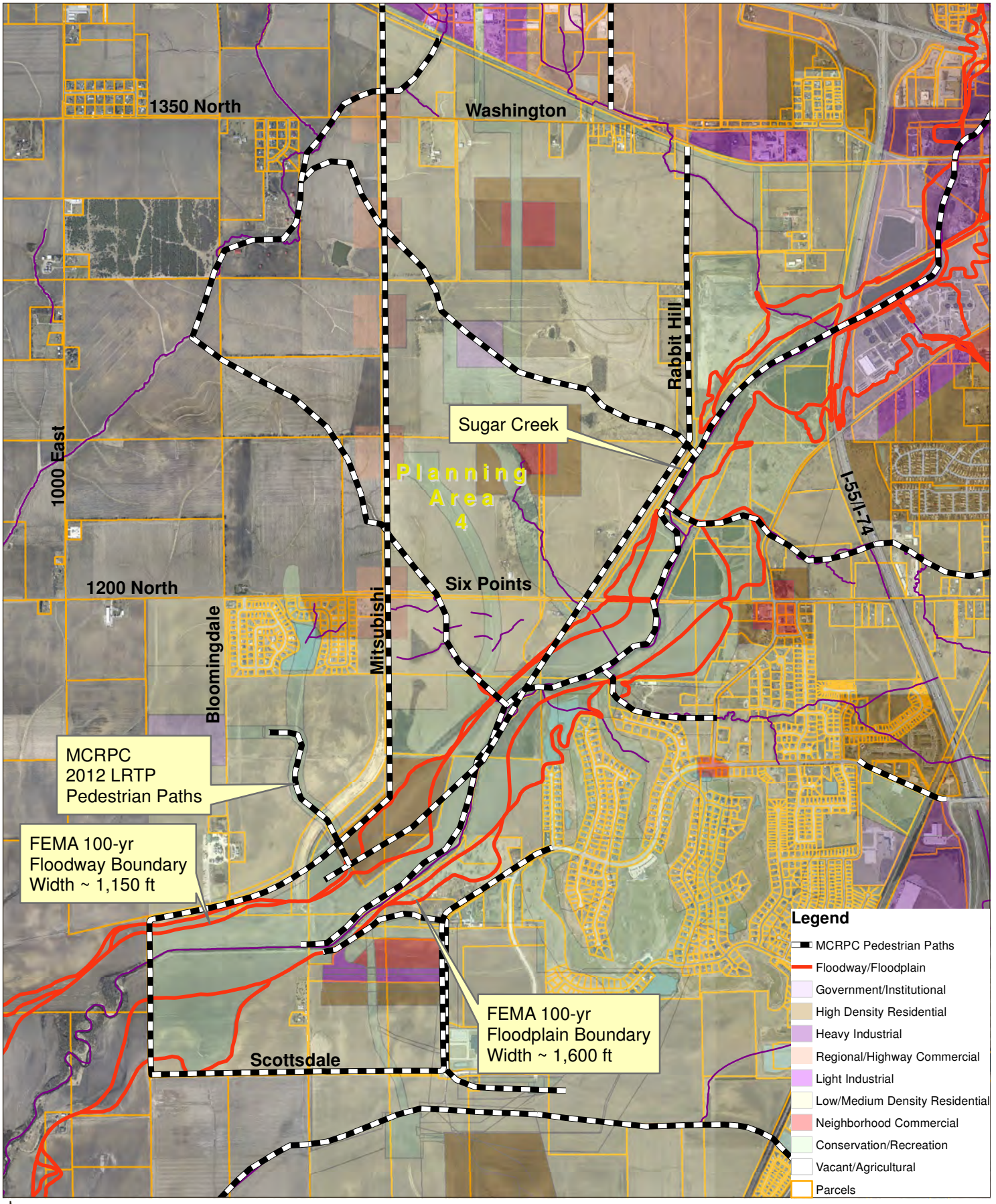
    - Provide a (minimum) 200-foot floodplain shelf on both sides of the channel. This will provide adequate room for flood conveyance and natural stream meander.
- Prior to development, it may be necessary to repair streambank erosion along the Sugar Creek in order to protect roadways and other sensitive features. Conduct a streambank inventory and implement a streambank restoration program. For cost estimating purposes, it is estimated that approximately 10% of this reach of the Sugar Creek (I-74 to CR 1025 E) will require some form of streambank stabilization within the time horizon of this master plan.
- The floodplain fringe* of the Sugar Creek may be a possible location for regional stormwater detention for developments in Planning Area 4. Part C (the following section in this document) includes a discussion of potential regional detention ponds.
- The 2012 Long-Range Transportation Plan (MCRPC) shows numerous bicycle/pedestrian pathways in Planning Area 4 (see Figure 9). Some of these pathways are shown in close proximity to the Sugar Creek. Careful planning will be required to verify pathways are constructed in the right location so as to avoid frequent inundation, although pathways within the floodplain zone should be acceptable.

***Stormwater Detention in Floodplain Fringe**

Constructing detention ponds in the floodplain fringe is feasible in limited cases where the hydraulic impacts of the receiving stream are not anticipated to impact the detention pond. This is usually the case when a pond is constructed along a drainage channel with a tributary area at least 2 orders of magnitude (i.e. 100 times) more than the area draining to the detention pond. This would typically only be possible along reaches of the Sugar Creek, Kickapoo Creek, and the Little Kickapoo within the City's future growth areas.

No detention pond should be constructed within the floodplain fringe without a detailed hydrologic/hydraulic analysis to demonstrate the pond can function adequately in the presence of potential backwater impacts from the receiving waterway. No part of the operating vertical range of the detention pond (normal water level to high water level) should be lower than the 30-year floodplain elevation in the receiving waterway.

In order to minimize future maintenance concerns, only publicly-owned detention ponds should be allowed within the floodplain fringe. No privately-owned detention ponds should be permitted in the floodplain fringe.



0 570 1,140 1,710 2,280 Feet

FIGURE 9
Planning Area 4 - Sugar Creek

OHM
888.522.6711
ohm-advisors.com

- Planning Area 7: The headwaters of the Kickapoo Creek originate in Planning Area 7. Although the upper reaches of this creek are largely undeveloped, *The Grove* subdivision included an enhancement of the Kickapoo Creek north of Ireland Grove Road. Upstream (north) of *The Grove*, two smaller tributaries of Kickapoo Creek flow in a north-to-south direction towards the Kickapoo (see Figure 10). These tributaries are relatively small and should be subject to the recommended channel right-of-way widths described in Table 1 (or as determined by a floodplain mapping effort as described below). As development continues within this planning area, the open drainage channels within the corridor should be addressed as follows:

    - There is approximately 10,000 lineal feet of the Kickapoo Creek within Planning Area 7. About half of this is downstream of *The Grove* and has a drainage area approaching 14 square miles. As development continues north of Ireland Grove Road, the lower half of this reach will likely experience streambank erosion due to changing flow patterns. Streambank stabilization should be implemented in the future as problems areas become apparent. For cost estimating purposes, it is estimated that approximately 20% of this reach will require some form of streambank stabilization within the time horizon of this master plan.
    - Perform a floodplain analysis of the two north-south tributaries of Kickapoo Creek and the main branch of Kickapoo Creek (within Planning Area 7) to define the baseline floodplain characteristics and confirm the appropriate stream buffer geometry. The existing floodplain along the main branch of the Kickapoo Creek is approximate only and should be updated to reflect more accurate hydrologic and hydraulic modeling. This analysis should be completed through the entire Planning Area 7.
    - Establish stream corridor protection widths based on the revised floodplain analysis described above.
    - The analysis completed for *The Grove* as part of the City's IEPA 319 Grant will be useful for establishing appropriate corridor widths north of Ireland Grove Road. The calculations from the *Kickapoo Creek Corridor Restoration* study should be used as a baseline to establish channel cross section and floodplain design for areas immediately upstream (north) of *The Grove* subdivision.
    - The 2012 Long-Range Transportation Plan (MCRPC) shows numerous bicycle/pedestrian pathways in Planning Area 7 (see Figure 10). The actual location of these pathways should be adjusted to accommodate the mapped floodplain and to leave adequate horizontal clearance to accommodate future greenway widths and channel protection zones.

Path: P:\0000_0100\0067110010_Bloomington IL Sewer Master Plan\EWRG\Stormwater Master Plan\SWMP REPORT DOCUMENTS\GIS and Miscellaneous Figures\Greenways Figure 10 - Planning Area 7.mxd

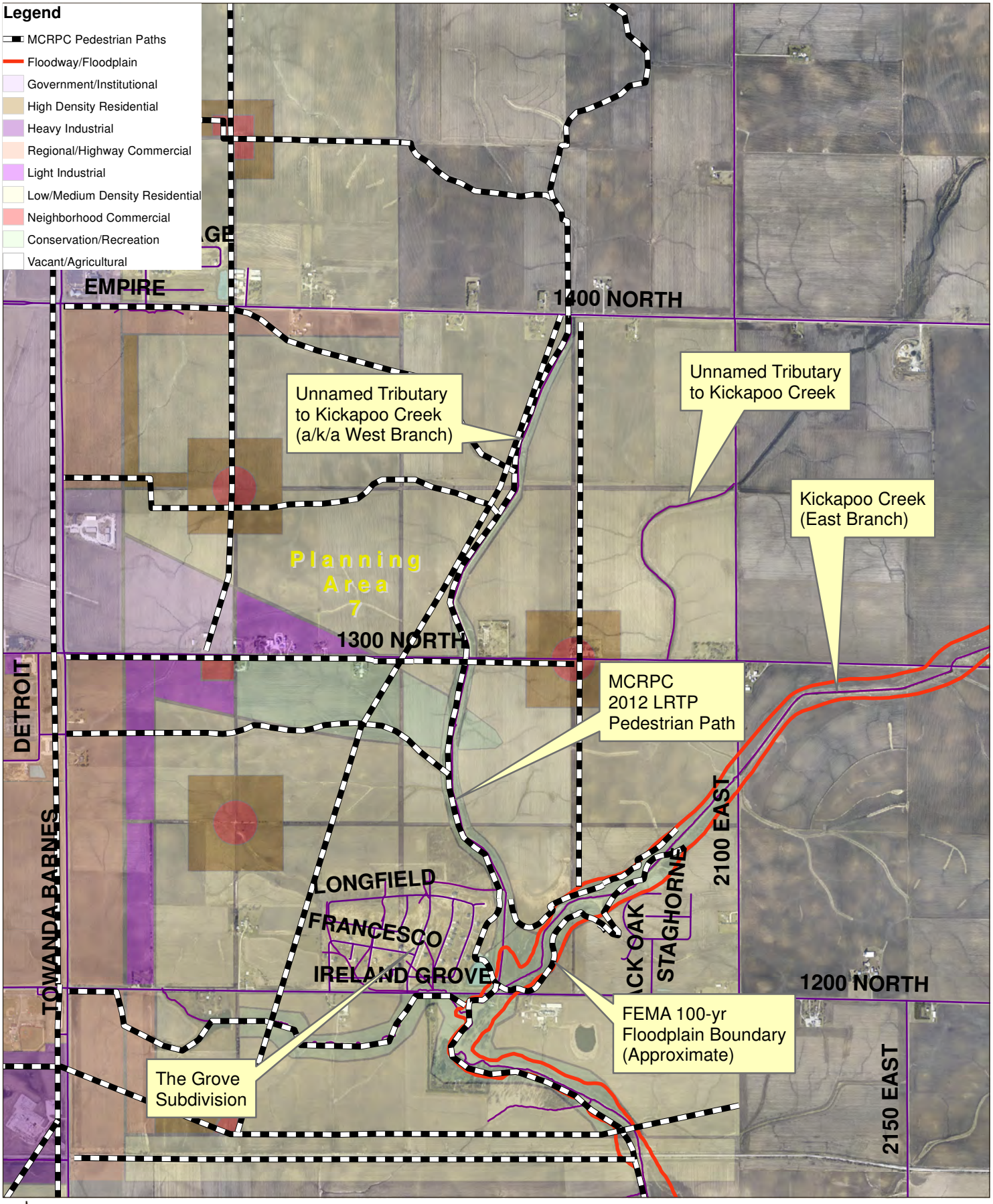


FIGURE 10
Planning Area 7 - Kickapoo Creek

OHM
888.522.6711
ohm-advisors.com

- Planning Area 8: The Little Kickapoo flows through Planning Area 8 and has a drainage area ranging from about 9 square miles to 13 square miles. This is a significant drainage course with an established wooded corridor. Along this reach of stream (about 2 miles from Hamilton Road to Interstate 74), the majority of the creek is in its natural condition, with a meandering channel and densely-wooded floodplain. Based on the FEMA Flood Insurance Study and available contour data, the floodplain width through this reach varies from 250 feet to nearly 500 feet. The proposed land along the Little Kickapoo Creek in this planning area is exclusively light industrial. As development continues south of Hamilton Road, the Little Kickapoo corridor should be addressed as follows:

    - The FEMA Flood Insurance Study shows a significant hydraulic bottleneck at the Norfolk & Western Railway bridge (immediately south of Hamilton Road, see Figure 11) that results in a 7-foot backup in headwater. Removing this bottleneck may result in additional developable area north of Hamilton Road.
        - Removing this hydraulic bottleneck will also introduce the potential for a pedestrian crossing at the enlarged bridge opening, thereby connecting the pathway system along Hamilton Road to the southern portion of Planning Area 8. A below-grade pedestrian crossing would allow for safe passage without crossing the track. *At-grade pedestrian crossings are typically not allowed by railroads unless at a roadway crossing.*
        - This effort should include a hydrologic/hydraulic study that identifies existing flood storage in the headwaters of the railroad culvert and any potential downstream impacts (i.e. increased flow rates) resulting from a bridge enhancement.
    - From Hamilton to Morrissey, the Little Kickapoo has a natural meander but there is no significant greenway along the creek. Expand the greenway to a minimum width for floodplain/floodway conveyance, natural stream meander, and future pathways. This will require a stream protection width varying from about 300 feet to over 500 feet (see Figure 12).

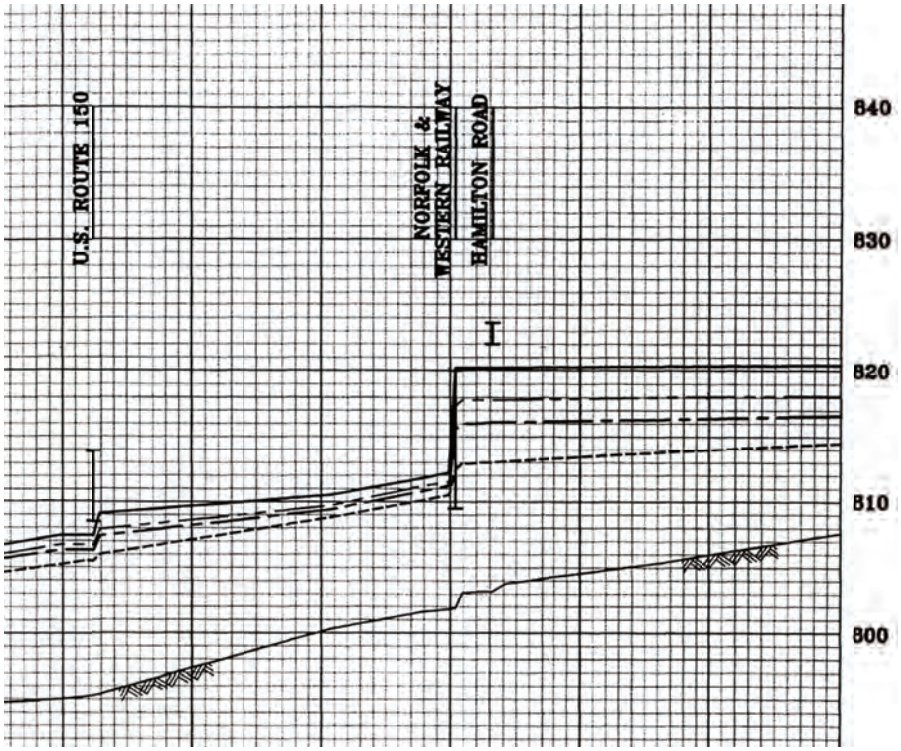
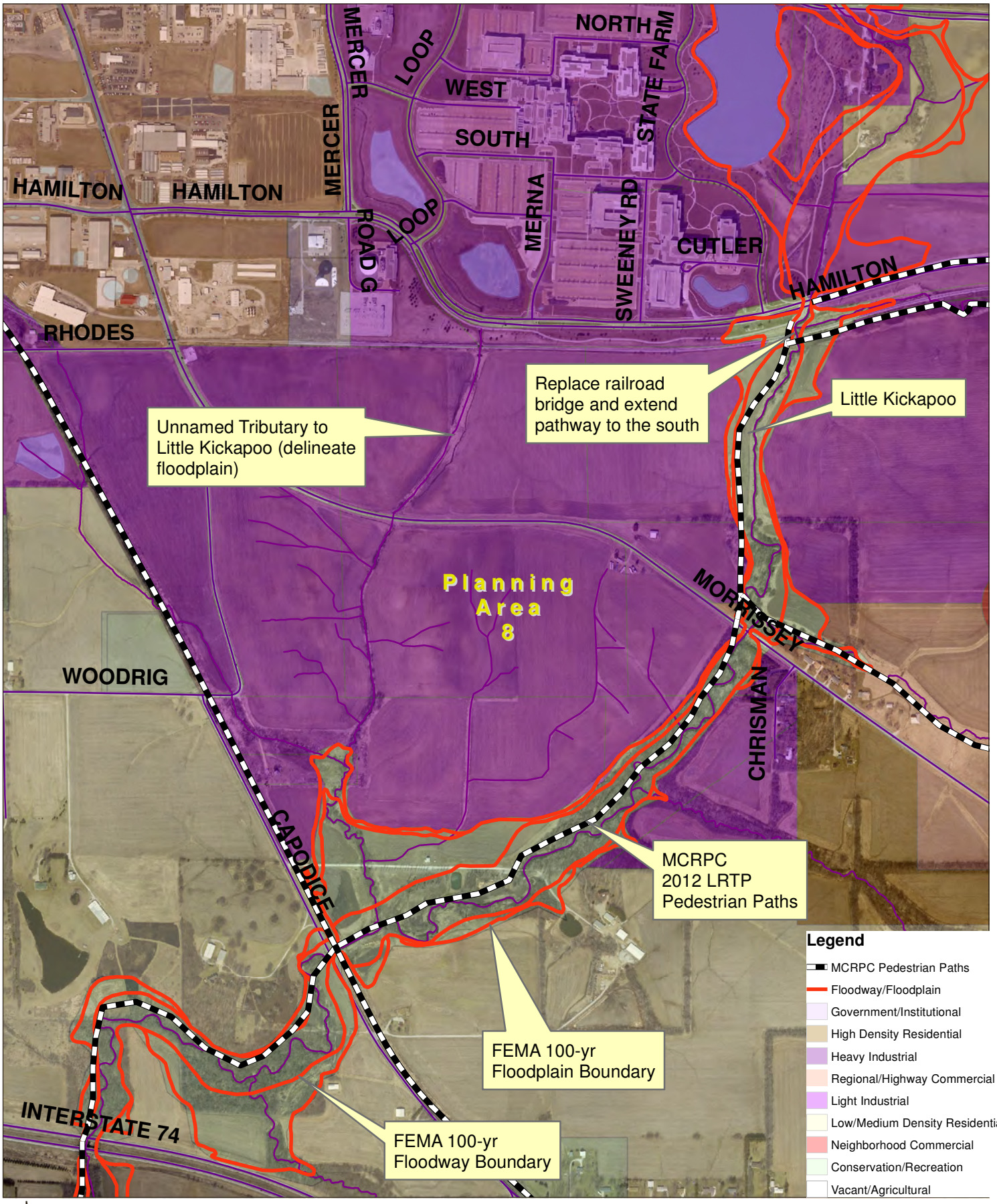


Figure 11
Flood Profile in Vicinity of Hamilton Road
source: FEMA Flood Insurance Study (February 2001)



0 270 540 810 1,080 Feet

FIGURE 12
Planning Area 8 - Little Kickapoo

OHM
888.522.6711
ohm-advisors.com

- There is an unnamed tributary to the Little Kickapoo (see Figure 12) approximately one-half mile west of the Little Kickapoo. The floodplain for this tributary should be defined so as to provide an adequate streambank protection area prior to development. Additionally, some streambank maintenance may be necessary along this reach. For cost estimating purposes, it is estimated that approximately 20% of this reach will require some form of streambank stabilization within the time horizon of this master plan.
- Downstream of Morrissey (through the south edge of Planning Area 8), the Little Kickapoo has a wide wooded floodplain, ranging from 250 feet to over 600 feet. As development occurs along this reach, this corridor should be preserved, but with the following enhancements:
    - Consider mixed used development along the creek corridor (as opposed to the planned light industrial). The unique features of the Little Kickapoo and its floodplain corridor may better be integrated with residential/commercial clusters.
    - Selectively remove trees to accommodate the proposed pedestrian/bicycle pathway (MCRPC 2012 LRTP) and to allow for easier access to the creek for maintenance purposes. The high density of trees will prevent any meaningful (and necessary) streambank restoration activities.
    - Conduct a streambank inventory and implement a streambank restoration program. For cost estimating purposes, it is estimated that approximately 20% of this reach will require some form of streambank stabilization within the time horizon of this master plan.

For all greenways described in this section, the City should provide some flexibility to allow for floodplain fill within the floodplain fringe. Because the floodplain boundary is often sinuous with many floodplain "fingers" extending into potentially-developable areas, some fill may be necessary to accommodate land development. Generally, floodplain fill should only be allowed when the following conditions are met:

1. All proposed fill is outside the floodway boundary.
2. The developer can demonstrate full compliance with the City's Floodplain Ordinance, which may require compensatory cut in the floodplain in the vicinity of the proposed fill and, in some cases, hydraulic calculations to demonstrate no adverse impact.

C. Land Dedication for Greenways

Upon establishing the appropriate greenway corridor widths, the type of land dedication needs to be determined. Easements and rights-of-way have been used by the City of Bloomington in the past to provide access to drainageways. Although easements are typically acceptable for smaller infrastructure, they have significant limitations when the drainage area increases and floodways/floodplains have a larger impact on neighboring properties.

In cases where there is an open drainage channel (nearly always the case for drainage areas exceeding 640 acres), it is inappropriate for private property to coincide with this drainage "backbone" as it currently does in the case of easements. Establishing rights-of-way keeps the property lines away from the main drainage features and allows the City to better control what happens along the greenway.

When establishing rights-of-way for greenways, the City should be prepared to assume the cost of maintaining the drainage corridor. As the City grows along the Sugar Creek, Little Kickapoo Creek and Kickapoo Creek, the added cost of corridor maintenance will need to be considered for budgeting purposes.

Easements versus Rights-of-Way

The following recommendations are offered for setting policy on establishing public access to drainage channels and greenways:

- Drainage area less than one square mile (640 acres):
  - For ditches/channels draining areas between 320 acres and 640 acres, establish a dedicated right-of-way to include the entire cross section, wide enough to accommodate the flow spread of the 100-year recurrence interval peak flow rate, as well as trails and maintenance pathways.
  - For ditches with low-flow pipes, establish a drainage easement wide enough to accommodate the piped ***and*** flood conveyance. The easement should be wide enough to accommodate the flow spread of the 100-year recurrence interval peak flow rate.
  - Prohibit the construction of any fences, out-buildings, or any other appurtenance that could inhibit flood conveyance within the easement.
  - Require developer to provide maintenance access points along entire length of easement. These points may be located at crossing roadways or can be provided via easement. Each access point must be wide enough to accommodate a City maintenance vehicle and must be designed so as to allow safe ingress/egress from the easement area.
- Drainage areas between one and three square miles (640 to ~2,000 acres):
  - Establish a dedicated Right-of-Way with a minimum width as described in Table 1.
  - Add Right-of-Way width as necessary to accommodate floodplain, woodland and wetland areas (Right-of-Way width may vary within a single development).
  - If a pedestrian/bicycle pathway cannot be accommodated within the designated Right-of-Way due to woodlands, wetlands, or unfavorable topographic conditions, add additional Right-of-Way width as necessary to accommodate a 10-foot wide pathway.
- Drainage areas exceeding three square miles (2,000 acres):
  - Set Right-of-Way width to accommodate floodplain and associated woodlands and wetlands.
  - Apply the same criteria for pedestrian/bicycle pathways as described above

A dedicated right-of-way is recommended for all above scenarios other than the low-flow pipe and overflow ditch option, which is only applicable to drainage areas less than 640 acres.

D. Regional Stormwater Detention

Regional stormwater detention provides flood control and water quality benefits while relieving developers of the hassle of detention pond design and construction, although they typically "buy in" to a regional system if their development is tributary to a publicly-owned detention pond. It also allows the City to control the design characteristics of the detention pond, thereby ensuring the City's goals for flood control and stormwater quality are met.

There are two primary approaches to regional detention, in-line and off-line. Table 2 summarizes the characteristics of each:

Table 2
Regional Stormwater Detention

Type of Regional Detention	Description	Benefits	Drawbacks
In-Line	Typically wet detention basins in-line with the main channel, although they should typically not be used when the drainage area is greater than 1 square mile (640 acres).	• Fewer, more centralized detention pond facilities. • Increased property values along pond shoreline. • Promotes upstream development.	• May trigger Illinois Dam Safety rules for Class III Dams* • Shoreline maintenance required. • Not practical as a use for compensatory storage for a single development. Must be designed for entire tributary area.
Off-Line	Wet or dry (or combination wet/dry) basins offset from the main channel. Usually contain wetland pockets for water quality enhancement and dry shelves for flood storage or other multi-use purposes such as soccer fields.	• Smaller, more naturalized basins with fewer shoreline maintenance needs. • Additional water quality benefits (as compared to in-line basins). • Promotes upstream development. • Fewer regulatory hurdles**	• Limited scalability: Typically, off-line basins are smaller and more numerous than in-line basins.

* *Class III Dam Safety rules apply to detention ponds with a developed tributary area greater than 640 acres or if the pond has an impounding capacity exceeding 50 acre-feet provided that the dam height is greater than 6 feet.*

** *IEPA / IDNR staff typically prefer regional detention basins to be off-line, as inline basins may negatively impact fish passage and disrupt other riparian functions (this is especially true for "blue line" streams with drainage areas exceeding one square mile).*

Based on our analysis of detention pond footprints in the upper reaches of the Sugar Creek watershed, the average footprint required to meet current City of Bloomington standards for stormwater detention is about 6.5% of tributary developed area. This is based on the total area dedicated to existing detention ponds divided by the total

developed areas tributary to the existing ponds and is representative of the City's current requirement to limit the 100-year peak post-development discharge to a 3-year pre-development level.

The actual footprint needed would depend on the intensity of land use, soil conditions, average land slopes, allowable storage depth, and future stormwater detention standards. Based on the recommendations in the *Sustainable Design Initiatives* section of this document, the required footprint for regional detention could likely be reduced to about 4% of total developed land area. For the purposes of siting potential regional pond locations, the 4% footprint was used. Additional area will be necessary if the stormwater detention standards remain in their current form.

Potential regional stormwater detention areas are illustrated in Figure 13 (Bloomington West, Planning Area 4), Figure 14 (Bloomington East, Planning Area 7) and Figure 15 (Bloomington South, Planning Area 8). Both in-line and off-line regional detention ponds are illustrated, based on the tributary drainage area. *Although these basins have not been sized based on any hydrologic analysis*, they are situated in strategic areas where topography and drainage patterns may be ideal for regional detention. Additional planning, developer coordination, hydrologic analysis and design will be necessary prior to confirming basin location and size.

Several regional stormwater detention areas coincide with the bicycle/pedestrian pathways in the MCRPC 2012 Long-Range Transportation Plan (see Figures 13-15). The City should coordinate with the MCPRC and land developers to ensure that any new pathways are constructed in order to accommodate stormwater detention footprints. This may require changing the proposed alignments of some pathways.

The regional detention ponds illustrated in Figures 13, 14 and 15 are for general planning purposes only.

- Planning Area 4 (Bloomington West)
    - The future land development areas on the City's west side (as defined by the Comprehensive Plan) are primarily west of I-74, south of Route 9, and north of Six Points Road. The majority of these areas are in the headwaters of first-order streams that discharge to Sugar Creek, which flows southwesterly along the south boundary of this growth area.
    - Six regional detention ponds are recommended in the Bloomington West area (see Figure 13):
        - Two off-line facilities along the north floodplain fringe of Sugar Creek (on the south side of Six Points Road). These ponds would provide detention storage for developments on the north and south sides of Six Points Road and provide water quality benefits by reducing stormwater pollutant loading to Sugar Creek.
        - Two in-line facilities located along smaller drainage channels serving the center of this growth area (in-line facilities were chosen in this area due to the relatively small drainage areas tributary to these facilities).

- Two off-line facilities along a tributary immediately south of Washington Road. These regional basins would serve areas immediately west and southwest of the basins.
- Some of the detention ponds are located partially or wholly within the Sugar Creek floodplain. Because of the large difference in drainage areas between Planning Area 4 and the Sugar Creek watershed, this scenario should be acceptable because the peak detention pond storage should not coincide with the peak flow in the Sugar Creek (see the *Stormwater Detention in Floodplain Fringe* textbox on Page 22).
- The total footprint identified for regional detention in this area is 30 acres, serving a development area of approximately 800 acres. This footprint represents about 3.8% of developable land, which represents the majority of anticipated detention needs in this area.
- The actual footprint necessary to achieve stormwater management goals in this area can be confirmed after a hydrologic analysis and determination of storage volumes available at each location. This effort cannot be fully implemented until early coordination with land developers.

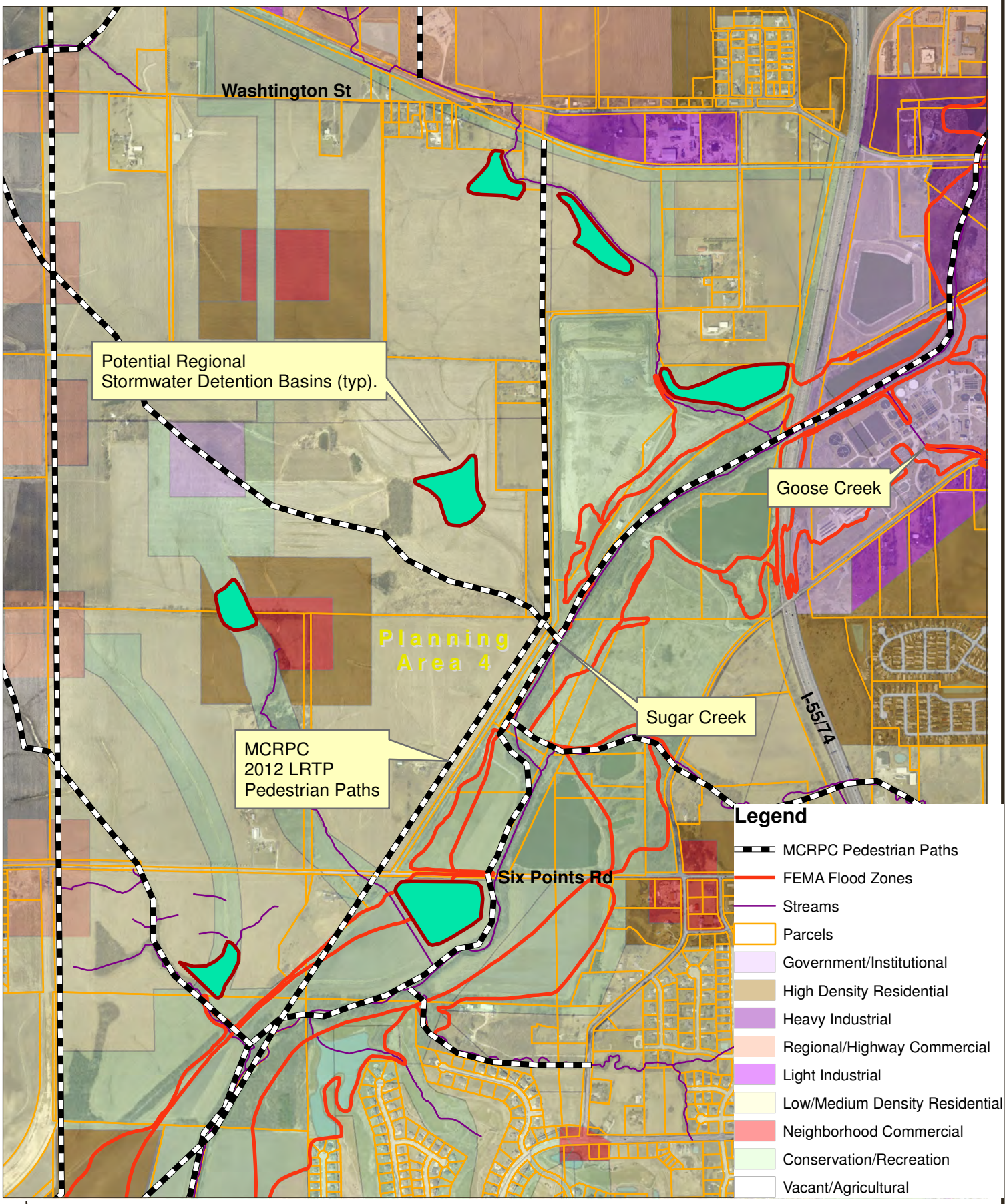


FIGURE 13
Planning Area 4 - Regional Detention

OHM
888.522.6711
ohm-advisors.com

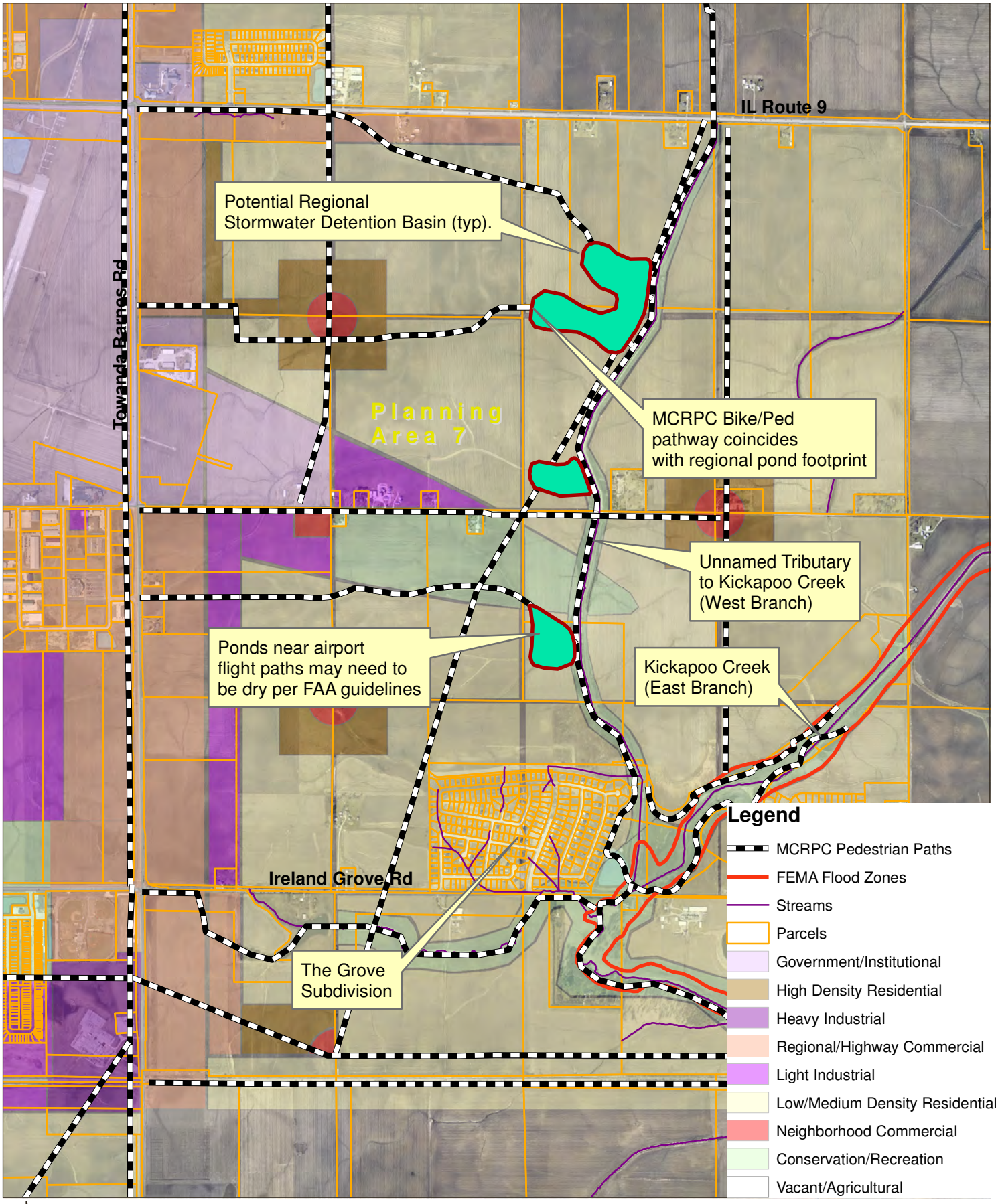
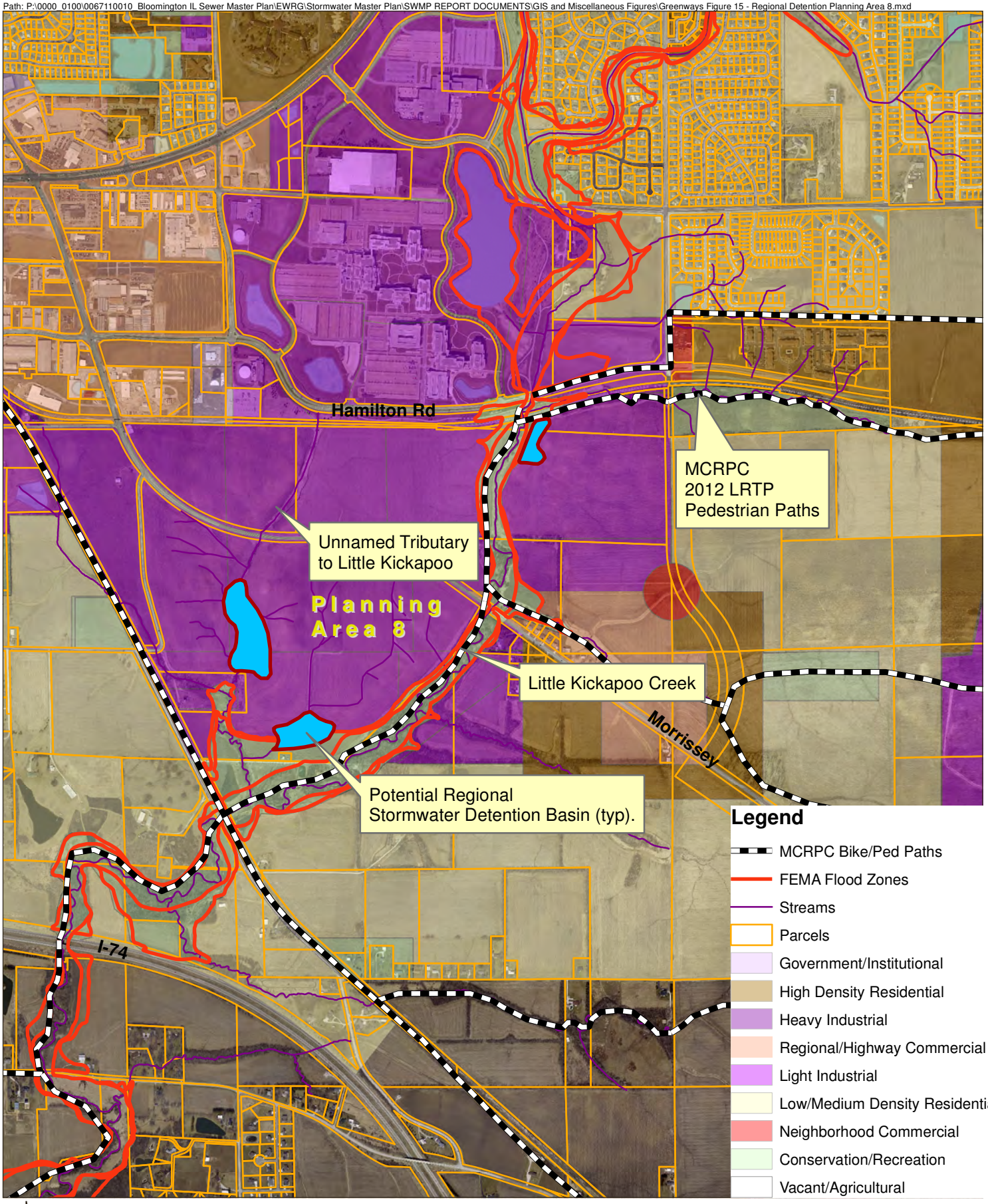


FIGURE 14
Planning Area 7 - Regional Detention

OHM
888.522.6711
ohm-advisors.com

Path: P:\0000_0100\0067110010_Bloomington IL Sewer Master Plan\EWRG\Stormwater Master Plan\SWMP REPORT DOCUMENTS\GIS and Miscellaneous Figures\Greenways Figure 15 - Regional Detention Planning Area 8.mxd



0 410 820 1,230 1,640 Feet

FIGURE 15
Planning Area 8 - Regional Detention

OHM
888.522.6711
ohm-advisors.com

- Planning Area 7 (Bloomington East)
    - The future land development areas on the City's east side (as defined by the Comprehensive Plan) are primarily east of Towanda Barnes Road, south of Route 9, and north of Ireland Grove Road. The majority of these areas are in the headwaters of first-order streams that discharge to an unnamed tributary of the Kickapoo Creek, which ultimately discharges to the south boundary of Planning Area 7.
    - The two remaining alignment options for the future East Side Highway will impact this growth area and also provide an opportunity to leverage the need for borrow material to create regional detention ponds. The proposed regional ponds illustrated in Figure 13 are each located immediately east of the easternmost highway alignment. They would be ideally situated to serve as borrow pits and could be expanded as necessary to accommodate the City's needs for regional stormwater detention.
    - Three regional detention ponds are recommended in the Bloomington East area (see Figure 14):
        - Each proposed regional pond is located on a minor tributary to an unnamed branch of the Kickapoo Creek. None of the proposed regional detention ponds is proposed to be in-line with the unnamed branch of the Kickapoo Creek.
        - None of the regional detention ponds is located within an official floodplain, although the pond locations and geometries may need to be adjusted once the floodplain for the unnamed tributary has been delineated.
        - The total footprint identified for regional detention in this area is 47 acres, serving a development area of approximately 1,200 acres between the unnamed tributary and Towanda Barnes Road, all north of *The Grove* subdivision. This footprint represents about 4.0% of the area tributary to the ponds, which represents the majority of anticipated detention needs between Towanda Barnes Road and the unnamed tributary.
        - The actual footprint necessary to achieve stormwater management goals in this area can be confirmed after a hydrologic analysis and determination of storage volumes available at each location. This effort cannot be fully implemented until early coordination with land developers.

- Planning Area 8 (Bloomington South)
    - The future land development areas on the City's south side (as defined by the Comprehensive Plan) are primarily south of Hamilton Road, along the Little Kickapoo Creek. These areas drain to small tributaries that outlet to the Little Kickapoo between Hamilton Road and I-74. Since the Little Kickapoo Creek has a relatively large drainage area in Planning Area 8, no regional detention ponds are proposed directly on the Little Kickapoo.
    - Three regional detention ponds are recommended in the Bloomington South area (see Figure 15):

- Each proposed regional pond is located on a minor tributary to the Little Kickapoo, each with a relatively small (<160 acres) drainage area.
- One of the regional detention ponds is located along the northern flood fringe of the Little Kickapoo. With proper planning and design, this location should accommodate a functioning detention pond.
- The total footprint identified for regional detention in this area is 17.5 acres, serving a development area of approximately 262 acres, primarily along the Morrissey corridor west of the Little Kickapoo. This footprint represents about 6.7% of the area tributary to the ponds. This is a higher percentage than those of Planning Areas 4 and 7, as the proposed land use in this area is Heavy Industrial which will likely require additional storage volume.
- Additional detention ponds will be necessary to serve outlying portions of Planning Area 8, as regional detention was not explored
- The actual footprint necessary to achieve stormwater management goals in this area can be confirmed after a hydrologic analysis and determination of storage volumes available at each location. This effort cannot be fully implemented until early coordination with land developers.

Where possible, regional detention ponds should be designed as wet ponds (i.e. over-excavated to provide permanent water storage). Wet detention provides water quality benefits that cannot be duplicated under a dry detention design, and they help to provide opportunities for increased property values. Table 3 includes a summary of the benefits and drawbacks of each stormwater detention scenario.

In areas surrounding the Central Illinois Regional Airport, detention pond design will need to follow FAA guidelines. The FAA strongly recommends that off-airport stormwater management systems (within the flight paths of the active runways) be designed and operated so as not to create above-ground standing water and that they be designed for a maximum 48-hour detention period after the storm, remaining dry between storms. Furthermore, these ponds should be clear of any vegetation that might provide food or cover for wildlife that could pose a strike hazard to airplanes. Where possible, these ponds should include underdrain systems to reduce the chances of saturated soils and standing water. Most of the regional detention ponds illustrated in this document should not be impacted by this rule, as these ponds are shown outside the immediate flight paths of the active runways. However, the proposed regional ponds in Planning Area 7 (north of The Grove Subdivision) should be evaluated on their potential to be impacted by FAA rules prior to design.

Table 3
Wet vs. Dry Stormwater Detention

Type of Stormwater Detention	Description	Benefits	Drawbacks
Wet	Permanent water pool, typically 8-foot minimum depth for establishment of fish population. Typically requires minimum drainage area of 25 acres to maintain designed water level.	• Enhanced water quality through pollutant settling. • Increased property values along pond shoreline. • Promotes aquatic habitat. • Provides opportunities for public access, including parks, gathering spaces, scenic pathways.	• Requires maintenance of shoreline against erosion (can be minimized with grade control and native vegetation along shoreline). • More expensive to construct (additional excavation and shoreline stabilization). • Potential for nuisance issues, such as mosquitoes, algae blooms, unwanted aquatic vegetation, strong organic odors, and sedimentation buildup
Dry	Vegetated basin, designed to remain dry except for wet weather events. Typically drains within 24-48 hours after design event. No minimum drainage area.	• Can serve multiple functions (i.e. soccer field doubling as detention basin). • Less expensive to construct (as compared to a wet detention pond). • Ideal for small developments. • Preferred alternative near airports.	• Pond bottom typically becomes unsightly without regular maintenance and underdrain system (buildup of debris and sediment). • Provides flood control only, and does not address water quality (unless micro-pool or sediment trap is installed).

Both wet and dry basins require regular inspection and maintenance, regardless of whether they are publicly- or privately-owned. In general, pond bottom (dry pond) and shoreline (wet pond) maintenance is more straightforward when the ponds are on City-owned property. Although this increases annual operating costs for the City, it helps to ensure that detention ponds are operating as designed and continue to protect the public interest.

E. Sustainability Design Initiatives

The City's current Manual of Practice sets the 100-year stormwater detention volume based on limiting post-development flows to the pre-development 3-year peak flow rate. Although this provides ample storage volume and reduces downstream peak flows, it unnecessarily reduces peak flows below the natural runoff response and accelerates the erosive processes on natural drainage channels within and downstream of the City (see Figure 16 for a detention pond hydrograph comparison).

Detention Ponds and Stream Erosion

Numerous technical papers have been published which demonstrate that detention ponds, if designed to over-restrict flows and discharge over an extended period, can have a negative impact on streambank stability. This happens when streambanks (downstream of a detention pond) are subjected to an increased period of saturation and potentially-erosive flow rates following wet weather events.

Detention pond design best practices have been trending towards mimicking pre-development hydrology. This often results in a more quickly-receding limb of the flow hydrograph, thereby limiting the impact of extended increased flows (see Figure 16). Papers that support this theory include:

US EPA, Green Infrastructure in Total Maximum Daily Loads (TMDLs), Green Infrastructure Permitting and Enforcement Series, Supplement 4, http://water.epa.gov/infrastructure/greeninfrastructure/upload/EPA-Green-Infrastructure-Supplement-4-061212-PJ.pdf

Simon, A., Langendoen, E.J., Thomas, R., 2003, *Incorporating Bank-Toe Erosion by Hydraulic Shear into a Bank-Stability Model: Missouri River, Eastern Montana*, First Interagency Conference on Research in the Watersheds, Benson, Arizona.

Peterson, H., Kacvinsky, G., 2004, Cool Creek Watershed Management Plan Modeling Approaches to Mitigate Effects of Urbanization on Downstream Channel Reaches, Proceedings of the Water Environment Federation, Watershed 2004, pp. 1107-1127.

Stormwater detention design is currently trending toward a "watershed" approach to stormwater management. Many communities are turning away from the prescribed over-restriction of stormwater discharge and changing to a practice of ***mimicking predevelopment hydrology***. Expected changes to IEPA and US EPA stormwater regulations also support this shift in design philosophy. The primary elements of this philosophy, also known as Low Impact Development (LID), are as follows:

- Set the post-development peak runoff to a level equal to the pre-development peak runoff. Attempt to match the hydrograph shapes for storms of varying duration and magnitude.
- Provide flow controls for more frequent (i.e. 1-year, 2-year) events to promote stormwater quality and promote creek/channel stability in receiving waterways. This is typically, but not always, accomplished through infiltration.
- Cluster development in higher densities away from natural features, leaving larger undeveloped areas along wetlands and streams.

Applying these philosophies to the City of Bloomington's Manual of Practice will accomplish the following:

- Reduced detention pond footprint and increased land area for development and greenway establishment.
- Enhanced stormwater quality.

- Healthier drainage channels, reduced streambank erosion, and enhanced aquatic habitat.
- More interesting land development patterns with increased access along greenways and increased connectivity between subdivisions through pedestrian/bicycle pathways along greenways. *This is accomplished through cluster development, where natural features (i.e. streams, wetlands, woodlands) are preserved in lieu of higher densities in non-sensitive areas.*

Numerous cities, counties, states and professional organizations have adopted this philosophy, including:

- State of Delaware
- State of South Carolina
- State of Maryland
- State of Wisconsin
- State of Michigan
- State of Minnesota
- King County (Seattle, WA)
- City of Colorado Springs, CO
- US EPA
- Center for Watershed Protection

Recommendations

- Stormwater detention requirements
    - Amend Section 6.02(C)(1)(c) to include three design storms for detention/retention pond design, including:
        - 2-year, 24-hour storm (Huff 3rd Quartile rainfall distribution)
        - 10-year, 24-hour storm (Huff 3rd Quartile rainfall distribution)
        - 100-yr, 24-hour storm (Huff 3rd Quartile rainfall distribution)
    - Amend Section 6.02(C)(1)(c)(ii) to change the pond volume calculation methods for developments larger than 5 acres. Instead of allowing the Rational Method, require the use of a stormwater model to demonstrate the routing of proposed runoff through a detention basin. This could be accomplished using WinTR-20, HEC-HMS, SWMM, PondPack, or similar programs.
        - This will require modifying Section 6.02(C)(1)(a) to limit the use of the Rational Method to sites smaller than 5 acres.
    - Amend Section 6.02(C)(1)(c)(iii) to state that the 100-year allowable release rate shall match the pre-development 100-year runoff rate based on established runoff potential by watershed. *The City should have the discretion to require reduced peak discharges if it is demonstrated that the receiving pipe or stream cannot accommodate the design flow rate.* It will be preferable for the City to calculate the stormwater runoff potential by watershed and publish these rates (cfs/acre) in the Manual of Practice. The same pre- versus post-development standard should also apply to the 2-year and 10-year storms.
        - A hydrologic analysis should be performed in the key Planning Areas (4, 7 and 8) to establish watershed-specific release

rates (cfs/acre) for each design storm, tailored to the topography and soil conditions for each region (see following example). In general, hydrologic analyses will likely reveal that the existing peak flow requirements are overly-restrictive.
    - This change will help to reduce stormwater detention costs, providing opportunities to invest in creating and maintaining a healthy greenway.
- Add a requirement to Section 6.02(C)(1)(c)(iii) that allows the City to establish a lower allowable release rate in the case of a restricted outlet capacity that is below the standard release rate. This may be necessary in urbanized areas where the detention pond outlet is a storm sewer pipe that is at or near its capacity, or in combined sewer service areas.

Watershed-Specific Release Rate: Example for Planning Area 4

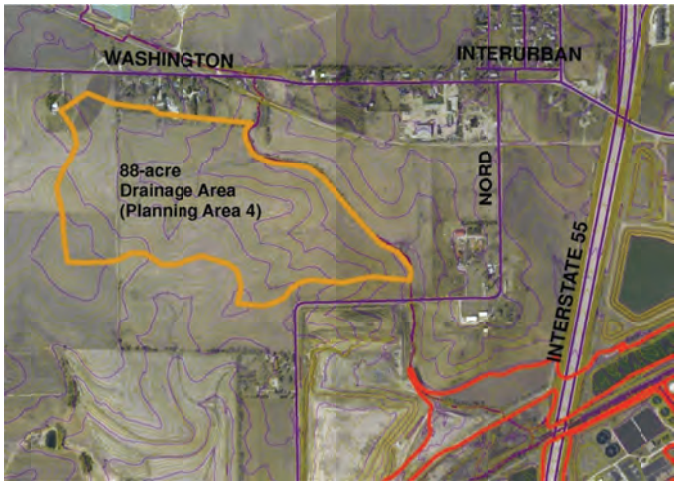
- 88-acre Subarea
- Soils: NRCS Type B, CN = 74
- Topography – Rolling (average slope >2.5%)
- 100-year pre-development peak flow (24-hour rainfall duration) = 45 cfs

Limit 24-hour post-development peak flow to:
45 cfs (0.5 cfs/acre)

Using the existing Manual of Practice:

3-year peak flow (24-hour rainfall duration):
15 cfs (0.17 cfs/acre)

- Existing detention standards may result in over-design of detention ponds
- Proposed changes will provide a better match to existing hydrologic conditions
- Proposed changes will help to minimize costs for land development without negative environmental impacts



- Update Section 6.02 to include a reference to NOAA Atlas 14 rainfall depths and durations. The NOAA Atlas 14 data represent the most recent and relevant statistics on rainfall exceedance probabilities.
- Remove the technical references from Exhibit P for stormwater calculations. Much of this information (including rainfall data) is

updated on a regular basis and should instead be referenced by "latest available version" or similar. Coefficients and calculation worksheets represent tools that are available to design engineers and these worksheets are typically embedded in stormwater analysis software that is used by most land development engineers. It should be the responsibility of those engineers to use the latest available tools to meet the requirements of the Manual of Practice.

- Stormwater calculations for site runoff control should include, at a minimum, the following detail:
  - Stormwater management narrative that explains the methodology of calculations (i.e. software used) and summarizes site constraints, key assumptions, and design recommendations.
  - Stormwater routing model data (input and output data, including graphical depiction of hydrographs for design storms).
  - Calculations demonstrating capacity of receiving pipe/channel.
  - Illustrations showing breakdown of drainage areas, flow paths, detention pond inlet/outlet structures, and receiving pipe/channel.

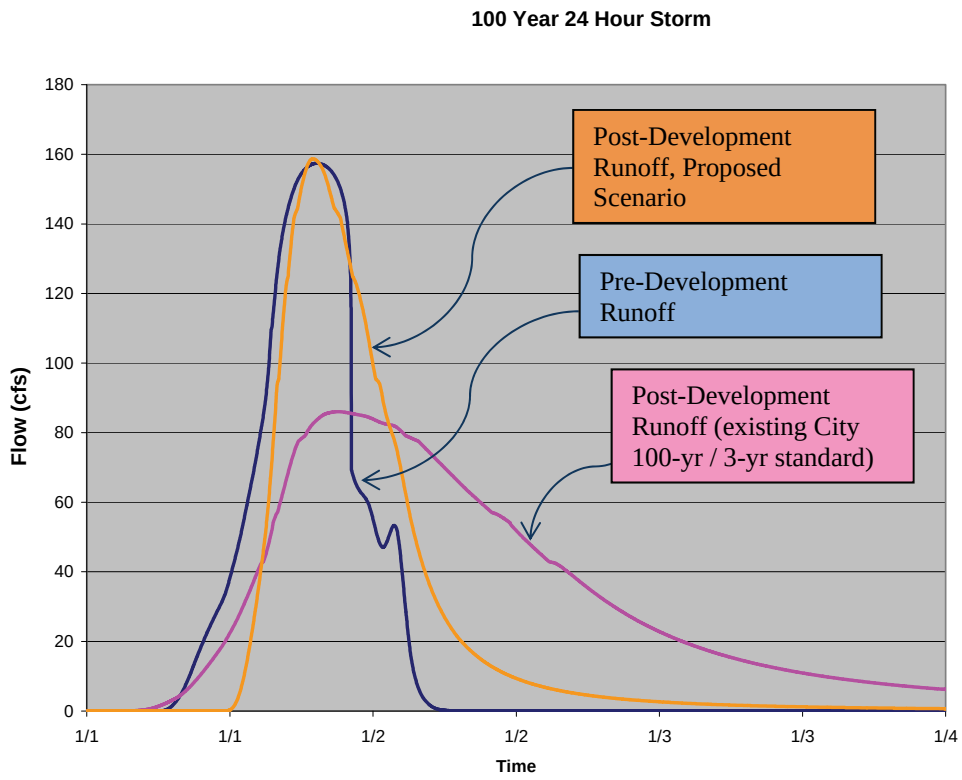


Figure 16
Detention Pond Discharge Rates – Conventional versus LID Design Philosophy
Proposed detention pond design aims to match the pre-development runoff response

- Stormwater infiltration requirements
    - Reducing runoff volume for frequent storm events through infiltration will help the City meet its long-term water quality goals and will reduce erosive pressure on drainage channels in developing areas. *No recommendations on infiltration standards are provided in this document, as the IEPA and the US EPA are both considering changes to NPDES MS4 permit language that will likely provide guidance on stormwater infiltration. Draft permit language is anticipated to be released by the US EPA in early 2014 (see Section G of this document for additional information).*

- Stormwater Fee Credits for BMPs
    - The City of Bloomington should expand the Stormwater Utility credit program to include a fee credit for installing BMPs that enhance stormwater quality. The Town of Normal Stormwater Credit Manual provides useful guidance on appropriate credits.
    - The credit program should require the property owner to inspect, repair (if necessary), and certify the condition of their detention pond or other BMP, on an annual basis, as a condition of receiving the credit.

- Detention Pond Grading and Shoreline Treatment
    - Shoreline erosion within wet detention basins is often the result of ineffective design and vegetation management (see Figure 17 for an example). 3:1 or 4:1 sideslopes are too steep and promote erosion near the water's edge.
    - In many cases, there is not enough separation between the pond water edge and the nearest private property boundary. As erosion begins to occur, it makes it difficult to maintain/repair the pond edge, as outbuildings, fences, and other private features encroach upon the shoreline area.
    - Modify Section 6.02(C)(2)(b) to include a maximum side slope of 6:1 above the permanent water level for wet detention ponds, for a minimum of 1 vertical foot above the permanent water level. Under the water surface, a 10:1 safety shelf should be included to a minimum depth of 1 foot below the water surface. This will help create a gentler slope that will be easier to maintain if/when erosion begins to occur.
        - Add a requirement to provide at least 30 feet from the pond edge (shoreline) to the nearest private property line. This 30-foot envelope should be part of the land dedication for future pond maintenance and should not be held as private property.



Figure 17
Eroded Shoreline
Mowed edges and steep (3:1 / 4:1) sideslopes typically result in moderate to severe erosion

- Promote naturalized vegetation along the shoreline (as opposed to turf grass). This could consist of tall prairie grasses above the water surface and wetland vegetation along the edge of the water.
  - Wetland pockets along pond shorelines are a sustainable design practice that protect shorelines and enhance stormwater quality. 10:1 side slopes near the edge of water promote the establishment of emergent wetland vegetation. A 10:1 slope on the wetland shelf separates deep water from the shoreline for safety and controls shoreline erosion. The vegetation on the wetland shelf also serves to filter surface stormwater flow, providing nutrient uptake and filtering sediment prior to discharge. This edge treatment is different than traditional detention ponds that have relatively steep slopes and mowed turfgrass down to water. As can be seen in many local developments, traditional detention pond design often leads to severe bank erosion within 5-10 years of development. Furthermore, the lack of naturalized shorelines invite unwanted waterfowl, such as Canada Geese (see Figure 18). Figures 19a and 19b illustrate the concept of natural shoreline design.



Figure 18
Traditional Shoreline Design Attracts Unwanted Visitors



Figure 19a
Typical Wetland Shelf
Source: Washington Department of Fish and Wildlife



Figure 19b
Wetland Shelf / Naturalized Shoreline
Source: Chicago Wilderness

- Density Credits
    - Implementing the recommendations in this document, including wider greenways and flatter pond side slopes, may require larger pockets of open space for individual developments. A common way to offset the economic impact of these rules is to allow flexibility on unit density in

developments where additional space is dedicated to protecting greenways and providing stormwater quality BMPs.

- The Low Impact Development philosophy includes "clustering" development away from environmentally-sensitive areas. In a typical residential site design, the developer may include 1/4-acre lots throughout the development while disturbing/grading sensitive water features. Density credits allow the developer to increase unit density in a way that maintains adequate revenue while preserving the features that protect stormwater quality and riparian habitat.
- These types of developments are unique and often command higher market values because of innovative lot layout and easy access to aesthetically-pleasing and natural open areas. Furthermore, with continuing demographic changes to an older population, there is an increased interest in properties with smaller, easy-to-maintain yards.
- City staff should coordinate with the Planning and Code Enforcement Department (PACE) to review model ordinances for unit density and setback flexibility resulting from Low Impact Development and modify local codes as desired. Making this change will be a necessary step in the successful implementation of the other changes referenced in this document.

- Use of fertilizer
  - As recommended in the Lake Bloomington Watershed Plan, local communities should provide "an increase in educational programs [to] raise awareness…to low or non-chemical lawn care". This could consist of establishing a Phosphorus-free fertilizer ordinance, as many Midwest communities have done to enhance stormwater quality.





Figure 20
Preserve Open Space / Increase Density in Upland Areas

F. Redevelopment and Stormwater Detention

As parcels redevelop, there is a unique opportunity to use the redevelopment to further control stormwater runoff and improve stormwater quality. However, at the same time it is necessary to promote economic development in the City's core and it is therefore important to develop and enforce rules that are reasonable and strike a balance between economic incentives and infrastructure sustainability.

There are three primary practices that communities use for redevelopment policies with respect to stormwater:

1. **Basic** (least intrusive to developer): Post-redevelopment peak flow shall not exceed pre-redevelopment peak flow, with no provisions for stormwater quality. For most commercial/industrial redevelopments (which are mostly impervious to begin with), the result is little to no stormwater detention or BMPs resulting from the redevelopment. Current policy focuses on impervious area, not peak flows.

2. **Intermediate**: Post-redevelopment peak flow shall not exceed the pre-redevelopment peak flow. However, stormwater quality management is required. This typically consists of stormwater controls that provide sediment removal and/or other pollutant reducing measures for a frequent storm event, typically ranging between 0.5 – 1.0 inches of rainfall.

3. **Advanced** (most intrusive to developer): Upon redevelopment, the entire site shall be subject to the City's stormwater management rules. In this case, stormwater detention shall be provided for peak flow control and all applicable stormwater quality provisions will apply.

All three redevelopment scenarios above are practiced, although the Basic and Intermediate stormwater controls are the most commonly enforced. The Intermediate level has been more popular in recent years, as stormwater quality (MS4) permits across the United States have become more stringent with respect to redevelopment.

For the City of Bloomington, the primary driver that will impact redevelopment is the pending changes to US EPA and IEPA municipal stormwater rules through the NPDES program. Although it is too early to determine what new rules will apply to redevelopment, it is likely that some additional requirements will impact how municipalities set policy for redevelopment and associated stormwater controls. The following recommendations are offered for redevelopment policy for stormwater:

- Continue with a Basic approach to stormwater detention policy for redevelopment, but monitor upcoming changes to US EPA and IEPA stormwater rules. It may be necessary to require stormwater quality BMPs under redevelopment scenarios if the next round of IEPA MS4 permits includes this provision.
    - If the City adopts new stormwater user fee credits for stormwater quality BMPs (as recommended in this document), this can be used

as a tool to incentivize developers to install BMPs during redevelopment and reduce their monthly user fee.

- Require the developer to calculate the hydraulic capacity of the receiving sewer or drainage channel and determine whether the redeveloped site runoff can be accommodated in the receiving system. In cases where the receiving system is not capable of conveying the runoff from the redeveloped site (regardless of whether the redeveloped site increases stormwater runoff), the developer should be required to provide on-site stormwater detention to control runoff to the level that the existing system can accommodate. The City may, at its discretion, assist the developer to improve the capacity of the receiving system (similar to the language in Section 6.05 of the Manual of Practice).

- Parking lot stormwater detention can be permitted if all of the following apply:
    - Maximum ponding depth shall be equal to or less than six inches.
    - No handicap parking stalls shall be permitted in the designated storage area(s).
    - No material storage, dumpsters, hazardous waste, or any other potential pollutant which may come into contact with stormwater shall be permitted in the designated storage area(s).
    - The hydraulic restrictor shall be located such that City inspectors can easily access and inspect the outlet. An access manhole shall be required at this location and shall not be permitted within a parking stall.

G. Fee-In-Lieu (Stormwater Detention)

Fee-in-lieu for stormwater detention is a useful tool for developers to “opt out” of providing detention storage for flood control, assuming that regional stormwater detention will be provided elsewhere for peak flow control, or for sites that are too small for the practical application of stormwater detention (there is no universally-accepted minimum lot size for which on-site detention should be waived). This payment should cover the City’s cost to provide stormwater detention for a given site, including:

- Land acquisition costs (estimated or realized)
- Construction costs (estimated or realized)
- Ongoing maintenance life cycle costs (estimated)

This option should only be available when the City has identified the size and location of (or has constructed) a regional detention pond to which a development is tributary. Under this scenario, the development's share of the regional pond (by volume or land area) should be determined by the City based on the pro-rated contributing drainage area, weighted by the total percent impervious coverage.

Furthermore, a developer should not have the option to pay a fee-in-lieu of constructing a stormwater detention pond if, in the opinion of engineering staff, undetained runoff from the development may adversely impact downstream systems or exacerbate an existing flooding problem.

The fee-in-lieu policy should apply only to ***flood control volume***. If future state/federal stormwater rules require infiltration (and/or other stormwater quality measures), the fee-in-lieu should *not* relieve the land developer from installing and maintaining stormwater BMPs necessary to meet future IEPA MS4 requirements for land development or redevelopment.

Stormwater quality BMPs are typically most efficient when applied on individual sites. Regional stormwater BMPs (other than regional detention ponds) are difficult to implement on a larger scale and therefore should not be made a part of the fee-in-lieu program.

Appendix A (Table A-1) includes a table showing examples of fee-in-lieu programs in the Midwest and other areas of the United States. Some programs have formulas based on acre-foot of storage, and others based on acre of development or square foot of impervious surface added. Within Illinois, several communities charge at or around $100,000 per acre-foot of required stormwater detention storage. Using the information contained in Table A-1, median fee-in-lieu costs could be as low as $10,000 - $15,000 per acre for residential developments to over $60,000 per acre for high density commercial or industrial developments, depending on how the fee is structured. ***The City of Bloomington's current fee of $6,000 is well below the typical fee of peer communities.***

The actual fee-in-lieu payment structure in Bloomington will be dependent on whether changes are made to the stormwater detention policy as recommended in this report. If the recommended changes are implemented, the total required storage volume per developed acre would decrease, as would the necessary fee. The fee should not be determined until final changes are made to local stormwater design policies. The fee-in-lieu payment should also be adjusted to account for any component of regional detention costs covered by the stormwater utility fee.

H. Pathways

The establishment of greenways in future development areas should include adequate space within the corridor for pedestrian/bicycle pathways. As greenways provide a safe way to interconnect neighborhoods, the City should place a priority on reserving a minimum 10-foot width for pathways. As there are no regulatory barriers to constructing pathways within the floodplain, they can typically be accommodated without having to increase the total greenway corridor width. The recommended pedestrian paths from the MCRPC's Long Range Transportation Plan 2040 (adopted in June 2007) are illustrated in the growth area figures in this document.

A secondary benefit of pathways is enhanced ease of maintenance for drainage channels. City equipment can use pathways to transport equipment and materials for streambank repair and other maintenance activities required along the channel corridor.

Future greenways provide a logical extension of the Constitution Trail (pictured in Figure 21). The City should continue to leverage this significant public asset and expand the network of trails through developing areas.



Figure 21
Constitution Trail

I. Water Quality – Meeting Current and Future Permit Requirements

Water quality goals are evolving from the regulatory perspective. Although there are currently no specific requirements to monitor surface water quality from MS4s in Illinois, there are two regulatory drivers that are changing how municipalities manage surface water quality:

- Total Maximum Daily Loads (TMDLs) set through local watershed plans
- NPDES MS4 permit regulations

TMDL priority areas are set by the IEPA based on the need to protect water quality in critical watersheds. In the Bloomington area, the following TMDLs have been developed:

- Lake Bloomington Watershed Plan: only impacts development on the City's far northeast side for areas tributary to Money Creek (http://web.extension.illinois.edu/lmw/downloads/22860.pdf)
- Evergreen Lake Watershed Plan: only impacts the Town of Normal and areas north (http://www.idaillinois.org/utils/getfile/collection/edi/id/529004/filename/538075.pdf)
- Kickapoo Creek Corridor Restoration Plan (IEPA 319 Grant): provides a useful framework for greenway corridor planning and design

The current IEPA MS4 General Permit cycle, set to expire in March 2014, will likely be replaced with provisions that meet new guidelines anticipated from the US EPA. Although those guidelines have not yet been released, early indications are that the US EPA will focus on reducing the overall volume of stormwater runoff by eliminating (where practical) directly-connected impervious surfaces and promoting infiltration. There is no indication that water quality testing will be required in the next permit cycle.

The Illinois Green Infrastructure for Clean Water Act (2009) required a report to the Governor about recommended changes to the IEPA NPDES MS4 permit. Among the recommendations in the submitted report was to develop a stormwater infiltration standard. Although it is unclear if (or when) those recommendations will be part of a new statewide MS4 permit, it is likely that some numerical standard will be set for stormwater infiltration. The report can be downloaded from the IEPA's Green Infrastructure website:

http://www.epa.state.il.us/green-infrastructure/

Implementing the recommendations in this document will help the City enhance the quality of stormwater runoff from both existing and future urbanized areas by accomplishing the following:

- Reduces Total Suspended Solids (TSS) loading through extended detention time for frequent (i.e. 2-year) storm events.
- Reduces streambank erosion through enhanced detention pond design criteria meant to mimic pre-development hydrology for storm events ranging from a 2-year through 100-year recurrence interval.
- Current urbanized areas can be retrofitted to enhance stormwater quality through channel cross section modification, detention pond retrofits, streambank restoration, new targeted stormwater BMPs on private property, and public education on appropriate turf management and fertilization techniques.

The above improvements will help the City document its ongoing compliance with its current NPDES MS4 permit.

There is no immediate need to monitor surface water quality, as it is not currently required by permit.

J. Public and Property Owner Buy-in and Education

It is important to convey the importance of greenways and sustainable design practices to the general public. In order to follow through on policy changes, it will be necessary to achieve local buy-in from those who will be initially impacted by policy changes.

- City Council
    - Getting buy-in starts and ends with City Council. Changes to land development policy will require City Council action, so educating

elected officials early and often will help to enhance the chances of enhancing policies as recommended in this document. It will also be important for the City Council to be made aware that City staff is coordinating with key stakeholders (as discussed below) prior to finalizing recommended policy changes.

- Land developers
    - Discuss the specifics of proposed changes with land developers and educate them to the economic benefits of enhanced greenways and sustainable land development. They may be initially averse to the proposed changes and will need to be convinced that the recommended policy changes will not impact their ability to develop land and make a reasonable profit.
- Consulting engineers
    - Consulting engineers will ultimately be responsible for the successful implementation of new rules, as they will need to understand, interpret and implement new technical standards in future site designs. City staff should work with local engineers to discuss the efficacy of the proposed changes to technical standards and work on solutions that meet the goals of this document while providing a framework that local engineers can adopt without too much difficulty.
- Environmental Advocacy Groups
    - Discuss proposed policy changes and seek feedback from advocacy groups that will likely have a stake in any changes to land development standards. Such groups may include:
        - Friends of Kickapoo Creek
        - Friends of the Constitution Trail
        - Prairie Rivers Network
        - Ecology Action Center
- Property owners along drainage channels
    - Provide information on best practices along drainage channels. This should be done to prevent future floodplain/floodway encroachments and pollution from dumping. Information to be shared may include:
        - Floodway/floodplain protection flyers (available from FEMA NFIP)
        - Information on upcoming drainage channel improvement projects (as recommended in this document and the Stream Bank Inventory section)
        - The “DOs” and “DON’Ts” of yard maintenance along channels, such as not dumping mulch/debris in channels, avoiding mowing too close to the edge of channel, and appropriate turf management and fertilizing techniques
- Property owners (general)
    - Encourage disconnection of roof downspouts from impervious surfaces and onto pervious (grassed) surfaces.
    - Encourage installation of rain barrels and rain gardens
    - Encourage use of Phosphorus-free fertilizer (consider adopting Phosphorus-free fertilizer ordinance).
- Key ratepayers for stormwater utility fee
    - Some landowners may be impacted by proposed changes to the stormwater credits recommended in this document. City staff should

be prepared to meet with key ratepayers to discuss how the installation of stormwater BMPs on their properties would impact their monthly stormwater fee. Additional coordination will be necessary to review initial credit applications for conformance to BMP guidelines.

Public education can be accomplished through multiple channels, and it is best to use established communication channels in order to convey the message quickly and cost-efficiently. Examples include:

- City's website (similar to that used for this Master Plan)
- Social media (Facebook, Twitter)
- City Council meetings (policy presentations, technical presentations)
- Advisory Committee and Stakeholder Meetings (with land developers, engineers, and environmental advocacy groups)
- Add information to materials already distributed as part of the City's NPDES MS4 permit

Table 4
Greenways Plan
Planning-Level Cost Opinions (Ongoing Projects)

Owner:	**City of Bloomigton, Illinois**	**Date:**	**12/9/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**Greenways / Sustainability Plan**	**Prepared By:**	**GPK**
		Reviewer:	

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	Publicly-Owned Detention Pond Inspection Program (city staffing cost)[1]	1	LS	$408,000	$408,000
2	Publicly-Owned Dry Detention Pond Sediment Removal[2]	1	LS	$680,000	$680,000
3	Publicly-Owned Pond Outlet Structure Maintenance and Repair[3]	1	LS	$272,000	$272,000
4	Publicly-Owned Ponds: Underdrain and Low-Flow Pump Maintenance[4]	1	LS	$1,359,000	$1,359,000
5	Publicly-Owned Wet Detention Pond Shoreline Maintenance[5]	1	LS	$1,413,000	$1,413,000
6	Privately-owned Detention Pond Inspection and Enforcement[6]	1	LS	$340,000	$340,000
				SUBTOTAL	**$4,472,000**
	Contingencies	30%			$1,340,000
				SUBTOTAL (w/CONTINGENCIES)	**$5,820,000**
	PROJECT COSTS				
	Floodway/Floodplain Encroachment Elimination Program				$834,000
	TOTAL PLANNING-LEVEL COST OPINION				**$6,650,000**

[1] *Present Value of a 20-year cycle of publicly-owned detention pond inspections and repair oversight (0.30 FTE = $30,000 annual cost)*
[2] *Present Value of a 20-year cycle of dry pond sediment removal (1,000 CY per year @ $50/CY for removal/disposal = $50,000 annual cost)*
[3] *Present Value of a 20-year cycle of outlet structure repair (2 per year, $10,000 per outlet = $20,000 annual cost)*
[4] *Present Value of a 20-year cycle of underdrain/pump repair ($100,000 per year)*
[5] *Present Value of a 20-year cycle of pond shoreline stabilization (650 lineal feet per year @ $160/LF = $104,000 annual cost)*
[6] *Present Value of a 20-year cycle of privately-owned detention pond inspections (0.25 FTE = $25,000 annual cost)*

Present Value calculations based on a discount rate of 4.0%

Table 5
Greenways Plan
Planning-Level Cost Opinions (One-Time Projects)

Owner:	**City of Bloomigton, Illinois**	**Date:**	**4/1/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**Greenways / Sustainability Plan**	**Prepared By:**	**GPK**
		Reviewer:	

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	Channel Modifications - Sugar Creek (Airport to GE Rd.)	1,500	LF	$650	$975,000
2	Channel Modifications - Rowe Drive Channel (Towanda to Veterans)	2,700	LF	$350	$945,000
3	Channel Modifications - 1019 Maple Street (outfall to Baker-Ash Basin)	300	LF	$400	$120,000
4	Letter of Map Revision - Tributary to Little Kickapoo (Ireland Grove East)	1	LS	$125,000	$125,000
5	Publicly-owned Detention Pond Retrofit - Targeted Locations Only	11	EA	$25,000	$275,000
6	Regional Detention Ponds - Planning Area 4	1	AC-FT	$0	$0
7	Regional Detention Ponds - Planning Area 7	1	AC-FT	$0	$0
8	Regional Detention Ponds - Planning Area 8	1	AC-FT	$0	$0
9	Develop Streambank Protection Ordinance	1	LS	$20,000	$20,000
10	Modify Detention Pond Standards	1	LS	$30,000	$30,000
11	Develop Revised Design Standards to meet IEPA MS4 rule changes[1]	1	LS	$30,000	$30,000
12	Streambank Stabilization - Planning Area 4 (Sugar Creek)	1,750	LF	$800	$1,400,000
13	Streambank Stabilization - Planning Area 8 (Little Kickapoo)	2,000	LF	$500	$1,000,000
14	Streambank Stabilization - Planning Area 7 (Tributary to Little Kickapoo)	1,000	LF	$400	$400,000
15	Streambank Stabilization - Planning Area 8 (Unnamed Trib to Little Kickapoo)	900	LF	$400	$360,000
16	Planning Area 8 - Address Railroad Hydraulic Restriction	1	LS	$2,000,000	$2,000,000
17	Planning Area 8 - Little Kickapoo Vegetation Removal	1	LS	$250,000	$250,000
18	Establish Watershed-Specific Release Rates (Hydrologic Study)	1	LS	$20,000	$20,000
19	Floodplain Mapping - Planning Area 7 (unnamed tributaries)	1	LS	$50,000	$50,000
20	Floodplain Mapping - Planning Area 8 (unnamed tributary)	1	LS	$40,000	$40,000
21	Floodplain Mapping - Planning Area 8 (unnamed tributary)	1	LS	$40,000	$40,000
				SUBTOTAL	**$8,080,000**
	Contingencies	30%			$2,420,000
				SUBTOTAL (w/CONTINGENCIES)	**$10,500,000**
	PROJECT COSTS				
	Engineering, Legal, Administrative (Design/Construction Projects Only)	25%			$1,800,000
	Enact Policy Changes - Public Education / Stakeholder Feedback				$75,000
	TOTAL PLANNING-LEVEL COST OPINION				**$12,380,000**

Pond costs not yet included. If pond costs are recovered by fee-in-lieu payments, then financial impact to the City should be a net of zero

[1] *IEPA rule changes anticipated after US EPA updates NPDES stormwater rules in early 2014*

APPENDIX A

Fee-In-Lieu Examples

Table A-1
Fee-in-Lieu Summary Table

State	County	City	Date Current Rule Effective	Fee Description
Illinois	Champgaign	Champaign	unknown	Calculated to establish property's share of costs to provide detention. Costs are actual costs of detention provided by contract/estimated costs for planned detention approved by city engineer. Also may require fee for each acre-foot of detention needed. ***See Table A-2 for example from City of Champaign pond construction cost history.***
	Cook	Evanston	July 2010	$12/cu. Ft, not to exceed 5% of development construction costs. Increases anually based on CPI % increase
	DuPage		August 2008	1. $/acre-ft of closest approved storage facility within the same watershed (which includes cost of planning, and acquisition, construction, operation, and long-term maintenance)* storage amount covered by the variance; 2. Fee schedule (Salt Creek or DesPlain River Tributary - $133,000/acre-foot, E. Branch DuPage River - $106,000/acre-ft, W. Branch DuPage River - $94,000, Sawmill Creek - $87,000, Fox River Tributary - $81,000)*storage amount
	Kane		2011	Unincorporated areas - $90,000/acre-ft of storage required (based on land value after development and cost of storage construction)
	Lake		November 2008	Like Kane county but collected funds are accounted for in separate watershed accounts (estimated construction and land cost for on-site storage)
	McHenry		April 2008	Like Lake county with additions: not allowed in regulatory floodway or to reduce flood-prone area storage volume to less than 95% of existing amounts within project reach or allow more than 20 cu. Yd. of lost storage volume for a development site (singularly or collectively)
	Will		March 2010	Same as Lake County
Wisconsin	Racine	Burlington	unknown	Determined in negotiation with City of Burlington
	Ozaukee	Cedarburg	unknown	Residential: $3,242/acre developed land, commercial/industrial/multi-family: $7,678/acre
	Dane	McFarland	unknown	Ordinance 54 Residential Construction Cost Per Acre ($) 890; Land Cost Per Acre ($) 400 Total Cost Per Acre ($)1,290. Commercial & Industrial Construction Cost Per Acre ($)1,640; Land Cost Per Acre ($)1,010; Total Cost Per Acre ($)2,650.
	Dane	Middleton	May 2012	1. Cost of land, engineering, and construction of storm water controls in a development 2. Additional fees for not implementing: peak flow control, runoff volume control, infiltration, recharge, sediment control, temperature control 3. Partial fees based on % required stormwater control or infiltration not achieved
Missouri	Greene	Springfield	unknown	From 0-24,000 cubic feet (cf) of pond volume: 1-2 family residential pays $1.00/cf, other uses $2.00/cf. From 24,000-100,000 cf: residential $0.50/cf, other $1.00/cf. Greater than 100,000 cf: residential and other $0.50/cf
	Greene	Republic	November 2002	Fee=K*(Ia), where (Ia) is acres of impervious surface added and K= $10,000 for first acre or less then additional $5,000 for over 1 acre. (K~cost of detention facility + revenue from sale of additional lots or increased value of lots-cost of development, financing, and reasonable profit, K is evaluated annually by city)
Michigan	Oakland	Novi	unknown	Based on SF of new impervious and semipervious lots, easements and roads, excluding single family residences. Fee for existing developments that contain detention on-site based on SF of impervious and semipervious areas that will be removed as a tributary of existing facility. Fee: Sum of total SF multiplied by a monetary amount set by the council. Single family residence sites will also include a fee specified by the council. For previously developed lots, fees required for any additional impervious or semipervious construction.
Maryland	Charles		June 2012	$1.35/sq.ft. disturbed, adjusted annually based on estimated CPI
	St. Mary's		2001	Amount equal to estimated cost of full implementation measures
Washington	King	Mercer Island	unknown	Based on new impervious area, with a sliding scale starting at $5,500 for the first 1,000 square feet, ranging up to $10,500 for up to 10,000 square feet. Above 10,000 square feet, the actual fee is based on a calculation of detention storage needed (case-by-case basis).
Colorado	Pitkin	Aspen	2011	$434 per each 100 square feet of impervious area added or redeveloped. $70/cubic ft of detention required. Required detention calculated by 6.2 cubic feet per 100 sq. ft of impervious area.
Texas	Travis	Austin	unknown	Construction component based on acres of impervious cover, land cost based on 5% of land cost per acre from Appraisal District values (capped at $40,000 per acre for single family and $120,000 per acre for commercial/multifamily). Total cost is the sum of construction and land components.
Oklahoma	Tulsa	Tulsa	April 2012	Fee = Rate X increase in impervious area, where Rate=$0.74/sq.ft and increase in impervious area is actual for commercial, industrial, and multi-family residental but for single family residential impervious area is calculated by using (platted acreage/# platted lots) on Figure 710 in the 1993 Stormwater Management Criteria Manual to find the impervious area which is then multiplied by the platted acreage and converted to sq. ft.
Arkansas	Pulaski	N. Little Rock	2007	$5,000/acre commercial, $500/acre residential

Table A-2
City of Champaign – Detention Pond Cost History (used for fee-in-lieu)

GASB Detention Basin Summary - Data sorted by year of construction
November 2012
Data is from GASB FY07/08 modified by FY11/12

Location (Name)	Plan Number	Detn Vol. (ac-ft)	Year Constructed	Replacement Cost As of 6/30/05	Price Index for Construction Year (Note 1)	Estimated Acquisition Value	Calculated Acquisition Unit Cost Check ($/ac-ft)	Calculated Acquisition Unit Cost Check ($/cu-ft)	
Oak - Ash Detention Basin	19XX-218	59.0	1980	$2,065,000	0.44	$915,547	$15,518	$0.36	
Eureka - Elm Detention Basin	1990-6	14.6	1990	$511,000	0.65	$331,195	$22,685	$0.52	
Healey St. Detention Basin		118.0	1999	- - -	Actual Const. Cost	$7,854,497	$66,564	$1.53	$4.72
Campustown Channel Detention		20.0	1999	- - -	Actual Const. Cost	$6,892,266	$344,613	$7.91	
Upper Boneyard Detention Basin CDI Sub.	CB2000-201	3.8	2000	- - -	Actual Const. Cost	$50,000	$34,291	$0.79	
	CB1997-231		1997	- - -	Actual Const. Cost	$79,277			
Second St Detention Basins		47.0	2010	- - -	Actual Const. Cost	$12,893,953	$274,339	$6.30	
Total		262.4							
Average							$126,335	$2.90	

Note 1:
Price index (1915-2005) is based on the Engineering News Record Construction Cost index.
Years not available from ENR (1900-1905) based on U.S. Census Bureau cost index.
The construction cost index is not used when actual construction cost is known.

Note 2:
Detention volumes taken from "Lower Boneyard Creek Improvement Plan, Volume II of III - Report" by Camp Dresser & McKee, Revised July 2001

Note 3:
The Upper Boneyard Creek Sunset Court Side Basin Detention (Plan No. 1997-1) was not counted. Its detention is minimal, estimated to be less tan 0.2 acre-feet.

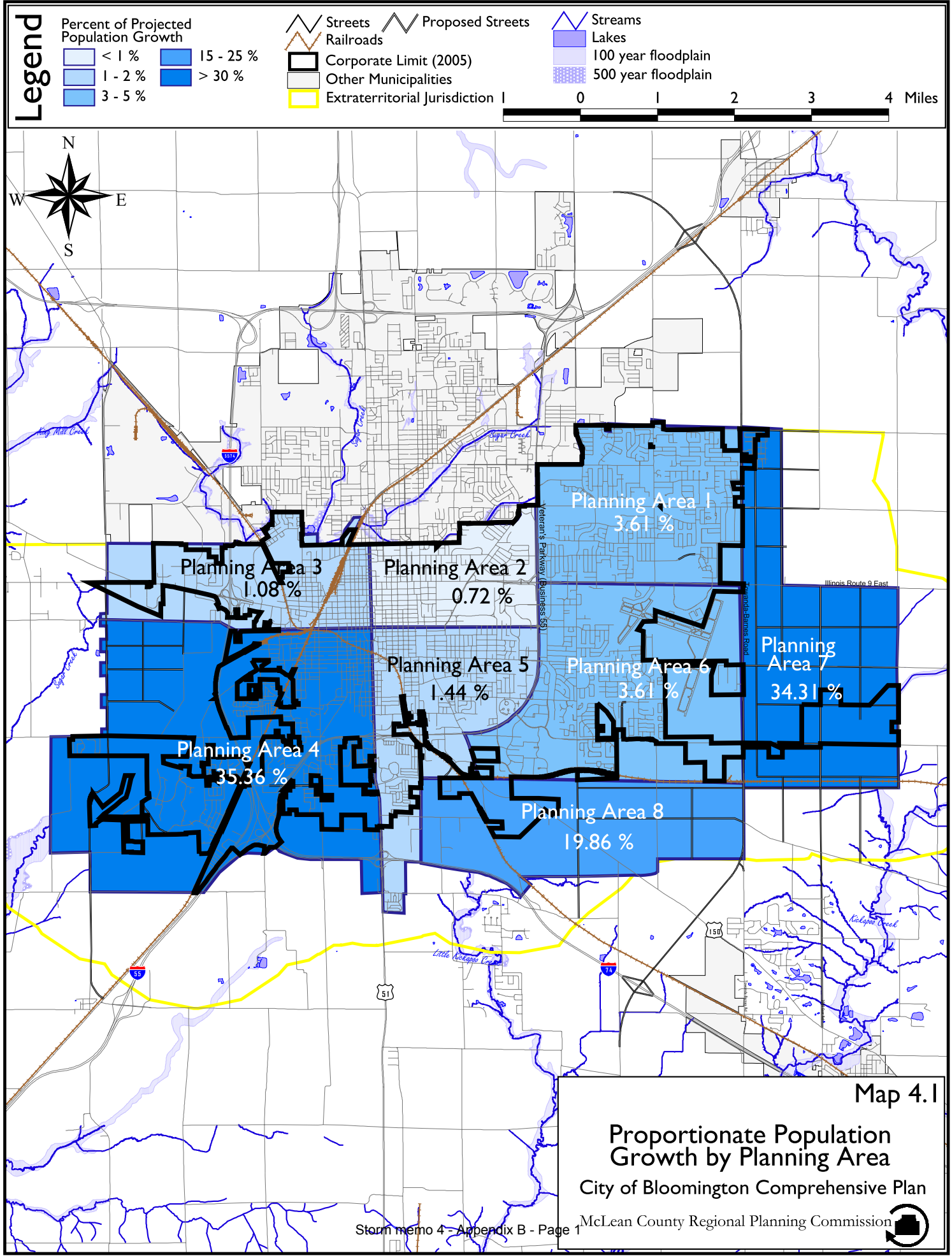
Note 4:
Healey Street Detention Basin costs estimated as nonland costs minus pump station costs.

Note 5:
Campustown Channel Detention costs estimated as 11' diameter pipe length for detention divided by total 10' and 11' diameter pipe length times nonland cost or 70% of project nonland cost.

Note 6:
Oak-Ash and Eureka-Elm Detention costs estimated from $35,000 average cost per acre-foot based on similar construction type of the "Upper Boneyard Detention Basin CDI Subdivision.

APPENDIX B

Planning Area Map
2005 City of Bloomington Comprehensive Plan



Map 4.1

Proportionate Population Growth by Planning Area

City of Bloomington Comprehensive Plan

McLean County Regional Planning Commission

Stormwater Technical Memoranda

ST5 - SUGAR CREEK ANALYSIS

Sugar Creek Analysis

Executive Summary

The City has recently experienced rapid development within the Sugar Creek watershed, which is on the City's east side (primarily north of the airport). New development, including the construction of numerous regional detention ponds, has changed the runoff characteristics within the upper reaches of Sugar Creek.

The purpose of this analysis is to identify changes to hydrologic response and associated floodplain elevations since the previous hydrologic and hydraulic analyses were performed in 1993 by the Illinois Department of Natural Resources (IDNR). Since that time, significant development has occurred in the headwaters of Sugar Creek (east of Veterans Parkway). Dozens of properties are within the official 100-year floodplain, which places a high economic burden on landowners through required flood insurance premiums.

Key Findings

- The Tipton Park detention ponds are not operating as intended. The predicted high water levels are significantly higher than the design high water levels, which could impact properties adjacent to the detention ponds.
- Stormwater ordinances in the City of Bloomington have resulted in the construction of over 560 acre-feet (182 million gallons) of stormwater detention pond storage in the Sugar Creek watershed, east of Veterans Parkway. This has a significant impact on reducing flood potential along the Sugar Creek, especially from Airport Road to Hershey Road. Some ponds have spare storage capacity.
- The FEMA official 100-year floodplain is no longer accurate, especially east (upstream) of Veterans Parkway. It generally over-predicts flood risk, which could impact land development potential.

Recommendations

- First floor and basement elevations within the Tipton Park Subdivision should be verified to determine whether there is a flood risk along the existing detention ponds.
- Targeted retrofits to existing detention ponds can further reduce flood potential and can enhance water quality. Furthermore, this spare volume could be sold to nearby land developers as regional stormwater detention. Four detention ponds are recommended for retrofit.
- Prepare a Letter of Map Revision (LOMR) and submit to FEMA for review and approval. This will help establish a more accurate floodplain boundary within the watershed. Up to 42 structures could be removed from the floodplain as a result of this effort.

Planning-Level Cost Summary	
Detention Pond Retrofits and FEMA LOMR	$ 460,000
TOTAL	**$ 460,000**

ARCHITECTS. ENGINEERS. PLANNERS.

OHM Advancing Communities

technical memorandum

Date: December 11, 2013

To: Ryan Otto, City of Bloomington
From: Greg Kacvinsky, OHM Advisors

Re: Stormwater Master Plan – Sugar Creek Analysis

Project Summary

The Sugar Creek watershed is a rapidly-developing area on the City's east side. New development, including the construction of numerous regional detention ponds, has changed the runoff characteristics within the upper reaches of Sugar Creek.

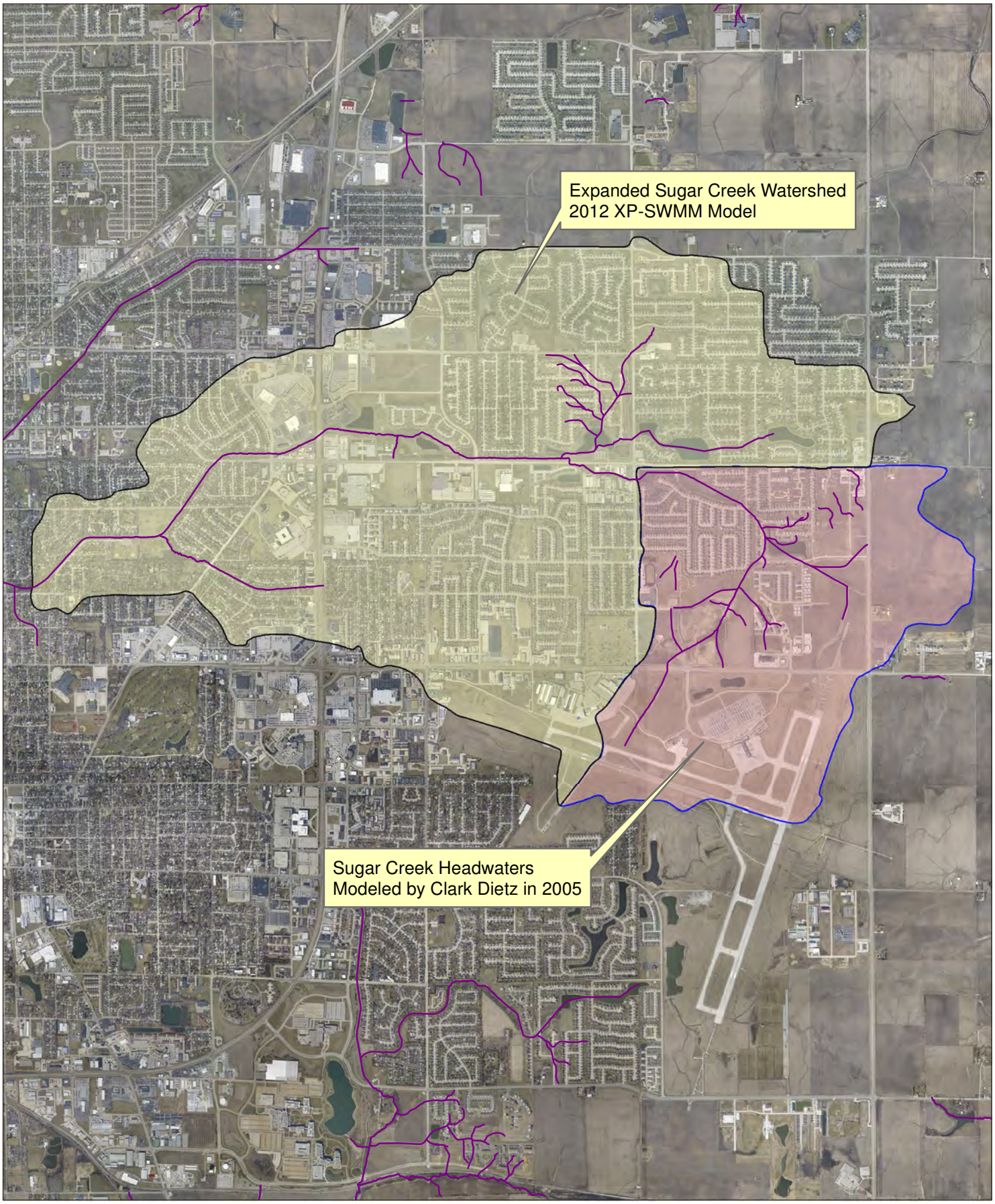
The purpose of this analysis is to expand the existing XP-SWMM hydrologic/hydraulic model of the headwaters of the Sugar Creek (created initially by Clark Dietz in 2005 for the analysis of Sapphire Lake) downstream through Veterans Parkway, Vernon Avenue, Jersey Avenue, and ending just upstream of the High School Branch (near Linden Street). See Figure 1 for a study area location map.

This modeling effort was performed to identify changes to hydrologic response and associated floodplain elevations since the previous hydrologic and hydraulic analyses were performed in 1993 by the Illinois Department of Natural Resources (IDNR). Since that time, significant development has occurred in the headwaters of Sugar Creek (east of Veterans Parkway) that have had the following impacts:

- Increase in stormwater detention volume through the installation of numerous regional stormwater detention basins. Several of these basins are classified as dams by the IDNR.
- Increase in developed area north of the airport. With detention ponds associated with each subdivision, the runoff response from each developed area has changed significantly, with lower peak flows but longer and sustained elevated discharge rates within 24-48 hours following a significant storm event.
- Modifications to the Sugar Creek cross section, due to:
    - Improvements from the widening of GE Road and the eastward extension of Constitution Trail
    - Continued streambank erosion
    - Modifications to accommodate new development

OHM Advisors
34000 PLYMOUTH ROAD
LIVONIA, MICHIGAN 48150
T 734.522.6711
F 734.522.6427
OHM-Advisors.com

Path: P:\0000_0100\0067110010_Bloomington IL Sewer Master Plan\EWRG\Stormwater Master Plan\SWMP REPORT DOCUMENTS\GIS Figures\Subwatershed Boundaries.mxd



0 2,000 4,000 6,000 Feet

FIGURE 1
SUGAR CREEK STUDY AREA

OHM
888.522.6711
ohm-advisors.com

Methodology

XP-SWMM 2011 was used to perform the hydrologic and hydraulic analyses for the Sugar Creek watershed. As the previous Sugar Creek headwater study was developed using a previous version of XP-SWMM, the use of the same model to continue the analysis downstream was considered appropriate and cost-effective.

Since several changes have occurred in the headwaters of the Sugar Creek watershed since the 2005 XP-SWMM model was developed, the following modifications were necessary to bring the model up to date:

- Airport detention pond outlet modifications (restrictor pipes inserted in two detentions ponds) increase flood storage and reduce peak flows.
- Development of Empire Business Park (and two associated detention ponds) increase flood storage and modify the hydrologic response in this area.
- The entire Empire Business Park was assumed as *fully-developed*.
- Sapphire Lake overflow weir modifications (per Farnsworth / Clark Dietz correspondence). The main overflow weir length was increased to 25 feet.

Detention Ponds

There are nearly 50 detention basins in the study area, and it was not practical to model each one. However, the largest 15 detention ponds in the studied watershed were modeled, as they have a significant impact on peak flows in the upper reaches of Sugar Creek. The following detention basins were modeled:

Table 1
Modeled Detention Ponds

Airport Detention Ponds (4 separate storage areas)	Hawthorne Subdivision (East Pond)	Tipton Park (Southwest Pond)
Empire Business Park Ponds (2 separate storage areas)	Hawthorne Subdivision (West Pond)	Royal Point Subdivision
Sapphire Lake	Royal Links Subdivision	G.E. Road Retention Basin
Eagle Creek Lake (East Pond)	Four Seasons Subdivision	Holder Subdivision
Eagle Creek Lake (West Pond)	Tipton Park (Southeast Pond)	Shirk Detention Basin (Jumers Pond)

Detention pond elevations, volumes, and outlet structure characteristics were determined using City-provided as-built drawings, supplemented by McLean County 2-foot contours to verify actual storage volumes.

Rainfall Statistics

NOAA Atlas 14 rainfall depths were used for multiple rainfall durations (in order to perform a critical duration analysis). The NOAA Atlas 14 data represent the most up-to-date statistical data set for rainfall in central Illinois. Bulletin 71, widely-referenced in Illinois, uses rainfall data through 1986. The NOAA data include approximately 20 years of additional rainfall statistics and is therefore assumed to be more representative of current climate conditions. Rainfall depths used in the XP-SWMM model are based on NOAA Atlas 14 and are listed, along with the older Bulletin 71 depths, in Table 2.

Table 2
Modeled Rainfall Depths
NOAA Atlas 14 versus Bulletin 71

	Rainfall Duration									
	2-hour rainfall depth (in.)		3-hour rainfall depth (in.)		6-hour rainfall depth (in.)		12-hour rainfall depth (in.)		24-hour rainfall depth (in.)	
Storm Frequency	*NOAA*	*Bulletin 71*	*NOAA*	*Bulletin 71*	*NOAA*	*Bulletin 71*	*NOAA*	*Bulletin 71*	*NOAA*	*Bulletin 71*
500-yr	4.96	N/A*	5.51	N/A*	6.54	N/A*	7.27	N/A*	8.79	N/A*
100-yr	3.87	4.08	4.24	4.43	5.01	5.19	5.63	6.02	6.57	6.92

* *Bulletin 71 did not include 500-year rainfall depths. Floodplain studies relied on extrapolation to determine the 500-year rainfall depth*

For all analyzed rainfall durations, the more recent (NOAA Atlas 14) data show a significant reduction in the total rainfall depth.

Runoff Calculations

The Runoff Curve Number (RCN) method was used to calculate the runoff response from the 66 individual subbasins in the XP-SWMM model. This is the same methodology as the 2005 XP-SWMM model prepared by Clark Dietz. Curve Numbers were selected based on land use observed using aerial photography. The NRCS Soil Type was assumed to be Type C for developed areas, assuming a compacted "urban" soil type. Key hydrologic parameters and a subbasin map are included in Appendix A.

Critical Duration Analysis

The critical duration storm in the upper reaches of the study area (from the Hershey Road culvert upstream) is the 24-hour rainfall (for both the 500-yr and 100-yr recurrence interval events). At Veterans Parkway downstream, the critical duration decreases to a virtual tie between the 3-, 6-, and 12-hour duration rainfall. Near Linden (just upstream of the High School branch), the critical duration decreases to a 3-hour storm.

Figures 2-7 illustrate the flow hydrographs at selected locations for the varying storm durations.

Typically, the critical duration increases as the total drainage area increases. However, the presence of stormwater detention usually increases the critical duration (as the shorter duration storms are attenuated with detention volume). Given the abundance of

stormwater detention volume in the upstream reaches, the longer critical duration (24 hours) was observed from Airport Road to Hershey Road. Further downstream (from Veterans Parkway west), stormwater detention has a smaller overall impact and therefore the shorter duration storms dictate the peak flow.
Critical durations at key locations include:

Location	Critical Duration
Airport Road:	24 hours
GE Road:	24 hours
Hershey Road:	24 hours
Veterans Parkway:	12 hours
Jersey Avenue:	12 hours
Confluence with High School Branch:	3 hours

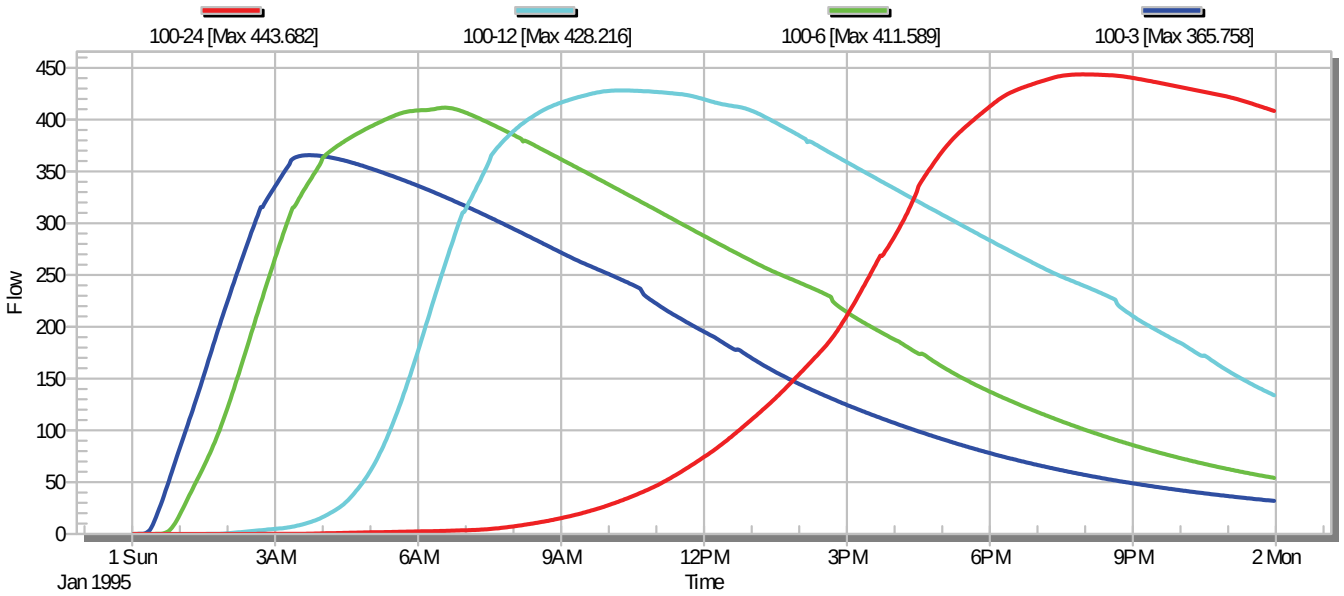


Figure 2
Critical Duration Analysis - Sugar Creek at Airport Road
100-year Storm

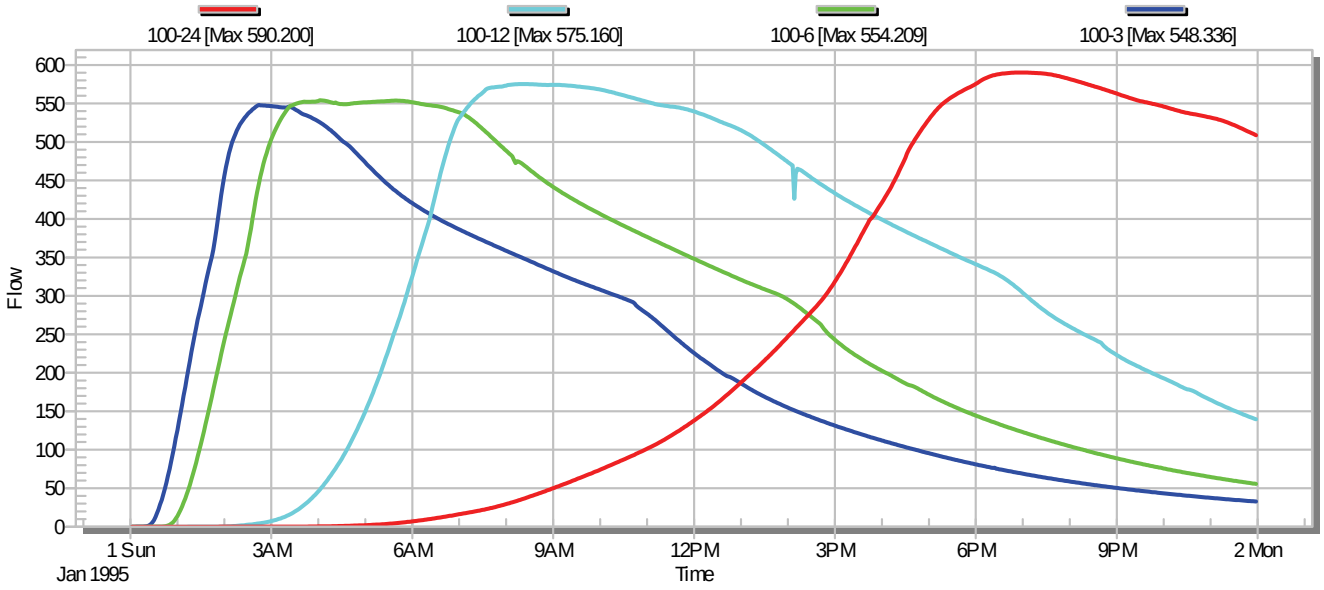


Figure 3
Critical Duration Analysis - Sugar Creek at GE Road
100-year Storm

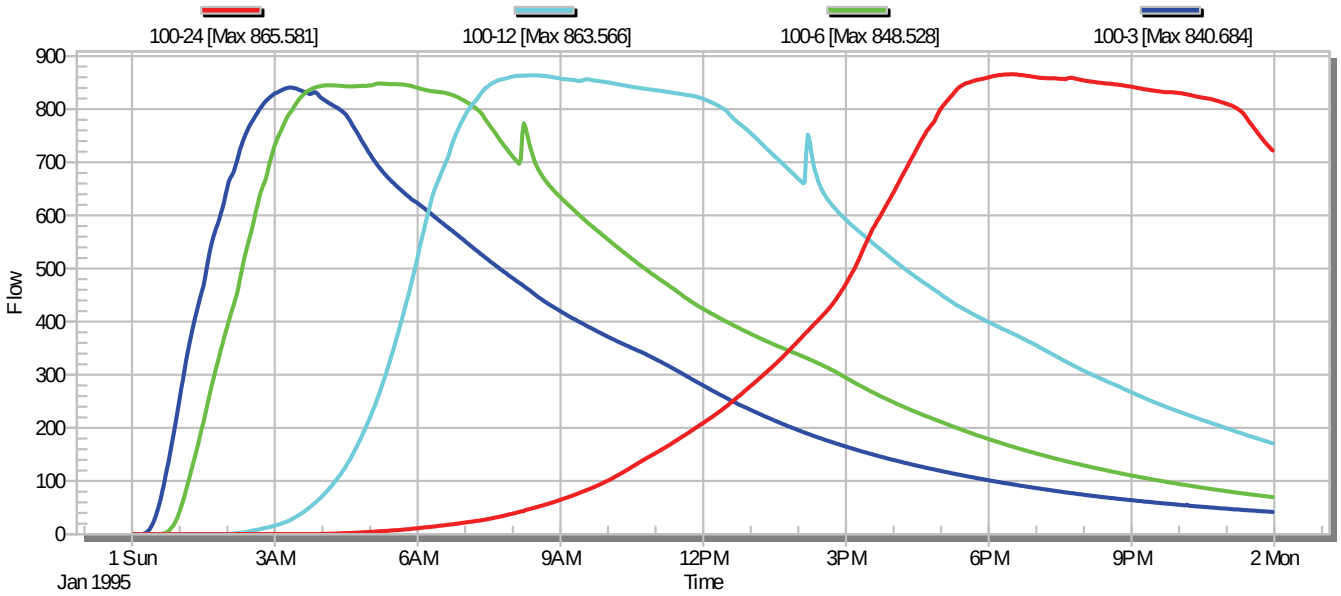


Figure 4
Critical Duration Analysis - Sugar Creek at Hershey Road
100-year Storm

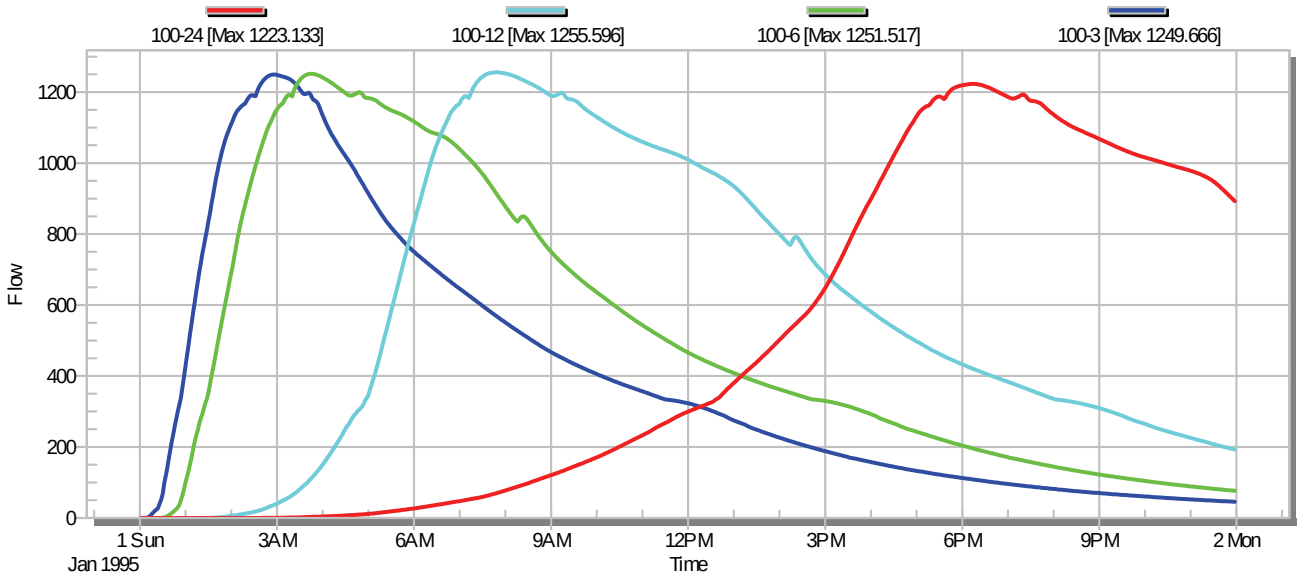


Figure 5
Critical Duration Analysis - Sugar Creek at Veterans Parkway
100-year Storm

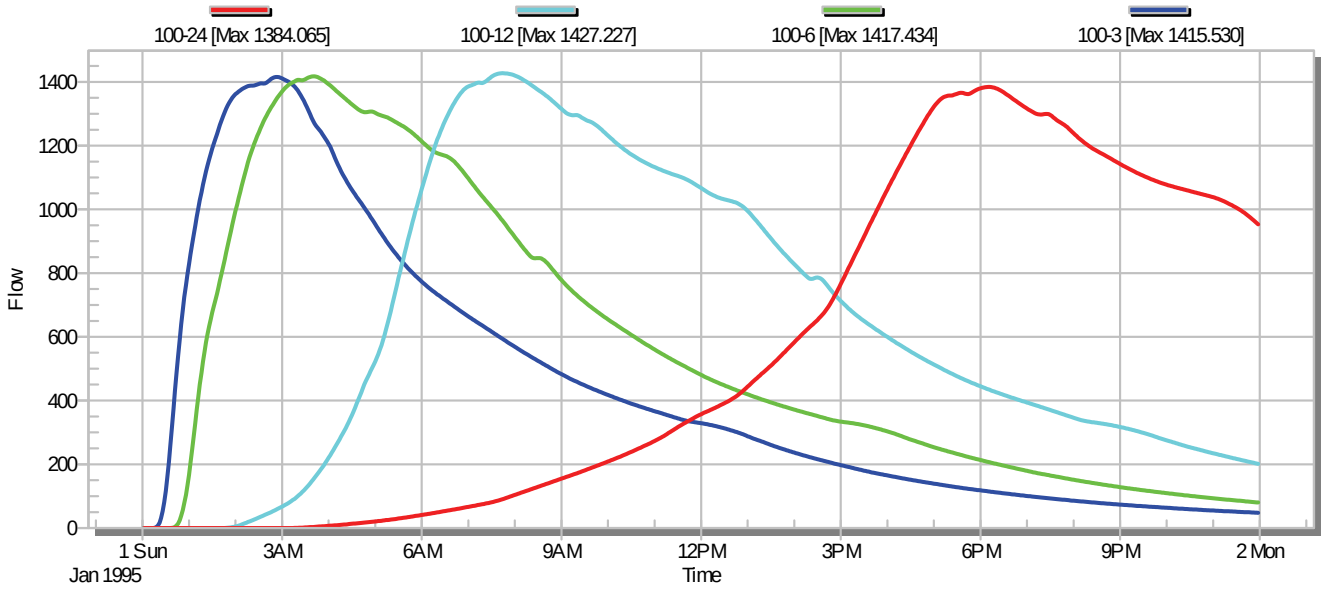


Figure 6
Critical Duration Analysis - Sugar Creek at Jersey Avenue
100-year Storm

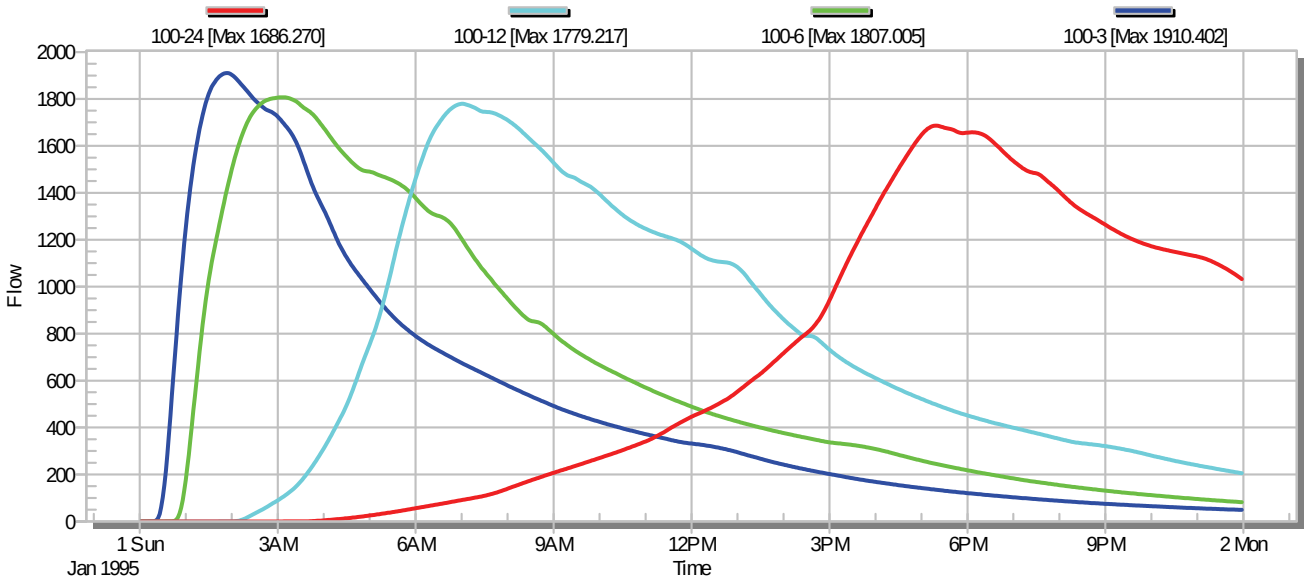


Figure 7
Critical Duration Analysis - Sugar Creek Confluence with High School Branch
100-year Storm

Model Calibration

There is no direct measure of streamflow within the project area. However, a USGS stream gage (Gage # 05580950) exists on the Sugar Creek in the vicinity of the West Wastewater Treatment Plant (WWWTP) on the City's west side (see Figure 8). The method chosen to calibrate the upstream component of the Sugar Creek is described as follows:

- The flow hydrograph as calculated at Linden Street (downstream end of study reach) was routed downstream to the USGS gage location. The flow was routed in a trapezoidal channel representing the concrete-lined channel downstream of Linden Street. This provided a physically-relevant time lag and channel attenuation to transform the modeled hydrograph to its appropriate shape at the location of the USGS gage.

- The total studied reach has a drainage area of 7.8 square miles, or 22.5% of the total drainage area (34.6 square miles) tributary to the USGS gage. Given that the study area consists of slopes and land use that are consistent with the remainder of the Sugar Creek watershed, it was assumed that the runoff response from the study area, as observed at the USGS gage location, would represent 22.5% of the instantaneous flow rate.

- The runoff response from the study area (as routed to the USGS gage location) was compared to the observed flow rate. In this case the observed flow rates were multiplied by a factor of 0.225 to adjust it to the assumed study area runoff component. This comparison was made for 3 observed storms:

- June 3-4, 2008 (1-year recurrence interval)
- September 14, 2008 (10-year recurrence interval)
- June 1, 2009 (1-year recurrence interval)

- The following hydrologic variables were adjusted to achieve a reasonable fit to observed peak flow rates:
  - *Runoff Curve Numbers (CN)* - the CN values were reduced slightly based on an over-prediction of modeled flow rates. The adjustments were minor (e.g. reducing a residential development CN from 85 to 83 or commercial from 94 to 92). The adjusted CN values still fall within the range of acceptable values for the respective land uses.
  - *Unit Hydrograph Shape Factor (HSF)* - the HSF was adjusted downward to 380 (from a Midwest standard of 484) to better match the observed hydrograph shape, but it did not have a significant impact on calculated peak flows.

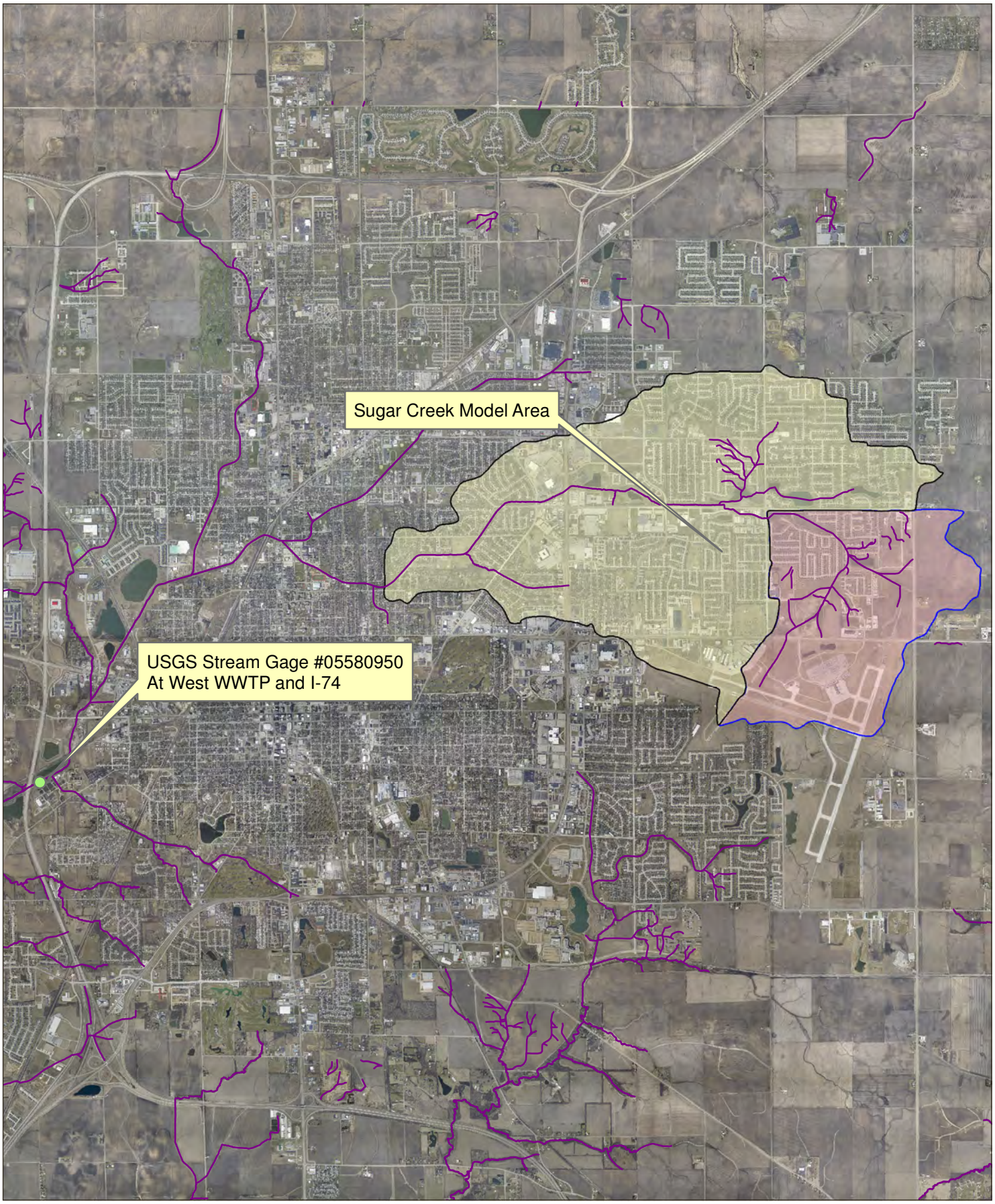
- The calibrated model resulted in the following peak flow predictions (see Figure 8a for graphical depictions of the calibration):

Table 3
Model Calibration Summary

Storm	Storm Summary	Observed Peak Flow (cfs)	Predicted Peak Flow (cfs)	Peak Flow Error (%)
June 3-4, 2008	1.2 inches in 6 hours (< 1 year storm)	302	415	+37
September 14, 2008	3.9 inches in 17 hours (~10 year storm)	800	720	-10
June 1, 2009	1.8 inches in 4 hours (1 year storm)	520	521	< +1

The three calibration events indicate that the model is not consistently under- or over-predicting the peak flow. Given spatial variability in rainfall over a large drainage area and varying antecedent moisture conditions, the calibration accuracy will be limited. However, the application of standard hydrologic analysis techniques in the study area, combined with this analysis, should provide a reasonable level of confidence in the XP-SWMM model for design event modeling.

Path: P:\0000_0100\0067110010_Bloomington IL Sewer Master Plan\EWRG\Stormwater Master Plan\SWMP REPORT DOCUMENTS\GIS and Miscellaneous Figures\Figure 8 - USGS Gage Location.mxd



0 3,100 6,200 9,300 Feet

FIGURE 8
USGS STREAM GAGE LOCATION

OHM
888.522.6711
ohm-advisors.com

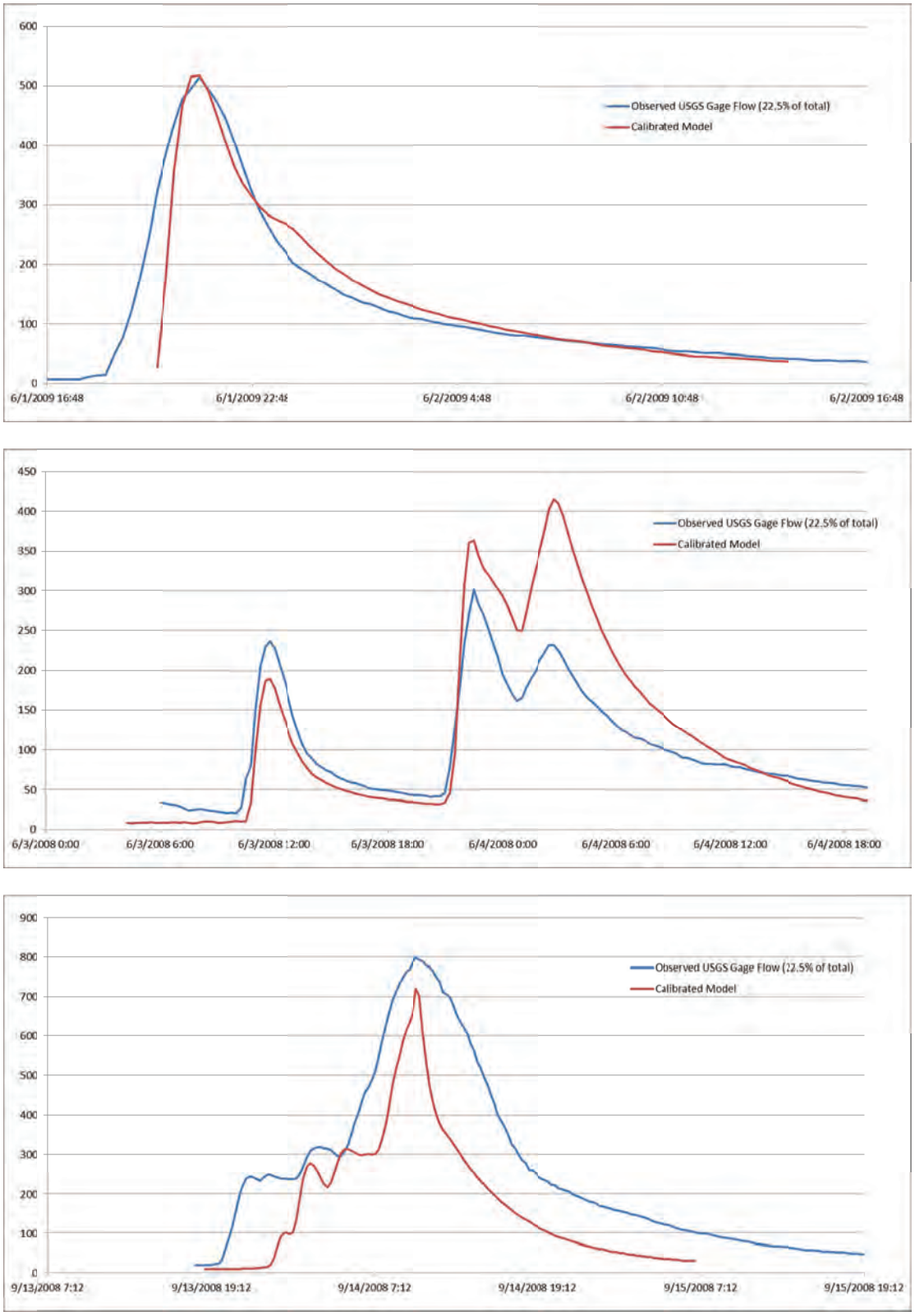


Figure 8a
Sugar Creek Calibration to Downstream USGS Gage

Key Findings

Maintenance of City-Owned Dry and Wet Detention Ponds

Discussion on the City's dry and wet detention pond maintenance is included in the *Greenways/Sustainability* chapter.

Tipton Park Detention Ponds

The detention ponds at Tipton Park (southeast and southwest ponds) are influenced by and connected to the Sugar Creek floodplain. As such, the Sugar Creek hydraulics impact the outlet capacities of the Tipton Park ponds and can result in reverse flow (i.e. water from Sugar Creek can flow ***into*** the detention ponds during low-probability rainfall events).

Based on our review of the Tipton Park site plan, it does not appear that the detention ponds were designed to account for the floodplain hydraulics of the Sugar Creek. This results in a 100-year high water level that is above the designed high water level for both detention ponds. This occurs when the Sugar Creek floodplain spills into the detention pond areas and the entire region becomes part of one contiguous floodplain (see Figure 11). The difference between the design and computed 100-year high water levels is summarized as follows:

Detention Pond	Design HWL	Computed HWL
Tipton - Southeast Cell:	798.9	801.7
Tipton - Southwest Cell:	800.6	801.6

Given that numerous homes have been built along the perimeter of both detention ponds, it is possible that some homes may have lower levels (especially walk-out basements) that could be susceptible to flooding during a 100-year event.

Impact of Detention Ponds in the Sugar Creek Headwaters

The peak stored volume for the 100-year 24-hr duration storm, 560 acre-feet (182 million gallons), represents approximately 26% of the total rainfall volume for the same storm (rainfall tributary to Veterans Parkway). This has a significant impact on peak flow control, especially from Airport Road to Hershey Road. From Veterans Parkway downstream, the impact of the detention ponds becomes less pronounced, as there are fewer detention basins west of this location. Table 4 includes a summary of the detention pond storage volumes and peak flow rates.

Table 4
Detention Pond Performance Summary

	100-year Recurrence Interval, 24-hour Duration Event					
Detention Pond(s)	**Modeled High Water Level (ft, NAVD88)**	**Design High Water Level (ft, NAVD88)**	**Peak Stored Volume (acre-feet)**	**Peak Inflow (cfs)**	**Peak Outflow (cfs)**	**Exceeds Design Elevation/Flow ? (Y/N)**
Airport Detention Ponds (4 separate storage areas)	Varies	Varies	82.3	270	96	NO
Empire Business Park Ponds (2 separate storage areas)	823.9 (N) 828.9 (S)	825.0 (N) 829.5 (S)	13.8 (N) 23.3 (S)	131 (N) 133 (S)	123 (N) 103 (S)	NO
Eagle Creek Lake (East Pond)	814.9	817.5	87.4	421	308	NO
Eagle Creek Lake (West Pond)	812.2	813.0	49.1	324	316	NO
Sapphire Lake	817.5*	817.5**	48.8	287	231	NO
Hawthorne Subdivision (East Pond)	828.4	830.0	10.9	97	84	NO
Hawthorne Subdivision (West Pond)	814.7	816.0	44.1	181	134	NO
G.E. Road Retention Basin	804.0	804.0	18.7	194	170	NO
Tipton Park (Southeast Pond)	801.7	798.9	60.0	221	130	YES
Tipton Park (Southwest Pond)	801.6	800.6	15.9	51	9	YES
Royal Point Subdivision	826.0	831.0***	22.8	134	59	NO
Royal Links Subdivision	818.2	823.3	11.8	73	58	NO
Four Seasons Subdivision	813.5	818.0	16.4	125	90	NO
Holder Subdivision	809.6	811.46	13.0	80	49	NO
Shirk Detention Basin (Jumers Pond)	791.0	792.0	43.4	177	115	NO

* *Sapphire Lake – HWL as measured upstream of the overflow weir (downstream of Janet Drive)*
** *Sapphire Lake – Official 100-year HWL revised after 2009 weir modifications*
*** *Royal Point Subdivision – Based on top of berm elevation of 832 (assuming 1' freeboard)*

Comparison Between 1993 FIS Data and 2012 XP-SWMM Model Output

A primary goal of this analysis was to update the Sugar Creek stormwater model and provide the City with more physically-relevant information on the hydrologic and hydraulic responses in the Sugar Creek watershed. In developing an updated model, there are important distinctions to make between the older methodology and new methodology to better understand why the results are different. Table 5 lists these key differences.

Figures 9 - 11 illustrate the differences in the floodplain geometry from Veterans Parkway to Airport Road. These figures clearly show that the 100-year floodplain, as estimated by the 2012 XP-SWMM modeling effort, varies significantly from the 1993 FIS. Numerous structures (residential and commercial) along the Sugar Creek could potentially be removed from the official floodplain in a remapping effort is implemented.

Figures 12 and 13 illustrate the XP-SWMM 100-year flood profile superimposed on the existing FEMA flood profile. These figures show that the reaches upstream of Veterans Parkway show a significant reduction in the flood profile.

The updated floodplain illustrated in Figures 9 - 11 is preliminary only. A Letter of Map Revision (LOMR) application would need to be filed with the IDNR and FEMA prior to making an official change to this floodplain. Although the modeling effort and preliminary floodplain maps created as part of this master plan provide a good starting point to a floodplain remapping effort, the LOMR process requires significant additional analysis and documentation to make these floodplains "official". Those additional efforts are reflected in the cost estimates included in Table 9.

Downstream of Veterans Parkway, the XP-SWMM model indicates a slight reduction in the 100-year flood profile. Although this may provide an opportunity for additional floodplain remapping, there are not many structures within the current floodplain boundary between the High School Branch and Veterans Parkway, and several of those structures are within the Town of Normal. The economic benefit of floodplain remapping through the lower reaches of this study is therefore questionable.

IDNR-OWR / FEMA Floodplain Remapping in Illinois

During the last decade, the IDNR-OWR has been working with individual Illinois counties to update floodplain maps. The funds provided by FEMA for the remapping effort were limited, and the remapping effort was therefore restricted to simple changes, such as:

- Conversion of old paper-based mapping to digital mapping (DFIRMs) with floodplains superimposed on aerial photography
- Map updates to reflect older Letters of Map Revision (LOMRs) since the previous mapping effort

The floodplain remapping effort for McLean County did *not* include any of the following efforts:

- Updated hydraulic analysis to reflect new bridges or culverts installed or replaced since the previous remapping effort
- Updated hydrologic analysis to reflect land use changes and the construction of regional detention ponds and dams

The INDR-OWR has previously stated that local governments will need to bear the cost of detailed hydrologic and hydraulic analysis necessary for the development of more accurate floodplain mapping. However, the IDNR-OWR will work with communities to provide technical feedback and review of hydrologic and hydraulic modeling as part of the regulatory process.

FIGURE 9
Sugar Creek Floodplain Comparison

City of Bloomington, IL



Legend

- FEMA Floodway

FEMA Floodplain

Floodplain Zones

- 100-yr Floodplain
- 500-yr Floodplain

Estimated floodplain boundary is preliminary only. More detailed analysis necessary for formal remapping.

0 70 140 210 280 Meters

Source: Data provided by FEMA and the City of Bloomington, IL. Orchard, Hiltz and McCliment does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

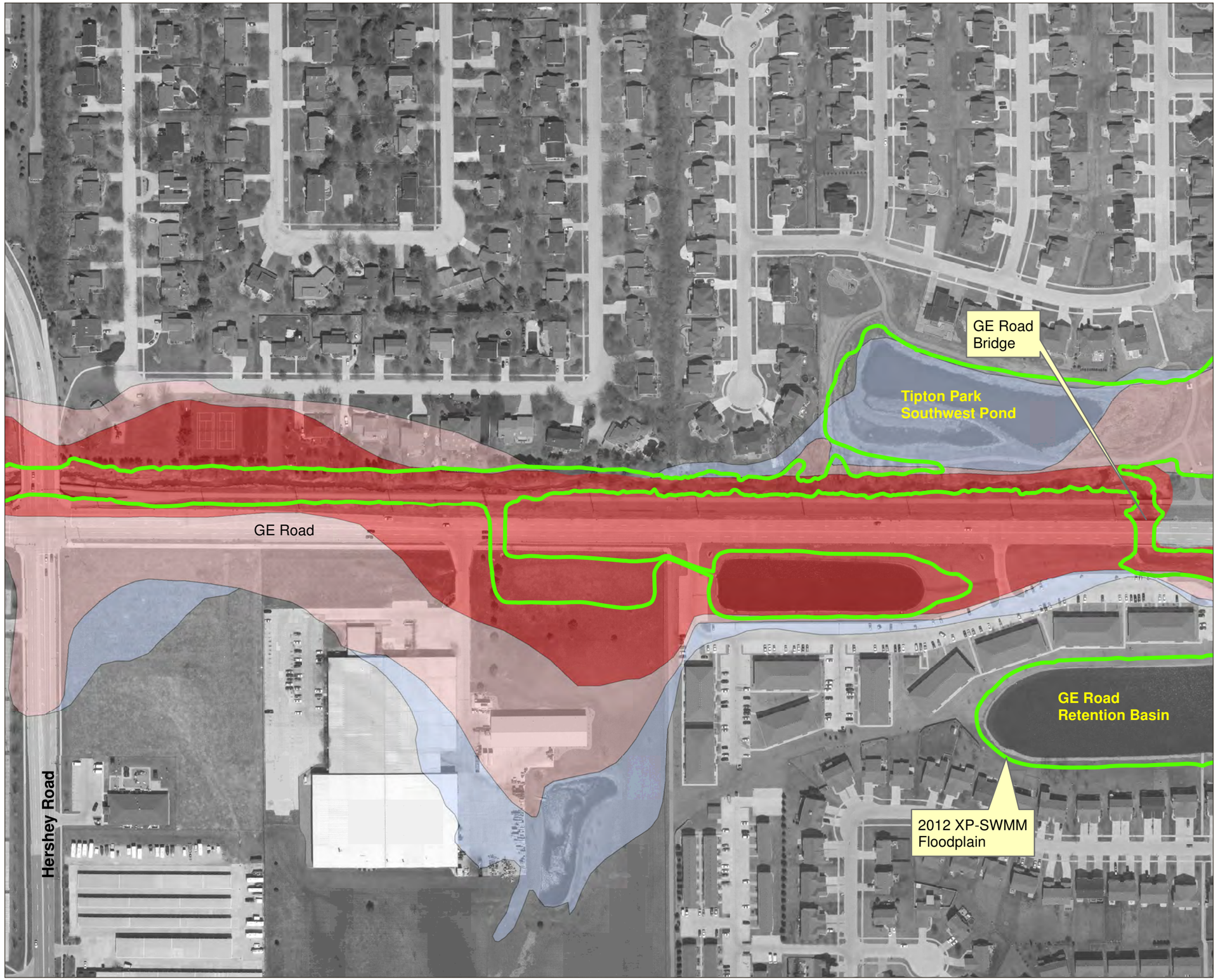
Coordinate System: Michigan South NAD 1983 State Plane International Feet

Map Published: June 1, 2012

OHM 888.522.6711 | ohm-advisors.com

FIGURE 10
Sugar Creek Floodplain Comparison

City of Bloomington, IL



Legend

- FEMA Floodway

FEMA Floodplain

Floodplain Zones

- 100-yr Floodplain
- 500-yr Floodplain

Estimated floodplain boundary is preliminary only. More detailed analysis necessary for formal remapping.

0 30 60 90 120 Meters

Source: Data provided by FEMA and the City of Bloomington, IL. Orchard, Hiltz and McCliment does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

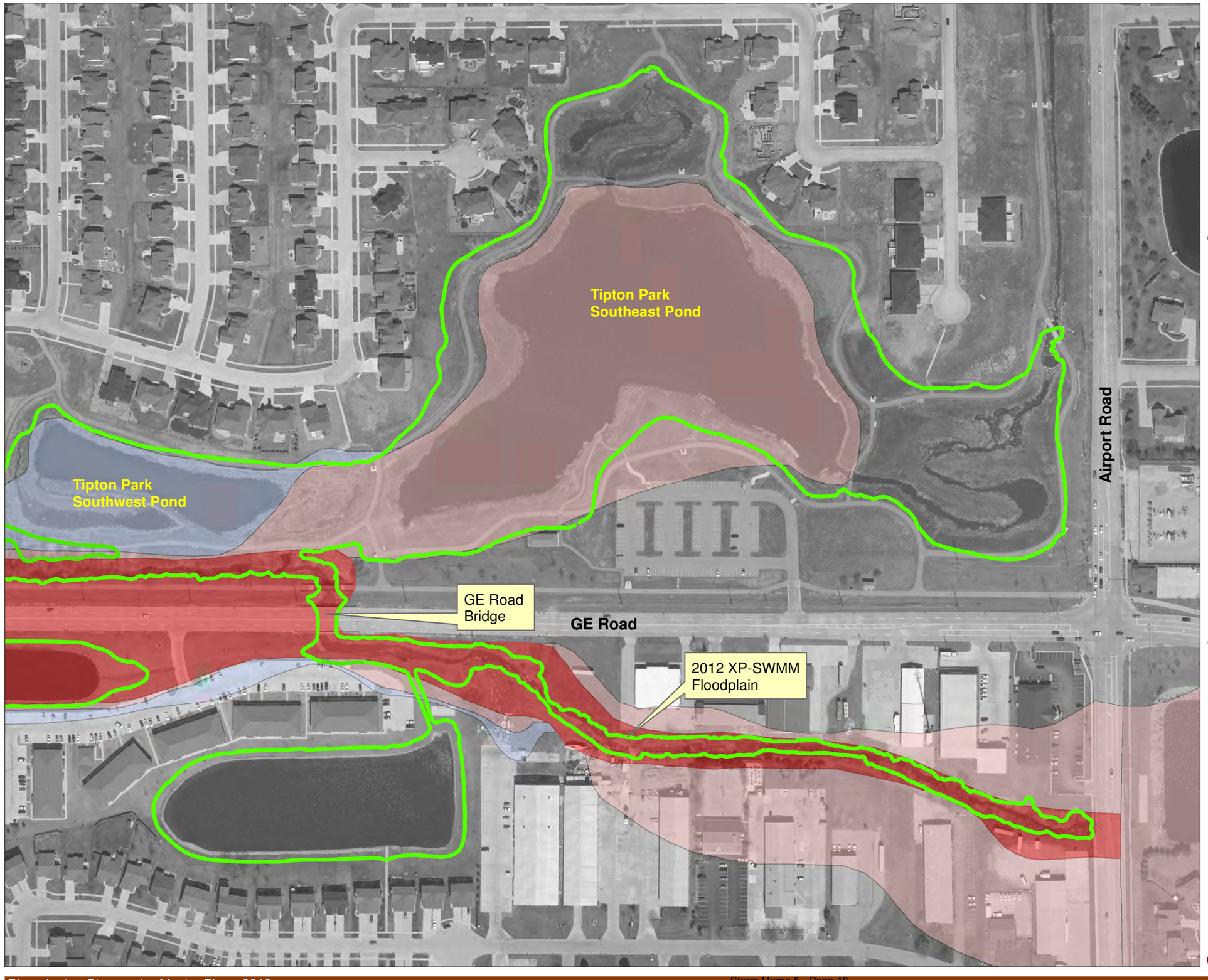
Coordinate System: Michigan South NAD 1983 State Plane International Feet

Map Published: June 1, 2012

OHM 888.522.6711 | ohm-advisors.com

FIGURE 11
Sugar Creek Floodplain Comparison

City of Bloomington, IL



Legend

- FEMA Floodway

FEMA Floodplain

Floodplain Zones

- 100-yr Floodplain
- 500-yr Floodplain

Estimated floodplain boundary is preliminary only. More detailed analysis necessary for formal remapping.

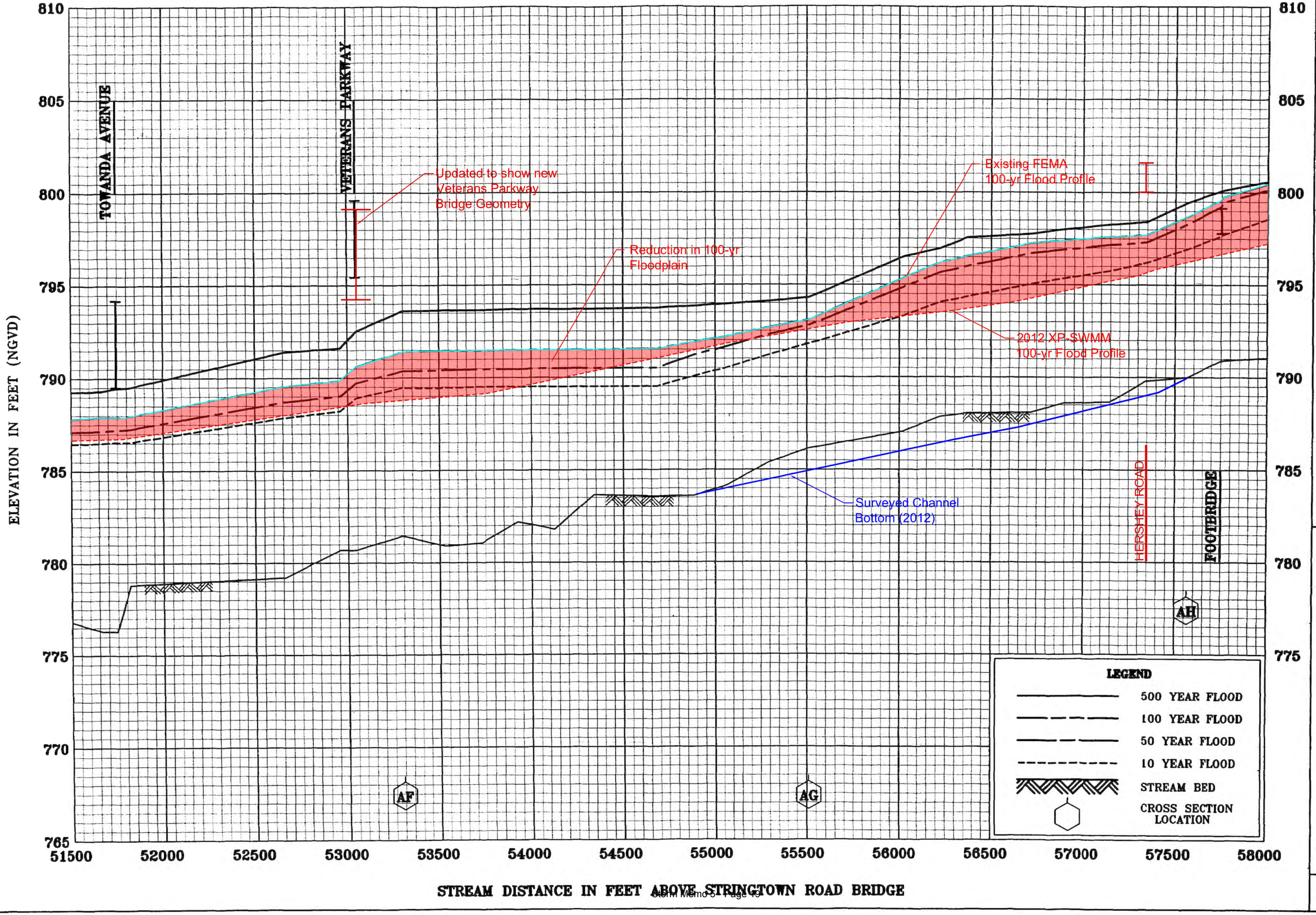
0 30 60 90 120 Meters

Source: Data provided by FEMA and the City of Bloomington, IL. Orchard, Hiltz and McCliment does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: Michigan South NAD 1983 State Plane International Feet

Map Published: June 1, 2012

OHM 888.522.6711 | ohm-advisors.com



FLOOD PROFILES

FIGURE 12 - SUGAR CREEK FLOOD PROFILES

FEDERAL EMERGENCY MANAGEMENT AGENCY

McLEAN COUNTY, IL

AND INCORPORATED AREAS

30P

ELEVATION IN FEET (NGVD)

825
820
815
810
805
800
795
790
785
780

BIKE TRAIL
GENERAL ELECTRIC ROAD
AIRPORT ROAD
LIMIT OF DETAILED STUDY

Existing FEMA
100-yr Flood Profile

THE 50- AND 500-YEAR FLOOD PROFILES
ARE TOO CLOSE TO THE 100-YEAR
ELEVATION TO BE SHOWN SEPARATELY

Reduction in 100-yr
Floodplain

2012 XP-SWMM
100-yr Flood Profile

AI
AJ
AK

58000
58500
59000
59500
60000
60500
61000
61500
62000

STREAM DISTANCE IN FEET ABOVE STRINGTOWN ROAD BRIDGE

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

FIGURE 13 - SUGAR CREEK FLOOD PROFILES

FEDERAL EMERGENCY MANAGEMENT AGENCY

McLEAN COUNTY, IL

AND INCORPORATED AREAS

Storm Memo 5, Page 20

Table 5
Key Model Differences (1993 FIS vs. 2012 Analysis)

Model Attribute	1993 FIS	2012 XP-SWMM	Key Differences
Rainfall statistics	Not specified in FIS	NOAA Atlas 14	NOAA Atlas 14 provides more recent rainfall statistics (through 2004).
Hydrologic Analysis	HEC-1	XP-SWMM	XP-SWMM has a graphical user interface, and it is easier to spot errors in the model. Similar runoff calculations to HEC-1 (curve number and time of concentration). *Both models are approved by FEMA for peak flow calculations.*
Hydraulic Analysis	HEC-2	XP-SWMM	Graphical user interface, easier to spot errors in model. Dynamic wave routing allows for more accurate channel and floodplain routing and flow attenuation. XP-SWMM also allows for analysis of closed (piped) systems and detention pond routing. *Both models are approved by FEMA for floodplain and floodway mapping.*
500-year flows	Extrapolation of the frequency-discharge curves from smaller storms	Direct model of 500-year recurrence interval rainfall (based on NOAA Atlas 14)	Directly modeling the 500-year recurrence interval rainfall allows for a more direct calculation of flow rates based on statistics and physical modeling rather than extrapolation.
Calibration	Various precipitation gages throughout McLean County (hourly data) with USGS stream gages	Precipitation gage in east Bloomington (15-minute data interval) with USGS stream gage at West WWTP	15-minute rainfall data provides for a more accurate analysis of peak rainfall intensity, which drives peak flow rates for this size watershed.
Channel and bridge measurements	Field-based survey at bridges/culverts and intermediate cross sections	Record drawings of bridges/culverts, 2-foot contour data for channels, supplemented with field survey	The 2012 model relies heavily on record drawings and McLean County contours. Some limited field data were collected to verify record drawing dimensions and provide more accurate channel cross sections.
Vertical Datum	NGVD29	NAVD88	NAVD 88 is the newer vertical datum used by modern GPS equipment and linked to McLean County contour data (in McLean County, this results in a difference of approximately 0.2 feet).

Table 6
Flow Rate Comparison (FEMA vs. 2012 XP-SWMM)

Location	Drainage Area (sq. mi.)		100-yr Peak Flows (cfs)		500-yr Peak Flows (cfs)	
	FEMA FIS	2012 Model	FEMA FIS	2012 Model	FEMA FIS	2012 Model
Airport Road	N/A	3.0	775*	444	1,100*	618
GE Road	3.4	3.7	775	590	1,100	767
Hershey Road	N/A	5.1	N/A	865	N/A	1,218
Veterans Parkway	4.6	6.3	1,085	1,255	1,600	1,700
Jersey Avenue	6.6	6.9	1,620	1,427	2,500	1,908
Upstream of confluence of High School Branch	7.8	7.8	1,915	1,910	3,000	2,802

** The FEMA FIS did not include a separate flow calculation at Airport Road. The FEMA hydraulic model used the peak flow at GE Road to determine the flood profiles up to Airport Road. The 2012 XP-SWMM model includes a separate flow calculation at Airport Road.*

Table 7
Flood Profile Comparison (FEMA vs. 2012 XP-SWMM)

Location	Drainage Area (sq. mi.)		100-yr High Water Level (feet)		500-yr High Water Level (feet)	
	FEMA FIS	2012 Model	FEMA FIS	2012 Model	FEMA FIS	2012 Model
Airport Road	N/A	3.0	808.3	805.2*	808.3	806.2*
GE Road	3.4	3.7	804.5	801.8	805.7	802.8
Hershey Road	N/A	5.1	798.5	795.8	799.0	796.9
Veterans Parkway	4.6	6.3	790.8	788.6	792.8	789.7
Jersey Avenue	6.6	6.9	783.5	780.6	785.7	781.4
Upstream of confluence of High School Branch	7.8	7.8	770.2	771.4	772.5	772.6

** The Airport Road high water level is computed at the downstream face of the culvert (upstream end of existing FEMA study). All other high water levels are measured at the upstream end of the associated bridge/culvert.*

Key Recommendations

1. Verify (by field survey) the walkout/viewout elevations of the homes surrounding the Tipton Park Subdivision detention ponds. As the calculated 100-year high water levels are significantly higher than the design elevations, it is possible that some homes are vulnerable to flooding.

2. Additional flow reduction is possible through targeted retrofits to detention pond discharge structures. Several detention ponds were identified as having additional available storage volume. The recommended retrofit opportunities should be further studied and implemented in order to control peak flow rates and enhance stormwater quality. For the purposes of cost estimation, it was assumed that four (4) detention ponds would be retrofitted. These retrofits would target the four largest volume capture opportunities.

   Table 4 reveals that several detention ponds operate well below their design high water elevation. Retrofitting detention basins to store additional stormwater volume have the following key benefits:

   - Provides a mechanism for the City to encourage land development (and redevelopment) within the Sugar Creek watershed by allowing developers to purchase detention volume capacity at a reasonable price, as the additional detention volume can be created at a low cost. A watershed-specific fee-in-lieu price could be established that allows both the City and land developers to benefit.
     - Prior to approving any site plans employing this “trading” mechanism, the hydrologic/hydraulic impacts of the land development (or redevelopment) should be confirmed. The development/redevelopment should not create any adverse hydraulic impacts and the “traded” stormwater detention volume should be as close as practical to the development area.
   - Reduces peak flow rates in the Sugar Creek and further reduces the floodplain elevation.
   - Enhances water quality and reduces strain on open channels by reducing pollutant and sediment loading to the Sugar Creek.

   Retrofits can be completed to accomplish one (or all) of the following:

   1. Provide a secondary hydraulic control for frequent events, thereby increasing residence time and encouraging sediment/pollutant removal from frequent "dirty" storms.
   2. Restrict the primary outlet to increase storage volume to the originally-intended design elevation and reduce peak flow rates for the design (100-year, 24-hour) event.
   3. As an option, the City could convert existing "dry" detention ponds into "wet" (permanent pool) ponds. Wet detention ponds typically provide significantly better water quality benefits as compared to dry ponds, as suspended solids, heavy metals, and other particulates settle out into the permanent water column instead of being flushed through the outlet. Furthermore, a wet pond provides a more attractive feature that may enhance the value of adjacent properties. This type of conversion does not typically provide significant additional storage volume, as the volume below the existing pond bottom is generally considered "dead storage" and is below the permanent pool.

- As an alternative to converting dry ponds into wet ponds, other practical solutions exist, including:
  - Replacement of turf grass with native, deep-rooted vegetation, thereby encouraging infiltration and reducing mowing/maintenance costs.
  - Installation of sediment pools near the outlet structure. These sediment pools can be cleaned out on a regular basis and can help reduce pollution without a full dry-to-wet conversion.

Based on the analysis in this study, ***there is an opportunity to gain approximately 120 acre-feet (39 million gallons) in additional flood storage*** through detention pond modification. This additional storage can be realized by making modifications to the pond outlet structures (i.e. without any significant pond regrading). Retrofit opportunities have been identified where the modeled 100-year high water level is at least 1.0 feet below the design elevation (excluding permitted dams, which are more problematic to retrofit, given the typical regulatory constraints). Table 8 lists the detention pond retrofit opportunities.

The pond retrofit cost estimates in Table 9 include the recommended outlet structure retrofits described in Items 1 and 2 above, but do not include the optional dry-to-wet conversions listed under Item 3. Dry-to-wet conversions require significant additional investment and are not as cost effective in reducing stormwater pollution as the outlet structure retrofits.

Table 8
Detention Pond Retrofit Opportunities

Detention Pond	Difference Between Design and Modeled 100-year High Water Level (ft)	Additional Available Storage (as measured to the originally-designed High Water Level) (acre-feet)	Opportunity to Convert from Dry Pond to Wet Pond?
Hawthorne Subdivision (East Pond)	1.6	15	N/A
Hawthorne Subdivision (West Pond)	1.3	24	N/A
Empire Business Park (North Pond)	1.1	3	N/A
Royal Links	5.1	26	N/A
Four Seasons Subdivision	4.5	33	**Yes**
Royal Pointe Pond	1.0*	4	**Yes**
Holder Subdivision	1.9	9	**Yes**
Shirk Detention Pond (Jumers Pond)	1.0	7	N/A
Total Additional Storage Volume Available		121 acre-feet	

* *The design high water level for the Royal Point detention pond could not be verified. However, GIS-based contours reveal that the top of pond elevation is at or about 830.0 and the calculated 100-year high water level is 828.0, leaving about 1.0 feet of storage while maintaining a 1-foot freeboard.*

Our analysis of the *Hawthorne Subdivision (West Pond)*, *Royal Links* and *Four Seasons* detention ponds indicate that the ponds do not provide much flow restriction and have significantly less flood storage volume than designed. These three ponds should be considered a top priority for retrofits, as there is over 80 acre-feet (26 million gallons) of additional storage capacity within the current storage limits of these detention ponds.

These recommendations for detention pond retrofit are preliminary only. Prior to designing any detention pond retrofits, the contributing drainage areas and detention pond outlet structures should be field-verified and modeled in more detail to verify the appropriate hydraulic modifications. Furthermore, historical pond performance data (including available photos and interviews of adjacent property owners) should be considered before making any physical changes that will impact future performance.

3. The significant changes to the hydrologic response in the Sugar Creek watershed, especially the upstream reaches, warrant a Letter of Map Revision (LOMR). The peak flow rates are significantly lower between Airport Road and GE Road, and the calculated water surface profile is significantly lower throughout the study reach. Modifying the floodplain in this area would ***remove approximately 42 structures from the floodplain*** and could save property owners significant money in flood insurance premiums. Of these 42 structures, 28 are residential and 14 are commercial / light industrial (southwest of the GE Road / Airport Road intersection). The reduced floodplain/floodway footprint would likely create additional developable area (for example, south of GE Road and east of Hershey Road).

4. A Letter of Map Revision will require additional analysis and documentation to receive IDNR and FEMA approval. This includes:
    a. Additional field work to verify cross section geometry and bridge/culvert opening areas.
    b. QA/QC analysis on the McLean County contour data. This includes a sampling of surveyed elevations compared to the latest LIDAR-based elevations.
    c. Documentation of hydrologic and hydraulic model data.
    d. Floodway / encroachment analysis (not part of this study).
    e. Cross section location map and illustrations for IDNR review.
    f. Formal submittal to IDNR and technical follow-up prior to final approval.
    g. Follow-up with FEMA staff prior to final approval and map revision.

Planning level cost opinions for the recommended actions are included in Table 9. ***Although the recommended pond retrofit projects are limited to the upper Sugar Creek watershed, the pond maintenance projects are projected City-wide, given the availability of GIS data.***

No bridge or culvert modifications are proposed as part of this analysis. Streambank restoration and channel modification improvements are covered under separate report chapters and are therefore not a part of this cost estimate.

Table 9
Sugar Creek Watershed Improvements
Planning-Level Cost Opinions

Owner:	**City of Bloomigton, Illinois**	**Date:**	**1/30/2013**
Project:	**Stormwater / Sanitary Master Plans**	**Project No.**	**0067-11-0010**
Work:	**Sugar Creek Pond Retrofits and FEMA LOMR Application**	**Prepared By:**	**GPK**
		Reviewer:	

Item No.	Item Description	Est. Quantity	Unit	Unit Price	Total Cost
1	Detention Pond Retrofit - Hawthorne Sub East	1	LS	$50,000	$50,000
2	Detention Pond Retrofit - Hawthorne Sub West	1	LS	$60,000	$60,000
3	Detention Pond Retrofit - Royal Links	1	LS	$40,000	$40,000
4	Detention Pond Retrofit[1] - Four Seasons Sub	1	LS	$40,000	$40,000
5	Letter of Map Revision - Veterans Pkwy to Airport Rd	1	LS	$125,000	$125,000
				SUBTOTAL	**$315,000**
	Contingencies	30%			$95,000
				SUBTOTAL (w/CONTINGENCIES)	**$410,000**
	PROJECT COSTS				
	Design/Admin Costs for Detention Pond Retrofits	25%			$47,500
	TOTAL PLANNING-LEVEL COST OPINION				**$460,000**

[1] *Includes outlet structure modifications only. Sediment removal and other maintenance costs covered in Greenways/Sustainability memorandum*

APPENDIX A

Subbasin Map
XP-SWMM Hydrologic Parameters

OHM Advisors
34000 PLYMOUTH ROAD
LIVONIA, MICHIGAN 48150
T 734.522.6711
F 734.522.6427
OHM-Advisors.com

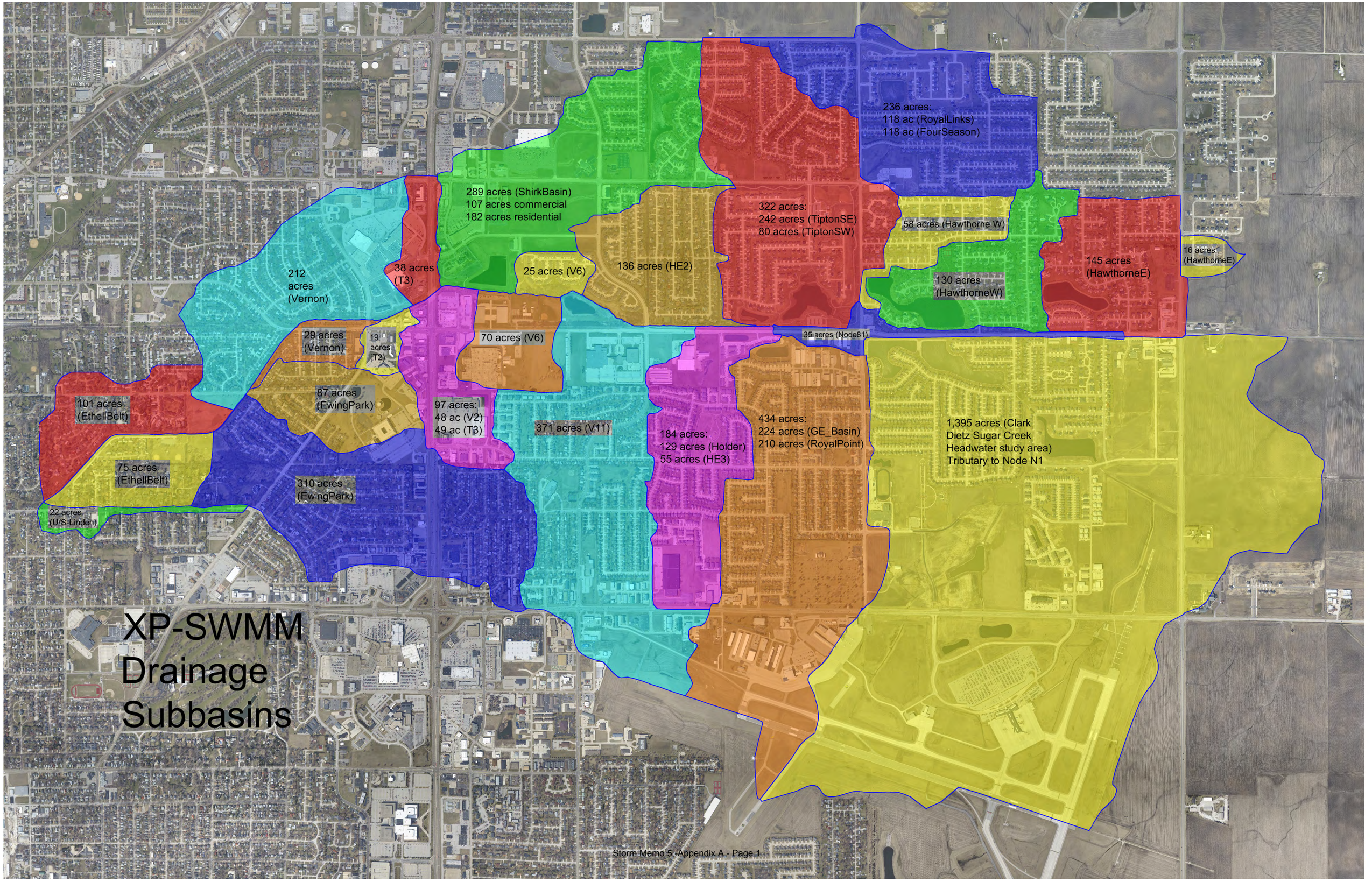

236 acres:
118 ac (RoyalLinks)
118 ac (FourSeason)
289 acres (ShirkBasin)
107 acres commercial
182 acres residential
322 acres:
242 acres (TiptonSE)
80 acres (TiptonSW)
58 acres (Hawthorne W)
16 acres (HawthorneE)
145 acres (HawthorneE)
212 acres (Vernon)
38 acres (T3)
25 acres (V6)
136 acres (HE2)
130 acres (HawthorneW)
35 acres (Node81)
29 acres (Vernon)
19 acres (T2)
70 acres (V6)
101 acres (EthellBelt)
87 acres (EwingPark)
97 acres:
48 ac (V2)
49 ac (T3)
371 acres (V11)
184 acres:
129 acres (Holder)
55 acres (HE3)
434 acres:
224 acres (GE_Basin)
210 acres (RoyalPoint)
1,395 acres (Clark Dietz Sugar Creek Headwater study area)
Tributary to Node N1
75 acres (EthellBelt)
310 acres (EwingPark)
22 acres (U/S-Linden)
XP-SWMM Drainage Subbasins

Table A-1
Hydrologic Parameters - XP-SWMM Subbasins
Sugar Creek - City of Bloomington

XP-SWMM Node	Subcatchment	Drainage Area (ac)	Pervious Area Curve Number	Hydrograph Shape Factor	Time of Concentration (min)
EagleEast	1	67	82	380	30
EagleWest	1	82	77	380	34
EagleWest	2	27	75	380	80
Empire1	1	51	91	380	27
Empire1	2	22	91	380	20
Empire2	1	56	92	380	35
EthellBelt	2	89	83	380	41
EthellBelt	4	62	82	380	41
EthellBelt	3	13	70	380	41
EthellBelt	1	12	70	380	41
EwingPark	3	273	84	380	68
EwingPark	1	87	84	380	54
EwingPark	2	37	91	380	47
FourSeason	1	118	84	380	54
GE_Basin	1	217	86	380	68
GE_Basin	2	7	96	380	7
HawthorneE	1	137	83	380	54
HawthorneE	3	16	76	380	47
HawthorneE	2	8	96	380	7
HawthorneW	1	115	84	380	54
HawthorneW	3	58	84	380	41
HawthorneW	2	15	96	380	7
HE2	1	136	83	380	61
HE3	1	55	87	380	47
Holder	1	129	85	380	61
N1	1	36	72	380	100
N17	1	21	78	380	30
N18	1	51	88	380	40
N30	1	184	75	380	126
N30	2	56	75	380	90
N34	1	41	71	380	80
N42	1	21	92	380	35
N7	1	47	78	380	30
Node81	1	35	88	380	41
Node82	1	8	84	380	22
Pond 1	1	170	82	380	96
Pond 2	1	113	82	380	53
Pond 3	1	58	85	380	14
Pond 5	2	95	75	380	97
Pond 5	1	42	88	380	108
RoyalLinks	1	118	84	380	54
RoyalPoint	1	123	90	380	54
RoyalPoint	2	87	83	380	61
Sapphire	2	95	75	380	120
Sapphire	4	71	75	380	93
Sapphire	1	68	75	380	30
Sapphire	3	41	80	380	30
Sapphire	5	41	84	380	36
ShirkBasin	2	182	83	380	81
ShirkBasin	1	107	90	380	54
T2	1	19	92	380	27
T3	1	49	90	380	27
T3	2	38	93	380	20
TiptonSE	1	235	83	380	81
TiptonSE	2	7	96	380	7
TiptonSW	1	80	85	380	47
U/S-Linden	1	22	84	380	27
V11	1	331	84	380	81
V11	2	40	90	380	20
V2	1	48	90	380	27
V6	1	40	90	380	47
V6	2	30	70	380	61
V6	3	25	85	380	34
Vernon	2	162	84	380	54
Vernon	1	50	91	380	34
Vernon	3	29	86	380	41

Asset Management Technical Memoranda

AM1 - PIPE CONDITION RATING METHODOLOGY RECOMMENDATIONS

PIPE CONDITION RATING METHODOLOGY RECOMMENDATIONS

CITY OF BLOOMINGTON, IL
DECEMBER 11, 2013

Executive Summary

This memorandum serves as a companion document to *GIS Based Infrastructure Rating System* (December 11, 2013). It provides a methodology for evaluating interior sanitary and storm sewer pipe condition.

Recommendations

- The National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) has become the industry standard for rating the interior condition of gravity pipelines. The method utilizes the PACP system of scoring defects or observations through closed-circuit television (CCTV) inspection of pipelines. It is recommended that the City of Bloomington require all CCTV inspections to comply with NASSCO-PACP specifications.
- The City of Bloomington Engineering Department utilizes PipeTech software for performing CCTV inspections. It is recommended that an automated business tool is developed to transfer pipe inspection rating scores into the Department's GIS system. This will automate storage of the data so that it can be used as part of the Department's Asset Management Program. Similarly, the business tool would include routines to back up historical data from previous inspections, so that it is accessible and not overwritten.
- It is recommended that an independent Quality Assurance review of Bloomington CCTV inspections is performed annually to evaluate its compliance with NASSCO PACP specifications. It is essential that inspections are carried out in a uniform, repeatable and compliant manner. The review would include a face-to-face feedback session for public works technicians and engineering staff.

The estimated costs for the above recommendations are summarized in the following table.

Table 0. Costs for Pipe Condition Methodology Implementation

Product	Description	Cost Estimate	Time Estimate
CCTV Integration Tool	Tool to automate transfer of CCTV inspections into City's GIS. This would include on-site testing, training and deployment.	$8,500 (one-time)	1 Week
Comply with NASSCO PACP specifications for CCTV Inspections	Quality assurance to insure compliance	$5,000 (annual)	2 weeks for review and 4 hrs for feedback session

PIPE CONDITION RATING METHODOLOGY RECOMMENDATIONS

CITY OF BLOOMINGTON, IL
DECEMBER 11, 2013

Based on Michael Baker's scope of work and on meetings with the City of Bloomington Engineering Staff in April 2012 to discuss pipe and infrastructure rating methodologies, Baker has produced the following memorandum.

PACP Pipe Rating

The National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) established methods to rate the condition of gravity pipelines. The methods utilize the PACP system of scoring defects or observations through closed-circuit television (CCTV) inspection of pipelines. Baker's recommended pipe condition rating methodology is based on the PACP pipe rating system. An overview of the PACP pipe rating system is provided below.

Structural defects and operation and maintenance (O&M) defects or observations are identified and assigned a grade. Per the PACP Condition Grading System, condition grades range from a scale of 1 to 5 based on the severity of the defects. The defect grades are as follows:

5 – Most significant defect grade
4 – Significant defect grade
3 – Moderate defect grade
2 – Minor to Moderate defect grade
1 – Minor defect grade
0 – No defects

Grade 5 defects are the most severe and include the following:

- Hinge Crack
- Hinge Fracture
- Broken Pipe (Soil and Void Visible)
- Hole in Pipe (Soil and Void Visible)
- Deformed Brick
- Reinforcement visible and/or corroded
- Missing Walls
- Dropped Invert
- Deposits, Encrustation, Grease, Rags, Silt greater than 30% of pipe area
- Infiltration – Gusher

Once each defect has been coded, segment grade scores are generated for each pipe segment. Segment grade scores require multiplying the number of defects for each grade by the grade number and then adding the values, according to the following equation.

Pipe Rating= 5×(# of Grade 5 defects)+
4×(# of Grade 4 defects)+
3×(# of Grade 3 defects)+
2×(# of Grade 2 defects)+
1×(# of Grade 1 defects)

As an example, three grade 4 defects would result in a grade 4 score of 12 (see table 1 for example). The reporting capabilities of PACP compliant CCTV software allow the user to view the output grade scores as shown below. Unique structural pipe ratings and O&M pipe ratings can be calculated by separately adding the structural defect grades and O&M defect grades.

Table 1. PACP Segment Grade Score

	Structural								O & M								Overall							
Segment	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index
20120807 MH_5637_SAN-MH_5638_SAN	0	0	0	0	0	0	0000		0	4	3	12	5	24	5143	3.4	0	4	3	12	5	24	5143	3.4

All structural grade scores are summarized into a structural rating score. Likewise operational and maintenance grade scores are summarized into an O & M rating score. Additionally, an overall score is recorded by adding the structural rating and O & M rating scores (see Overall rating column in table 2 below).

Table 2. Overall Rating = Structural Rating + O & M Rating

	Structural								O & M								Overall							
Segment	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index
20120807 MH_5637_SAN-MH_5638_SAN	0	0	0	0	0	0	0000		0	4	3	12	5	24	5143	3.4	0	4	3	12	5	24	5143	3.4

Recommended Pipe Condition Rating System

The recommended pipe condition rating uses NASSCO defect scores together with the maximum grade for a given pipe segment. It is important to record the maximum grade (Max Grade) reported from the PACP-compliant inspection report. Storing the Max Grade allows each pipe segment to be categorized by the most severe grade defect observed (i.e., all the pipe segments that have a defect grade '5' will be grouped together, '4' grouped together, etc.). The example in table 3 indicates a max grade of 5.

Table 3. Max Grade Recorded

	Structural								O & M								Overall							
Segment	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index
20120807 MH_5637_SAN-MH_5638_SAN	0	0	0	0	0	0	0000		0	4	3	12	5	24	5143	3.4	0	4	3	12	5	24	5143	3.4

The pipe rating will consist of a four digit number, the fourth digit (in the thousandths place) of which corresponds to the Max Grade recorded. This digit will therefore range between 1 and 5. The other three digits (hundredths place through one's place) correspond to the overall rating as presented in table 2. Thus, a pipe having a Max Grade = 5 and PACP Overall Rating Score = 521 will have a resulting pipe rating CCTV Score of 5,521. Should the PACP Overall Rating Score exceed 999, it is rounded down to this value for use in the pipe rating CCTV Score.

Following this methodology, the maximum pipe rating CCTV Scores for each pipe of a given Max Grade are as follows:

Max Grade = 5: Max CCTV Score = 5,999
Max Grade = 4: Max CCTV Score = 4,999
Max Grade = 3: Max CCTV Score = 3,999
Max Grade = 2: Max CCTV Score = 2,999
Max Grade = 1: Max CCTV Score = 1,999

Integration of Pipe Condition Rating Methodology into Infrastructure Rating

The results of the pipe rating for each segment are useful for prioritizing maintenance decisions and CIP planning at two different levels.

1. CCTV NASSCO Prioritization

The CCTV inspection results can be used as an immediate indicator of pipes requiring repair and replacement. Pipes with severe NASSCO defect codes are identified and addressed based on the Pipe Rating methodology results. Pipe segments are grouped by the highest NASSCO defect observed, and prioritization is carried out within each group. The reason for this is that for pipelines having Grade 3 through 5 defects, the most severe defect typically defines the highest probability of failure. Pipes with any Grade 5 defect most likely have a higher probability of failure than pipes with only Grade 3 defects. Therefore, pipes with Grade 5 defects should be compared with other pipes with Grade 5 defects until all of those pipes are addressed, using the Pipe Rating Methodology scores that result from the matrix. Pipes with Grade 4 defects should be addressed subsequently. Thus, the pipe defect grades themselves, together with the Pipe Rating Methodology, provide the City of Bloomington with valuable and immediate information about where to focus its efforts.

2. Business Risk Exposure Prioritization

The pipe rating will be incorporated as a factor into Bloomington's GIS infrastructure rating system, which is based on the development of a business risk exposure (BRE) for each infrastructure segment. Business risk is defined by the equation:

$BRE_1 = PoF * CoF_{CAP1}$, where

BRE_1	= Business Risk Exposure based on desktop information
PoF	= the likelihood of failure for the infrastructure component, normalized to a numeric scale.
CoF_{CAP1}	= the consequences of failure of the infrastructure component, on a numeric scale

While it is not the intent of this memorandum to describe the methodology to be used for the GIS infrastructure rating system, a description of its incorporation of CCTV pipe ratings obtained through inspections is appropriate. In Baker's meeting with Bloomington on April 16, 2012, it was explained that the BREs depend on several factors. Bloomington staff and Baker identified the following factors (which here on out will be referred to as desktop factors) that the City feels are most important in estimating the likelihood of failure (PoF Factors) for its sanitary pipe segments:

- Roots, Grease, Deposits (all in 30/60/90 layer)
- Age
- Material
- Lateral Tie-ins*
- History of service orders

*Subsequently eliminated as a factor

It is important to note that the CCTV pipe rating will influence the calculation of the PoF and carry significant weight on the overall BRE; however, the desktop factors in mention also have a bearing. In some cases, these factors may represent

the only information available if CCTV inspections or other studies have not been performed. The equation below demonstrates this concept, where the CCTV pipe rating is more heavily weighted.

$BRE_2 = (0.25*PoF_{Desktop\ Factors} + 0.75*PoF_{CCTV\ Rtg}) * CoF_{CAP1}$

Where	BRE_2	= Business Risk Exposure at a refined level
	$PoF_{Desktop\ Factors}$	= Likelihood of failure based on Bloomington Factors
	$PoF_{CCTV\ Rtg}$	= Likelihood of failure based on CCTV Priority Rating
	CoF_{CAP1}	= Consequence of Failure

Thus, if CCTV pipe ratings are available, they carry a heavy weight in the overall BRE_2 rating. If not, then the BRE will depend solely on the desktop factors. Bloomington should focus its field studies, including CCTV video inspections, on those pipes having higher values of BRE_1. The exact trigger value for performing such inspections will depend on the function of the pipe (sanitary or storm), and recommendations for each of these cases are provided in a separate memorandum entitled *GIS Based Infrastructure Rating System*. The calculation of $PoF_{CCTV\ Rtg}$ is directly proportional to the pipe rating CCTV score, and is described in the same document.

Management of Pipe Ratings and GIS Incorporation

Since the pipe ratings will allow Bloomington to both identify segments with severe needs, as well as to refine its overall GIS infrastructure ratings, the adequate management of this information is therefore important for the City's CIP and maintenance optimization planning. Capability to see trends in the data (from one inspection to the next) is a requirement. Access of the most recent pipe rating through Bloomington's GIS system is needed for BRE refinement. The following section describes Baker's recommendations to achieve these two objectives.

For the GIS-based rating system, Baker will recommend expanding Bloomington's Water Utility GIS Data Model to include the desktop factors previously listed for PoF. Consequence of failure (CoF) factors will also be included in the model.

Baker recommends that the PipeTech database information for defects and severity is stored in related database tables, where it can be utilized in the calculation of BREs and used to prioritize maintenance and CIP decisions. This database table will constitute the historical record of pipe ratings for each individual pipe and include information such as structural, O&M, and overall segment grade scores. Since the information utilized to calculate values for these fields needs to originate from CCTV inspections performed utilizing PipeTech software, it is recommended that an automated business tool be developed to transfer pipe inspection rating scores into the GIS system. Similarly, the business tool would include routines to back up historical data from previous inspections, so that it is accessible and not overwritten.

In order to provide a standardized format for passing data from one software system to another, NASSCO requires all PACP compliant CCTV software vendors to include an export function within their software to export to the PACP standard database developed by NASSCO. To facilitate this, PipeTech includes an export to PACP database tool. It is recommended that the business tool read information from a standard PACP compliant database file created utilizing PipeTech's export to PACP database tool.

Since ArcGIS is the GIS software utilized by Bloomington, it is recommended that a custom ArcObjects add-in or python script be developed and made available from within ArcGIS as part of a custom Bloomington Pipe Rating Utility toolbox. The following steps outline the business logic that such a program or tool would need to follow. The add-in would function with the requirement that all recorded CCTV data is PACP compliant with the associated assigned defect ratings. Inspections performed without following the PACP rules would either be excluded from consideration, or required to be converted.

I. Locate PACP export database file
II. Read data from Inspection table

a. For each Inspection
    i. Confirm the CCTV pipe segment inspection data matches a GIS pipe segment
    ii. Verify if Inspection has already been loaded previously
        1. True
            a. Move to Next Inspection
        2. False
            a. Record Pipe Length
            b. Read related Observations table
            c. For each defect in Observations table
                i. Translate PACP_Code to Grade
                ii. Categorize Grade
                iii. Validate Max Grade
b. Calculate Structural Grade Score
c. Calculate O & M Grade Score
d. Calculate Overall Grade Score
e. Calculate the pipe rating CCTV score for the segment (based on the methodology presented in table 3)

III. Save to GIS System tables

Once stored in the GIS system table, the pipe rating and associated information is available in GIS to be used for Infrastructure Rating calculation, or BRE, as well as to be used for prioritization decisions based on highest defect code. As previously stated, the calculation of BREs and the GIS Based Rating System are detailed in a separate memorandum.

2014 City of Bloomington
Stormwater and Sanitary Sewer Master Plans

Asset Management Technical Memoranda

AM2 - GIS BASED INFRASTRUCTURE RATING SYSTEM

GIS BASED INFRASTRUCTURE RATING SYSTEM

DECEMBER 11, 2013

EXECUTIVE SUMMARY

The following Memorandum provides specific guidelines and recommendations for the development of a GIS Based Infrastructure Rating System. This tool is a critical component of an overall strategic and justifiable approach to evaluating, prioritizing and selecting the most critical sewer/stormwater infrastructure elements on which to target funding and maintenance efforts. Bloomington's end goal for such activities is to reduce life cycle costs for its sewer assets and to practice "smart" operations, maintenance, and replacement actions that are coordinated with related asset activities including road repair and utility replacement.

The Rating System establishes a business risk score for selected assets taking into account identifiable factors that contribute to the likelihood for an asset to fail as well as those indicating a severe impact to the City of Bloomington (COB), its customers or the community if a particular asset were to fail. It relies on efficient tracking of work order history, age of infrastructure, and other data in a well maintained database that can be linked and compared to current and future planned projects across the City's departments (Parks, Engineering, Water, etc.). The frequency of large scale and potential costly failures is reduced through the use of the database in the planning and execution of repair, rehabilitation and replacement activities. At the same time, redundancy in expenditures is achieved through coordination between departments of infrastructure related activities.

The GIS Based Rating Tool has been developed to function within COB's current GIS system and information layers. One of the caveats with this particular Tool is that it is largely based on available data sources, many of which have limited historical information. Additionally, with the implementation of MUNIS or an alternative system for handling work orders and inspections currently pending along with the possible transition by COB from a file-based GIS system to a possible enterprise database system, the format and location of many supporting data references is certain to change. Therefore it is necessary to implement the following recommendations for the effective application of the GIS Tool:

1. The supporting data structures must be in place and well organized.
2. The required scripting tools must be in place and properly maintained

Costs associated with these recommendations are estimated as follows:

Table 0 – Future Costs Associated with GIS Based Infrastructure System

Product	Description	Cost Estimate	Time Estimate
Consulting/GIS BRE Toolset Development/Maintenance	Ongoing Maintenance & Support	$10,500	Annual Service (estimated at approximately 100 hours)
CCTV Integration Tool	Tool to automate transfer of CCTV inspections into Business Risk Model. This would include on-site testing, training and deployment.	$8,500	1 Week
MUNIS GIS Integration	Data conversion and business automation tools. GIS and asset management data integration and web enablement.	$100,000 – $250,000	1 Time Service (potential minor upgrades every several years as software updates occur)

GIS BASED INFRASTRUCTURE RATING SYSTEM

PILOT AREA EVALUATION – PHASE 1 (CAP 1 & 2)
CITY OF BLOOMINGTON, IL
DECEMBER 11, 2013

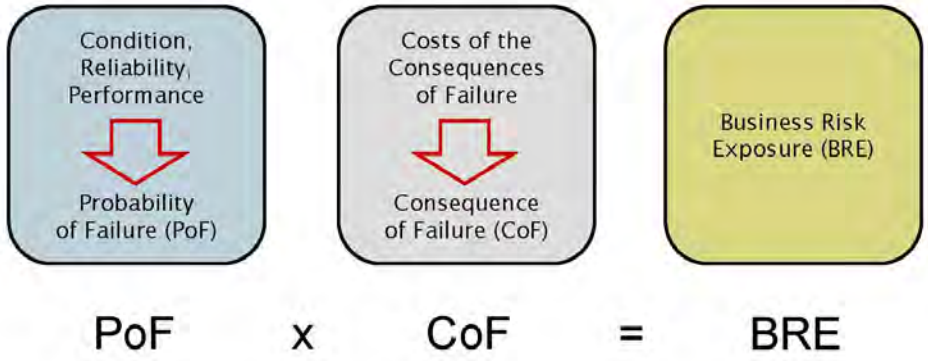
OVERVIEW

In an effort to assist the City of Bloomington Engineering/Maintenance & Operations staff with a strategic and justifiable approach in evaluating, prioritizing and selecting the most critical sewer/stormwater infrastructure elements to target funding and maintenance efforts, Michael Baker Jr, Inc. has been working on the development of a GIS Based Infrastructure Rating System. The Rating System establishes a business risk score for selected assets taking into account identifiable factors that contribute to the likelihood for an asset to fail as well as those indicating a severe impact to the City of Bloomington, its customers or the community if a particular asset were to fail. The identification and selection of Probability of Failure (PoF) and Consequence of Failure (CoF) factors to be utilized in this approach was based on Best Management Practices from research agencies including the Water Environment Research Foundation (WERF), National Association of Sewer Service Companies (NASSCO) and National Research Council Canada (NRCC), as well as interviews with Bloomington staff and the availability of supporting data.

METHODOLOGY

A risk based approach is used to prioritize the critical infrastructure. Business risk exposure (BRE) is the risk that a component will not allow a utility to operate at defined levels of service in the most cost effective manner. Mathematically, BRE is defined as the consequence of failure (CoF) combined with the likelihood of occurrence (PoF) and is presented by the following equation:

Risk (criticality) metric



This equation then can be used to define critical assets as those assets that have a high business risk exposure – that is, significant consequences if they do fail (major expense, system failure, safety concerns, regulatory violation, etc.), and that have a high likelihood of failing (old, poor condition, etc.).

Evaluating risk requires that sanitary and storm sewer assets are assessed in terms of their condition and associated remaining life. The assets must also be evaluated for the consequences that their failure would cause.

Levels of the Rating System

The GIS Based Rating System consists of two phases or levels of certainty, denominated CAP 1 and CAP 2. CAP comes from the term "Condition Assessment Protocol". CAP 1 is the first level of condition assessment protocol, and relies on assessing indirect factors that come from desktop information including age, estimated remaining useful life, and environmental considerations. CAP 2 refines the CAP 1 rating to include field investigations such as CCTV video inspections, smoke and dye testing, hydraulic capacity analyses, and others. Both CAP 1 and CAP 2 result in a Business Risk Exposure rating, which are denominated as BRE_{CAP1} and BRE_{CAP2}. BRE_{CAP2} may be thought as a refined risk exposure value, which incorporates "hard" information about the state of the infrastructure obtained from field studies. Graphically, the process of developing information to the CAP 1 level, proceeding to the CAP 2 level, and ultimately proceeding to corrective actions (BRE Actions) is depicted in Figure 0. Each level of BRE incorporates more detailed information. Ultimately, it is typical that the assets with highest CAP 2 business risk exposure (as determined by the BRE_{CAP2} values) will receive a detailed review by a CIP Committee, which reviews the information driving the BRE score, as well as cost and available budget, to validate and take decisions regarding the BRE actions to implement. The process starts over on a periodic basis, which in most cases is annually during the fiscal budget planning process. Desktop information is updated to reflect past repairs, rehabilitations and replacements implemented as a result of the previous year's BRE actions, and the process begins from the CAP 1 level.

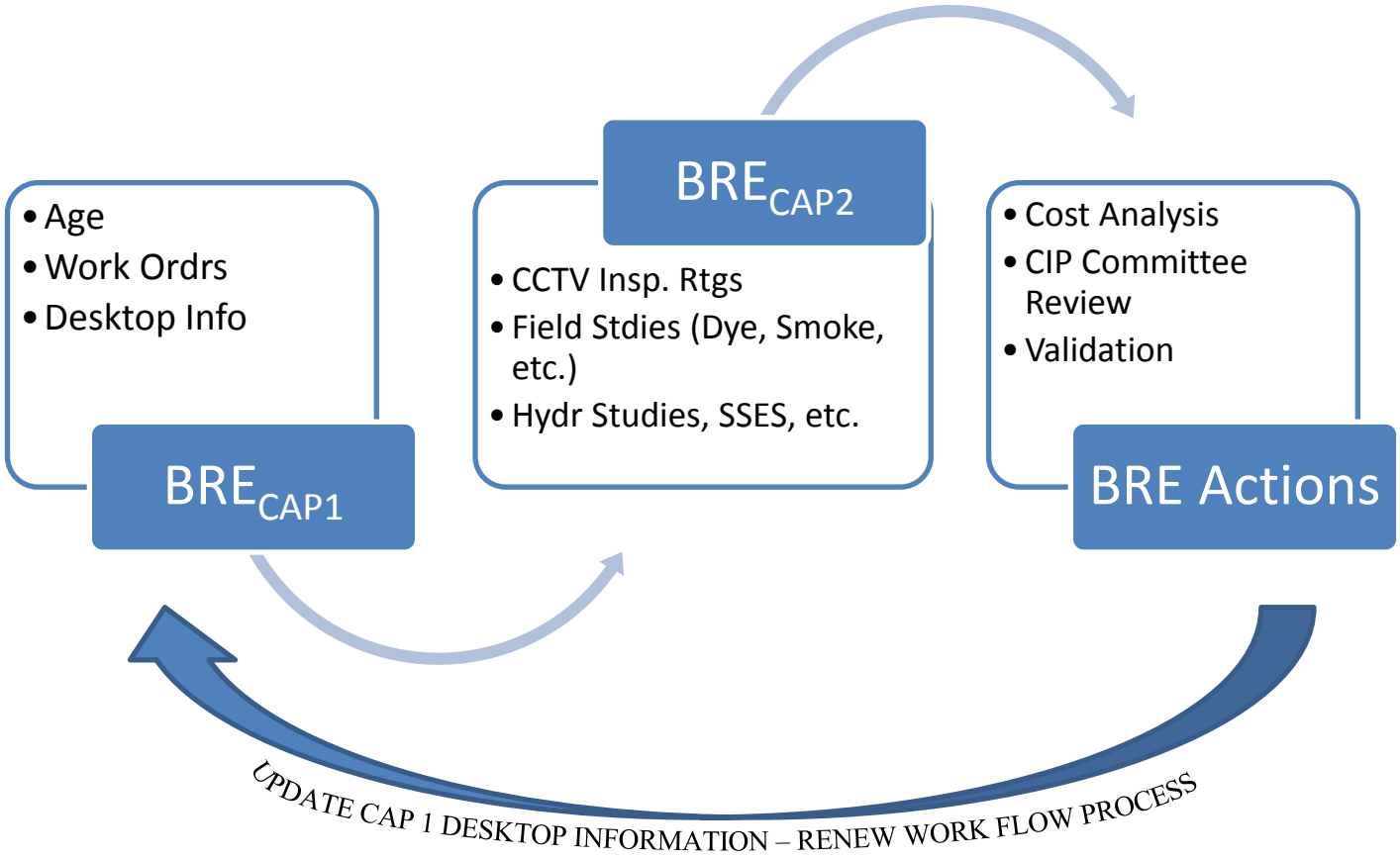


Figure 0 – Progression of Business Risk Exposure Analysis

Phase 1 of Rating System (CAP 1)

As related to its pipe infrastructure, failure is influenced by a number of factors, some internal and others external. The external factors are shown in the figure below. Often, without invasive investigations, the existence of these factors cannot be identified.

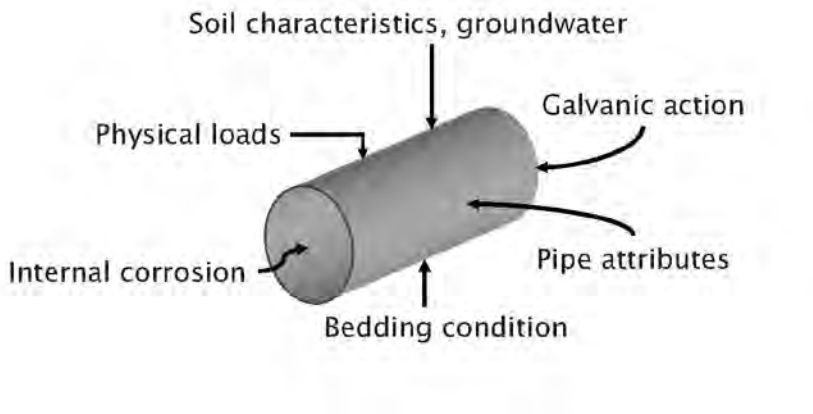


Figure 1

CAP 1 of the rating system consists of evaluating pipes primarily by their age (with some additional factors also considered), and applying generic deterioration curves developed by the NRCC that allow the remaining life to be evaluated. The process is shown graphically in Figure 2 below. As the asset nears the end of its useful life, its performance decreases and it is assigned a higher probability of failure (condition) rating. The graph demonstrates a 1 – 10 scale based on percent of effective life consumed. The range actually used for Bloomington's system is based on a scale of 1 – 5, following the NRCC recommendations.

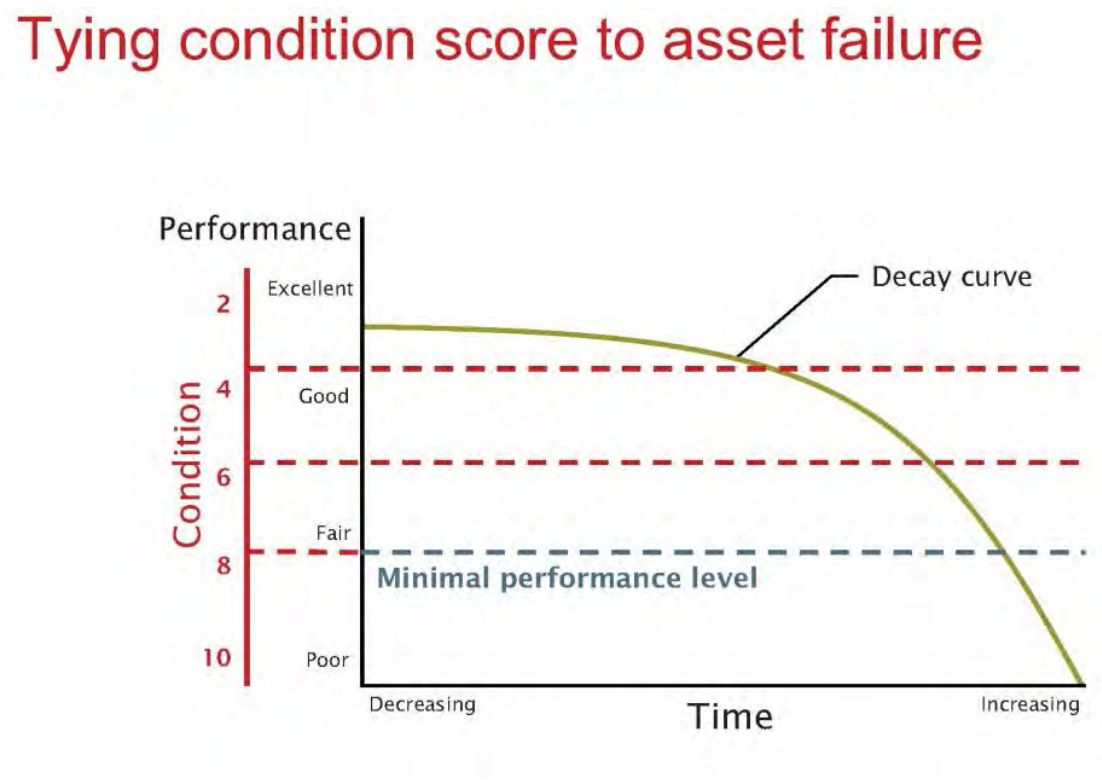


Figure 2 - Deterioration Decay Curve

Supplemental Rating Factors – Sanitary Pipe Infrastructure

While age gives a rough approximation to the remaining useful life of pipes, it should not be relied on as the sole factor in rating infrastructure. Baker reviewed Bloomington's digital maintenance logs for other factors which historically may indicate a greater likelihood of failure for a certain class of infrastructure. A workshop was held with Engineering Department staff in April of 2012 to discuss factors that they've noted from their experience. The project team and Bloomington staff jointly decided that the following factors in bold font should be used to evaluate the PoF for pipe segments:

- **Roots, Grease, Deposits (all in 30/60/90 layer)**
- **Age and Material**
- **Lateral Tie-ins (particularly break-in tie ins if it possible to identify or find a surrogate for)** – subsequently removed by Bloomington due to lack of available information
- Occurrence of cave-ins over mainline sewers
- Occurrence of sewer backups in structures

In the April meeting Bloomington also noted that it experiences a number of "cave-ins" over pipes. Baker reviewed Bloomington's work order history, currently kept in a Microsoft Access database, and extracted the entries related to cave-ins. Given that Bloomington has but four years of digital records of work

orders, the available information is limited, but it was decided that these factors should be part of the rating system going forward and thus they are considered in estimating the PoFs for the GIS infrastructure rating system. The existence of sewer backups was also utilized as a factor in the calculation of PoF scores for each pipe segment. The source for sewer backups consisted of a shape file compiled by Bloomington staff representing the location of call-in's from past major storms.

Consequences of Failure – Sanitary Pipe Infrastructure

The consequences of failure for assets (CoFs) are generally dependent on their adjacency to critical infrastructure or environmentally sensitive areas. The project team together with Bloomington determined that the following CoF factors should considered in calculating this rating:

- Location – Infrastructure
    - Roadway – ADT
    - Structures – Under buildings
    - Airport – within property limits
    - Railroads
    - Buried Manholes
- Location – Environmental (consequences are with EPA, insurance (must pay for damages), and administrative (city council explanation, etc.)
    - Pipes under water bodies and streams
    - Pipes under wet bottom, dry bottom detention basins
- Pipeline function
    - Diameter/Size Function (combined sewer has higher consequences than straight sanitary; force main probably has higher consequences, etc.)
- Excessive depth (consistently greater than 25 ft – such as in state farm area, etc. – these are very rare).

CAP 1 Calculation of BREs

CoFs for Sanitary Sewer Pipes

Since the calculation of a Business Risk Exposure score is dependent on the development of a composite Consequence of Failure (CoF) measure and composite Probability of Failure (PoF) measure, it was first necessary to develop a method for scoring these two elements by weighting the factors on which they depend. Bloomington expressed a desire to have the BRE range from 1-10 in order to coincide with the scoring range of Bloomington's pavement condition system (PASER).

Each individual factor on which CoF depends was typically given a score of 1 or 3, 1 indicating no influence or evidence of occurrence and 3 indicating it is a significant factor. The exceptions to this was diameter, which was scored on a 1 to 3 range indicating low, medium or high significance, and ADT, which also was scored on the same 1 to 3 range. Each factor was then grouped into one of three categories entitled Location, Environmental and Sewer Pipe. Weighting factors were applied, in some cases to the individual factors and in other cases to the categories. The higher the weight, the higher that

category's or factor's significance to the overall CoF score. The Sanitary Sewer CoF factors selected for this evaluation study as well as the assigned range of scores and categorical weights are reflected in table 1 below.

Table 1: Sanitary Sewer CoF Factors

Consequence of Failure (COF)			
Criteria	*Source*	*Score*	*Weight*
Location Factors			0.6
Critical Customer (Hospitals; Gov't Bldgs; Schools)	Pipe Attribute	1 or 3	
Access (Buildings, Railroad, Airport)	Related Spatial (Intersects)	1 or 3	
Traffic (ADT)	Related Spatial (see Traffic (ADT))	<= 2000 = 1; > 2000 & < 10,000 = 2; >= 10,000 = 3	
Environmental (Waterways/Detention Basins/CSO & SSO Reports)	Related Spatial (Intersects)	1 or 3	
Sewer Pipe Factors			0.4
Diameter	Pipe Attribute	<18 = 1; 18-24 = 2; > 24 = 3	
Excessive Depth > 25'	Pipe Attribute	1 or 3	

In the table above, if a pipe exhibits one or more of the "Critical Customer", the "Access", the "Traffic", or the "Environmental" conditions, the highest score of the four is assigned to the Location Factors category. If a pipe satisfies one or more of the "Diameter" or "Excessive Depth" conditions, the highest score of the two is assigned to the Sewer Pipe Factors category. For "Environmental" conditions, CSO or SSO reports implies that at least one occurrence of a verifiable sewer overflow to a fresh water body, or to the stormwater system, has been associated with the pipe. Such information should be recorded in Bloomington's future maintenance work order system.

Following this methodology results in the following maximum and minimum scores for sanitary sewer pipe CoF:

CoF Score = (CoF_Location * 0.6) + (Cof_Sewer Pipe * 0.4)

Max CoF Score = (3 x 0.6) + (3 x 0.4) = 3

Min CoF Score = (1 x 0.6) + (1 x 0.4) = 1

Two pilot areas were selected to validate the methodologies and test the weightings. These are graphically presented later in this memorandum under the validation section. All analysis and scoring within the pilot areas was performed using ArcGIS Desktop tools. As indicated in the Source column of table 1, some information was retrieved directly from the pipe attribute table and some had to be performed through spatial queries on intersecting features. Scoring Traffic (ADT) was a multi-part process using the following logic.

1. Select Road Segment in Streetscount layer w/ Traffic Count (ADT >= 2,000 AND < 10, 000).

2. Select Pavement polygons that intersect selected features in Streetscount layer.

3. Select Pipe features that intersect selected pavement polygons. Repeat process switching selection in step 1 to Traffic Count (ADT >= 10,000)

Additionally, a critical customer and critical depth field were added to the sanitary sewer pipe attribute table to streamline access to this information.

CoFs for Storm Pipes

With the exception of the unique factors and weights selected, the same methodology was utilized for calculating a composite CoF score for each stormwater pipe. The factors, scoring and weights utilized for the stormwater pipe system are outlined in table 2.

Table 2: Storm Sewer CoF Factors

Consequence of Failure (COF)			
Criteria	*Source*	*Score*	*Weight*
Location Factors			0.6
Access (Buildings, Railroad, Airport)	Related Spatial (Intersects)	1 or 3	
Traffic (ADT)	Related Spatial (see Traffic (ADT))	<= 2000 = 1; > 2000 & < 10,000 = 2; >= 10,000 = 3	
Sewer Pipe Factors			
Diameter	Pipe Attribute	<18 = 1; 18-24 = 2; > 24 = 3	0.4

In the table above, if a pipe exhibits one or more of the "Access or "Traffic" conditions, the higher of the two scores is assigned to the Location Factors category, which is then multiplied by the indicated weight. The Sewer Pipe Factors has its own individual weight assigned which depends strictly on diameter. It should be noted that an environmental factor indicating presence of high flat plateau areas that are susceptible to flooding was discussed between Baker and Bloomington staff; however it was left out in this evaluation study due to lack of an available data source.

This methodology results in the following max and min scores for stormwater pipe CoF:

CoF Score = (CoF_Location x .6) + (CoF_Diameter x .4)

Max CoF Score = (3 x 0.6) + (3 x 0.4) = 3

Min CoF Score = (1 x 0.6) + (1 x 0.4) = 1

PoFs for Sanitary Sewer and Storm Pipes

The next step was to create a composite scoring method for Probability of Failure (PoF) for both Sanitary and Storm pipe assets. The most heavily scored and weighted factor for PoF is material life expectancy (Age/Material). This factor represents the estimated remaining useful life based on deterioration curves for each particular type of material and provides a solid base to start from in evaluating pipe condition. Baker based the scoring criteria based on the results from research performed by the NRCC Institute for Research in Construction (Newton & Vanier, 2006), which provided deterioration curves for each type of material based on significant investigation of municipal entities in Canada. The scoring criteria developed are presented in table 3.

Table 3: Estimated Pipe Life Expectancy by Material

Pipe Material	Pipe Age	Score
VC	(1 - 40)	1
	(40-60)	2
	(60-100)	3
	(100 - 120)	4
	>120	5
PVC; HDPE (High Density Polyethylene)	(1-10)	1
	(10-25)	2
	(25-45)	3
	(45-65)	4
	>65	5
Brick	(1 - 40)	1
	(40-60)	2
	(60-100)	3
	(100 - 120)	4
	>120	5
Concrete Pipe	(1-40)	1
	(40-70)	2
	(70-90)	3
	(90-105)	4
	>105	5
Corrugate Metal (CMP); Ductile Iron; BOX; CIP; MCP	(1-40)	1
	(40-70)	2
	(70-90)	3
	(90-105)	4
	>105	5

Pipe liners will be assigned a life expectancy range equal to that of PVC, HDPE. Data for pipe liner life expectancy is limited. However, it was verified that the City of Seattle (T. Martin, 2007) assigns a life expectancy to lined pipes of 50 years, and thus it was deemed appropriate to use the distribution for PVC/HDPE pipe.

Calculation of the PoF depends on the age of the pipe. One set of equations are used for pipes in the highest age range for a given material (when Age/Material = 5), as seen in table 4. A second set of equations is used for pipes in any of the other age ranges (when Age/Material = 1 to 4), as presented in table 5. The former set of equations place more weight on the age of the pipe as compared to other factors.

Table 4: Sanitary Sewer PoF Factors (when Age/Material = 5)

Probability of Failure (POF)			
Criteria	*Source*	*Score*	*CAP 1 Weight*
Structural/Physical Factors			
Age/Material	Pipe Attribute	(5) * .726	0.7
Operations & Maintenance Factors			
Cleaning Frequency (Roots, Grease, Deposits 30/60/90 Layer)	Pipe Attribute	0 or {15,30,60,90,180} = 3	0.05
# Sewer Repair related Work Orders	Related Spatial or Table (within 50')	0 or >= 1 = 3	0.2
Backups and/or Street Flooding	Related Spatial or Table (See Backups)	0 or >= 1 = 3	0.05

Table 5: Sanitary Sewer PoF Factors (when Age/Material = 1 to 4)

Probability of Failure (POF)			
Criteria	*Source*	*Score*	*CAP 1 Weight*
Structural/Physical Factors			
Age/Material	Pipe Attribute	(1,2,3,4) * .775	0.5
Operations & Maintenance Factors			
Cleaning Frequency (Roots, Grease, Deposits 30/60/90 Layer)	Pipe Attribute	0 or {15,30,60,90,180} = 3	0.15
# Sewer Repair related Work Orders	Related Spatial or Table (within 50')	0 or >= 1 = 3	0.3
Backups and/or Street Flooding	Related Spatial or Table (See Backups)	0 or >= 1 = 3	0.05

For pipes in the highest age range, this methodology as presented in table 4 results in the following maximum and minimum scores for sanitary sewer pipe PoFs:

PoF Score = (matLXP x 0.726 x 0.7) + (Work Orders x 0.2) + (Clean Freq x .05) + (Backups/Fld x .05)

Max PoF Score = (5 x 0.726 x 0.7) + (3 x 0.2) + (3 x 0.05) + (3 x 0.05) = 3.44

Min PoF Score = (1 x 0.726 x 0.7) + (0 x 0.2) + (0 x 0.05) + (0 x 0.05) = 0.5082 (rounded to 1).

For pipes in age ranges less than the highest, this methodology as presented in table 5 results in the following maximum and minimum scores for sanitary sewer pipe PoFs:

PoF Score = (matLXP x 0.775 x 0.5) + (Work Orders x 0.30) + (Clean Freq x 0.15) + (Backups/Fld x 0.05)

Max PoF Score = (4 x 0.5 x0.775) + (3 x 0.30) + (3 x 0.15) + (3 x 0.05) = 3.05

Min PoF Score = (1 x 0.5 x 0.775) + (0 x 0.30) + (0 x 0.15) + (0 x 0.05) = 0.3875 (rounded to 1).

Street flooding and/or sewer service backups are indications of insufficient capacity, excessive infiltration and/or inflow, or a blockage. Pertaining to the category of sanitary sewers, the presence of street flooding should only be incorporated in the PoF score for combined sewers, which are grouped together with sanitary sewers in the Rating tool. Thus, if there is strictly sanitary sewer under a street that experiences flooding, the weight of 0.05 would not apply unless there is also a report of sewer backups at service connections.

For stormwater pipe, PoF parameters employed are provided in table 6 for pipes in the highest age range, and in table 7 for pipes in lesser age ranges. A factor based on the quality rating of detention basins was discussed between Bloomington and Baker staff; however this information was not included as specific detention basin ratings were not available at the time of this analysis. In any case, the proposed rating system is focused on pipe infrastructure. Incorporation of this factor would only influence the rating of pipes flowing into or out of detention basins.

Table 6: Stormwater PoF Factors (when Age/Material = 5)

Probability of Failure (POF)			
Criteria	*Source*	*Score*	*CAP 1 Weight*
Structural/Physical Factors			
Age/Material	Pipe Attribute	(5) * .726	0.7
Operations & Maintenance Factors			
# Sewer Repair related Work Orders	Related Spatial or Table (within 50')	0 or >= 1 = 3	0.2
Flood Maintenance	Related Spatial or Table (within 50')	0 or >= 1 = 3	0.1

Table 7: Stormwater PoF Factors (when Age/Material = 1 to 4)

Probability of Failure (POF)			
Criteria	*Source*	*Score*	*CAP 1 Weight*
Structural/Physical Factors			
Age/Material	Pipe Attribute	(1,2,3,4) * .775	0.5
Operations & Maintenance Factors			
# Sewer Repair related Work Orders	Related Spatial or Table (within 50')	0 or >= 1 = 3	0.3
Flood Maintenance	Related Spatial or Table (within 50')	0 or >= 1 = 3	0.2

For pipes in the highest age range, this methodology as presented in table 6 results in the following maximum and minimum scores for stormwater pipe PoF:

PoF Score = (matLXP x 0.7 x 0.726) + (Work Orders x 0.2) + (Flood Maintenance Issues x 0.1)

Max PoF Score = (5 x0.7 x 0.726) + (3 x 0.2) + (3 x 0.1) = 3.44

Min PoF Score = (1 x0.7 x 0.726) + (0 x 0.2) + (0 x 0.1) = .508 rounded to 1

For pipes in age ranges less than the highest, this methodology as presented in table 7 results in the following maximum and minimum scores for stormwater pipe PoF:

PoF Score = (matLXP x 0.5 x 0.775) + (Work Orders x 0.3) + (Flood Maintenance Issues x 0.2)

Max PoF Score = (4 x0.5 x 0.775) + (3 x 0.3) + (3 x 0.2) = 3.05

Min PoF Score = (1 x0.5 x 0.775) + (0 x 0.3) + (0 x 0.2) = 0.3875 rounded to 1

At the time of this analysis historical work order information was rather limited and consisted of cave-in locations that had been tracked by general address location in a Microsoft Access database. For the purpose of this review, this information was geocoded into a point feature class layer and stored in an ESRI personal geodatabase. All pipes that were located within 50’ of one of the geocoded work orders receive a score of 3. Ultimately, when Bloomington has a computerized maintenance management system (CMMS) with work order information, the use of cave-ins as a factor would be changed to the existence of work orders, covering cave-ins and other factors in the system. Similarly, the Flood Maintenance factor was taken from a GIS layer prepared by Bloomington that reflects areas where the city has

experienced periodic flooding due primarily to maintenance issues such as blocked pipes and inlets. The eventual use of a CMMS would permit Bloomington to pull this data directly from the service orders or complaints modules, rather than attempting to maintain an up-to-date GIS layer.

Phase 2 (CAP 2) of GIS Based Rating System

The CAP 1 level GIS rating methodology provides Bloomington with a GIS tool for identifying the business risk of its infrastructure and prioritizing further actions. Expensive, invasive assessments using techniques such as CCTV inspections, dye or smoke testing, hydraulic modeling, and flow monitoring are not utilized in the CAP 1 BRE assessment, due to their expense. The objective is to save these funds for the most critical and valuable infrastructure assets (i.e., those with the highest initial value BRE_{CAP1}).

On the figure below of condition assessment protocol, the analysis presented in this memo within the pilot sewersheds would be analogous with CAP 1 (lower sophistication, but most or the entire infrastructure considered). As part of CAP 2, the next activities consist of performing additional investigations of the infrastructure at highest risk (that is, most critical), and expanding the risk analysis to other sewersheds outside of the two pilot areas. This would take Bloomington to a situation similar to CAP 2 on the figure, where a lesser but targeted percentage of the infrastructure has been assessed to a higher level of sophistication and detail. These additional investigations will in many cases consist of either CCTV inspections or dye and smoke testing.

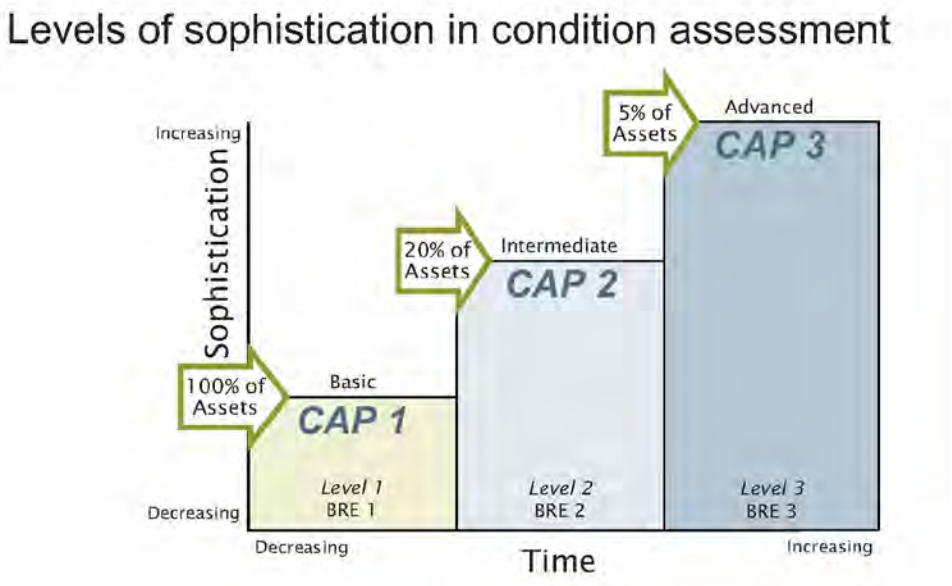


Figure 3 – Level of Assessment Related to BRE

A separate BRE_{CAP2} would be calculated which is heavily weighted on the results of the CAP 2 studies, be these CCTV, smoke or dye testing, or others. Obtaining BRE_{CAP2} estimates provides added certainty in evaluating the needs for corrective or preventive actions. It allows a final analysis to be performed, wherein the data driving the ratings is validated by a committee or knowledgeable technical staff, and budget availability is evaluated, leading to decisions on actions that may include repair, rehabilitation or replacement of the assets. Such a process is depicted in Figure 0 of this document.

CAP 2 Calculation of BREs

The methodology for developing CAP 2 level BRE scores incorporates field study information that may come from dye or smoke testing, SSES studies, capacity analyses, or CCTV inspection data. In effect, this information is used to refine, or push, the BRE_{CAP1} score to a BRE_{CAP2} value. For CCTV inspection data, the use of the Pipeline Assessment & Certification Program (PACP) as promoted by the National Association of Sewer Service Companies (NASSCO) is recommended for scoring defects or observations obtained through closed-circuit television (CCTV) inspection of pipelines. Note that a separate memorandum entitled "Pipe Condition Rating Methodology Recommendations" was produced to detail the pipe condition rating system to be applied to CCTV inspections. This pipe condition rating is not to be confused with the BREs that are products of the overall GIS Based Infrastructure Rating System described in the present memo. The pipe condition rating is focused strictly on the current interior condition of the conduit. It is an element of the BRE_{CAP2} score, but other factors as described previously also influence the business risk exposure, which is more inclusive of external conditions, failure history and potential consequences. An overview of the methodology for integrating Bloomington's CCTV inspections into a historical GIS based reference table, as well as the incorporation of the CCTV pipe condition rating into the calculation of the BRE_{CAP2} score, is provided below.

<u>CCTV Inspection GIS Integration</u>

The recommended methodology includes expanding Bloomington's GIS Data Model to include the database table as shown in table 8, which stores CCTV inspection information pertinent in calculating CAP 2 BRE scores. In addition to being a critical component in the calculation of CAP 2 BRE scores, an important benefit for Bloomington will come from the future capability to easily retrieve historical CCTV inspection information through a GIS interface.

Table 8: INSP_CCTV_RATING database table

Field Name	Data Type	Description
OBJECTID	AutoNumber	
ASSET_ID	Text	Reference to Sewer Pipe unique ID
STRUCT_GRADE_SCORE	Number	Structural Rating
OM_GRADE_SCORE	Number	O & M Rating
OVERALL_GRADE_SCORE	Number	Overall Rating
INSPECTION_ID	Number	Reference to Inspection ID in PACP Inspection table
INSPECTION_RECORD	Text	Flags inspection as Active (Latest) or Historical(Previous)
MAX_PIPE_GRADE	Number	Most severe grade score reported
DATE_INSPECTED	Text	Date of Inspection
UPSTREAM_MH	Text	Upstream Manhole
DOWNSTREAM_MH	Text	Downstream Manhole
CCTV_SCORE	Number	Max_Pipe_Grade (X) & Overall Grade Score (O) represented as 4 digit numeric value formatted as (XOOO)
POF_CCTV_RATING	Number	CCTV POF Score - Constrained to min value of 1 and max value of 3.44

NASSCO has developed specific condition grade scores on a scale of 1 to 5 for each type of observation or defect identified during a typical televised inspection. This information is available in Appendix D of the PACP certification reference manual. The defect grades are as follows:

5 – Most significant defect grade
4 – Significant defect grade
3 – Moderate defect grade
2 – Minor to Moderate defect grade

1 – Minor defect grade
0 – No defects

Grade 5 defects are the most severe and include the following:

- Hinge Crack
- Hinge Fracture
- Broken Pipe (Soil and Void Visible)
- Hole in Pipe (Soil and Void Visible)
- Deformed Brick
- Reinforcement visible and/or corroded
- Missing Walls
- Dropped Invert
- Deposits, Encrustation, Grease, Rags, Silt greater than 30% of pipe area
- Infiltration – Gusher

Once each defect has been coded, segment grade scores are generated for each pipe segment. Segment grade scores consist of multiplying the number of defects for each grade by the grade number. As an example, three grade 4 defects would result in a grade 4 score of 12 (see table 9 for example). The reporting capabilities of PACP compliant CCTV software allow the user to view the output grade scores as shown below.

Table 9. PACP Segment Grade Score

	Structural								O & M								Overall							
Segment	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index
20120807 MH_5637_SAN-MH_5638_SAN	0	0	0	0	0	0	0000		0	4	3	12	5	24	5143	3.4	0	4	3	12	5	24	5143	3.4

All structural grade scores are summarized into a structural rating score. Likewise operational and maintenance grade scores are summarized into an O & M rating score. Additionally, an overall score is recorded by adding the structural rating and O & M rating score (see Overall rating column in table 10 below).

Table 10. Overall Rating = Structural Rating + O & M Rating

	Structural								O & M								Overall							
Segment	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index
20120807 MH_5637_SAN-MH_5638_SAN	0	0	0	0	0	0	0000		0	4	3	12	5	24	5143	3.4	0	4	3	12	5	24	5143	3.4

GIS Inspection Database Parameters for Capture

As described in the Pipe Condition Rating Methodology Memorandum, several parameters are used to derive a rating result from the CCTV inspections. These should be captured and maintained in the INSP_CCTV_RATING database table.

Max Grade

It is important to record the Max Grade reported from the associated inspection report. Storing the Max Grade allows each pipe segment to be categorized by the most severe grade defect observed (i.e., all the

pipe segments that have a defect grade '5' will be grouped together, '4' grouped together, etc.). The example below in table 11indicates a max grade of 5.

Table 11. Max Grade Recorded

	Structural								O & M								Overall							
Segment	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Rating	Quick	Index
20120807 MH_5637_SAN-MH_5638_SAN	0	0	0	0	0	0	0000		0	4	3	12	5	24	5143	3.4	0	4	3	12	5	24	5143	3.4

Max Grade = 5

In this manner, Bloomington can quickly review pipes that have severe interior degradation as revealed by the CCTV inspections.

Pipe Rating System

The pipe condition rating developed through the use of NASSCO defect scores is dependent on the maximum pipe grade for a given segment. The pipe rating will consist of a four digit number, the fourth digit (in the thousandths place) of which corresponds to the Max Grade recorded. This digit will therefore range between 1 and 5. The other three digits (hundredths place through one's place) correspond to the overall rating as presented in table 10. Thus, a pipe having a Max Grade = 5 and PACP Overall Grade Score = 521 will have a resulting pipe rating CCTV Score of 5,521. Should the PACP Overall Grade Score exceed 999, it is rounded down to this value for use in the pipe rating CCTV Score.

Following this methodology, the maximum pipe rating CCTV Scores for each pipe of a given Max Grade are as follows:

Max Grade = 5: Max CCTV Score = 5,999
Max Grade = 4: Max CCTV Score = 4,999
Max Grade = 3: Max CCTV Score = 3,999
Max Grade = 2: Max CCTV Score = 2,999
Max Grade = 1: Max CCTV Score = 1,999

PoF CCTV Score

The pipe rating CCTV Scores for each pipe segment are converted to a PoF CCTV Score by dividing the CCTV Score by 1744, such that the PoF for the pipe will range between 1 and 3.44. This may be thought as the PoF_{CAP2} for the pipe based on CCTV data. Values of less than 1 are rounded up, such that the range of PoF_{CAP2} is the same (1 – 3.44) as that of PoF_{CAP1}. The INSP_CCTV_RATING database table previously described is used to capture values for the CCTV pipe rating (CCTV_SCORE) and the PoF_{CAP2} (POF_CCTV_RATING). The methodology described herein was applied to the pipe segment inspection data provided by the City of Bloomington, and the results are presented in Table 12.

Table 12. Pipe Rating CCTV and PoF CCTV Scores for Bloomington Inspected Pipes

ssPIPE_CCTV_RATING

DATE_INSPECTED	UPSTREAM_MH	DOWNSTREAM_MH	MAX_PIPE_GRADE	OVERALL_GRADE_SCORE	CCTV_SCORE	POF_CCTV_RATING
20130211	MH_S-171_1105_COMB	MH_S-171_440_COMB	5	521	5521	3.165711
20130207	MH_S-535_556_COMB	MH_S-535_282_COMB	5	224	5224	2.995413
20130211	MH_873_SAN	MH_17286_SAN	5	174	5174	2.966743
20130205	MH_S-403_2734_SAN	MH_S-403_2475_SAN	4	218	4218	2.418578
20130211	MH_17280_COMB	MH_17281_COMB	3	279	3279	1.880161
20130206	MH_S-282_2950_COMB	MH_S-282_2725_COMB	3	178	3178	1.822248
20130206	MH_S-73_1920_COMB_107moo	MH_S-73_800_COMB_1	3	176	3176	1.821101
20130205	MH_S-282_2355_COMB	MH_S-282_12_COMB	2	161	2161	1.239106
20130206	MH_S-73_1920_COMB	MH_S-73_800_COMB	2	53	2053	1.17717

Other Studies Integration in Calculation of $BRE_{CAP\ 2}$

The methodology for developing CAP 2 level BRE scores incorporates field study information that may include dye or smoke testing, SSES studies, capacity analyses, or CCTV inspection data. The use of CCTV inspection data in the calculation of $BRE_{CAP\ 2}$ was covered in the preceding section. Bloomington will also acquire data from non-CCTV activities, and it is important that the results of these studies are weighted into the CAP 2 analysis of BREs. Similar to CCTV inspection results, it is recommended that Bloomington track these "other studies" results in its GIS system, as described in the following section.

BRE Database Design

In order to store field studies data and related study information (hydraulic, SSES, etc.) necessary for business risk analysis, as well as the results of the business risk analysis itself, the GIS Data Model templates in Figure 4 and 5 are recommended. CCTV data, as explained previously, is stored in the INSP_CCTV_RATING table. Information from other studies, be it dye, smoke or the results of a capacity analysis, is stored in the ssPIPE_STUDY_RATING table. All results for this table should include a Study Rating Factor (POF_STUDY_RATING) of 1 to 4 for each pipe. Thus, anytime Bloomington performs or contracts a study, *one* deliverable from the study should be a GIS layer for all pipes in the study, in which each individual segment is rated from 1 to 4 depending on the nature and severity of the identified issue. For instance, a pipe segment shown to have high potential inflow or infiltration though smoke testing, would be assigned a POF_STUDY_RATING of 3 or 4. A pipe segment, or series of pipe segments that have been identified as undersized in a hydraulic study, would be assigned a POF_STUDY_RATING of 3 or 4. The scale of 1 to 4 is chosen due to its simplicity. A score of 1 corresponds to a low priority or degree of problem, 2 to a medium degree, 3 to high degree, and 4 to severe degree.

CAP 2 Calculation of BRE

The CAP 2 assessment calculates a BRE_{CAP2} score using the following formula:

Equation 1: $BRE_{CAP2} = (0.25*PoF_{CAP1} + 0.75*PoF_{CAP2})* CoF_{CAP1}$

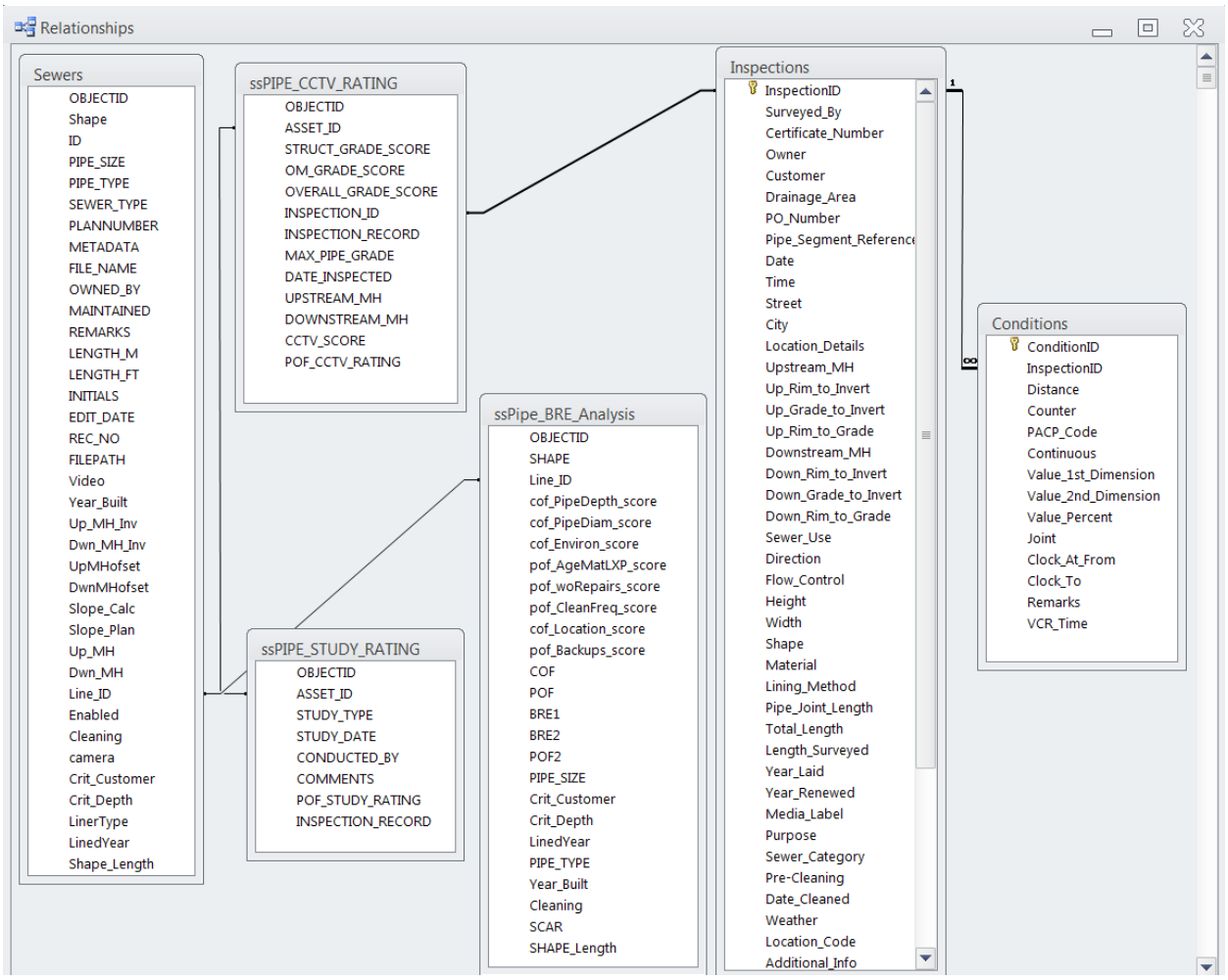


Figure 4 - Sanitary BRE Data Model

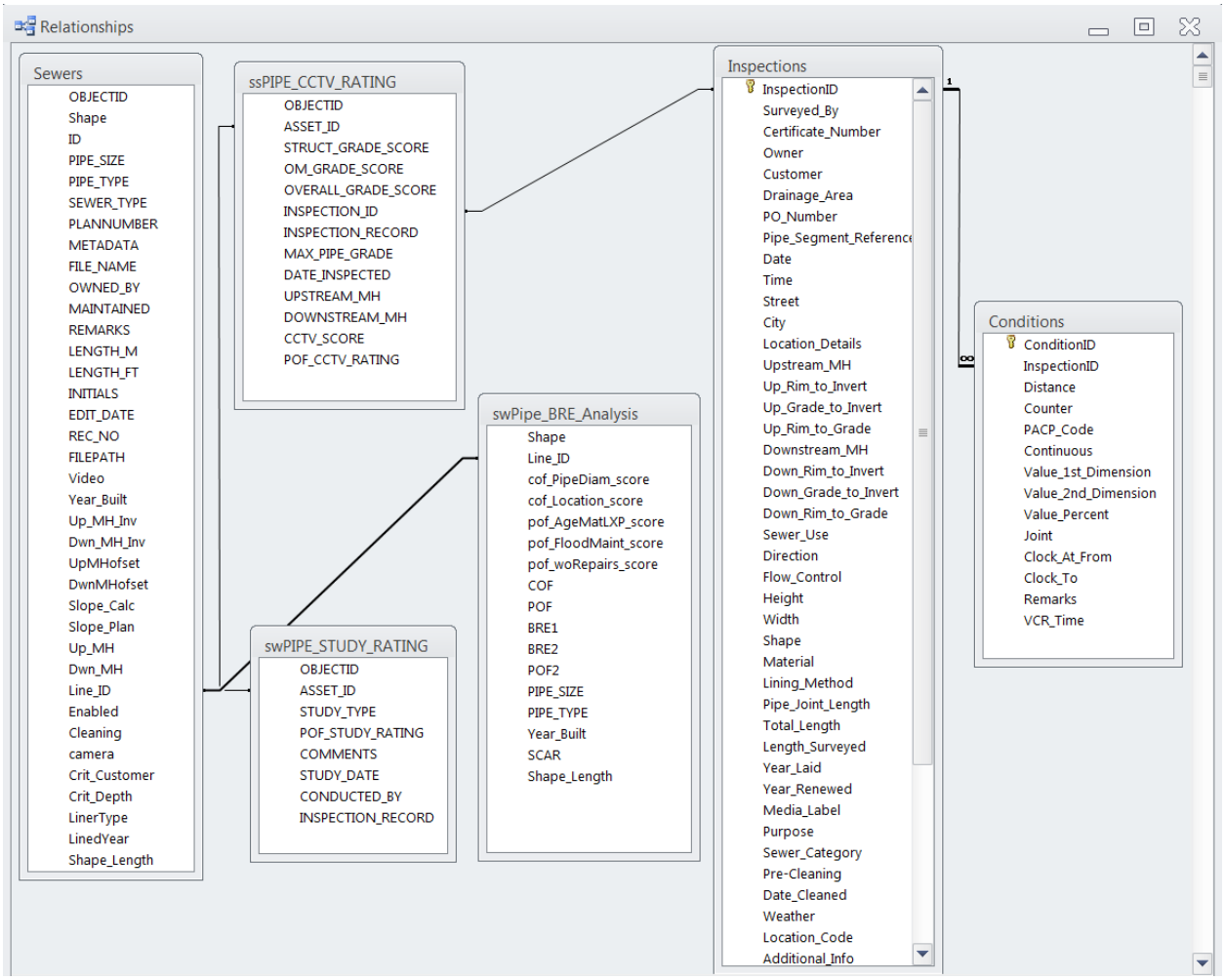


Figure 5 – Stormwater BRE Data Model

Where:

PoF_{CAP2} = the highest value between POF_CCTV_RATING and POF_STUDY_RATING*0.86, taken from the INSP_CCTV_RATING or PIPE_STUDY_RATING tables

Note: A factor of 0 .86 was used to normalize Pipe Study Ratings (POF_STUDY_RATING), *which are based on a 1 – 4 Range, to the required POF range of 1-3.44. If the highest* PoF_{CAP2} *score is derived from the CCTV Rating (POF_CCTV_RATING), then the 0.86 normalizing factor is not applied.*

And:

BRE_{CAP2}= the business risk exposure at a CAP 2 level of analysis, reflecting the incorporation of field study information.

PoF_{CAP1} = the composite PoF that was calculated for the CAP 1 level of analysis (which relied on desktop information)

CoF_{CAP1} = the composite consequences of failure rating obtained during the CAP 1 evaluation of BRE.

In the BRE_{CAP2} equation, PoF_{CAP2} is weighted at 75%, while the CAP 1 value of PoF is weighted at 25%. This reflects the assertion that field data is typically more reliable in evaluating the condition of infrastructure than is desktop information. Nonetheless, desktop information should not be discarded. The BRE_{CAP1} reflects important information about the pipe segment, while BRE_{CAP2} focuses on only one type of field information. For example, a pipe conceivably may not have capacity of infiltration issues, and yet be very old and have a history of work orders. It would be incorrect to disregard the CAP 1 rating in this case.

RESULTS CAP 1 & CAP 2: Pilot Areas

Two pilot areas were selected in order to apply the developed business risk methodology. Pilot Areas 1 and 2 are presented in Figure 6. Pilot Area 1 is bounded by Empire St to the north, Ireland Grove and Hamilton Rd to the south, Hershey Rd to the east and Veterans Parkway to the west and consists of an area approximately 1.1 square miles. Within this area there are approximately 16.6 miles of sanitary or combined sewer pipes. The average age of all sanitary or combined sewer pipes this area is 40 years. Material types consist predominately of VCP and ESVCP, which for purposes of condition analysis are considered to behave similarly and belong to the same category of pipes. Additionally, Pilot Area 1 contains 14.8 miles of storm sewer pipe with an overall average age of 46 years. The majority of storm pipes are of RCP, RCCP, RCP TYPE 1 or RCP TYPE 2.

Drainage features in Pilot Area 1 include a 4,842 foot stretch of the Little Kickapoo Creek, subject to ten sanitary sewer pipe crossings. The area also contains one small lake feature and 22 detention basins. With respect to maintenance issues, two backup events were recorded, with no significant cave-in work orders, and two known flood maintenance issues.

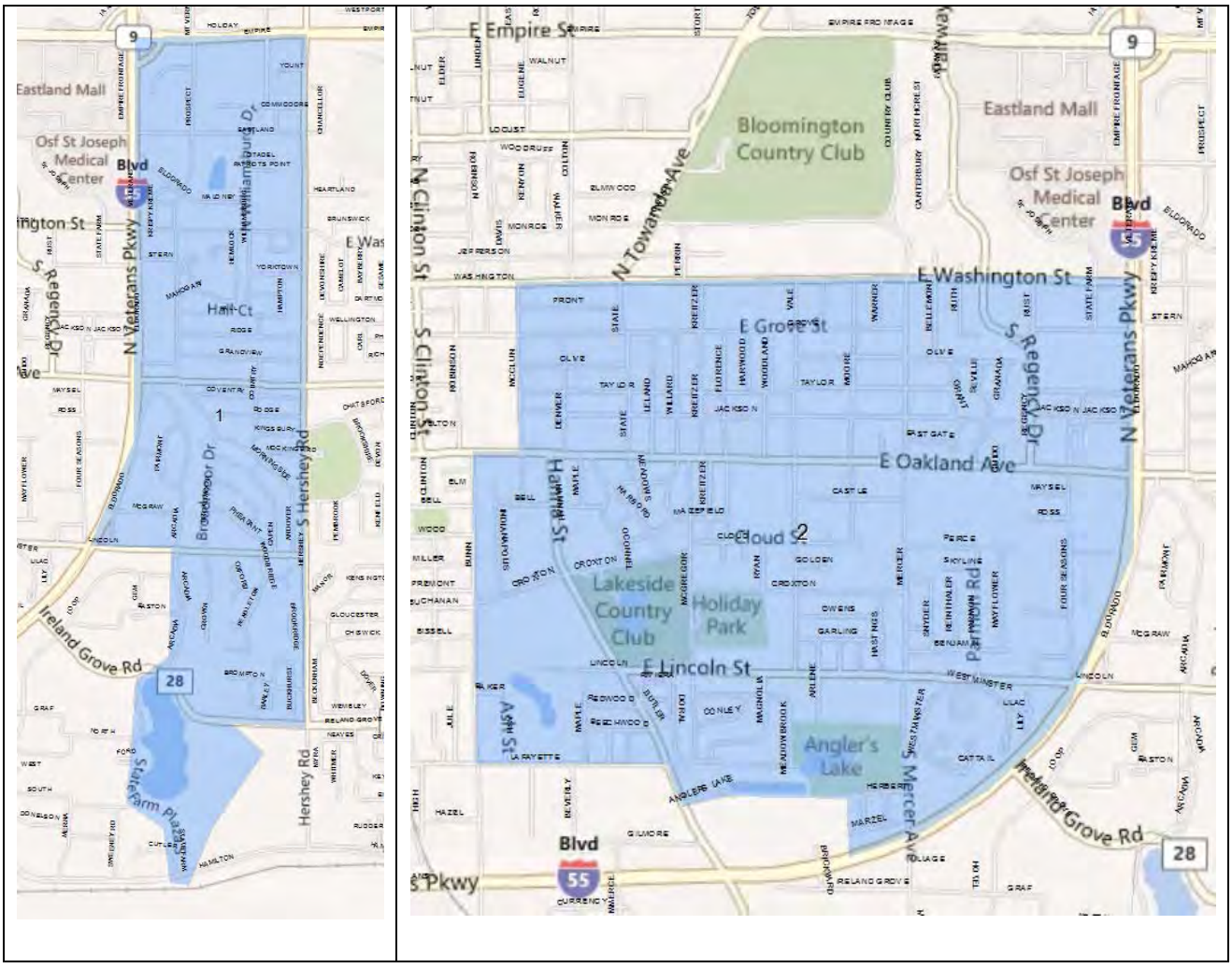


Figure 6 – Pilot Areas 1 (left) and 2 (right)

The flood issues reported included street flooding on Eastland Dr. during moderate rainfalls and flooding in Brookridge Park during heavy rains.

Pilot Area 2 covers an area of approximately 1.7 square miles. It is bounded by Washington St to the north, Veterans Parkway to the south, Veterans Parkway to the east and Bunn St to the west. There are approximately 29 miles of sanitary or combined sewer pipes in Area 2 with an overall average age of 88 years. This age may be skewed however as there are numerous records with a recorded age of 1850 (subsequently revised to 1870 per Bloomington's direction). Removal of these brings the average age to 66 years so it is probably safe to say that the average age is still well above 70 years. This area is predominately made up of VCP pipe.

Approximately 15.5 miles of storm sewer pipe are located in Pilot Area 2. The average age was harder to ascertain from this set of data as there were a large number of sewer pipes recorded as being built in 1850.

Including these resulted in an average age of 83 years while excluding these resulted in an average age of 56 years. It is a likely conclusion that this is an older area in which the average age approaches 70 years. With respect to pipe material, the majority of pipes fall into the RCP family.

As for drainage features there are nine small lakes, 27 detention basins and no streams. Maintenance issues in Pilot Area 2 consisted of seven significant reported cave-in work orders, 11 reported flooding issues and 12 reported backup issues. Results for the CAP 1 and CAP 2 application within the pilot areas are presented as follows.

RESULTS – CAP 1

PILOT AREA 1: SANITARY SEWER

Business Risk Analysis of sanitary sewer pipes in Pilot Area 1 provided the following results. BRE scores are on a scale of 1 to 10 per Bloomington request.

BRE Score	# of Records
8	3
9	94
10	215
Sample of Lowest Scoring Pipes	**Map (Higher Risk Pipes in Red)**

COF	POF	BRE1	Line_ID
2.2	0.3875	9	MH_P-1003_1156_SAN/MH_P-1003_9968_SAN
2.2	0.3875	9	MH_P-1003_550_SAN/MH_P-1003_9968_SAN
2.2	0.775	9	MH_53_SAN/MH_18158_SAN
2.2	0.775	9	MH_54_SAN/MH_55_SAN
2.6	0.775	8	MH_55_SAN/MH_13310_SAN
1.6	0.775	9	MH_SU-62_917_SAN/MH_SU-62_721_SAN
1.6	0.775	9	MH_SU-62_1387_SAN/MH_SU-62_917_SAN
1.6	0.775	9	MH_S-596_518_SAN/MH_S-596_493_SAN
2.2	0.775	9	MH_71_SAN/MH_19861
2.2	0.775	9	MH_S-597_564_SAN/MH_S-597_224_SAN
2.2	0.775	9	MH_192_SAN/MH_11947_SAN
2.2	0.3875	9	MH_S-819_1197_SAN/MH_S-819_38263_SAN
2.2	0.775	9	MH_SU-94_969_SAN/MH_SU-94_645_SAN
2.2	0.775	9	MH_SU-94_645_SAN/MH_SU-94_2706_SAN
1.6	1.1625	9	MH_SP-752_447_SAN/MH_SP-752_319_SAN
2.2	0.3875	9	MH_P-1016_319_SAN/MH_P-1016_9968_SAN
1.6	0.3875	9	MH_S-836_265_SAN/MH_S-836_627_SAN
2.2	0.3875	9	MH_SU-150_800_SAN/MH_SU-150_1426_SAN
2.2	0.3875	9	MH_SU-119_340_SAN/MH_SU-119_276_SAN
2.2	0.5375	9	MH_SU-119_381_SAN/MH_SU-119_1633_SAN
1.8	0.3875	9	MH_S-573_1085_SAN/MH_S-573_745_SAN
1.8	0.3875	9	MH_S-573_1426_SAN/MH_S-573_1085_SAN
1.8	0.3875	9	MH_S-573_1633_SAN/MH_S-573__SAN
1.8	0.3875	9	MH_4954_SAN/MH_4952_SAN
1.8	0.3875	9	MH_S-573_1934_SAN/MH_S-573_1633_SAN
1.8	0.3875	9	MH_S-573_3503_SAN/MH_S-573_3207_SAN
2.4	0.3875	9	MH_S-573_259_SAN/MH_S-573_3503_SAN
1.8	0.3875	9	MH_4965_SAN/MH_4969_SAN
3	0.3875	8	MH_S-573_3207_SAN/MH_S-573_276_SAN
2.2	1.225	8	MH_23103_SAN/MH_22494_SAN

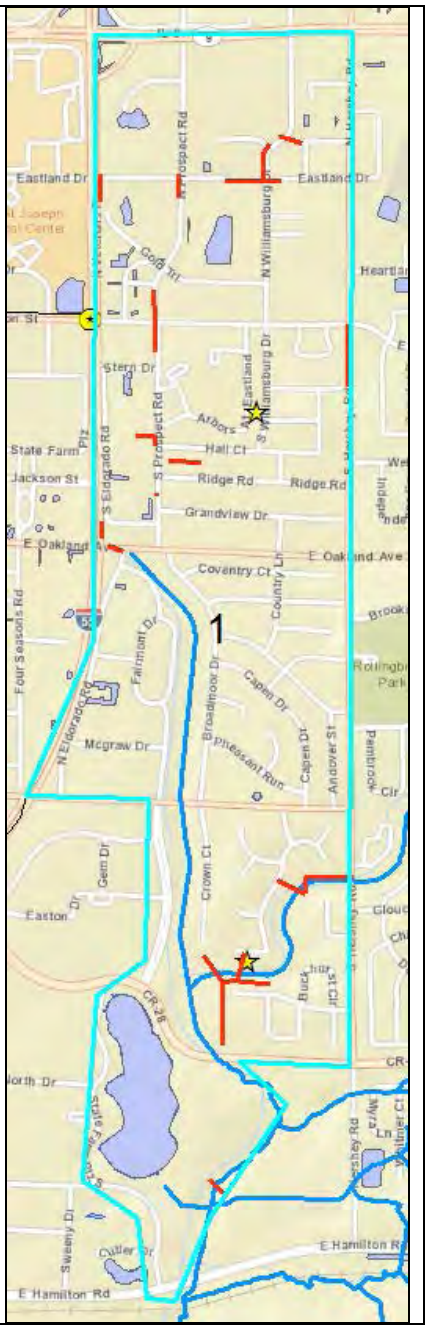


Figure 8 – Sanitary BRE Scores for Pilot Area 1

Due the relatively young age of the sewer infrastructure in this area and a lack of work order history, there were essentially no pipes with low BRE scores (indicating high business risk) in this pilot area. The BREs are high for sanitary sewer pipes in Pilot Area 1 and by themselves would not indicate the need for further action or study. With this in mind, it is recommended that only BREs of 7 or lower receive some specific review of the reasons for the rating. This task would start by simply reviewing the factors that lead to the PoF and CoF scores, and then determining if further investigation such as field visits is warranted. After such preliminary review, it is likely that most pipes would simply be deemed as having an acceptable

BRE score even though somewhat lower than others. At this level of analysis (CAP 1), Bloomington labor and resources would likely be better spent addressing other pipe infrastructure with lower BREs.

PILOT 1: STORM SEWER

Business risk analysis of storm sewer pipes in Pilot Area 1 provided the following results.

BRE Score	# of Records
5	4
8	56
9	307
10	284

Sample of Lowest Scoring Pipes

COF	POF	BRE1	Line_ID
2.4	2.541	5	/
2.4	2.541	5	/
2.4	2.541	5	/
2.4	2.541	5	/
3	0.3875	8	MH_40_ST/MH_41_ST
3	0.775	8	MH_59_ST/MH_933_ST
3	0.775	8	MH_65_ST/MH_66_ST
3	0.775	8	MH_66_ST/MH_13159_ST
3	0.775	8	MH_70_ST/
2.6	0.775	8	MH_74_ST/MH_207_ST
3	0.775	8	MH_190_ST/MH_23165_ST
3	0.775	8	MH_191_ST/MH_23164_ST
3	0.775	8	MH_207_ST/MH_18030_ST
3	0.775	8	MH_933_ST/934
3	0.775	8	MH_1709_ST/MH_18030_ST
2.6	0.775	8	MH_1710_ST/MH_1709_ST
2.6	0.775	8	MH_1712_ST/MH_1713_ST
2.6	0.775	8	MH_1713_ST/MH_1710_ST
3	0.775	8	MH_5957_ST/MH_5958_ST
3	0.775	8	MH_5958_ST/MH_5959_ST
3	0.775	8	MH_5959_ST/MH_10969_ST
2.6	0.775	8	MH_6483_ST/MH_22836_ST
3	0.775	8	MH_10969_ST/MH_13160_ST
3	0.775	8	MH_11064_ST/MH_13160_ST
3	0.775	8	MH_11742_ST/
3	0.775	8	MH_11948_ST/MH_22996_ST
2.6	0.775	8	MH_12253_ST/MH_12257_ST
2.6	0.775	8	MH_12257_ST/MH_22900_ST
3	0.775	8	MH_13160_ST/MH_65_ST
3	0.3875	8	MH_13760_ST/MH_41_ST
2.2	1.375	8	MH_15999_ST/MH_16000_ST
2.2	1.375	8	MH_16000_ST/MH_42_ST
3	0.3875	8	MH_16395_ST/MH_16396_ST
3	0.775	8	MH_16848_ST/MH_16850_ST
3	0.775	8	MH_16850_ST/MH_16851_ST
3	0.775	8	MH_16851_ST/MH_16852_ST
3	0.775	8	MH_16852_ST/934
3	0.775	8	MH_16855_ST/MH_16852_ST

Map (Higher Risk Pipes in Red)



Figure 9 – Storm BRE Scores for Pilot Area 1

Several storm sewers in Pilot Area 1 do show a potential business risk and merit additional investigation, according to the results. Many of the BRE scores of 8 are driven by pipes with a consequence of failure of 3, meaning that the traffic counts have an ADT greater than 10,000 or the pipe is in an non-accessible location, and the pipe is larger than 24-in diameter. A CoF of 3 without some degree of likelihood of failure (i.e., a PoF>1) may not be enough to justify taking additional actions. With this in mind, it is recommended that only BREs of 7 or lower receive some specific review of the reasons for the rating. This task would start by simply reviewing the factors that lead to the PoF and CoF scores, and then determining if further investigation such as field visits is warranted. After such preliminary review, some pipes will still likely be deemed as having an acceptable BRE score even though somewhat lower than others.

PILOT 2: SANITARY SEWER

Business Risk Analysis of sanitary sewer pipes in Pilot Area 2 provided the following results.

BRE Score	# of Records
3	13
4	2
5	34
6	16
7	43
8	109
9	194
10	255

Sample of Lowest Pipe Scores

COF	POF	BRE1	Line_ID
3	2.541	3	MH_S-380_333_COMB/MH_S-380_9092_COMB
3	2.541	3	MH_264_COMB/MH_17038_COMB
3	2.541	3	MH_3331_ST/MH_3309_ST
3	2.541	3	MH_S-405_8730_COMB/MH_S-405_999_COMB
3	2.541	3	MH_S-282_9775_COMB/MH_S-282_9092_COMB
3	2.541	3	MH_S-282_2355_COMB/MH_S-282_12_COMB
3	2.541	3	MH_S-339_10148_SAN/MH_S-339_9775_SAN
3	2.541	3	MH_13240_COMB/MH_264_COMB
3	2.541	3	MH_S-380_924_COMB/MH_S-380_333_COMB
3	2.541	3	MH_S-536_545_COMB/MH_S-536_232_COMB
3	2.541	3	MH_S-536_232_COMB/MH_S-536_924_COMB
3	2.541	3	MH_S-509_142_COMB/MH_S-509_9092_COMB
3	2.541	3	MH_255_COMB/MH_11989_COMB
2.6	2.541	4	MH_17281_COMB/MH_S-384_9092_COMB
2.6	2.541	4	MH_S-499_1414_COMB/MH_S-499_1011_COMB
2.4	2.541	5	MH_S-62_2136_COMB/MH_S-62_1542_COMB
2.4	2.541	5	MH_S-62_1542_COMB/MH_S-62_999_COMB
2.2	2.541	5	MH_S-172_1517_COMB/MH_S-172_440_COMB
2.2	2.541	5	MH_279_COMB/MH_13072_COMB
2.2	2.541	5	MH_S-111_1107_COMB/MH_S-111__COMB
2.2	2.541	5	MH_858_COMB/MH_270_COMB
2.2	2.541	5	MH_860_COMB/MH_17658_COMB
2.4	2.541	5	MH_S-282_728_SAN/MH_S-282_711_SAN
2.4	2.541	5	MH_S-282_1045_SAN/MH_S-282_728_SAN
2.4	2.541	5	MH_S-282_1261_SAN/MH_S-282_1045_SAN
2.4	2.541	5	MH_S-282_1548_SAN/MH_S-282_1261_SAN
2.2	2.541	5	MH_3408_COMB/MH_3405_COMB
2.2	2.541	5	MH_3429_COMB/MH_3433_COMB
2.2	2.541	5	MH_3431_SAN/MH_3321_SAN
2.2	2.541	5	MH_3433_COMB/MH_3434_COMB
2.2	2.541	5	MH_3434_COMB/MH_3405_COMB
2.2	2.541	5	MH_S-59_999_COMB/MH_S-59__COMB
2.4	2.541	5	MH_S-282_2950_COMB/MH_S-282_2725_COMB
2.2	2.541	5	MH_13072_COMB/MH_13073_COMB
2.2	2.541	5	MH_13073_COMB/MH_13074_COMB
2.2	2.541	5	MH_PB-05_2923_COMB/MH_PB-05__COMB
2.2	2.541	5	MH_S-380_1541_COMB/MH_S-380_924_COMB
2.2	2.541	5	MH_S-358_300_COMB/MH_S-358_1107_COMB
2.2	2.541	5	MH_S-509_1600_COMB/MH_S-509_1230_COMB
2.2	2.541	5	MH_S-509_1230_COMB/MH_S-509_142_COMB
2.2	2.541	5	MH_P-626_2103_COMB/MH_P-626_1517_COMB
2.2	2.541	5	MH_S-275_604_COMB/MH_S-275_1230_COMB
2.2	2.541	5	MH_S-233_624_COMB/MH_S-233_232_COMB
2.2	2.541	5	MH_S-59_1048_COMB/MH_S-59_999_COMB

Map (Higher Risk Pipes Red)

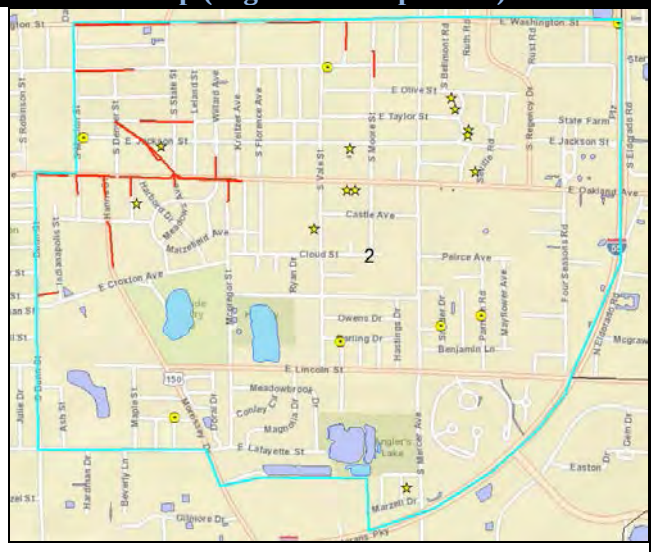


Figure 10 – Sanitary BRE Scores for Pilot Area2

Pilot Area 2 is an older area and pipe age was a contributing factor to some of the higher POF scores and consequently lower BRE_{CAP1} scores. High cleaning frequency was also a contributing factor in many cases. For the purpose of further evaluation regarding sanitary sewer BREs, Baker recommends selecting all pipes with a BRE1 score less than or equal to 7. This resulted in 108 records in Pilot Area 2. The records listed in the "Pipes for Review" table listed above represent a sample of these. Thirteen of these contain a BRE score of 3 so it would be prudent to focus on these first. After reviewing the factors leading to the lower BRE score, the next logical step in some cases would be to perform CCTV inspections to determine the interior condition of these segments.

PILOT 2: STORM SEWER

Business Risk Analysis of storm sewer pipes in Pilot Area 2 provided the following results.

BRE Score	# of Records
3	5
4	3
5	34
6	22
7	46
8	104
9	362
10	376
Pipes for Review	**Map (Review Pipes in Red)**

COF	POF	BRE1	Line_ID
3	2.541	3	MH_3407_ST/MH_3406_ST
3	2.541	3	MH_3411_ST/MH_3407_ST
3	2.541	3	MH_3412_ST/MH_3411_ST
3	2.541	3	MH_3413_ST/MH_3412_ST
3	2.541	3	MH_3414_ST/MH_3413_ST
2.6	2.541	4	MH_12080_ST/MH_12077_ST
2.6	2.541	4	MH_13910_ST/MH_12077_ST
2.6	2.541	4	MH_19013_ST/MH_19012_ST
2.2	2.541	5	MH_1822_ST/MH_18550_ST
2.4	2.541	5	MH_3311_ST/MH_3310_ST
2.4	2.541	5	MH_3312_ST/MH_3311_ST
2.2	2.541	5	MH_3416_ST/MH_3411_ST
2.2	2.541	5	MH_3418_ST/MH_3412_ST
2.2	2.541	5	MH_3419_ST/MH_3412_ST
2.2	2.541	5	MH_3420_ST/MH_3413_ST
2.2	2.541	5	MH_3421_ST/MH_3413_ST
2.2	2.541	5	MH_3422_ST/MH_3414_ST
2.2	2.541	5	MH_3423_ST/MH_3422_ST
2.2	2.541	5	MH_3424_ST/MH_3425_ST
2.2	2.541	5	MH_3425_ST/MH_3414_ST
2.2	2.541	5	MH_3426_ST/MH_3425_ST
2.2	2.541	5	MH_3427_ST/MH_3414_ST
2.2	2.541	5	MH_12087_ST/MH_12082_ST
2.2	2.541	5	MH_12631_ST/MH_12628_ST
2.2	2.541	5	MH_12633_ST/MH_12634_ST
2.2	2.541	5	MH_12636_ST/MH_3384_ST
2.2	2.541	5	MH_13028_ST/MH_3427_ST
2.2	2.541	5	MH_13703_ST/MH_3407_ST
2.2	2.541	5	MH_13906_ST/MH_12077_ST
2.2	2.541	5	MH_13908_ST/
2.2	2.541	5	MH_15974_ST/MH_3422_ST
2.2	2.541	5	MH_17274_ST/MH_16899_COMB
3	2.15	5	MH_18545_ST/MH_17266_COMB
2.4	2.541	5	MH_18551_ST/MH_18552_ST
2.2	2.541	5	MH_20525_ST/MH_13703_ST
2.2	2.541	5	MH_21917_ST/MH_21923_ST
2.2	2.541	5	MH_21921_ST/MH_21803_COMB
2.2	2.541	5	MH_21922_ST/MH_21803_COMB
2.2	2.541	5	MH_21923_ST/MH_21916_ST
2.2	2.541	5	MH_23180_ST/MH_3411_ST
2.4	2.541	5	/
2.2	2.541	5	MH_13908_ST/

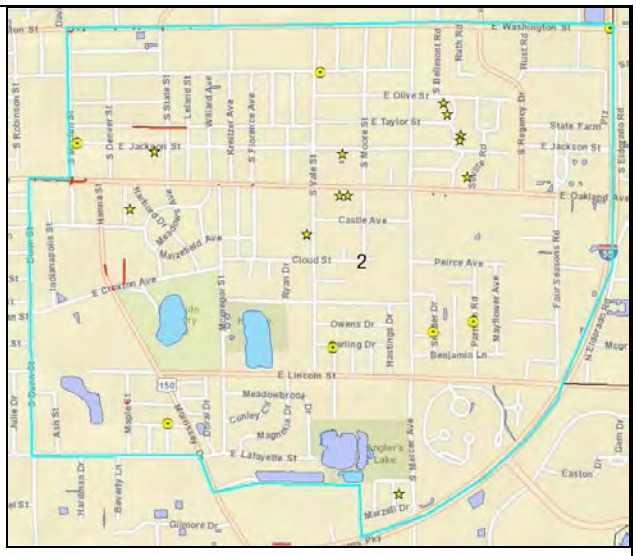


Figure 11 – Storm BRE Scores for Pilot Area2

Applying the POF and COF factors for storm sewer in Pilot Area 2 provided a significant variability of BRE scores. This is attributable to the presence of older sewer pipes, known flooding issues (highlighted in yellow) in the region, and a number of larger pipes in locations evaluated as having a higher consequence if the pipe were to fail. Similar to the conclusions for Pilot Area 1, storm segments with a BRE of 7 or lower should at least warrant some specific review of the reasons for the rating, and if necessary field investigations should be performed.

RESULTS – CAP 2

The City of Bloomington provided a selected set of pipes in which a CCTV inspection was performed. The information contained within the CCTV inspection was utilized to perform CAP 2 assessments for sanitary sewer for Pilot Area 2. A CAP 2 assessment calculates a BRE_{CAP2} score using the formula provided previously in Equation 1. Specifically, the POF_CCTV_RATING value in the INSP_CCTV_RATING table of Table 8 is used as the PoF_{CAP2} factor.

In addition to the CCTV inspections, the hydraulic modeling and capacity study executed by Foth afforded Baker the opportunity to perform a CAP 2 assessment utilizing information correlating to additional pipe studies, as taken from PIPE_STUDY_RATING database tables presented in Figures 4 and 5. As previously mentioned, if both CCTV inspection and additional studies (I&I, Capacity, etc...) have been performed, the CAP 2 assessment will incorporate the highest POF score amongst them. The study provided by Foth included data on a select set of combined and storm sewer pipes in Pilot Area 2. One deliverable resulting from this task was a GIS layer in which each individual segment in the study is rated from 1 to 4 depending on the relative severity of its capacity deficit. A score of one indicates little or no capacity issues and thus a low priority for replacement, while a value of four indicates severe capacity issues and a high need to address. As indicated previously, it is recommended that all additional studies are accompanied by such a GIS layer, which can be input into the PIPE_STUDY_RATING database tables. The values of 1-4 became the PoF_{CAP2} factor of Equation 1 unless there is a higher value for the POF_CCTV_RATING parameter.

PILOT AREA 2 - CAP 2 RESULTS: SANITARY SEWER

The Sanitary Sewer CAP 2 assessment in Pilot Area 2 provided BRE_{CAP2} scores for approximately 58 pipe segments. A sample of segments with relatively lower BRE_{CAP2} values is presented in the following table and map.

CAP 2 CCTV RATING PILOT 2

ASSET_ID *	MAX_PIPE_GRADE	OVERALL_GRADE_SCORE	CCTV_SCORE	POF_CCTV_RATING
MH_S-171_1105_COMB/MH_S-171_440_COMB	5	521	5521	3.165711
MH_S-535_556_COMB/MH_S-535_282_COMB	5	224	5224	2.995413
MH_873_SAN/MH_17286_SAN	5	174	5174	2.966743
MH_S-403_2734_SAN/MH_S-403_2475_SAN	4	218	4218	2.418578
MH_17280_COMB/MH_17281_COMB	3	279	3279	1.880161
MH_S-282_2950_COMB/MH_S-282_2725_COMB	3	178	3178	1.822248
MH_S-282_2355_COMB/MH_S-282_12_COMB	2	161	2161	1.239106
MH_S-73_1920_COMB/MH_S-73_800_COMB	2	53	2053	1.177179

POF 2 PIPE STUDY PILOT 2

ASSET_ID *	STUDY_TYPE	POF_STUDY_RATING *
MH_17269_COMB/MH_17270_COMB	Capacity	4
MH_17270_COMB/MH_17271_COMB	Capacity	4
MH_S-217_630_COMB/MH_S-217_1230_COMB	Capacity	3
MH_S-190_622_COMB/MH_S-190_730_COMB	Capacity	3
MH_S-439_418_COMB/MH_S-439_624_COMB	Capacity	3
MH_S-233_624_COMB/MH_S-233_232_COMB	Capacity	3
MH_S-380_333_COMB/MH_S-380_9092_COMB	Capacity	1
MH_264_COMB/MH_17038_COMB	Capacity	1
MH_S-282_9775_COMB/MH_S-282_9092_COMB	Capacity	1
MH_S-339_10148_SAN/MH_S-339_9775_SAN	Capacity	1
MH_13240_COMB/MH_264_COMB	Capacity	1
MH_S-380_924_COMB/MH_S-380_333_COMB	Capacity	1
MH_S-536_545_COMB/MH_S-536_232_COMB	Capacity	1
MH_S-536_232_COMB/MH_S-536_924_COMB	Capacity	1

BRE RESULTS

BRE1	BRE2	COF	POF	POF2	Line_ID
5	7	2.4	2.541	1.822248	MH_S-282_2950_COMB/MH_S-282_2725_COMB
3	7	3	2.541	1.239106	MH_S-282_2355_COMB/MH_S-282_12_COMB
7	8	2.2	2	1.177179	MH_S-73_1920_COMB/MH_S-73_800_COMB
3	8	3	2.541	1	MH_S-380_333_COMB/MH_S-380_9092_COMB
3	8	3	2.541	1	MH_264_COMB/MH_17038_COMB
8	8	1	3.141	3.165711	MH_S-171_1105_COMB/MH_S-171_440_COMB
8	8	1	2.691	2.966743	MH_873_SAN/MH_17286_SAN
8	8	1.6	2.125	2.418578	MH_S-403_2734_SAN/MH_S-403_2475_SAN
3	8	3	2.541	1	MH_S-282_9775_COMB/MH_S-282_9092_COMB
3	8	3	2.541	1	MH_S-339_10148_SAN/MH_S-339_9775_SAN
3	8	3	2.541	1	MH_13240_COMB/MH_264_COMB
3	8	3	2.541	1	MH_S-380_924_COMB/MH_S-380_333_COMB
3	8	3	2.541	1	MH_S-536_545_COMB/MH_S-536_232_COMB
3	8	3	2.541	1	MH_S-536_232_COMB/MH_S-536_924_COMB
8	8	2.2	1.55	2.58	MH_S-217_630_COMB/MH_S-217_1230_COMB
8	8	2.2	1.55	2.58	MH_S-190_622_COMB/MH_S-190_730_COMB
8	8	1	2.541	3.44	MH_17269_COMB/MH_17270_COMB
8	8	1	2.541	3.44	MH_17270_COMB/MH_17271_COMB
8	8	1	2.541	2.58	MH_S-439_418_COMB/MH_S-439_624_COMB
5	8	2.2	2.541	2.58	MH_S-233_624_COMB/MH_S-233_232_COMB

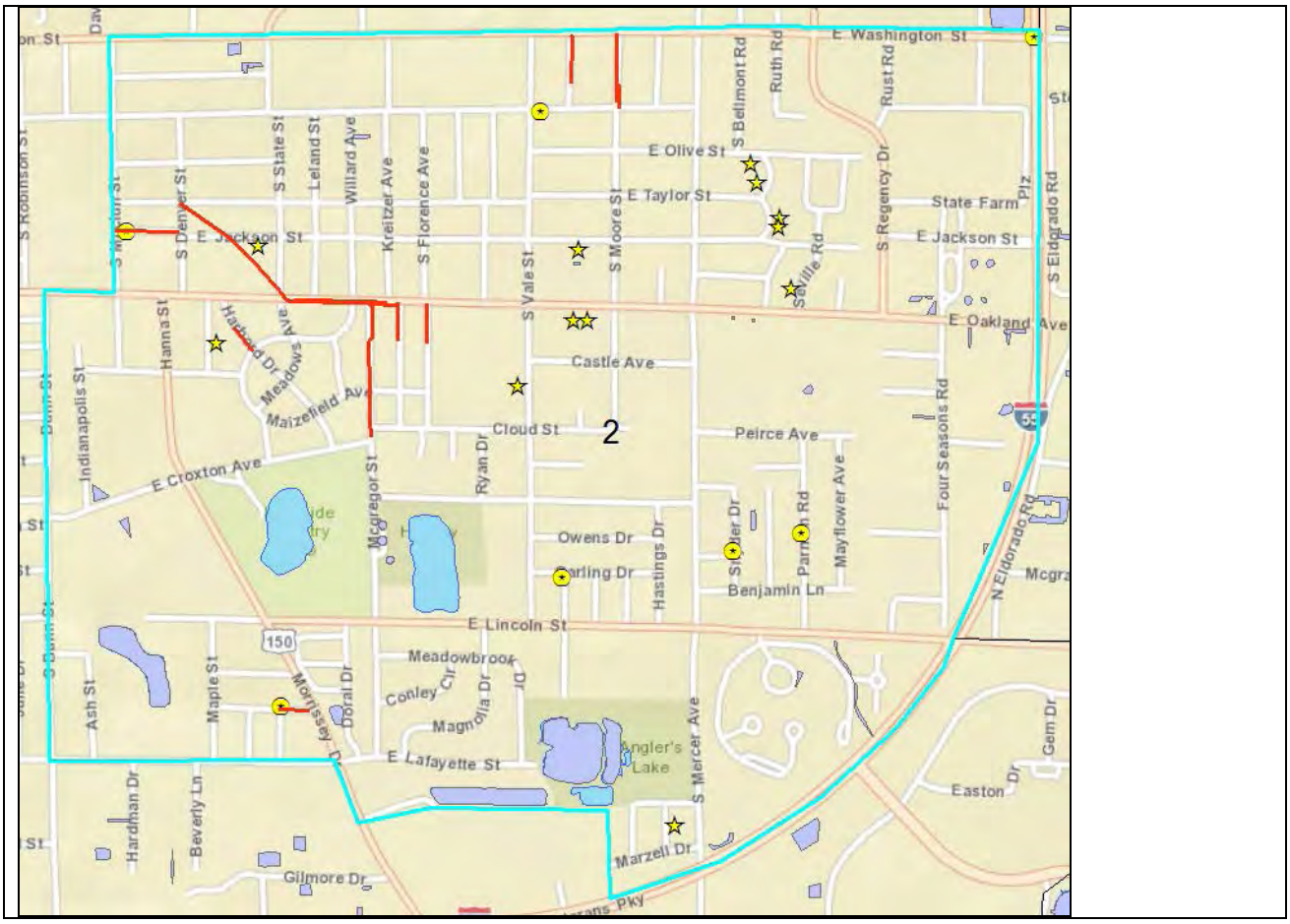


Figure 12 – Sanitary $BRE_{CAP\ 2}$ Scores for Pilot Area 2

Note that a number of CAP 1 scores changed upwards, often times significantly. The additional information acquired from either the capacity studies or the CCTV inspections caused the methodology to show lower risk in these cases. However, the BRE_{CAP1} scores should not be ignored in evaluating business risk or required follow-up activities. As previously stated, the CAP2 analysis only incorporates the results of a specific field study, while the CAP1 analysis emphasizes other factors including age and historical issues. A breakdown of all $BRE_{CAP\ 2}$ sanitary sewer scores in Pilot Area 2 is presented in Table 11. The table indicates the total number of records (or pipe segments) corresponding to a specific $BRE_{CAP\ 2}$ score, as well as the number of scores driven by CCTV studies or by "other studies", which in this case are the hydraulic modeling and capacity studies previously mentioned.

Table 11 – BRE_{CAP2} Sanitary Sewer Scores in Pilot Area 2

CAP 2 SANITARY ASSESSMENT			
BRE 2 SCORE	TOTAL # RECORDS	# RECORDS CCTV	# RECORDS OTHER STUDIES
7	2	2	0
8	18	4	14
9	20	2	18
10	9	0	9

PILOT AREA 2 - CAP 2 RESULTS: STORM SEWER

The hydraulic modeling and capacity study executed by Foth afforded Baker the opportunity to perform a CAP 2 assessment utilizing information correlating to additional pipe studies, as taken from PIPE_STUDY_RATING database tables presented in Figure 5. The Storm Sewer CAP 2 assessment in Pilot Area 2 provided the following results for lower scoring pipe segments. Note that CAP 2 information for Pilot Area 1 was not available.

CAP 2 CCTV RATING PILOT 2

N/A

POF 2 PIPE STUDY PILOT 2

ASSET_ID *	POF_STUDY_RATING	STUDY_TYPE
MH_3407_ST/MH_3406_ST	2	Capacity
MH_3411_ST/MH_3407_ST	2	Capacity
MH_3412_ST/MH_3411_ST	2	Capacity
MH_3413_ST/MH_3412_ST	2	Capacity
MH_3414_ST/MH_3413_ST	2	Capacity
MH_3311_ST/MH_3310_ST	1	Capacity
MH_3312_ST/MH_3311_ST	1	Capacity

BRE RESULTS

COF	POF	POF2	BRE1	BRE2	Line_ID
3	2.541	1.72	3	5	MH_3407_ST/MH_3406_ST
3	2.541	1.72	3	5	MH_3411_ST/MH_3407_ST
3	2.541	1.72	3	5	MH_3412_ST/MH_3411_ST
3	2.541	1.72	3	5	MH_3413_ST/MH_3412_ST
3	2.541	1.72	3	5	MH_3414_ST/MH_3413_ST
2.4	2.541	0.86	5	8	MH_3311_ST/MH_3310_ST
2.4	2.541	0.86	5	8	MH_3312_ST/MH_3311_ST

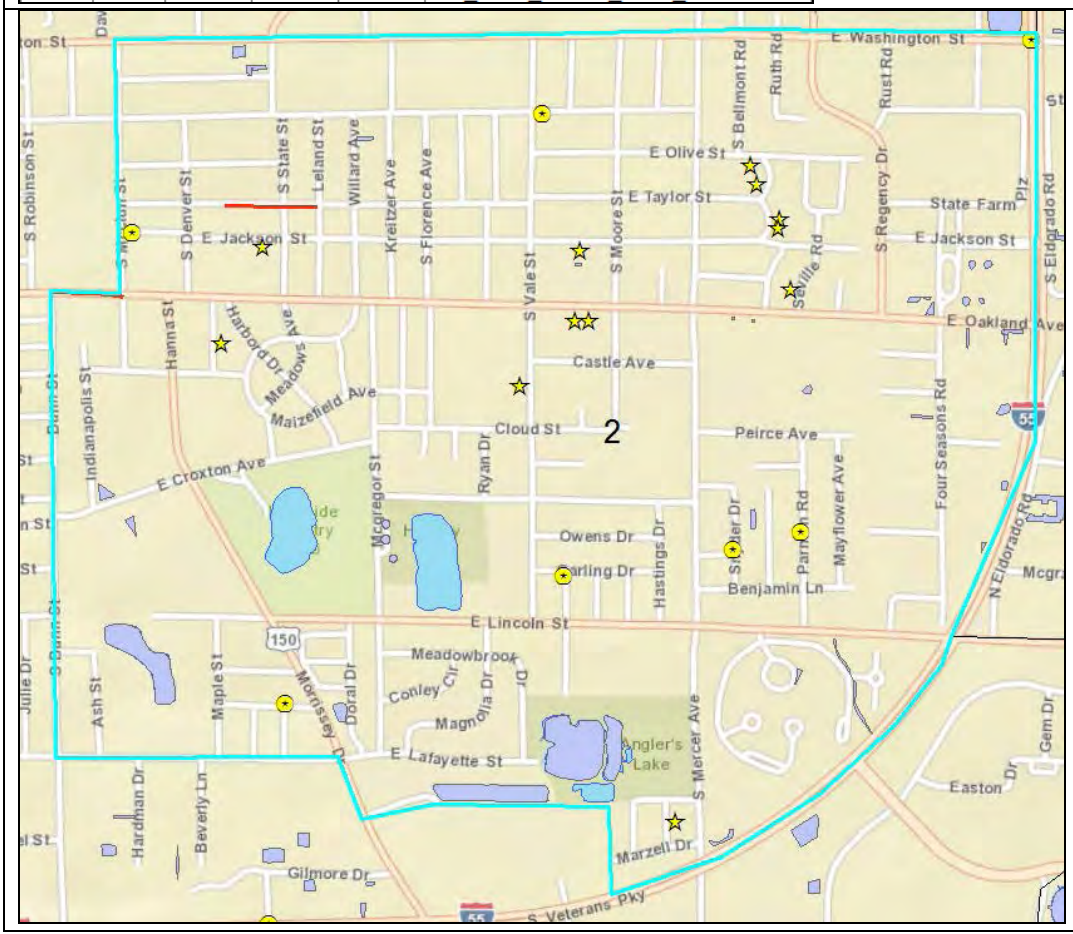


Figure 13 – Storm $BRE_{CAP\ 2}$ Scores for Pilot Area 2

A breakdown of all $BRE_{CAP\ 2}$ storm sewer scores in Pilot Area 2 is presented in Table 12. Since there were no CCTV inspections performed on the storm system, all BRE_{CAP2} scores were driven by the hydraulic modeling study results (classified as "other studies").

Table 12 – BRE_{CAP2} Storm Sewer Scores in Pilot Area 2

CAP 2 STORM ASSESSMENT			
BRE 2 SCORE	TOTAL # RECORDS	# RECORDS CCTV	# RECORDS OTHER STUDIES
5	5	0	5
8	2	0	2
9	9	0	9
10	6	0	6

In examining the BRE_{CAP2} scores for sanitary and storm sewers in Pilot Area 2, the following observations are apparent:

- CCTV inspections, when performed, should focus on the pipes with a lower BRE_{CAP1} score indicating higher risk.
- The CAP 2 analysis for storm sewers yielded five scores of 5, while for sanitary sewers there were two scores of 7. At this CAP 2 level of analysis, scores of 5 for stormwater and 7 for sanitary indicate that a more detailed review should be performed on the feasibility and appropriateness of addressing the factors behind the risk. This may result in cost estimates and inclusion of these pipes in the CIP budgeting of the next fiscal year of thereafter, or it may result in a decision to more closely monitor the issue than for other lower risk pipe segments. Many municipalities use a CIP Committee or team to review such infrastructure elements and take decisions on the appropriate course of action. Factors to take into account at this point include the historical cost of work orders associated with the asset, costs of monitoring, and the existence of other projects planned for the area that would lead to an economy of scale for executing both activities at once. If the current fiscal year budget does not allow for rehabilitation or further field studies, then it is important that these pipes are flagged in a maintenance-repair schedule. This schedule may be thought of as a running "wish list" for expenditures directed at renewing deteriorating infrastructure on a routine basis. Each year when budgets are set, the maintenance-repair list would be a source to be consulted with for proposed funding of renewal activities.
- Note should be taken that the higher BRE_{CAP2} scores do not imply that the BRE_{CAP1} scores are to be ignored. The pipes could very well have mortality issues and high business risk due to factors other than capacity. Therefore, both BREs at CAP 1 and CAP 2 levels are important in evaluating business risk and subsequent actions to be taken by the municipality.

SERVICE & CONDITION ASSESSMENT RATING (SCAR)

The Business Risk Exposure ratings are measures of the risk to Bloomington that a component will not allow its sewer systems to operate at defined levels of service in the most cost effective manner. Based on input from the City's Engineering Department, a separate rating focused strictly on the overall condition

of the pipe together with its ability to function adequately was developed. It is called the Service and Condition Assessment Rating (SCAR), and is meant to provide a general idea of piping stock conditions without regard to pipe location or consequences of failure. The equation for SCAR is:

Equation 2: SCAR = Abs (3 * (Highest Score of [POF1] or [POF2]) - 11)

Upon application to all sanitary sewer pipes in the Bloomington system, the following breakdown of scores was obtained:

Table 13 – SCAR ratings for Bloomington Sanitary sewer Pipes

	OID	SCAR	Count_SCAR	Sum_SHAPE_Length
▸	0	1	5	1799.133877
	1	2	57	18398.495446
	2	3	1567	423824.172078
	3	4	2	467.858243
	4	5	17	3952.189478
	5	6	156	42107.83003
	6	7	284	62315.369259
	7	8	113	30235.664485
	8	9	1482	350288.968354
	9	10	3702	948077.556819

SCARs ranging from scores of 1 – 3 correspond to a total of some 444,021 feet of sewer. If Bloomington were to replace one percent of its pipe stock annually, which is a benchmark goal for many leading utilities, it would require approximately 22 years to address pipes with SCARs of 1 – 3.

RECOMMENDATIONS

It should be noted that the development of this GIS based infrastructure rating system provides a platform to build on. Over time as Bloomington's asset management system begins to mature and evolve scoring will more likely be captured by performing a database query on work orders associated with a particular asset via its unique asset number. An effective Computerized Maintenance Management System (CMMS) will greatly facilitate this transformation. Additionally, weights can be adjusted as more data becomes available. For example, Bloomington may want to begin to place less weight on desktop projection factors such as material life expectancy and more on known performance measures such as work order history.

Bloomington may also want to consider incorporating more factors as well in its BRE formulas. Baker has provided some additional parameters for consideration in Table 11. An important consideration of course would be whether expanding the input parameters and increasing the complexity provides enough value given the level of effort to gather this extra information.

Baker has created a set of scripting tools to automate the storage and calculation of POF and COF parameters as well as final BRE CAP 1 and CAP 2 scores. These scripts do not move data from CCTV inspections into the GIS table utilized for the CCTV Pipe Ratings, and it is recommended that such a

script is developed and used to automate the process of moving data from CCTV inspections into the GIS table utilized for CCTV Pipe Ratings (INSP_CCTV_RATING). This will not only save time but also promote data integrity by eliminating any potential data entry errors. The memo previously provided by Baker, "Pipe Condition Rating Methodology Recommendations," provides a high level outline of the logic necessary to automate this process.

Table 13: Optional Parameters for future consideration:

Criteria	*Source*	*Comments*
Deteriation Factors		
Structural/Physical		
Slope	Pipe Attribute	Flat slope contributes to sediments
Pipe Renewal (Lining)	Pipe Attribute	May extend RUL
Environmental		
Live Load (Traffic ADT)		This has been allocated as a COF
Dead Load	see Installation	
Soil Type	Pipe Attribute	Can contribute to Corrosion
Groundwater Table	Pipe Attribute	Contributes to Load issues
Flooding		Contributes to Soil/Load issues
Avg Distance to Trees		Contributes to Root Problems
Installation/Construction		
Install Rating	Pipe Attribute	Domain (Proper; Adequate; Improper)
Pipe Bedding (Y,N or Class A,B,C,D)	Related Table	Contributes to Load issues
Trench Backfill (Type)	Related Table	Cohensionless granular material; Sand and Gravel; Saturated topsoil; Clay; Saturated Clay
Backfill frictional characteristics	Look up Table (Domain)	Used to calculate Dead Load
Depth	Related Table	Used to calculate Dead Load
Unit weight backfill	Related Table	Used to calculate Dead Load
Trench width	Related Table	Should not exceed (Diameter + 24") Used to calculate Dead Load
Dead Load	Related Table	Calculated Lbs/sq ft
Operations & Maintenance		
SSO/CSO		
Odor Complaints		Sediments
Inspections		*Used for Level 2 Pipe Rating Analysis*
Infiltration/Inflow		Smoke/Dye Testing
Capacity Issues		Flood Study

BIBLIOGRAPHY

Newton, L., & Vanier, D. (2006). *MIIP Report: The State of Canadian Sewers – Analysis of Asset Inventory and Condition.* Canada: Institute for Research in Construction & National Reserch Council Canada.

T. Martin, D. J. (2007). Using Historical Repair Data to Create Customized Predictive Failure. *LESAM 2007 - 2nd Leading Edge Conference on Strategic Asset Management.* Portugal: International Water Association.

Asset Management Technical Memoranda

AM3 - ASSET MANAGEMENT PROGRAM WORK ORDER NEEDS ANALYSIS

Asset Management Program Work Order Needs Analysis
City of Bloomington, IL
Michael Baker Jr., Inc.
December 11, 2013

Executive Summary

The City of Bloomington Public Works Department (COBPW) has initiated the development and implementation of an asset management program (AMP) for its storm and sewer infrastructure. Implementation of the AMP will result in a strategic and justifiable approach for evaluating, prioritizing and selecting the most critical sewer/stormwater infrastructure elements in order to target funding and maintenance efforts. The goal of such activities is to reduce life cycle costs for its sewer assets and to practice "smart" operations, maintenance, and replacement actions that are coordinated with related asset activities including road repair and utility replacement.

The implementation of a successful Asset Management Program (AMP) starts with having an accurate inventory of assets together with the means to track operations and maintenance (O&M) actions and associated repair costs. COBPW wishes to continue leveraging the efficiency of using GIS tools for accomplishing these objectives, such that the efficient capture, restoration, and editing of asset inventories in a GIS environment is indispensable. COBPW thus requires what is known as a GIS-based AMP of which the foundation is an asset management system.

Given that the City of Bloomington (COB) has selected MUNIS® ERP for the management of its assets, this memorandum describes needed functions that COBPW requires (from MUNIS or otherwise) in order to implement its Asset Management objectives. A key component for COB will involve geo-enabling the MUNIS asset management system. The MUNIS system's current non GIS-centric approach to asset management will otherwise limit its ability to perform the tracking and inventorying functions critical to COBPW's objectives.

The over-arching recommendation of this memorandum is to establish an interface between COBPW's GIS system and MUNIS such that asset additions, modifications, and repair activities are originated and directed from the GIS system. A rough estimate of the costs for implementing and maintain this functionality is provided in Table 1. The first item is an annual support service that covers other items in addition to MUNIS-COBPW interface upkeep, such as GIS-based infrastructure rating tools and pipe inspection software. The second item may be thought of as an interface that allows COBPW's GIS and MUNIS to "talk" to one another.

Table 1 GIS SERVICES FOR OPTIMIZATION OF INFRASTRUCTURE MANAGEMENT - COST ESTIMATE

Product	Description	Cost Estimate	Time Estimate
Consulting/GIS BRE Toolset Development/Maintenance	Ongoing maintenance & Support	$10,500	Annual Service (Amount estimated at approximately 100 hours of support)
MUNIS GIS Integration	Data conversion and business automation tools. GIS and asset management data integration and web enablement.	$100,000 – $250,000	One Time – Approximately 6 months

Asset Management Program Work Order Needs Analysis
City of Bloomington, IL
Michael Baker Jr., Inc.
December 11, 2013

I. Introduction

A critical objective for the City of Bloomington Public Works Department (COBPW) is to implement a strategic and justifiable approach for evaluating, prioritizing and selecting the most critical sewer/stormwater infrastructure elements in order to target funding and maintenance efforts. The goal of such activities is to reduce life cycle costs for its sewer assets and to practice "smart" operations, maintenance and replacement actions that are coordinated with related asset activities such as road repair and utility replacement. The implementation of a successful Asset Management Program (AMP) starts with having an accurate inventory of assets. COBPW wishes to continue leveraging the efficiency of using GIS tools for accomplishing these objectives, such that the efficient capture, restoration, and editing of asset inventories in a GIS environment is indispensable. COBPW thus requires what is known as a GIS-based AMP.

The main functions of an AMP typically include:

- ✓ Asset Data Management
- ✓ Work Order Management
- ✓ Inspection/Condition Data
- ✓ Inventory Management
- ✓ Report Generation

This technical memorandum focuses on the work order management component of the AMP and the need for a GIS-based work order system. Examples are also provided to illustrate how processing work orders impacts and interacts with the proposed GIS-based Infrastructure Rating System. Baker has recently submitted memos entitled GIS-based Infrastructure Rating System, dated 11/19/2012, and Pipe Condition Rating Methodology Recommendations, dated 9/4/2012. A GIS-based work order management system is essential to enable the implementation of the rating systems described in these two documents.

Given that the City of Bloomington has selected MUNIS® ERP for the management of its resources, this memorandum describes needed functions that COBPW requires in order to implement its Asset Management objectives. The intent of the memo is to allow for the evaluation of MUNIS's capabilities to provide the functions. As such, throughout this memo references are made to an *Evaluation Table*, which indicates the required

function, the pages (s) in this memo where it is described, the ability of GIS-based AMP software solution to deliver the function, and space to provide a description of how MUNIS can or cannot meet the same requirements. It is recommended that the City of Bloomington and/or representatives from the MUNIS implementation team complete the table under the MUNIS column.

II. Work Order Management System

Work orders are intended to manage all aspects of work necessary to maintaining an asset so that it delivers the required level of service. Work orders can be ***preventative*** (scheduled) or ***reactive*** (response to asset failure). Typical functionality of a work order system includes the ability to:

- ✓ Create, assign, schedule, and dispatch
- ✓ Create a project (multiple work orders for multiple assets) for a defined event (e.g. flushing program, sewer lining program)
- ✓ Join multiple assets with a work order
- ✓ Identify resources (labor, parts, materials, and equipment)
- ✓ Outline workflow (standard operating procedure to execute)
- ✓ Break an activity in multiple tasks
- ✓ Map and spatially display work order locations
- ✓ Estimate cost (inclusive labor and materials)
- ✓ Upload sketches, photos, manuals, permits, and notes
- ✓ Generate reports and queries
- ✓ Closeout

The history of all completed work orders associated with an asset is important to continuously assess the condition of the asset and establish its Business Risk Exposure (BRE) score. Assets and their condition ratings are tracked throughout their life in a cyclical manner to determine when to provide maintenance, rehabilitation, or complete replacement.

II.1 Creating Work Orders

Depending on the software used, there are many ways to create a work order. The most user-friendly and simplest way of creating a work order is by using a digital map and selecting an asset or group of assets, then clicking a button (or using a dropdown menu) to pull up the work order template. The same process can be used to generate a work order for multiple assets. The user can select multiple assets from the GIS map and group them to generate a work order [EVALUTION TABLE FUNCTIONALITY 1 – SEE APPENDIX].

COBPW maintains most of its asset inventories in GIS. By starting from a GIS map and clicking on an asset (or group of assets) a work order template can be displayed. Certain cells of the work order will be automatically populated with predetermined attributes of the asset such as the asset ID, type, materials, size, depth, slope, location and address, work order history, attachments (photos, notes), and inspection reports (CCTV, Dye, Smoke, etc.) [EVALUTION TABLE FUNCTIONALITY 2 – SEE APPENDIX]. A dropdown menu can then be used to fill-in specific requirements for the work order (required activities, instructional notes, resources and personnel).

The process of automatically populating work orders with predetermined GIS attributes of the assets (as desired by the COBPW) shows the importance and criticality of capturing and editing asset inventories in GIS environment. A robust GIS process to capture, restore, manipulate and edit asset inventories is required to be in-place prior to the implementation of an effective and efficient work order management system. Having the GIS system at the core of the AMP maintains a centralized database to integrate assets, and therefore, ensures consistency of asset data and eliminates the need to duplicated data in multiple databases or update different databases to keep data synchronized.

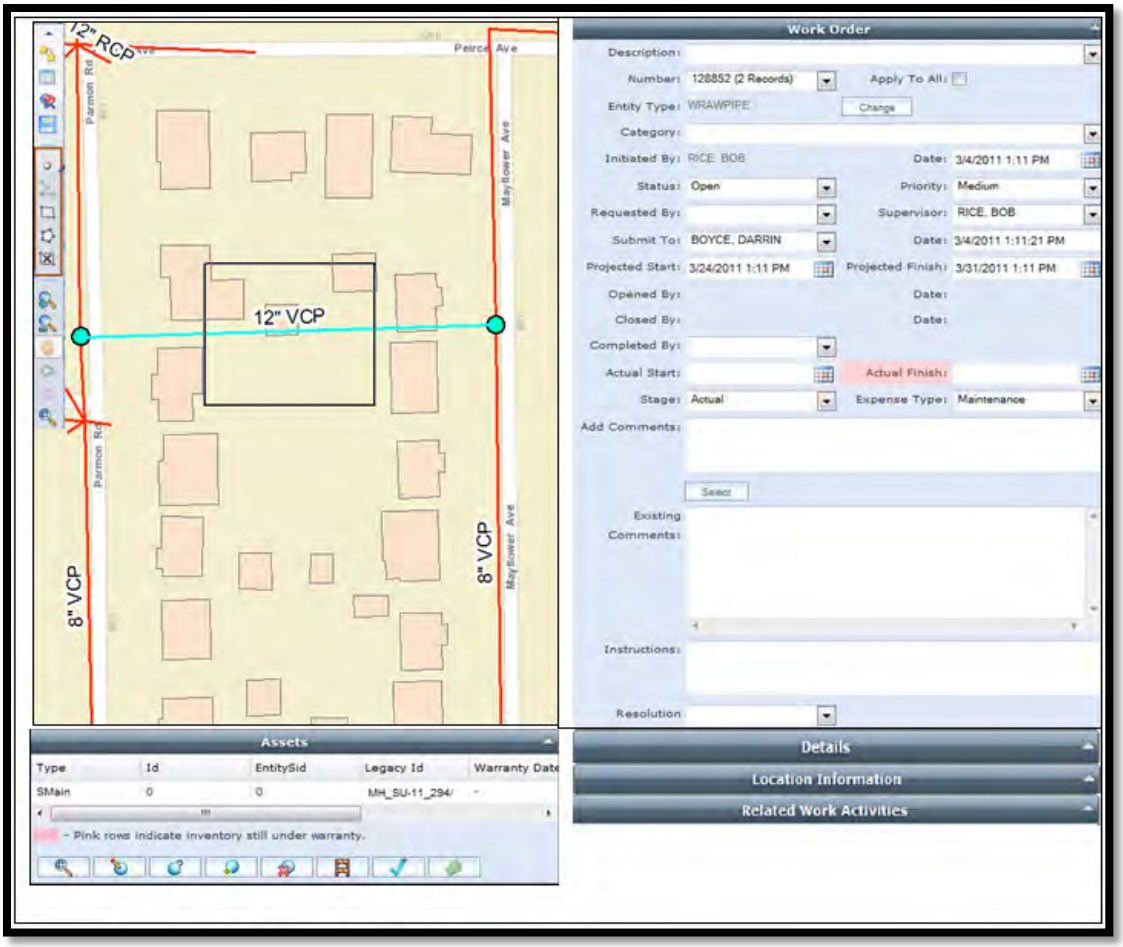


Figure 1: Creating Work Orders *(Using a GIS map and automatically populating predetermined attributes of assets)*

Another method of creating a work order is as a result of a service request. Service requests (logged by Customer Services Department) from customers may require a work order action to be resolved by City staff. The user can use the address included in the service request to generate a work order. The user can display the address on the GIS map and select associated assets for the work order [EVALUTION TABLE FUNCTIONALITY 3 – SEE APPENDIX].

II.2 Tracking Work Progress

The work order management system allows users to track and query work orders based on certain criteria (e.g. work order status, location, dates). For example, the status can be active (in progress), closed (completed), or scheduled. COBPW may be interested in all active work orders in order to optimize utilization of its field crews. A quick query of the work order system can provide all work orders with the status "active" and display them on the map, allowing the City to take appropriate action.

Another example is to track "overdue" work orders (by establishing criteria in the work order template for defining an overdue work order).

The tracking can also focus on an asset or collection of assets. The system can provide a history for all work orders associated with an asset or collection of assets. Information obtained from the work order history on assets can be used in evaluating the conditions of the assets, prioritizing, and selecting infrastructure elements for renewal, replacement, and budgeting efforts [EVALUTION TABLE FUNCTIONALITY 4 – SEE APPENDIX].

II.3 Closeout of Work Orders

The closeout process of the work orders includes all steps necessary to report on the activities completed in the work, and generally includes restoring service, updating attributes of affected assets (new acquisition, renewal, or replacement), costs, and uploading of photos and inspection reports. A GIS-based system facilitates an easy process to maintain and integrate asset data in a centralized database and eliminate the need to duplicate data in multiple databases or update different databases to keep data synchronized. Information to be transferred into the system at the time of closing a work order should include:

- ✓ The results of the activity
- ✓ The inspection observations, if applicable
- ✓ The origin of the work order (e.g. complaints or service orders should be linked)
- ✓ The reason or cause for the work order (cave-in, collapsed pipe, clogged detention basin outlet, etc.) [EVALUTION TABLE FUNCTIONALITY 4a – SEE APPENDIX]
- ✓ Changes to the asset conditions (renewal, replacement, rehabilitation, etc.)
- ✓ New assets created as a result of a work order (acquisition) [EVALUTION TABLE FUNCTIONALITY 5 – SEE APPENDIX]
- ✓ Update resource requirements (personnel, costing)
- ✓ Update workflow (if needed)
- ✓ Update GIS connectivity [EVALUTION TABLE FUNCTIONALITY 5a – SEE APPENDIX]

III. Workflow Examples

In the following section examples are provided to demonstrate typical workflow steps to execute a work order and to illustrate some of the required features in a GIS-based work order management system. The examples highlight functionalities that COBPW wishes to be evaluated by the MUNIS implementation team with the intent of determining if MUNIS can or cannot meet the same requirements. The *Evaluation*

Table in the Appendix lists specific functionalities requiring a response the MUNIS implementation team and provides space to do so.

III.1 Scenario 1: Encountering a New Asset

Scenario Description: COBPW was required to address a recent sanitary sewer overflow incident at a certain location within the sewer network. Review of the GIS identified the line as (001807 SEWP) connecting two manholes: 001629SSMH and 001630SSMH (See Figure 2). Querying the GIS-based AMP system for specific work order history [EVALUTION TABLE FUNCTIONALITY 4 – SEE APPENDIX] and previous CCTV inspection data [EVALUTION TABLE FUNCTIONALITY 6 – SEE APPENDIX] along the pipe showed the presence of roots and heavy debris at certain sections along the sewer line. Inspection notes suggested heavy cleaning (mechanically powered and vacuum cleaning equipment) to remove the debris and roots.

A GIS map was used to create a heavy cleaning work order, from which multiple pipe segments were selected by moving and clicking a cursor [EVALUTION TABLE FUNCTIONALITY 1 – SEE APPENDIX]. A list of all required equipment was included in the work order and reserved from the inventory warehouse for this task. Crew A was assigned the work order and dispatched to the work area.

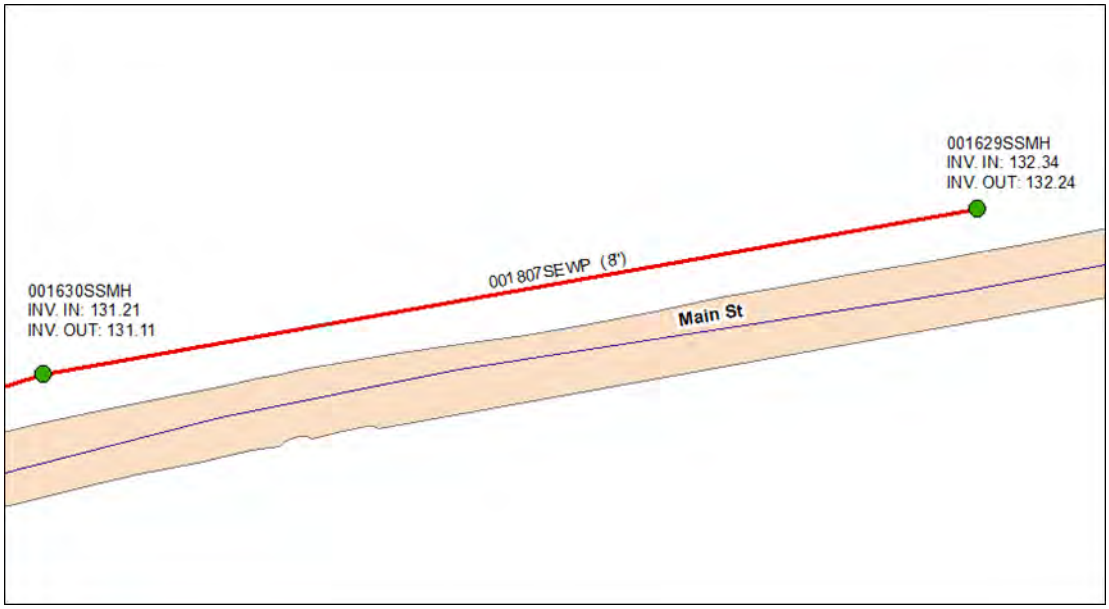


Figure 2: Scenario 1_WO map showing location of sewer main and manholes

Field Conditions: At the work area location, Crew A found that there was an additional intermediate manhole between the two manholes included in the work

order. Crew A proceeded to complete the heavy cleaning operation from 001629SSMH to 001630SSMH (cutting the roots and removing debris mechanically, and hydrojetting). Crew A then conducted a post CCTV inspection along the cleaned line. The Crew completed a tasks log and inspection observations and entered these items into the work order template [EVALUTION TABLE FUNCTIONALITY 6 – SEE APPENDIX]. Crew A also marked up the GIS map to show location and invert information of the newly found manhole (Figure 3).

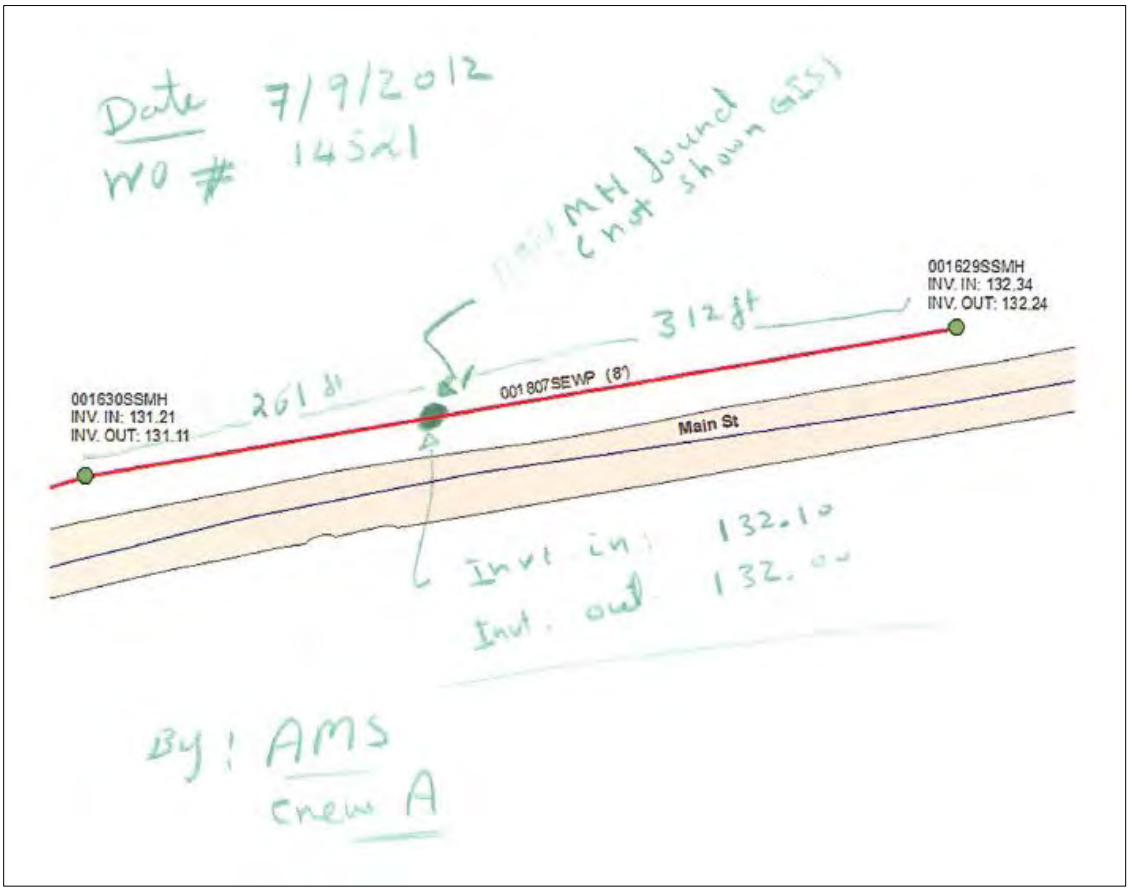


Figure 3: Scenario 1_Marked-up map showing location of newly found manhole

<u>Work Order Closeout</u>: At the office, the supervisor of Crew A entered the work order details into the system (including uploading the CCTV record) and submitted the marked-up GIS map to the GIS personnel. The supervisor added a new task to the open work order to update the GIS system. The status of the work order remained as "Active" pending the update of the GIS system and the adjustment to the rating of pipe 001807SEWP.

Based on the marked-up GIS map and following the COBPW Standard Operating Procedure (SOP) to capture new assets in GIS, the GIS staff added a new manhole and split line 001807SEWP into two lines (using the ID bank). Service laterals were appropriately linked to their respective sewer main. Work order basic information was updated to reflect the two pipeline segments (with the new IDs). As such, while the original work order was linked to a single pipe, the final work order is now linked to multiple assets [EVALUTION TABLE FUNCTIONALITY 5 – SEE APPENDIX]. Additionally, the staff updated the GIS-base rating system and assigned new BREs to the work area assets. The status of the work order was changed to "Closed".

III.2 Scenario 2: Sewer Relocation

Scenario Description: COBPW decided to relocate a sewer line (currently under pavement) to a new alignment as shown in Figure 4. A work order was created detailing required tasks, bypass pumping plan, safety plan, easement information, permits, traffic controls, and required personnel and equipment. Required equipment and tools were identified and reserved from the inventory warehouse. Crew C was assigned the work order and dispatched to the work area.

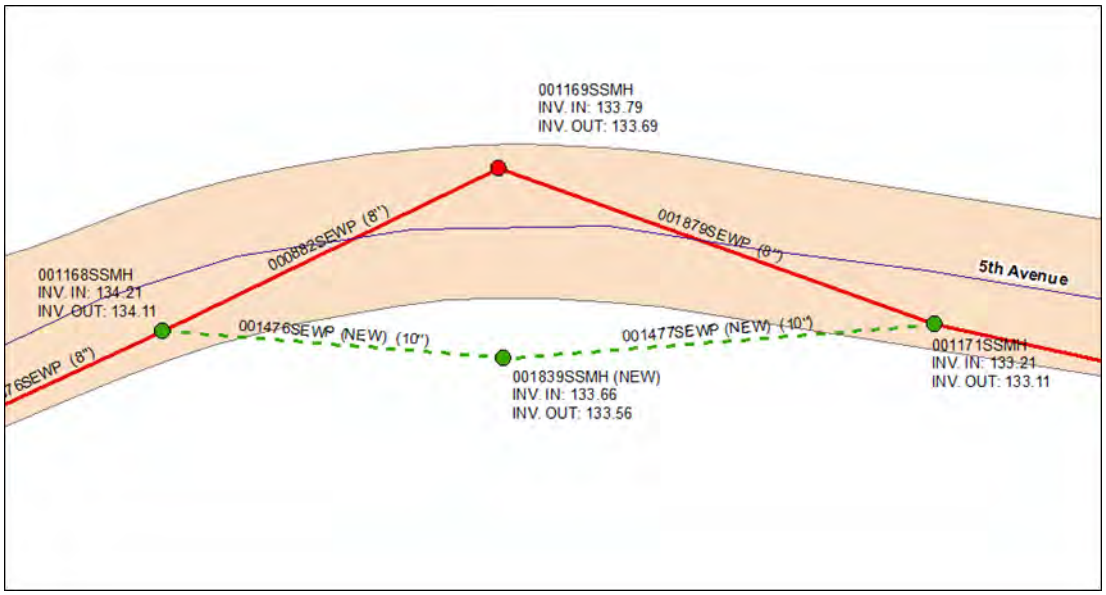


Figure 4: Scenario 2_WO map showing location of existing and proposed facilities

Field Conditions: At the end of each working day, the supervisor of Crew C updated the work order template with work progress, man-hours, and costs. Additional tasks were added to the work order as needed (e.g. inspection requests, equipment maintenance requests).

Work Order Closeout: After the completion of the project construction, Crew C prepared as-built information of the new sewer line. The supervisor completed the work order information and added a "GIS-update" task request. The status of the work order remained as "Active" pending the update of the GIS system and acquisition of the new assets.

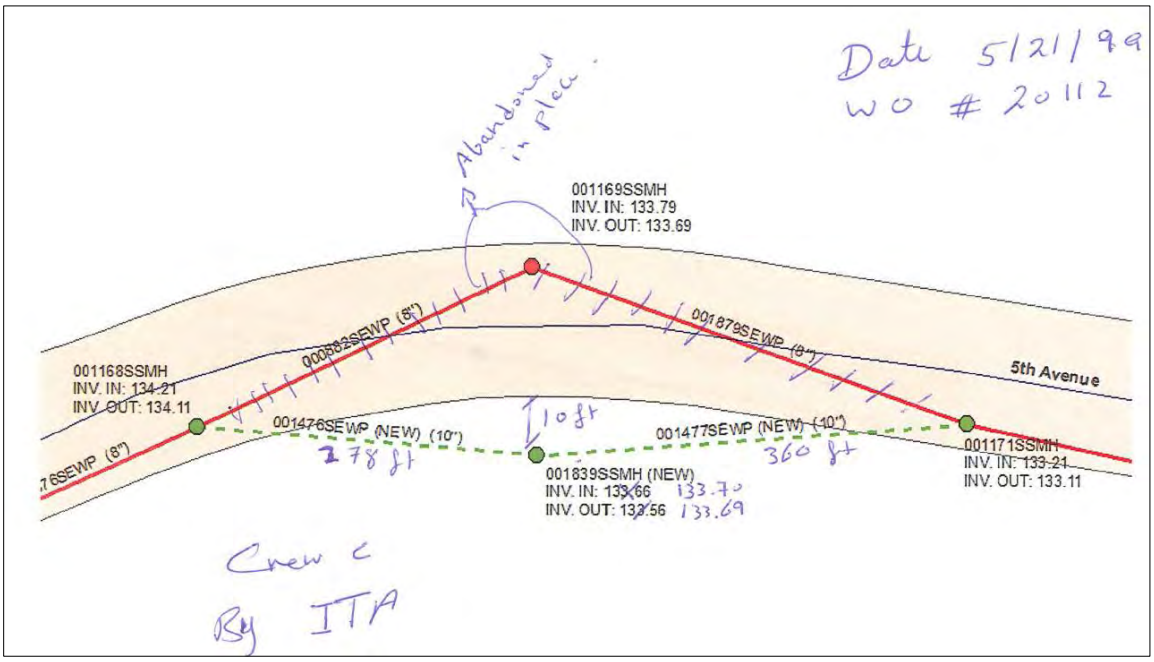


Figure 5: Scenario 2_As-built information of newly constructed facilities

Following the COBPW SOP to update GIS, the GIS staff added the newly constructed assets (pipelines and manholes), assigning IDs and populating attribute information (materials, sizes, depth, and invert information) [EVALUTION TABLE FUNCTIONALITY 5 – SEE APPENDIX]. The staff uploaded a scan of the as-built plan and easement information.

The GIS staff updated the GIS-based rating system for the new assets. Consequences of Failure (COF) changed significantly for the new pipes due to changes in the location factor and pipes (diameter and depth). The Probability of Failure (POF) changed as well due to updated structural/physical factors (age and material). New BRE scores were assigned to the pipelines. The work order status was changed to "Closed".

In this example the GIS was efficient for adding the new assets (sewer pipelines and manhole) to the assets inventory. It is worth noting that the capabilities of the GIS (in capturing new assets data) prove to be more critical and much needed as the number of new assets increases (e.g., capturing new assets that are part of a newly constructed subdivision).

III.3 Scenario 3: Cave-in Repair

Scenario Description: Customer Services Department received a phone call reporting a cave-in incident along a major road within City of Bloomington. A service order request was generated including the address of the incident (as reported by the caller) and assigned to Crew C.

Field Conditions: Crew C Supervisor queried the GIS data based on the provided address and quickly viewed all nearby assets (manholes, pipes, inlets) [EVALUTION TABLE FUNCTIONALITY 3 – SEE APPENDIX]. From the GIS information it was determined that the cave-in was within the right-of-way, with a location near stormwater pipes (001429STWP and 001430STWP), and that the cave-in was not close to any buildings or structures. Additionally, the Supervisor reviewed history of cave-in work orders in the area using the GIS work order query function [EVALUTION TABLE FUNCTIONALITY 4 – SEE APPENDIX] and did not find prior cave-in incidents.

The Supervisor dispatched an Inspector to investigate the reported cave-in incident. The Inspector concurred with the Supervisor's initial assessment and reported that the cave-in was not large. The Supervisor decided to fill the cave-in immediately without doing a full field investigation. The Supervisor proceeded to close the Service Order and generated a cave-in repair work order. Crew C was dispatched to the work area. Crew C repaired the cave-in by placing filter fabric in the hole with stone backfill and a pavement patch. Crew C filled-in the required fields in the work order.

Work Order Closeout: The Supervisor updated the work order information in the work order management system (uploaded inspection report and photos). The Supervisor linked the work order with the original service order. Additionally, although no work was completed on the stormwater pipes 001429STWP and 001430STWP, the Supervisor linked these pipes to the work order [EVALUTION TABLE FUNCTIONALITY 7 – SEE APPENDIX]. A future query review of cave-ins in the system will now associate stormwater pipes 001429STWP and 001430STWP with a cave-in occurrence, even though no prior work was done on the pipes themselves as part of the work order. The work order status was changed to "Closed".

III.4 Scenario 4: Street Flooding

Scenario Description: Customer Services Department received a phone call reporting street flooding extending onto lawns and sidewalks on a secondary road within the City of Bloomington. A service order request was generated including the address of the incident (as reported by the caller) and assigned to Crew C.

Field Conditions: Crew C Supervisor queried the GIS based on the provided address and quickly viewed all nearby assets (manholes, pipes, inlets) [EVALUTION TABLE FUNCTIONALITY 3 – SEE APPENDIX]. The Supervisor reviewed the history of flooding service and work orders in the area using the GIS work order query function [EVALUTION TABLE FUNCTIONALITY 4 – SEE APPENDIX] and saw several prior reports, although no resultant work orders.

The Supervisor dispatched an Inspector to investigate the reported incident. The Inspector found signs of flooding (since subsided) and discussed the incident with several residents. The inspector observed that there was no damage within the City of Bloomington's right-of-way. The Supervisor checked for past CCTV inspections related to the flooding in the area, using the GIS based query function [EVALUTION TABLE FUNCTIONALITY 6 – SEE APPENDIX], and discovered that an inspection was performed within the last year indicating no blockage and minimal debris within the pipe reach. Since there was no resultant damage from the flooding and no evident cause for the flooding, the Supervisor and Inspector did NOT open a work order. The Supervisor proceeded to close the service order.

Service Order Closeout: The Supervisor updated the service order information in the service order management system (uploaded inspection report). Additionally, although no work was completed in response to the service order, the Supervisor linked several pipe segments and structures to the service order [EVALUTION TABLE FUNCTIONALITY 7a – SEE APPENDIX]. A future query review of flooding reports will now associate several stormwater pipe segments, inlets and manholes to this flooding incident, even though no prior work was done on the pipes themselves as a response to the service order. The service order status was changed to "Closed".

IV. Summary

This memo has provided a general description of a GIS-based AMP work order management system and has reviewed major functionality required of the system to include creation, tracking, and closeout of work and service orders. General examples were provided to highlight some of the critical interactions among the City of Bloomington personnel and departments, and within the work order management system

and the GIS system. The illustrative examples were conceptual in nature and were intended to promote thoughts about building an efficient and effective AMP.

When evaluating software for its work order management system, COBPW should investigate the interaction features displayed in the illustrative examples (Section III). For example:

- Can a work order be generated from a GIS environment?
- Can all asset inventories be centralized in one database?
- Does editing/changing an attribute of an asset (e.g. due to completed work order), requires changing the same attribute for the same asset in another database?
- Can the work order system have direct access to inspection records (CCTV inspection, smoke testing, etc.)?
- Can the work order system have direct access to the GIS-based Infrastructure Rating System?
- Can a work order be associated with multiple assets?
- Can the work order system be linked to the inventory warehouse (parts and equipment)?
- Can additional tasks be added to an already created work order?
- Can reports of flooding, sewer service backups, cave-ins, and other incidents be easily tracked and queried for use in prioritizing capital improvement and O&M activities?

The *Evaluation Table* in the Appendix has a column designated such that the MUNIS implementation team can evaluate and describe the capabilities of MUNIS to carry out the indicated functions. The table should be completed and a meeting be held between COBPW and the MUNIS implementation team, with the objective of determining an appropriate course of action to assure that COBPW's requirements for its Asset Management Program are met.

APPENDIX

Evaluation Table – GIS Based AMP Software and MUNIS

#	**Functionality**	**Location of Descript-ion**	**Capability of GIS – Based AMP Solutions**	**MUNIS capability description (to be filled in by the MUNIS Implementation Team)**
1	Multiple work order creation	Page 4 and 8	Selecting an asset or group of assets from map, then click a button	
2	Automatic attributing/population of work orders	Page 5	Selected assets of the WO are automatically populated with predetermined attributes	
3	Display the service order address on the GIS map and select associated assets for the work order	Pages 6 12 and 13	WO created from service request w/ multiple assets selected from map	
4	Query WO and service request history on assets for specific failure causes (cave-in, fracture, basement sewer backup, street flooding)	Pages 7,8 12 and 13	WO history can be queried to pull specific failure causes associated with asset; service request causes can be linked to assets and queried.	
4a	Close-out of WO/identify specific failure causes (cave-in, fracture, basement sewer backup, street flooding)	Page 7	Closeout of WO is controlled by COBPW and proper attributing of failure cause is accomplished through GIS	
5	Close-out of WO/new assets created as a result of a work order (acquisition)	Pages 7,10 and 11	New assets (e.g. additional manholes and pipes) are integrated easily (using ESRI GIS functions) in a centralized database with no for duplicate data in multiple databases or updates to different databases to keep data synchronized	

5a	Close-out of WO/GIS connectivity updated to reflect the work	Page 7	Work performed and modifications or new assets are linked/connected and topologically correct	
6	CCTV Ratings, Dye and SmokeTesting – Field Study Data Storage	Pages 8,9 and 13	CCTV rating information (as well as Dye/Smoke Testing) and observation info is stored in the GIS Based AMP system and can be queried for review and use.	
7	Work order closeout - Link assets initially associated with a service order (or in the vicinity) to the resulting work order.	Page 12	Provide convenient means to associate pipes, manholes and other structures with a work order even though no work is physically done on these assets themselves. Pavement repairs, sodding and landscaping, cleanup of surface debris in the right-of-way after flooding, and so forth can be linked to potentially faulty nearby assets that were not addressed as part of the work order.	
7a	Service order closeout - Link assets initially associated with a service order to the service order and its cause at time of close out.	Page 13	Associate pipes, manholes and other structures with a service order even though no work is physically done on these assets themselves in response to the service order. Service orders caused by flooding can be linked to nearby assets that may be potentially responsible, regardless of actual repair work that may or may not be performed	

Asset Management Technical Memoranda

AM4 - ASSESSMENT FOR CCTV INSPECTIONS

JANUARY 17, 2013

Executive Summary

The City of Bloomington contracted Michael Baker Jr., Inc. (Baker) to provide an assessment of the closed circuit television (CCTV) inspection of sixteen (16) pipe segments. Baker evaluated CCTV videos and inspection forms for compliance with National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). This report provides a summary of the deficiencies identified in the provided CCTV video and logs, and provides recommendations that will assist the City of Bloomington's staff with completing PACP-compliant inspection reviews. Proper evaluation of CCTV inspections using PACP is key to the success of the City's asset management program under development.

Recommendations

- The National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) has become the industry standard for rating the interior condition of gravity pipelines. The method utilizes the PACP system of scoring defects or observations through closed-circuit television (CCTV) inspection of pipelines. It is recommended that the City of Bloomington require all CCTV inspections to comply with NASSCO-PACP specifications.
- It is recommended that an independent Quality Assurance review of Bloomington CCTV inspections is performed annually to evaluate its compliance with NASSCO PACP specifications. It is essential that inspections are carried out in a uniform, repeatable and compliant manner. The review would include a face-to-face feedback session for public works technicians and engineering staff.

The estimated costs for the above recommendations are summarized in the following table.

Table 1. Costs for Compliance with NASSCO PACP specifications for CCTV Inspections

Product	Description	Cost Estimate	Time Estimate
Comply with NASSCO PACP specifications for CCTV Inspections	Quality assurance to insure compliance	$5,000 (annual)	2 weeks for review and 4 hrs for feedback session

BACKGROUND

City of Bloomington contracted Michael Baker Jr., Inc. (Baker) to provide an assessment of the closed circuit television (CCTV) inspection of sixteen (16) pipe segments. Baker evaluated CCTV videos and inspection forms for compliance with National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). This report provides a summary of the deficiencies identified in the provided CCTV video and logs, and provides recommendations that will assist the City of Bloomington's staff with completing PACP-compliant inspection reviews. Proper evaluation of CCTV inspections using PACP is key to the success of the City's asset management program under development. Baker's evaluation was reviewed with City staff through a presentation and through watching individual video inspections. The presentation is attached to this memorandum.

EVALUATION PROCESS

The PACP method assesses each pipeline to identify structural and/or operation and maintenance (O&M) defects within the pipeline. Structural defects are defects that affect the physical condition of the line. The following is a brief list of examples of commonly found structural defects:

- Cracks, fractures, hole in the pipe
- Broken pipe
- Deformed
- Surface damage
- Lining failure
- Pipe buckling

The PACP method also identifies O&M defects which typically affect the performance of the pipeline. Although O&M defects do not typically affect the structural integrity of the pipe, they can cause issues in pipeline performance. Common O&M defects are provided below:

- Attached grease deposits
- Root intrusion and infiltration through pipe joints
- Deposits and debris in the pipe

PACP assigns different structural defects and operation and maintenance (O&M) defects or observations specific numeric grades. Per the PACP Condition Grading System, condition grades range from a scale of 1 to 5 based on the severity of the defects. The defect grades are as follows:

5 – Most significant defect grade
4 – Significant defect grade
3 – Moderate defect grade
2 – Minor to Moderate defect grade
1 – Minor defect grade

Baker reviewed with Bloomington staff the significance of implementing exacting PACP standards in evaluating pipelines, including the need to delineate what may be perceived by some as minor differences in observations. Specifically, the following was noted:

- The quantity and severity of defects will aid in prioritizing pipe renewal decisions
- Certain observations may trigger implementing best management practices. These could include:
    - Treatment for grease / ID source of grease
    - Treatment for roots
    - Pipe cleaning

- Even minor defects are used to track pipe condition over time. For example, the distinction between a crack and a fracture can show deterioration trends that may be occurring over time. These trends will be important in implementing and monitoring the City's asset management program.

The City of Bloomington provided Baker 15 CCTV video files from staff that inspected the pipelines utilizing NASSCO PACP standards. Baker performed quality assurance reviews of each video file to identify potential deficiencies in the City's inspection method. Deficiencies and other general observations are summarized in the following section.

SUMMARY OF OBSERVATIONS

The pipeline diameters of the reviewed videos ranged between 8 and 60 inches. All but one of the pipelines observed appeared to be clay sanitary sewer mains. The 60-inch brick sewer was identified as storm sewer and was the only pipeline constructed of brick. The following summaries key observations:

- All of the inspection reports contained incomplete information in the header form. Per PACP standards, several header fields are mandatory. This information is necessary to accurately identify each pipe segment and it characteristics. Additionally, the information that is provided in the inspection header form will be used to complete the overall GIS infrastructure rating methodology. Mandatory fields include:
    - Surveyed By
    - Certificate Number
    - Date
    - Street, City
    - Upstream and Downstream Manhole Numbers
    - Direction of Inspection
    - Height, Width, and Shape
    - Material
    - Precleaning
- Material, Pipe Joint Length, Total Length and Length Surveyed should be populated and confirmed after the inspection is complete.
- Generally, the CCTV camera moved through the pipeline a speed higher than recommended. It can be difficult to accurately assess the condition of the pipe at times due to the speed at which the camera was moving. Some videos were moving at 45 to 60 feet per minute. Per PACP, the camera speed should not exceed 30 feet per minute. In cases where there is a lot of debris, even slower speeds may be necessary to identify defects.
- Numerous CCTV inspections were abandoned for various reasons, some unknown. It is important to provide reason for survey abandonment through the use of a PACP code. In some cases, a comment was provided in the remarks field providing the reason; however, comments have limited use in the asset management program. Proper codes may trigger action items or aid in determining pipe condition.
- When a survey is abandoned from one direction, a survey should be attempted from the opposite direction of the initial survey. If a reversal of the survey cannot be completed, justification should be provided. The justification should be in the form of a PACP code. Reverse surveys were not provided to Baker.
- Continuous defects were observed during Baker's review of the CCTV inspections, but were not properly coded on the inspection form (in some cases, a general comment was made in the remarks field providing indicating continuous issues – again, this has limited use for an asset management program). There are multiple pipe segments that contained continuous defects at joints (i.e. fine

roots, encrusted attached deposits, and attached grease deposits). For proper coding, the inspector should remember to close the defects when they are no longer continuous. The continuous defects have a significant effect on the overall pipe rating and should be coded properly. The definition of continuous defects was reviewed with staff. Continuous defects fall into one of the following two categories:

  - "Truly Continuous Defects" which run along the sewer without any interruption for more than three feet (e.g., grease build-up).
  - "Repeated Continuous Defects", which occur at regular intervals along the sewer, quite often at pipe joints. Roots that appear at consecutive joints would be an example of "repeated" continuous defects.

- Defects that occurred at a joint were not designated appropriately. Defects that occur at or within 8 inches of a joint must be coded with a joint designation. This designation may aid in determining potential renewal actions.
- The defect code "deposits attached encrustations (DAE)" was utilized in multiple instances. In many cases, the DAE code was used where the code, "deposits attached grease (DAGS)" should have been used. The encrustation of deposits (DAE) typically occurs at joints and is often a result of some type of infiltration. The CCTV footage that was observed displayed multiple occurrences of deposits attached grease (DAGS) and should be identified as continuous defects in many line segments. Baker emphasized the importance to identify grease properly as it may trigger action items such as treating a line for grease or investigating a grease source.
- Many laterals were coded as active taps (TPA) when they should be coded as defective taps (TPD) because the tap is damaged, has a gap around it or between the mainline, has infiltration or roots, or is installed pointing upstream. Additionally, there were various service taps that were coded as active (TPA) but should have been coded as intruding (TPI). Defect coding of taps is limited. If other issues are identified and associated with a tap (such as roots) then the appropriate defect code should also be included.
- There were some defects coded as circumferential cracks (CC) that should be coded as a broken pipe (B) *[ex. File 10]*. Baker emphasized the difference between a circumferential crack (level 1 defect) versus a broken pipe (level 5 defect). Level 5 defects will often trigger immediate action, whereas level 1 defects may not necessarily trigger any action. Baker reviewed the association of defects with defect grades to emphasize the distinction.
- A change in water level was identified in some pipe segments but was not noted by City staff. Changes in water level can indicate defects like obstructions or sags in the pipe.
- Limited observations regarding debris in pipe were coded. At times, comments for debris were entered in the remarks field. Debris in pipe invert should be coded as a defect. Debris defects may be used to trigger action items, such as pipe cleaning, but rehabilitation actions can only attributed to defects that are properly coded.

RECOMMENDATIONS

In addition to strict adherence to PACP, Baker recommends implementing some additional measures to improve the CCTV process. Many of the recommendations will assist in provide more clarity to the actual field conditions of the pipe. Some of the recommendations will allow the operators to provide a better quality video, which will produce a more thorough field inspection.

It is recommended to perform some type of pre-cleaning prior to commencing the CCTV video. Many of the pipelines exhibited debris along the flow line and along the pipe walls which make it difficult to assess the condition of the pipe in some cases. The precleaning will potentially remove the excess material from the pipe wall to allow an unobstructed view of any defects that may be present. If

precleaning produces excessive sand or soils, precleaning should be stopped to identify a source. Excessive cleaning of certain defects such as holes in pipes can result in subsidence of the overburden.

To assist with locating defects along the pipe, it is recommended to slow camera speed when performing inspection. Although PACP states camera speed should not exceed 30 feet per minute, Baker recommends reducing speed to approximate 20 to 25 feet per minute, especially if no precleaning was completed, to minimize the number of defects that are overlooked.

Baker also recommends developing a separate Standard Operating Procedure (SOP) for larger diameter pipelines. The large diameter pipelines have a greater potential to collect debris and collect settled deposits in the flow line due to the reduced slopes. A routine cleaning and inspection schedule has potential to reduce the occurrence of O&M defects over an extended period of time.

Asset Management Technical Memoranda

AM5 - BEST MANAGEMENT PRACTICES (BMPS) FOR BLOOMINGTON STORM AND SANITARY UTILITY OPERATIONS

Best Management Practices (BMPs) for Bloomington Storm and Sanitary Utility Operations
City of Bloomington, IL
Michael Baker Jr., Inc.
December 11, 2013

Executive Summary

The following Memorandum provides specific guidelines and recommendations for the operation, maintenance and management of the City of Bloomington's storm and sanitary assets. The recommendations focus primarily on buried assets, though many of the strategies are applicable to above ground assets as well. The Memorandum includes details for Best Management Practices (BMP) that will reduce infrastructure life-cycle costs and result in increased stakeholder satisfaction.

For each BMP a cost estimate or framework for implementation has been provided. A summary of the cost estimates developed is presented below in Table 1. The summary indicates the total number of personnel required. In some cases Bloomington may already have existing staff employed in these positions; the table does not account or subtract for this. It is meant to provide guidance on the approximate operations, maintenance and data management investments going forward that the City of Bloomington should make in order to implement an effective sanitary sewer and stormwater program that meets established levels-of-service goals while meeting regulatory requirements and optimizing cost expenditures. Investments in actual infrastructure improvements are not included in the Memorandum, having been presented in other Master Plan documents provided by the consultant team.

A summary of recommendations provided in the sections of this report (corresponding to Table 1) is as follows:

- GIS ESRI Model Incorporation - Implement updates to COBPW's GIS database system to incorporate an ESRI Local Government Model to improve efficiency of management of critical infrastructure data
- Manhole Inventory - Perform a complete inventory of manhole structures and incorporate into COBPW's GIS data base, to permit efficient management of operations, management and repairs.
- GIS Asset Management Tools Support - COBPW has invested in the development of GIS based asset management tools that allow more efficient decision making regarding maintenance activities as well as timing of repair, rehabilitation and replacement of deteriorating infrastructure. It is necessary that ongoing support for tool upgrades and maintenance is provided.

- CCTV Integration Tool - It is recommended that an automated business tool is developed to transfer pipe inspection rating scores from COBPW's CCTV PipeTech software into the Department's GIS system. This will automate storage of the data so that it can be used as part of the Department's Asset Management Program.
- MUNIS GIS Interface for COBPW - The MUNIS system currently does not allow asset modifications and additions to be linked, or driven, by updates performed in COBPW's GIS system. This will limit executing the tracking, modification and inventorying functions critical to COBPW's asset management objectives. It is therefore recommended to establish an interface between COBPW's GIS system and MUNIS such that asset additions, modifications, and repair activities are originated and directed from the GIS system, while permitting automated transfers of information such as service calls and work order frequency.
- Establish GIS Coordinator position – COBPW currently has one GIS staff person and also makes use of summer interns. The staff person spends a significant portion of his time responding to requests for information from internal and external departments and agencies. The use of industry-standard informational tools that enable lower O&M and repair costs requires a full time, dedicated professional with the necessary experience and availability. It is recommended that COBPW add a new GIS coordinator or manager to its staff. This position description includes providing direction to all GIS related technology initiatives, coordinating GIS related training support, and implementing centralized GIS data management. Execution of consistent application of policies, procedures, and standards would be included along with implementing actions to accomplish long term asset management objectives.
- CCTV Inspection Program – To adequately project pipe renovation costs as part of Bloomington's Master Plan, as well as to gauge the rate of deteriorating infrastructure, it is necessary to establish an initial baseline condition concerning interior pipe condition. COBPW should carry out inspections of its entire sanitary system within five years, after which follow-on inspections would be performed at longer intervals depending on the risk that a pipe presents to the community.
- Manhole Inspection Program – Similar to the CCTV inspection program, Baker recommends that COBPW establish a manhole inspection program on a similar time interval. Manholes are a significant contributor of infiltration, cave-ins, and other issues when not adequately addressed and monitored.
- Fats, Oils and Grease (FOG) Inspection Program - A FOG Program that includes permitting, inspection, enforcement, and public outreach should be implemented in order to provide more reliable sanitary sewer service to customers, and to minimize the number of sanitary sewer overflows that may result from FOG accumulations. It will also reduce current expenditures for cleaning the sewers.
- Sewer Service Laterals - COBPW spends significant time and resources addressing issues with sewer service laterals. It is recommended that City Council adopt an ordinance or policy clarifying the ownership and maintenance responsibilities for sewer service laterals.

Table 1 BMP INVESTMENT COSTS FOR BLOOMINGTON SANITARY AND STORMWATER SYSTEMS

Critical Program	Early Action Projects (Year 1 -5)			Long Term CIP (Years 6-20)		
	Personnel Required*	Total Cost (labor + OH, equipment and contractor)	Net Present Value of Total Cost (4% discount rate)**	Personnel Required*	Total Cost (labor + OH, equipment and contractor)	Net Present Value of Total Cost (4% discount rate)**
Implement ESRI Local Government Model	0	$45,000	$45,000	0	0	0
Inventory Manholes and Structures	0	$120,000	$120,000	0	0	0
GIS Asset Management Tools Support	0	$52,500	$52,500	0	$157,500	$157,500
CCTV Integration Tool	0	$8,500	$8,500	0	0	0
MUNIS GIS Interface for COBPW	0	$175,000	$175,000	0	0	0
GIS Coordinator Position	1	$488,000	$488,000	1	$1,463,000	$1,463,000
CCTV Inspection Program	2	$3,706,000	$3,706,000	2	$4,281,000	$4,281,000
Manhole Inspection Program	0.7	$446,000	$446,000	0.25	$849,900	$849,900
FOG Inspection Program	2.5	$1,229,000	$1,229,000	2.5	$3,686,000	$3,686,000

*Total number of staff positions required. Does not take into account any existing personnel that Bloomington may already have in these positions.

** Prevailing municipal discount rates are very similar to the historical inflation rate – such that inflation and discount rate cancel each other out for most expenditures.

Acronyms

BMP - Best Management Practices
BRE - Business Risk Exposure
CAP - Condition Assessment Protocol
CCTV - Closed Circuit Televised Video
CIP - Capital Improvement Program
CIPP - Cured in Place Pipe
CMOM - Capacity Assurance, Management, Operation, and Maintenance Program
COBPW - City of Bloomington Public Works Department
CSO - Combined Sewer Overflow
DSS - Decision Support System
EPA - Environmental Protection Agency
FOG – Fats, Oils, and Grease
GIS - Geographic Information System
I&I - Inflow and Infiltration
LOS - Level of Service
MACP - Manhole Assessment and Certification Program
MIC - Microbiologically influenced corrosion
NASSCO - National Association of Sewer Service Companies
O&M - Operations and Maintenance
PACP - Pipeline Assessment and Certification Program
RRR List - Replace, Rehabilitate, or Repair List
SAMP - Strategic Asset Management Plan
SOP - Standard Operating Procedure
SSES - Sanitary Sewer Evaluation Studies
SSO - Sanitary Sewer Overflows

Best Management Practices (BMPs) for Bloomington Storm and Sanitary Utility Operations

City of Bloomington, IL

Michael Baker Jr., Inc.

December 11, 2013

The following sections provide specific guidelines and recommendations for the operation, maintenance and management of the City of Bloomington's storm and sanitary assets. The recommendations focus primarily on buried assets though many of the strategies are applicable to above ground assets as well. The specific BMP's addressed in this Memorandum include the following:

- Closed Circuit Televised Video (CCTV) inspection program recommendations
- Recommendations for Geographic Information System (GIS) attributes to track and incorporate for Bloomington's Asset Management Program
- Considerations and steps for implementation of a manhole lining program
- Considerations and steps for implementation of a sewer lining program
- Recommendations and general considerations for root control program
- Recommendations and outline for developing a grease, oil and fats program
- Recommendations of maintenance strategies that can be applied to major classes of infrastructure (pipe, manholes, and/or pumps), consisting of predictive and preventive activities that should be implemented.

The above listed BMPs should be applied following a stepped, asset management planning approach. Baker has held several meetings with the City of Bloomington Public Works Department (COBPW) to define the elements of a strategic asset management plan (SAMP). Implementation of the SAMP will result in a strategic and justifiable approach for evaluating, prioritizing and selecting the most critical sewer/stormwater infrastructure elements in order to target funding and maintenance efforts. The goal of such activities is to reduce life cycle costs for its sewer assets and to practice "smart" operations, maintenance, and replacement actions that are coordinated with related asset activities including road repair and utility replacement.

Major components of the SAMP developed to date include a GIS Based Infrastructure Rating System that allows COBPW to prioritize its operations and maintenance (O&M) actions as well as the execution of major projects in its Capital Improvement Program (CIP). Additionally, a Pipe Condition Inspection Methodology has been developed specifically for performing CCTV video inspections of sewer pipe. Pertaining to management of information for COBPW's storm

and sanitary system, a review and identification of the needs for a GIS-based Work Order Management System was produced. The output from these three tools should form the basis for decisions regarding the BMP actions described in this document, as depicted graphically in Figure 1.

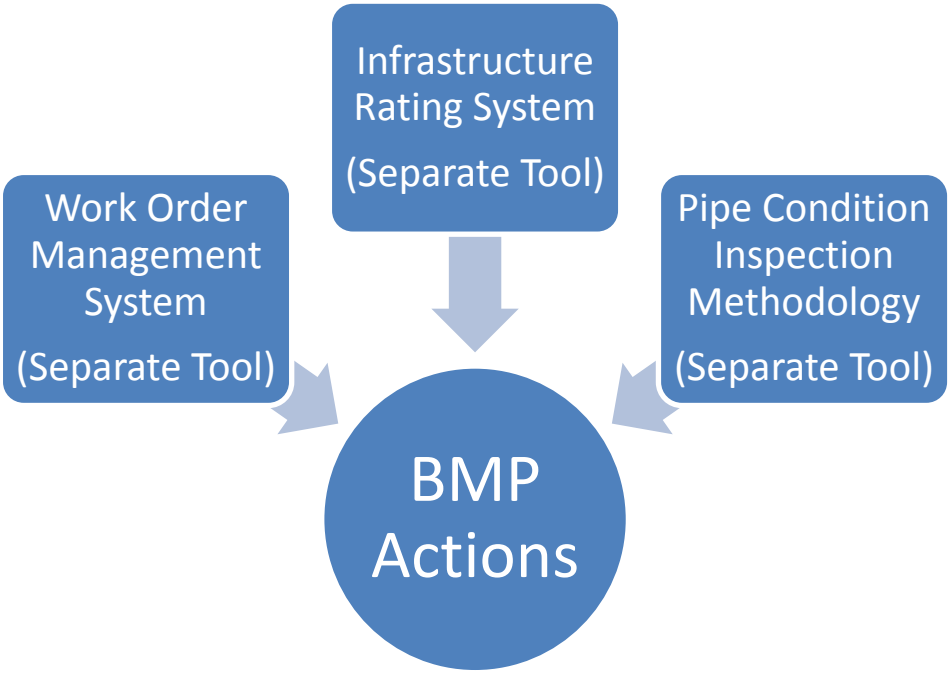


Figure 1. Components of City of Bloomington's Strategic Asset Management Plan (SAMP)

The elements as shown allow for reductions in O&M and CIP costs to be realized, and together qualify as a basic SAMP. Asset management planning presents opportunities to move towards advanced levels of analysis, with tools and procedures including detailed benefit/cost analysis, automated decision support systems (DSS), operation manuals, emergency response plans, and confidence and validation techniques for CIP evaluation. The basic SAMP provides the foundation for reducing costs, with some immediate or near-term results. The scope of the current project is based on the development of the basic SAMP, which can be built upon as COBPW gathers experience, information, and resources in coming years.

I. CCTV Inspection Program Recommendations

The City of Bloomington has one camera trucks with Aries Pathfinder CCTV equipment. The details of the information are as follows:

Table 2 BLOOMINGTON CCTV EQUIPMENT

S39 Camera truck
Ford E-450
Camera is an Aries Pathfinder
Panasonic Toughbook CF-52
Software V 6.0.1

A significant financial investment is made yearly in performing CCTV video inspections of sanitary sewer systems. While historical information regarding COBPW's CCTV inspection costs could not be attained, one recent study estimated an annual equipment operating cost of $55,000 per camera truck (RMC Water and Environnment, 2010). Labor costs were estimated at approximately $200,000 including overhead (at 50% of direct labor) for a two person crew. Thus, extrapolation to the City of Bloomington would suggest that some $500,000 to $600,000 would be spent per year if the two trucks are fully utilized. Such a significant expense suggests that efforts to optimize COBPW's CCTV inspection program may result in significant savings for the City.

The inspections accomplish three objectives:

1. Identification of reported or observed problems
2. Verification of quality and norms of new systems associated with subdivisions or other development, for acceptance into the COB system.
3. Tracking of condition for assessment and preventative or reactive maintenance.

In order to maximize the benefits of its CCTV inspection program, the following guidelines should be followed:

1. Pipes should be inspected and assessed in the field using the Pipeline Assessment and Certification Program (PACP) coding system as supported by the National Association of Sewer Service Companies (NASSCO). Technicians should be PACP Certified to insure consistency in the pipe inspections. All inspections, regardless of the original objective for the work, should be collected in accordance with PACP© rules and be exported to a PACP© Standard Database. Baker provided a quality assurance review of recent CCTV inspection videos produced by COBPW field staff, and provided recommendations for improvements to its procedures in order to adhere to PACP© rules (Michael Baker Jr., Inc., January 17, 2013).
2. A pipe condition rating should be assigned to any inspected segment based on the guidelines in the document entitled Pipe Condition Rating Methodology Recommendations (Michael Baker Jr., Inc., September 4, 2012). The rating should be exported into COBPW's GIS system per the procedure outlined in the methodology. Currently COBPW does not have an automated procedure for developing the rating or

exporting it to the GIS system. Costs for development of such a tool have been provided and are found in Section II of this document.

3. Initially, COBPW should have the goal of performing inspections of its entire sanitary system in order to establish a baseline interior pipe condition rating. The time period for completing this goal would be five years.
4. The order of the initial system-wide pipe inspections should be prioritized according to the condition assessment protocol CAP 1 and CAP 2 business risk exposure (BRE) ratings determined through application of the GIS-based Infrastructure Rating Tool. Baker provided a memorandum to COBPW describing the procedure to use for assigning a BRE value to each segment of its buried pipe infrastructure (Michael Baker Jr., Inc., November 19, 2012), which included the description of the Infrastructure Rating Tool and how it may be applied.
5. After completion of the initial system-wide pipe inspections, future inspections should be driven by the business risk associated with pipe segments, as determined from the GIS-based Infrastructure Rating Tool. Sanitary pipe segments with a BRE1 or BRE2 of 8 or less should be inspected every five years. Sanitary pipe segments with a BRE2 of greater than 8 should be inspected every ten years.
6. The CCTV pipe condition rating should be used as an input for the purposes of updating the BRE rating of the pipe. Each time a CCTV rating is performed, the BREs for that pipe should be updated using the GIS-based Infrastructure Rating Tool. This will enable COBPW to prioritize its maintenance strategies and update its repair and replacement schedules, as well as its Capital Improvement Program, following the methods described in Section V.

The costs for executing the inspections using strictly COBPW staff and equipment have been estimated and are shown in Table 3.

Table 3 CCTV INSPECTION COSTS - PERFORMED INTERNALLY BY COBPW

Year of Program	Pipe Ft Inspected per year	Personnel Required	Labor Cost**	Truck Maintenance*	Cost per year	20-year Net Present Value
1-5	417170	5.8	$ 546,156	$ 145,285.71	$ 691,442	$8,000,000
6-10	14265	0.2	$ 19,399	$ 111,985.71	$ 131,384	
11-15	388640	5.4	$ 502,460	$ 145,285.71	$ 647,746	
16-20	14265	0.2	$ 19,399	$ 111,985.71	$ 131,384	

*Camera truck purchase cost assumed at $220,000 and is spread over seven years with 5% additional for maintenance and an estimated 15,000 miles annual fuel requirement at 10 mpg. Three camera trucks in high use periods (yrs 1-5, 11-15) and one in low use.

**Supervisor assumed at $35 labor rate. Technicians at $28 rate. Overhead at 50% of direct labor

The information in Table 3 indicates that the annual costs are higher during years 1-5 when all sanitary sewers are initially inspected. The costs are also high during years 11-15 when low risk (BRE>8) pipes come up for their ten year inspection. During years 6-10 and 16-20 the inspection activities are much lower, since only higher risk (BRE less than or equal to 8, which is assumed to be 3.4%) pipes are inspected.

There are several alternative expenditure strategies to address this disparity in work load. Bloomington might choose to use strictly COBPW resources to perform this task during years 6 - 20, as was assumed in Table 3, but move up the inspection of some pipe segments to years 6-10 to balance the production load. Some pipes will therefore receive their second inspection before ten years pass, even though they are categorized as low risk and thus normally wouldn't be inspected as soon. This approach would result in two camera trucks, each with a two person crew. The two trucks and crews would be fully utilized in years 1-5 and 11-15; one of the two trucks would partially be used during the other periods, and one of the two crews would be partially freed to work on other tasks during these "off periods". The initial five-year period would require additional outside resources in order to obtain the goal of full, system-wide inspection coverage. The work of COBPW during this period can be supplemented with outside contractors. This option is presented in Table 4.

Table 4 CCTV INSPECTION COSTS – TWO COBPW CAMERA TRUCKS PLUS OUTSIDE CONTRACTOR

Year of Program	Pipe Ft Inspected per year	Personnel Required	Labor Cost**	Truck Mainten-ance*	Contract-or Cost	Cost per year	20-year Net Present Value
1-5	417170	4.0	$ 371,374	$ 96,857	$ 233,042	$ 701,272	$8,800,000
6-10	201453	2.8	$ 259,962	$ 93,257	$ 0	$ 353,219	
11-15	201453	2.8	$ 259,962	$ 93,257	$ 0	$ 353,219	
16-20	201453	2.8	$ 259,962	$ 93,257	$ 0	$ 353,219	

*Camera truck purchase cost assumed at $220,000 and is spread over seven years with 5% additional for maintenance and an estimated 15,000 miles annual fuel requirement at 10 mpg. Two COBPW camera trucks in use.
**Supervisor assumed at $35 labor rate. Technicians at $28 rate. Overhead at 50% of direct labor

Another viable option is to use one COBPW CCTV camera crew and truck continuously over the 20 years of analysis, and supplement with outside contractors during years 1-5 and 11-15. Pipe segments in this option would follow the regular 10-year period for low risk (BRE>8) and 5-year period for high risk (BRE 8 or less).

This option is presented in Table 5.

Table 5 CCTV INSPECTION COSTS – ONE COBPW CAMERA TRUCK PLUS OUTSIDE CONTRACTORS

Year of Program	Pipe Ft Inspected per year	Personnel Required	Labor Cost**	Truck Mainte-nance*	Contractor Cost	Cost per year	20-year Net Present Value
1-5	417170	2.0	$ 196,591	$ 48,429	$ 496,145	$ 741,165	$8,000,000
6-10	14265	0.2	$ 19,399	$ 38,129	$ 0	$ 57,527	
11-15	388640	2.0	$ 196,591	$ 48,429	$ 444,222	$ 741,165	
16-20	14265	0.2	$ 19,399	$ 38,129	$ 0	$ 57,527	

*Camera truck purchase cost assumed at $220,000 and is spread over seven years with 5% additional for maintenance and an estimated 15,000 miles annual fuel requirement at 10 mpg. One COBPW camera trucks in use.
**Supervisor assumed at $35 labor rate. Technicians at $28 rate. Overhead at 50% of direct labor

Finally, COBPW could choose to contract out all CCTV inspections, per the estimated costs of Table 6.

Table 6 CCTV INSPECTION COSTS – PERFORMED BY OUTSIDE CONTRACTOR

Year of Program	Pipe Ft Inspected per year	Cost per year	20-year Net Present Value
1-5	417170	$ 858,034	$9,600,000
6-10	14265	$ 102,232	
11-15	388640	$ 858,034	
16-20	14265	$ 102,232	

Assumptions:
8-33 inch diameter pipes have a unit cost of $1.96 per linear foot. 36- 108 inch diameter pipes have a unit cost of $2.75 per linear foot.

While the option of using strictly outside contractors for CCTV inspections would appear to be cost competitive, Baker recommends selecting the option of one COBPW camera truck plus outside contractors. This provides COBPW additional control over its program and allows for high priority sewer segments or emergency inspections to be quickly performed. For periods when low-risk pipes are not due for televising, such as years 6-10 and 15-20, the COBPW camera crew can be utilized for inspection and acceptance of new sub-division systems, manhole inspections, and also for problem storm sewer segments (not routinely inspected) or other activities. In this manner there should always be enough work to keep one crew and camera truck busy.

II. Recommendations for GIS Attributes to Track and Incorporate for Bloomington's Asset Management Program

The COBPW has made significant investments in its GIS and has entered the next logical implementation phase, which consists of leveraging GIS for use as a decision support tool for effective asset management. The following recommendations are aimed at optimizing the COBPW's use of GIS as a tool to assist in the complex decision making process involved with strategic planning for maintenance, operational and capital investments, and resource allocation. Four key areas have been identified, which should be considered in future GIS planning, work, and funding efforts.

- Data Management
- Data Collection and Inventory
- Asset Management Integration & Business Tools
- Staffing & Support

A. Data Management BMP for Water/Wastewater

The information contained in a GIS system provides the foundation of a successful asset management program. Low quality data impacts decision making and can increase costs. Data management principals, workflow processes, and data assurance/quality controls should be thoughtfully put in place in order to ensure that information is easily accessible, current, and accurate.

Baker highly recommends that COBPW consider adopting ESRI's local government data model template, specifically, the Water/Wastewater components of the model. The local government model includes a data model template based on industry domain expertise, which can be used as-is or as a platform from which to build. Incorporation of the local government model will have the added benefit of providing the framework for support of ArcGIS for Water Utilities (ESRI) (http://resources.arcgis.com/content/water-utilities). This ESRI resource provides a set of maps and applications that specifically targets improved Asset Management, Planning & Analysis, Field Mobility, Operational Awareness, and Stakeholder Engagement. Since ESRI manages these applications, users do not need to be concerned with keeping the applications up to date with the latest software release. Consultant support to provide assistance with implementation, application configuration, and user training would be required concerning implementation of ESRI's local government model. The one-time expense for this activity is presented in Table 7.

Table 7 ESRI IMPLEMENTATION COST ESTIMATE

Product	Description	Cost Estimate	Time Estimate
Implement ESRI Local Government Model for Water/Wastewater	Implementation and training support services for deploying ESRI local government maps and apps.	$45,000	8 Weeks



Figure 2. Sewer Inspection Form using Infrastructure Mobile Map

The Infrastructure Mobile Map as shown in Figure 2 above is an example of an optimized field work application that would be available to Bloomington as part of this implementation approach.

Over the years, ESRI has developed a number of supporting technologies and techniques in order to promote data quality assurance and control. The following recommendations are based on ESRI's recommended best management practices for Water/Wastewater Utility data management.

- Using a Geodatabase
- Using Properly Configured Data Model
- Using Geometric Networks
- Using Standardized Workflows – Roles and Responsibilities
- Taking Advantage of Versioning
- Utilizing Geoprocessing Models and Scripts
- Configuring the Infrastructure Editing Template

1. Geodatabase

Use of a geodatabase maximizes the full capabilities of the ArcGIS platform designed to enhance data quality and management. The COBPW is currently using a personal geodatabase and is in the process of migrating to an enterprise geodatabase using SQL Server as the platform database. This will allow them to take advantage of all the inherent data management capacities of a client/server database management system such as reliability, data integrity, performance, and scalability. A personal geodatabase is built off of the Microsoft Jet Database Engine (Microsoft Access), which is a file-sharing database. If a personal computer or the network fails when using a file sharing database often times file processes will be left in an uncompleted state and the back-end database will become corrupt. Client Server Databases safeguard against this by not allowing direct reads and writes to the tables, and instead use an intelligent transaction data manager. Partially completed transactions or processes are simply not committed to the database. Utilizing a SQL Server geodatabase will also allow for easier data integration on the application level and expanded data management and sharing functionalities such as data replication and web editing.

2. Versioning

There are three types of Editing Models available when implementing an ArcSDE geodatabase.

- Versioned
- Non-Versioned Editing
- Versioned Editing with Option Edits to Base

A versioned geodatabase enables multi-user editing and the ability to establish QA/QC workflows, whereby only an assigned user can post final edits to the production database. If the

COBPW is going to have multiple editors maintaining their GIS datasets, Baker recommends implementing this option.

The non-versioned editing option is equivalent to a standard database transaction model for editing spatial data. The non-versioned editing option only supports editing simple point, line, or polygon features. Editing feature classes participating in a topology or geometric network is not supported. Users should be aware of concurrency and locking implications with this editing option as well. See: (ESRI, 2011). Geodatabase replication is not supported with this option.

http://help.arcgis.com/en/arcgisdesktop/10.0/help/#/Concurrency_and_locking/00270000000800 0000/

Versioned editing with the option to move edits to the base tables enables users in both versioned and non-versioned scenarios. This is a more advanced scenario but it is usually implemented when editing data tables externally using standard SQL statements while forcing other datasets to be edited through the ArcGIS versioning framework. This option will also prohibit an organization from taking advantage of geodatabase replication.

If the COBPW is going to leverage multiple editors as part of their data editing/maintenance strategy, Baker recommends employing full versioning and establishing QA/QC guidelines and workflows.

The link below provides an excellent video on versioning workflows as well as a discussion regarding Versioned Editing. (ESRI, 2011).

http://blogs.esri.com/esri/esritrainingmatters/2011/09/29/versioned-editing-seminar-your-questions-answered/

3. Workflows

In order to promote data currency and reduce communication and input errors, Baker recommends that the COBPW document a formal set of rules and procedures for data maintenance. This would likely be in the format of a standard operating procedures manual. ESRI's also provides an out-of-the-box solution called ArcGIS Workflow Manager to assist in formalizing workflows. However, it may be difficult to justify the purchase and use of this extension depending on the number of editors the COBPW will employ.

4. Standardized Data Model

A properly configured data model will help ensure that asset information important to the COBPW is accurately recorded in the GIS system and that topology rules are in place to enforce spatial connectivity and referential integrity. Incorporating ESRI's local government model will provide the COBPW with an industry standard template from which to work. Implementation of this model will also allow COBPW to take advantage of the Water/Wastewater application templates provided by ESRI. The Infrastructure Editing Template is one such application. This

application template provides a series of editing and reporting tools that streamline the editing and maintenance process.

5. Geometric Networks

The COBPW should also model their collection system using a geometric network. Geometric networks model how the system actually operates or flows in the real world and therefore will enable the COBPW to perform modeling scenarios such as upstream and downstream tracing. An inherent quality of working with geometric networks is the ability to establish connectivity rules during an edit session thus reinforcing data quality and accuracy. Using geometric networks will also make it easier to make adjustments or corrections in the existing GIS system such as changing the location of a manhole. For example, consider a manhole located with a GPS unit that has not been accurately placed in the GIS. Updating the GIS system would simply involve importing the new coordinates and moving the manhole to the new, correct location. By utilizing a geometric network, all connected edges will automatically be moved or adjusted as well to reflect the updated accuracy and no connectivity will be lost.

6. Using Geoprocessing Models or Scripts

ESRI provides an extension called data reviewer, which allows users to run a series of custom quality control geoprocessing models to flag issues or errors within the data. The majority of these models can be easily duplicated. As part of a documented, formalized workflow plan, Baker recommends that the COBPW develop a series of models to perform specific checks on its GIS data. This will provide the COBPW a repeatable and consistent framework for flagging possible errors or inconsistencies in the data. It is estimated that the cost to implement a series of scripts to handle quality assurance would fall in the range of $4,000 to $5,000 and would be done through the use of a consultant. It could be completed as part of the annual ongoing maintenance and support services detailed in Table 9.

B. Data Collection and Inventory

The first step in asset management is developing an accurate inventory of assets owned by the COBPW. Evaluating the COBPW's existing GIS data holdings reveals that currently the sewer/stormwater network GIS layer is limited only to linear structures. Baker recommends that the COBPW expand its existing sewer GIS data model and digital inventory to include network point structures or facilities (e.g., manholes, inlets, discharge locations). Storing network facilities that play an active role in the sewer network will help to enforce digital accuracy as well ensure that all assets are accounted for and are being properly maintained. This will also help to ensure that COBPW meets existing and future mandated GASB 34 reporting requirements. Additional benefits include:

- The maintenance and health of network structures play a critical role in safeguarding the system and meeting expected levels of service.
- Attributes collected on network structures, such as manholes, help validate the accuracy of attributes maintained within the sewer pipe layer, such as pipe slope.

- Storing accurately located structures, work order information, failures, and estimated conditions within GIS will introduce significant savings in staff time and effort and increase the COBPW's ability to effectively plan, execute and report on associated maintenance practices.

Performing the required data collection and integration of relevant facilities or network structures into COBPW's GIS data model can be accomplished in a variety of ways. Table 8 below outlines a number of options for COBPW's consideration. Note that the costs listed are only approximations. Further research should be conducted for a more accurate cost assessment.

Table 8 DATA COLLECTION AND INVENTORY OPTIONS

Option	Product	Staffing		Rate	Cost Estimate	Time Estimate*
1	Sanitary MH Structures	Hire dedicated Full-Time GIS Data Technician		$40,000/yr	$120,000	2 years
Comments: Option 1 involves creating a new full-time position. For estimating purposes the employee salary has been set at $40,000 per year plus an overhead rate of 50% for an annual compensation of $60,000. The two year estimate is based on targeting asset collection towards a specific business group. Note: This cost estimate does not include GPS equipment, software or computer hardware.						
2	Sanitary MH Structures	1 Intern Field GPS Collection		$14.00/hr	$73,800	5 summers
Comments: Option 2 is based on hiring one intern at $14.00/hr working an estimated 70 days out of year. This estimate result's in an annual cost of $11,760 per intern. The total amount funded for interns over the 5 year estimate would be $58,800.00. Note: An additional $15,000 per intern has been added to cost for additional Field Equipment Rental and Computer hardware. If choosing to utilize interns as part of your data collection strategy it is important to ensure that well defined QA/QC procedures are in place and enforced by a full-time COBPW staff member to ensure data quality. Hiring multiple interns or adding a full-time technician to assist in data collection would greatly reduce the amount of time required to complete the inventory. This is shown in option 3.						
3	Sanitary MH Structures	1 Intern Field GPS Collection		$14.00/hr	$23,520	2 summers
	Sanitary MH Structures	Full-Time GIS Data Technician		$40,000/yr	$90,000	1.5 years
Comments: Combining a full-time employee to perform field work and manage the interns performing such tasks could maximize the quality of work and reduce the time to complete.						
4	Sanitary MH Structures	Consultant Field GPS/Attribute			$398,925	6 months

		Data Collection				
Comments: Hire consultant to perform a complete GPS field inventory. Cost estimates are based on a $45.00/mh rate. This is generally a more costly approach; however it ensures that the work is completed within a well-defined time period and has followed a rigorous QA/QC process. Note that that QC can be time-consuming. Need to ensure that consultant has well-defined QA/QC procedures in place.						
5	Sanitary MH Structures and Stormwater Structures	Mobile LiDAR			$120,000	3 months
Comments: Survey Grade accurate data collection via Mobile LiDAR Vehicle w/dual scanning sensor system. Cost estimate is based on an approximate 300 mile drive estimate. Note: Capturing inverts and additional attributes would not be included in this task. Capturing this info could be performed internally as part of a manhole inspection program described in Section III. Benefits include: -Quick turnaround of digital asset inventory. -Maximum ROI (support of comprehensive inventory of city-wide assets such as signs, trees, utilities) as well as other engineering and planning project efforts -Fewer staff and safety -Cost effective Challenges include: Buried MHs, submerged outlets, dense vegetation, obscured locations, and off road locations require traditional GPS pickup. This effort is included in the cost estimate.						

*With the exception of Option 5 (using mobile LiDAR), estimates provided above are based on an estimated 8,865 sanitary structures to be inventoried. Baker has estimated there are approximately 17,283 stormwater structures; thereby the costs and time involved for completing a stormwater structure data inventory would be roughly double that of inventorying the sanitary system. Note: Field inventory is based on capturing an average of 25 structures per day. This data collection effort does not include lifting manhole covers to obtain subsurface manhole attributes such as invert depth. It is anticipated that invert elevations and other internal manhole characteristics and conditions would be captured as part of the manhole inspection program.

C. Data Modeling & Business Tools

The successful development and implementation of a GIS based business risk exposure model is contingent on the selection and availability of supporting data structures, methodologies, and scripting tools. Baker assisted COBPW in building such a model and submitted a separate memorandum describing this tool (Michael Baker Jr., Inc., November 19, 2012). One of the caveats with this particular model is that it is largely based on available data sources, many of which have limited historical information. Additionally, with the implementation of MUNIS or an alternative system for handling work orders and inspections currently pending along with the possible transition by COBPW from a file based GIS system to a possible enterprise database system, the format and location of many supporting data references is certain to change. The following recommendations for COBPW's consideration are directed at achieving the following objectives:

- The supporting data structures are in place and well organized.
- The risk based methodology in place optimally assesses the most at risk infrastructure.
- The required scripting tools are in place and properly maintained.

1. Future BRE modeling considerations

Incorporating enough information in building a decision support system and having the required resources required to gather and manage the information is a complex balance. As COBPW looks toward the future, a good reference source for considering data structures to include as the system matures is the work being conducted by the Water Environment Resource Federation (WERF). WERF has been actively involved in the research and formulation of a standard data structure for assessing pipe performance and business risk. It published its report breaking down recommended data structures into 4 groups (Gold, Silver, Bronze and Wood) based on size of the utility (Sunil Sinha, 2010). The Gold standard contains 51 essential and 47 preferable parameters and is designed for large utilities that have a special team devoted to continually updating the wastewater database.

Concerning pipes, COBPW currently meets the essential requirements at the Bronze level, which is characteristic of smaller sized utilities that have limited man-hours due to a smaller workforce. It should be noted that while it is worthwhile to carefully review and assess all potential factors which may support predicting the remaining economic life of asset infrastructure and formulation of a business risk exposure model, the inclusion of parameters into COBPW's supporting data structure should be limited to those deemed most impactful based on local practices and environmental conditions. As COBPW's system evolves, some additional data elements the city may want to consider monitoring and maintaining as decision support factors include:

Physical/Structural

- Pipe Bedding (Y,N or Class A,B,C,D)
- Trench Backfill (Type)
- Trench Width

Operational/Functional

- Operational & Maintenance Practices (Type-Level)
- Infiltration/Inflow (Level-Gal/Min)
- Odor Complaints
- SSO/CSO
- Primary Failure Mode (Capacity; LOS; Physical Mortality; Cost to Operate)

Environmental

- Soil Type
- Groundwater Table (Feet)

- Dead Load (Lbs./sq.ft.)
- Soil Disturbance (Yes/No)
- Proximity to Trees (Feet)

Financial

- Annual Maintenance Cost $/Year
- Annual Repair/Rehabilitation Cost $/Year
- Installed and Replacement Cost $/Year
- Annual Operational Cost $/Year

Others

- Customer Complaint (quantity/segment)
- Overall Pipe Condition
- Density of Connections
- Resident Population Served

2. Support for BRE tools

Baker has created a set of geoprocessing scripts to automate the storage and calculation of business risk parameters as well as final BRE CAP 1 and CAP 2 scores. The tools collectively comprise a GIS based Infrastructure Rating Tool as described in previous sections of this report. These scripts look for information in a GIS table of CCTV Pipe Ratings (INSP_CCTV_RATING). Currently, COBPW does not have an automated script to populate the table from the data exported from its CCTV software. The GIS-based Infrastructure Rating Tool requires this information and thus Baker recommends that such a script be developed and used to automate this process. This will not only save time but also promote data integrity by eliminating any potential data entry errors.

Baker recommends that upgrades and maintenance to the provided business risk toolsets, including the CCTV data integration script described in the paragraph immediately before, are prioritized as budgetary items. Over time, the expanded availability of applicable data sources, the incorporation of new systems (asset management), and new releases in software will necessitate the need to update the scripting tools provided by Baker.

Another key component for Bloomington will involve geo-enabling the MUNIS asset management system. The MUNIS system's non GIS-centric approach to asset management will limit its ability to perform the following functions:

- Utilizing location as an organizational tool for planning and scheduling maintenance
- Visualizing assets and maintenance history in spatial context
- Validating location and synchronizing Asset ID assignment
- Location based request, inspection, and work order status tracking

- Identifying patterns and trends

Baker recommends that COBPW enhance MUNIS implementation to support pertinent GIS integration tasks.

As a means to increase implementation efficiencies and foster further growth and support of Bloomington’s asset management program the following GIS services are recommended.

Table 9 GIS SERVICES FOR OPTIMIZATION OF INFRASTRUCTURE MANAGEMENT - COST ESTIMATE

Product	Description	Cost Estimate	Time Estimate
Consulting/GIS BRE Toolset Development/Maintenance	Ongoing maintenance & Support	$10,500	Annual Service (Amount estimated at approximately 100 hours of support)
CCTV Integration Tool	Tool to automate transfer of CCTV inspections into Business Risk Model. This would include on-site testing, training and deployment.	$8,500	1 Week
MUNIS GIS Integration	Data conversion and business automation tools. GIS and asset management data integration and web enablement.	$100,000 – $250,000	

D. Staffing & Support

All successful GIS implementations can be traced back to investments made by the sponsoring organization in acquiring motivated and skilled staff to coordinate, build, manage, and maintain the system. To assist COBPW in formulating a staffing and support recommendation plan, Baker compiled some notes regarding GIS staffing support made by other Illinois communities similar in population to Bloomington. The comments generally refer to GIS operations at a city-wide level rather than for a specific department.

Table 10 GIS STAFFING SUPPORT IN SELECT ILLINOIS COMMUNITIES

Village of Arlington Heights, IL	Population: 75,428
Arlington Heights currently employs a GIS manager. The Village previously had a GIS analyst position but due to budgetary cuts this position was eliminated. They now employ an intern (GIS technician) part-time throughout the year. They have moved away from a more centralized approach to GIS data management to a more decentralized approach whereby each supporting department has assigned a representative to help maintain their GIS datasets and convey their needs. According to Arlington Height's GIS Manager, adding GIS responsibilities to non-GIS professionals has had its challenges. In some cases data quality and organization of data has been a problem. To offset this training has been provided by the GIS manager who is a certified ESRI trainer. Additionally, the GIS manager has advised staff to take advantage of the free online courses.	
Village of Bolingbrook, IL	Population: 73,366
Bolingbrook employ's a GIS technician to manage the GIS datasets and create supporting map documents. GIS datasets are predominately provided in shapefile format.	
Decatur, IL	Population: 76,096
Decatur's GIS is managed through its MIT department by a staff member playing a dual role of systems administrator/GIS manager. The GIS manager is more of a responsibility rather than an official title. Decatur is currently using personal geodatabases to hold the majority of its GIS data layers and is looking to migrate over to an enterprise geodatabase. They have recently completed an agreement with Eastern Illinois University, which provided interns to perform GIS data collection as part of the University's GIS program. They noted that this arrangement allowed them to inventory their water/wastewater datasets in a cost effective manner. However, it was noted that data quality provided could have been better in some cases, and they are still working through some connectivity issues.	
Elgin, IL	Population: 109,104
Elgin's GIS is managed through its IT Department by a staff member playing a dual role of network administrator and GIS manager. A GIS Analyst/Planner takes an active role in GIS efforts pertaining to the department of planning. Three technicians have also been designated to assist in maintaining GIS datasets related to water/wastewater and public works related datasets. Additionally, a GIS Consultant was employed to perform the majority of it water/wastewater GIS data collection efforts. Elgin utilizes personal geodatabases for GIS data management and is looking to migrate to a full enterprise geodatabase in the near future.	
Champaign, IL	Population: 81,291
Champaign's current IT Director was formerly the assistant IT Director for GIS with the city. The city has recently hired a full-time GIS Analyst who reports to the IT Director and is responsible for coordinating all GIS efforts in the City. Public works also maintains one part-time GIS technician position and one full-time GIS technician position. Additional support is provided through Champaign's membership with the Champaign County GIS consortium which is an organization similar in function to the Mclean County GIS Consortium (MCGIS) which Bloomington participates with. Champaign utilizes an enterprise geodatabase to manage its GIS information.	

Schaumburg, IL	Population: 74,550
For quite some time Schaumburg embraced GIS technology under the guidance of a GIS manager. About three years ago, facing budgetary restraints, Schaumburg changed directions in their approach to GIS staffing and elected to integrate GIS related tasks into selected departmental staff member's job descriptions and responsibilities. At this time there are no GIS positions within the city of Schaumburg.	

A common theme running through all of these communities is the necessity to do more with less. Many positions are required to multi-task splitting time between their primary job classification and a secondary one related to GIS data maintenance. It is likely COBPW will need to follow this model. There also appears to be a clear correlation between investment in staff and existing GIS capabilities. It is important to evaluate an organization's status with respect to GIS capability maturity when determining the best strategy for staffing a GIS program. Some of these agencies had a coordinator in place in the early years to design and build the system, which has allowed later staff an easier path to follow in keeping the system properly maintained.

While it is understood that COBPW faces economic challenges, supporting technology initiatives through staff augmentation will not only promote greater efficiencies in government workflow processes, but also provide key decision support aimed at improving services to its constituents and reducing life cycle costs of its infrastructure holdings.

At this time, the biggest impact made with regards to additional staff would be to hire a GIS coordinator or manager. This position would establish a representative voice providing direction to all GIS related technology initiatives, GIS related training support, and centralized GIS data management. A person in this role can facilitate expanding existing staff GIS capabilities as well as coordinate external staffing support arrangements through local universities or Mclean County Geographic Information System. A person in this position would support COBPW's GIS and Asset Management Program objectives by promoting the following:

- Consistency: The ability to maintain consistent application of policies, procedures, and standards to accomplish objectives
- Objectivity: The ability to maintain independence and avoid bias in analysis and developing solutions that are most beneficial to the City of Bloomington in the long-term.
- Focus: The ability to maintain focus on accomplishing long term asset management objectives and avoid getting side tracked by day to day activities.
- Efficiency: The ability to meet short term and long term goals with a minimum level of resources.

1. Bloomington Staffing Recommendations

Table 11 GIS SUPPORT STAFF COST ESTIMATE

Staffing Position	Description	Annual Cost Estimate
GIS Coordinator/Manager	Provide guidance, management and coordination of the City's short and long term GIS strategic initiatives.	$97,500 *

*Salary of $65,000 with an OH rate of 50% assumed

Once the appropriate staff is in place it is important to have a training plan so that staff knowledge and skills continue to grow and evolve. ESRI provides an example of such a plan, specific to their software.

Example: ESRI Comprehensive Training Plan for ArcGIS (ESRI, 2010)
http://downloads2.esri.com/campus/downloads/sad/ArcGIS_Comprehensive_Training_Plan.pdf

ESRI also provides a host of free online training seminars (ESRI)
(http://training.esri.com/gateway/index.cfm?fa=search.results&cannedsearch=2).

Even if it is just one hour out of the week, allowing staff focused training time to take advantage of these courses as a part of a training strategy will pay huge dividends not only with respect to advancing the City of Bloomington's use of GIS but also with respect to employee growth, job satisfaction, and efficient management of COBPW's infrastructure.

E. Summary of Recommended Investments

A conservative summary of costs for the improvements recommended in this section is presented in the following table. Where several options for a specific goal have been presented, the option that the consultant team considers as most beneficial for Bloomington is listed.

Table 12 GIS SUMMARY OF RECOMMENDED INVESTMENTS

GIS Improvement	Cost	Cost Type - Annual or One Time	Year of Implementation
MUNIS-GIS Interface	$100,000 to $250,000	One Time	Year 1
GIS Coordinator Manager	$97,500	Annual	Years 1 - 20
Implement ESRI Local Government Model for Water/Wastewater	$45,000	One Time	Year 1

III. Considerations and Steps for Implementation of a Manhole Rehabilitation Program

The purpose of this section is to provide recommendations for the components of a manhole inspection and rehabilitation program. There are numerous alternatives for manhole rehabilitation that are considered to be industry-wide best practices. Manhole defects vary in magnitude. Recommendations in this Section are made for the following cases:

- Replace Manhole Frame and Cover: Frame or cover is cracked, broken, or missing
- Reset Frame: Frame is loose or offset
- Replace Frame Insert: Insert is cracked, broken, heavily corroded, or missing, and no insert provided
- Provide Frame Insert: Cover receives inflow or infiltration
- Provide Chimney Seal: Adjustment rings are cracked or heavily corroded; infiltration from frame or adjustment rings is present
- Line Manhole: Deterioration of cone and walls; cracking of cone and walls; root intrusion or infiltration present
- Rehabilitate Manhole Bench: Exposed aggregate; cracking of material on bench
- Grout Pipe Penetration: Defective/collapsed pipe interface conditions exist

In manhole rehabilitation, four design conditions based on the structural integrity of the existing manhole may be encountered. These design conditions may be defined as follows:

Condition I - The manhole is considered structurally sound with no indications of settlement, cracking or other signs of structural fatigue. Inflow is not apparent at precast joints, mortar joints or around the pipe connection

Condition II – The manhole is considered structurally sound with no indications of settlement, cracking or other signs of structural fatigue. Signs of inflow or infiltration through precast joints, mortar joints, or around the pipe connection are evident.

Condition III – The manhole is exhibiting early signs of structural fatigue evidenced by minor cracks, loss of mortar or brick, corrosion (less than 0.5 inches in depth), minor cross sectional distortion (less than 10 percent).

Condition IV – The manhole is exhibiting severe structural fatigue and collapse is imminent. Conditions indicating this degree of deterioration would be distortion beyond 10 percent, severe corrosion (exposed reinforcing), or missing large sections of the existing structure.

Later in this Section a suggested rating system is discussed for tracking manhole condition (see Figure 3).

A. Discussion

Many manufacturers provide products engineered specifically for manhole rehabilitation. In addition, contractors have become specialized in manhole rehabilitation. New manhole rehabilitation products and applications are routinely developed.

The competence of the contractor represents the crucial component for any manhole rehabilitation because of the extensive surface preparation requirements, use of specialized materials, high quality control standards, and varying manhole environmental conditions.

Manhole contractors typically have crews comprised of a superintendent and 4 to 5 technicians to complete the work. The superintendent typically has over 5 years work experience. All the contractors should be certified or have a long standing relationship with the manufacturer. Crews typically have equipment to prepare the manhole walls, facilitate repairs, and apply liners.

Contractor experience is key to the success of the rehabilitation method selected. The following Table 13 is a summary of the suggested 3-year experience requirements for manhole rehabilitation:

Table 13 EXPERIENCE REQUIREMENTS FOR MANHOLE REHABILITATION

Task	Minimum Requirements
Chimney Seals	500 structures
Cementitious Liners	1000 vertical feet
Epoxy Coatings	1000 vertical feet

1. Municipal Interviews/Reviews

Baker has in the past contacted various municipalities and reviewed municipal manhole specifications to identify manhole rehabilitation methods and products used by several municipalities. The following is a summary of these discussions:

- Hampton Roads Sanitation District (HRSD): manholes are repaired using various types of cementitious products followed by a protective lining. Epoxy coatings are used but begin to show wear after 10 to 12 years. Pure calcium-aluminate liners such as SewperCoat® have been used with success and very little posterior corrosion. HRSD has had success using a pure calcium-aluminate mortar that includes cement and aggregate.
- City of Portsmouth, VA: specifies in their General Provisions to use a Sewpercoat 2000 HS or approved equal. The high compressive strength, durability and performance are reasons for their selection. For manhole chimney seals, the City specifies a mechanical type product.
- City of Newport News, VA: has been pleased with Permacast/Permaform licensed contractors and specify this product for manhole rehabilitation.

- Spotsylvania County, VA: specifies the Permaform and Permacast (with Conshield) methods for manhole rehabilitation.

B. Rehabilitation Defects

Based on findings from a number of SSES reports, interviews with contractors, manufacturers and utilities, and a review of technical specifications, papers and product sheets, the following areas represent typical manhole repairs. A summary of specific products for the rehabilitation options discussed below is presented in Table 15.

1. Frame, Cover, & Insert

The manhole cover and frame is subject to street loading and changes in weather. This item was viewed as a standard item requiring replacement. Some manholes require a water tight seal, a locking mechanism, or an insert to prevent inflow and infiltration.

Defect: Deteriorated/Broken Frame and Cover

Typical Repair Options:

1. Replace the cast iron frame and cover. Note that manufacturers have developed non-metallic manhole frame and covers. Consideration should be given to pilot testing them as they provide advantages including weight sealing against inflow and infiltration, as well as corrosion.

Defect: Manhole Cover Infiltration/Inflow

Typical Repair Options:

1. Install a plastic or stainless steel insert. Manholes subject to flooding should have a water tight cover.
2. In areas were the manhole requires additional security, install a locking device.

2. Adjustment Rings & Chimney Seal

Defect: Settled Manhole Frame

A manhole frame and cover that has settled below the existing grade can allow water to pond during rain events, which leads to increased inflow. Additionally, depressed manholes in roads can create driving hazards or aggravation.

Typical Repair Options:

1. The manhole frame is brought back to grade by replacing the adjustment rings.
   a. Precast concrete adjustment rings may be cast to specific dimensions so that the repair matches the manhole size and grade.
   b. HDPE adjustment rings, which are newer to the market, are light weight, have high load capacity, have interlocking design, and are non-corrosive. In order to match grade, a

correctly sized ring needs to be in stock.

2. Install paving rings.

Defect: Chimney Infiltration

The chimney refers to the area located between the cone section and the manhole frame. A chimney seal is installed in these areas to mitigate infiltration. Mechanical and elastomeric seals are interior chimney seals. A wrap type seal is used as an exterior seal and typically applied during new construction, when the exterior of the chimney is exposed. The mechanical type seal has been an industry standard. The elastomeric seal is relatively new to the market with the first installation in the mid 1990's. Baker has observed various installations, talked with manufacturer's representatives, and municipal clients about various chimney seals. The comments are based on these observations. With all chimney seal applications, the proper measurement and surface preparation are critical components for a proper installation.

Typical Repair Options (interior):

1. Mechanical Seal. A mechanical seal is comprised of two stainless steel bands and a rubber boot. In the right application these mechanical seals work well; however, the stainless steel bands may require adjustment. If the mechanical seal is not installed properly, the band and boot can fall into the manhole. Securing the stainless steel band to an out-of-round cone seating area is a recurring problem. This area should be built up so the band has a good seating surface. Installed correctly, the mechanical seal prevents infiltration. Some municipalities only use this type of chimney seal.

2. Elastomeric Seal. An elastomeric seal is typically a hand applied chemical sealant. This product adheres well to chimney and cone sections but the manhole frame requires additional preparation depending on the product. Additional surface preparation is critical for these type seals, like sand blasting the frame down to white metal so that the seal adheres to the frame. Some products are applied with less effort but may have a reduced service life. These seals should be pliable with time, easy to repair, and not mask a failure. The following are materials used for interior chimney seals:

   a. Aromatic urethane type seal are reported to remain flexible for the life of the product (25-30 years).
   b. 100% solids polyamine epoxy type seal are reported to be rigid in nature and may crack with time.
   c. Fiber-reinforced, asphalt-modified urethane seals are made with petroleum distillates and will out gas and dry out with time. Of these type products, this appears to be the easiest to install.

Elastomeric seals to stop chimney seals are newer to the market and have limited history. However, several municipalities are using this product with success. Of the three alternatives discussed above, the specifications for the aromatic urethane type seals appear to be the most durable solution.

Typical Repair Options (exterior):

Wrap Seal. A wrap seal is applied during new construction or if the area around the manhole excavated away from the chimney area. A flexible wrap is typically used because chimneys and frames may shift with time. In addition, the seal must be able to handle the expansion and contraction due to changes in season. The following are materials used for exterior chimney seals:

a. Heat shrinkable wrap.
b. Rubber and non-hardening butyl mastic wrap.

3. Manhole Structure (Chimney/Cone/Barrel/Bench/Channel)

Defect: Inflow and Infiltration

Before completing other repair options, significant leaks must often first be restricted. As leaks become more aggressive, chemical grouting is used to stop leaks. Manholes exhibiting infiltration through the cone or barrel are often subject to addition rehabilitation, such as lining.

Typical Repair Options:

1. Active light leaks are typically contained by a quick set hydraulic cementitious water plug. A water plug may be applied in a dry form directly to minor infiltration or mixed with water to a thicker consistency for application to more active leaks.

2. Active, heavy leaks because of medium to large cracks or joints repairs are typically accomplished by using a chemical grout. Grouts used to the various applications for manhole repairs are engineered for a specific application.
   a. Acrylic or acrylate base grout
   b. Urethane base grout
   c. Oil-free oakum water plugs

Defect: Roots Through Structure

Typical Repair Options:

1. Root growth in manholes may be indicative of other manhole defects, such as structural fatigue or infiltration. Roots may be treated with root growth inhibitor; however, roots are likely to return. Root growth inhibitor may be applied directly to roots or may be mixed with a chemical grout. If roots are present, additional rehabilitation, such as manhole restoration/lining, is likely to be required.

Defect: Manhole Voids and Bench Deterioration

Typical Repair Options:

1. Voids in manhole walls and necessary repairs to benches are typically accomplished with high-strength patching material or brick and grout. A rapid setting Portland-cement or calcium-aluminate mortar may be used for filling voids and repairing inverts in concrete, brick or other masonry-constructed structures. A Portland-cement based, high strength, fiber-reinforced, micro silica (silica fume) type mortar (PCMC) provides a cost effective way of repairing the surface. Silica fume is a typical component to high strength concrete. Significant voids or the presence of other defects may require additional rehabilitation, such as manhole lining.

Defect: Defective Pipe Interface Conditions

The primary defect at the pipe-to-manhole interface is a defective seal that results in infiltration. More serious conditions may be present such as the pipe pulling from the manhole or a damaged/collapsed pipe.

Typical Repair Options:

1. Infiltration at the interface, from defects such as a defective seal or pipe separation from the manhole, is typically repaired using appropriate grouts as discussed previously.

2. Repairs to address pipe collapse or damage, often requires excavation outside of the manhole to complete a pipe point repair.

Defect: Manhole Deterioration (Mild-to-moderate, primarily from surface corrosion)

Microbiologically influenced corrosion (MIC) caused by the presence of hydrogen sulfide gas is a common cause for manhole deterioration. Manhole structures with a higher surface acidity require a greater level of protection. The following is a general guideline to classify lining materials and relative cost of application:

Typical Liner Options:

1. Calcium-aluminate/Portland cement mix mortar: Mortar is applied to the properly prepared manhole walls. This mortar is resistant to MIC; but can still experience some corrosion. Several manufactures prefer to use this type surface as a primer for an epoxy coating because of excellent adhesion properties.

2. Pure calcium-aluminate cement products appear to provide good protection in manholes with very low pH (as low as pH around 2).

3. Epoxy coatings should be 100-percent solids such as the Raven 405 epoxy coating system. Epoxy application is strongly dependent on surface preparation. In addition, environmental conditions can affect certain epoxies. Depending on the condition of the manhole surface, epoxy coating should be used in conjunction with a mortar substructure consisting of calcium-aluminate/ Portland cement mix.

With the application of an epoxy liner, a pinhole leak may cause future problems; epoxy systems not properly applied may mask MIC. The holiday test (a procedure to identify breaks and defects through application of electrical current) is an industry standard to specify following epoxy liner application.

The following table summarizes the lining materials discussed previously:

Table 14 LINING MATERIALS FOR MANHOLE DETERIORATION DUE TO MIC

Product	Characteristic			
	Corrosion Resistance	**Permeability**	**Compressive Strength**	**Relative Cost**
Portland Cement with Micro Silica (PCMS)	Low	Dense	>9000 psi	Low
Calcium-aluminate with Silica Aggregate	Good	Dense	>8000 psi	Moderate
Pure Calcium-aluminate & Aggregate	Excellent	Dense	>9000 psi	Moderate plus 30%
Epoxy Coating	Excellent	Complete Barrier	–	High

Defect: Structurally Impaired Manhole

When a manhole exhibits severe structural fatigue, rehabilitation to extending the service life of the manhole is accomplished by restoring the manhole structural condition.

This type defect requires replacement of the manhole support structure either by replacing the manhole structure or installing a structural supporting liner. Depending on the location and condition of the manhole, adding a structurally supporting liner is can be the most cost-effective option. With new structural supporting walls, the inside diameter of the manhole is reduced.

Typical Repair Options:

1. PVC or HDPE liner. A formed-in-place seamless concrete manhole is constructed within the existing manhole, extending from the bench to the frame. A concrete form is set up within the manhole containing a PVC or HDPE liner. Concrete is poured behind the form as a monolithic pour to prevent cold joints. When the concrete is set, the forms are removed, and the result is a PVC or HDPE lined manhole. The PVC or HDPE liner is embedded into the new structure. The concrete thickness can be designed for the structural requirements of the manhole.

2. Cured-in-place liner. A cured-in-place liner is custom fabricated to match the dimensions of the manhole. Multiple structural layers of fiberglass with non-porous membrane layer between fiberglass, or Polyvinyl Chloride/Polyester (PVCP) liner with a fiberglass layer, bonded to manhole under pressure and heat. The thickness of the liner may be designed for the structural requirements of the manhole.

3. Fiberglass Manhole Insert. A new fiberglass manhole can be manufactured with a diameter

smaller than the inside diameter of the existing manhole. The fiberglass manhole meets the full loading requirements of the manhole conditions. The cone of the existing manhole is excavated/removed and the fiberglass manhole is inserted and rests on the manhole bench. The annular space behind the fiberglass is typically filled with mortar. The manhole is backfilled and a new frame and cover is installed. The resulting manhole meets the original design loadings and is resistant to MIC.

A summary of specific products for the rehabilitation options previously discussed is presented in Table 15.

Table 15 MANHOLE REHABILITATION METHODS AND PRODUCT EXAMPLES

Manhole Frame and Cover				
Defect	**Category**	**Company Name**	**Product**	**Relative Cost**
Frame Cracked/Worn	Cast Iron	East Jordan Iron Work	Manhole and frame	Low
	Manhole Insert	Barton Southern Co. Inc.	LockDown-LockDry Manhole Insert	Low
	Manhole Insert	ThoRoc	Sewer Guard Manhole Insert	Low
	Manhole Insert	Parsons Environmental Products	HDPE or Stainless Steel	Low
Settled Manhole Frame	Concrete	Varies	Varies	Low
	HDPE	LADTECH	Adjustable Ring	Mod
Manhole Structure (Chimney/Cone/Barrel/Bench/Channel)				
Defect	**Category**	**Company Name**	**Product**	**Relative Cost**
Inflow and Infiltration and Defective Pipe Interface Conditions	Quick Set Leak Stop	Perma-Liner Industries	Quick Set Hydraulic Cement	Low
	Quick Set Leak Stop	Quadex Inc.	Quad Plug	Low
	Quick Set Leak Stop	Sauereisen	InstaPlug F-180	Low
	Polyurethane (Heavy Leaks)	Deneef	Hydroactive Polyurethane Grout	Mod
	Polyurethane (Heavy Leaks)	Sauereisen	Hydroactive Polyurethane Grout F-370	Mod
Manhole Voids and Bench Deterioration	Rapid Set Calcium Aluminate cement	Strong Company, Inc.	Strong QSR	Low
	Rapid Set cement + micro silica	Quadex Inc.	Hyperform	Low
	Rapid Set cement + micro silica	Sauereisen	Underlayment F-120	Low
Roots Through Structure	Root Inhibitor	3M Avanti International	AV 118 Duriflex with AC 50W Root Inhibitor Additive (dichlobenil product)	Low
Chimney Seal				
Defect	**Category**	**Company Name**	**Product**	**Relative Cost**
Chimney Infiltration	Internal Seal - Mechanical	Cretex Specialty Products	Cretex Wrap	Mod
	Internal Seal - Mechanical	Trelleborg	FlexRib Seal	Mod
	Internal Seal - Elastomeric	Sealing Systems, Inc.	Flex-Seal Utility Sealant	Mod
	Internal Seal - Elastomeric	Sauereisen	Manhole Chimney Seal F-88	Low
	External Seal - Wrap	Sealing Systems, Inc.	Infi-Shield Uniband	Mod
	External Seal - Wrap	CANUSA-CPS	WrapidSeal	Mod

Manhole Structure (Chimney/Cone/Barrel/Bench/Channel) (Continued)				
Manhole Deterioration (Mild-to-moderate): Used in conjunction with Epoxy Coatings listed herein	Calcium Aluminate Based Liner	Quadex Inc. - Cement	Aluminaliner	Mod
	Calcium Aluminate Based Liner	Sauereisen - Cement with Silica	SewerSeal	Mod
	Epoxy Coatings	ThoRoc	Sewer Guard HBS100 Epoxy Liner	High
	Epoxy Coatings	Tnemec	Series 434 Perma-Shield	High
	Epoxy Coatings	Sauereisen	SewerGard Epoxy Systems	High
Manhole Deterioration (Mild-to-moderate)	Calcium Aluminate	Lafarge	SewperCoat 2000 HS	Mod-High
	Portland Based Cement	AP/M Permaform	Permacast / MS10,000 with CONSHIELD	Mod
Manhole Deterioration (Mild-to-moderate)	Epoxy Coatings	Raven	400 Series Liner	High
Structurally Impaired Manhole	Liner: PVC	Ameron	T-Lock Lining	Very High
	Liner: HDPE	Agru America, Inc.	Agru Sure-Grip, HDPE Concrete Protective Liner	Very High
	Liner: HDPE	GSE	Studliner	Very High
	Liner: Concrete Poured-In-Place	AP/M Permaform	Permaform	Very High
	Liner: Concrete Poured-In-Place	Monoform, Inc	Manoform Manhole Liner System	Very High
	Liner: CIPP	Terre-Hill	Multi-Plexx Liner System	Very High
	Liner: CIPP	Poly-Triplex Technologies	Poly-Triplex Liner	Very High
	Liner: Fiberglass	Containment Solutions, Inc	Flowtite Fiberglass Rehabilitation Manhole	Very High

C. Summary

The following summarizes important manhole rehabilitation elements:

1. Manhole rehabilitation requires a method of accurately assessing the condition of the manhole.

2. The Contractor's experience and skill is an important component for completing repairs regardless of the product.

3. Surface preparation must be accomplished to manufacturer specifications.

4. The manhole Contractor should have five to 10 years of experience, a solid reference list, and a good relationship with the manufacturer. The contractor should be certified or approved for using the products. In addition, the site supervisor should have five to 10 years of experience with manhole rehabilitation.

5. The owner should have working knowledge of the products used to extend the life of the manhole structures since contractors often present an "or equal" which does not meet the specifications.

6. Portland cement based products enhance the strength of the structure and represent the most cost effective means of reducing the inflow of ground water into the manhole where MIC is not a problem.

7. Blended calcium-aluminate/Portland cement adds to the strength of the structure and provides protection against moderate levels of H_2S. This type liner also provides an excellent substrate before applying an epoxy coating. In addition, this type liner provides additional protection from H_2S in the event of a failure to the epoxy system.

8. Pure calcium-aluminate cement adds to the strength of the structure and provides protection against MIC.

9. Epoxy coating systems have a higher cost for lining manhole structures. These systems work well in manholes impacted by MIC. The epoxy coating systems require proper surface preparation, holiday testing after each installation, and post installation certification.

10. Repairing structurally impaired walls varies depending on the size, depth, location, and condition of the manhole. Some projects may require calculations supporting the thickness of the liner required for structural support. Among the rehabilitation methods identified, using liners (of any type) is the most expensive type method.

11. A post installation certification is recommended after rehabilitation activities are completed.

D. Recommendations

The following recommendations have been developed to identify proven manhole rehabilitation methods with a substantial track record. Manhole rehabilitation has received more visibility as a means to reduce inflow and infiltration as new products enter the market each year.

1. The contractor's experience and skill is critical for all manhole rehabilitation projects. The following items should be included in the specifications:
   a. Crews need to be pre-qualified if part of a larger project.
   b. Five years of experience performing the work.
   c. Three years of experience with the liner material.
   d. The contractor must be certified or approved for the rehabilitation alternatives.
   e. Crews must have a full line of products to complete the work.

2. The following products in Table 16 are recommended:

Table 16 RECOMMENDED PRODUCTS FOR MANHOLE REHABILITATION

Defect	Recommendation
Deteriorated/Broken Frame and Cover	Replace the frame and cover as required.
Manhole Cover Infiltration/ Inflow	1. Plastic or stainless steel inserts for normal wear areas.
	2. Replace with water-tight covers in areas prone to flooding.
	3. Specialty covers in areas requiring additional security.
Settled Manhole Frame	1. Precast Concrete or HDPE Adjustment Ring
	2. Paving Rings
Chimney Infiltration	1. Aromatic urethane type seal
	2. Chimney Seal (Mechanical) with proper seating surfaces
	3. Chimney Seal (Wrap) if chimney is excavated
Inflow and Infiltration through structure	Stop leaks and line manhole per Manhole Defect Options in this document (mild-to-moderate)
Roots Through Structure	Treat roots and line manhole per Manhole Defect Options in this document (mild-to-moderate)
Manhole Void and Bench Deterioration	Rebuild with rapid set cement or calcium-aluminate type product and line manhole as necessary
Defective Pipe Interface Conditions	Grout seal; point repair pipe as necessary
Manhole Deterioration (Mild-to-moderate, primarily from surface corrosion)	1. Line with Calcium-aluminate/Portland cement mix mortar with Epoxy Coating
	2. Pure Calcium-aluminate mortar coating
	3. Epoxy Coating (100 % solids), Raven 405 system or equivalent
Structurally Impaired Manhole	1. Formed in place concrete and PVC/HDPE liner
	2. Cured-in-place liner (structural) 3. Fiberglass manhole insert

3. COBPW does not have a fully developed GIS layer for its manhole infrastructure. The existence of such data and the availability to track manhole conditions, much in a parallel procedure to that of the CCTV Pipe Inspection Program presented in Section I, is essential to making prudent decisions on the optimum time for proactive maintenance and for which strategy to use: repair, replacement or rehabilitation. Maintenance of such data is extremely valuable and allows for prioritizing and selecting the most critical sewer or stormwater manholes in order to target funding and maintenance efforts. Coordination with other infrastructure activities such as work on streets, utilities, and pipe segments, is also made possible through the availability of this data. COBPW should develop a manhole database layer and develop an inspection program.

   Recommendations for developing this database are provided in Section II. As for the inspection protocol, NASCCO has developed a Manhole Assessment and Certification Program (MACP) that uses the established defect code system used in the PACP program to the extent possible. The assessment procedure is newer and thus less established in comparison to the PACP. The consultant team recommendation is that the Manhole Inspection Program commence with a streamlined protocol. The consultant team member OHM performed an inspection of 151 manholes as part of a sanitary sewer evaluation study (Orchard, Hill and McCliment, Inc., 2012) for Bloomington's Master Sanitary Plan, in which an infiltration/inflow and structure rating table was used to assign a condition rating to each manhole on a scale of 1 (excellent condition) to 7 (major work required). The table is presented in Figure 3, with certain modifications designed to make the rating more applicable to a routine inspection program. Baker recommends using this system as the basis for the inspections, with the following changes:

   - Use strictly the four deficiency factors for the structural category (corbel/wall condition, brick/block pieces and cracks, mortar and brick cover) plus the two listed for the infiltration category (dampness and roots). The presence of these factors would not be distinguished between the upper three feet and the lower structure in performing the inspections; the existence of any of these factors at any height influences the condition rating.
   - Simplify the rating to four levels rather than seven. A value of 1 on the OHM scale corresponds to a condition rating of 1. The values 2 or 3 on the scale correspond to a condition rating of 2; similarly, the values of 4 or 5 correspond to a condition rating of 3, and 6 or 7 to a rating of 4.

   COBPW should establish an inspection frequency similar to that suggested in Section I for CCTV pipe inspections. All manholes would be inspected during a period of five years. Manholes identified as high risk would continue to be inspected on a five-year interval, with the remaining structures inspected every 10 years.

   The estimated costs for implementation of the Manhole Inspection Program are provided in Table 17.

I/I Source	Location		1	2		3		4	
						Scale			
		Deficiency	1	2	3	4	5	6	7
			No Work			**Minor Work**			**Major Work**
Infiltration **F**	Presence of water from bottom of manhole to 3' below Top of Casting	Dampness	No Dampness	Bottom 1'	Bottom 2'	Bottom 3-4'	Entire MH Wet	Entire MH Wet + Minor Mineral Deposits	Active Leak + Major Mineral Deposits
		Roots	No Roots	1%-5% Roots	6%-10% Roots	11-25% Roots	26-50% Roots	51%-75% Roots	76%-100% Roots
Structure **S**	Structural Deficiency <u>below</u> the top 3' of manhole (i.e. from bottom of manhole to 3' below Top of Casting)	Brick Cover	No Work	Can see 1%-5% Brick	Can see 6%-25% Brick	Can see 11-25% Brick	Can see 26-50% Brick	Can see 51%-75% Brick	Can see 76%-100% Brick
		Mortar	No Mortar Missing	1%-5% Mortar Missing	6%-25% Mortar Missing	11-25% Mortar Missing	26-50% Mortar Missing	51%-75% Mortar Missing	76%-100% Mortar Missing
		Brick/Block Pieces	No Brick/Block Missing and/or No Cracks	1%-5% Brick/Block Missing and/or Hairline Cracks	6%-25% Brick/Block Missing and/or 16^{th}-inch Crack	11%-25% Brick/Block Missing and/or 8^{th}-inch Crack	26-50% Brick/Block Missing and/or 4^{th}-inch Crack	51%-75% Brick/Block Missing and/or 0.5-1" Crack/Gap	76%-100% Brick/Block Missing and/or 1-inch Crack/Gap
		Corbel/Wall Condition	Good	Fair		Fair		Poor	

Figure 3. Manhole Condition Rating Table for East Side SSES with Suggested Modifications

Table 17 IMPLEMENTATION COSTS FOR MANHOLE INSPECTION PROGRAM

Year of Program	MH Inspected per year	Personnel Required	Labor Cost	Truck Maintenance*	Equipment Cost	Cost per year
1-5	1729	0.7	$ 61,174	$ 23,571	$ 4,500	$ 89,245
6-10	59	0.02	$ 1,748	$11,697	$ 4,500	$ 17,939
11-15	1729	0.7	$ 61,174	$ 23,571	$ 4,500	$ 89,245
16-20	59	0.02	$ 1,748	$11,697	$ 4,500	$ 17,939

Note: Assumed 25 manholes inspected per day
*Vehicle purchase cost assumed at $30,000 and is spread over seven years with 5% additional for maintenance and an estimated 15,000 miles annual fuel requirement at 10 mpg.

Note that very few manholes come up for inspection on a 5-yr cycle, such that the inspections in years 6-10 and 16-20 are very infrequent. Baker recommends that a portion of the manholes normally inspected on a 10-yr cycle have their first re-inspection in a shorter time frame, such that the FTE work load in years 6-20 can be balanced. In this manner, a more likely breakdown of implementation costs would be as presented in Table 18.

Table 18 BALANCED IMPLEMENTATION COSTS FOR MANHOLE INSPECTION PROGRAM

Year of Program	MH Inspected per year	Personnel Required	Labor Cost	Truck Maintenance*	Equipment Cost	Cost per year
1-5	1729	0.7	$ 61,174	$ 23,571	$ 4,500	$ 89,245
6-10	616	0.26	$ 22,355	$ 13,131	$ 4,500	$ 39,987
11-15	616	0.26	$ 22,355	$ 13,131	$ 4,500	$ 39,987
16-20	616	0.26	$ 22,355	$ 13,131	$ 4,500	$ 39,987

Manholes that are rated at a condition of 4 should be programmed for repair, replacement or rehabilitation according to the previous recommendations of this section of the Memorandum. Structures at a rating of 3 should be placed on the five year inspection cycle and repairs of other utilities should be an additional factor that drives the decision to address these structures. If the street will already be closed or dug up for a utility repair, there is likely a good justification to perform the necessary rehabilitation of manholes with a condition rating of 3 (and 4 if not already addressed). As stated previously, it is important for COBPW to establish the GIS data layers and procedures necessary to capture and maintain manhole inspection data, as shown in Table 17.

A final adjustment concerning timing of manhole inspections is to perform them as part of CCTV inspections starting in year 6. The 0.25 FTE requirement may potentially be absorbed within the FTEs recommended for the CCTV inspection program as presented in Table 1.

IV. Considerations and Steps for Implementation of a Sewer Lining Program

Sewer lining options are numerous and the selection of the optimal technology depends on many factors. The most common technologies available are:

- Pipe Bursting
- Slip-Lining
- Close-Fit Lining - CIPP or Fold and Formed
- Coatings – Structural
- Point Repairs

Excerpts from a presentation are presented below to describe each technology (Malcom Pirnie, 2009).

Pipe Bursting: It is the process of outwardly displacing the existing pipe to make room for a slip lined pipe. It is normally used with short sections, and allows for larger diameter pipes than existing pipes.

Slip Lining: Slide a flexible pipe of a slightly smaller diameter into the existing pipe – the space between new and old pipe is grouted (foam, pea gravel, etc.). Can continuously prevent leaks and improve structural integrity

Fold and Formed: As shown in Figure 4 fold and formed is when flexible pipe in a U shape is inserted into host pipe. Rounding mandrels are used to round out the pipe. Then the liner is heated and pressurized to conform to original pipe shape. Swagelined and rolldown use chemical and mechanical forms respectively to temporarily compress the lining before it is drawn into the pipe.

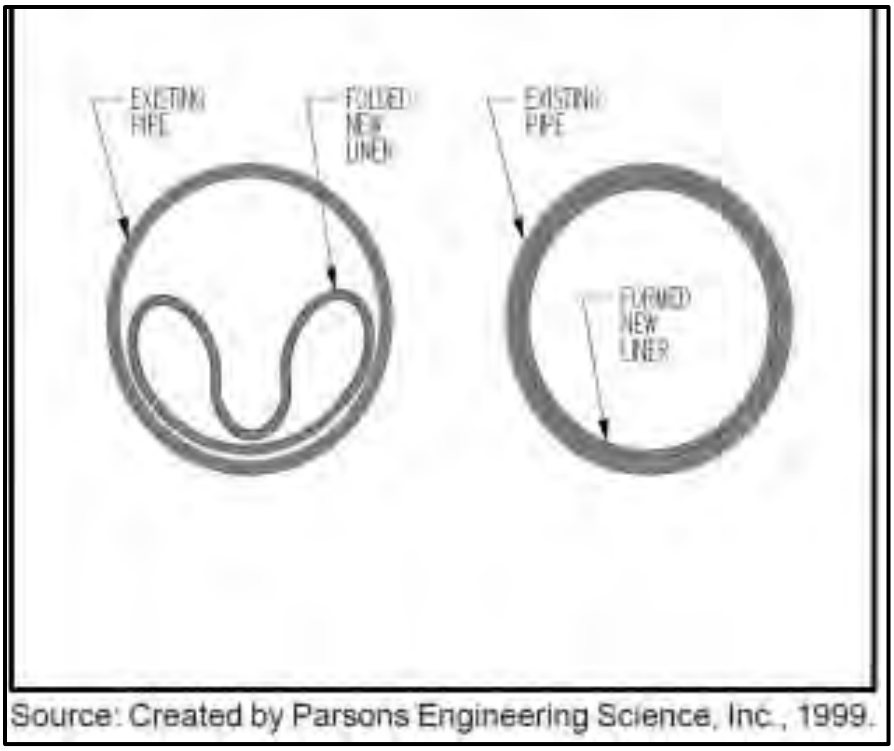


Figure 4. Slip Lining Schematic

Cured in Place Pipe (CIPP): A flexible liner, such as felt, that is impregnated with thermosetting resins is inserted through the manholes into the pipe and then the resin is set (hardens) through contact with steam or hot water. It is inserted by winch in place and invert in place methods.

Coatings: Material is applied by spray, trowel, or roller to the host pipe and can be used as a patch or complete rehabilitation. Options are epoxy, shotcrete, polyester, silicone, urethane, and vinylester. Some coatings are not feasible for application in smaller pipes. Shotcrete, for instance, is not recommended for pipes less than 48-in diameter due to the difficulty of inserting the equipment (Dr. John Matthews, 2011).

Point Repair: Techniques include chemical grouting, point CIPP, and grouting with mechanical sleeves.

The factors to consider in selecting one technology over another are numerous; those most commonly present include:

- High bypass flow requirement – for sewer runs with high baseflow the costs of bypassing during installation can be considerable. In such cases slip-lining is an option that can be utilized with little required flow bypass.
- High traffic – significant costs can be incurred for traffic control. Slip lining requires large access pits, as does pipe bursting, which tend to require shutdown of several traffic

lanes. In such cases a CIPP or fold and form solution requires much less disruption of traffic.

- Irregularities in pipe sections, pipe offsets, and alignment deflections – CIPP or fold and form technologies are apt for such situations, while slip lining cannot negotiate turns and changes in shape, such that access pits at each manhole or deflection point are required. Multiple access pits can have a more significant effect on traffic.
- Need to upsize pipe diameter/capacity – while to some limited extent lining techniques may increase hydraulic capacity, the need to significantly increase capacity requires increasing the pipe diameter, and in this case only pipe bursting or open cut replacement is feasible.
- Structural rehabilitation required – for pipes with structural deficiencies, CIPP and sliplining can provide improvements in structural integrity, as can mechanical sleeves with grouting and reinforced cement-mortar spray on coatings.

The solution selected for pipe repair, rehabilitation, or replacement should be measured through a triple bottom line evaluation of costs and benefits. Costs, as well as benefits, can be economic, social, or environmental. Shutdown of traffic in a popular commercial area or along an annual parade route may outweigh another option's lower economic cost. As an illustration of the triple bottom line approach, consider a case study for the City of Indianapolis as presented in a recent EPA report (Dr. John Matthews, 2011) for the Merrill Street Combined Sewer Rehabilitation, which required the rehabilitation of approximately 2,100 linear feet of 60 in. and 700 linear feet of 66 in. concrete combined sewer that was built in the 1950s.



Figure 5. Bypass Pumping and Piping Required for CIPP Operations on Merrill Street
Source: EPA Report Contract No. EP-C-05-057, 2011

Figure 5 shows the amount of bypassing pumping and piping required, which closed two of the five lanes near Alabama St. and Henry St., which nearly eliminated CIPP from being selected. Generally, the cost of bypass pumping is the most critical factor for Indianapolis, due to the large

volume of flow in the medium to large size segments that are attached to the interceptor system. However, for this project other factors played a larger role than bypass requirements.

Ultimately, all of the large diameter remediation options were considered and three were evaluated before making the final rehabilitation method selection. The amount of bypass could have been reduced had sliplining been used, but due to the slight alignment changes at the majority of the manholes, which required access pits at each location, it was more cost-effective to use CIPP, which would eliminate the need for multiple access pits. The multiple access pits would have had a more significant impact on the traffic than the closure of the two lanes for the bypass system. There was also a high volume of adjacent utilities along the alignment which would have made digging access pits very difficult and time consuming. Shotcrete was also considered, but it was eliminated from further consideration due to concerns about capacity and corrosion.

The choice of the rehabilitation method for large projects should be the result of the application of a business case to the potential alternatives. The City of Seattle, for example, requires that a business case is performed for any project that would cost more than $1 million (Terry Martin - Seattle Public Utilities, 2013). Typically the business case will include an evaluation of all economic and triple bottom line costs and benefits. At a minimum, a summary table should be produced with available backup for the decisions made, such as Table 19 below for the case the Merrill Street rehabilitation previously presented.

Table 19 SUMMARY OF REHABILITATION RECOMMENDATIONS (DR. JOHN MATTHEWS, 2011)

Open Cut	Not considered due to the: (1) depth of the sewer; and (2) proximity to utilities and major thoroughfares.	Only trenchless options were evaluated
Shotcrete	Eliminated from consideration due to: (1) a slight capacity decrease (~4%); and (2) concerns about corrosion of the material.	Eliminated despite being cheaper than CIPP and sliplining
Sliplining	Eliminated from consideration due to the: (1) need for access pits at each alignment change; and (2) larger impact on traffic conditions.	Eliminated despite requiring less bypass than CIPP
CIPP	Recommended and selected due to: (1) limited excavations since the liner can negotiate bends; and (2) the significant capacity increase (~45%).	Engineer's estimate at 90% design was around $3.9 million

For Bloomington, CIPP would appear to be a useful and applicable technology for smaller pipes. The City of Columbus, OH reported using CIPP for 99% of its small and large diameter

rehabilitations, while Indianapolis uses it for 95% of its rehabilitations of pipe less than 54-in diameter. Other municipalities, however, make much more use of open cut replacement, such as Dallas where 97% of its rehabilitation has been by open cut (Dr. John Matthews, 2011). In recent years the city has begun to use more trenchless technology and had reported performing around 5,700 linear feet of CIPP rehabilitation and 4,500 linear feet of fold-and-form.

From a life cycle cost perspective, the reasons why a replacement, repair, or rehabilitation is necessary should be considered first. Pipe lining can be advantageous in cases where a certain degree of structural deterioration is noted. It can also be effective in some cases for reducing infiltration and inflow (I&I) into a sanitary sewer system. However, the source of I&I must be well analyzed before moving to a potential pipe lining solution. Such solutions will not address cross connections from storm drains or connections of foundation drains to sewer laterals, for instance. Furthermore, there may be significant infiltration into sewers at faulty lateral connections. In such cases, simply lining the mainline sewer will not eliminate inflow at the connection points. Lateral connection lining (top hats), interface seals, chemical grouting or lateral lining at the connection must be employed in these cases.

Pipe lining is expensive and if pipe segments have been rated as low risk using the GIS-based Infrastructure Rating Tool previously discussed (Michael Baker Jr., Inc., November 19, 2012), then other alternatives for reducing I&I should be thoroughly explored before using this technology. These alternatives likely include pilot studies of footing drain cross connection frequency in problem areas, followed by disconnection programs. If the BRE is high (indicating low business risk rating), spot repairs such as chemical grouting, localized CIPP, or replacement point repairs that are identified based on the results of CCTV inspections could very well provide similar reductions in I&I at a lower cost than full CIPP lining. Manhole rehabilitation may be more cost effective as well and thus thorough inspections should take place before resorting to a complete pipe lining approach as an intended method to reduce I&I. If after verifying other sources it is found that the I&I is directly related to the defects or deterioration in the piping itself, then pipe lining becomes an acceptable solution.

V. Best Practices for Management of Assets and Life Cycle Cost Optimization

The strategies used by COBPW to more effectively manage its storm and sanitary sewer systems should be developed to accomplish two major goals:

i. Meeting a desired level of service that is acceptable to its stakeholders.
ii. Reducing the lifecycle costs associated with its infrastructure.

The accomplishment of the aforementioned goals will require time for development. It is a process whereby information is collected over time and used to make smarter decisions about O&M investments and CIP decisions. An effective set of strategies will enable COBPW to:

1. Establish what its work crews should be doing to minimize costs, and where and when they should be doing it.
2. Develop needed CIP projects and establish the order in which they should be done.
3. Decide for classes of infrastructure component when to repair, when to rehabilitate, and when to replace.

The elemental tools that allow for appropriate strategies to be implemented were shown in Figure 1. They are the tools for management of information and identification of critical infrastructure issues. In this section of the present Memorandum, a framework is established that allows the information derived from the tools to be used for establishing maintenance strategies (both predictive and preventative). The framework is based on leading industry practices and consultation with Bloomington staff. It establishes the best initial approaches towards implementing strategies that lead to the desired results enumerated in bullet items i - ii and 1-3 above. In straightforward terms, the framework may be thought of as answering the question, "now that we have the information, what should we do with it?"

A. Establishing Levels of Service

In order to determine appropriate repair/replacement priorities, COBPW must establish a level of service goal. This is an industry standard practice that effective utilities implement as a driver of their programs. An organization's level of service (LOS) should be practical, attainable, and sustainable; it may also differ for different types of assets. The level of service document, or agreement, is a multi-faceted tool that fulfills a variety of purposes including (New Mexico Environmental Finance Center, New Mexico Tech, 2006):

- Communicate the system's operation to the customers (residential, industrial, or commercial)
- Determine critical assets
- Provide a means of assessing overall system performance
- Provide a direct link between costs and service

- Serve as an internal guide for system management and operations staff
- Provide information for system annual report or annual meeting presentation
- Reduce system costs through customer involvement

In general, levels of service embody:

- Quality
- Quantity
- Reliability
- Environmental standards
- Legal requirements
- Customer demand characteristics
- Governing board policies
- Community standards

The answers to the following questions will help COBPW develop a level of service definition:

- What level of service do stakeholders and customers demand?
- What are the legal requirements?
- What do the regulators require?
- What is the utility's actual performance?
- What are the physical capabilities of the assets?

The foundation for establishing a defined level of service begins with COBPW's Vision and Mission statements. Examples of levels of service are driven from the eight elements noted above (quality, quantity, reliability, etc.); such an example is presented in Table 20:

Table 20 EXAMPLE OF LEVELS OF SERVICE

Level of Service		Target
Waste-water	Compliance with effluent discharge permits	100%
	Sanitary sewer overflows	Zero
	Odor complaints	2 per month maximum
	Confirmed Basement Sewer Backups	2 per year
	Combined sewer overflows	Zero
Stormwater	Compliance with NPDES MS4 Permit	100%
	Street Flooding	5-yr return period
	Culvert/Roadway Overtopping	50-yr design return period
General	Employee health and safety	Zero injuries
	Competitive rates	Within 10% of surrounding utilities
	Public image	No adverse media reports

It should be noted that "performance measures" are not the same as "levels of service". It is important that levels of service are measurable; however, performance measures are more specific. Below are potential performance measures to be considered by COBPW. Each one identified below would be compared to an agreed upon objective to determine performance:

- Annual water quality samples tested
- Linear feet of pipe rehabilitated, replaced, or repaired
- Number of sanitary sewer system defects per 1,000 miles of main
- Telephone calls per year answered (e.g. -- < one minute)
- On-time arrival by sanitary sewer repair crew (e.g. -- < 2 hours)
- Percent sewer capital projects under construction that are on, or ahead of schedule
- Linear feet of pipe per year that is CCTV inspected

Of particular importance among the purposes of the LOS is the ability it affords to a wastewater utility to communicate with its customers in order to avoid confusion, bad feelings, accusations of improper operation, and to make clear what the customer's expectations should be. A defined

LOS that has at least some measurable items allows for a utility to track information regarding how well they are meeting these criteria and use that as one measure in assessing the overall operation of the system (New Mexico Environmental Finance Center, New Mexico Tech, 2006).

Establishing its LOS and communicating to its stakeholders should be one of the initial steps in developing Bloomington's SAMP. Ultimately, the LOS must reflect the values of Bloomington residents and elected officials, and be balanced against the cost of maintaining the desired levels. For some items, benchmarking information can be of assistance. Benchmarking is a process of investigation and learning from the best in a class to get useful information for improving and changing an organization. Below are two figures representing benchmarking information from the Water Infrastructure Database (WATERiD) (Virginia Polytechnic Institute and State University (Virginia Tech), 2011).

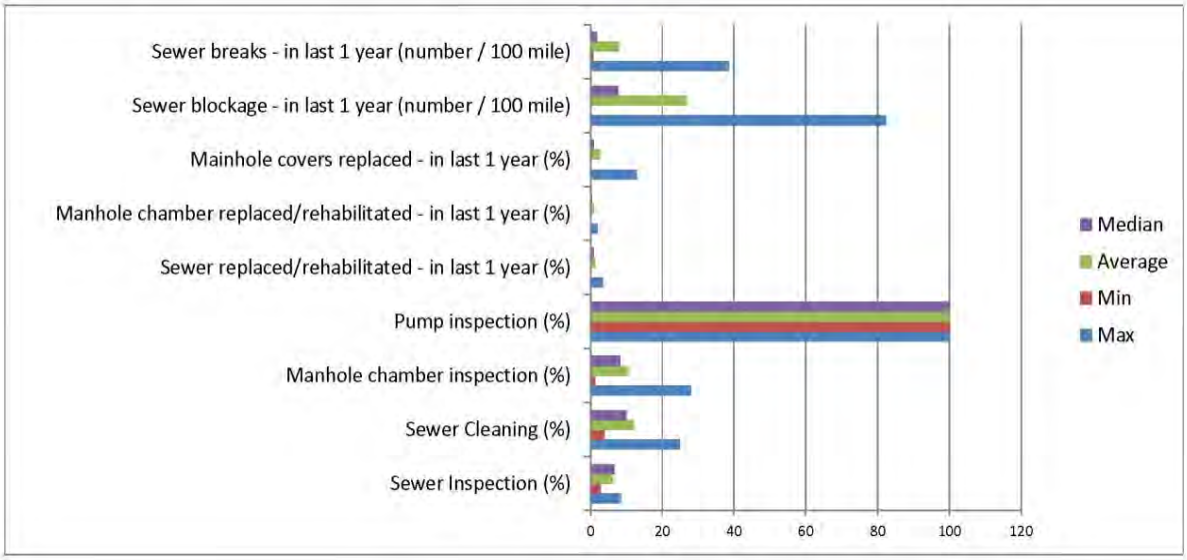


Figure 6. Benchmarking Information for Operational Performance

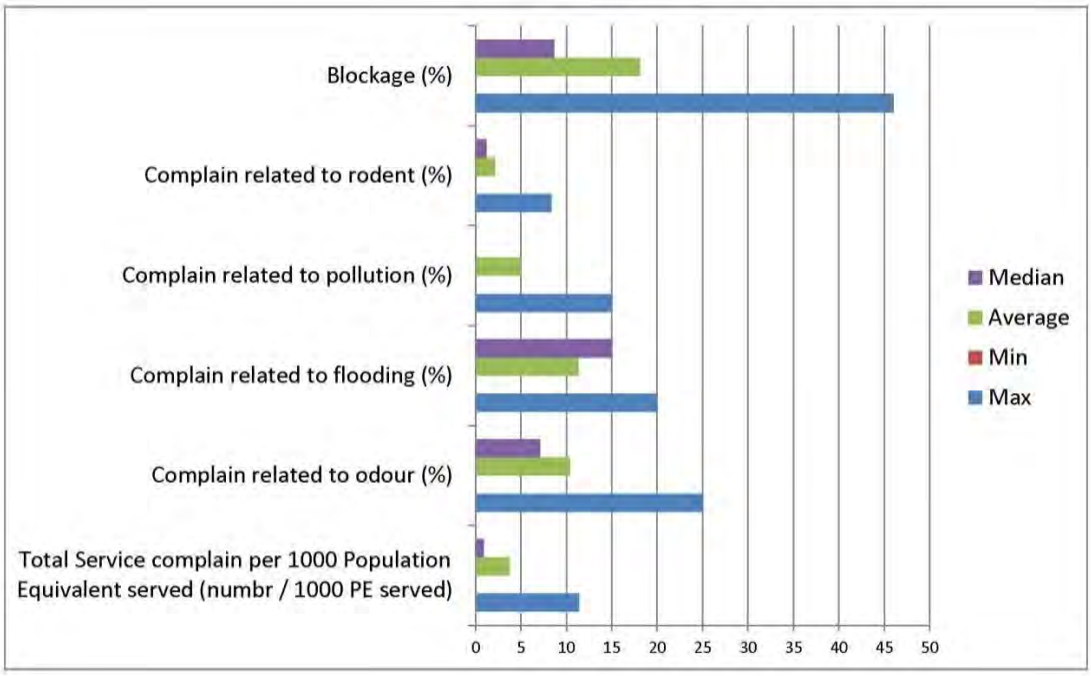


Figure 7. Benchmarking Information for Customer Inquiries

The information presented in the graphs represents feedback provided by numerous utilities across the United States. It may be used as a starting point for development of certain LOS parameters. However, COBPW will need to evaluate which LOS parameters are relevant and applicable to its operations. Ideally, the public should be involved in the final development of the LOS document, through focus groups, surveys, or other means. Practically, it is difficult to get the customers to attend meetings or complete surveys and it can be difficult for them to understand certain components of the LOS. The best-case scenario may be to ask for specific input on items that directly affect the customers and for which they would have a reasonable understanding of the social and economic costs associated with the item (New Mexico Environmental Finance Center, New Mexico Tech, 2006). Feedback from key stakeholders will ultimately result in a more effective LOS document that helps to justify the decisions and priorities of COBPW relative to its O&M and CIP programs.

B. Reducing Lifecycle Costs Associated with Sanitary and Stormwater Infrastructure

Reducing lifecycle costs is a principal goal for COBPW for the operation, maintenance, and replacement or expansion of its sanitary and storm infrastructure. The SAMP described at the beginning of the document is predicated on a stepped approach, in which Bloomington's infrastructure is assessed, evaluated for risks, and then prioritized for maintenance, repair, or replacement. The prioritization is determined by which action will provide the best ratio of economic, social, and environmental benefits, compared to associated costs. These steps will be

further elaborated in the following sections, together with examples developed from City of Bloomington data collected and analyzed during the Master Planning project.

1. Inventory Assets and Establish Information Tracking

Before infrastructure can be strategically managed, it is necessary to know what the infrastructure is. In simple terms, "you've got to know what you have before you can make it better." The requirements for COBPW to obtain an acceptable data management system for the purposes of the SAMP are covered in Section II of this document. Requirements for data tracking, in the form of a GIS-based work order platform, were covered in a separate memorandum (Michael Baker Jr., Inc., 2013). Having adequate data that is easily retrievable and current is perhaps the most important single step that COBPW can take to move toward a strategic approach to managing its assets.

2. Assessment and Risk Evaluation of COBPW sewer Infrastructure

The second step in the SAMP is to assess the condition of the storm and sanitary assets (pipes, manholes, pump stations). The development of a rating system establishes a business risk score, or business risk exposure (BRE), for selected assets by taking into account identifiable factors that contribute to the likelihood for an asset to fail as well as factors indicating a severe impact to the City of Bloomington, its customers, or the community if a particular asset were to fail. The BRE is the risk that a component will not allow a utility to operate at defined levels of service in the most cost effective manner. The present Master Planning project included the development of a GIS-based Infrastructure Rating Tool for which the details and recommended use are presented in a separate memorandum (Michael Baker Jr., Inc., November 19, 2012). In addition, a specific pipe rating methodology for CCTV inspections was developed and is also described in a separate memorandum (Michael Baker Jr., Inc., September 4, 2012). Results from these two ratings are the basis for prioritizing O&M as well as CIP decisions such that the use of resources is optimized according to the goals defined in the LOS.

3. Prioritization of Maintenance, Repair and Replacement Actions

The BRE scale ranges from 1 – 10, with one being the highest risk and ten the lowest. BREs may be developed at a level of CAP 1 or CAP 2. CAP 1 level BREs are based strictly on desktop information including pipe age, historical repairs, and customer complaints. If the BRE has been developed in part based on actual field information, such as CCTV inspections, dye testing, or hydraulic studies to evaluate capacity, it is considered to be at a level of CAP 2. This signifies that the BRE should be more reliable in terms of reflecting the actual business risk. Business risk is defined as the potential that an infrastructure element (pipe, manhole, etc.) will cause the utility to fail to meet its LOS. It is important to note that a component of infrastructure that does not result in cost effectiveness is also considered a failure to meet LOS. The methodologies for

developing the BREs and the parameters that influence the numerical rating are discussed in the previously mentioned memorandum on the GIS-based Infrastructure Rating Tool, and thus are not described in great detail in this section.

Once the ratings are obtained using the tool, the process of prioritizing O&M as well as CIP projects begins. Infrastructure elements with lower BREs (signifying higher risk) will receive attention before lower risk items. In addition to the rating tool risk, other factors within Bloomington's operations must also be taken into account, such as pavement condition reports, potential regulatory actions confronting the City, and CCTV ratings. Over time COBPW staff will develop and refine its methodology for prioritization of activities in response to BRE ratings. The goal is to spend the right amount of money, on the right infrastructure, and at the right time. An initial recommended standard operating procedure (SOP) is as follows:

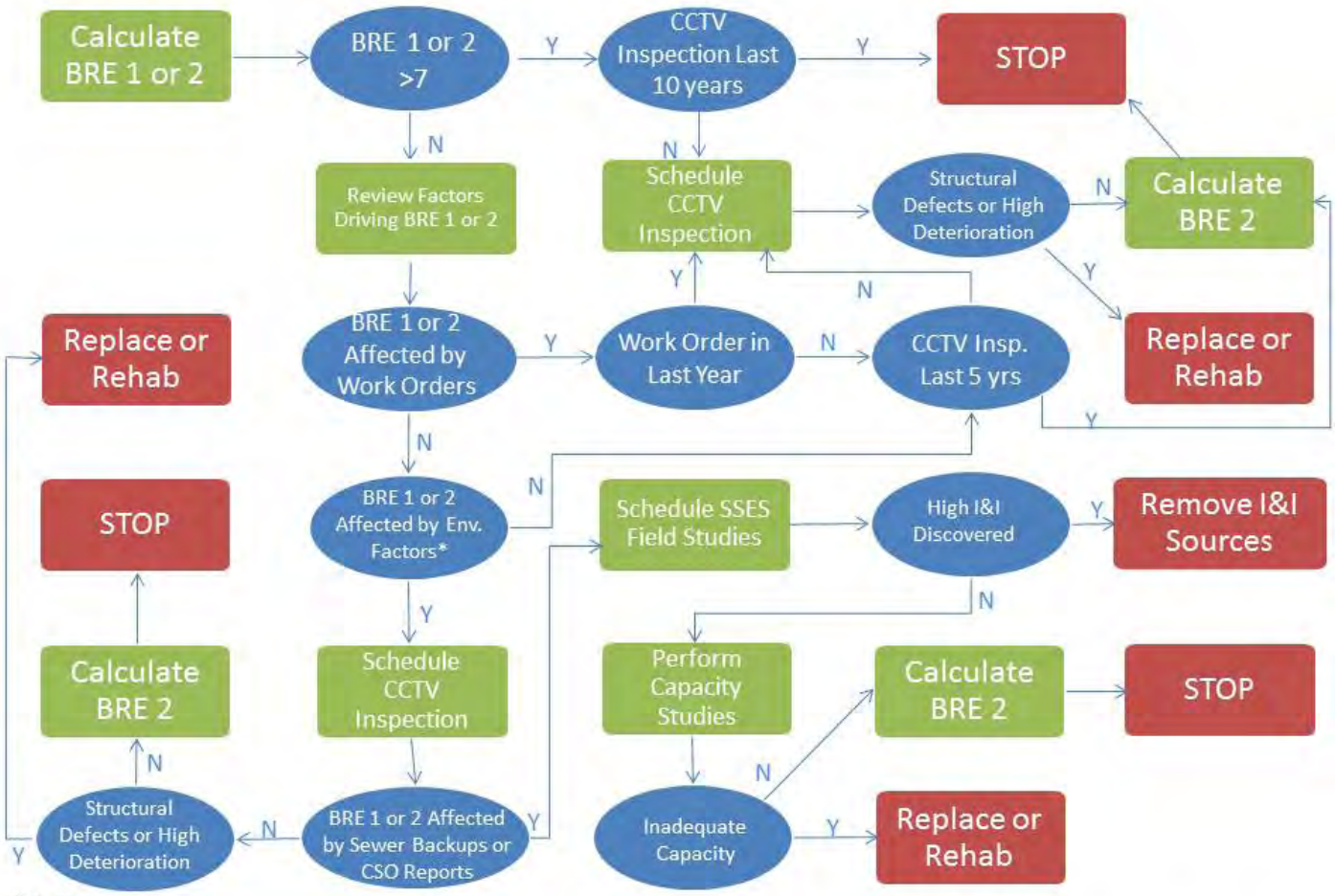
a) Apply the GIS-based Rating Tool and perform a subsequent infrastructure review annually.

b) Use the results of the infrastructure review to identify required O&M activities and CIP projects following certain initial guidelines – typically a decision tree that includes "trigger" points for when one type of activity is preferred over another.

c) Optimize decision making. Review the results of the identification based on COBPW staff knowledge of funding, social factors, and specific details. This step is performed to validate the initial selection in step b) against additional information not reflected in the ratings. It is an additional filter of the initial selection leading to a final set of scheduled O&M activities and CIP projects, which are grounded in good engineering judgment and the other factors previously mentioned.

d) Create a list of planned O&M as well as CIP Projects based on the results of step c) on an annual basis and inform City Council and other stakeholders.

These steps are presented in the following decision trees, which includes trigger points and critical factors that determine the best course of action.



Notes:
All terms in chart are defined and explained in the memorandum: *GIS Based Infrastructure Rating System Pilot Area Evaluation – Phase 1 (Cap 1 & 2).* City of Bloomington, IL; Michael Baker Jr., Inc. (November 19, 2012).
*Pipe or Manholes under waterways and detention basins, or reports of SSOs/CSOs. See GIS Based Infrastructure Memorandum

Figure 8. Decision Tree for Prioritization of Maintenance and CIP Projects

Figure 8 starts with the calculation of the BRE for each asset (pipes, manholes, etc.), which should be carried out annually. The BREs change over time due to new work order reports, increased age, and updated field information from both CCTV inspections as well as other studies. The GIS-based Rating Tool, when applied to two pilot areas, showed that a BRE of 7 or less appears to be a breakpoint for which a select set of infrastructure components reflect a higher degree of risk to COBPW. By filtering these assets, COBPW can then review the factors that affect the BRE, as presented in the memorandum on the GIS-based Rating System. If past work orders appear to drive the drop in BRE score, the general path is to perform or review CCTV inspections. If environmental factors drive the BRE, such as pipes under water bodies, then a CCTV inspection is still performed as a first review mechanism. Such pipes will thus receive more frequent CCTV inspections as a result of the methodology, since the BRE SOP in the Figure is repeated on an annual basis. For environmentally driven BRE scores, the pipe or asset is further analyzed for reports of sanitary sewer overflows (SSO), combined sewer overflows (CSO), or basement sewer backups, which trigger the execution of field studies (known as sanitary sewer evaluation studies, or SSES) to better define the causes. Following the decision tree results in a list of infrastructure for which it is recommendable to replace, rehabilitate, or repair (RRR List). All infrastructure is re-evaluated annually using the Rating Tool.

Actions to address the infrastructure on the RRR List may be evaluated and optimized further through use of the decision tree of Figure 9.

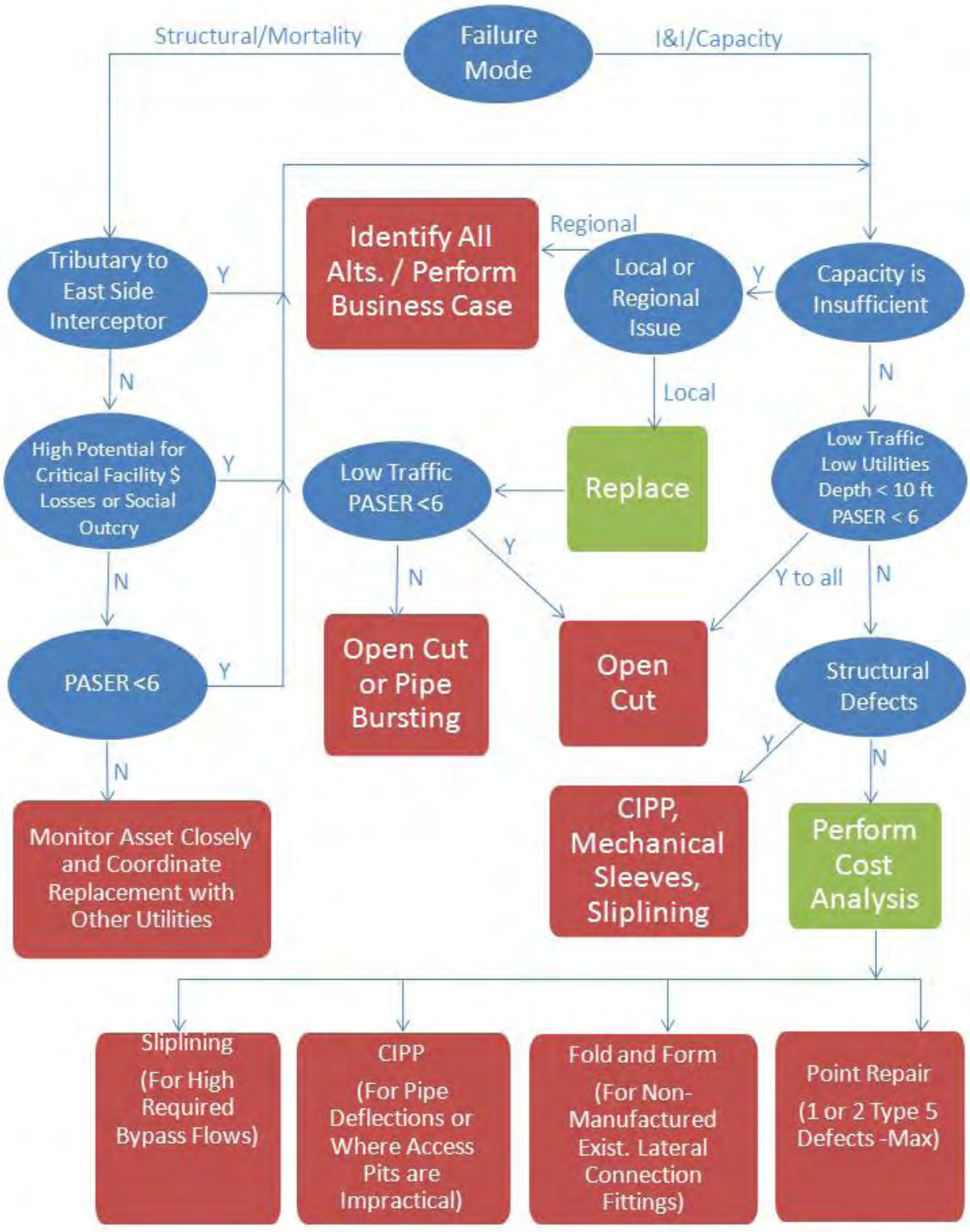


Figure 9. Decision Tree for O&M/CIP Optimization

For infrastructure affected by inflow and infiltration (I&I) and/or capacity issues, the choice typically is between open cut replacement, trenchless replacement, or rehabilitation using lining or spot repairs. Figure 9 provides some factors to consider in choosing the best technology. More details on selecting a technology are covered in Sections III and IV of this Memorandum. All available and feasible technologies should be considered before making a selection, and COBPW may want to provide bidders with the option of proposing several different options rather than limiting itself to one.

Infrastructure affected by structural and mortality issues follows a different decision path, in which various key decision cost factors are evaluated. These factors may be thought of as triple bottom line costs, consisting of economic, social, and environmental. For instance, given the concern that Bloomington Normal Water Reclamation District (BNWRD) has concerning I&I into its East Side Interceptor, the decision tree is directed to immediate action if the element is tributary to the system. This is not due to an economic cost to COBPW, but rather a social (and to some extent, environmental) cost. High potential cost to critical facilities might include a major hospital, or airport, that would be shut down or limited due to the failure. It might also include unwanted negative media attention and stakeholder outcry. Both of these fall into the categories of social and economic costs. The state of the pavement is taken into account in the decision process as well. When in good condition, it may be more cost effective to monitor assets with low BREs more closely rather than address the problem immediately, and to coordinate with other utilities and pavement condition ratings to perform construction activities at the same time in order to optimize pavement replacement and mobilization expenses.

4. Optimization Strategies for O&M and CIP Actions

a) Business Cases for Optimization

Often times it is helpful to develop a business case to support the decision making process concerning the options of addressing the problem or simply increasing monitoring of the issue. A hypothetical example of a business case is presented in Appendix A. It demonstrates how to evaluate various options from an economic standpoint. COBPW should apply such an analysis to projects that it deems significant, such as those that may cost $1 million or more. The analysis can be time-consuming and thus should not to be applied to each and every asset on the RRR List.

b) Case Examples within Pilot Area

(1) Hannah Street

A specific application of the prioritization and optimization process recommended herein may be made to several cases seen in Pilot Area 2, one of two pilot areas in which the GIS-based Rating Tool was tested and is presented in Figure 10. The GIS Tool returned a value of 7 for the BRE1

for a segment of combined sewer a long Hannah Street south of Oakland Avenue. Foth performed a survey of residents about drainage and sewer problems as part of the Master Plan project, and subsequently performed XP-SWMM modeling of this segment. (Foth, 2013). Foth's study was performed independently of the GIS Tool analysis performed by Baker. The Foth survey included a cluster of three reports of sewer backups, which are shown in Figure 11. The sewer backups are not in COBPW's current GIS layer that is maintained with such information. The BRE1 value of 7 was driven primarily by the age of the pipe, which is approximately 140 years or more, and also to some extent by the location factor given that the pipe is in a medium to high traffic area. Had the report of basement sewer backups been available to the GIS Tool, a BRE1 value slightly lower would have resulted, but still reported back as 7 due to rounding.



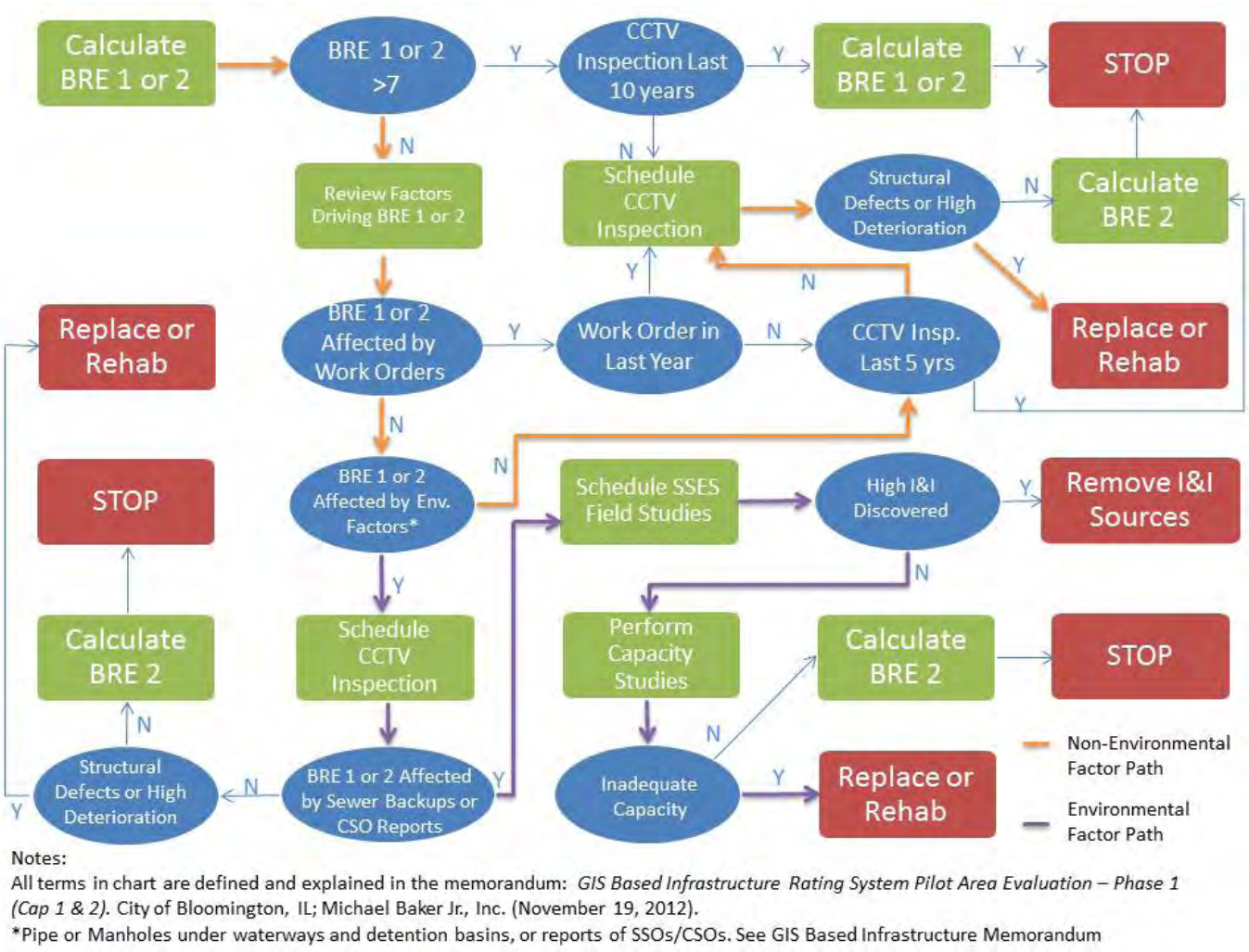
Figure 10. Pilot Area 2

Following the flow chart in Figure 8, COBPW would note that the BRE1 is not larger than a value of 7, and would thus review the factors driving (or affecting) the score. Since there are no reported work orders along the pipe segment (such as cave-in repairs), COBPW would check to see if the BRE1 was affected by environmental factors, meaning a pipe under a waterway or a report of a CSO/SSO along the segment. If so, then a CCTV inspection is scheduled. If the pipe is specifically affected by reports of CSO/SSO or sewer backups, SSES studies would then be scheduled (assuming the problem is not evident from the CCTV inspection). If a high level of I&I is discovered, the planned action is to remove I&I sources. Alternatively, the segment or system serving this area is studied for capacity issues. Inadequate capacity results in the scheduled action of replacement.



Figure 11. Hannah Street South of Oakland Avenue and Reports of Sewer Backups

The two decision paths described are presented in Figure 12. Specific considerations and points of emphasis related to the Hannah Street example are as follows:



Notes:
All terms in chart are defined and explained in the memorandum: *GIS Based Infrastructure Rating System Pilot Area Evaluation – Phase 1 (Cap 1 & 2).* City of Bloomington, IL; Michael Baker Jr., Inc. (November 19, 2012).
*Pipe or Manholes under waterways and detention basins, or reports of SSOs/CSOs. See GIS Based Infrastructure Memorandum

Figure 12. Potential Decision Paths for Prioritization of Actions along Hannah Street

- Management and availability of data is critical to the decision making process. Lack of a work order management system such as shown in Figure 1, or an equivalent information management system, signifies that information on sewer backups in homes or about reported CSOs and SSOs will not influence the decision making process. In such a case, the path designated as “non-environmental” in Figure 12 would be followed, and would result in replacement or rehabilitation only if severe structural defects are found. Furthermore, such action may not address the environmental issues, such as CSOs due to inadequate capacity, or an SSO due to illicit connections.
- The definition of a CSO should include surcharge onto streets, which often can result in contamination of surface water resources. Along Hannah there is also a storm sewer system, and it is possible that there are inlets connected to the storm sewer which could receive the CSOs. Bloomington should track CSOs as part of its future work order system and consider street flooding from combined sewer as a type of incident to record.
- The Foth modeling indicates that the Hannah combined sewer would surcharge for the 5-yr period design storm, such that this particular sewer would be a candidate for replacement, or alternatively reduction of inflow.

The flow chart of Figure 8 (as annotated in Figure 12) may result in either replacement or rehabilitation due to severe structural defects (the non-environmental decision path), or the same action due to insufficient capacity or excessive I&I (the environmental decision path). In this specific example it has been determined that capacity is clearly an issue, through the previously mentioned modeling. COBPW can use a second decision tree as presented in Figure 9, and annotated for the specific example of Hannah Street in Figure 13, as a guide towards determining the most cost effective, and thus the most optimized, solution. Costs are both monetary, but also entail social and environmental. Together these have become known as triple bottom line costs.

Use of the decision tree starts with determining the failure mode, which should be evident after use of Figure 8. The example of Hannah Street relates to a capacity issue as previously seen in Figure 12, thus the path advances to the right of the chart. If capacity is indeed insufficient (based on the desired LOS), then it must be determined if the failure mode is localized or regional in nature. If the failure is localized, addressing the pipe segment alone will correct the issue, but if the failure is regional then segments up and downstream of the pipe reach may need to be addressed as well (such as for a regional, systemic capacity deficiency). A regional issue requires that all alternatives are identified and evaluated using a business case approach, in which benefits and costs are compared. In the case of Hannah Street, the issue appears to be local, and the decision is to replace the pipe. Options available include open cut (most common), or by pipe bursting. The later technology “is a well-established method for trenchless replacement of worn out and undersized gas, water and sewer pipes. An existing pipe is replaced

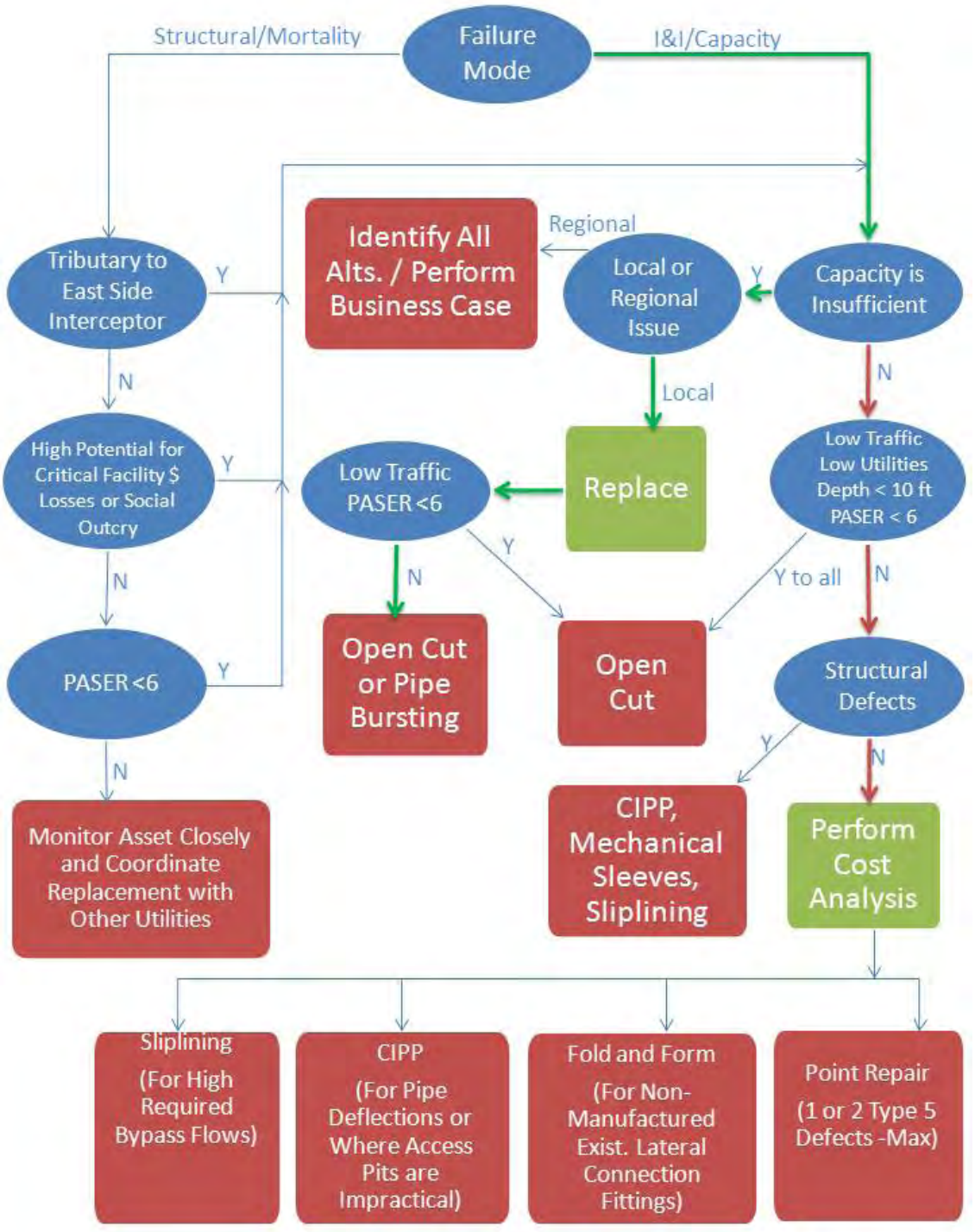


Figure 13. Alternatives Decision Path for CSO along Hannah Street

size-for-size or up-sized with a new pipe in the same location. The technique is the most cost effective when there are few lateral connections, when the old pipe is structurally deteriorated, and when additional capacity is needed" (Jadranka Simicevic, 2001). While it is not the intent of this Memorandum to provide extensive information on trenchless technologies, pipe bursting may be advantageous when there is an enhanced depth of lines that increases the cost of open cut replacement through extra excavation, shoring, and dewatering or when indirect cost savings, due to less traffic disturbance, shorter time or replacement, and less business interruption are significant (Jadranka Simicevic, 2001).

If the issue wasn't capacity, the decision path would continue to analysis of typical cost factors including traffic use, utility complications, depth of the segment(s), or condition of the pavement. If none of these factors are critical (meaning no utility complications, deep pipes, high traffic or high condition pavement), then the open cut with replacement is likely the best solution, based on standard practices seen in Baker's experience and research. If one or more of the factors are critical, then the decision flow continues to a trenchless solution. The potential solutions are listed on the flow chart. Considerations for lining pipe segments are presented in Section IV of this Memorandum.

The use of Figure 9 in selecting and optimizing corrective actions is recommended for COBPW mainly for two reasons:

- The Figure combines considerations of monetary costs with social and environmental costs.
- The Figure encourages consideration of the best technology and best practice for each action on the RRR List. The avoidance of surface destruction and trenching through pavement in good condition is considered, for instance. Traffic disruption is taken into account. The segment's ultimate discharge point is tracked as well, such that defective pipes draining to the East Side Interceptor are addressed sooner rather than potentially deferring RRR actions in favor of close monitoring; this in deference to the concerns of BNWRD around I&I into its system. As previously stated, COBPW should apply a business case analysis to projects that approach a certain cost threshold, such as $1 Million or more.

Performing an in-depth analysis and business case often reveals alternatives not considered otherwise. In the case of Hannah Street, COBPW GIS information indicates that there is a storm sewer draining south to Croxton Road that is not significantly far from the location of the sewer backups. It would be recommendable to study the feasibility of separating inlets from the combined sewer north of Bell and directing them through a new proposed storm sewer to the existing storm sewer.

(2) McGregor Street

The Foth survey also revealed reports of flooding along McGregor Street south of Oakland as well as basement sewer backups, as shown in Figure 14. These reports are not in COBPW's GIS layers. The GIS-based Rating Tool uses strictly information in the GIS layers, since the data is assumed to have been verified and validated. The Rating Tool returned a value of 5 for BRE1. Had the report of street flooding been validated, this would be considered a CSO by the tool.

This together with the sewer backup would have resulted in a value of BRE1 of 5. Implementation of the Work Order Management System previously described will allow for better recording and retrieval of such critical information, resulting in more accurate evaluations of business risk. Foth's sewer modeling indicated a severity of 3 on a scale of 1 to 4 for the hydraulic capacity of the segment, which results in a value of BRE2 of 7. The GIS-based Rating Tool uses a severity scale of 1 to 4 from either CCTV inspections or field studies (SSES, capacity, etc.) to estimate a BRE2, which is a refined value of BRE that is weighted more heavily on results of the field studies. Further details for calculation of BRE2 may be found in the memorandum describing the tool (Michael Baker Jr., Inc., November 19, 2012).

Using the decision tree flowchart of Figure 8, the flow will progress to a decision to perform CCTV inspections followed SSES field studies, given the presence of CSO reports and sewer backups. If high infiltration is discovered, the decision tree points to the action of removing it. If I&I is not an issue, then performance of capacity studies is indicated as the action (which has already been performed by Foth).

Use of Figure 9 for identification of the optimized solution would likely lead to the decision of open cut pipe replacement if the flooding and other issues are local, meaning related to the immediate pipe segment. However, in this area reports of sewer backup have been reported along Kreitzer and Florence Avenue as well as along Croxton east of Vale. Street flooding has been reported by COBPW at the intersection of Oakland and Meadows as well. The regional nature of the identified problems points to the action of identifying all possible alternatives and performing a business case. Alternatives include:

- Separation of combined sewers and redirection of storm runoff into the existing storm sewer branches at the intersections of McGregor/Maizefield and Oakland Meadow. These branches flow to a large 60-in diameter storm sewer along Croxton near Morrissey. Reducing stormwater flow into the combined sewers will lower the HGL and the frequency of basement sewer backups, as well as CSOs onto the street. As part of the analysis, the condition and capacity of the large diameter storm sewer should be considered. For instance, the BRE1 for this sewer ranges from 5 to 8 and is driven principally by the age of 140 years or more. It may be necessary to replace or rehabilitate the storm sewer rather than simply using it. Another possibility is that the capacity may be insufficient. In the former situation, both open cut as well as the trenchless technology of CIPP or point repairs (such as mechanical sleeves) should be considered, since the pipe will likely have some serious structural deficiencies. However, point repairs cannot be performed on aging brick sewers.
- Augmentation of capacity of the combined sewers along McGregor, Kreitzer and Florence. This will result in additional peak flow to the combined sewer along Oakland Avenue, and downstream effects should be analyzed.
- Installation of ejector pumps/overhead sewers for the properties affected by sewer backups along Kreitzer, Florence, and Croxton east of Vale.

All alternatives should be evaluated in terms of the benefits they provide against cost. For instance, the separation of stormwater from the combined sewer along McGregor and use of the existing storm sewer at Maizefield will reduce the amount of stormwater that eventually needs to be treated. This is a benefit that would influence this option's feasibility as compared to the

others. Alternatives should also be considered in light of the LOS defined by COBPW. If the LOS indicates that a certain number of basement sewer backups are reasonable on an annual basis, and the aforementioned incidents fall within the permissible quantity, then there may not be a need for a solution. This degree of review is predicated on having reliable information in a work order management system that can be retrieved to determine LOS compliance, and is yet another justification for investment in COBPWs information management systems. The costs for such investment into data management systems together with specific requirements are presented in Section II.

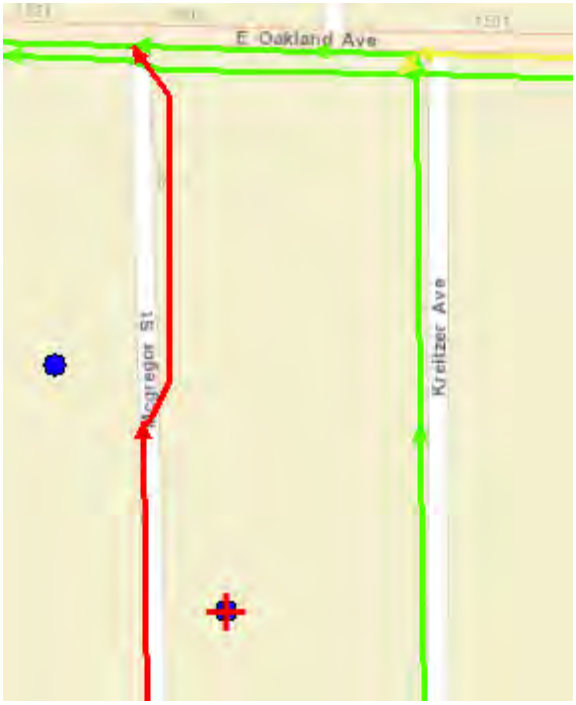


Figure 14. McGregor Street Reported Flooding and Basement Sewer Backups

VI. Recommendations and General Considerations for Root Control Program

An effective root control program is an important component of any SAMP for sanitary sewer. Root intrusion were reported by COBPW in several meetings held with Baker, and are known to be a significant consumer of this Department's time and financial resources. This section of the Memorandum is intended to provide general considerations for when to establish a program, together with guidelines for its implementation.

A. Decision Triggers for Root Control

According to one source, "Root-related sewer problems include: sewer stoppages and overflows; structural damage caused by growing roots; formation of septic pools behind root masses (which generate hydrogen sulfide, other gases, and odors); reduction in hydraulic capacity and loss of self-scouring velocities; infiltration in areas where pipes are seasonally under a water table; and exfiltration of sewage into soils around cracked or separated joints. Sewer stoppages and overflows are the way that most municipalities and homeowners find out about their root problems. Structural damage, on the other hand, usually goes unnoticed until the damage is verified through video probing. In the long run, structural damage is probably more costly than sewer stoppages. Effective use of early, preventive root control can avoid costly and permanent structural damage. However, municipalities are unlikely to fund preventive root control programs but usually wait until identified problems alert officials to the need for control (Marer, 1996)". This as well as many other sources including COBPW's own experience would suggest that root control programs can provide potential benefits and cost savings.

Baker recommends that decisions regarding when to implement such activities are based on the same BRE rating system previously described in this Memorandum. Through application of the GIS-based Infrastructure Rating System (Michael Baker Jr., Inc., November 19, 2012) developed as part of the SAMP, and subsequent use of the Decision Tree as presented in Figure 8, COBPW will be able to identify segments of pipe that present a higher risk to meeting its overall LOS for its stakeholders. When there is evidence of past work orders for these reaches involving root intrusion, a root control maintenance program should be considered. In order for the program to operate effectively, three immediate requirements are evident:

- The work order management system previously discussed at the onset of this Memorandum in Figure 1 must be in place, which allows for tracking of historical root issues and repairs.
- CCTV inspections of pipe segments should follow the guidelines presented in Section I, particularly concerning the application of the PACP rating methodology.

- CCTV inspection data should be input into COBPW's GIS, preferably using automated techniques as recommended and described in Section II.

The management and recording of data through these tools will allow for COBPW to identify reoccurrence of root issues and to determine when proactive future maintenance is justified from a business risk standpoint.

B. Root Control Program Methods

This section presents considerations for the types of root control to be employed. The entire text presented herein is from an excellent source on such programs, which may be consulted for additional information (Marer, 1996).

"A successful sewer line root control program will integrate a variety of root control methods. This includes non-chemical control methods such as planning and management during sewer line construction, physical control procedures, and mechanical root removal. Non-chemical methods are usually augmented with chemical control methods when necessary. Chemical control involves the use of certain herbicides.

1. Non-Chemical Control

Several non-chemical methods of sewer line root control are available to root control experts and public works officials. Although non-chemical methods generally do not provide the same level of results as chemical methods they have an important place in sewer line maintenance. For example, mechanical methods are best for opening plugged sewers and for removing roots from sewers that are at imminent risk of plugging. Pipe re-lining, grouting, and sealing may deter intrusion by roots. Proper planning during design and installation of sewer lines may discourage root problems.

In some cases chemical control methods should not or cannot be used. For instance, chemicals are not normally applied to sewer lines that are near treatment plants. Also, herbicide use may be restricted due to environmental or safety considerations.

Planning: Proper planning during sewer line design and construction is a practice that can prevent or minimize tree root invasion problems. Root problems are reduced by: (1) carefully installing and inspecting sewer lines during construction to assure all joints are properly sealed; and (2) controlling the selection of tree species and planting sites near sewer lines. Sewer connections with air-tight joints and seams make it difficult for roots to penetrate. Municipalities should pay special attention to and carefully inspect connections where plumbers join building laterals to the mainline sewer to be sure these are tight. Also, homeowners should be advised of the potential for future root problems and should be discouraged from planting deep-rooted or fast-growing trees near sewer lines. Willow trees in particular have adventurous and thirsty roots and can cause serious sewer line problems.

a) Physical Control

Physical control of sewer line roots involves isolating the environment of the sewer pipe from roots that could cause problems. Examples of physical control include tree removal, sewer pipe replacement, and pipe relining.

Tree removal works best when removing a single troublesome tree such as a willow whose roots have invaded sewer pipes. Unfortunately it is often difficult to convince homeowners to remove trees in the vicinity of sewer lines. This is not only expensive but does not guarantee an end to root problems. Roots may survive long after removal of aboveground tree parts, necessitating the use of mechanical or chemical controls for some time afterward. For tree removal to be most effective, stumps should be removed or chemically treated with a basal application herbicide.

Pipe replacement involves removing old, defective sewer lines and replacing them with new pipes. As discussed above, the new lines must have air-tight joints and properly installed connections in order to prevent tree roots from becoming problems. Pipe replacement corrects structural defects as well as existing root problems. Major disadvantages to pipe replacement include cost, disruption of traffic and property, and the destruction of trees and shrubs planted in the vicinity of the trench line. Also, roots can still enter the newly installed line through older lateral lines coming from buildings. If existing sewer pipes are in danger of collapsing or are in a state of structural failure, pipe replacement may be the best method of control. Pipe replacement is not warranted, however, when sewer lines are in sound structural condition.

Pipe lining includes various techniques that are used for rehabilitating sewer pipes. Roots must be chemically or mechanically removed before installing pipe linings. A method known as slip-lining involves pulling a seamless pipe through the existing sewer and digging only where building laterals require connecting. Installing a cured-in-place lining involves inflating and curing a resin impregnated fiber sleeve that conforms to the shape of the pipe. Robotic devices are then used to cut lateral building connections into the liner.

Installing linings in existing sewer lines addresses infiltration problems and some structural defects and is less disruptive than pipe replacement. This technique promises long-term control against root regrowth through joints and cracks. A disadvantage to this technique is that it can be more costly than sewer line pipe replacement. Also, roots can still reenter the mainline sewer through unlined building laterals. Even after relining the mainline, chemical control may be required to prevent roots from penetrating through these service connections.

b) Mechanical Control

Mechanical control is the most common method of root control and the most important non-chemical method. Mechanical control involves the use of tools or other devices which cut and remove roots from inside sewers.

Drill machines, also called coil rodders, are spring-like, flexible steel cables which turn augers or blades inside the sewer line. These devices are either hand or power driven. Drill machines are

most often used by plumbers to relieve blockages in house-lines or other small diameter sewers. They are seldom used in mainline sewers.

Rodding machines are flexible steel rods with attached rotating blade cutters, augers, or corkscrews. Rodding machines are most effective in small diameter sewers, up to 12 inches.

Jetters are also known as flushers, flush trucks, jet rodders, jet trucks, and hydraulic sewer cleaners. A jetter consists of a high pressure water pump, water tank, hose reel, and 1/2 to 1-inch sewer cleaning hose. Orifices in the rear of the nozzle propel the hose through the sewer as the nozzle blasts through obstructions. As the hose and nozzle is retrieved, debris is hydraulically flushed back to the insertion manhole for removal. Jetters can also be equipped with root cutters which use the force of water to spin blades. Unfortunately, root cutters can easily get stuck in sewer lines, especially where there are protruding taps or other structural defects. Once root cutters become stuck they often can only be removed by digging them out.

Winches, also called drag machines or bucket machines, are large engine-driven devices which pull buckets, brushes, or porcupine-like scrapers through sewer pipes. They are equipped with special tools designed to cut roots. Winches are most often used on large diameter sewers which cannot be cleaned efficiently with jetters. Winches are used for heavy cleaning to remove large volumes of solids.

The main advantage of mechanical controls is that they are the only methods of immediately relieving root blockages. Chemicals are ineffective and dangerous when used in plugged or surcharging sewers. Sewer stoppages are emergency situations that require municipalities to have some type of mechanical control devices to correct such problems. However, mechanical control methods do not provide residual or long-term control. Roots respond to injury by producing the plant hormone *abscisic* acid which hastens and thickens regrowth. As a result, root masses grow back heavier each time they are cut. Tap roots continue to grow in diameter and in time place additional stress on sewer pipes.

Mechanical control is often used in conjunction with chemical or other controls. For example, mechanical cleaning is used to prepare sewer lines for rehabilitation with pipe lining or re-grouting.

2. Chemical Root Control

Herbicides registered by the US EPA and the State of ……. for use as root control agents can kill roots for distances beyond the point of contact, providing control of root growth even outside sewer pipes. Choosing the best herbicide for the job is important. Herbicides kill plants or plant parts by contact or through systemic action. A contact herbicide has a localized effect and kills only the plant parts contacted by the chemical. Systemic herbicides are absorbed by roots or foliage and carried throughout the plant. Contact herbicides result in quick die -back of the affected parts while systemics take longer, up to two weeks or more, to provide the desired results. Metam-sodium is a contact herbicide.

Herbicide activity is either selective or non-selective, depending on the chemical used. Selective herbicides kill certain types of weeds such as broadleaf or grassy plants. They are used to reduce

unwanted weeds without harming desirable plants. Non-selective herbicides kill all plants present if applied at an adequate rate. They are used where no plant growth is wanted. Metam-sodium, for example, is a non-selective herbicide.

Many chemicals such as bensulide, dichlobenil, dinoseb, endothall, metam-sodium, paraquat, trifluralin, 2, 4-D, 2, 4, 5-T, copper sulfate, and chlorthiamid have been used for root control. Also, acid and basic compounds such as sulfamic or sulfuric acid and sodium or potassium hydroxide are commonly used as pour down products in residential settings. Not all of these herbicides are registered for use in all states for sewer root control. Before using any chemical for root control, check to see that it is labeled for use in …..*the State of Illinois*… for this purpose."

C. Root Control Program Implementation Options

COBPW may consider several options for executing root control activities, mainly using completely internal resources, external (contractor), or a combination of the two. For mechanical removal, COBPW can consider continued use of the cleaning equipment it currently has that is equipped with root cutter or other equipment/attachments. The feasibility of using internal resources is dependent on the prevalence of root issues and current workforce and equipment holdings, and thus is a decision that can be evaluated through development of adequate information management systems (CCTV inspection databases, work order management systems, etc.) previously discussed. Use of these information tools will allow for analysis to be performed on potential costs and benefits of each option.

Should COBPW determine that outside assistance is required, chemical treatment may be cost effective and should be considered. It is not recommended that COBPW consider chemical treatment application by its own personnel without adequate training and without first verifying adequate safety measures are in place for accidents, spills and tracking. A sample chemical control specification that can be used as a basis for developing a request for services is presented in Appendix B.

Chemical treatment success can depend on many factors and requires a certain level of expertise. Some of the considerations include (Marer, 1996):

- Pipe Slope: a major design criteria of wastewater collection systems because the systems depend mainly on gravity to produce flow. Pipe slope and flow velocity will affect the application and retention time of some treatment chemicals. If retention time is too short, higher amounts of the root control chemicals will flow into treatment facilities.
- Grade: is an important consideration when applying root control chemicals, but is not a factor of pipe slope. Grade refers to the elevation at one location in relation to the

elevation at another. A building's sewer is termed below grade if the elevation of its floor drains is below the invert elevation of the nearest upstream manhole.

- Flow: can affect root growth patterns. Flow is also an important consideration in sewer line treatment. The rate and quantity of flow may dictate treatment methods, the rate of root decay after treatment, the rate at which chemicals drift toward treatment plants, and the rate of dilution of chemicals in wastewater streams. Flows may change during peak periods of residential or industrial use. Pumping stations coming on line may cause sudden increases in flows. In some situations, flow rates can be influenced by groundwater infiltration. The rate of flow can affect the dilution of root control chemicals before they reach treatment plants. High flows may dilute root control chemicals too much and therefore decrease their effectiveness at sites where they are applied.
- Certification: several sewer line root control pesticides are classified as *restricted-use* and as such must be handled and applied only by certified pesticide applicators or under the direct supervision of certified applicators.

VII. Recommendations for Developing a Grease, Oil and Fats Program

A. Introduction

1. Background

The COBPW requested that Baker develop recommendations for the implementation of a fats, oils, and greases (FOG) control program. FOG tends to accumulate on the interior of sanitary sewer pipes. Over time, the accumulation can become severe enough to result in clogged pipes and sewage overflows.

The goal of a FOG program is to provide a more reliable sanitary sewer service to customers, and to minimize the number of sanitary sewer overflows that may result from FOG accumulations. In addition, a FOG management program can play a vital role in the Environmental Protection Agency, Capacity Assurance, Management, Operation, and Maintenance (CMOM) Program approach.

The intent of this document is to provide an overview of possible components of a FOG program and the approach of different municipalities with respect to controlling FOG. This document is a survey of information from which the City can establish its own FOG program.

2. Overview

FOG control devices are required in accordance with the International Plumbing Code to prevent the discharge of oil and grease that may be harmful or hazardous to the building drainage system, public sewer, or sewage treatment plant or processes. FOG is generated during food preparation and processing, or during washing of dishware in contact with food. Establishments from which significant quantities of FOG may be generated include the following:

- Restaurants, bars, delis, country clubs, and caterers
- Food processors, and butcher shops
- Retirement communities, Nursing homes, High-density residential units
- Day care facilities, churches
- Fraternal organizations, schools

Baker was provided data by the COBPW, which shows that it has 119 food service establishments, 4 hotels, 5 medical centers, 16 elementary schools, 3 junior high schools, 2 high schools, and 1 university (food service establishments include locations with public seating).

Implementing a FOG program will require developing relationships with multiple groups inside and outside of the COBPW. For example, the following governmental personnel may be affected:

- Plumbing/Building inspectors
- Health Department inspectors
- Fire and Police Department Personnel

Private groups that could be affected by the implementation of a FOG program could include the following:

- Restaurant Association
- FOG Transporters
- Schools
- Hospitals
- Civic groups
- Public interest groups
- Commercial land developers
- High-density residential groups

Depending on the program elements implemented, some of the groups indicated may be financially impacted. Consequently, the City should coordinate with these groups early in the process. These groups may provide valuable information for the program. In addition, cooperating with these groups may provide greater acceptance by the community and administration and reduce the barriers to implement the program. The Town of Cary, North Carolina used an extensive public relations campaign, with specific emphasis on the Restaurant Association, before its FOG program was implemented.

B. Legal Authority

The following section summarizes Baker's review of the Bloomington municipal code and the International Plumbing Code regarding the City's authority to require construction and maintenance of FOG control devices. In addition, a survey of other municipalities' codes with respect to FOG control is provided.

1. City Code Analysis

Baker reviewed Chapters 34 (Plumbing) and 37 (Sewers and Sewage Disposal) of the City's municipal code and found that Chapter 34, Section 131 requires grease interceptors and authorizes the City to require reimbursement for any cost related to cleaning a City sewer that a business has caused to become laden with FOG. Chapter 34 adopts the Illinois State Plumbing Code, which has specific requirements for grease interceptors.

It may be legally difficult to link the sewers that need cleaning with the grease interceptors that are causing the problem. The City may want to consider modifying their code to allow fines for non-compliance and use the sewer cleaning as a guide for targeting locations needing more frequent inspections. The City should also confirm that their code grants them access to inspect indoor and outdoor grease interceptors.

2. Code Comparison

Baker reviewed a sample of municipal codes to evaluate how municipalities have regulated the discharge of FOG into sewer systems. The content of the codes varies significantly with respect to FOG criteria. Of the codes reviewed, Baker identified several approaches to regulating FOG. A summary of the methods used to limit the discharge of FOG to sanitary sewer systems is presented in Table 21.

Table 21 FOG PROHIBITIONS

Municipality	Prohibition
Alexandria, VA	Discharge of FOG in excess of 100 mg/L; interceptors required for food preparation establishments and from commercial establishments that discharge FOG; interceptor design parameters provided
Fairfax County, VA	Substances that may cause obstruction of flow, including grease. Interceptors may be required, but not for residential users
Falls Church, VA	Any discharge that may restrict the flow in the system
Hampton, VA	Any discharge that may restrict the flow in the system
Loudoun County, VA	Not specified (Code not included in Appendix A)
Newport News, VA	Discharge of FOG in excess of 100 mg/L
Norfolk, VA	Any discharge that may restrict the flow in the system
Suffolk, VA	Any discharge harmful to the system, including FOG in excess of 100 mg/L. Pretreatment required to comply with limits
Cary, NC	Any discharge that may restrict the flow in the system, including grease. Extensive guidance regarding control of FOG, although a discharge limit is not provided
Hillsborough County, FL	Solid or viscous substances which may cause obstruction to the flow in a POTW or other interference with the operation of the wastewater treatment facilities including grease
Naperville, IL	Adopted Illinois State Plumbing Code, therefore Grease Interceptors are required where necessary for commercial establishments or institutions
Normal, IL	Adopted Illinois State Plumbing Code, therefore Grease Interceptors are required where necessary for commercial establishments or institutions
Champaign, IL	Adopted Illinois State Plumbing Code, therefore Grease Interceptors are required where necessary for commercial establishments or institutions

Key elements of the municipal codes are presented in Table 22. It is important to note the information presented in this section is only related to the material contained within municipal codes. Additional FOG program components may be included in separate sanitary sewer standards.

Table 22 COMPONENTS OF FOG PROGRAMS SPECIFIED IN MUNICIPAL CODES

Municipality	FOG specifically referenced?	Discharge limit set?	Pretreatment Required?	Interceptor design guidelines?	Maintenance requirements?	Record keeping requirements?	FOG Program In Place?
Alexandria, VA	X	X	X	X			
Fairfax County, VA	X		X		X	X	
Falls Church, VA							
Hampton, VA							X[a]
Loudoun County, VA							X
Newport News, VA	X	X					
Norfolk, VA							X
Suffolk, VA	X	X	X		X		
Cary, NC	X		X	X	X	X	X
Hillsborough County, FL	X						X
Naperville, IL	X			X			
Normal, IL				X			
Champaign, IL				X			

At a minimum, the City must have the authority to implement a FOG program as discussed within this Memorandum. In addition to the general rights to implement the program, the City should also have the authority to enter private establishments to inspect facilities and review required records. In addition, the City should have the authority to enforce the program by imposing penalties.

C. Permitting Programs

1. Overview

Baker identified two aspects of permitting programs: permits for establishments operating the FOG control devices and permits for the contractors that clean the devices and dispose of the FOG. The goal of permitting establishments is to promote the use of FOG interceptors when needed, to verify that proper installation of them has occurred, and to verify that proper maintenance is being conducted on the device. The goal of permitting the contractors is to verify waste is being disposed of in a proper manner (not into the storm sewer or in a nearby sanitary sewer manhole) and to verify the contractors are fulfilling their commitment to properly clean the devices.

Many municipalities with FOG programs considered whether facilities with traps/interceptors should be permitted based on manpower requirements. Some municipalities choose not to permit establishments, but implement strong inspection programs instead. Other municipalities

have too many food service establishments with high turnover rates to initiate a permitting program.

Baker recommends that if an FOG Program is implemented, it includes permitting both establishments and haulers.

2. Program Comparison

a) Establishment Permits

Establishment permits may be based on discharge limits (e.g., 100 mg/L) or performance standards (e.g., require inspection and cleaning on a specified cycle to be determined based on facility operations). Permits should consider who is required to obtain the permit. For example, if a restaurant is located on a leased property, the responsible party could be either the lessor or the lessee. In North Carolina, the liability falls on the lessor.

A permit application should contain the following:

- General facility information
- Seating capacity, if applicable
- Description of kitchen equipment
- Monthly water consumption
- Description of traps/interceptors
- Duration
- Transferability (consider permitting the location of a business, not the specific business)
- Requirements such as reporting requirements, effluent requirements, maintenance requirements
- Penalty summary

New permits may be required under the following circumstances:

- A new facility is constructed
- An existing facility changes owners
- An existing facility converts from a non-FOG generating business to a FOG-generating business

The City may consider alternative methods to determine when a facility is to be permitted. At the same time, the City would determine whether a FOG control device is necessary. This process could be triggered through the events listed in Table 23. Table 23 also presents problems or issues with using each trigger.

Table 23 PERMIT TRIGGERS

Trigger	Issue
When new construction plans are submitted to the City for review	City may not receive plans if facilities are to be renovated or simply change owners
When the owner of a food service establishment (FSE) applies for a new Health Department license	Not all facilities requiring a FOG control device may apply for a health department license (e.g., food preparation facilities with no public seating do not require a license)
When an owner applies for a new business license	Utilities may already be constructed at the time of license submittal and may be difficult to retrofit a FOG control device

The City of Saint Petersburg, Florida manages approximately 700 food service establishments with a permit and inspection program. The permit application is provided to the establishment at the time a business license is requested. The system requires quarterly reporting. Saint Petersburg uses two supervisors to run the permitting system as well as scheduling for four inspectors.

New York City does not permit either the establishments or the haulers primarily because of the difficulty in administering the program; New York City has approximately 20,000 food service establishments with 10 percent annual turnover of ownership.

b) Hauler Permits

By permitting haulers, the City encourages haulers to collect and dispose of waste properly. Incidences have been noted where haulers are charging restaurants for cleaning traps, but do not clean them (restaurant operators often do not open their traps). In other cases, haulers will clean the traps and discharge the waste into a nearby storm sewer or sanitary manhole. A system used in Sydney, Australia called WasteSafe, utilized a complete cradle-to-grave system of tracking FOG waste. This system included features such as remote data loggers to record information regarding the customers visited, pump-out volumes, and details of the FOG waste disposal. This system was implemented to ensure grease separation devices were regularly pumped out and disposed of at appropriate locations.

A possible permit system utilizes a voucher program in which the restaurant obtains a permit. Once permitted, the restaurant receives vouchers. Vouchers are provided to the pumper truck

operator when the traps/interceptors are cleaned. The pumper truck operators are paid when they discharge their truck contents to an authorized treatment facility.

c) Miscellaneous Permitting Coordination

The City should to coordinate aspects of developing the FOG program with the Health Department. The Health Department regulates any food service establishment with public seating, as well as grocery and retail stores. The City should consider working with the Health Department to incorporate grease trap awareness into the Health Department's existing food safety training. The City should also consider using database information maintained by the Health Department to help track when new FOG control devices may be required. In addition, the City may also coordinate with the Department of Agriculture, which inspects those facilities that are involved in meat, poultry, and egg processing.

D. Design Issues

1. Overview

There is no single standard for design and sizing of FOG control devices. FOG control devices are generally divided into two categories: grease traps and interceptors. For the purposes of this report, a grease interceptor is generally a large device (minimum 1000 gallon capacity currently required by Bloomington Code) and is located exterior to the facility it serves. A grease trap is a smaller device (less than 500 gallon capacity) located indoors.

The design standards below discuss calculations of detention time, which is not mentioned in the Bloomington Code or the Illinois State Plumbing Code. Bloomington should consider adding this requirement to their code or permitting process.

Grease separation devices allow wastewater to pass through while free or emulsified oil floats to the top for retention. The devices should be designed based on the following elements.

1. Time: The device must provide sufficient retention time to allow emulsified grease and oil to separate and float to the surface of the chamber.
2. Temperature: The device must provide adequate volume to allow the wastewater to cool sufficiently for emulsified grease to separate.
3. Turbulence: Turbulence through the device must be controlled so that grease and solids are not suspended in the wastewater. Turbulence control is important during high discharge rates associated with draining a triple sink or dishwasher.
4. Tankage: The grease separation device must provide sufficient storage capacity for accumulated grease and solids between cleaning.

Some municipalities provide a standard interceptor design utilizing a baffled concrete tank as shown in Figure 15. However, proprietary designs such as the Proceptor should provide adequate control of FOG. Manufacturers of typical concrete interceptors similar to that presented in Figure 15 include Norwalk Tank of Joliet.

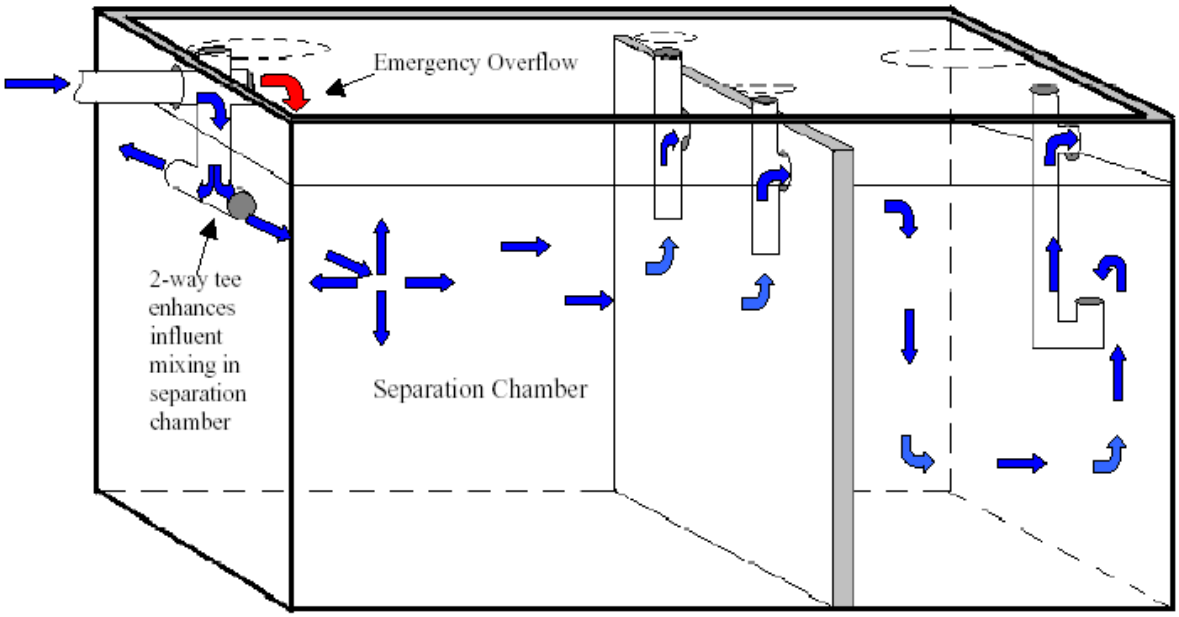


Figure 15. Typical Interceptor Device
(North Carolina FOG Task Force, 2002)

2. Design Sizing Standards

Different municipalities use different methods of sizing FOG control devices. A few of the different methods are provided below. Several municipalities contacted utilize methods to provide 30 minutes of detention time at the peak drainage rate. A 30-minute detention time is recommended by (Eddy, 1991). Oversized interceptors or excessive detention times may cause septicity in a device, resulting in odor problems and low effluent pH. Baker recommends that a detention time calculation is included in the permitting and sizing of grease interceptors.

a) Method 1 & 2

These methods are based on EPA standards. Method 1 is the EPA method for restaurants and Method 2 applies to hospitals, nursing homes, and other types of commercial kitchens. At a minimum, EPA requires a 750-gallon interceptor. The generic sizing formula is as follows:

(# seats) x (gal/meal) x (storage factor) x (1/2 # hours open) x (loading factor) = Volume (gal)

The State of Florida plumbing code also uses variations of these sizing methods.

b) Method 3

This method is based on the Uniform Plumbing Code guidelines. The size calculation is as follows:

(# meals/peak hour) x (waste flow rate) x (retention time) x (storage factor) = Device size

Several municipalities in the western part of the country, including Phoenix, Arizona and other California municipalities, utilize this method for sizing interceptors.

E. Maintenance requirements

1. Overview

Routine maintenance is required to maintain adequate FOG control device performance. A grease trap/interceptor has a fixed capacity; as the device fills with FOG/sludge, the hydraulic detention time decreases, which lowers the device efficiency. The maintenance frequency is dependent on the quantity/rate of grease discharge to the device (how quickly FOG/sludge accumulates in the device).

Maintenance should include emptying the entire contents of the trap or interceptor into an approved container or pumper truck for proper disposal at an authorized location. Some municipalities recommend filling the device with water before it is placed back in service. Filling the device allows it to work properly right away and prevent it from floating out of the ground.

In general, there are two methods to determine maintenance frequency. One method is based on a discharge concentration (e.g., when the discharge from the device exceeds a certain value). A second method is based on an established time interval (e.g., once a month). These two methods are discussed below. Based on the cost and additional effort of sampling for the discharge concentration based maintenance frequency, Baker recommends the incorporation of a time-based maintenance frequency into the FOG Program.

2. Discharge Concentration-Based Maintenance Frequency

a) Sampling/Analysis Issues

In the concentration-based maintenance routine, maintenance is performed when the FOG control device effluent exceeds a predetermined concentration. The concentration from the device is determined by collecting a routine sample from the device effluent and analyzing it for FOG. Currently, there is one EPA approved analytical method for quantifying FOG: Hexane Extraction (EPA Method 1664A).

b) Maintenance issues

Several issues identified regarding the use of concentration-based maintenance intervals include:

- Sampling from a sample port could result in knocking large grease particles from the wall of the structure into the sample, skewing the results
- High cost for sampling/inspection (monthly pumping is not unreasonable)
- Low accuracy of sample (whether sample was conducted during a peak or off-peak time)
- There is a lag between the sample analysis and time of cleaning; resulting in the discharge of unwanted FOG into the sanitary sewer system

There is great uncertainty whether specified discharge limits will result in the prevention of FOG accumulations in sanitary sewer pipes.

3. Time-Based Maintenance Frequency

Baker identified the following regarding a time-based interval for maintenance:

- There are no additional costs for sampling
- Cleaning can be contracted out, possibly saving time, money, and other problems
- There is no lag between when it is determined necessary to clean and when it is cleaned
- More frequent pumping could be required during high use times, which may result in unwanted FOG discharge to sewer

According to (North Carolina FOG Task Force, 2002) five North Carolina programs require monthly pumping of all outside units. Raleigh requires pumping of inside units every 14 days, or as needed.

Some municipalities, including Hillsborough County, Florida and Cary, North Carolina, also incorporate a 20 percent or 25 percent rule for additional cleaning. In accordance with this rule, grease and sludge within the trap cannot exceed 20 percent or 25 percent of the capacity before cleaning. The FOG/sludge content is quickly estimated using tools such as a Sludge Judge®.

Saint Petersburg, Florida requires monthly pumping unless a facility requests a variance. If an establishment requests a variance, inspectors visit the facility every 10 days and estimate the sludge/FOG content in the interceptor. The time interval for routine pump out is determined by the time for the grease to reach a thickness of 6 inches or the solids to reach a thickness of 8 inches.

F. Inspection Programs

1. Overview

There are four situations that should be included in an inspection program: construction inspection of traps/interceptors, routine trap/interceptor device inspections, sewer main line inspections, and sewer pumping station inspection. Construction inspections are performed to verify the proper installation of traps/interceptors and the plumbing connected to them. Routine device inspections identify if the devices are properly maintained and if device owners are conducting operations that hinder device performance. Sewer main line inspections and sewer pumping station inspections are conducted to determine whether the devices are functioning properly.

2. Construction Inspections

Inspections conducted during the construction/installation of FOG control devices are an important component to ensure their proper operation. Inspectors contacted by Baker have observed installation problems such as grease traps/interceptors installed backwards or not on a level foundation. Improper installation can significantly affect efficiency.

Most of the inspections can be conducted shortly after an interceptor/trap is installed. Inspections can be coordinated with the plumbing department if they are not already performing inspections. However, plumbing inspectors should be notified of typical problems associated with the interceptors. The Town of Cary requires FOG inspectors to be present for the installation of every interceptor and trap.

3. Routine Device Inspections

Interceptor cleaning standards could include frequency requirements and cleaning protocols.

Routine device inspections will require entry onto the private property containing the FOG control devices and into the buildings if smaller grease traps are used. The City must have the regulatory authority to enter each establishment, the right to inspect the facilities, and the right to review required records.

Routine device inspection components could include the following:

- Grease trap/interceptor conditions
- Kitchen equipment, and plumbing connections
- Kitchen techniques (e.g., is grease waste being properly handled)
- Relevant records, including hauler records (as applicable)
- The immediate downstream manhole, if it is easily accessible

Hillsborough County, Florida has two full time inspectors for over 1,000 inspection sites. The inspectors try to inspect every trap/interceptor approximately every 90 days. Inspectors spend approximately 5 minutes at an outside interceptor and 15 minutes at an inside trap. The inspection time consists of opening the device and checking the sludge/FOG content with a Sludge Judge. Inspectors do not review records or facility operations.

Saint Petersburg, Florida will have four inspectors for approximately 700 facilities. Two supervisors will conduct scheduling for the inspectors. The inspectors will try to inspect every FOG control device at least twice a year. The inspectors will spend approximately half of their time performing FOG program duties. Inspections consist of using a Sludge Judge to estimate the sludge/FOG content of each device.

The Town of Cary, North Carolina inspectors spend approximately 30 minutes at each facility. Their inspection includes using a Sludge Judge in each device and reviewing records that are required to be maintained onsite. Cary has two inspectors that inspect approximately 600 locations.

4. Sewer Main Inspections

Improper discharge of FOG to the sanitary sewer system will appear as deposits within manholes or the sanitary sewer lines. Sanitary sewer lines and manholes are easily inspected through closed-circuit television systems or through the use of mirrors. If deposits are noted in sanitary sewer lines, the source of the discharge may be able to be identified.

A routine sewer main inspection program, whether performed specifically to target FOG or as a general assessment program, can be an effective component of a FOG program. During sewer main inspections, FOG accumulations should be specifically identified and flagged for further investigation. Sewer service calls can also become a part of a FOG program. If the source of service calls can be linked to FOG accumulations, then the source of the FOG accumulation should be investigated.

5. Sewer Pumping Station Inspections

FOG that passes through the gravity sewer mains will tend to accumulate in the wet wells of the City's pump stations. A pump station wet well inspection process could include a grease-rating component to trigger other FOG program components, such as sewer line cleaning, inspections of potential sources, or public relations campaigns.

G. Enforcement Programs

1. Overview

The City must have the authority to enforce the FOG program. The current ordinance authorizes the City to require reimbursement at a minimum of $2,500 for sewer cleaning or the actual cost, whichever is greater, and fines will double for every reoccurrence of this violation.

It may be legally difficult to tie the sewers that need cleaning with the grease interceptors that are causing the problem. The City may want to consider modifying their code to allow fines for non-compliance and use the sewer cleaning as a guide to target locations needing more frequent inspections.

Enforcement programs can include a system based on penalties and rewards. Several municipalities established an escalating penalty system involving any of the following: administrative action, judicial action, assessment of penalties, or termination of service. With the cooperation of the Health Department, ultimate penalties can be linked to forfeiting the establishment's Health Department or business license.

2. Program Comparison

Hillsborough County, Florida utilizes the following escalating enforcement guidelines:

1. Administrative fee of $1,000 with the next event of continued non-compliance
2. A publication in a regional newspaper as a polluter in the community
3. A final penalty of termination of wastewater service

The City of Atlanta follows the following guidelines:

1. First offense: $1,000 fine
2. Second offense: $1,000 fine and confinement in city jail for a period not to exceed 30 days
3. Third offense: $1,000 fine and confinement in city jail for a period not less than 7 days and not more than 60 days

4. If the business violates the grease discharge permit ordinance three times within 24 months, the permit will be revoked

New York City, New York relies on enforcement and monetary fines as the significant component of its FOG program. This municipality does not permit facilities; it inspects facilities and levies fines for violations. It found that without significant fines, violators did not respond to the program.

Saint Petersburg, Florida will primarily rely on reinspection fees instead of penalty fees. This municipality believes that penalty fees should be levied through the court system and not by the utility. According to this program, if a grease interceptor or trap has to be re-inspected because of deficiencies found during the previous inspection, and all of the deficiencies have been corrected, there shall be no charge for the re-inspection. If all of the deficiencies have not been corrected, a first re-inspection fee of $150.00 shall be charged to the food service facility. If a second re-inspection is required, a second re-inspection fee of $250.00 shall be charged to the food service facility if all of the deficiencies have still not been corrected. If a third or more re-inspections are required a re-inspection fee of $500.00 for each successive re-inspection shall be charged to the food service facility in addition to other enforcement actions if all of the deficiencies have still not been corrected.

H. Data management

Data management for the FOG Program will tie into the City's SAMP. Permits, inspections, work orders for sewer cleaning, and enforcement records can all be maintained as part of the SAMP. The work order management system previously discussed at the onset of this Memorandum and shown in Figure 1 should be used to house and track this information.

I. Public Education and Outreach

Public education and outreach should target both noncommercial generators (residential) and commercial generators of FOG. Numerous examples of public outreach materials are available. The focus of these materials is to educate the public regarding the consequences of discharging FOG into the sanitary sewer system and to encourage their participation in preventing the problem. Public outreach materials tend to be graphic and easy to read. In addition to explaining the problems associated with FOG discharge to sanitary sewer systems, public outreach materials should include suggestions for eliminating the discharge.

J. Preliminary Recommended Program

The goal of a FOG program is to provide a more reliable sanitary sewer service to customers, and to minimize the number of sanitary sewer overflows that may result from FOG accumulations. Aspects of a preliminary recommended FOG Program should include:

- Permitting Program including:
    - design standards based on detention time

    - maintenance based on time-based maintenance frequency
- Inspection Program including:
    - installation
    - routine inspection
    - sewer line inspection
    - sewer pumping station inspection
- Enforcement Program:
    - Code modification to allow for penalties based on non-compliant inspection result
- Data Management tied to SAMP
- Public Education and Outreach

The information presented below summarizes the personnel requirements estimated by Baker for the implementation of such an FOG programs. Baker was provided data by the COBPW, which shows that it has 150 food service establishments that have public seating. This number represents a significant portion of facilities that would be included in a FOG program; however, it does not include facilities such as churches, grocery stores, nursing homes, high-density residential buildings, and other establishments that do not have public seating. In order to factor in these locations, the total number of assumed facilities to be included in an inspection program was raised to 200.

Below are the duties assumed for the inspectors:

- All facilities to be inspected quarterly at a minimum, with problem areas being inspected monthly
- Sewer line inspection (can be covered within CCTV Inspection Program)
- Sewer pumping station inspection
- Construction installation inspection
- Permit review
- Data management

Based on these duties, Baker recommends a staff consisting of two inspectors and one part-time supervisor.

K. Cost/ Benefit

The implementation of a FOG program could alleviate some of the COBPW's need for frequent sewer cleanings in areas that are currently impacted by FOG discharge. City staff members that are currently working on crews performing these cleanings could be trained to implement the FOG Program.

The COBPW has a 15-, 30-, 60-, 90-, and 180-day schedule to clean certain, designated sewer lines. A cost estimate is provided below in Table 24 for the cleaning of these designated pipes that are located within 500 feet of a producer of FOG. Table 25 provides estimated financial benefits of implementing an FOG inspection program, depending on the success of the program

at reducing FOG discharge. The financial benefits table does not take financial penalties into account. Figure 16 shows that sewer backup complaints are generally located near the sewer lines with a current FOG problem. If the need for sewer cleaning is reduced, it is possible to assume that the sewer backups would also be reduced. Finally, Table 26 provides a summary of the estimated cost of implementing an FOG program.

Table 24 ESTIMATED YEARLY COST OF SEWER CLEANING

	Pipe length (ft)	Cleanings per year	Pipe Length Cleaned Per Year**
15 day cleaning	4,118	24	98,830
30 day cleaning	23,080	12	276,958
60 day cleaning	13,420	6	80,523
90 day cleaning	28,981	4	115,923
180 day cleaning	11,855	2	23,711
Total length of pipe cleaned yearly			595,945
Unit Cost of pipe cleaning *			$ 1.00
Total Yearly Sewer Cleaning Cost			$ 595,945.39

*$1.00/LF estimated based on reviewing costs of other municipalities and private contractors

**Pipes on 15-30-60-90-180 Cleaning List within 500 feet of a FOG Producer"

Table 25 ESTIMATED FINANCIAL BENEFITS OF IMPLEMENTING FOG PROGRAM

10% reduction in cleaning cost	$ 59,594.54
25% reduction in cleaning cost	$ 148,986.35
50% reduction in cleaning cost	$ 297,972.70

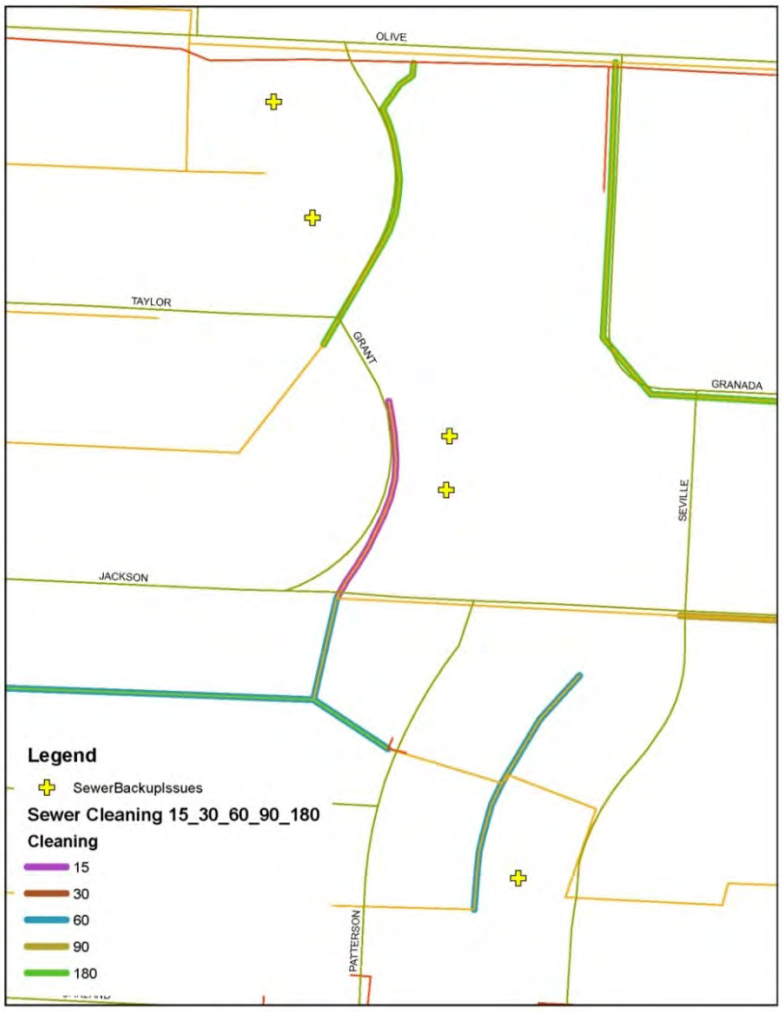


Figure 16. Sewer Backup Issue Locations and Pipes that Require Frequent Cleaning

Table 26 ESTIMATED YEARLY COST OF IMPLEMENTING FOG PROGRAM

	FOG Program Utilization	Hourly Rate	Multiplier for Overhead	Total Yearly Cost
Inspector #1*	100%	$ 28.01	1.5	$ 87,391
Inspector #2*	100%	$ 28.01	1.5	$ 87,391
Supervisor #1	50%	$ 35.00	1.5	$ 54,600
Personnel Cost				$ 229,382
Equipment Cost				$ 1,800
Vehicle Cost**				$ 14,571
Total Program Cost				$ 245,754

* Inspector hourly rates based on Bloomington's agreement with AFSCME Local 699
**Assumed two vehicles in use

L. FOG Conclusions

A FOG Program that includes permitting, inspection, enforcement, and public outreach should aid the COBPW in providing more reliable sanitary sewer service to customers, and to minimize the number of sanitary sewer overflows that may result from FOG accumulations. Depending on the degree of success of such a program, the current costs to clean the sewers should be reduced. While the costs of such a program would appear to exceed the potential benefits, it should be noted that permit fees and fines for violations are not included. Additionally, there are other benefits which previously in this Memorandum were designated as triple bottom line, including social (less basement sewer backups, reduced odors, and thus reduced complaints) and environmental (reduction of SSOs and CSOs).

Since there multiple options available when creating an effective program, one should be developed that is tailored to Bloomington's philosophy, staff and budget resources, and specific issues. Coordinating with the public, Bloomington staff, the Health Department, and the local restaurant association is a key step in beginning a program and the best way to estimate potential costs to the community.

VIII. Bibliography

Dr. John Matthews, W. C. (2011). *Decision Support for Renewal of Wastewater Collection and Water Distribution Systems - EPA/600/R-11/077.* Edison, NJ: EPA - Urban Watershed Branch, Contract No. EP-C-05-057.

Eddy, M. a. (1991). *Wastewater Engineering Treatment, Disposal and Reuse.* Mcgraw-Hill.

ESRI. (2010). *Comprehensive Training Plan for ArcGIS*. Retrieved from ESRI: http://downloads2.esri.com/campus/downloads/sad/ArcGIS_Comprehensive_Training_Plan.pdf

ESRI. (2011, January 5). *Concurrency and Locking*. Retrieved from ArcEsri: http://help.arcgis.com/en/arcgisdesktop/10.0/help/#/Concurrency_and_locking/002700000008000000/

ESRI. (2011, September 29). *Versioned Editing Seminar: Your Questions Answered*. Retrieved from ESRI Training Matters: http://blogs.esri.com/esri/esritrainingmatters/2011/09/29/versioned-editing-seminar-your-questions-answered/

ESRI. (n.d.). *ArcGIS for Water Utilities*. Retrieved from ESRI: http://resources.arcgis.com/content/water-utilities

ESRI. (n.d.). *Training Catalog Search Results*. Retrieved from ESRI: http://training.esri.com/gateway/index.cfm?fa=search.results&cannedsearch=2

Foth. (2013). *Hydrologic/Hydraulic Modeling in Selected Basins, Oakland Avenue Watershed Stormwater Model* . City of Bloomingtion, IL.

Jadranka Simicevic, R. L. (2001). *Guidelines for Pipe Bursting - TTC Technical Report #2001.02.* Vicksburg: USACE Army Corps of Engineers.

Malcom Pirnie. (2009, October 1). Rehabilitation Alternatives - MWEA Collection System Seminar.

Marer, P. J. (1996). *Sewer Line Root Control.* Davis: University of California.

Michael Baker Jr., Inc. (2013). *Asset Management Program Work Order Needs Analysis.* Bloomington, IL: City of Bloomington Department of Public Works,.

Michael Baker Jr., Inc. (January 17, 2013). *Assessment for CCTV Inspections.* City of Bloomington, IL.

Michael Baker Jr., Inc. (November 19, 2012). *GIS Based Infrastructure Rating System Pilot Area Evaluation – Phase 1 (Cap 1 & 2).* City of Bloomington, IL.

Michael Baker Jr., Inc. (September 4, 2012). *Pipe Condition Rating Methodology Recommendations.* Bloomington, IL.

New Mexico Environmental Finance Center, New Mexico Tech. (2006). *Asset Management: A Guide for Water and Wastewater Systems.* New Mexico Environmental Finance Center.

North Carolina FOG Task Force. (2002). *Considerations for the Management of Discharge of FOG to Sanitary Sewer Systems.* Raleigh: State of North Carolina.

Orchard, Hill and McCliment, Inc. (2012). *East Side Interceptor - Sanitary Sewer Evaluation Study (SSES).* City of Bloomington, IL.

RMC Water and Environnment. (2010). *Sewer Maintenance Cost Estimates for Administrative Order Compliance.* Oakland: Public Works Agency - Department of Infrastructure and Operations.

Sunil Sinha, T. A. (2010). *Predicting the Remaining Economic Life of Wastewater Pipes.* Alexandra, VA: Water Reserach Environment Foundation.

Terry Martin - Seattle Public Utilities. (2013). The Role of Economic Analysis in Asset Management - Using Triple Bottom Line Economics and Customer Willingness to Pay to Develop KPIs and Service Levels. *8th Annual WERF Research Forum.* Chicago: Water Environment Research Foundation (WERF).

Virginia Polytechnic Institute and State University (Virginia Tech). (2011). *WATER Infrastructure DATABASE (WATERiD).* Retrieved March 13, 2013, from http://waterid.org/

Water Research Environmental Federation (WERF). (2006). *SIMPLE - Sustainable Infrastructure Management Program Learning Environment*. Retrieved 2013, from WERF Project 03-CTS-14: http://simple.werf.org/simple/media/BCT/examples.html

Appendices

Appendix A

Worked Examples: Wastewater Benefit Cost Scenario - Hospital (Water Research Environmental Federation (WERF), 2006)

Example 1: Potential pipe failure demonstrating risk weighted benefits

Scenario:

A recent CCTV inspection of a section of a 12" unlined concrete pipe that runs within a few feet and beneath the driveway/parking area of the emergency room entrance of a community (public) hospital exhibits signs that the joint is failing. The pipe is the only service line to the emergency room wing.

A physical collapse of the pipe could trigger a full shut down of the emergency care function. The hospital is the only one within a 50 mile range and the emergency room is the only urgent care facility within that area.

The hospital has scheduled to expand and renovate the wing that houses the emergency room in four years. It would strongly prefer to wait until then to replace the pipe (which is scheduled by the Sewer Agency to be replaced with a 24" pipe at the time of the hospital renovation to accommodate additional growth anticipated in the area), preferring an interim solution if such is technically feasible and the risk is not too high.

Technical factors:

Type of pipe: (gravity line) unreinforced, unlined concrete with grouted bell joints, no rubber ring

Current age of pipe: 35 years

Expected useful life of pipe (as a class): 45 years

Condition:

- Substantial soil intrusion into the pipe at the joint is visible in the CCTV image; no inspection has been performed to see if there is a void outside the pipe.
- It is unknown whether the joint is failing due to bedding issues (perhaps a void beneath the pipe segment complicated with vehicle loading overtop) or due to roots pushing the joint apart. Previous CCTV footage showed substantial root intrusion at that joint approximately 5 years ago. Old timers say that roots at that location have long been a problem. The most recent roots were eliminated by the maintenance crew shortly after the latest CCTV inspection.

- If the failure is being driven by bedding collapse issues, the failure progression could be quite rapid; if driven by roots, the failure progression is more likely to be quite slow as long as roots are kept out of the joint.
- No other meaningful defects have been identified in the pipe segment.
- CCTV does not clearly indicate whether the bell is damaged or the joint is simply separating.

Consequences of pipe collapse:

The emergency room could function without the dedicated emergency entrance with only minor inconvenience; closing the entrance would negligibly impact response-to-care times for those admittances which are in life critical situations.

However, shutting down the emergency room due to a major pipe collapse would necessitate closure of the emergency room due to a lack of adequate wastewater drainage facilities. Closure of the emergency room for even a short time would be "catastrophic" in the words of the hospital board chairman. On average, three patients per hour are admitted to the emergency room, of which one is in an urgent care situation and one in ten is in a life critical situation.

Proposed Alternative Treatments:

The Sewer Agency feels it has two feasible options given that the pipe is scheduled to be replaced in four years:

- *Baseline:* Leave as is but monitor closely (assess the deterioration every six months)
- *Alternative:* As soon as it can be scheduled, excavate the joint area, grout and re-bed the joint, and close the excavation; expected time out of service due to repair time if on a scheduled basis – 36 hours; likely required time if pipe fails, creating a sink hole and damaging adjacent segments – 48 hours.

Summary of the Analysis by Step

1. **Purpose of the analysis**
   Identify whether the alternative treatment has greater community benefit on a risk weighted basis than the baseline alternative.
2. **Formulate baseline parameters and assumptions**
   Baseline: Leave the pipe as is but monitor closely (assess the condition every six months)
   Procedural steps: CCTV every six months for four years, inspection to be performed by a contract inspection company

   Alternative: Repair the joint now
   Procedural steps: bypass the damaged pipe section, excavate the joint area, clean, grout, and re-bed the joint

   Failure curve (probability of failure related to age):
   Probability of failure = (Life to date/expected life)^4

Time frame of analysis: 4 years
Average emergency room customer invoice - $2500

3. **Measure benefits in monetary terms**
   The determining benefits here are largely of the cost avoidance type - that is, avoiding 1) the extensive costs to the community triggered by shutting down the emergency room, and 2) the extensive repair cost should the repair prove unnecessary, since the repair will only function for a maximum of four years.

   In this case it is estimated $100,000 in property damage, $540,000 in reduced receipts due to service outage, and $250,000 in litigation costs, for a total of $890,000.

4. **Measure costs in monetary terms**
   These costs are comprised largely of direct Agency costs and direct customer (hospital) costs. Intangibles are largely consequence of failure costs which are treated as cost avoidance on the benefits side of the worksheet.

   In this case, the costs would be $11,000 to rehabilitate the pipe.

5. **Determine NPV of benefit and costs**
   Since the work is done immediately, the NPV is the same as the initial cost and benefit.

   NPV = $890,000 * 85% = $756,500
   Costs = $11,000
   B/C Ratio = 69

6. **Review, Finalize Recommendation(s)**
   In this example, “Total Benefits” has been weighted by a risk factor of 85% representing the probability of failure of the pipe during the next 4 years. This weighting recognizes that the identified benefits are realized only were the pipe to actually fail before it was replaced in four years. It is possible that the pipe might not fail in that period. Note that the value assigned to the probability has a significant impact on the outcome.

Appendix B – Sample Chemical Root Treatment Specification

Section 02743 – Sanitary Sewer Line Chemical Root Control

1. General:

The Contractor shall furnish all labor, equipment, material, and supplies and perform all operations necessary to properly treat and inhibit root growth in sanitary sewer lines and manholes.

1.01 Sewer Line Chemical Root Control

The intent of this project is to utilize a chemical root control agent to kill the root growth present in sanitary sewer lines and manholes to inhibit re-growth, without permanently damaging the vegetation producing the roots.

1.02 Definitions:

(A) HRSD – Hampton Roads Sanitation District

(B) Chemical Root Control: The application of a chemical root control agent to sanitary sewers, in order to kill the root growth present in the lines and manholes and to inhibit re-growth, without permanently damaging the vegetation producing the roots.

(C) Chemical Root Control Agent: The active substance applied to roots in sanitary sewers to kill and inhibit the growth of roots.

(D) Active Ingredient: The ingredients that comprise the chemical root control agent.

1.03 Submittals

(A) The active ingredient of the chemical root control agent shall be submitted to HRSD for approval and shall be labeled for use in sewers to control tree roots.

(B) The Contractor shall submit, with his bid, specimen product label(s) and Material Safety Data Sheets for any chemical root control agents that the Contractor proposes to use on the contract.

(C) The Contractor's Federal DOT number and material EPA registration number must be submitted with bid. The Contractor is directed to ensure compliance with all Federal, State and Local ordinances pertaining to the type of work specified herein. Particular attention shall be paid to those laws and ordinances relating to transportation of material (DOT), the application of sewer root control herbicides (EPA), and traffic safety regulations.

(D) Each bidder is required to submit with his bid the contractor qualification form attached to these specifications (see Appendix A). Contractors who do not meet the experience and other qualifications specified herein shall not be considered for award of the contract.

(1) All work must be supervised by someone who is licensed as a Certified Pesticide Applicator with the State Pesticide Regulatory Agency prior to the bid date. Certified Pesticide Applicators shall have a minimum three years of experience in performing the type of work specified, and shall each have personally performed a minimum of 300,000 linear feet of treatments as a Certified Pesticide Applicator and/or under the direct supervision of a Certified Pesticide Applicator. A minimum of three Certified Pesticide Applicators that are registered with the Virginia Department of Agriculture and Consumer Services, prior to the bid, is required. License numbers for these three applicators shall be submitted with the bid.

(2) Bidders must be licensed with the Virginia Department of Agriculture and Consumer Services prior to the bid date. License number(s) shall be submitted with the bid.

(3) The Contractor shall demonstrate a minimum level of four (4) years direct experience in applying chemical sewer root control agents. The Contractor must have performed at least 10 other jobs similar in size and scope to the work specified herein, and have treated in excess of 300,000 linear feet of sanitary sewer. Any work performed by subcontractors for the Contractor will not be considered.

(4) All work shall be conducted by a Certified Confined Space Entry technician. The Contractor shall employ a minimum of two Certified Confined Space Entry technicians at each site where chemical root control operations occur. Confined Space Entry Certificates shall be submitted with the bid.

(E) As specified herein and required in Section 103 (Award and Execution of the Contract), the Contractor shall submit written evidence that he has obtained pollution liability coverage.

(F) Root Treatment Report

(1) Contractor shall submit a Root Treatment Report for each pipe section treated.

(2) The Root Treatment Report shall include the following information:

i. Pump station service area name.

ii. Street name.

iii. Upstream and downstream manhole asset identification numbers to identify each pipe section.

iv. Pipe diameter in inches from field measurement (assume 8-inch unless otherwise indicated on service area maps).

v. Pipe material (from field observation).

vi. Date treated for roots.

vii. Length of sanitary sewer line treated.

viii. An indication if an obstruction was encountered or entire line was not treated.

ix. Distance measured to obstruction in feet.

x. An indication if the Contractor certifies the sanitary sewer pipe has been treated and is ready for Owner acceptance.

xi. Method used for control of sewage flow.

xii. Quantity of Active ingredient used in the line treatment.

(G) Progress Updates.

(1) The Contractor shall submit the following progress update:

i. Monthly progress reports broken down by service area, indicating work completed for period and inception to date. Progress reports shall accompany all payment requests.

ii. Monthly all Root Treatment Reports.

(2) Progress reports and invoice formats shall be reviewed and approved by the Owner.

2. Products:

2.01 Equipment

(A) General

(1) The Contractor shall certify that backup equipment is available and can be delivered to the site within 24 hours.

(B) Root Treatment Equipment

(1) The Contractor shall provide all equipment necessary for the proper application of chemical root control. All equipment shall be subject to the review and approval of the Owner.

(2) The Contractor shall protect the sanitary sewer lines from damage that might be inflicted by the improper use of chemical root control equipment and products. Sanitary sewer lines or manholes damaged as a result of the Contractor's improper operations shall be promptly repaired by the Contractor at no cost to the Owner.

(3) All equipment, devices and tools required for this Contract shall be owned (or leased) and operated by the Contractor.

2.02 Materials

(A) Water required for cleaning operations is the responsibility of the Contractor. The Contractor may obtain and use City water metered through a hydrant meter with a reduced pressure zone backflow device. The Contractor shall comply with the requirements of the City issuing the water meter. Contact the Business Office at 427-4631 to answer questions pertaining to procedures for authorization of fire hydrant meter rentals.

2.03 Products

(A) The chemical agent shall be currently registered with the USEPA and the State Pesticide Regulatory Agency.

(B) The chemical root control agent shall contain an active ingredient for controlling sewer roots and deterring their re-growth. There shall also be a surfactant system to deliver the active ingredient (herbicide) to the target root tissue. Surfactants designed to foam chemically, upon contact with water, shall not be accepted.

(C) The Contractor shall be responsible for insuring that the chemical root control treatments shall not have any adverse effects on wastewater treatment plants and/or receiving waters downstream from the applications.

2.04 Guarantee

(A) The Contractor shall provide a two year money-back guarantee on all work specified herein as set forth below.

(B) For each sewer section (manhole-to-manhole) that is treated under the Contract, the Contractor shall guarantee the work as follows. At the option of the Owner, the Contractor shall, at his own expense, re-treat a sewer section, or refund 100% of the payment received to treat that section, in the event that:

(1) Live roots are found in the section within six months after the application; or,

(2) The section plugs up and floods due to tree root obstructions within a period of two years, beginning on the date of treatment, and ending two years after the date of treatment. Re-treatments, performed at no charge in honor of the guarantee, do not extend the expiration date of the guarantee.

(C) The guarantee applies to sewer stoppages caused by live tree roots. It does not apply to stoppages caused by grease or other foreign matter; flat, collapsed or deformed pipe; or flooding caused by a surcharged or plugged sewer section downstream from a guaranteed sewer section. This guarantee applies to main line sewers only. The decision of the Owner as to the cause of a stoppage is binding.

3. Execution:

3.01 General

(A) Refer to Appendix C for a suggested sequence of work.

(B) The Contractor's attention is drawn to the following terms, conditions and responsibilities:

(1) Should any chemical root agent spill on the ground, the chemical and affected soil shall be removed and safely disposed of. The area shall be restored to a condition equal to or better than before the spill. Any damage to vegetation resulting from misuse of the chemical root control agent shall be the responsibility of the Contractor.

(2) The Contractor is responsible for all property damage and for all clean up and restoration associated with any chemical spill.

(3) The Contractor shall place proper traffic warning devices to protect the specific job site and to prevent accidents or personal injury to the public. Traffic control shall be in accordance with the specifications as described in Section 512 – Maintaining Traffic.

(4) The Contractor shall return within 4 to 8 months after the work is completed and periodically throughout the life of the guarantee, in order to evaluate the success of the project, and to arrange any free guarantee work that may arise.

(5) The Contractor shall respect the rights of property owners, and not enter upon private property without obtaining permission from the owner of the property.

3.02 Chemical Root Control Application

(A) All work shall be performed according to label instructions and in accordance with the best recommended practice for conditions present in the line under treatment. All applications shall be done by foaming or other methods as provided on the product label.

(B) The application of chemical agent shall be performed in such a way as to contact roots within the primary main line sewer to be treated. Effort will also be made to penetrate secondary lateral sewers in order to contact roots residing in the lateral connections.

3.03 Protection of Wastewater Treatment Plant

(A) The Contractor shall be financially responsible for any adverse effects on wastewater treatment plant processes which are, directly or indirectly, caused by the chemical application, including but not limited to the following: damages to plant processes or equipment; clean-up and restoration costs, fines imposed on the Owner or on the Operator of the wastewater treatment plant by State or Federal agencies, pollution of receiving waters, and civil suits. The Contractor shall further indemnify and hold harmless the Owner, and the Operator of the wastewater treatment plant, against all costs, including legal expenses, relating to treatment plant failure or other damages or pollution caused, directly or indirectly, by the applications of chemicals by the Contractor.

(B) In the event that a wastewater treatment plant experiences any reduction in operating efficiency during the execution of the contract, the Contractor shall immediately suspend all applications, at the direction of the Owner. The contractor shall continue operations only after problems at the wastewater treatment plant have been corrected, satisfactory to the Wastewater Treatment Plant Operator.

(C) The Contractor attests, through submittal of a bid or proposal. or through agreeing to the contract, that the Contractor is expert in this type of work, and recognizes and understands the risks posed by this type of work on

wastewater treatment plant processes. The Contractor shall not rely on the Owner for guidance in this regard.

(D) Introduction of any materials in any wastewater treatment plant must be with the approval of the wastewater treatment plant operator for that plant.

(E) The contractor shall notify the Wastewater Treatment Plant Operator of any wastewater treatment plant that may be effected by the Contractor's performance of the Contract, of the date and time of all intended work, and provide the Operator with data or other information requested by the Operator, including specimen product labels and Material Safety Data Sheets, for any materials introduced to the collection system.

(F) The Contractor shall provide the Wastewater Treatment Plant Operator with names and phone numbers of individuals in a position to notify the Contractor's crew of the need to immediately stop work, including the names and phone numbers of the Owner, the Contractor, and the hotel or other local phone number of the Contractor's on-site supervisor. The Contractor shall maintain daily communications with the Wastewater Treatment Plant Operator to assure that the chemical root control treatments are not having any adverse effects on wastewater treatment plant processes. In the event that a wastewater treatment plant experiences any reduction in operating efficiency during the execution of the contract, whether the result of the chemical treatments or not, the Contractor shall immediately suspend all applications, and notify the Owner. The contractor shall continue operations only after problems at the wastewater treatment plant have been corrected, and the Contractor has taken appropriate steps, satisfactory to the Owner and the wastewater plant operator, to prevent recurrence of any problems at the wastewater treatment plant that may be the result of chemical applications.

3.04 Assistance Provided By the Owner:

(A) The Owner shall decide all questions in relation to the contract documents or the execution of the contract and the Contractor's obligations and performance there under. The Owner shall decide every question which may arise relative to the fulfillment of the contract on the part of the Contractor. Nothing contained in this section or elsewhere in the contract documents shall be construed as limiting the extent of the Contractor's responsibility for payment of damages resulting from his operations under the contract. By submitting a bid, the Contractor agrees to hold harmless

and indemnify the Owner, its officers, agents, servants, and employees, against any claims, losses, or damages of any expenses related thereto.

(B) A representative of the Owner will accompany the Contractor's crew, and/or sewer system drawings will be provided showing the exact locations of the pipes to be treated.

(C) The Owner shall provide for the entering of private lands, public lands and right-of-ways.

(D) The Owner shall locate and uncover hidden or buried manholes, and restore street surfaces, easements, etc.

3.05 Debris Removal and Disposal

(A) All debris and other solid or semisolid waste material resulting from the chemical root control operation shall be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.

(B) Under no circumstances shall debris and other solid or semisolid waste removed during these operations be dumped or spilled into streets, ditches, storm drains or other sanitary sewers. All debris and other solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of as specified in Section 106.04, Disposal Areas.

(C) The Contractor shall keep his haul route and work area(s) neat and clean and reasonably free of odor, and shall bear all responsibility for the cleanup of any spill which occurs during the transport of cleaning/surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this Contract and in accordance with applicable law and regulations. The Contractor shall immediately clean up any such spill or debris release. Refer to Section 107.01, Laws to be Observed, for additional requirements.

(D) The haul routes used by the Contractor for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

3.06 Acceptance of Treatment Operation

(A) The Contractor shall submit a Root Treatment Report for all lines where chemical root control has been applied.

(B) Acceptance of sewer line chemical root control where treatment has occurred shall be made upon the successful completion of the chemical root control application and shall be to the satisfaction of the Owner. If the chemical root control treatment is found to be unsatisfactory, the Contractor shall be required to re-treat the sewer line until the treatment is shown to be satisfactory. Re-treatment of the sanitary sewer line shall be at no additional cost to the Owner.

4. Measurement of Payment

4.01 Method of Measurement:

(A) General: Work covered by the contract documents consists of providing all work indicated on drawings or required by project manual complete-in-place. Payment for the item includes, but is not limited to, testing, disposal of debris, cleanup, and restoration of all disturbed areas to original condition unless specified otherwise.

(B) Measurement and Payment: Measurement of pay items will be made by the Owner. Measurement and payment will not be made for items which require Owner approval prior to execution if approval has not been obtained. Only the items specified in this article "Measurement and Payment" shall be defined to be pay items except as otherwise expressly provided for under the terms of the contract documents.

(1) The following items are classified as incidental work and will not be measured for separate payment. The cost thereof shall be included in the lump sum or unit prices bid for the other items of work.

i. Traffic Control.
ii. Mobilization and demobilization to service areas of equipment, labor and materials.
iii. Noise control.
iv. Flow control (excluding bypass pumping).
v. Restoration of property.
vi. Preparing/submitting Reports and progress updates.
vii. Water for treatment.
viii. Debris removal and disposal and associated disposal fees.

(C) Chemical Root Control:

(1) Measurement shall be based upon the linear footage of sanitary sewer lines treated with chemical root control as measured on the ground surface from manhole to manhole, for each size pipe.

(2) No measurement will be made for chemical root control when operations are abandoned due to an obstruction and no further action is required for the line section.

4.02 Basis of Payment:

(A) Chemical Root Control: Payment shall be made at the contract unit price bid per linear foot of pipe treated with chemical root control. The unit price includes all labor, materials, equipment, and associated costs.

END OF SECTION