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Investing in clean water resources

Volume 3
Final Sanitary Sewers Remedial Measures Plan

Submitted

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Revised to include a Negotiated Plan and Resubmitted June 09, 2017

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I certify under penalty of law that I have examined and am familiar with the information submitted in this document and all attachments and that this document and its attachments were prepared under my direction or supervision in a manner designed to ensure that qualified and knowledgeable personnel properly gather and present the information contained therein. I further certify, based on my inquiry of those individuals immediately responsible for obtaining the information, that I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.

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Acronyms and Abbreviations

CCTV	closed-circuit television
CIPP	cured-in-place pipe
CMOM	capacity, management, operations, and maintenance
CSO	combined sewer overflow
CSS	combined sewer system
Decree	Consent Decree between Evansville Water and Sewer Utility and the United States and State of Indiana
DWF	dry-weather flow
EPA	U.S. Environmental Protection Agency
I/I	infiltration and inflow
in	inches
IOCP	Integrated Overflow Control Plan
LTCP	Long-term Control Plan
MG	million gallons
mgd	million gallons per day
O&M	operations and maintenance
PACC	Program Alternative Cost Calculator
SSA	sewer systems assessment
SSES	sanitary sewer evaluation study
SSO	sanitary sewer overflow
SSS	sanitary sewer system
SSRMP	Sanitary Sewers Remedial Measures Plan
Utility	Evansville Water & Sewer Utility
WWF	wet-weather flow
WWTP	wastewater treatment plant

Terminology and Naming Conventions

The following terminology is used throughout this report to describe the Evansville Water & Sewer Utility's (Utility) wastewater collection and treatment system:

- **Alternative:** a grouping of projects basin-wide from which one can assess the level of performance.
- **Basin or sewershed:** geographic areas currently served by a trunk sewer and the building blocks of the wastewater treatment plant (WWTP) service areas. The Utility considers trunk sewers in the sanitary sewer system (SSS) be pipes 12 inches or more in diameter. Flow from all but one of the Utility's SSS basins is transported through the combined sewer system, and most of the basins discharge the SSS flow into the combined sewer system trunk sewers by gravity. Only one SSS basin pumps flow to another SSS basin. Basins comprise multiple subbasins and are typically named using distinctive geographic features that make them easily identifiable.
- **Collector sewers:** sewers less than 12 inches in diameter. These sewers collect flow from homes and businesses and transport the flow to trunk sewers. The majority of the Utility's collector sewers are 8 and 10 inches in diameter.
- **Interceptors:** combined sewer system trunk sewers that transport dry-weather flow to the WWTP. During wet weather, the Utility maximizes the use of the interceptors for transport and storage of wet-weather flow.
- **Interceptor system or subsystem:** geographic areas containing multiple basins served by a single interceptor.
- **Projects:** a grouping of technologies in a specific area.
- **Subbasins:** the basic building blocks of basins. In this case, subbasins comprise the collector sewers and the properties assumed to discharge into the collector sewers.
- **Trunk sewers:** SSS sewers that are 12 inches or more in diameter. These sewers transport flow from the neighborhood collector sewers to combined sewer system or SSS lift stations—or to combined sewer interceptors or the WWTP—via gravity.
- **Utility service area:** the geographic area currently served by the Utility and the area that could potentially be served by the Utility without annexation. Currently, the Utility service area includes the City of Evansville and Vanderburgh County; it comprises the East and West WWTP Service Areas which, in turn, include some areas that do not yet have public sewer service.
- **WWTP service areas:** The geographic areas served by each of the Utility's WWTPs. Currently, the East and West Service Areas are separate and distinct, with no transfer of flow from one WWTP service area to the other. Each of the two service areas comprises several interceptor systems.

SECTION 1

Introduction

1.1 Introduction and Background

This document includes a Recommended Sanitary Sewer Remedial Measures Plan described in Section 4 below, which was submitted to EPA and IDEM for review on May 31, 2013, and a final Negotiated Plan dated January 15, 2016, described in Section 5 below which is based upon an agreement between Evansville and EPA and IDEM regarding the approach to sanitary sewer overflow control. The Negotiated Plan supercedes the Recommended Plan.

This report fulfills the requirements set forth in Appendix C, Section H of the November 2011 Consent Decree (Decree) between Evansville Water & Sewer Utility (Utility) and the United States and State of Indiana. The Decree requires the City of Evansville to develop and implement an Integrated Overflow Control Plan (IOCP), which includes this Sanitary Sewers Remedial Measures Plan (SSRMP).

The SSRMP establishes the plan and schedule for implementing remedial measures to prevent and eliminate sanitary sewer overflows (SSOs) for all storms smaller than the selected site-specific or system-wide design storm under current and future projected flow conditions. Per Appendix C, Section H of the Decree, the SSRMP is required to address the specific items listed in Table 1-1. Table 1-1 also identifies the section(s) of this report that most directly addresses each of the required items and should facilitate the review for Decree compliance.

Table 1-1 Consent Decree Appendix C, Section H Requirements

Consent Decree Appendix C, Section H (paraphrased)		Response	
Subsection and Requirement		Section(s)	Synopsis
H.1.a	Identify measures to achieve adequate capacity.	1, 3, and 4	Projects to provide adequate capacity for the selected design storm are summarized in Section 1. Additional details regarding the various levels of service are presented in Section 3, and approach/projects to achieve adequate capacity are described in Section 4.
H.1.a	Specify a plan for implementing measures to achieve adequate capacity.	4	Projects to address capacity related issues are presented. An adaptive management approach will be used to refine/confirm sizing in future years.
H.1.b	Estimate the degree to which infiltration and inflow will be cost-effectively reduced.	3.3.3.1	Areas with the highest R values will be targeted for additional investigation and remediation.
H.1.c	Identify sanitary sewer system remedial measures to rehabilitate degradation.	4	Efforts will focus on rehabilitation of defects observed during sanitary sewer evaluation study investigations.
H.1.d	Prioritize sewer system remedial measures.	4	Projects will be prioritized to alleviate basement flooding, reduce infiltration and inflow, and address known SSOs.

Table 1-1 Consent Decree Appendix C, Section H Requirements

Consent Decree Appendix C, Section H (paraphrased)		Response	
Subsection and Requirement		Section(s)	Synopsis
H.1.e	Provide estimated capital, operations and maintenance, and present-value costs.	4	Planning-level costs for the selected SSRMP projects are presented per Decree requirement.
H.1.f	Provide a schedule that is as expeditious as possible.	4	Schedule is provided, and an adaptive management approach will focus on investigation and rehabilitation as expeditiously as possible.

1.2 SSRMP Document Organization

This SSRMP is the third volume of the IOCP. It focuses on the sanitary sewer system (SSS), and it identifies the remedial measures and develops an implementation plan to prevent and eliminate SSOs to the targeted level of system capacity. This SSRMP is organized as follows:

Section 1, Introduction. Section 1 provides an overview of SSRMP contents and the general approach used in developing the SSRMP.

Section 2, System Characterization. Section 2 describes the existing and projected future flow conditions that were considered in developing the SSRMP, and it summarizes and expands on data and information presented and discussed in the *Initial System Characterization including Separate Sanitary Sewer Hydraulic Model Development* (CH2M HILL, 2011a) and *Sewer Systems Assessment Report* (CH2M HILL, 2012a).

Section 3, Development and Evaluation of Alternatives for SSO Control. Section 3 presents the approach and factors used to evaluate and select the various discharge elimination solutions in each sewer basin. This section describes the alternatives evaluation methodology and results used to develop the remedial measures plan presented in Section 4.

Section 4, Recommended Remedial Measures Plan – May 31, 2015. Section 4 describes the recommended remedial measures plan submitted to EPA and IDEM, the process used to prioritize projects, and the implementation schedule. Costs in Section 4 are in 2012 dollars.

Section 5, Final Negotiated Remedial Measures Plan – January 15, 2016. Section 5 describes the final negotiated plan for SSO control as agreed to by Evansville and EPA and IDEM.

Section 6, Works Cited. Section 5 contains bibliographic references for documents cited in this SSRMP. Costs in Section 5 are in 2015 dollars.

1.3 Related Documents

Several technical analyses relevant to this SSRMP were documented previously. Required SSS- and SSRMP-related content not addressed in this report is addressed in distinct reports required by other sections of the Decree. Reports completed to date are listed in Table 1-2 and are available at www.renewevansville.com. Additionally, items related to the combined sewer system (CSS) and wastewater treatment plants (WWTPs) are addressed in the other volumes of this set of documents:

- Volume 1 – IOCP
- Volume 2 – Long-term Control Plan (LTCP)
- Volume 4 –Facility Plan for the West and East WWTPs

Table 1-2 Decree Deliverables

	Deliverable	Due Date	Status	Description
1	*Separate Sanitary Sewer System Evaluation Work Plan* (CH2M HILL, 2010)	November 30, 2010	Submitted	Basis for conducting sanitary sewer evaluation studies on portions of the SSS
4	*West WWTP and 7th Avenue Pump Station Wet-weather Operating Plan* (CH2M HILL, 2011b)	January 31, 2011	Submitted	Documents current operational attributes of the 7th Avenue Lift Station and West Side Interceptor System, as well as the relationship between the 7th Avenue Lift Station and the West WWTP
5	*Modeling Work Plan, including Capacity Assessment Work Plan and Approach for Determining Critical Storm Duration* (CH2M HILL, 2011c)	April 30, 2011	Submitted	Basis for facilitating development, calibration, and validation of the hydraulic models
10	*2011 Stream Reach Characterization and Evaluation Report Update* (CH2M HILL, 2011d)	August 31, 2011	Submitted	Documents the Utility's current understanding of the receiving waters
11	*West WWTP Stress Testing Protocols and Secondary Clarifier Capacity Report* (CH2M HILL, 2011e)	November 1, 2011	Submitted	Documents current operational attributes of the West WWTP
12	*West WWTP Step Feed and Contact Stabilization Study* (CH2M HILL, 2011f) *East WWTP Step Feed and Contact Stabilization Study* (CH2M HILL, 2011g)	November 1, 2011	Submitted	Document current operational attributes of the West and East WWTPs
14	Complete trunk sewer survey and condition assessment	November 30, 2011	Complete	Used as the primary means for data acquisition to adequately support development of the hydraulic models
15	*Initial System Characterization including Separate Sanitary Sewer Hydraulic Model Development* (CH2M HILL, 2011a)	November 30, 2011	Submitted	Documents the Utility's current understanding of sewer system conditions
16	*Critical Storm Duration Analysis* (CH2M HILL, 2011h)	December 31, 2011	Submitted	Establishes the storm used to conduct the capacity assessment

Table 1-2 Decree Deliverables

	Deliverable	Due Date	Status	Description
20	*Sewer Systems Assessment Report* (CH2M HILL, 2012a)	March 31, 2012, Revised July 31, 2012	Submitted	Presents results of sanitary sewer evaluation study condition assessment and capacity assessment
23	Volume 1 – Draft IOCP Volume 2 – Draft LTCP Volume 3 – Draft SSRMP Volume 4 – Draft Facility Plan for the West and East WWTPs	July 31, 2012	Submitted	Presents the draft plans based on system characteristics
26	Final Recommended IOCP	May 31, 2012	This Document	Final recommended plans incorporating revisions resulting from public and agency comment period

1.4 Planning Approach

A single, consistent approach was used in each SSS basin to evaluate and select projects for inclusion in this SSRMP. The standardized approach consisted of the following elements:

- Conduct flow monitoring to measure dry-weather sanitary flows, groundwater infiltration, and wet-weather infiltration and inflow (I/I).
- Develop estimates of the existing system's response to rainfall based on flow monitoring data collected in 2010 and 2011.
- Develop projections of future dry-weather flows (DWFs) and wet-weather flows (WWFs).
- Perform hydraulic modeling to analyze current and projected future DWFs and WWFs to predict hydraulic limitations and overflows that may result from capacity limitations.
- Develop projects to rehabilitate pipe and manhole defects, and eliminate sources of stormwater inflow identified during the 2011 sanitary sewer evaluation study (SSES) work.
- Develop project alternatives designed to convey projected DFWs and WWFs without SSOs for each of the various design storms established in the *Critical Storm Duration Analysis* (CH2M HILL, 2011h) under existing (2012) and future (2032) flow conditions.
- Compare SSO locations predicted by the hydraulic models to SSOs reported in the Utility's Semi-Annual Reports to identify known SSO locations for remedy and to develop the priority for remediation.
- Evaluate and compare the project alternatives comprising the remedial measures plan for each design storm.
- Select and prioritize the proposed projects comprising the recommended SSRMP.

Additional approach details are provided in later sections of this SSRMP and in the revised *Sewer Systems Assessment Report* (CH2M HILL, 2012a).

1.5 SSRMP Summary

The ultimate goal of the Utility's SSRMP is to prevent SSOs that may occur as a result of the sewer systems' inability to transport anticipated peak WWFs corresponding to the selected design storm to the CSS trunk sewers or the WWTPs. The SSRMP focuses on reducing I/I and on remediation of recurring SSO. CSS releases and WWTP capacity issues are addressed as part of the LTCP and the WWTP Facility Plan for the West and East WWTPs, respectively.

Based on the results of the flow monitoring, SSES efforts, hydraulic modeling work conducted in 2010, and the analyses completed to develop the SSRMP, and in light of the Utility's financial capability, Evansville will implement an adaptive management approach to SSO control that focuses on continuous improvement and effective asset management. The SSRMP approach can be summarized as follows:

1. Identify recurring SSO locations to establish the priority for SSRMP work, as described in *Identifying SSOs Included in the SSRMP* (CH2M HILL, 2013)
2. Implement the inflow reduction, manhole rehabilitation, and Priority 2 and 3 cured-in-place pipe (CIPP) projects (infrastructure condition improvement projects) identified in the revised *Sewer Systems Assessment Report* (CH2M HILL, 2012a), with priority given to areas with reported SSOs.
3. Continue and expand the ongoing sewer assessment and flow monitoring program to identify and remove inflow sources and to verify the existence and extent of capacity limitations/ bottlenecks, with priority given to areas with reported SSOs that were identified through the flow monitoring and hydraulic modeling efforts as having potential SSOs.
4. Refine and recalibrate the hydraulic models on an ongoing basis to accurately assess and understand the benefits of I/I removal and wet-weather flow changes, and closely monitor and model areas with forecasted growth to ensure that adequate dry- and wet-weather capacity is available to convey flows without SSOs.
5. Implement the capacity improvement, storage, or pumping improvement projects identified in Section 3 if sewer rehabilitation and I/I reduction efforts are not effective at controlling or eliminating SSOs and hydraulic capacity limitations.

1.5.1 Condition and Capacity Improvements

Table 1-3 lists condition improvement projects proposed in each basin and the total cost of each of the project types systemwide. The condition improvement projects are the highest priority and are common to all SSRMP alternatives considered. Table 1-4 lists the projects that will address the capacity limitations that cause or contribute to recurring SSOs. The capacity projects will be implemented after the condition improvement projects and the Utility will determine after post-construction monitoring and model refinement the final extent and capacity of these projects. The SSRMP projects and costs listed in Tables 1-3 and 1-4 are incorporated in the IOCP presented in Volume 1, and CSS improvements presented within the LTCP for future condition (2032) flows are based upon these SSS projects being completed.

Table 1-3 Capital Costs for Condition Improvement Projects by Basin

Service Area	Basin	Project Type	Total Capital Cost (in dollars)
West	Northwest	Inflow Reduction	322,000
		Manhole Rehabilitation	189,000
		Sewer Main Rehabilitation	677,000
		Post-construction Flow Monitoring	18,000
	Southwest	Inflow Reduction	1,437,000
		Manhole Rehabilitation	289,000
		Sewer Main Rehabilitation	548,000
		Post-construction Flow Monitoring	18,000
	University Heights	Manhole Rehabilitation	62,000
	Allens Lane/Skylane North	Inflow Reduction	20,000
		Manhole Rehabilitation	104,000
		Sewer Main Rehabilitation	137,000
		Post-construction Flow Monitoring	9,000
	North Park (W-8)	Inflow Reduction	1,128,000
		Manhole Rehabilitation	907,000
		Sewer Main Rehabilitation	2,175,000
		Post-construction Flow Monitoring	37,000
	Millersburg/HWY 41	Manhole Rehabilitation	458,000
		Post-construction Flow Monitoring	28,000
East	E-11	Inflow Reduction	1,918,000
		Manhole Rehabilitation	198,000
		Sewer Main Rehabilitation	1,133,000
		Post-construction Flow Monitoring	37,000
East (cont'd)	Lloyd	Inflow Reduction	174,000
		Manhole Rehabilitation	480,000
		Sewer Main Rehabilitation	1,875,000
		Post-construction Flow Monitoring	55,000
	Covert	Inflow Reduction	1,149,000
		Manhole Rehabilitation	345,000
		Sewer Main Rehabilitation	815,000
		Post-construction Flow Monitoring	28,000
	Riverside-Vann	Inflow Reduction	271,000
		Manhole Rehabilitation	41,000
		Sewer Main Rehabilitation	218,000
		Post-construction Flow Monitoring	9,000
Total			**17,309,000**

Table 1-4 Capital Costs for Capacity Projects by Basin

Service Area	Basin	Project Type	Total Capital Cost (in dollars)
West	Northwest / Southwest	West Terrace PS	3,054,000
	North Park (W-8)	1st and Mill Road to Longfield	3,927,000
		Longfield to Pigeon Creed	3,494,000
		North Park PS	3,498,000
East	E-11	Bergdolt	7,088,000
		Bergdolt PS	3,639,000
	Lloyd	Lincoln Avenue	2,959,000
Total			**27,659,000**

1.5.2 Schedule and Prioritization

The Recommended SSRMP will be implemented as expeditiously as possible, and it will eliminate the recurring SSOs in the priority areas noted in Table 1-4 by or before May 31, 2032. Table 1-5 lists the SSRMP projects and the project implementation schedule for the Recommended Plan.

Table 1-5 Recommended SSRMP Capacity Projects

Project	Addresses	Planning Level Opinions of Probable Capital Costs
North Park Capacity Projects	Mill Road SSOs	4,247,000
Lloyd Expressway Capacity Projects	Lincoln Avenue SSOs	2,9 61,000
NW/SW Capacity Projects	Tekoppel Avenue SSOs	3,054,000
E-11 Capacity Projects	Bergdolt Road SSOs	10,760,000
Proposed IOCP Cost		21,022,000

Notes:

1. Refer to the LTCP, SSRMP, and WWTP Facility Plan for specific project details and development of cost opinions.
2. The proposed bid, commencement of construction, and achievement of full operation dates are subject to change based on state and federal (including U.S. Army Corps of Engineer) permitting and approval.
3. These summary tables present only capital cost since it is the key scheduling component of cost. Project operations and maintenance (O&M) costs and Life Cycle cost are presented with project details in the appendixes to the SSRMP.

SECTION 2

System Characterization

As required by the Decree, the Utility updated its System Characterization Program to augment and support development of the IOCP and to document its understanding of the current conditions of the sewer systems and receiving waters. The results of this update were documented in the *Initial System Characterization including Separate Sanitary Sewer Hydraulic Model Development* report (CH2M HILL, 2011a). Subsequently, the Utility prepared and submitted to the U.S. Environmental Protection Agency (EPA) the *Sewer Systems Assessment Report* (CH2M HILL, 2012a), which described the results of its evaluation of portions of the SSS and the results of the SSS capacity assessment. These efforts and documents established the baseline conditions used to evaluate SSRMP alternatives. This section highlights and summarizes information previously submitted or provides additional information relevant to development of the SSRMP.

2.1 Compilation of Existing Data

The SSS system characterization materials are presented in several documents that were submitted previously in accordance with Appendixes B and C of the Decree. Table 2-1 summarizes the Decree deliverables related to system characterization, each document's relationship to system characterization, and the section of the Decree that outlines the document requirements. Although the information is not repeated in this SSRMP, each report is available for review at www.renewevansville.com, and all deliverables are incorporated by reference into the IOCP to form a complete record of the technical work required by the Decree.

Table 2-1 Decree Deliverables Related to SSS System Characterization

	Decree Deliverable [a]	Deliverable Due Date	Relationship to System Characterization	Consent Decree Requirement
1	*Separate Sanitary Sewer System Evaluation Work Plan* (CH2M HILL, 2010)	November 30, 2010	Basis for conducting SSESs on portions of the SSS.	Appendix C, Section D
5	*Modeling Work Plan, including Capacity Assessment Work Plan and Approach for Determining Critical Storm Duration* (CH2M HILL, 2011c)	April 30, 2011	Basis for development, calibration, and validation of the hydraulic models.	Appendix C, Section E
14	Separate sanitary survey and condition assessment [b]	November 30, 2011	Field investigation effort that served as the primary means for data acquisition. Data supported the development of the hydraulic models.	Appendix C, Section D
15	*Initial System Characterization including Separate Sanitary Sewer Hydraulic Model Development* (CH2M HILL, 2011a)	November 30, 2011	Documented physical characteristics of the sewer systems (SSS and CSS) and WWTPs. Data supported development of the hydraulic models.	Appendix C, Sections C and E

Table 2-1 Decree Deliverables Related to SSS System Characterization

	Decree Deliverable [a]	Deliverable Due Date	Relationship to System Characterization	Consent Decree Requirement
16	*Critical Storm Duration Analysis* (CH2M HILL, 2011h)	December 31, 2011	Established the storm duration used to conduct the capacity assessment.	Appendix C, Section F, Paragraph 1
20	*Sewer Systems Assessment Report*[c] (CH2M HILL, 2012a)	March 31, 2012	Presented and correlated results of the sewer system characterization, SSES, and capacity assessment.	Appendix C, Section G

[a] Submittal number per Appendix B of the Decree and document title.
[b] Field investigation—no printed deliverable. Deliverable date reflects the required date for completion of the fieldwork.
[c] Submittal content included the capacity assessment required per Decree Appendix C, Section F.

Development of the SSS hydraulic models and related documents are described in the following sections.

2.1.1 Sanitary Sewer System Hydraulic Model Development

In 2011, the Utility began developing hydraulic computer models of the SSS in accordance with the requirements of Decree Appendix C, Section E. Detailed descriptions of SSS model development were provided as part of previous submittals in accordance with the Decree:

- Protocols and procedures for model development, the capacity assessment work plan, and the approach for determining the critical storm duration are described in *Modeling Work Plan, including Capacity Assessment Work Plan and Approach for Determining Critical Storm Duration* (CH2M HILL, 2011c), submitted on April 30, 2011.
- Model development and calibration are described in *System Characterization and SSS Model Calibration Reports* (CH2M HILL, 2011a), submitted on November 30, 2011.
- The critical storm duration evaluation is presented in *Critical Storm Duration Analysis* (CH2M HILL, 2011h) submitted on December 31, 2011.

The hydraulic models were used to evaluate the capacity of the SSS system.

2.1.2 Sewer Systems Assessment Report

In accordance with the Decree, the *Sewer Systems Assessment Report* (CH2M HILL, 2012a) compiled and correlated the results of the SSES work and the capacity assessment. DWFs, WWFs, infiltration rates, structural defects, surcharged segments, and manhole structures that overflow were evaluated as part of the evaluation and capacity assessment effort. Following submittal of that report, it was updated in response to comments from the EPA. A revised *Sewer Systems Assessment Report* (CH2M HILL, 2012a) was submitted with the July 31, 2012 Draft SSRMP. Future flow estimates were subsequently updated in *EWSU SSS Future Flow Projections Technical Memorandum* (CH2M HILL, 2013a) presented in Appendix A. Updated future flow rate and volume data are presented within this section.

2.1.3 Long-term Control Plan

SSS flows and projects affect the flows and project needs in the downstream CSS. The CSS hydraulic models were updated to incorporate the SSS flows to more accurately represent system conditions and to identify planning needs. Similar to the SSRMP, the LTCP identifies a range of levels of controls (with planning-level costs) to address combined sewer overflow (CSOs). The LTCP is presented as Volume 2 of the IOCP.

2.1.4 Integrated Overflow Control Plan

The IOCP integrates and unifies the results of the LTCP, SSRMP, and WWTP Facility Plan. The IOCP is presented as Volume 1 of the IOCP.

2.2 SSS Flows for Capacity Assessment and SSRMP Development

The Utility's sewer systems contain more than 800 miles of combined and SSS pipelines, two WWTPs, and 90 lift stations. The 65-square-mile service area is divided into two WWTP service areas that are separate and distinct, with no transfer of flow from one WWTP service area to the other. This section compiles and summarizes the SSS flows that were considered in the development of the SSRMP.

SSS flow responses to precipitation were developed for specific storm events in accordance with Decree requirements. The critical storm durations calculated for Evansville's systems are summarized in Table 2-2. These storm events were evaluated under existing (2012) and projected future (2032) conditions.

Table 2-2 Storm Events Evaluated for Capacity Assessment

Storm Events (per Decree)	Return Frequency	Storm Duration	
		West Service Area	East Service Area
(i)	2 years	24 hours[a]	3 hours[a]
(ii)	5 years	24 hours[a]	3 hours[a]
(iii)	10 years	24 hours	24 hours
(iv)	10 years	24 hours[a,b]	3 hours[a]

[a] Critical storm duration.
[b] Storm events (iii) and (iv) are identical due to the West Service Area critical storm duration of 24 hours.

The following sections describe, by basin, the results of this evaluation. Information on basin geography and the sewer inventory can be found in the *Initial System Characterization including Separate Sanitary Sewer Hydraulic Model Development* (CH2M HILL, 2011a).

2.2.1 West Service Area

The West Service Area comprises three subsystems:

- Western Basins Subsystem
- West Side Interceptor System (CSS basins only)
- Pigeon Creek Interceptor System (both CSS and SSS basins)

Only the SSS basins in the West Service Area are discussed in this section. Information on basin geography and the sewer inventory can be found in the *Initial System Characterization, including Separate Sanitary Sewer Hydraulic Model Development* (CH2M HILL, 2011a) and is not repeated here.

2.2.1.1 Western Basins Subsystem

The Western Basins Subsystem comprises two SSS basins that flow by gravity through the CSS and to the West WWTP:

- Southwest SSS Basin
- Northwest SSS Basin

The Southwest and Northwest SSS basins combine before discharging into the CSS; therefore, these basins were combined for analysis and modeling. Table 2-3 lists the existing flows (2012) and projected future flows (2032) for the Southwest and Northwest SSS Basins.

Table 2-3 Southwest and Northwest Sanitary Sewer System Basins, Modeled Flows

	Existing Flows		Future Flows		Percent Difference	
Storm Event	**Peak Flow Rate (mgd)**	**Flow Volume (MG)**	**Peak Flow Rate (mgd)**	**Flow Volume (MG)**	**Peak Flow Rate**	**Flow Volume**
Dry Weather	2.38	1.51a	3.38	2.02Z[a]	42	34
2-year, 24-hour	7.93	19.72	8.51	25.94	7	32
5-year, 24- hour	8.15	20.41	8.45	26.28	4	29
10-year, 24-hour	8.81	20.55	9.28	26.61	5	29

[a] Average flow rate (in mgd) for dry-weather simulations.

MG = million gallons
mgd = million gallons per day

Table 2-4 lists the R values calculated for the Northwest and Southwest SSS Basins. The R value is the percentage of rainfall falling on the sewershed that results in I/I. Figure 2-1 shows the flow monitor locations, modeled sewersheds, SSES areas, modeled overflows, and calculated R values in the Northwest and Southwest SSS Basins.

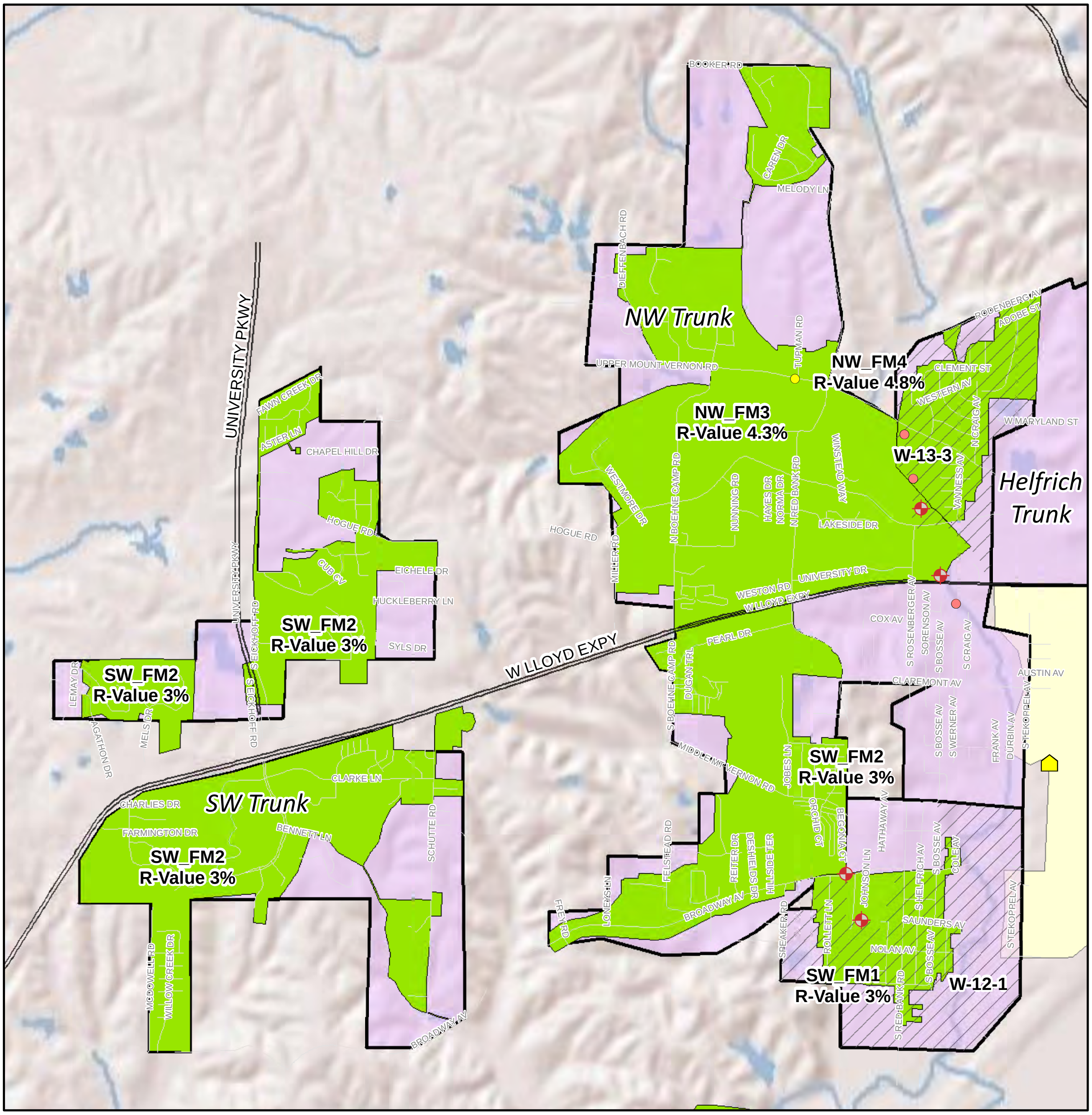
Table 2-4 Northwest and Southwest Sanitary Sewer System Basins Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM1	3.0%
FM2	3.0%
FM3	4.3%
FM4	4.8%

2.2.1.2 Pigeon Creek Interceptor System

The following SSS basins are located within the Pigeon Creek Interceptor System:

- Helfrich SSS Basin
- Allen's Lane North SSS Basin
- North Park (W-8) SSS Basin
- Millersburg SSS Basin
- U.S. Highway 41 SSS Basin



LEGEND

- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 24 hour Event
- 5 year 24 hour Event
- 10 Year 24 Hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%

N

0 2,000 4,000
Feet

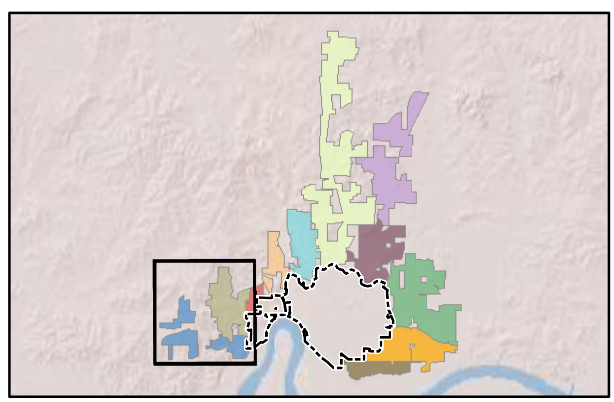


FIGURE 2-1
NW/SW Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
May 31, 2013

The flow from these basins is all collected by the Pigeon Creek Interceptor and flows by gravity to the 7th Avenue Lift Station, which pumps DWF and WWF to a gravity sewer that ultimately discharges to the West WWTP.

2.2.1.2.1 Helfrich Sanitary Sewer System Basin

Flows in this basin generally travel east into the CSS and through the Maryland Street Interceptor to the Pigeon Creek Interceptor and south through the CSS to the West WWTP. Table 2-5 lists the existing flows (2012) and future flows (2032) for the Helfrich SSS Basin.

Table 2-5 Helfrich Sanitary Sewer System Basin, Modeled Flows

	Existing Flows		Future Flows		Percent Difference	
Storm Event	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate	Flow Volume
Dry Weather	0.32	0.21[a]	0.39	0.24[a]	22	18
2-year, 24-hour	1.30	2.68	1.51	3.27	16	22
5-year, 24-hour	1.53	2.81	1.78	3.42	16	22
10-year, 24-hour	1.74	2.92	2.02	3.56	16	22

[a] Average flow rate (in mgd) for dry-weather simulations.

Table 2-6 lists the R values calculated for the Helfrich SSS Basins. Figure 2-2 shows the flow monitor locations, modeled sewersheds, SSES areas, and modeled overflows in the Helfrich SSS Basin.

Table 2-6 Helfrich Sanitary Sewer System Basin Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM5	4.5%

2.2.1.2.2 Allens Lane North Sanitary Sewer System Basin

Flows in this basin generally travel south and east, and the Allens Lane North trunk sewer discharges by gravity into the Pigeon Creek Interceptor near the Dresden CSO. Table 2-7 presents the existing flows (2012) and the future flows (2032) for the Allens Lane North SSS Basin.

Table 2-7 Allens Lane North Sanitary Sewer System Basin, Modeled Flows

	Existing Flows		Future Flows		Percent Difference	
Storm Event	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate	Flow Volume
Dry Weather	1.11	0.67[a]	1.29	0.75[a]	17	12
2-year, 24-hour	3.74	9.84	3.89	11.36	4	15
5-year, 24-hour	4.05	10.44	4.05	11.99	0	15
10-year, 24-hour	4.17	10.97	4.17	12.34	0	12

[a] Average flow rate (in mgd) for dry-weather simulations.

Table 2-8 lists the R values calculated for the Allens Lane North SSS Basin. Figure 2-3 shows the flow monitor locations, modeled sewersheds, SSES areas, and modeled overflows in the Allens Lane North SSS Basin.

Table 2-8 Allens Lane North Basin Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM6	5%

2.2.1.2.3 North Park (W-8) Sanitary Sewer System Basin

Flows in this basin generally travel south and east and are then discharged by gravity directly into the Pigeon Creek Interceptor just downstream of the Diamond Avenue CSO. Table 2-9 presents the existing flows (2012) and the future flows (2032) for the North Park (W-8) SSS Basin.

Table 2-9 North Park (W-8) Sanitary Sewer System Basin, Modeled Flows

	Existing Flows		Future Flows		Percent Difference	
Storm Event	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate	Flow Volume
Dry Weather	1.33	0.89[a]	1.56	1.02[a]	17	14
2-year, 24-hour	8.05	17.70	8.06	19.38	0	9
5-year, 24-hour	8.63	19.10	8.64	20.74	0	9
10-year, 24-hour	9.12	20.25	9.12	21.90	0	8

[a] Average flow rate (in mgd) for dry-weather simulations.

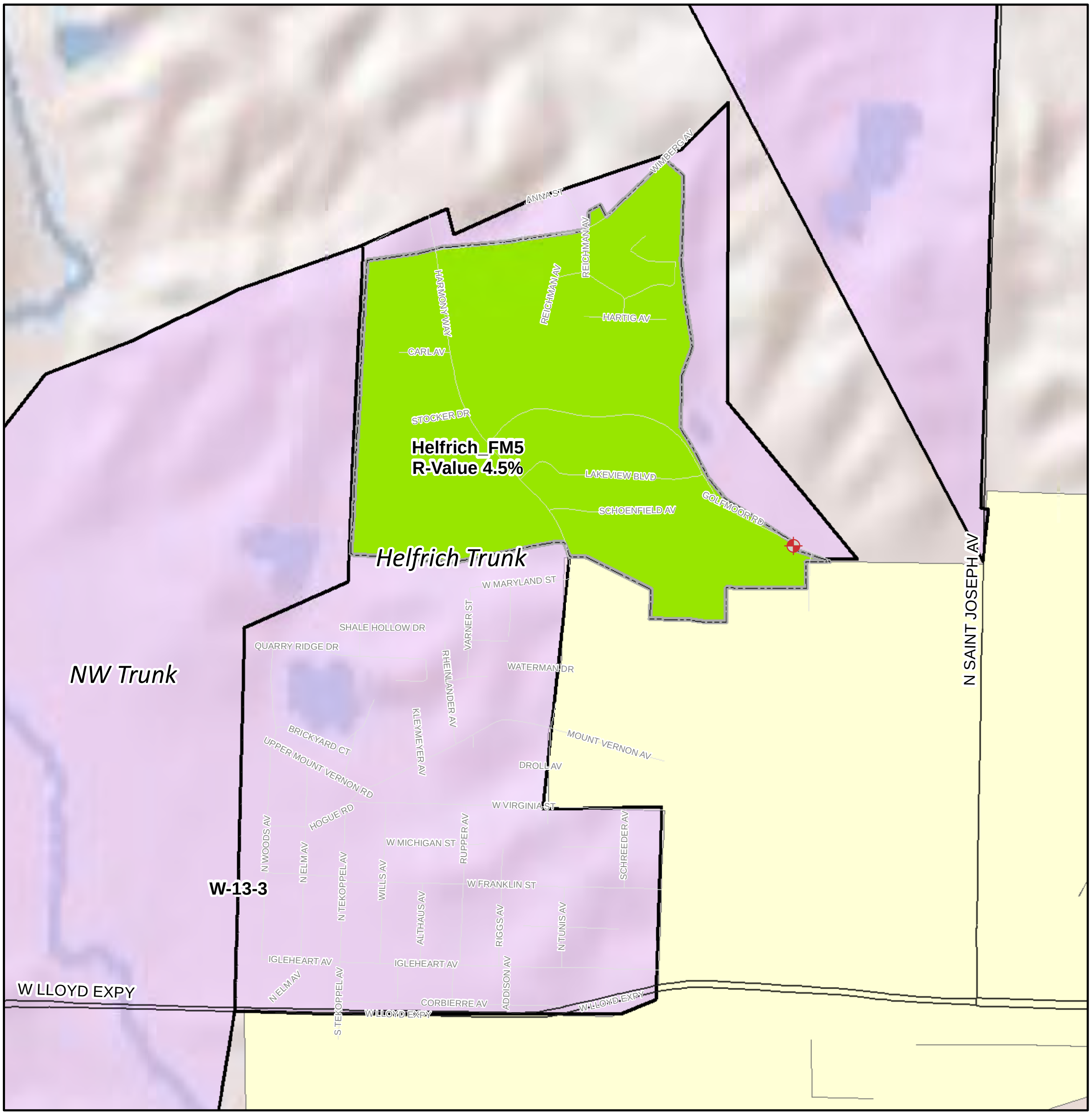
Table 2-10 lists the R values calculated for the North Park (W-8) SSS Basin. Figure 2-4 shows the flow monitor locations, modeled sewersheds, SSES areas, and modeled overflows in the North Park (W-8) SSS Basin.

Table 2-10 North Park (W-8) Basin Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM7	1.5%
FM8	18.0%
FM10	7.3%
FM11	9.0%

2.2.1.2.4 Millersburg and U.S. Highway 41 Sanitary Sewer System Basins

The Millersburg SSS Basin flows are pumped into the U.S. Highway 41 trunk sewer; therefore, these basins were combined for analysis and modeling. Flows from the Millersburg Basin are pumped to the U.S. Highway 41 SSS Basin from the Millersburg Lift Station. The flow in the U.S. Highway 41 SSS Basin generally travels south to the Pfeiffer Road Lift Station, and flow is then pumped to the Diamond-Evans Interceptor in the CSS. Table 2-11 presents the existing flows (2012) and the future flows (2032) for the Millersburg and U.S. Highway 41 SSS Basins.



LEGEND

- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 24 hour Event
- 5 year 24 hour Event
- 10 Year 24 Hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%

N

0 500 1,000
Feet

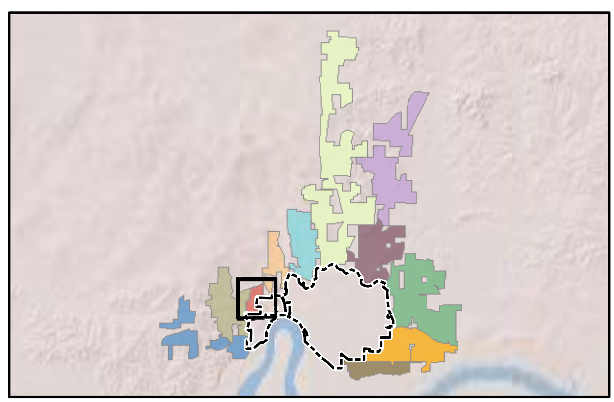
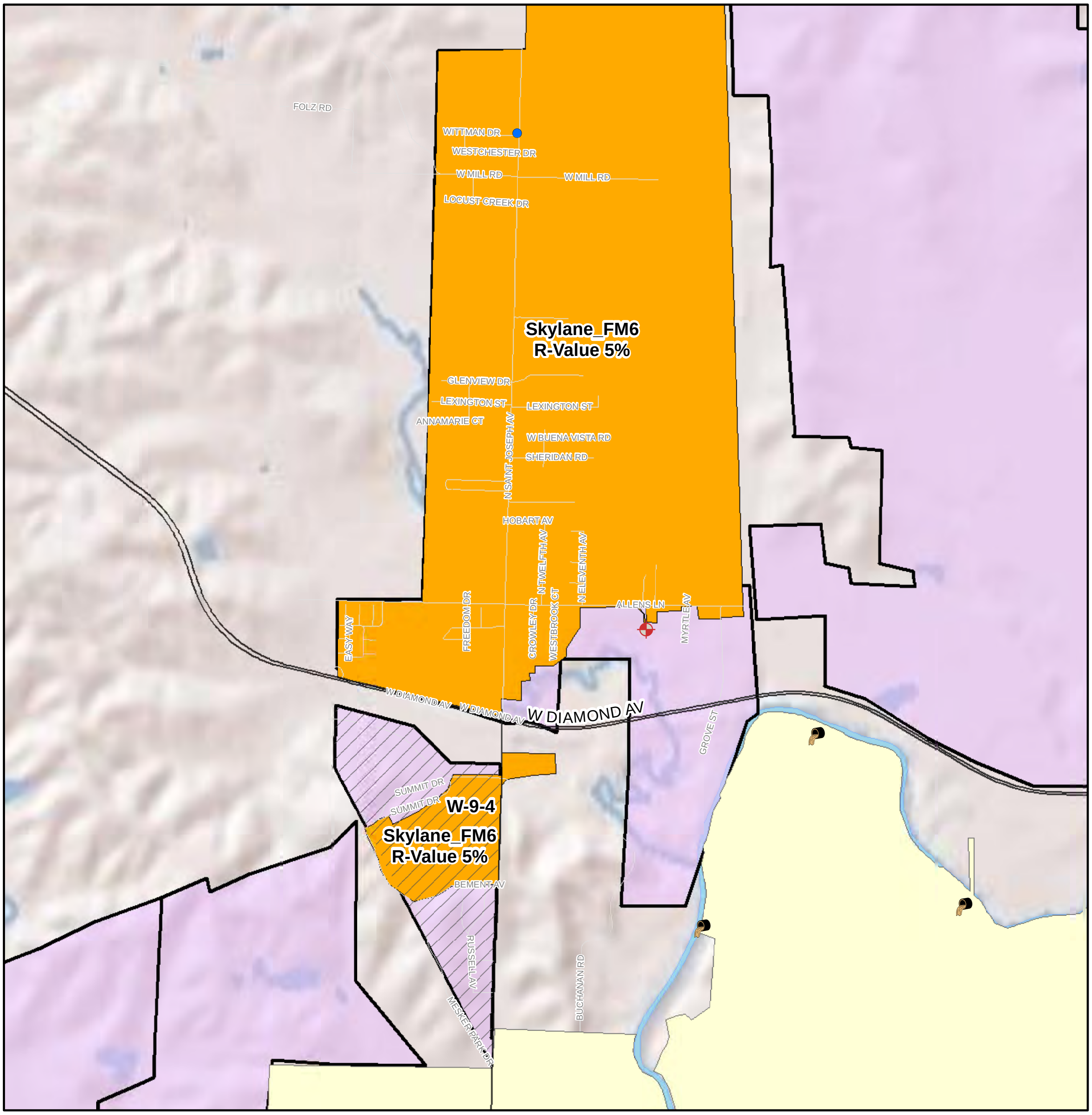


FIGURE 2-2
Helfrich Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
May 31, 2013



LEGEND

- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 24 hour Event
- 5 year 24 hour Event
- 10 Year 24 Hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%

N

0 1,500 3,000
Feet

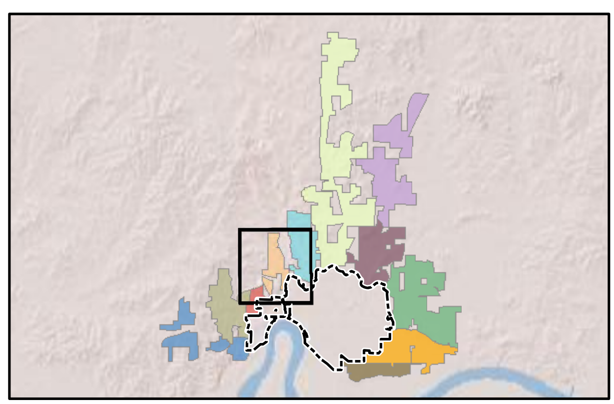
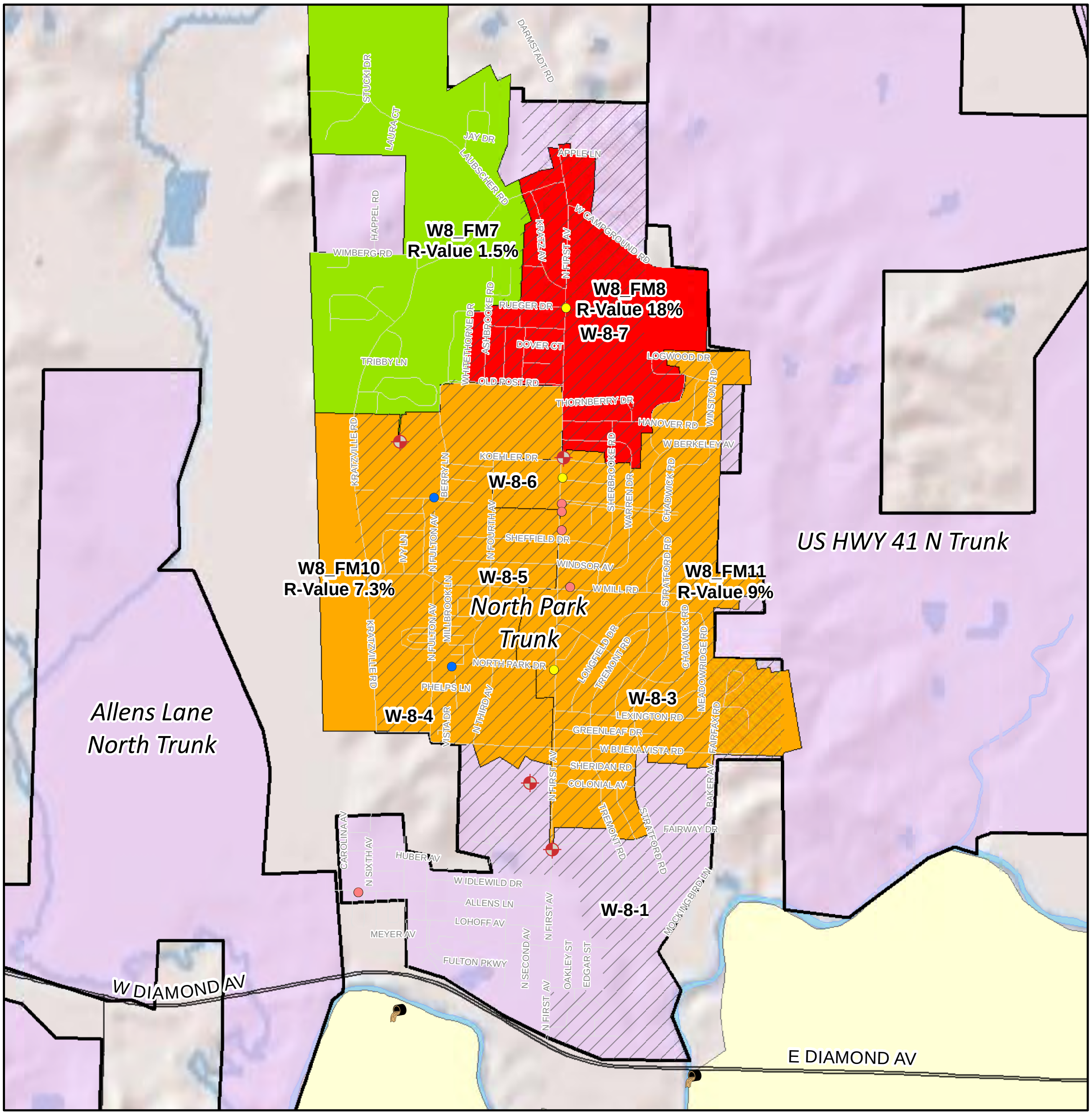


FIGURE 2-3
Allens Lane North Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
May 31, 2013



LEGEND

- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 24 hour Event
- 5 year 24 hour Event
- 10 Year 24 Hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%

N

0 1,500 3,000

Feet

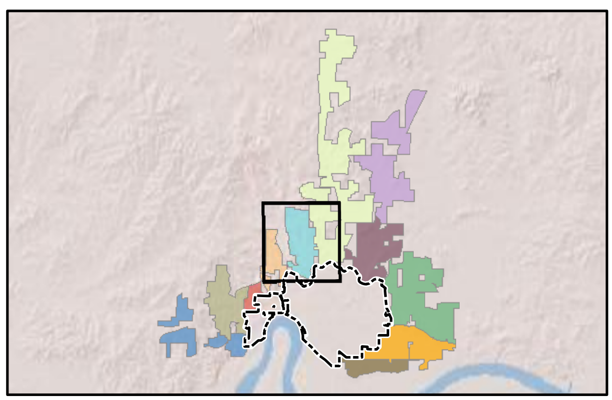


FIGURE 2-4
North Park Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
*May 31, **2013***

Table 2-11 Millersburg/U.S. Highway 41 Sanitary Sewer System Basin, Modeled Flows

Storm Event	Existing Flows		Future Flows		Percent Difference	
	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate	Flow Volume
Dry Weather	4.03	2.74[a]	7.06	5.23[a]	75	91
2-year, 24-hour	8.05	33.38	7.93	55.29	-2	66
5-year, 24-hour	7.94	33.84	7.82	54.56	-1	61
10-year, 24-hour	7.80	34.10	7.91	55.48	1	63

[a] Average flow rate (in mgd) for dry-weather simulations.

Table 2-11 lists the R values calculated for the Millersburg/US Highway 41 SSS Basin. Figure 2-5 shows the flow monitor locations, modeled sewersheds, SSES areas, and modeled overflows in the Millersburg/U.S. Highway 41 SSS Basin.

Table 2-11a Millersburg/U.S. Highway 41 Sanitary Sewer System Basins Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM9	1.4%
FM12	3.9%
FM27	1.6%
FMMB	1.7%

2.2.2 East Service Area

The East WWTP Service Area comprises three major sewer systems:

- Pigeon Creek East System
- Bee Slough System
- Ohio River East/Downtown System (CSS basins)

2.2.2.1 Pigeon Creek East System

The Pigeon Creek East System comprises two SSS basins:

- Lloyd Expressway SSS Basin
- E-11 SSS Basin

2.2.2.1.1 Lloyd Expressway Sanitary Sewer System Basin Interaction

The Lloyd Expressway SSS sewer flows into the CSS and splits, partially flowing north towards the Pigeon Creek Interceptor via the Wesselman Park Interceptor and the rest flowing south into the Bee Slough System. Therefore, details regarding this SSS basin can be found in Section 2.2.2.2, Bee Slough System.

2.2.2.1.2 E-11 Sanitary Sewer System Basin

Flows in this basin generally travel south towards the Weinbach Lift Station, where all flows from the basin are collected and pumped to the Weinbach Interceptor en route to the East

WWTP. Table 2-12 presents the existing flows (2012) and the future flows (2032) for the E-11 SSS Basin.

Table 2-12 E-11 Sanitary Sewer System Basin, Modeled Flows

	Existing Flows		Future Flows		Percent Difference	
Storm Event	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate	Flow Volume
Dry Weather	1.27	0.84[a]	2.09	1.39[a]	65	66
2-year, 3-hour	9.09	16.26	9.60	22.06	6	36
5-year, 3-hour	9.67	16.98	9.79	22.79	1	34
10-year, 3-hour	9.73	17.36	9.73	22.94	0	32
10-year, 24-hour	9.90	21.94	10.00	27.74	1	26

[a] Average flow rate (in mgd) for dry-weather simulations.

Table 2-13 lists the R values calculated for the E-11 SSS Basin. Figure 2-6 shows the flow monitor locations, modeled sewersheds, SSES areas, and modeled overflows in the E-11 SSS Basin.

Table 2-13 E-11 Sanitary Sewer System Basin Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM13	6.1%
FM14	5.2%
FM15	2.9%
FM16	7.9%

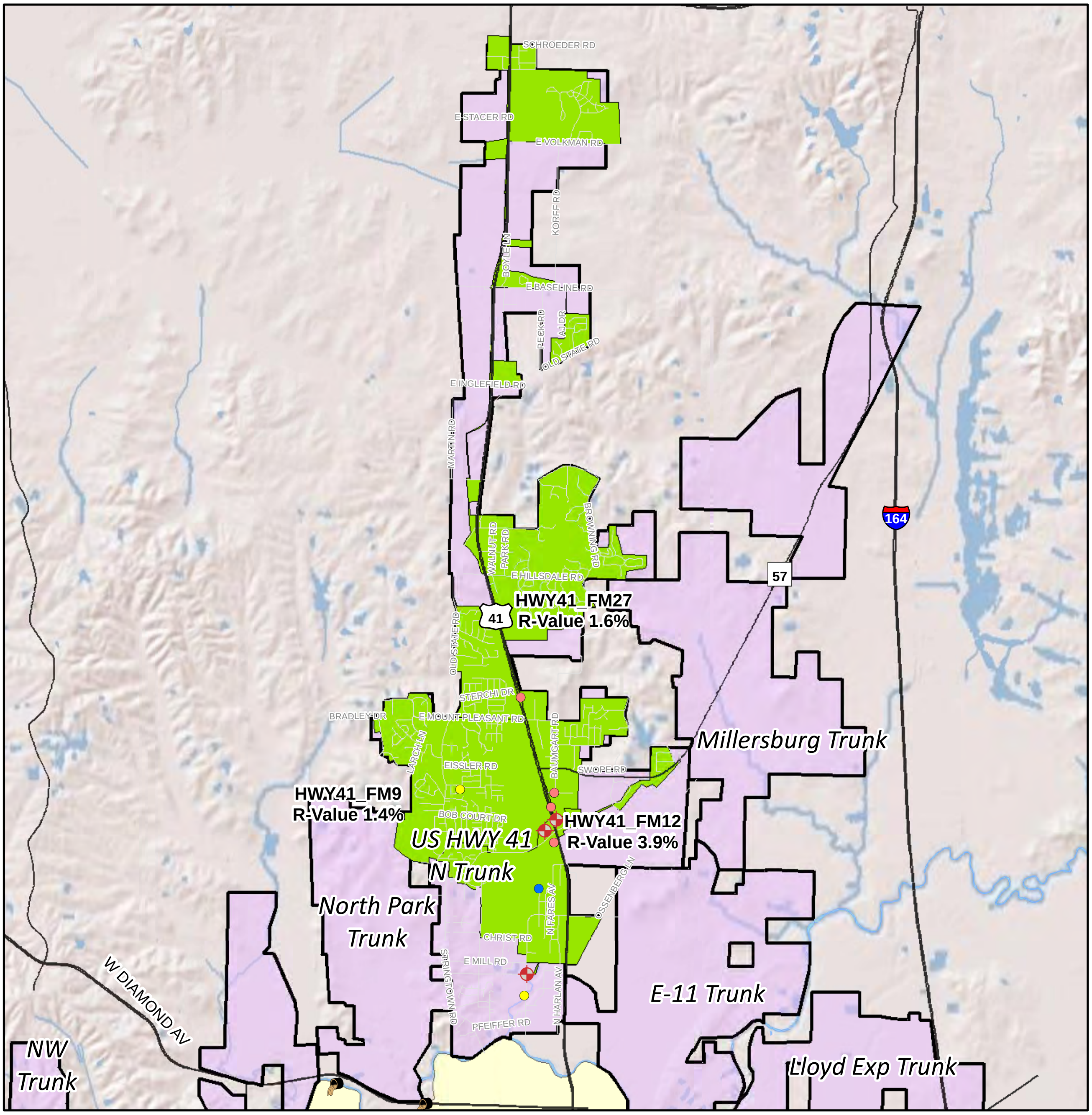
2.2.2.2 Bee Slough System

The Bee Slough System comprises three SSS basins:

- Lloyd Expressway SSS Basin
- Covert SSS Basin
- Riverside-Vann SSS Basin

2.2.2.2.1 Lloyd Expressway Sanitary Sewer System Basin

Flows in this basin travel towards the Lloyd Expressway and into the Lloyd Expressway Interceptor, which flows west towards the CSS. Table 2-14 presents the existing flows (2012) and the future flows (2032) for the Lloyd Expressway SSS Basin.



LEGEND

- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 24 hour Event
- 5 year 24 hour Event
- 10 Year 24 Hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%

N

0 5,100 10,200

Feet

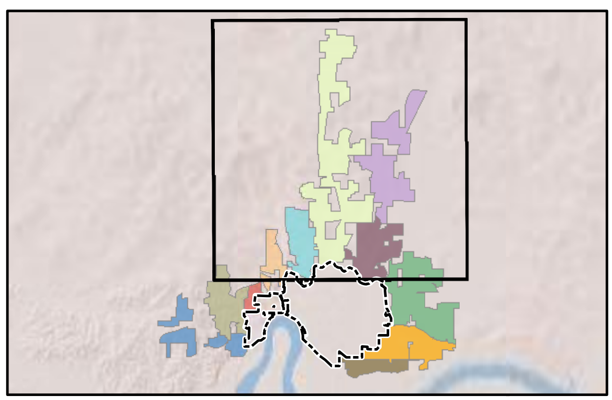


FIGURE 2-5
US Hwy 41 N Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
May 31, 2013

Table 2-14 Lloyd Expressway Sanitary Sewer System Basin, Modeled Flows

Storm Event	Existing Flows		Future Flows		Percent Difference	
	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate	Flow Volume
Dry Weather	4.87	3.19 [a]	5.06	3.33 [a]	4	5
2-year, 3-hour	28.76	42.24	28.13	43.69	-2	3
5-year, 3-hour	30.08	43.80	30.06	45.23	0	3
10-year, 3-hour	39.51	48.20	39.75	49.80	1	3
10-year, 24-hour	18.64	51.20	16.59	52.56	-11	3

[a] Average flow rate (in mgd) for dry-weather simulations.

Table 2-15 lists the R values calculated for the Lloyd Expressway SSS Basin. Figure 2-7 shows the flow monitor locations, modeled sewersheds, SSES areas, and modeled overflows in the Lloyd Expressway SSS Basin.

Table 2-15 Lloyd Expressway Sanitary Sewer System Basin Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM17	2.4%
FM18	7.2%
FM19	1.9%
FM20	3.9%
FM21	4.8%
FM22	9.7%

2.2.2.2.2 Covert Sanitary Sewer System Basin

Flows in this basin generally travel towards Covert Avenue and into the Covert Avenue Interceptor, which flows west towards the CSS. Table 2-16 presents the existing flows (2012) and the future flows (2032) for the Covert SSS Basin.

Table 2-16 Covert Sanitary Sewer System Basin, Modeled Flows

Storm Event	Existing Flows		Future Flows		Percent Difference	
	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate	Flow Volume
Dry Weather	1.74	0.91 [a]	1.77	0.93 [a]	2	2
2-year, 3-hour	31.80	11.73	28.34	11.88	-11	1
5-year, 3-hour	35.55	12.05	35.45	12.32	0	2
10-year, 3-hour	34.21	12.82	35.31	13.00	3	1
10-year, 24-hour	17.22	15.13	18.84	15.61	9	3

[a] Average flow rate (in mgd) for dry-weather simulations.

Table 2-17 lists the R values calculated for the Lloyd Expressway SSS Basin. Figure 2-8 shows the flow monitor locations, modeled sewersheds, SSES areas, and modeled overflows in the Covert SSS Basin.

Table 2-17 Covert Sanitary Sewer System Basin Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM23	1.3%
FM24	2.6%
FM 25	4.0%

2.2.2.2.3 Riverside-Vann Sanitary Sewer System Basin

Flows in this basin generally travel towards Riverside Drive and into the Riverside-Vann Trunk Sewer, which flows west towards the CSS. Table 2-18 presents the existing flows (2012) and the future flows (2032) for the Riverside-Vann SSS Basin.

Table 2-18 Riverside-Vann Sanitary Sewer System Basin, Modeled Flows

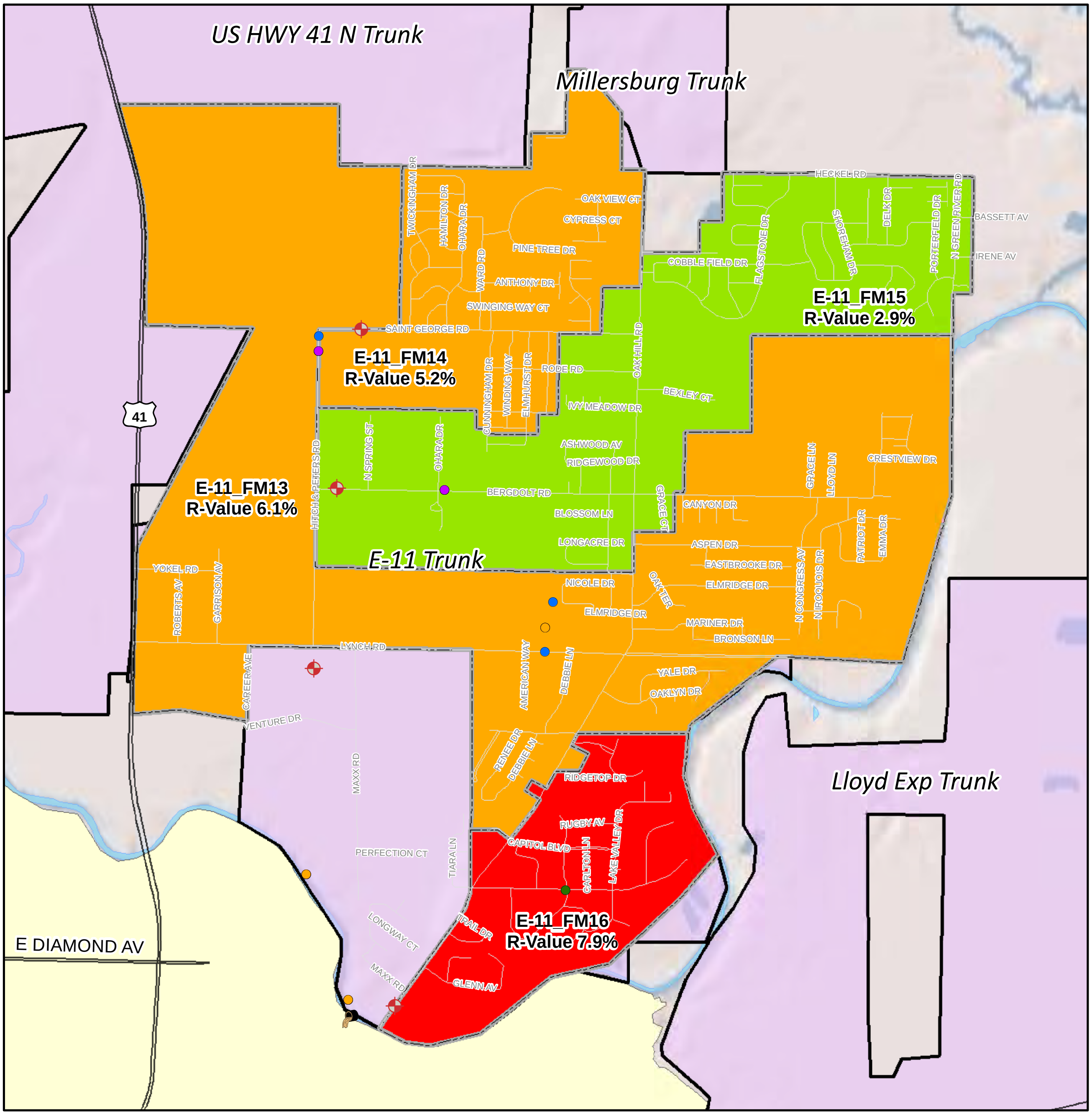
	Existing Flows		Future Flows		Percent Difference	
Storm Event	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate (mgd)	Flow Volume (MG)	Peak Flow Rate	Flow Volume
Dry Weather	0.69	0.46 [a]	0.73	0.48 [a]	6	6
2-year, 3-hour	7.22	6.86	7.12	7.18	-1	5
5-year, 3-hour	9.76	7.04	9.68	7.37	-1	5
10-year, 3-hour	10.67	7.18	10.93	7.52	2	5
10-year, 24-hour	7.22	9.17	7.24	9.61	0	5

[a] Average flow rate (in mgd) for dry-weather simulations.

Table 2-19 lists the R values calculated for the Lloyd Expressway SSS Basin. Figure 2-9 shows the flow monitor locations, modeled sewersheds, SSES areas, and modeled overflows in the Riverside-Vann SSS Basin.

Table 2-19 Riverside-Vann Sanitary Sewer System Basin Calculated Infiltration and Inflow Values

Flow Monitor	Total R Value
FM26	4.3%



LEGEND

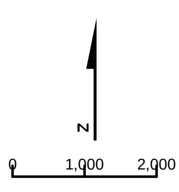
- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 3 hour Event
- 5 year 3 hour Event
- 10 year 3 hour Event
- 10 year 24 hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%



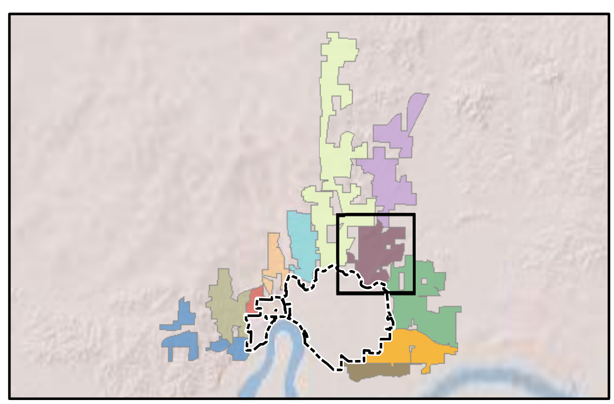
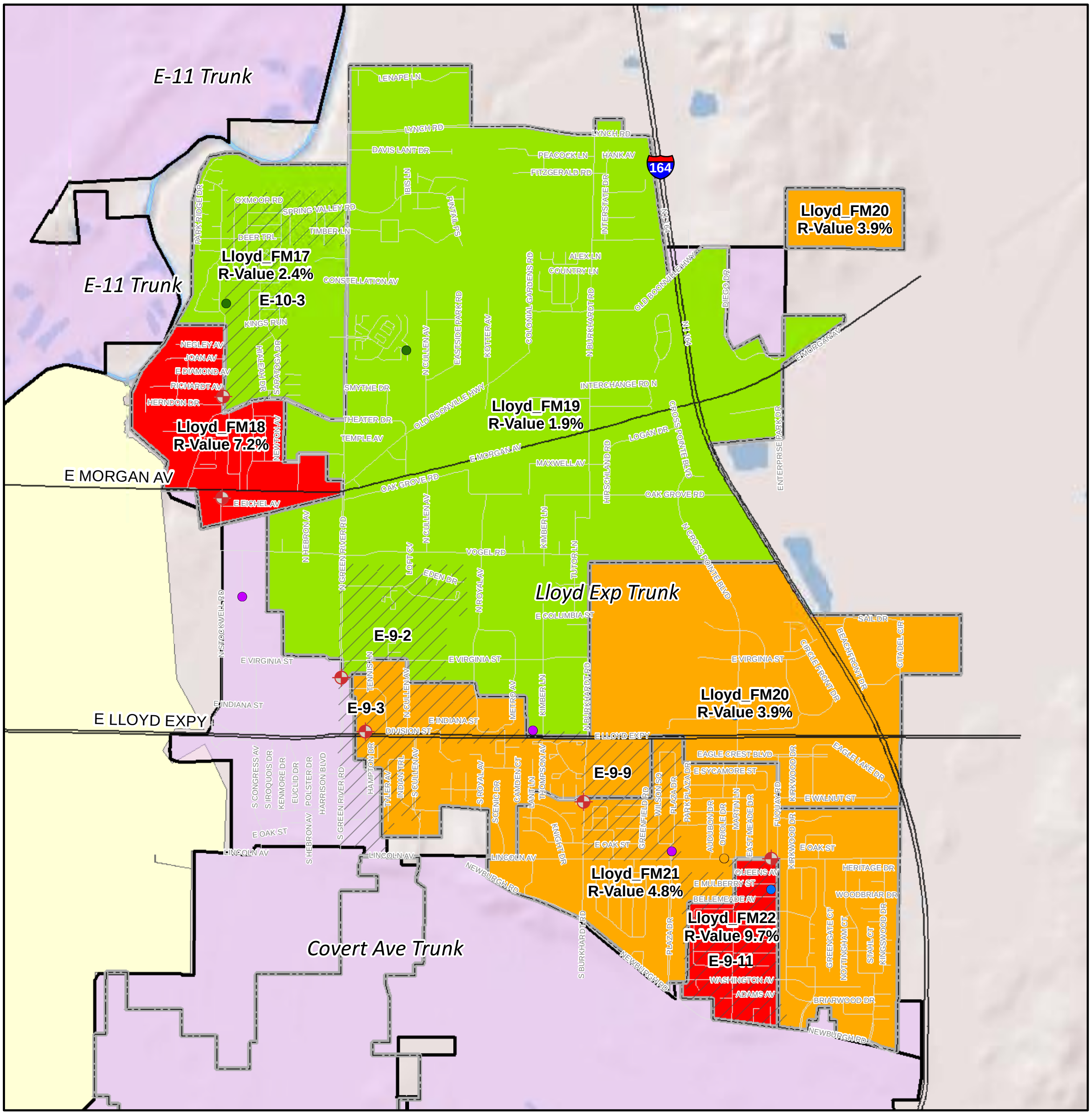


FIGURE 2-6
E-11 Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
May 31, 2013



LEGEND

- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 3 hour Event
- 5 year 3 hour Event
- 10 year 3 hour Event
- 10 year 24 hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%

N

0 2,100 4,200
Feet

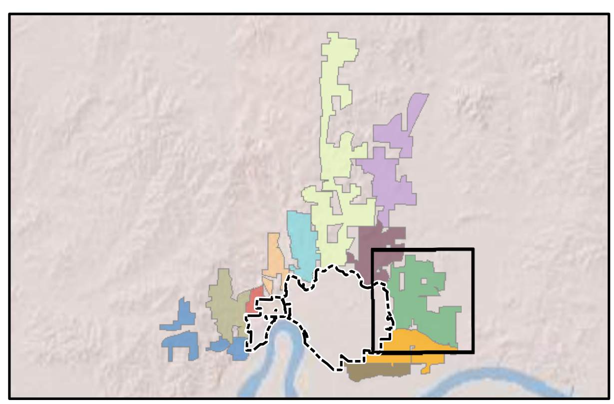
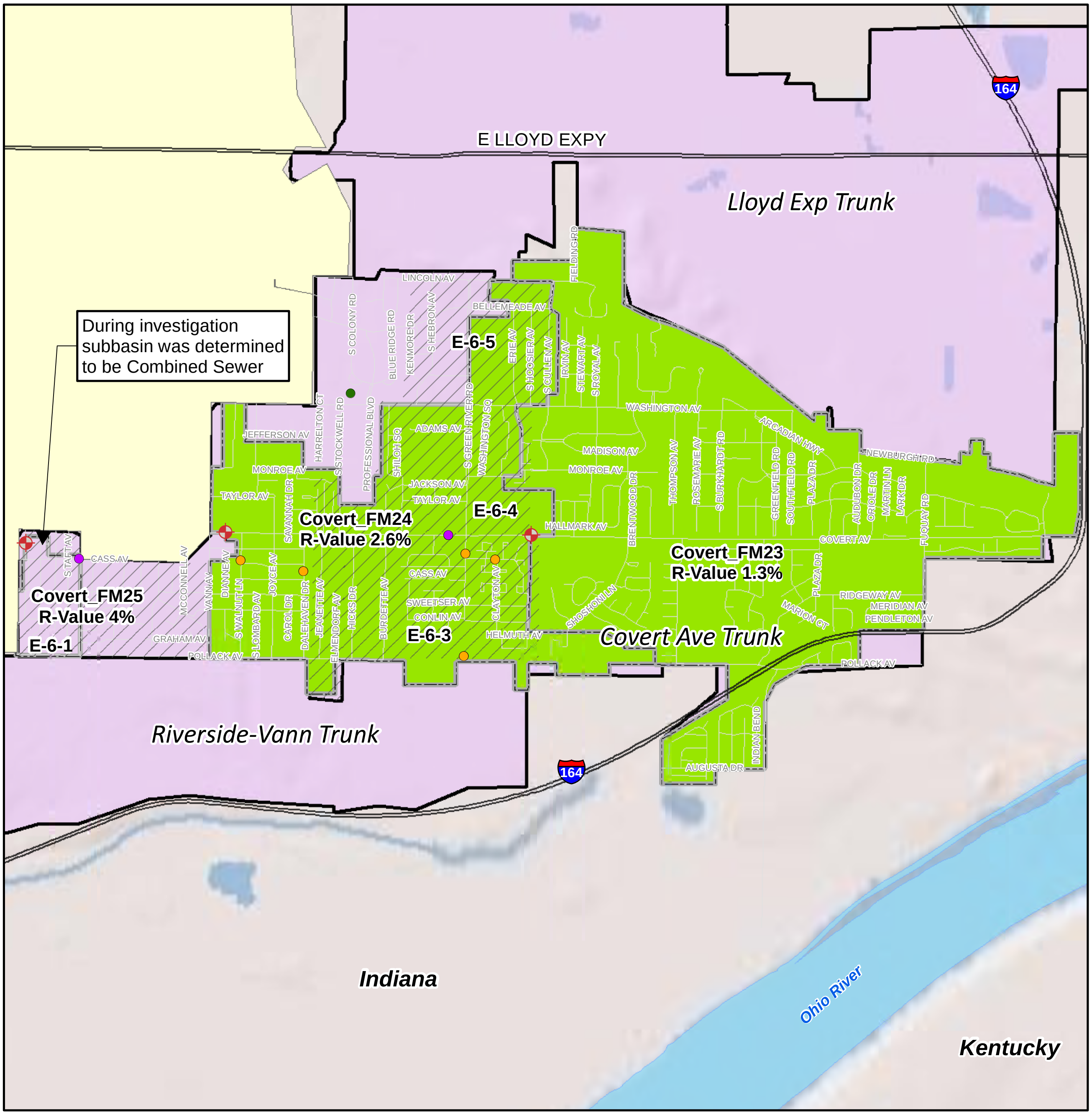


FIGURE 2-7
Lloyd Exp Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
*May 31, **2013***



LEGEND

- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 3 hour Event
- 5 year 3 hour Event
- 10 year 3 hour Event
- 10 year 24 hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%

N

0 2,000 4,000
Feet

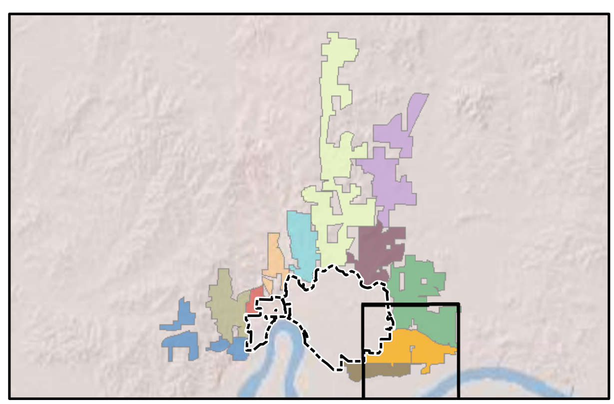
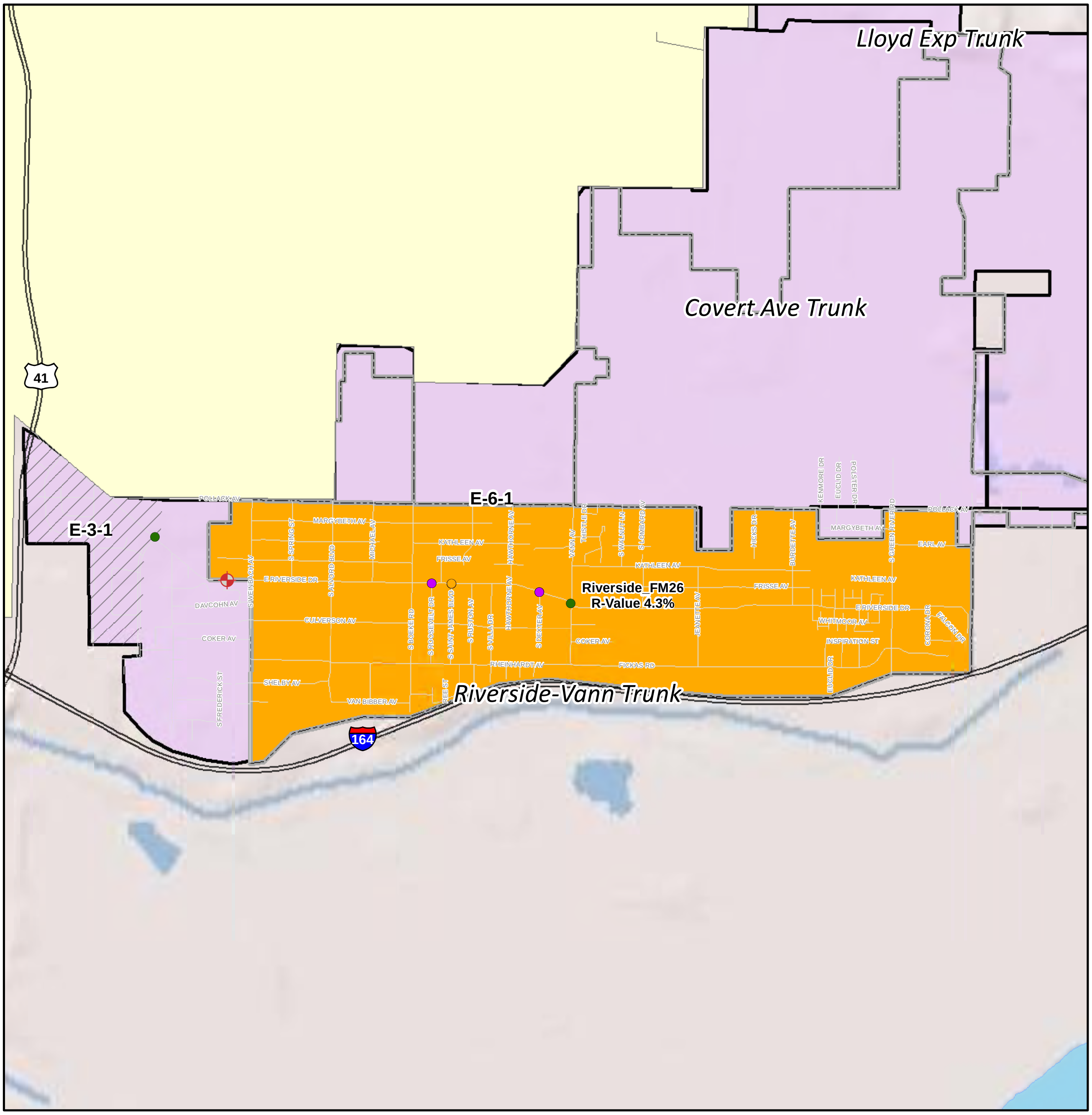


FIGURE 2-8
Covert Ave Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
May 31, 2013



LEGEND

- Flow Monitor
- CSO
- Wastewater Treatment Plant
- Streets
- Priority Subbasin
- Separate Sanitary Sewer Area
- Sewer Basin Boundary
- Combined Area
- Hydrography

Modeled Overflows for 2012 Flows

- 2 year 3 hour Event
- 5 year 3 hour Event
- 10 year 3 hour Event
- 10 year 24 hour Event

R Value by Metered Sewershed

- >10%
- 5% to 9.99%
- 0 to 4.99%

N

0 1,000 2,000

Feet

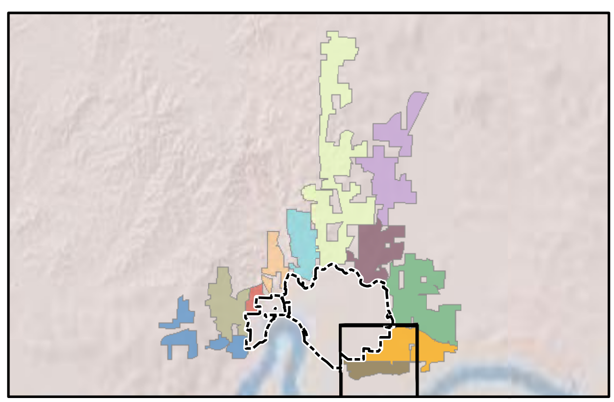


FIGURE 2-9
Riverside-Vann Trunk
Metered Sewershed R Values
Sanitary Sewers Remedial Measures Plan
May 31, 2013

2.3 Capacity Assessment for SSRMP Development

An SSS capacity assessment was conducted in accordance with Decree requirements. The assessment used the SSS hydraulic models to identify portions of the SSS that were projected to have insufficient capacity to convey WWFs without SSOs. System performance was evaluated for the four different design storms presented in Table 2-2, and the associated existing and future flows described in Section 2.2. The capacity assessment evaluated:

- Twelve-inch-diameter (or larger) gravity sewer segments, lift stations, and force mains that are directly connected to the modeled sewers
- Gravity sewer segments smaller than 12 inches in diameter in areas that have mainline capacity-related overflows or in areas of widespread capacity-related basement backups

The assessment identified the hydraulic capacities of gravity sewer segments, lift stations, and force mains and compared those capacities with existing and projected 20-year growth. Sewer system performance was evaluated for each dry-weather and wet-weather condition to determine where SSOs may occur and to identify pipe segments that are in a surcharged condition.

To evaluate the surcharge condition, a pipe utilization analysis was performed for each sewer segment modeled. Pipe utilization, expressed as a percentage, is the ratio of the actual modeled flow rate to the nominal full-pipe flow capacity. Pipes become overused when they carry more flow than they were designed for initially, usually because of groundwater infiltration or wet-weather I/I from contributing sewersheds. Tables 2-20 and 2-21 summarize the results of the simulations for the West and East Service Areas, respectively. The tables identify, by basin, the anticipated number of SSOs and total length of surcharged sewer segments resulting from the specified storm events, for existing and future flows. Total lengths of surcharged sewer segments are organized by pipe utilization.

The revised *Sewer Systems Assessment* [SSA] *Report* (CH2M HILL, 2012a) provides more detailed information on the approach and scope of the capacity assessment.

2.3.1 SSO Analysis

An analysis of SSO data was completed to identify observed and modeled capacity limitations that are causing or contributing to SSO. The SSO identified maintenance vs. wet-weather events, then separated out and identify locations where multiple events occur. The primary data used in this analysis included the cumulative list of overflows reported in the September 2012 Semi-Annual Report (the SAR 2012-2 List), the locations where the SSS models project SSOs to occur during a 2-year storm and for existing flow conditions (the Modeled SSOs), and the 2010 list of possible SSO locations identified by EPA from 2003-2008 data created by former private operator, EMC. Differing priority levels were developed by comparing the different lists as presented in Table 2-22.

Table 2-20 Summary of SSS Capacity Assessment Results, West Service Area

Basin	Storm Event	Number of Modeled SSOs		Total Length of Surcharged Sewer Segments (feet)							
		Existing	Future	Existing 100%–119%	Existing 120%–149%	Existing 150%+	Existing % of Total	Future 100%–119%	Future 120%–149%	Future 150%+	Future % of Total
Northwest/ Southwest SSS Basin	Dry Weather	0	0	54	87	701	1.5	439	258	614	2.4
	2-yr, 24-hr	9	12	3,414	2,653	4,385	19.2	3,632	2,219	5,366	20.6
	5-yr, 24-hr	11	14	5,227	3,301	4,590	24.1	5,564	2,670	5,366	24.9
	10-yr, 24-hr	13	15	3,602	4,357	4,774	23.3	3,794	3,910	5,366	24.0
Helfrich SSS Basin	Dry Weather	0	0	0	0	0	0.0	0	0	0	0.0
	2-yr, 24-hr	0	0	0	0	400	3.8	0	0	400	3.8
	5-yr, 24-hr	0	0	0	0	400	3.8	0	0	400	3.8
	10-yr, 24-hr	0	0	0	0	400	3.8	0	0	400	3.8
Allens Lane (Skylane) North SSS Basin	Dry Weather	0	0	0	0	627	2.7	320	0	627	4.0
	2-yr, 24-hr	2	3	2,528	2,007	2,198	28.5	2,146	2,497	3,128	32.9
	5-yr, 24-hr	6	8	3,538	2,375	3,038	37.9	3,515	2,497	3,128	38.7
	10-yr, 24-hr	7	8	3,698	2,375	3,038	38.6	3,378	2,565	3,358	39.4
North Park (W-8) SSS Basin	Dry Weather	0	0	0	130	180	0.6	181	0	311	0.9
	2-yr, 24-hr	16	16	6,337	4,491	4,656	28.9	6,217	4,782	4,656	29.2
	5-yr, 24-hr	17	17	5,562	5,974	4,987	30.8	5,599	6,264	4,987	31.4
	10-yr, 24-hr	19	20	5,659	6,010	5,578	32.2	5,659	6,010	5,578	32.2
Millersburg/	Dry Weather	0	1	516	392	4,206	3.9	2,718	4,131	5,283	9.3
U.S. Highway 41 SSS Basin	2-yr, 24-hr	9	22	6,439	3,509	9,281	14.8	12,500	5,528	12,171	23.3
	5-yr, 24-hr	13	26	5,526	5,336	9,415	15.6	14,126	6,197	12,305	25.1
	10-yr, 24-hr	16	31	6,849	6,525	9,415	17.6	14,194	6,448	12,675	25.7

Table 2-21 Summary of SSS Capacity Assessment Results, East Service Area
Evansville, IN – Sanitary Sewers Remedial Measures Plan

		Number of Modeled SSOs		Total Length of Surcharged Sewer Segments (feet)							
Basin	**Storm Event**	**Existing**	**Future**	**Existing 100%–119%**	**Existing 120%–149%**	**Existing 150%+**	**Existing % of Total**	**Future 100%–119%**	**Future 120%–149%**	**Future 150%+**	**Future % of Total**
E-11 SSS Basin	Dry Weather	0	0	0	176	0	0.5	259	0	176	1.2
	2-yr, 3-hr	2	5	8,243	6,463	7,105	59.7	6,005	8,169	8,031	60.8
	5-yr, 3-hr	4	6	6,751	7,656	8,117	61.7	5,900	6,768	10,252	62.7
	10-yr, 3-hr	6	9	6,308	7,449	9,097	62.6	4,568	7,836	10,515	62.7
	10-yr, 24-hr	8	11	4,830	7,253	7,372	53.3	4,246	6,669	8,605	53.4
Lloyd Expressway SSS Basin	Dry Weather	0	0	425	0	356	1.1	390	347	356	1.5
	2-yr, 3-hr	3	4	6,915	6,684	11,946	36.1	7,907	6,649	12,388	38.1
	5-yr, 3-hr	6	7	6,423	7,899	12,382	37.8	7,285	7,922	12,146	38.7
	10-yr, 3-hr	7	8	7,826	7,439	12,723	39.6	8,420	8,252	12,740	41.6
	10-yr, 24-hr	8	8	7,539	6,915	8,613	32.6	8,636	5,019	9,382	32.6
Covert SSS Basin	Dry Weather	0	0	0	0	0	0.0	0	0	0	0.0
	2-yr, 3-hr	5	5	5,991	4,910	10,324	44.3	5,647	5,895	9,799	44.5
	5-yr, 3-hr	6	6	5,467	6,125	10,588	46.3	5,073	5,072	11,404	45.0
	10-yr, 3-hr	7	7	5,494	7,041	12,595	52.4	5,403	7,283	12,327	52.2
	10-yr, 24-hr	4	4	4,854	2,342	3,599	22.5	3,419	3,334	4,112	22.7
Riverside-Vann SSS Basin	Dry Weather	0	0	0	0	327	1.7	0	0	327	1.7
	2-yr, 3-hr	1	1	2,981	3,728	7,353	74.4	2,912	3,919	6,880	72.5
	5-yr, 3-hr	2	2	1,225	5,764	9,076	85.0	1,032	5,435	9,405	84.0
	10-yr, 3-hr	3	4	1,552	5,084	9,756	86.7	1,552	5,084	9,756	86.7
	10-yr, 24-hr	2	2	3,947	2,522	6,098	66.5	3,607	3,803	6,098	71.5

Table 2-22 Location Prioritization for Development of SSO List

Location Has Multiple Wet-Weather SSOs Reported in SAR 2012-2	Location Has Only One SSO Reported in SAR 2012-2	Location Has Modeled SSO	Location Has Backup Reported in 2010 List	Location Priority
Y		Y	Y	A
	Y	Y	Y	B
	Y	Y		C
	Y		Y	D
		Y	Y	E
	Y			F
		Y		G
			Y	H

Note:

If a location is in any of the other priority levels and it is located near (and systemically related to) a Priority A location, then it will be grouped with the Priority A locations and included in the SSRMP.

Four groups encompassing seven locations have been identified to be addressed through the Utility's SSRMP through a combination of sewer rehabilitation and I/I removal projects, and projects to increase conveyance capacity and/or add pumping at the CSS/SSS interface to better and more independently control SSS hydraulics during wet weather. These locations were confirmed during hydraulic modeling to have capacity limitations that are causing or contributing to SSOs, consequently these locations are considered to be the highest priority for remediation. Capital projects are planned for each of the following SSO groups:

1. Mill Road Group – pump station at CSS/SSS interface and increased conveyance capacity
2. Lincoln Road Group – increased conveyance capacity and pump station/force main improvements
3. Bergdolt Road Group – increased conveyance capacity
4. Tekoppel Ave/West WWTP Headworks – pump station at CSS/SSS interface, or relief sewer in conjunction with new West WWTP headworks facility

2.4 Condition Assessment for SSRMP Development

SSES and a cursory trunk sewer condition assessment effort were conducted in accordance with the *Separate Sanitary Sewer System Evaluation Work Plan* (CH2M HILL, 2010). The condition assessments for the Utility's SSS were based solely on field observations and data analyzed for the manholes and pipe segments included in these efforts. The observations and data recordings were based on ground and weather conditions at the time of the evaluations. Altogether, the SSES program included the following evaluations:

- Quick-view inspections of trunk sewers
- Manhole inspections in both priority subbasins and on trunk sewers

- Smoke testing within the priority subbasins
- Closed-circuit television (CCTV) inspections within the priority subbasins

Manhole defects during trunk sewer manhole inspections were prioritized by severity as follows: Major Issue (Priority 3), Minor Issue (Priority 2), and No Issue (Priority 1). In general, major issues included structural defects and excessive amounts or evidence of I/I, and minor issues included less critical defects such as root intrusion or surface corrosion.

Smoke testing was completed for selected trunk and collector sewers during the summer months when ground conditions were dry. Smoke-testing defects were classified by type (public or private), source (such as catch basin, cleanout, or pipe), and approximate drainage area contributing inflow. CCTV was used for pipe segments that were identified as having one or more public defects during smoke testing. Recurring backups previously recorded by the Utility were also included in the television recommendations. Pipeline defects (such as joint issues, surface corrosion, cracks, or breaks) were noted and the following priority rankings assigned:

- Priority 3 (highest priority) segments exhibited signs of heavy infiltration and/or major structural damage (such as collapse or hole in pipe).
- Priority 2 segments exhibited signs of moderate infiltration and/or minor structural issues (such as cracking or minor joint offsets).
- Priority 1 (lowest priority) segments exhibited signs of minor infiltration and/or maintenance issues (such as settled debris and minor root intrusion).
- Priority 0 (no priority) segments displayed no visible signs of infiltration or structural or maintenance issues.

Tables 2-23 and 2-24 summarize the key findings of the condition assessment in the West and East Service Areas, respectively. The tables identify, by basin, the total number and type of defects observed. In addition, priority rankings are summarized where applicable.

Table 2-23 West Service Area SSS Condition Assessment Findings – Total Number and Type of Defects

	Southwest SSS Basin	Northwest SSS Basin	Helfrich SSS Basin	North Park (W-8) SSS Basin	Allens Lane (Skylane) North SSS Basin	Millersburg/ U.S. Highway 41 SSS Basin
Trunk Manholes						
Priority 3 ranking	20	18	2	30	8	56
Priority 2 ranking	12	19	0	10	7	81
Priority 1 ranking	42	51	15	133	33	251
Collector Manholes						
Open vent holes	22	21	---	110	5	---
Observed infiltration	3	2	---	8	0	---
Evidence of surcharging	15	19	---	60	0	---
Major sewer capacity issue identified	0	16	---	66	9	---

Table 2-23 West Service Area SSS Condition Assessment Findings – Total Number and Type of Defects

	Southwest SSS Basin	Northwest SSS Basin	Helfrich SSS Basin	North Park (W-8) SSS Basin	Allens Lane (Skylane) North SSS Basin	Millersburg/ U.S. Highway 41 SSS Basin
Observed structural defects	8	5	---	46	2	---
Estimated inflow rate (mgd)	0.34	0.64	---	6.28	0.18	---
Smoke Testing						
Smoke testing defects (inlet)	6	9	---	23	0	---
Smoke testing defects (downspout)	1	8	---	7	3	---
Smoke testing defects cumulative cA	0.92	0.9	---	11.88	0.3	---
Estimated inflow rate (mgd)	0.46	0.37	---	3.84	0.15	---
CCTV Inspections						
Priority 3 ranking	4	12	---	37	3	---
Priority 2 ranking	9	18	---	42	3	---
Priority 1 ranking	4	8	---	39	0	---
Priority 0 ranking	3	3	---	12	0	---
Estimated infiltration rate (mgd)	0.97	0.89	---	2.25	0.12	---

Table 2-24 East Service Area SSS Condition Assessment Findings – Total Number and Type of Defects

	E-11 SSS Basin	Lloyd Expressway SSS Basin	Covert SSS Basin	Riverside-Vann SSS Basin
Trunk Manholes				
Priority 3 ranking	4	64	8	1
Priority 2 ranking	24	32	76	17
Priority 1 ranking	88	178	110	41
Collector Manholes				
Open vent holes	34	34	113	11
Observed infiltration	3	6	0	0

Table 2-24 East Service Area SSS Condition Assessment Findings – Total Number and Type of Defects

	E-11 SSS Basin	Lloyd Expressway SSS Basin	Covert SSS Basin	Riverside-Vann SSS Basin
Evidence of surcharging	24	21	36	5
Major sewer capacity issue identified	16	10	29	1
Observed structural defects	27	37	28	3
Estimated inflow rate (mgd)	0.52	0.67	2.33	0.64
Smoke Testing				
Smoke testing defects (inlet)	4	0	61	2
Smoke testing defects (downspout)	5	4	10	0
Smoke testing defects cumulative cA	2.83	0.64	28.21	1.05
Estimated inflow rate (mgd)	2.63	0.86	27.54	1.11
CCTV Inspections				
Priority 3 ranking	15	25	15	3
Priority 2 ranking	23	33	8	2
Priority 1 ranking	4	33	55	6
Priority 0 ranking	0	0	0	0
Estimated infiltration rate (mgd)	0.001	0.003	0.002	0.001

SECTION 3

SSO Control Measures Approach and Alternatives Development

A consistent approach was developed and used to evaluate projects for inclusion in this SSRMP. Much of the evaluation was based on the efforts documented in Table 2-1 in Section 2, and the evaluation expanded on the capacity assessment results.

The alternatives development and evaluation effort undertaken after completion of the original SSA Report included the following tasks:

- Performing hydraulic modeling to analyze current and projected future DWFs and WWFs to identify hydraulic limitations and any overflows predicted to result from capacity limitations
- Conducting SSO control measures technology screening
- Developing projects to rehabilitate pipe and manhole defects and eliminating obvious sources of stormwater inflow identified during the 2011 SSES work (referred to as condition projects)
- Develop projects to remedy existing, recurring SSOs not otherwise addressed through a combination of sewer rehabilitation and I/I removal projects, and/or projects to increase conveyance capacity and/or add pumping at the CSS/SSS interface to better and more independently control SSS hydraulics during wet weather
- Developing project alternatives that would be designed to convey projected DWFs and WWFs without SSOs for each of the various design storms established in the *Critical Storm Duration Analysis* (CH2M HILL, 2011h) under existing (2012) and future (2032) flow conditions
- Evaluating and comparing the project alternatives comprising the remedial measures plan for each design storm

This section summarizes the standardized approach used to identify, screen, and evaluate control measures for incorporation in this SSRMP. The goal of the evaluation was to identify projects that prevent and eliminate (to the selected level of capacity) SSOs, while maximizing benefits to the community in an affordable and cost-effective manner.

3.1 SSO Control Measures Technology Screening

The objective of the SSO control measures technology screening was to evaluate and identify options appropriate for further consideration to help remedy capacity- and condition-related issues that may be causing or contributing to SSOs. SSO control measure technologies considered are those identified in the *Combined Sewer Overflow Alternatives Analysis Screening Report* (CH2M HILL, 2012b) to expand upon the work completed to develop that deliverable and also to identify whether specific technologies could be integrated to provide benefit from both a CSO and SSO control perspective. Many potential solutions were considered for evaluation and provided a broad framework for a thorough evaluation of alternatives, including system improvement alternatives and I/I reduction options. The list of technologies was screened to develop a short list appropriate for the Utility's SSO control needs. The technologies and their screening are summarized in Table 3-1.

Table 3-1 Potential Sanitary Sewer Overflow Control Alternatives

Technology Classification	Technologies	Not Applicable to SSS	Notes
Inflow Reduction	Stormwater Management/Green Infrastructure	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Industrial Pretreatment/ Other Source Controls	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Partial Sewer Separation	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Complete Sewer Separation	X	Generally not appropriate for addressing separate sanitary sewer overflows
Sewer System Modification	Flow Redirection	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Infiltration/Inflow Reduction		Applicable throughout SSS
	Interceptor Sewer Construction	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Relief Sewer Construction		Applicable if additional capacity needed
	Relocation of CSO Outfalls	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Outfall Consolidation	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Pump Station Modifications		Applicable if additional capacity needed
	Static Flow Control		Applicable if additional capacity needed
	Variable Flow Control		Applicable if additional capacity needed
	Real-Time Flow Control		Applicable if additional capacity needed
Storage	Open Basins and Tanks	X	Not applicable due to proximity to public and health concerns
	Closed Storage Tanks		Applicable if additional capacity needed
	Storage Conduits		Applicable if additional capacity needed
	Storage Tunnels	X	Evaluated in the LTCP
	Existing Tunnels or Conduits (Abandoned)	X	Generally not appropriate for addressing separate sanitary sewer overflows

Table 3-1 Potential Sanitary Sewer Overflow Control Alternatives

Technology Classification	Technologies	Not Applicable to SSS	Notes
Physical/ Chemical Satellite Treatment	Floatables Control (Screening)	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Swirl Concentrators and Vortex Separators	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Sedimentation	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Compressed Media Filtration	X	Generally not appropriate for addressing separate sanitary sewer overflows
	High-rate Treatment/Ballasted Flocculation	X	Generally not appropriate for addressing separate sanitary sewer overflows
	Disinfection/Dechlorination	X	Generally not appropriate for addressing separate sanitary sewer overflows
Biological Treatment	New Secondary or Advanced WWTPs	X	Previously cited studies concluded that new WWTPs were not warranted
	Increased Treatment Capacities at Existing Facilities	X	The integrated planning approach assumes SSS flows are conveyed to the downstream combined system. Increased treatment capacity is therefore addressed as part of the WWTP facility plans, LTCP, and IOCP.
	Constructed Treatment Wetlands	X	Sufficient land not available adjacent to modeled SSO locations

The SSO control measures technology screening resulted in a short list of technologies appropriate for the SSSs. The short list of technologies that were reviewed further for potential inclusion in the SSRMP is as follows:

- I/I reduction in the subbasins evaluated in 2011
- Relief pipes, either by increasing pipe size or adding parallel pipes
- Inline storage with discharge control
- Offline storage with pump-out
- Pump station modifications, if additional capacity is needed

3.2 Project Costing Methodology

Opinions of probable capital cost were developed using the Program Alternative Cost Calculator (PACC), a spreadsheet tool developed by CH2M HILL for cost estimating (CH2M HILL, 2012c), which is the latest generation of a tool initiated in Cincinnati (BBS, 2005) that has evolved through several subsequent wet-weather programs. The PACC was used consistently to develop opinions of capital cost for SSRMP and LTCP projects. It provides unit costs for estimating the planning-level capital cost of each selected technology and was developed from the following sources:

- R.S. Means
- Richardson Process Plant Estimating Standards
- Mechanical Contractors Association – Labor Manual
- National Electrical Contractors Association – Labor Unit Manual
- EPA references and standards
- Costs from various municipalities
- CH2M HILL historical data
- Vendor quotes on equipment and materials, where appropriate
- Estimator judgment

Cost estimating experts from several national engineering consultants reviewed the PACC previously and judged it suitable for developing estimates at this planning level. AACE International[1] *Recommended Practice No. 18R-97* classifies such an estimate (prepared on the basis of limited information, where the preliminary engineering is from 1 percent to 15 percent complete) as a Class 4 estimate with an expected accuracy within plus 50 percent to minus 30 percent of the estimated cost (AACE International, 2003). Costs generated using the PACC tool are calculated primarily on the basis of the size or capacity of the facility required, but they also include allowances for features unique to the particular installation. For example, relief-sewer costs may be adjusted for expected construction difficulties through bedrock, and storage costs may be adjusted to reflect extraordinary odor control needs. The PACC allows the combination of numerous distinct projects into basin-wide alternatives. The tool also estimates the lifecycle costs of the projects and alternatives and allows rapid comparison of alternatives to assist selection of cost-effective alternatives.

Opinions of probable capital costs were updated to reflect January 2012 dollar values (*Engineering News-Record* Construction Cost Index of 8301, based on a small cities adjustment using R.S. Means indexes for Cincinnati and Evansville).

In general, cost curves and estimates in the PACC include such costs to the contractor as labor, material, equipment, subcontractor cost, mobilization/construction access, contractor markups, and site restoration after construction is complete. Assumptions within the PACC tool include the following:

- Right-of-way costs
- Planning and preliminary design
- Design services

[1] AACE International formerly was the Association for the Advancement of Cost Engineering.

- Administrative costs
- Miscellaneous –permit to install, test bore, essential control and instrumentation inspector, right-of-way
- Capitalized interest
- Field engineering and inspection
- Project contingencies

The PACC was used to calculate operations and maintenance and lifecycle cost estimates.

A key aspect of the potential project testing was assessment of the basin impact of a particular project. If an upstream relief project increased downstream flows, then downstream projects had to accommodate the increased flows. Options were considered viable only if their impacts could be accommodated throughout the basin, and viable options were identified as distinct potential projects.

3.3 Development of SSO Control Measures

This section describes the approach used to develop the specific alternatives considered in each basin. In general, alternatives included a combination of capacity- and condition-improvement projects.

3.3.1 Capacity Improvement Projects

Capacity projects were developed to control SSOs within the SSS basins for existing and future flows and for each of the design storms listed in Table 2-2 in Section 2. The SSO control alternatives were developed using a two-step approach:

To address recurring or modeled overflows attributable to system capacity or physical limitations (inadequate pipe size or negative or flat slopes), conveyance improvements were proposed and sized to convey flows without SSOs.

To address modeled overflows due to the backwater conditions from the CSS, in-system storage was proposed near the CSS/SSS interface.

This approach can reduce or eliminate the need for conveyance improvements and focuses on addressing CSS backwater more effectively with in-system storage. As part of the conveyance evaluation, it was determined that smaller-diameter pipes should not exist downstream of larger-diameter pipes. Therefore, if an upstream pipe was increased in size because of capacity requirements, the pipe downstream was increased in size and was included as part of the improvements, if necessary. In cases where the lack of capacity was due to a few, flat sections, a new slope was recommended because of the adverse slope conditions, and existing pipe diameters were used. Use of this approach avoided unnecessary upsizing.

Only technologies identified in the SSO control measures technology screening were considered. Furthermore, capacity projects were developed and sized assuming little to no reduction in I/I in any of the basins in order to understand the maximum cost that could be expected if I/I reduction and rehabilitation projects were not effective in controlling or eliminating SSOs and hydraulic capacity limitations. Projects developed to provide additional conveyance capacity are considered to be replacement sewers as opposed to parallel relief sewers. In most cases, parallel relief sewers can be constructed for lower cost, and if the projects are implemented, the

Utility will perform value engineering during preliminary design. However, at this planning stage, full replacement was proposed because the sewers can be constructed with relatively few buried utility conflicts or land acquisition, and the higher project costs relative to parallel relief sewers provide additional contingency for unforeseen circumstances. Maps identifying the locations of capacity projects for the various design storm events can be found in Appendixes B through I. Project lists and project locations associated with the condition projects can also be found in Appendixes B through I.

3.3.2 Condition Improvement Projects

As stated in Section 1, sewer rehabilitation and inflow reduction projects recommended in the revised SSA Report are considered by the Utility to be the highest-priority projects because these projects reduce I/I and extend the useful life of the sewer assets. Consequently, these projects are common to all SSRMP alternatives.

As described in SSA Report, the goal of the SSES work was to target for investigation areas that would benefit most from infrastructure reinvestment. Potential projects were assembled and prioritized based on Decree requirements and condition assessment findings. Infrastructure with defects that were public and/or environmental safety hazards was assigned the highest priority. Infrastructure with defects that contributed significant inflow was assigned the next-highest priority, followed by manholes and sewer segments with structural defects and visible signs of infiltration. Therefore, the following condition assessment findings were selected for rehabilitation:

- Priority 3 trunk sewer manholes
- Collector sewer manholes with observed defects
- Priority 3 and Priority 2 CCTV sewer segments
- Public defects observed from smoke testing

Proposed manhole rehabilitations included one or more of the following actions: constructing benchwalls, resetting frames/covers, replacing frames/covers, full-depth lining, and grouting joints/voids. Proposed sewer segment rehabilitations included replacing segments with CIPP or conducting point repairs as needed. Public defects contributing to significant inflow (such as connected inlets and manhole pickholes) were proposed to be addressed by CIPP or point repairs as well. In addition to the rehabilitation work, post-construction flow monitoring is proposed to monitor progress and project performance and to collect data that will support possible refinement of the hydraulic models.

Appendixes B through I include lists of rehabilitation and capacity projects, including estimated quantities and recommended actions. Data from these appendixes and CH2M HILL's PACC tool were used to develop capital costs for each basin. Details on specific projects in a given basin can be found in Section 3.4.

3.3.3 Other Considerations

3.3.3.1 Cost-effective I/I Removal

Industry experience and the experience of Evansville's IOCP development team has shown that I/I removal can be cost effective for reducing R values by 50 percent (for R values higher than 10 percent) or down to 5 percent (for R values between 5 percent and 10 percent), whichever is higher. The Utility has been and will continue to conduct sewer rehabilitation and I/I removal projects and to evaluate the effectiveness of those projects in Evansville's collection system to specifically determine at what level I/I removal remains cost effective and at what point I/I reductions begin to downsize proposed and potential future capacity projects. Determining the cost effectiveness of I/I removal is a key component of the Utility's adaptive management approach, and the R values calculated using the 2011 flow data, along with a robust analysis of the PACP data collected during CCTV inspections, have been key performance criteria used to prioritize areas for investigation and rehabilitation in the ongoing sewer system assessment program conducted through capacity, management, operations, and maintenance (CMOM).

3.3.3.2 West Sanitary Sewer System Regional Relief Sewer

All but two of the West SSS basins discharge into the Pigeon Creek Interceptor, and the LTCP alternatives analysis determined that a parallel Pigeon Creek relief sewer was not the most cost effective alternative; therefore, this alternative was not considered further.

3.3.3.3 East Sanitary Sewer System Regional Relief Sewer

Evansville did not evaluate a regional relief sewer that captures flows from the East SSS basins and conveys it "around" the CSS and directly to the East WWTP for the following reasons:

1. The relief sewer would need to be constructed through a heavily urbanized area, making it highly expensive and disruptive to the public to construct.
2. Numerous utility conflicts along the route would result in a very deep sewer constructed in poor soils, increasing costs, and risk.
3. The sewer's depth would require an additional, deep pump station at the WWTP, further increasing costs for the relief sewer.
4. The East SSS modeling team modeled the East SSS basins without the CSS boundary condition, simulating a free outfall condition at the CSS/SSS interface. In these runs, only approximately 30 percent of the SSOs were addressed, meaning that a significant number of the capacity projects developed would need to be implemented in conjunction with this relief sewer.
5. Constructing storage projects at the CSS/SSS interface is more cost effective.

3.4 Alternatives for SSO Control

This section presents the alternatives developed for SSO control. Projects are grouped and summarized by basin. Detailed cost summary tables and project location maps for capacity and condition projects, from which capital costs were developed, can be found in Appendixes B through I. SSRMP cost databases for condition improvements, existing flow capacity projects, and future flow capacity projects are included in Appendix K, in electronic format

3.4.1 West Service Area

3.4.1.1 Northwest and Southwest Sanitary Sewer System Basin

Projects for the Northwest and Southwest SSS Basins would include a combination of capacity and condition improvement projects. As mentioned in Section 2, the Northwest and Southwest SSS Basins combine prior to discharging into the CSS. Therefore, for analysis purposes, these basins were grouped together as Northwest/Southwest SSS Basins capacity improvement projects. To address recurring wet weather overflows, a pump station at the CSS/SSS interface, or relief sewer in conjunction with new West WWTP headworks facility would be required. Tables 3-2 and 3-3 summarize capital costs for capacity projects by storm event, for existing and future flows, respectively. For existing flows (2012), relief sewers would be required for all storm events. For future flows (2032) relief sewers and additional pumping capacity would be required for all storm events.

Table 3-2 Capital Cost Summary of Northwest/Southwest Sanitary Sewer System Basin Capacity Projects, Existing Flows

	2 year – 24 Hour ($)	5 year – 24 Hour ($)	10 year – 24 hour ($)
Relief Sewer (in)	6,787,000	7,379,000	7,963,000
New Pump Station (MGD)	3,054,000	3,054,000	3,054,000
Additional Pumping Capacity (MGD)	1,125,000	1,168,000	1,197,000
Grand Total	**10,966,000**	**11,601,000**	**12,214,000**

in = inches

Table 3-3 Capital Cost Summary of Northwest/Southwest Sanitary Sewer System Basin Capacity Projects, Future Flows

	2y24h ($)	5y24h ($)	10y24h ($)
Upsize sewer (in)	8,296,000	8,859,000	11,845,000
Upsize PS (mgd)	1,125,000	1,168,000	1,197,000
New PS (mgd)	3,054,000	3,348,000	3,551,000
Grand Total	**12,475,000**	**13,375,000**	**16,593,000**

The capacity improvement project to eliminate the recurring SSO at Tekoppel Avenue near the West WWTP is included in the SSRMP and has an estimated capital cost of $3.0 million and it will achieve full operation by January 1, 2028. The condition improvement projects described below would be implemented prior to initiating this project, and the hydraulic model will be refined in order appropriately size the project to achieve the goal of eliminating the SSO at the lowest possible life cycle cost. In addition, this project will be evaluated during the design of the West WWTP headworks facility to determine whether implementation of the headworks replacement can eliminate this recurring SSO.

Unlike the capacity assessment, SSES work was conducted without consideration for basin hydraulics; therefore, condition projects were identified for each individual SSS basin. In addition, a more in-depth investigation was conducted in the University Heights area (a subbasin of the Southwest SSS). That investigation was conducted per Decree requirements, prior to SSES work; therefore, condition projects were identified for each of the three basins.

Tables 3-4 through 3-6 summarize the capital costs for condition projects associated with the Northwest, Southwest, and University Heights Basins. Refer to Figures B-1 and B-2 in Appendix B for project location maps. The Northwest and Southwest Basins include inflow reduction, manhole rehabilitation, and sewer rehabilitation projects. In addition, both basins would include post construction flow monitoring which would gauge the progress and effectiveness of these projects on I/I reduction. The University Heights Subbasin would include only manhole rehabilitation.

Table 3-4 Capital Cost Summary of Northwest Sanitary Sewer System Basin Condition Projects

	Total Capital Cost (in dollars)
Inflow Reduction	326,000
Manhole Rehabilitation	189,000
Post-construction Flow Monitoring	18,000
Sewer Main Rehabilitation	734,000
Total	**1,267,000**

Table 3-5 Capital Cost Summary of Southwest Sanitary Sewer System Basin Condition Projects

	Total Capital Cost (in dollars)
Inflow Reduction	1,437,000
Manhole Rehabilitation	289,000
Post-construction Flow Monitoring	18,000
Sewer Main Rehabilitation	536,000
Total	**2,280,000**

Table 3-6 Capital Cost Summary of University Heights Sanitary Sewer System Basin Condition Projects

	Total Capital Cost (in dollars)
Manhole Rehabilitation	67,000
Total	**67,000**

3.4.1.2 Helfrich Sanitary Sewer System Basin

No capacity or condition projects were identified in the Helfrich SSS Basin.

3.4.1.3 Allens Lane North (Skylane) Sanitary Sewer System Basin

Projects for the Allens Lane SSS Basin would include a combination of capacity and condition improvement projects. Tables 3-7 and 3-8 summarize the capital costs for capacity projects by storm event, for existing and future flows, respectively. Relief sewers, a pump station at the CSS/SSS interface and additional pumping capacity would be required for all storm events for both existing and future flows.

Table 3-7 Capital Cost Summary of Allens Lane North (Skylane) Sanitary Sewer System Basin Capacity Projects, Existing Flows

	2 year – 24 Hour ($)	5 year – 24 Hour ($)	10 year – 24 hour ($)
Relief Sewer (in)	3,467,000	3,731,000	4,176,000
New Pump Station (MGD)	1,874,000	1,898,000	1,988,000
Additional Pumping Capacity (MGD)	964,000	968,000	975,000
New Force Main (in)	3,488,000	3,488,000	3,488,000
Grand Total	**9,793,000**	**10,085,000**	**10,627,000**

Table 3-8 Capital Cost Summary of Allens Lane North (Skylane) Sanitary Sewer System Basin Capacity Projects, Future Flows

	2y24h ($)	5y24h ($)	10y24h ($)
Upsize sewer (in)	4,245,000	4,415,000	4,468,000
Manhole Adjustment – seal manhole	4,000	4,000	4,000
Upsize Pump Station (mgd)	964,000	968,000	975,000
New Pump Station (mgd)	1,874,000	1,898,000	1,988,000
New force main (in)	6,092,000	6,092,000	6,092,000
Grand Total	**13,179,000**	**13,377,000**	**13,527,000**

Table 3-9 summarizes the capital costs for condition projects associated with the Allens Lane North (Skylane) SSS Basin. This basin would include inflow reduction, manhole rehabilitation, and sewer rehabilitation projects. In addition, this basin would include post-construction flow monitoring to gauge the progress and effectiveness of these projects on I/I reduction. Refer to Figures C-1 and C-2 in Appendix C for project location maps.

Table 3-9 Capital Cost Summary of Allens Lane North (Skylane) Sanitary Sewer System Basin Condition Projects

	Total Capital Cost (in dollars)
Inflow Reduction	20,000
Manhole Rehabilitation	104,000
Post-construction Flow Monitoring	9,000
Sewer Main Rehabilitation	127,000
Total	**260,000**

3.4.1.4 North Park (W-8) Sanitary Sewer System Basin

Projects for the North Park (W-8) SSS Basin would include capacity and condition improvement projects. Recurring overflows in the Mill Road area requires a pump station at the CSS/SSS interface and increased conveyance capacity. In addition, relief sewer and manhole adjustments are required for all storm events. Tables 3-10 through 3-11A summarize the capital costs and condition projects associated with the North Park (W-8) SSS Basin.

This basin would include inflow reduction, manhole rehabilitation, and sewer rehabilitation projects. In addition, this basin would include post-construction flow monitoring to gauge the progress and effectiveness of these projects on I/I reduction. Refer to Figures D-1 and D-2 in Appendix D for project location maps.

Table 3-10 Capital Cost Summary of North Park (W-8) Sanitary Sewer System Basin Capacity Projects, Existing Flows

	2 year – 24 Hour ($)	**5 year – 24 Hour ($)**	**10 year – 24 hour ($)**
Relief Sewer (in)	12,667,000	13,192,000	13,725,000
New Pump Station (MGD)	3,499,000	3,788,000	4,064,000
Manhole Adjustment – seal manhole	8,000	8,000	8,000
Grand Total	**16,174,000**	**16,988,000**	**17,797,000**

Table 3-11 Capital Cost Summary of North Park (W-8) Sanitary Sewer System Basin Capacity Projects, Future Flows

	2y24h ($)	**5y24h ($)**	**10y24h ($)**
Upsize sewer (in)	14,806,000	15,264,000	15,538,000
Manhole Adjustment – seal manhole	10,000	10,000	10,000
New Pump Station (mgd)	3,498,000	3,788,000	4,064,000
Grand Total	**18,314,000**	**19,062,000**	**19,612,000**

The capacity improvement projects to eliminate the recurring SSOs at Mill Road and 1st Avenue are included in the SSRMP and the projects have an estimated capital cost of $10.5 million and the projects will achieve full operation by May 31, 2035. The condition improvement projects described below would be implemented prior to initiating the capacity projects, and the hydraulic model will be refined in order appropriately size the projects to achieve the goal of eliminating the SSOs at the lowest possible life cycle cost.

Table 3-11A Capital Cost Summary of North Park (W-8) Sanitary Sewer System Basin Condition Projects

	Total Capital Cost (in dollars)
Inflow Reduction	1,128,000
Manhole Rehabilitation	907,000
Post-construction Flow Monitoring	37,000
Sewer Main Rehabilitation	2,175,000
Total	**4,247,000**

3.4.1.5 Millersburg and U.S. Highway 41 Sanitary Sewer System Basins

Projects for the Millersburg and U.S. Highway 41 SSS Basins would include a combination of capacity and condition improvement projects. As mentioned in Section 2, the Millersburg and U.S. Highway 41 SSS Basins combine prior to discharging into the CSS. Therefore, for analysis purposes, these basins were grouped together as Millersburg/U.S. Highway 41 SSS Basins capacity improvement projects. Tables 3-12 and 3-13 summarize the capital costs for capacity projects by storm event, for existing and future flows, respectively. Relief sewers, additional pumping capacity, and storage capacity would be required for all storm events for both the existing and future flow.

Table 3-12 Capital Cost Summary of Millersburg/U.S. Highway 41 Sanitary Sewer System Basins Capacity Projects, Existing Flows

	2 year – 24 Hour ($)	5 year – 24 Hour ($)	10 year – 24 hour ($)
Relief Sewer (in)	77,787,000	83,050,000	84,337,000
Additional Pumping Capacity (MGD)	1,792,000	1,906,000	2,000,000
New storage basin (MG)	13,054,000	16,929,000	20,172,000
Grand Total	**92,633,000**	**101,885,000**	**106,509,000**

Table 3-13 Capital Cost Summary of Millersburg/U.S. Highway 41 Sanitary Sewer System Basin Capacity Projects, Future Flows

	2y24h ($)	5y24h ($)	10y24h ($)
Upsize sewer (in)	48,670,000	54,897,000	55,032,000
MH Adjustment – weir length (feet)	10,000	10,000	10,000
Upsize Pump Station (mgd)	7,155,000	7,301,000	7,452,000
Storage (MG)	6,272,000	12,085,000	15,234,000
Grand Total	**62,107,000**	**74,293,000**	**77,728,000**

Table 3-14 summarizes the capital costs for condition projects associated with the Millersburg/U.S. Highway 41 SSS Basins. The Millersburg/U.S. Highway 41 SSS Basins include manhole rehabilitation. In addition, these basins would include post-construction flow monitoring to gauge the progress and effectiveness of these projects on I/I reduction. Refer to Figures E-1 and E-2 in Appendix E for project location maps.

Table 3-14 Capital Cost Summary of Millersburg/U.S. Highway 41 Sanitary Sewer System Basin Condition Projects

	Total Capital Cost (in dollars)
Manhole Rehabilitation	458,000
Post-construction Flow Monitoring	28,000
Total	**486,000**

3.4.2 East Service Area

3.4.2.1 E-11 Sanitary Sewer System Basin

Projects for the E-11 SSS Basin would include a combination of capacity and condition improvement projects. Tables 3-15 and 3-16 summarize the capital costs for capacity projects by storm event, for existing and future flows, respectively. Relief sewers, manhole elevation adjustments, and a new pump station at the CSS/SSS interface would be required to address recurring overflows for all storm events.

Table 3-15 Capital Cost Summary of E-11 Sanitary Sewer System Basin Capacity Projects, Existing Flows

	2 year – 3 Hour ($)	**5 year – 3 hour ($)**	**10 year – 3 hour ($)**	**10 year – 24 hour ($)**
Relief Sewer (in)	13,330,000	12,019,000	13,754,000	13,899,000
New Pump Station (MGD)	3,322,000	3,665,000	3,817,000	3,728,000
Manhole Adjustment (elevation)	255,000	263,000	263,000	263,000
Grand Total	**16,907,000**	**15,947,000**	**17,834,000**	**17,890,000**

Table 3-16 Capital Cost Summary of E-11 Sanitary Sewer System Basin Capacity Projects, Future Flows

	2y3h ($)	**5y3h ($)**	**10y3h ($)**	**10y24h ($)**
Upsize sewer (in)	10,563,000	14,037,000	14,051,000	13,455,000
Manhole Adjustment – new invert (elevation)	105,000	105,000	105,000	105,000
Upsize Pump Station (mgd)	1,066,000	1,099,000	1,125,000	1,118,000
New Pump Station (mgd)	3,639,000	3,969,000	4,338,000	3,678,000
Grand Total	**15,373,000**	**19,210,000**	**19,619,000**	**18,356,000**

The capacity improvement projects to eliminate the recurring SSOs near Bergdolt Road are included in the SSRMP and the projects have an estimated capital cost of $10.8 million and the projects will achieve full operation by January 1, 2030. The condition improvement projects described below would be implemented prior to initiating the capacity projects, and the hydraulic model will be refined in order appropriately size the projects to achieve the goal of eliminating the SSOs at the lowest possible life cycle cost.

Table 3-17 summarizes the capital costs for condition projects associated with the E-11 SSS Basin. This basin would include inflow reduction, manhole rehabilitation, and sewer rehabilitation projects. In addition, this basin would include post-construction flow monitoring to gauge the progress and effectiveness of these projects on I/I reduction. Refer to Figures F-1 and F-2 in Appendix F for project location maps.

Table 3-17 Capital Cost Summary of E-11 Sanitary Sewer System Basin Condition Projects

	Total Capital Cost (in dollars)
Inflow Reduction	1,911,000
Manhole Rehabilitation	198,000
Post-construction Flow Monitoring	37,000
Sewer Main Rehabilitation	1,105,000
Total	**3,251,000**

3.4.2.2 Lloyd Expressway Sanitary Sewer System Basin

Projects for the Lloyd Expressway SSS Basin would include a combination of capacity and condition improvement projects. Tables 3-18 and 3-19 summarize the capital costs for capacity projects by storm event, for existing and future flows, respectively. For existing and future flows, relief sewers, a new pump station at the CSS/SSS interface, manhole adjustments, and additional pumping would all be required.

Table 3-18 Capital Cost Summary of Lloyd Sanitary Sewer System Basin Capacity Projects, Existing Flows

	2 year – 3 Hour ($)	5 year – 3 hour ($)	10 year – 3 hour ($)	10 year – 24 hour ($)
Relief Sewer (in)	9,406,000	14,182,000	15,376,000	18,480,000
New Pump Station (MGD)	5,363,000	5,629,000	5,896,000	5,833,000
Additional Pumping Capacity (MGD)	2,184,000	2,132,000	5,324,000	4,279,000
Manhole Adjustment (elevation)	19,000	30,000	32,000	106,000
Manhole Adjustment (seal MH)	5,000			
Grand Total	**16,977,000**	**21,973,000**	**26,628,000**	**28,698,000**

Table 3-19 Capital Cost Summary of Lloyd Sanitary Sewer System Basin Capacity Projects, Future Flows

	2y3h ($)	5y3h ($)	10y3h ($)	10y24h ($)
Upsize sewer (in)	9,427,000	14,730,000	20,862,000	20,671,000
MH Adjustment – new invert (El.)	8,000			
Upsize Pump Station (mgd)	2,231,000	3,369,000	9,648,000	5,264,000
New Pump Station (mgd)	3,183,000	3,411,000	3,665,000	3,678,000
Grand Total	**14,849,000**	**21,510,000**	**34,175,000**	**29,613,000**

The capacity improvement projects to eliminate the recurring SSOs near Lincoln Avenue are included in the SSRMP and the projects have an estimated capital cost of $3.0 million and the projects will achieve full operation by January 1, 2027. The condition improvement projects described below would be implemented prior to initiating the capacity projects, and the hydraulic model will be refined in order appropriately size the projects to achieve the goal of eliminating the SSOs at the lowest possible life cycle cost.

Table 3-20 summarizes the capital costs for condition projects associated with the Lloyd Expressway SSS Basin. This basin would include inflow reduction, manhole rehabilitation, and sewer rehabilitation projects. In addition, this basin would include post-construction flow monitoring to gauge the progress and effectiveness of these projects on I/I reduction. Refer to Figures G-1 and G-2 in Appendix G for project location maps.

Table 3-20 Capital Cost Summary of Lloyd Sanitary Sewer System Basin Condition Projects

	Total Capital Cost (in dollars)
Inflow Reduction	168,000
Manhole Rehabilitation	554,000
Post-construction Flow Monitoring	55,000
Sewer Main Rehabilitation	1,665,000
Total	**2,442,000**

3.4.2.3 Covert Sanitary Sewer System Basin

Projects for the Covert SSS Basin would include a combination of capacity and condition improvement projects. Tables 3-21 and 3-22 summarize the capital costs for capacity projects by storm event, for existing and future flows, respectively. Relief sewers, additional pumping capacity, and a new pump station at the CSS/SSS interface would be required for all storm events for both existing and future flows.

Table 3-21 Capital Cost Summary of Covert Sanitary Sewer System Basin Capacity Projects, Existing Flows

	2 year – 3 Hour ($)	**5 year – 3 hour ($)**	**10 year – 3 hour ($)**	**10 year – 24 hour ($)**
Relief Sewer (in)	2,594,000	7,120,000	9,123,000	5,345,000
New Pump Station (MGD)	6,124,000	6,759,000	7,343,000	5,452,000
Additional Pumping Capacity (MGD)	1,694,000	2,754,000	2,827,000	2,664,000
Grand Total	**10,412,000**	**16,633,000**	**19,293,000**	**13,461,000**

Table 3-22 Capital Cost Summary of Covert Sanitary Sewer System Basin Capacity Projects, Future Flows

	2y3h ($)	**5y3h ($)**	**10y3h ($)**	**10y24h ($)**
Upsize sewer (in)	2,570,000	5,930,000	13,032,000	3,129,000
Upsize Pump Station (mgd)	2,651,000	3,762,000	3,787,000	3,549,000
New Pump Station (mgd)	7,056,000	6,733,000	7,356,000	5,439,000
Grand Total	**12,277,000**	**16,425,000**	**24,175,000**	**12,117,000**

Table 3-23 summarizes the capital costs for condition projects associated with the Covert SSS Basin. This basin would include inflow reduction, manhole rehabilitation, and sewer rehabilitation projects. In addition, this basin would include post-construction flow monitoring to gauge the progress and effectiveness of these projects on I/I reduction. Refer to Figures H-1 and H-2 in Appendix H for project location maps.

Table 3-23 Capital Cost Summary of Covert Sanitary Sewer System Basin Condition Projects
Evansville, IN – Sanitary Sewers Remedial Measures Plan

	Total Capital Cost (in dollars)
Inflow Reduction	1,134,000
Manhole Rehabilitation	345,000
Post-construction Flow Monitoring	28,000
Sewer Main Rehabilitation	631,000
Total	**2,138,000**

3.4.2.4 Riverside-Vann Sanitary Sewer System Basin

Projects for the Riverside-Vann SSS Basin would include a combination of capacity and condition improvement projects. Tables 3-24 and 3-25 summarize the capital costs for capacity projects by storm event, for existing and future flows, respectively. Relief sewers, additional pumping capacity, and a new pump station at the CSS/SSS interface would be required for all storm events for both existing and future flows.

Table 3-24 Capital Cost Summary of Riverside-Vann Sanitary Sewer System Basin Capacity Projects, Existing Flows

	2 year – 3 Hour ($)	**5 year – 3 hour ($)**	**10 year – 3 hour ($)**	**10 year – 24 hour ($)**
Relief Sewer (in)	10,307,000	12,097,000	12,129,000	12,190,000
New Pump Station (MGD)	2,942,000	3,221,000	6,454,000	
Additional Pumping Capacity (MGD)	1,260,000	1,325,000	1,338,000	1,325,000
Grand Total	**14,509,000**	**16,643,000**	**19,921,000**	**13,515,000**

Table 3-25 Capital Cost Summary of Riverside-Vann Sanitary Sewer System Basin Capacity Projects, Existing Flows

	2y3h ($)	**5y3h ($)**	**10y3h ($)**	**10y24h ($)**
Upsize sewer (in)	8,961,000	11,740,000	12,591,000	10,655,000
Upsize Pump Station (mgd)	1,260,000	1,325,000	1,351,000	1,260,000
New Pump Station (mgd)	2,955,000	3,247,000	3,436,000	3,030,000
Grand Total	**13,176,000**	**16,312,000**	**17,378,000**	**14,945,000**

Table 3-26 summarizes the capital costs for condition projects associated with the Riverside-Vann SSS Basin. This basin would include inflow reduction, manhole rehabilitation, and sewer rehabilitation projects. In addition, this basin would include post-construction flow monitoring to gauge the progress and effectiveness of these projects on I/I reduction. Refer to Figures I-1 and I-2 in Appendix I for project location maps.

Table 3-26 Capital Cost Summary of Riverside-Vann Sanitary Sewer System Basin Condition Projects
Evansville, IN – Sanitary Sewers Remedial Measures Plan

	Total Capital Cost (in dollars)
Inflow Reduction	271,000
Manhole Rehabilitation	41,000
Post-construction Flow Monitoring	9,000
Sewer Main Rehabilitation	218,000
Total	**539,000**

SECTION 4

Recommended Remedial Measures Plan – May 31, 2013

The purpose of this SSRMP is to establish a plan for implementing remedial measures designed to prevent and eliminate SSOs for the selected design storm under current and future projected flow conditions.

The ultimate goal of the Utility's SSRMP is to prevent SSOs that may occur as a result of the sewer systems' inability to transport to the CSS trunk sewers or the WWTPs' anticipated peak WWFs that correspond to the selected design storm. The SSRMP focuses on SSO control. CSS releases and WWTP capacity issues are addressed as part of the Draft LTCP and the Draft WWTP Facility Plan for the West and East WWTPs, respectively.

Based on the results of the flow monitoring, SSES, hydraulic modeling work conducted in 2010, the analyses completed to develop the SSRMP, and in light of the Utility's financial capability, Evansville is proposing an adaptive management approach to SSO control that focuses on continuous improvement and effective asset management. The SSRMP approach can be summarized as follows:

1. Implement inflow reduction, manhole rehabilitation, and Priority 2 and 3 CIPP projects (infrastructure condition improvement projects) identified in Section 3.
2. Continue and expand the ongoing sewer assessment and flow monitoring program to identify and remove inflow sources and to verify and correct capacity limitations/bottlenecks in the areas identified through the flow monitoring and hydraulic modeling efforts as having potential SSOs or the greatest potential to contribute high levels of I/I.
3. Closely monitor areas with forecasted growth to ensure that adequate dry- and wet-weather capacity is available to convey flows without SSOs.
4. During IOCP Phase 2, implement the capacity improvement, storage, or pumping improvement projects identified in Section 3 if sewer rehabilitation and I/I reduction efforts are not effective at controlling or eliminating SSOs and hydraulic capacity limitations.

4.1 Planning Approach and Project Selection

The SSRMP projects have been developed using planning-level computer models and other engineering analysis tools that were calibrated based on the condition of the existing system and using data that were largely collected during 2011. 2011 has been documented as the wettest year in Evansville's history since precipitation data began being recorded in the 1890s. This created challenges in sewer system model development and the other technical assessments conducted to develop the IOCP. Analysis and project development using planning-level models and approaches is inherently conservative and, under normal circumstances, presents opportunities for project and cost refinement during plan implementation. However, refinement opportunities generally require actual performance data gathered through time and after system optimization and I/I reduction. In the Utility's case, the complexity and interdependency of the CSS and SSS and the system's operation in relation to the operation of the flood protection system have made model calibration more difficult, and the extremely wet year introduced significant additional challenges and uncertainty. This uncertainty forces additional conservatism in predicting overflow volumes and flow rates, which may translate into higher projected costs for overflow control facilities and capacity projects. The Utility requested and was granted an additional six months to collect additional flow data during a drier period and to refine the computer models used for planning the IOCP projects, which resulted in a more cost-effective plan and better projected performance. However, an adaptive approach is still warranted to achieve the best performance at the lowest life-cycle cost across the entire IOCP.

The proposed phased IOCP implementation approach recognizes the conservatism and uncertainty inherent in this process. It also recognizes that system conditions and, therefore, future facility sizing, will change. Changes will occur as a result of implementing specific optimization or real-time control projects and constructing overflow control facilities and reducing I/I or stormwater runoff into the system.

The system characterization efforts completed in 2011 included the investigation of approximately 20 percent of the separate SSS to determine the causes of system backups and overflows, the conditions contributing to unplanned and reactive work by Utility crews, and the extent of the system that was receiving preventive maintenance. These areas were deemed to be the highest priority due to the relative frequency of service line backups, overflows, and reactive maintenance work. As such, the goal was to target for investigation the areas that would benefit the most from infrastructure reinvestment and reduce the burden on the Utility's crews to repeatedly respond to overflows in certain areas or conduct preventive maintenance activities at unsustainable frequencies. Rehabilitation investment in these high-priority areas and across the entire system will result in reductions in I/I levels, thereby reducing the potential for SSOs.

The Utility's approach to implementation of the SSRMP projects is aligned with the overall IOCP approach of continuous improvement and adaptive management to appropriately size future improvements and to address the most pressing problems first. Based on the results of the capacity analysis and system evaluation activities, the Utility's SSRMP includes sewer rehabilitation projects to reduce major sources of I/I, and capacity projects to address and eliminate the four priority recurring SSO locations. The SSRMP projects proposed to be implemented first will focus on cost effectively reducing sources of I/I and on fixing structural defects that could cause or contribute to SSOs or system backups. This phase will be integrated with and aligned with the Utility's ongoing capacity, management, operations, and maintenance program. It includes an ongoing post-construction monitoring program to monitor progress and project performance and collecting data to support the refinement and possible recalibration of the hydraulic models prior to the implementation of the capacity projects that will eliminate the recurring SSOs.

4.2 Level of Control

The CSS system-wide improvement evaluation described within the LTCP is based on the typical year rainfall event. As noted in previous sections, the SSRMP alternatives were evaluated for the 2-year, 5-year, and 10-year design storms (Critical Storm Events). A storm similar to the CSS typical year rainfall dataset was sought for the SSS analysis, because using the typical year rainfall data for the analysis of both the West SSS and CSS is beneficial in terms of understanding the interactions between the CSS and the SSS.

Appendix L presents an analysis of typical year rainfall and design storm events. The sanitary system improvement evaluations based on the typical year simulation will produce projects that convey or store flows similar to the 2-year 24 hour design storm. As a result, the Utility selected the 2-year storm as the design storm for the capacity projects to eliminate the recurring SSOs. Although the design storm selection was based upon the comparison of typical year and design storm events, affordability considerations further validate this selection. Capital costs for SSS improvements do not vary significantly between the design storms, but life cycle costs are significantly higher for the 5- and 10-year storms.

4.2.1 Interaction between the CSS and SSS

EWSU developed an integrated plan due, in part, to the connectivity and interaction between the CSS and SSS, with the understanding that improvements in the CSS may alleviate capacity related issues within the SSS. Evaluating the interconnected system as a whole prevents oversizing or unnecessary improvements in the SSS that may be favorably impacted by improvements within the CSS.

The CSS and SSS model boundary conditions were defined at the time of SSS model calibration. Examples of CSS wet weather impacts on the SSS are presented within Appendix J. The planning approach outlined within Section 4.1 takes advantage of the benefits associated with the integrated planning approach.

4.3 Project Capital Costs and Implementation Schedule

4.3.1 Sewer Rehabilitation Projects

During the sewer system evaluation projects conducted in 2010 and 2011, the Utility investigated approximately 20 percent of the separate sanitary sewer system to identify sources of stormwater inflow, structural defects in the sewers, and sources of groundwater infiltration.

4.3.2 Capacity Projects for SSO Elimination

As summarized above, the sewer system evaluation projects conducted as part of IOCP development determined that there are opportunities to reduce excessive I/I and to correct structural defects that may be causing or contributing to sewer overflows. In addition, the hydraulic modeling conducted during the IOCP development process also determined that much of the SSS is impacted by CSS operation during wet weather, which could lead to SSS surcharging and potential sewer overflows. Large and expensive capacity improvement projects would be needed to remedy the capacity issues caused by hydraulic interaction between the CSS and SSS, with little guarantee that the projects would actually remedy the situation. Furthermore, as stated above, the Utility believes that future improvements in both the CSS and SSS will change the conditions in the system. This could improve the ability of the SSS trunk sewers to convey flows or eliminate the surcharging, up to the level of system capacity selected, which is caused by the hydraulic interaction between the CSS and SSS. For example, the proposed new West WWTP Headworks Facility will be designed to better control influent sewer hydraulics, which will improve hydraulic conditions in the upstream sewers and could alone remedy the SSO located near the WWTP at Tekoppel Avenue. The sewer rehabilitation projects, in combination with the Utility’s ongoing capacity, management, operations, and maintenance program, are focused on reducing excessive I/I and eliminating structural bottlenecks, which will change and improve conditions as well.

As described above, the SSO analysis determined that there are four recurring SSO locations that will require system improvements to provide additional capacity to convey wet-weather flows. The locations, in order of priority, are:

1. 1st Avenue and Mill Road
2. Lincoln Avenue near Plaza Drive
3. Tekoppel Avenue near the West WWTP
4. Bergdolt Road near Oak Hill Road

The capacity projects being implemented in the SSRMP are focused on eliminating these SSO locations, and the capacity projects include the infrastructure downstream of these locations that was identified in the hydraulic models as being needed to remedy the overflows.

4.3.3 Implementation Schedule

Table 4-1 provides the SSRMP implementation schedule.

Table 4-1 Recommended Plan SSRMP Implementation Schedule

Project	Addresses	Planning Level Opinions of Probable Capital Costs	Bid Date	Commencement of Construction	Achievement of Full Operation
North Park Rehabilitation Projects	Mill Road SSOs	10,529,000	1/1/2018	1/1/2019	1/1/2023
North Park Capacity Projects	Mill Road SSOs	4,247,000	1/1/2030	1/1/2031	5/31/2035
Lloyd Expressway Rehabilitation Projects	Lincoln Avenue SSOs	2,442,000	1/1/2021	1/1/2022	1/1/2025
Lloyd Expressway Capacity Projects	Lincoln Avenue SSOs	2,961,000	1/1/2024	1/1/2025	1/1/2027
NW/SW Rehabilitation Projects	Tekoppel Avenue SSOs	3,614,000	1/1/2022	1/1/2023	1/1/2027
NW/SW Capacity Projects	Tekoppel Avenue SSOs	3,054,000	1/1/2026	1/1/2027	1/1/2028
E-11 Rehabilitation Projects	Bergdolt Road SSOs	3,251,000	1/1/2022	1/1/2023	1/1/2026
E-11 Capacity Projects	Bergdolt Road SSOs	10,760,000	1/1/2027	1/1/2028	1/1/2030
SSS Rehabilitation Projects	SSS Basins	3,423,000	1/1/2024	1/1/2025	5/31/2035
Proposed SSRMP Cost		**44,281,000**			

Notes:

1. Refer to the LTCP, SSRMP, and WWTP Facility Plan for specific project details and development of cost opinions.
2. The proposed bid, commencement of construction, and achievement of full operation dates are subject to change based on state and federal (including USACE) permitting and approval.
3. These summary tables present only capital cost since it is the key scheduling component of cost. Project O&M costs and Life Cycle cost are presented with project details in the appendixes to the SSRMP.
4. Costs in 2012 dollars.

SECTION 5

Final Negotiated Remedial Measures Plan – January 15, 2016

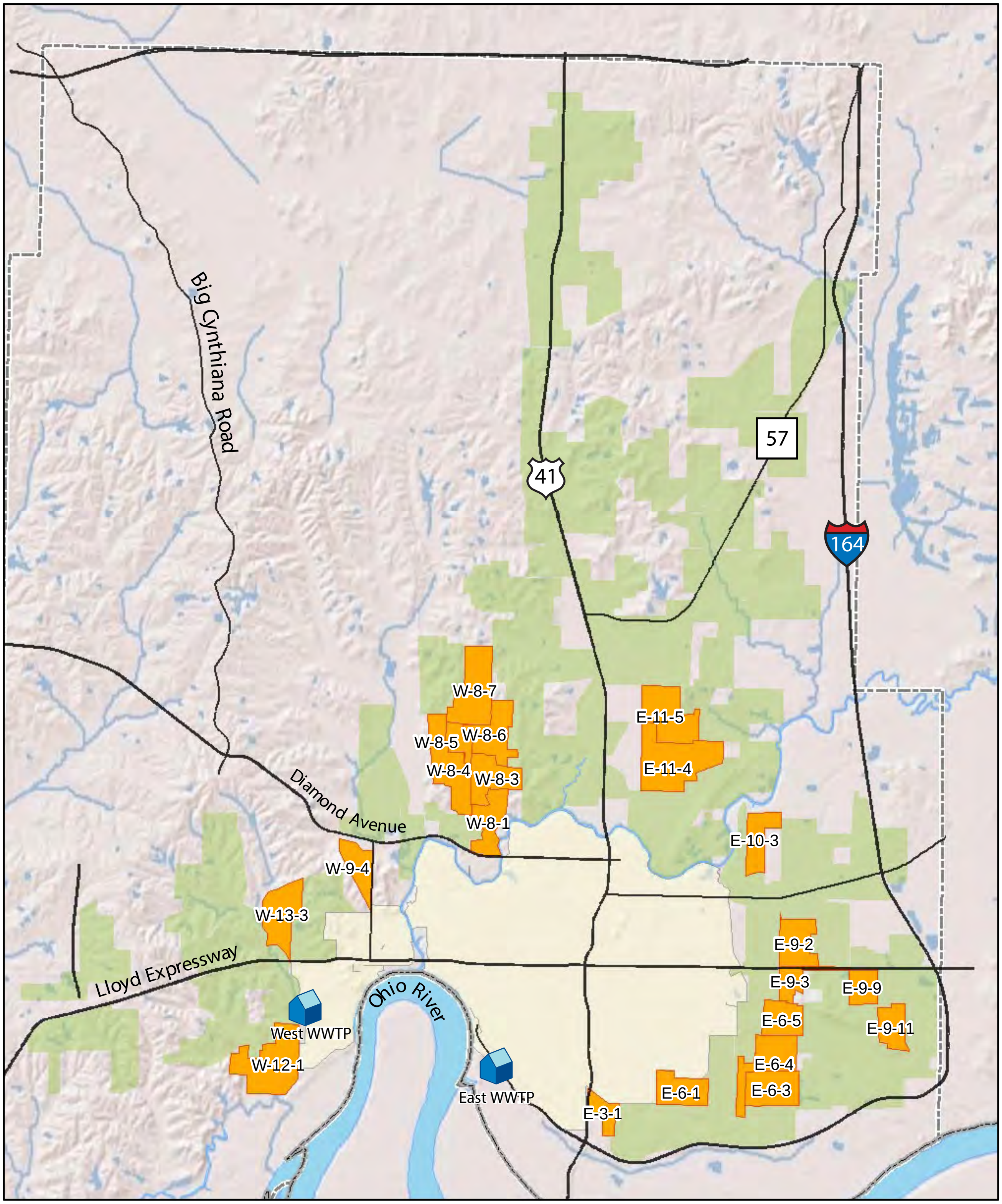
This section describes the Utility's Negotiated Plan reached via agreement with EPA and IDEM for meeting CWA objectives and reducing SSOs.

5.1 Negotiated SSRMP Overview

The Utility will invest approximately $53 million to eliminate chronic SSOs occurring in four areas of the separate sanitary system through a combination of infiltration/inflow reduction and increased collection system conveyance capacity. Known defects and bottlenecks in the separate system also will be remedied to eliminate these SSOs. Through the Utility's ongoing inspection and maintenance plan, other areas that experience capacity-related SSOs in the future will be evaluated and addressed through an adaptive management approach. Using this approach, the removal of stormwater inflow and infiltration from the system and sewer line rehabilitation will be a priority for the Utility to prevent SSOs. Where additional conveyance volume is necessary to remedy future capacity-related SSOs, the Utility will increase capacity to accommodate a two-year design storm.

5.2 SSRMP Projects

During the sewer system evaluation projects conducted in 2010 and 2011, the Utility investigated approximately 20 percent of the separate sanitary sewer system to identify sources of stormwater inflow, structural defects in the sewers, and sources of groundwater infiltration. The SSRMP describes in detail the projects proposed to be implemented in the investigation areas to reduce stormwater inflow, repair broken manholes and pipes, and restore sewer mains using trenchless technologies. Figure 5-1 shows the areas where these projects are proposed.



Legend

- Wastewater Treatment Plant
- Sanitary Sewer Rehabilitation Project Areas
- Separate Sanitary Sewer Area
- Combined Sewer Area
- Hydrography
- Major Road
- Indiana State Boundary

6,000 Feet

North

Figure 5-1
Evansville Sewer Rehabilitation
Integrated Overflow Control Plan
January 15, 2016

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Using this analysis, the Utility identified locations that experienced recurring, wet weather-related SSOs and should therefore be included in the SSRMP as well as the projects and schedule for eliminating the SSO events at those locations. Locations that currently experience wet-weather related SSOs were further analyzed to determine whether the locations experience recurring SSOs and whether the SSS models predict such an occurrence. Maintenance-related SSOs caused by problems in the Utility's system are corrected immediately upon discovery and typically do not recur. Any locations with two or more maintenance-related SSOs are identified, and the Utility's collection systems maintenance teams address these locations through the Repeat Blockage Cleaning and Inspection Program conducted under the Utility's CMOM program. Consequently, maintenance-related SSOs are not included in the SSRMP. This analysis resulted in the identification of four recurring SSO locations that will require system improvements to provide additional capacity to convey wet-weather flows. The locations, in order of priority, are:

1. 1st Avenue and Mill Road
2. Lincoln Avenue near Plaza Drive
3. Tekoppel Avenue near the West WWTP
4. Bergdolt Road near Oak Hill Road

The four recurring SSOs listed above will be eliminated for storms up to and including the 10-year storm.

The Utility takes an adaptive management approach to address any future locations with recurring SSOs. The Utility will evaluate SSO reports to identify areas that may experience recurring SSOs in the future, and any such locations will be addressed by the Utility's CMOM program and potentially through additional capital projects. Any new recurring SSOs discovered will be eliminated for storms up to and including the 2-year storm.

5.3 Capital Costs and Implementation Schedule

Table 5-1 provides planning-level opinions of probable capital costs for the SSRMP projects and the 25-year implementation schedule. It includes the key dates required by the Decree: the bid date, commencement of construction, and achievement of full operation.

5.4 Adaptive Management Implementation Approach

As previously described, the Utility is taking an adaptive management approach to the IOCP. This approach to implementing the IOCP is being used because the projects proposed to be conducted in the early years of the IOCP will reduce stormwater inflow into the sewer systems or redirect stormwater inflow out of the sewer systems. This will reduce the size and cost of new overflow control infrastructure projects proposed in later years. Additionally, the uncertainty inherent in any computer model used to size projects needs to be refined and recalibrated over time to ensure the right-sizing of projects.

Table 5-1
Approved SSRMP Remedial Measures, Design Criteria, Performance Criteria, and Implementation Schedule

					Description of Proposed Design and Performance Criteria		Implementation Schedule			
Control Measure/Plan	**Project**	**Outfall Number or Overflow**	**Name**	**Description**	**Design Criteria**	**Performance Criteria**	**Bid Date**	**Commencement of Construction**	**Achievement of Full Operation**	**Planning Level Opinions of Probable Capital Cost**
SSRMP	North Park Rehabilitation Projects		Mill Road SSOs	Sewer and manhole rehabilitation	Defendants shall spend $4,555,000, in 2015 dollars.		1/1/2018	1/1/2019	1/1/2023	$ 4,555,000
SSRMP	North Park Capacity Projects	SSO	Mill Road SSOs	Increase conveyance capacity by upsizing trunk sewers; raise manhole rim elevations; pump flow into CSS	Conveyance pump station with minimum sustained design capacity of 17.7 million gallons per day. Upsize a total length of 7,759 feet of sanitary sewer. Relief sewer diameter will be determined using 10-year level of SSO control. Seal manholes associated with upsized sewer lines. See Evansville's approved Sanitary Sewers Remedial Measures Plan for more specific project details.	0 SSOs, 10-year level of SSO control	1/1/2030	1/1/2031	5/31/2035	$ 12,453,000
SSRMP	Lloyd Expressway Rehabilitation Projects	SSO	Lincoln Avenue SSOs	Sewer and manhole rehabilitation	Defendants will spend $2,619,000, in 2015 dollars.		1/1/2021	1/1/2022	1/1/2025	$ 2,619,000
SSRMP	Lloyd Expressway Capacity Projects	SSO	Lincoln Avenue SSOs	Increase conveyance capacity by upsizing trunk sewers; raise manhole rim elevations	Upsize a total length of 5,951 feet of sanitary sewer. Relief sewer diameter based on 10-year level of SSO control. Adjust 2 manhole inverts. See Evansville's approved Sanitary Sewers Remedial Measures Plan for more specific project details.	0 SSOs, 10-year level of SSO control	1/1/2024	1/1/2025	1/1/2027	$ 3,215,000
SSRMP	NW/SW Rehabilitation Projects	SSO	Tekoppel Avenue SSOs	Sewer and manhole rehabilitation	Defendants shall spend $3,876,000, in 2015 dollars.		1/1/2022	1/1/2023	1/1/2027	$ 3,876,000
SSRMP	NW/SW Capacity Projects	SSO	Tekoppel Avenue SSOs	Increase conveyance capacity by upsizing trunk sewers; raise manhole rim elevations; pump flow into CSS	Conveyance pump station with minimum sustained design capacity of 14.5 million gallons per day. Size any relief sewer diameter based on 10-year level of SSO control. See Evansville's approved Sanitary Sewers Remedial Measures Plan for more specific project details.	0 SSOs, 10-year level of SSO control	1/1/2026	1/1/2027	1/1/2028	$ 3,808,000
SSRMP	E-11 Rehabilitation Projects	SSO	Bergdilt Rd SSOs	Sewer and manhole rehabilitation	Defendants shall spend $3,487,000, in 2015 dollars.		1/1/2022	1/1/2023	1/1/2026	$ 3,487,000
SSRMP	E-11 Capacity Projects	SSO	Bergdilt Rd SSOs	Increase conveyance capacity by upsizing trunk sewers; raise manhole rim elevations; pump flow into CSS	Conveyance pump station with minimum sustained design capacity of 14.5 million gallons per day. Upsize a total sewer length of 12,043 feet. Relief sewer diameter based on 10-year level of SSO control. Adjust 21 manhole inverts. See Evansville's approved Sanitary Sewers Remedial Measures Plan for more specific project details.	0 SSOs, 10-year level of SSO control	1/1/2027	1/1/2028	1/1/2030	$ 15,882,000
SSRMP	SSS Rehabilitation Projects	SSO	SSS Basins	Sewer and manhole rehabilitation	Defendants shall spend $3,671,000, in 2015 dollars.		1/1/2024	1/1/2025	1/1/2035	$ 3,671,000

SECTION 6

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APPENDIX A

Evansville Water and Sewer Utility – SSS Future Flow Projections

Evansville Water and Sewer Utility – SSS Future Flow Projections

PREPARED FOR: Evansville Water and Sewer Utility

PREPARED BY: CH2M HILL

DATE: 2/28/2013

Purpose

The purpose of this memo is to document the development of the future flows used as part of the Integrated Overflow Control Plan (IOCP) analysis. The future flow calculation depends upon the population to be served by Evansville Water and Sewer Utility (Utility) and the additional area within the Utility's sewered area by 2032, the build-out year for the IOCP analysis.

Introduction

Future development is projected in the Utility's separate sanitary sewer (SSS) area. The existing base sanitary flow and groundwater infiltration in the Utility's system were reported in the Revised Sewer Systems Assessment Report (CH2M HILL, July 2012). The system wide total dry weather flows are summarized in Table 1.

Table 1. Existing Dry Weather Flows

Contributing Flow	Flow (mgd)
Existing Average Day Base Sanitary Flow	8.13
Existing Groundwater Infiltration (GWI)	7.45
Total	**15.58**

Future dry weather flow estimates are calculated as the sum of the existing dry weather flow and the following contributing flows:

- **Future residential flow** – based on new residential population and the addition of existing septic developments anticipated to be sewered by 2032
- **Future additional groundwater infiltration** – based on the estimated area for new residential development and the existing septic areas anticipated to be sewered by 2032
- **Future additional industrial flow** – based on estimated industrial development
- **Future additional commercial flow** – based on estimated commercial development
- **Additional trade flow** – additional flows generated outside the Utility's service area that the Utility will provide sewer service for

The methodology used to determine the additional population and acreages that the dry weather flows are dependent upon, and the subsequent projected dry weather flow from each contributing flow source, are described in the following sections.

Future New Residential Population and Area

Residential population projections at the township level were provided by the Evansville-Vanderburgh County Area Plan Commission (EVAPC). The township projections summarized in Table 2 were allocated at the sub-basin level using the following process:

- The number of people per household was calculated for each township using the EVAPC population and housing unit projections.
- The population density (people/acre) for each township was calculated by multiplying the people per household by a factor of 2.6 households per acre (which is equivalent to 0.38 acres per household). Subdivision density of 2.6 households per acre was determined by the Utility based on a review of development data from 2006 through 2012.
- Armstrong, German, Union, and Pigeon Townships are not projected to contribute to the SSS based on analysis of current EWSU service extent. Additionally, the township level population projections from EVAPC indicate small population increases or population decreases for these particular townships. Excluding these townships from the future flow analysis results in the SSS population growth total exceeding the total projected County population growth.
- The Utility's review of development data between 2006 and 2012 indicates that, on average, 85% of new lots are sewered. The remaining 15% of lots are developed outside the Utility's sewered area and are served by septic systems. As a result, the number of future sewered households was calculated as 85% of the projected housing unit gain.
- The new sewered area (acres) was calculated by multiplying the number of new sewered households by 0.38 acres per household
- The new sewered population was calculated by multiplying the population density (people/acre) by the new sewered area
- New residential SSS contributing acreage was calculated by summing up the township totals and deducting 105 acres. The Utility's review of development data indicates that there are currently 105 acres of existing sewered but vacant, undeveloped lots. The deduction accounts for future occupancy of the existing lots and yields the additional acreage needed for the new sewered population and was applied to Center Township.

The new residential sewered area was allocated in locations within the SSS based on the projected land use maps provided by the EVAPC and discussions with EVAPC and Utility staff (Attachment A). New sewered area and population were not allocated to the "In City" portion of Center Township, as there was no projected population change. Similarly, new sewered area and population were not allocated to the "In City" portion of Perry Township due to the projected decline in population and housing units.

Table 2. 2030 Township Area Projections

Township		Vanderburgh County Projected Population Gain/Loss, 2010-2030	Projected Housing Units Gain/Loss, 2010-2030	People per Household	Population Density (people/acre)[a]	Sewered 2030 (Y/N)	New Sewered Households (85%)	New Sewered Area [ac]	New Sewered Population
Armstrong		(139)	4			N			
Center	In City	0	(23)	0.00	0.00	Y	0	0	0
	Out	8,345	4,235	1.97	5.12	Y	3,600	1,368[c]	7,009
German		449	342	1.31	3.41	N			
Knight		734	559	1.31	3.41	Y	476	181	618
Perry	In City	(200)	(93)	2.15	5.59	Y	-80	-30	-170
	Out	3,000	1,035	2.90	7.54	Y	880	334	2,520
Pigeon		(5,257)	(1,604)	3.28	8.52	Not in SSS			
Scott		5,000	2,434	2.05	5.34	Y	2,069	786	4,199
Union		(50)	(41)	1.22	3.17	N			
Total		**11,882**	**6,848**	**1.74**	**4.51**		**6,945**	**2,639[b]**	**14,175**

[a] Population density calculated assuming a factor of 2.6 households per acre based on review of 2006-2012 development data
[b] Final new sewered area is **2,534 ac** based on deduction of 105 ac of vacant residential lots available for development (Center Township)
[c] Center Township new sewered area mapped as 1263 ac after deduction of 105 ac vacant residential lots available for development

Existing Septic System Population and Area to be Sewered

In addition to residential flow increases attributed to the projected population gain, several areas currently served by septic systems may be sewered and contribute to residential flows. The *Evansville Septic Site Study Engineering Report* (Powers Engineering, September 2010) reviewed areas served by septic systems and ranked the priority for sewering these areas. It was assumed that the top ten subdivisions identified as part of the study would be completed by 2032. The ten subdivisions and corresponding population and acreages to be served are listed in Table 4 and shown in the Attachment A.

Table 3. Residential Population Increase due to Existing Septic Population

Subdivision	Number of Developed Parcels	Developed Population	Subdivision Area (acres)
Mill	8	18	5
Cave	93	208	45
Speaker	11	25	35
Fickas	13	29	9
Buchanan	21	47	59
Mount Auburn	71	159	108
Kratzville	46	103	71
Dorothy	21	47	22
Maryland	6	13	20
Boehne	24	54	84
Total	314	703	458

Industrial and Commercial Development

Additional industrial and commercial flows are estimated based on the acreage anticipated to be developed. The added industrial and commercial areas and flows were based on Vanderburgh County labor force projections and the projected ratio of 2030 industrial to commercial land use development. Labor force estimates and projected annual growth rates for Vanderburgh County were obtained from STATS Indiana/Indiana Business Research Center (http://stats.indiana.edu), and potential 2030 land use development data were received from EVAPC.

The 2010 Vanderburgh County workforce was reported as 92,560. Growth of the Vanderburgh County labor force is projected to be 0.1%-0.9% annually between 2010 and 2020, and a labor force decline of up to 0.4% annually is projected between 2020 and 2030. For purposes of the flow projection evaluation, it was assumed that the labor force would grow 0.9% annually from 2010-2020, and remain at that level through 2030 rather than decline. With 0.9% growth over 10 years, 8,676 workers would be added to the existing Vanderburgh County labor force.

The 2030 land use projection data received from EVAPC indicates that development of industrial versus commercial acreage is projected at a ratio of approximately 3.27:1. Using this ratio of industrial to commercial development, and estimated employee densities of 20 workers per industrial acre and 2.9 workers per commercial acre, the area that would be needed to accommodate 8,676 additional workers was calculated as follows:

$$\text{Industrial Acres} \times 20\ \text{Workers/Industrial Acre} + \text{Commercial Acres} \times 2.9\ \text{Workers/Commercial Acre} = 8{,}676\ \text{Added Workers}$$

$$\text{with Industrial Acres} = 3.28 \times \text{Commercial Acres}$$

This methodology results in an estimated addition of approximately 127 commercial acres and 415 added industrial acres. These acreages were added in locations within the SSS based on the projected land use maps provided by the EVAPC and discussions with EVAPC and Utility staff (Attachment A).

Flow Factors

The future additional dry weather flow projections were developed using the following flow factors:

- **Residential base sanitary flows:** A factor of 100 gallons per person per day (gpcd) was applied to the new residential population, as well as to the existing septic population to be sewered by 2030, to calculate additional residential dry weather base sanitary flow. This value was used from Ten State Standards guidance and a review of East SSS hydraulic model development data.
- **Groundwater infiltration:** Based on an analysis of data used for development of the East SSS hydraulic model, a factor of 350 gallons per acre per day (gpad) was added to the residential acreage to account for GWI. Residential acreage consists of the area to be developed to accommodate new population, as well as the septic areas that will be sewered by 2030.
- **Industrial flows:** Future industrial flows were developed by multiplying the projected additional industrial area by 1,000 gpad. This flow value was derived from data utilized as part of the East SSS hydraulic model development.
- **Commercial flows:** Future commercial flows were developed by multiplying the projected additional commercial area by 500 gpad. This value was derived from data utilized as part of the East SSS hydraulic model development.

Results

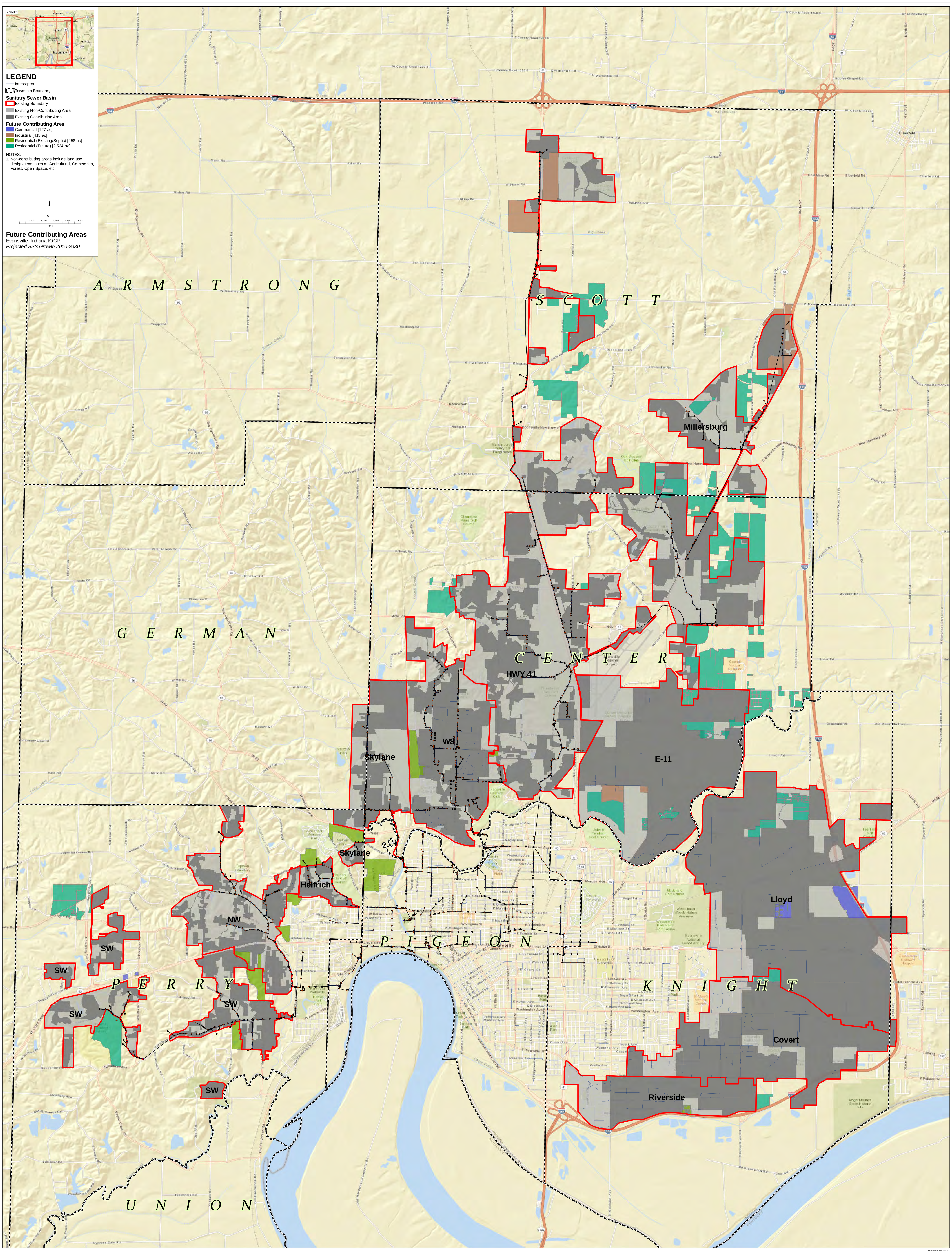
The methodology results in an additional projected 4.5 mgd of dry weather flow, for a total 2032 dry weather flow of just over 20 mgd. System wide future flow projections are provided in Table 4.

Table 4. Future Projected Dry Weather Flows

Source of Contributing Flow	Area/Population	Units	Flow (mgd)
Existing Base Sanitary Flow			8.13
Existing Groundwater Infiltration			7.45
Future Additional Residential Population	14,175	People	1.42
Future Additional Residential Acreage	2,534	Acres	0.89
Existing Septic Acreage to be Sewered	458	Acres	0.16
Existing Septic Population to be Sewered	703	People	0.07
Future Additional Industry Acreage	415	Acres	0.42
Future Additional Commercial Acreage	127	Acres	0.06
Future Additional Trade Flow			1.50
Total			**20.09**

ATTACHMENT A

Future Contributing Areas



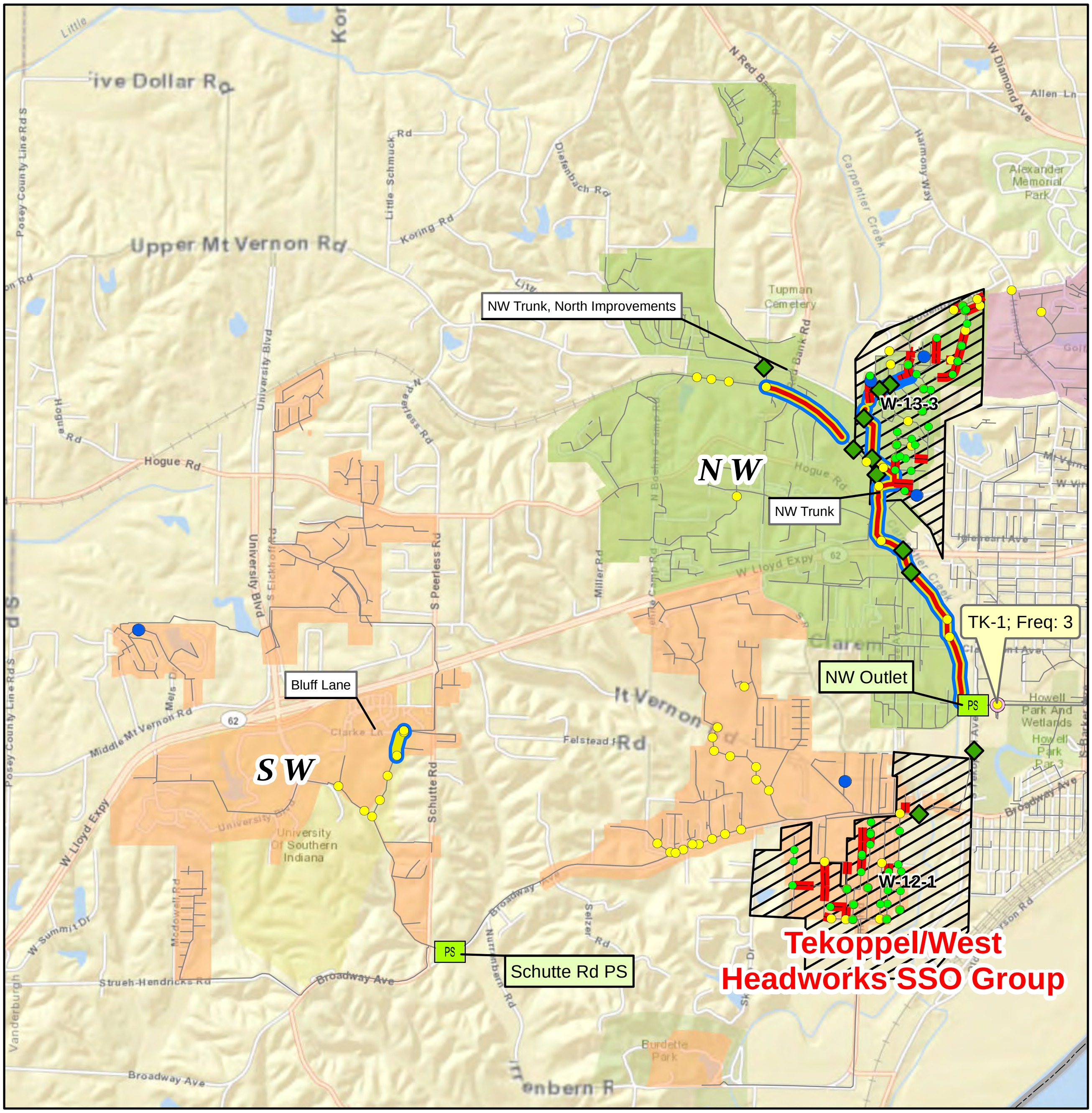
VICINITY
Evansville
LEGEND
Interceptor
Township Boundary
Sanitary Sewer Basin
Existing Boundary
Existing Non-Contributing Area
Existing Contributing Area
Future Contributing Area
Commercial [127 ac]
Industrial [415 ac]
Residential (Existing/Septic) [458 ac]
Residential (Future) [2,534 ac]
NOTES:
1. Non-contributing areas include land use designations such as Agricultural, Cemeteries, Forest, Open Space, etc.
N
0 1,000 2,000 3,000 4,000 5,000
Feet
Future Contributing Areas
Evansville, Indiana IOCP
Projected SSS Growth 2010-2030
A R M S T R O N G
S C O T T
G E R M A N
C E N T E R
P E R R Y
P I G E O N
K N I G H T
U N I O N
Millersburg
HWY 41
W8
Skylane
E-11
Helfrich
NW
SW
Lloyd
Covert
Riverside
Darmstadt
Evansville
CH2MHILL

APPENDIX B

Northwest/Southwest Basins

This appendix includes supporting data used to develop the capital costs for capacity and condition improvement projects identified in the Northwest and Southwest Basins. Data is organized in following manner:

Section	Title	Description
Capacity Improvement Projects		
B1	Capital cost summary tables	These tables include project names, descriptions, and summaries of quantities for each storm event, for existing and future flows.
Condition Improvement Projects		
B2	Capital cost summary tables	These tables include project names, descriptions, project IDs, and summaries of quantities
B3	SSES Quantities	These tables summarize results of field investigations conducted during the SSES



LEGEND

- Inflow Reduction Projects
- Manhole Rehabilitation Projects
- Manhole Seal
- Recurring Wet-Weather SSOs in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- Added Storage Basin
- PS Added Pumping Capacity
- Sewer Main Rehabilitation
- Added Pipe Capacity (2-Year 24-Hour)
- Added Pipe Capacity (5-Year 24-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

0 1,500 3,000
Feet

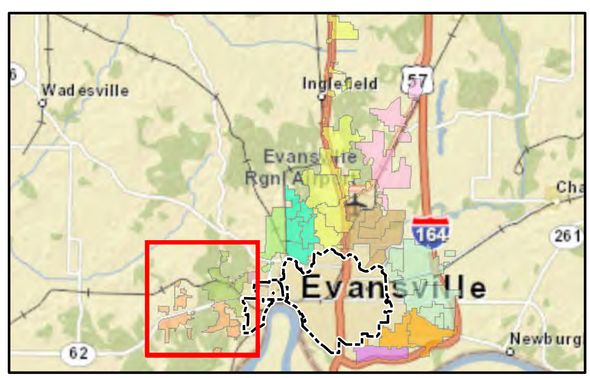
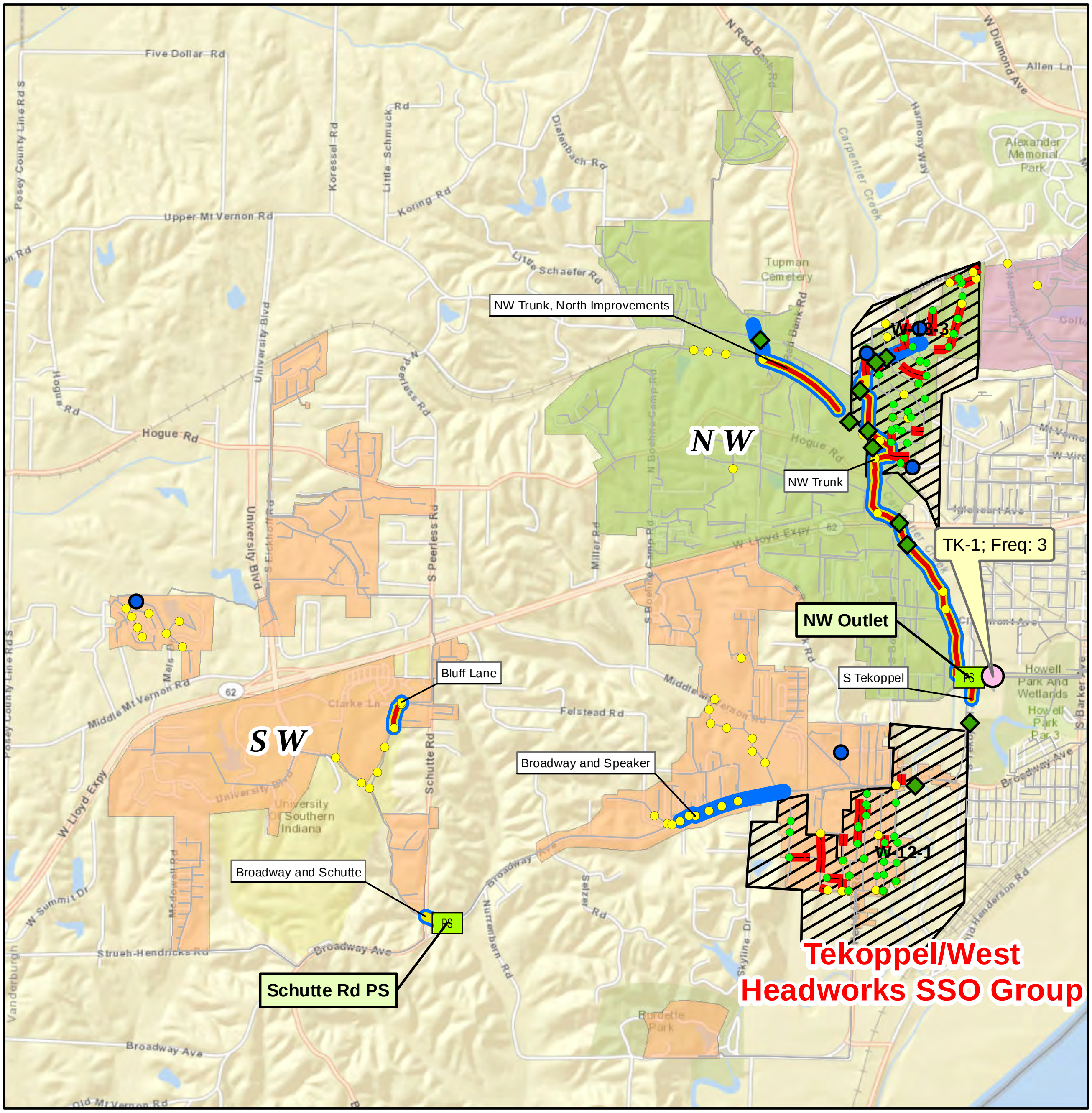


FIGURE B-1
NW and SW Basins, Proposed Capacity Projects for All Storms, 2012 Flows
Sanitary Sewer Remedial Measures Plan, May 2013



Recurring Wet-Weather SSO in SAR 2012-2
Modeled SSO
Location Included in 2010 List of Potential SSOs
Inflow Reduction Projects
Manhole Rehabilitation Projects
Sewer Main Rehabilitation
Added Storage Basin
Added Pumping Capacity
Added Pipe Capacity (2-Year 24-Hour)
Added Pipe Capacity (5-Year 24-Hour)
Added Pipe Capacity (10-Year 24-Hour)
Sewer Main
Priority Subbasin

0 1,000 2,000 3,000
Feet

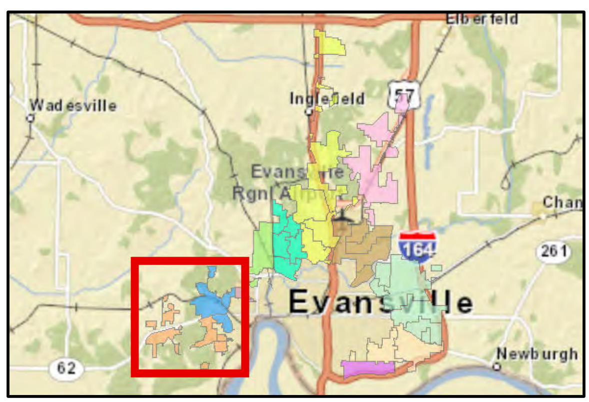


FIGURE B-2
NW and SW Basins, Proposed Capacity Projects for All Storms, 2032 Flows
Sanitary Sewer Remedial Measures Plan, May 2013

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B1 - Capital Cost Summary Tables for Capacity Improvement Projects

Cost estimates included in this proposal are in January 2012 Dollars (ENRCCI-8301). To escalate to February 2012 Dollars (ENRCCI – 8903) multiply by 7.25 percent.

NW/SW Basin Capacity Improvement Projects, 2012 Flows

Basin	NW-SW
Storm	2 year - 24 Hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
NW Trunk - Lower Section	**Relief Sewer (in)**	15	18	871	$ 634,000
			24	5,066	$ 3,863,000
NW Trunk - North Section	**Relief Sewer (in)**	12	15	2,216	$ 993,000
NW Trunk - Western Terrace	**Relief Sewer (in)**	8	15	126	$ 53,000
		10	15	1,301	$ 634,000
		12	15	985	$ 610,000
NW/SW Outlet Pump Station	**New Pump Station (MGD)**	(blank)	10.55		$ 3,054,000
Broadway & Schutte Road Pump Station	**Additional Pumping Capacity (MGD)**	(blank)	3.88		$ 1,125,000
Grand Total				**10,565**	**$ 10,966,000**

Basin	NW-SW
Storm	5 year - 24 Hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
NW Trunk - Lower Section	**Relief Sewer (in)**	15	18	871	$ 634,000
			24	5,066	$ 3,863,000
NW Trunk - North Section	**Relief Sewer (in)**	12	15	2,216	$ 993,000
NW Trunk - Western Terrace	**Relief Sewer (in)**	8	15	347	$ 193,000
		10	15	1,595	$ 742,000
		12	15	1,049	$ 596,000
NW/SW Outlet Pump Station	**New Pump Station (MGD)**	(blank)	12.87		$ 3,054,000
Broadway & Schutte Road Pump Station	**Additional Pumping Capacity (MGD)**	(blank)	4.54		$ 1,168,000
Bluff Lane	**Relief Sewer (in)**	10	15	32	$ 21,000
		12	15	634	$ 337,000
Grand Total				**11,810**	**$ 11,601,000**

Basin	NW-SW
Storm	10 year - 24 hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
NW Trunk - Lower Section	**Relief Sewer (in)**	15	18	871	$ 634,000
			24	893	$ 921,000
			30	4,173	$ 3,224,000
NW Trunk - North Section	**Relief Sewer (in)**	12	15	2,216	$ 993,000
NW Trunk - Western Terrace	**Relief Sewer (in)**	12	15	1,270	$ 736,000
		9.996	15	2,248	$ 968,000
		9.96	15	147	$ 76,000
		8.004	15	126	$ 53,000
NW/SW Outlet Pump Station	**New Pump Station (MGD)**	(blank)	14.47		$ 3,054,000
Broadway & Schutte Road Pump Station	**Additional Pumping Capacity (MGD)**	(blank)	4.98		$ 1,197,000
Bluff Lane	**Relief Sewer (in)**	10	15	32	$ 21,000
		12	15	634	$ 337,000
Grand Total				**12,610**	**$ 12,214,000**

NW/SW Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	NW/SW
Storm	2y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
NW Trunk, Lower Section	**Upsize sewer (in)**	15	18	871	$ 634,000
			24	5,107	$ 3,907,000
NW Trunk, North Improvements	**Upsize sewer (in)**	12	15	2,216	$ 992,000
NW Trunk, West Terrace	**Upsize sewer (in)**	8	15	126	$ 53,000
		10	15	538	$ 277,000
		12	15	1,904	$ 1,080,000
		9	15	795	$ 378,000
	New PS (mgd)	0	10.55	0	$ 3,054,000
Broadway and Schutte	**Upsize PS (mgd)**	2.1	3.88	0	$ 1,125,000
SW Trunk, Bluff Lane	**Upsize sewer (in)**	10	15	32	$ 21,000
		12	15	634	$ 337,000
South Tekoppel	**Upsize sewer (in)**	36	36	612	$ 617,000
Grand Total				**12,835**	**$ 12,475,000**

Basin	NW/SW
Storm	5y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
NW Trunk, Lower Section	**Upsize sewer (in)**	15	18	871	$ 634,000
			24	5,107	$ 3,907,000
NW Trunk, North Improvements	**Upsize sewer (in)**	12	15	2,216	$ 992,000
NW Trunk, West Terrace	**Upsize sewer (in)**	8	15	126	$ 53,000
		10	15	1,970	$ 933,000
		12	15	1,904	$ 1,068,000
	New PS (mgd)	0	12.87	0	$ 3,348,000
Broadway and Schutte	**Upsize sewer (in)**	15	24	205	$ 100,000
		18	24	324	$ 197,000
	Upsize PS (mgd)	2.1	4.541	0	$ 1,168,000
SW Trunk, Bluff Lane	**Upsize sewer (in)**	10	15	32	$ 21,000
		12	15	634	$ 337,000
South Tekoppel	**Upsize sewer (in)**	36	36	612	$ 617,000
Grand Total				**13,999**	**$ 13,375,000**

NW/SW Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	NW/SW
Storm	10y24h

				Values	
Project Name	**Description**	**Existing Size**	**Proposed Size**	**Sum of Pipe Length (ft)**	**Sum of Capital Cost**
NW Trunk, Lower Section	**Upsize sewer (in)**	15	18	871	$ 634,000
			24	933	$ 965,000
			30	4,173	$ 3,224,000
NW Trunk, North Improvements	**Upsize sewer (in)**	8	15	308	$ 119,000
		12	15	2,827	$ 1,251,000
NW Trunk, West Terrace	**Upsize sewer (in)**	8	15	126	$ 53,000
		10	15	3,150	$ 1,375,000
		12	15	1,904	$ 1,068,000
	New PS (mgd)	0	14.47	0	$ 3,551,000
Broadway and Schutte	**Upsize sewer (in)**	15	24	205	$ 100,000
		18	24	324	$ 197,000
		21	27	431	$ 394,000
		24	27	2,208	$ 1,490,000
	Upsize PS (mgd)	2.1	4.978	0	$ 1,197,000
SW Trunk, Bluff Lane	**Upsize sewer (in)**	10	15	32	$ 21,000
		12	15	634	$ 337,000
South Tekoppel	**Upsize sewer (in)**	36	36	612	$ 617,000
Grand Total				**18,738**	**$ 16,593,000**

B2 - Capital Cost Summary Tables for Condition Improvement Projects

NW Basin Condition Improvement Projects

Basin	NW

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Inflow Reduction					
F/C replacements	502	21			$ 90,000
Field Investigation	503		200		$ 96,000
Inlet Separation	504	6	250		$ 140,000
Manhole Rehabilitation					
Construct Benchwall	505	16			$ 16,000
F/C replacements	506	1			$ 4,000
Manhole Lining Rehabilitation	508	15			$ 164,000
Grout Joint/Void (Number of Repairs)	507	11			$ 5,000
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	509			2	$ 18,000
Sewer Main Rehabitilation					
CIPP	500		6,350		$ 711,000
Point Repair	501		40		$ 23,000
Grand Total		**70**	**6,840**	**2**	**$ 1,267,000**

SW Basin Condition Improvement Projects

Basin	SW

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Inflow Reduction					
F/C replacements	511	22			$ 90,000
Inlet Separation	512	16	3,000		$ 1,347,000
Manhole Rehabilitation					
Construct Benchwall	514	1			$ 1,000
F/C replacements	515	2			$ 11,000
Manhole Lining Rehabilitation	517	25			$ 273,000
Grout Joint/Void (Number of Repairs)	513	8			$ 4,000
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	519			2	$ 18,000
Sewer Main Rehabitilation					
CIPP	510		3,898		$ 536,000
Grand Total		**74**	**6,898**	**2**	**$ 2,280,000**

University Heights Basin Condition Improvement Projects

Basin	SW - University Heights

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Manhole Rehabilitation					
Construct Benchwall	576	1			$ 1,000
F/C replacements	516	6			$ 24,000
Manhole Lining Rehabilitation	518	5			$ 38,000
Reset F/C	516	1			$ 4,000
Grout Joint/Void (Number of Repairs)	577	1			$ -
Grand Total		**14**			**$ 67,000**

B3 – SSES Quantities

Northwest Basin—Sanitary Sewer Manhole Rehabilitation
Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Subbasin	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining*	Grout Joint/Void	Project ID
Northwest	W-13-1	14622A	---	---	---	---	1	507
Northwest	W-13-1	14610	---	---	---	1	---	508
Northwest	W-13-2	138991	---	---	---	---	1	507
Northwest	W-13-2	11487	---	---	---	---	1	507
Northwest	W-13-2	11489	---	---	---	---	1	507
Northwest	W-13-2	11488	---	---	---	---	1	507
Northwest	W-12-3	14677	---	---	---	1	---	508
Northwest	W-12-3	14674	---	---	---	1	---	508
Northwest	W-12-3	14671	---	---	---	1	---	508
Northwest	W-12-3	14670	---	---	---	1	---	508
Northwest	W-12-3	14675	---	---	---	---	2	507
Northwest	W-12-3	14676	---	---	---	1	---	508
Northwest	W-1-1	11205	---	---	---	1	---	508
Northwest	W-1-1	11202	---	---	---	---	2	507
Northwest	W-13-3	11537	---	---	---	1	---	508
Northwest	W-13-3	11558	---	---	1	---	---	506
Northwest	W-13-1	11540	---	---	---	1	---	508
Northwest	W-13-2	100042	---	---	---	1	---	508
Northwest		11403	1	---	---	1	---	505, 508
Northwest		11404	1	---	---	---	---	505
Northwest		11406	1	---	---	1	---	505, 508
Northwest		11409	1	---	---	---	---	505
Northwest		11410	1	---	---	---	---	505
Northwest		11411	1	---	---	---	---	505
Northwest		11412	1	---	---	---	---	505
Northwest		11433	1	---	---	---	---	505
Northwest		11438	1	---	---	1	---	505, 508
Northwest		11561	---	---	---	---	1	507
Northwest		11562	1	---	---	1	---	505, 508
Northwest		11596	1	---	---	---	---	505
Northwest		11602	1	---	---	---	---	505
Northwest		14567	1	---	---	---	---	505
Northwest		125649	---	---	---	1	---	508
Northwest		127989	1	---	---	---	1	505, 507
Northwest		128005	1	---	---	---	---	505
Northwest		128216	1	---	---	---	---	505
		TOTAL	**16**	**0**	**1**	**15**	**11**	

Note:

*Assumes an average depth of 10 VLF per manhole

[b]Measured depth of manhole used for University Heights lining quantities

Segment Identification			Summary Statistics						Segment Recommendations		
Basin	Subbasin	Pipe Facility ID	Diameter (in.)	Material	Length (ft)	Average Depth (ft)	Visible Infiltration Rate (gpd)	Number of Lateral Reconnections	Priority	Action	Project Number
Northwest	W-13-3	13367	8	VCP	190	7.4	---	4	2	CIPP	500
Northwest	W-13-3	13374	8	VCP	300	7.3	---	5	2	CIPP	500
Northwest	W-13-3	13386	8	VCP	290	8.3	---	0	2	CIPP	500
Northwest	W-13-3	13387	8	VCP	145	12.8	60	3	3	Point Repair	501
Northwest	W-13-3	13388	8	VCP	196	11.9	2	0	2	CIPP	500
Northwest	W-13-3	13709	10	VCP	240	7.1	---	4	3	CIPP	500
Northwest	W-13-3	13730	8	VCP	127	3.3	---	1	2	CIPP	500
Northwest	W-13-3	13734	8	VCP	150	7.3	2	0	3	CIPP	500
Northwest	W-13-3	13736	8	VCP	131	3.3	---	0	2	Point Repair	501
Northwest	W-13-3	13741	8	VCP	141	6.2	---	1	3	CIPP	500
Northwest	W-13-3	13743	8	VCP	390	4.8	---	6	3	CIPP	500
Northwest	W-13-3	13748	8	VCP	382	4.7	---	7	2	CIPP	500
Northwest	W-13-3	13753	8	VCP	341	4.9	90	11	3	CIPP	500
Northwest	W-13-3	13756	8	VCP	532	3.7	---	1	3	CIPP	500
Northwest	W-13-3	13756	8	VCP	532	3.7	---	0	3	Point Repair	501
Northwest	W-13-3	13757	8	VCP	217	3.1	1	1	3	CIPP	500
Northwest	W-13-3	13758	8	VCP	286	4.2	123	6	3	CIPP	500
Northwest	W-13-3	13759	8	Truss	156	3.7	60	1	2	CIPP	500
Northwest	W-13-3	13761	8	Truss	55	3.9	60	0	2	CIPP	500
Northwest	W-13-3	13763	8	VCP	32	6.5		12	3	CIPP	500
Northwest	W-13-3	13775	8	VCP	169	5.9	31	3	2	CIPP	500
Northwest	W-13-3	13936	8	VCP	225	4.8	30	4	2	CIPP	500
Northwest	W-13-3	13939	8	VCP	350	5.7	---	0	2	CIPP	500
Northwest	W-13-3	13939	8	VCP	350	5.7	---	1	3	CIPP	500
Northwest	W-13-3	15638	12	VCP	141	6	---	3	2	CIPP	500
Northwest	W-13-3	22827	8	VCP	225	7.6	120	3	3	CIPP	500
Northwest	W-13-3	23782	8	VCP	379	5	---	11	2	CIPP	500
Northwest	W-13-3	23787	8	VCP	N/A	7	2	0	2	CIPP	500
Northwest	W-13-3	23787A	8	VCP	N/A	3.1	---	0	2	CIPP	500
Northwest	W-13-3	23787B	8	VCP	N/A	3.3	2	1	2	CIPP	500
Northwest	W-13-3	23787B	8	VCP	N/A	3.3	---	3	2	CIPP	500
Northwest	W-13-3	23792	8	VCP	N/A	3.3	---	0	3	CIPP	500
Northwest	W-13-3	26124	8	VCP	486	4.5	---	0	3	Point Repair	501
Northwest	W-13-3	26124	8	VCP	486	4.5	---	1	3	CIPP	500

Table A- Northwest Basin Inflow Reduction

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Northwest	Inlet	4407 Wolcott St	13372	---	448,000	504
Northwest	Inlet	1601 Western Hills Dr	13762	---	448000	504
Northwest	Inlet	1600 Western Hills Dr	13763	---	448,000	504
Northwest	Inlet	1400 Western Hills Dr	13743	---	448000	504
Northwest	Inlet	1501 Western Hills Dr	13938	---	448,000	504
Northwest	Manhole	---	---	11562	15609.6	502
Northwest	Manhole	---	---	11602	82,944	502
Northwest	Manhole	---	---	127990	13824	502
Northwest	Manhole	---	---	128005	152,064	502
Northwest	Manhole	---	---	100038	27734.4	502
Northwest	Manhole	---	---	127989	27,734	502
Northwest	Manhole	---	---	11404	13824	502
Northwest	Manhole	---	---	11411	13,824	502
Northwest	Manhole	---	---	125649	110592	502
Northwest	Manhole	---	---	128004	27,734	502
Northwest	Manhole	---	---	11549	6912	502
Northwest	Manhole	---	---	11561	15,610	502
Northwest	Manhole	---	---	11582	6912	502
Northwest	Manhole	---	---	11556	15,610	502
Northwest	Manhole	---	---	11410	1728	502
Northwest	Manhole	---	---	11557	15,610	502
Northwest	Manhole	---	---	11579	6912	502
Northwest	Manhole	---	---	11580	15,610	502
Northwest	Manhole	---	---	100037	15609.6	502
Northwest	Manhole	---	---	127994	13,824	502
Northwest	Manhole	---	---	128006	41472	502

Table A- Northwest Basin Inflow Reduction (Inlet Disconnect Projects)

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Subbasin	Number of Inlets*	Number of Manholes	12" Storm Sewer (LF)	Project Number
Northwest	W-13-3	5	5	250	504
Northwest**		**2**		**200**	**502**

Note:

*Quantities do not include private inlet relocations

** Segment requires further investigation to determine connectivity

Table A- Northwest Basin Private I&I Removal

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Northwest	Downspout	605 Vanness Ave	13378	---	5,000	N/A
Northwest	Downspout	3208 Western Hills	13735	---	5000	N/A
Northwest	Downspout	1401 Terrace Ave	13756	---	5,000	N/A
Northwest	Downspout	3916 Western Ave	13769	---	5000	N/A
Northwest	Downspout	4212 Western Ave	22827	---	5,000	N/A
Northwest	Downspout	4301 Upper Mt. Vernon Rd	23190	---	5000	N/A
Northwest	Inlet	900 Helfrich Ave	23190	---	5,000	N/A

Note:

*Private I&I Removal Projects were not included in Cost Estiamte and were not assigned Project Numbers

Basin	Subbasin	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining*	Grout Joint/Void	Project ID
Southwest	W-12-5	126259A	---	---	---	1	---	517
Southwest	W-12-4	14888	---	---	---	1	---	517
Southwest	W-12-4	14880	---	---	---	1	---	517
Southwest	W-12-4	14875	---	---	---	1	---	517
Southwest	W-12-4	14870	---	---	---	1	---	517
Southwest	W-12-4	14911	---	---	---	1	---	517
Southwest	W-12-4	14909	---	---	---	---	2	513
Southwest	W-12-4	14910	---	---	---	---	1	513
Southwest	W-12-4	14871	---	---	---	1	---	517
Southwest	W-12-5	126074	---	---	---	1	---	517
Southwest	W-12-5	15027	1	---	---	1	---	514, 517
Southwest	W-12-5	130005	---	---	---	1	---	517
Southwest	W-12-5	15022	---	---	---	1	---	517
Southwest	W-12-5	11303	---	---	---	1	---	517
Southwest	W-12-4	14919	---	---	---	1	---	517
Southwest	W-12-4	14668	---	---	---	1	---	517
Southwest	W-12-5	15033	---	---	---	---	2	513
Southwest	W-12-5	15030	---	---	---	1	---	517
Southwest	W-12-5	126259	---	---	---	1	---	517
Southwest	W-12-2	1483	---	---	---	1	---	517
Southwest		1469	---	---	---	---	1	513
Southwest		1470	---	---	---	1	---	517
Southwest		1473	---	---	---	---	1	513
Southwest		1474	---	---	---	1	---	517
Southwest		1475	---	---	---	1	---	517
Southwest		1482	---	---	1	1	---	515, 517
Southwest		1484	---	---	---	1	---	517
Southwest		1492	---	---	---	1	---	517
Southwest		1496	---	---	---	1	---	517
Southwest		100628	---	---	---	---	1	513
Southwest		100803	---	---	---	1	---	517
Southwest		100806	---	---	1	---	---	515
Southwest[b]	University Heights	15057	1	---	1	9	---	516, 518, 576
Southwest	University Heights	126175	---	---	1	---	1	516, 577
Southwest[b]	University Heights	126184	---	1	---	6	---	516, 518
Southwest[b]	University Heights	126186	---	---	1	5	---	516, 518
Southwest[b]	University Heights	126187	---	---	1	6	---	516, 518
Southwest[b]	University Heights	126188	---	---	1	5	---	516, 518
Southwest	University Heights	126198	---	---	1	---	---	516
		TOTAL	**2**	**1**	**8**	**56**	**9**	

Note:

*Assumes an average depth of 10 VLF per manhole

[b]Measured depth of manhole used for University Heights lining quantities

Segment Identification			Summary Statistics						Segment Recommendations		
Basin	Subbasin	Pipe Facility ID	Diameter (in.)	Material	Length (ft)	Average Depth (ft)	Visible Infiltration Rate (gpd)	Number of Lateral Reconnections	Priority	Action	Project Number
Southwest	W-12-1	13457	8	VCP	350	4.2	---	0	3	CIPP	510
Southwest	W-12-1	13475	8	VCP	326	5.4	---	5	3	CIPP	510
Southwest	W-12-1	14069	8	VCP	387	6.3	30	4	2	CIPP	510
Southwest	W-12-1	14071	8	VCP	286	12	---	2	2	CIPP	510
Southwest	W-12-1	14074	8	VCP	286	8.6	30	2	2	CIPP	510
Southwest	W-12-1	14081	8	VCP	734	11.8	181	2	2	CIPP	510
Southwest	W-12-1	14085	10	VCP	185	8.7	---	0	2	CIPP	510
Southwest	W-12-1	14093	8	VCP	394	5.3	---	3	2	CIPP	510
Southwest	W-12-1	15663	15	RCP	365	14.6	121	0	2	CIPP	510
Southwest	W-12-1	15665	15	RCP	585	12.6	251	0	3	CIPP	510

Table B- Southwest Basin Inflow Reduction

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Southwest	Inlet	1824 S Bosse Ave	13463	---	64000	512
Southwest	Inlet	1825 S Bosse Ave	13463	---	64,000	512
Southwest	Inlet	1810 S Bosse Ave	13475	---	64000	512
Southwest	Inlet	1701 S Red Bank Rd	13457	---	46,000	512
Southwest	Inlet	1725 S Red Bank Rd	14093	---	46000	512
Southwest	Inlet	1627 S Helfrich Ave	Unknown	---	13,000	512
Southwest	Manhole	---	---	100809	13824	511
Southwest	Manhole	---	---	1472	13,824	511
Southwest	Manhole	---	---	1482	55468.8	511
Southwest	Manhole	---	---	1496	1,728	511
Southwest	Manhole	---	---	100803	3456	511
Southwest	Manhole	---	---	1473	3,456	511
Southwest	Manhole	---	---	1476	13824	511
Southwest	Manhole	---	---	1486	3,456	511
Southwest	Manhole	---	---	100808	13881.6	511
Southwest	Manhole	---	---	15444	13,824	511
Southwest	Manhole	---	---	100807	13824	511
Southwest	Manhole	---	---	1481	13,824	511
Southwest	Manhole	---	---	15446	27734.4	511
Southwest	Manhole	---	---	100633	13,882	511
Southwest	Manhole	---	---	100634	13881.6	511
Southwest	Manhole	---	---	100640	13,882	511
Southwest	Manhole	---	---	100642	13824	511
Southwest	Manhole	---	---	100805	13,824	511
Southwest	Manhole	---	---	100806	13824	511
Southwest	Manhole	---	---	100811	3,456	511
Southwest	Manhole	---	---	124431	27734.4	511
Southwest	Manhole	---	---	125670	31,219	511

Southwest Basin—Inflow Reduction (Inlet Disconnect Projects)

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Subbasin	Number of Inlets*	Number of Manholes	12" Storm Sewer (LF)	Project Numbers
Southwest	W-12-1	6	10	3000	512

Note:
*Quantities do not include private inlet relocations

Table A- Private I&I Removal

Evansville, IN – Sanitary Sewers Remedial Measures Plan

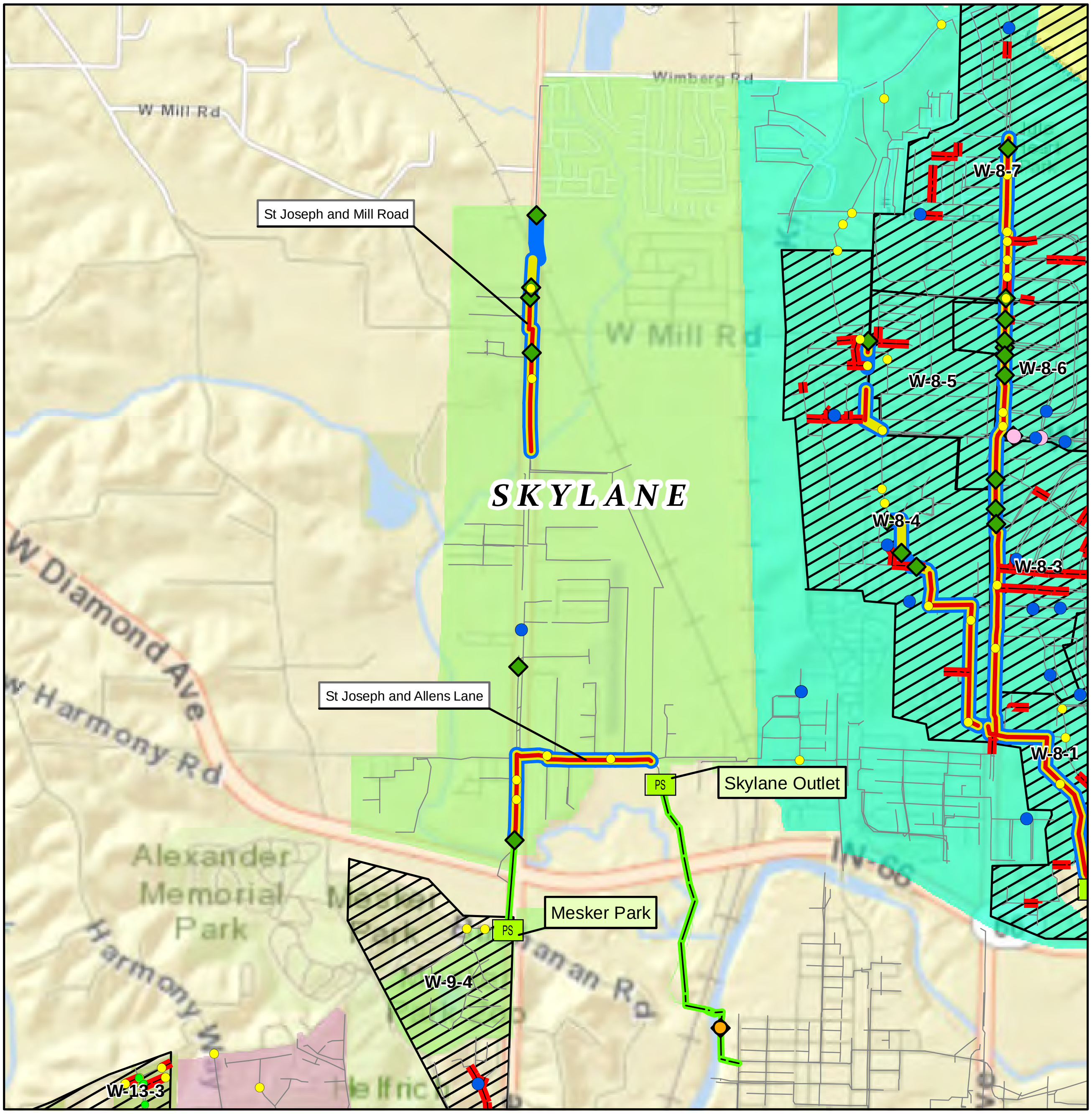
Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Southwest	Downspout	1709 Rollett Ln	14096	---	3000	

APPENDIX C

Allen’s Lane (Skylane North) Basin

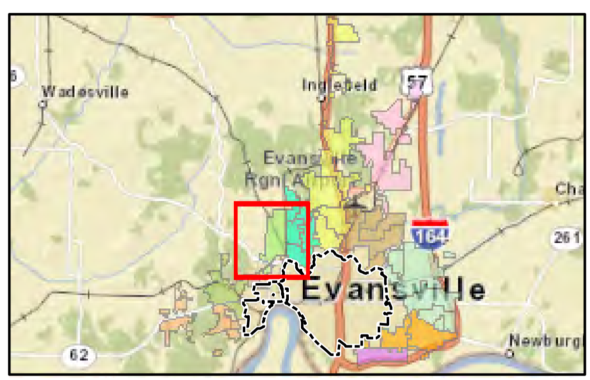
This appendix includes supporting data used to develop the capital costs for capacity and condition improvement projects identified in the Allen’s Lane (Skylane North) Basin. Data is organized in following manner:

Section	Title	Description
Capacity Improvement Projects		
C1	Capital cost summary tables	These tables include project names, descriptions, and summaries of quantities for each storm event, for existing and future flows.
Condition Improvement Projects		
C2	Capital cost summary tables	These tables include project names, descriptions, project IDs, and summaries of quantities.
C3	SSES Quantities	These tables summarize results of field investigations conducted during the SSES



LEGEND

- Inflow Reduction Projects
- Manhole Rehabilitation Projects
- Manhole Seal
- Recurring Wet-Weather SSOs in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- Added Storage Basin
- PS Added Pumping Capacity
- Forcemain Improvement
- Sewer Main Rehabilitation
- Added Pipe Capacity (2-Year 24-Hour)
- Added Pipe Capacity (5-Year 24-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

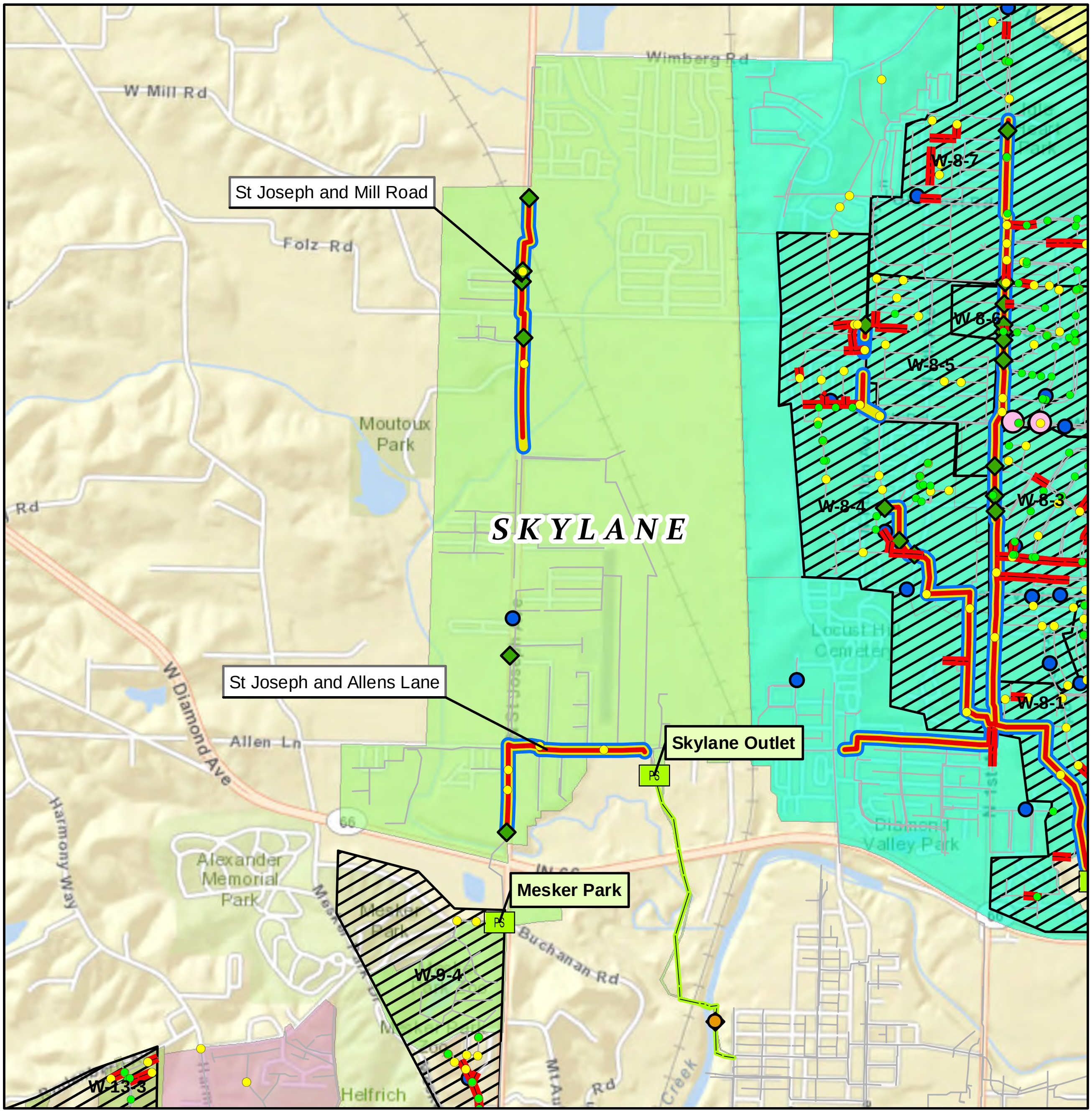


0 1,000 2,000
Feet

FIGURE C-1

Skylane Basin, Proposed Capacity Projects for All Storms, 2012 Flows

Sanitary Sewer Remedial Measures Plan, May 2013



Recurring Wet-Weather SSO in SAR 2012-2
Modeled SSO
Location Included in 2010 List of Potential SSOs
Inflow Reduction Projects
Manhole Rehabilitation Projects
Sewer Main Rehabilitation
Manhole Seal
Added Storage Basin
PS Added Pumping Capacity
Forcemain Improvements
Added Pipe Capacity (2-Year 24-Hour)
Added Pipe Capacity (5-Year 24-Hour)
Added Pipe Capacity (10-Year 24-Hour)
Sewer Main
Priority Subbasin

N
0 1,000 2,000
Feet

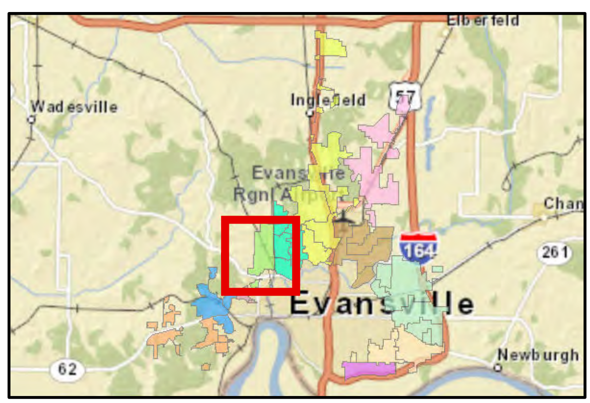


FIGURE C-2
Skylane Basin, Proposed Capacity Projects for All Storms, 2032 Flows
Sanitary Sewer Remedial Measures Plan, May 2013

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APPENDIX C

Allen’s Lane (Skylane North) Basin

C1 - Capital Cost Summary Tables for Capacity Improvement Projects

Allen's Lane (Skylane North) Basin Capacity Improvement Projects, 2012 Flows

Basin	Allen's Lane North (Skylane)
Storm	2 year - 24 Hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
Mesker Park	**Additional Pumping Capacity (MGD)**	(blank)	0.82		$ 964,000
St. Joseph & Allens Lane Pump Station	**New Pump Station (MGD)**	(blank)	5.31		$ 1,874,000
	New Force Main (in)	(blank)	18	5,667	$ 3,488,000
St. Joseph & Allens Lane Sewers	**Relief Sewer (in)**	8	12	1,334	$ 667,000
		12	18	2,072	$ 1,482,000
		15	18	62	$ 48,000
St. Joseph & Mill Road	**Relief Sewer (in)**	12	15	2,601	$ 1,270,000
Grand Total				**11,737**	**$ 9,793,000**

Basin	Allen's Lane North (Skylane)
Storm	5 year - 24 Hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
Mesker Park	**Additional Pumping Capacity (MGD)**	(blank)	0.86		$ 968,000
St. Joseph & Allens Lane Pump Station	**New Pump Station (MGD)**	(blank)	5.5		$ 1,898,000
	New Force Main (in)	(blank)	18	5,667	$ 3,488,000
St. Joseph & Allens Lane Sewers	**Relief Sewer (in)**	8	12	1,334	$ 667,000
		12	18	2,072	$ 1,482,000
		15	18	62	$ 48,000
St. Joseph & Mill Road	**Relief Sewer (in)**	12	15	1,091	$ 530,000
			18	1,951	$ 1,004,000
Grand Total				**12,177**	**$ 10,085,000**

Basin	Allen's Lane North (Skylane)
Storm	10 year - 24 hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
Mesker Park	**Additional Pumping Capacity (MGD)**	(blank)	0.97		$ 975,000
St. Joseph & Allens Lane Pump Station	**New Pump Station (MGD)**	(blank)	6.21		$ 1,988,000
	New Force Main (in)	(blank)	18	5,667	$ 3,488,000
St. Joseph & Allens Lane Sewers	**Relief Sewer (in)**	8	18	1,334	$ 720,000
		12	18	2,072	$ 1,482,000
		15	18	62	$ 48,000
St. Joseph & Mill Road	**Relief Sewer (in)**	12	15	1,865	$ 922,000
			18	1,951	$ 1,004,000
Grand Total				**12,951**	**$ 10,627,000**

Allen's Lane (Skylane North) Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	Skylane
Storm	2y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Locust Creek	**MH Adjustment - seal MH**	(blank)	-	0	$ 4,000
	Upsize sewer (in)	(blank)	24	517	$ 286,000
Mesker Park	**Upsize PS (mgd)**	0.71	0.8249	0	$ 964,000
St. Joe and Allens Lane PS	**New PS (mgd)**	0	5.307	0	$ 1,874,000
	New force main (in)	0	18	5,667	$ 6,092,000
St. Joe and Allens Lane	**Upsize sewer (in)**	8	12	1,334	$ 667,000
		12	18	2,072	$ 1,418,000
		15	18	62	$ 48,000
St. Joe and Mill Rd	**Upsize sewer (in)**	12	15	3,816	$ 1,826,000
Grand Total				**13,468**	**$ 13,179,000**

Basin	Skylane
Storm	5y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Locust Creek	**MH Adjustment - seal MH**	(blank)	-	0	$ 4,000
	Upsize sewer (in)	(blank)	24	517	$ 286,000
Mesker Park	**Upsize PS (mgd)**	0.71	0.8613	0	$ 968,000
St. Joe and Allens Lane PS	**New PS (mgd)**	0	5.499	0	$ 1,898,000
	New force main (in)	0	18	5,667	$ 6,092,000
St. Joe and Allens Lane	**Upsize sewer (in)**	8	12	1,334	$ 667,000
		12	18	2,072	$ 1,418,000
		15	18	62	$ 48,000
St. Joe and Mill Rd	**Upsize sewer (in)**	12	15	2,245	$ 1,081,000
			18	1,721	$ 915,000
Grand Total				**13,619**	**$ 13,377,000**

Basin	Skylane
Storm	10y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Locust Creek	**MH Adjustment - seal MH**	(blank)	-	0	$ 4,000
	Upsize sewer (in)	(blank)	24	517	$ 286,000
Mesker Park	**Upsize PS (mgd)**	0.71	0.9746	0	$ 975,000
St. Joe and Allens Lane PS	**New PS (mgd)**	0	6.213	0	$ 1,988,000
	New force main (in)	0	18	5,667	$ 6,092,000
St. Joe and Allens Lane	**Upsize sewer (in)**	8	18	1,334	$ 720,000
		12	18	2,072	$ 1,418,000
		15	18	62	$ 48,000
St. Joe and Mill Rd	**Upsize sewer (in)**	12	15	2,245	$ 1,081,000
			18	1,721	$ 915,000
Grand Total				**13,619**	**$ 13,527,000**

C2 - Capital Cost Summary Tables for Condition Improvement Projects

Allen's Lane Basin Condition Improvement Projects

Basin	Allen's Lane / Skylane North

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Inflow Reduction					
F/C replacements	522	5			$ 20,000
Manhole Rehabilitation					
Construct Benchwall	523	8			$ 8,000
F/C replacements	524	2			$ 8,000
Manhole Lining Rehabilitation	526	8			$ 88,000
Grout Joint/Void (Number of Repairs)	525	1			$ -
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	527			1	$ 9,000
Sewer Main Rehabitilation					
CIPP	520		1,172		$ 120,000
Point Repair	521		10		$ 7,000
Grand Total		**24**	**1,182**	**1**	**$ 260,000**

C3 – SSES Quantities

Basin	Subbasin	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining*	Grout Joint/Void	Project ID
Allen's Lane North (Skylane)	W-9-3	4826	---	---	---	1	---	526
Allen's Lane North (Skylane)	W-9-2	4751	---	---	---	1	---	526
Allen's Lane North (Skylane)	W-9-2	38505	---	---	---	1	---	526
Allen's Lane North (Skylane)	W-9-2	38543	---	---	---	---	1	525
Allen's Lane North (Skylane)	W-9-3	4839	---	---	---	1	---	526
Allen's Lane North (Skylane)	W-9-4	4744	---	---	---	1	---	526
Allen's Lane North (Skylane)	W-9-4	4745	---	---	---	1	---	526
Allen's Lane North (Skylane)		4747	---	---	1	---	---	524
Allen's Lane North (Skylane)		8153	1	---	---	---	---	523
Allen's Lane North (Skylane)		8154	1	---	---	1	---	523, 526
Allen's Lane North (Skylane)		8279	1	---	---	---	---	523
Allen's Lane North (Skylane)		8281	1	---	---	1	---	523, 526
Allen's Lane North (Skylane)		8283	1	---	---	---	---	523
Allen's Lane North (Skylane)		8285	1	---	---	---	---	523
Allen's Lane North (Skylane)		8287	1	---	1	---	---	523, 524
Allen's Lane North (Skylane)		99124	1	---	---	---	---	523
		TOTAL	**8**	**0**	**2**	**8**	**1**	

Note:

*Assumes an average depth of 10 VLF per manhole

[b]Measured depth of manhole used for University Heights lining quantities

Allen's Lane North (Skylane)—Sanitary Sewer Main Rehabilitation

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Segment Identification			Summary Statistics						Segment Recommendations		
Basin	Subbasin	Pipe Facility ID	Diameter (in.)	Material	Length (ft)	Average Depth (ft)	Visible Infiltration Rate (gpd)	Number of Lateral Reconnections	Priority	Action	Project Number
Allen's Lane North (Skylane)	W-9-4	6455	8	VCP	235	10.3	---	3	3	CIPP	520
Allen's Lane North (Skylane)	W-9-4	12383	8	VCP	143	6.4	---	0	3	CIPP & Point Repair	520
Allen's Lane North (Skylane)	W-9-4	23080	10	VCP	128	8.7	32	4	2	CIPP	520
Allen's Lane North (Skylane)	W-9-4	23083	8	VCP	206	7.7	2	3	2	CIPP	520
Allen's Lane North (Skylane)	W-9-4	23084	8	VCP	158	5.3	33	0	2	CIPP	520
Allen's Lane North (Skylane)	W-9-4	23086	8	VCP	302	8.1	17	5	3	CIPP	520

Table G-1 West Service Area—Inflow Reduction per Basin

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Allen's Lane North (Skylane)	Manhole	---	---	8153	43,358	522
Allen's Lane North (Skylane)	Manhole	---	---	8285	13824	522
Allen's Lane North (Skylane)	Manhole	---	---	8154	41,472	522
Allen's Lane North (Skylane)	Manhole	---	---	8152	41472	522
Allen's Lane North (Skylane)	Manhole	---	---	8283	41,472	522

Table A- Private I&I Removal

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Allens Lane	Downspout	1700 Charlotte Ave	23083	---	6,000	
Allens Lane	Downspout	1704 Charlotte Ave	23083	---	6000	
Allens Lane	Downspout	1708 Russell Ave	23085	---	6,000	

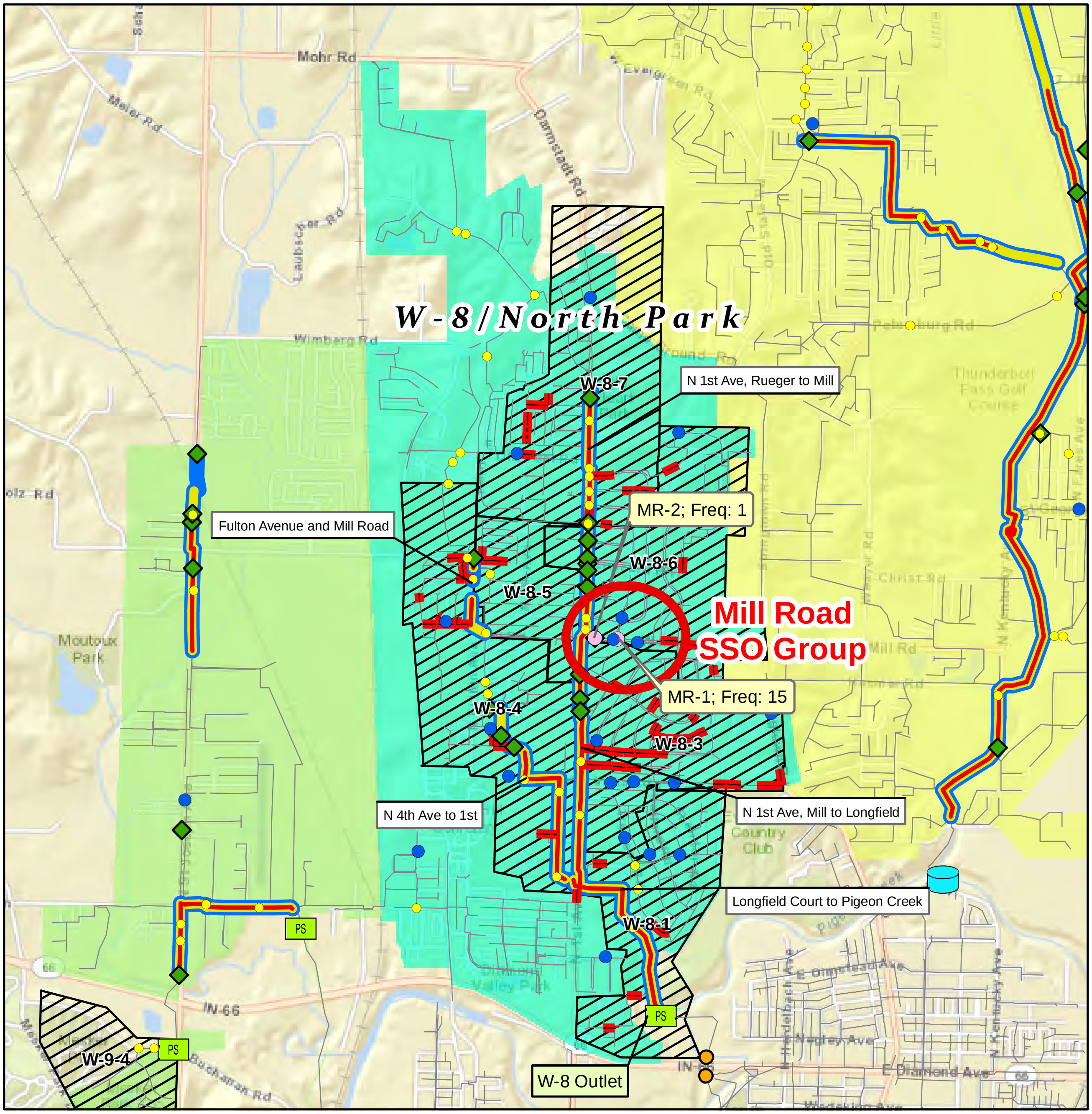
Private I&I Removal Projects were not included in Cost Estiamte and were not assigned Project Numbers

APPENDIX D

W-8 (North Park) Basin

This appendix includes supporting data used to develop the capital costs for capacity and condition improvement projects identified in the W-8 (North Park) Basin. Data is organized in following manner:

Section	Title	Description
Capacity Improvement Projects		
D1	Capital cost summary tables	These tables include project names, descriptions, and summaries of quantities.
Condition Improvement Projects		
D2	Capital cost summary tables	These tables include project names, descriptions, and summaries of quantities.
D3	SSES Quantities	These tables summarize results of field investigations conducted during the SSES



LEGEND

- Inflow Reduction Projects
- Manhole Rehabilitation Projects
- Manhole Seal
- Recurring Wet-Weather SSOs in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- Added Storage Basin
- Added Pumping Capacity
- Sewer Main Rehabilitation
- Added Pipe Capacity (2-Year 24-Hour)
- Added Pipe Capacity (5-Year 24-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

0 1,000 2,000
Feet

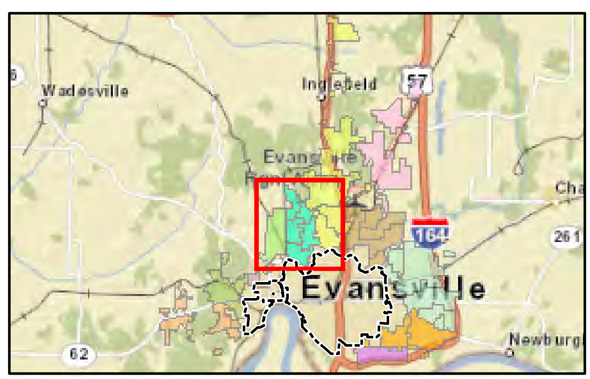
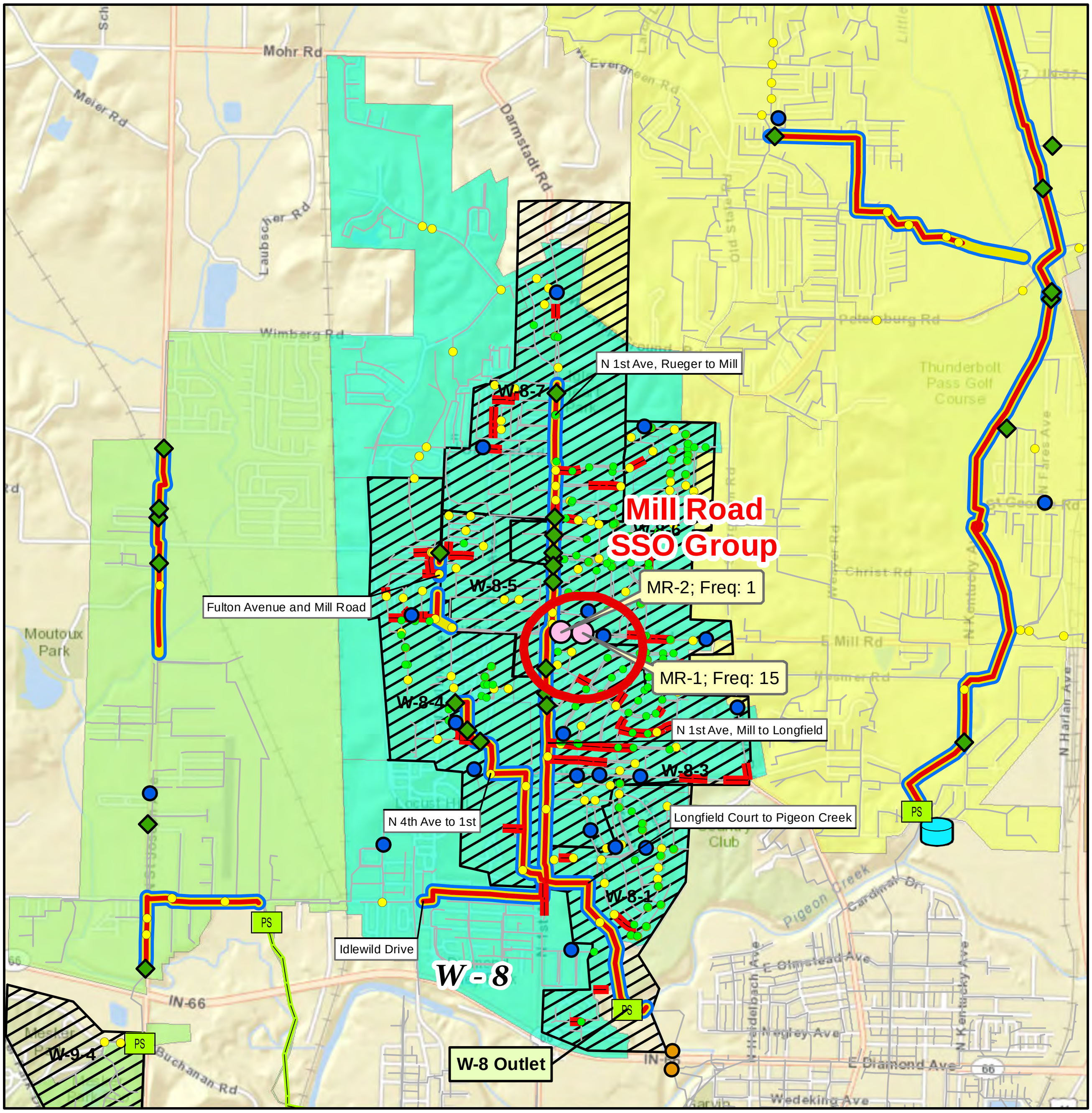


FIGURE D-1

W-8/North Park Basin, Proposed Capacity Projects for All Storms, 2012 Flows

Sanitary Sewer Remedial Measures Plan, May 2013



Recurring Wet-Weather SSO in SAR 2012-2

Modeled SSO

Location Included in 2010 List of Potential SSOs

Inflow Reduction Projects

Manhole Rehabilitation Projects

Sewer Main Rehabilitation

Manhole Seal

Added Storage Basin

Added Pumping Capacity

Forcemain Improvements

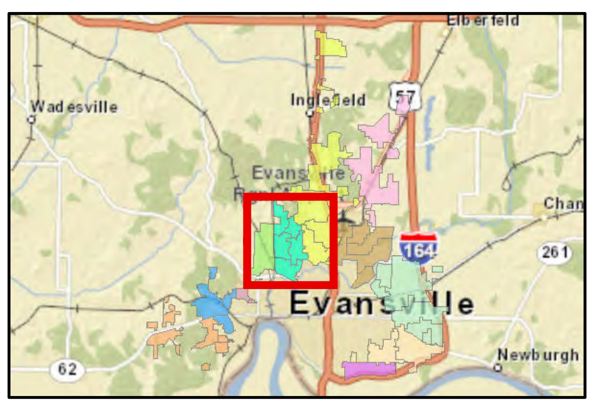
Added Pipe Capacity (2-Year 24-Hour)

Added Pipe Capacity (5-Year 24-Hour)

Added Pipe Capacity (10-Year 24-Hour)

Sewer Main

Priority Subbasin



N

0 1,000 2,000

Feet

FIGURE D-2

W-8/North Park Basin, Proposed Capacity Projects for All Storms, 2032 Flows

Sanitary Sewer Remedial Measures Plan, May 2013

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D1 - Capital Cost Summary Tables for Capacity Improvement Projects

North Park (W-8) Basin Capacity Improvement Projects, 2012 Flows

Basin	Northpark (W-8)
Storm	2 year - 24 Hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
1st & Mill to Longfield	**Relief Sewer (in)**	12	24	1,700	$ 996,000
		15	24	904	$ 614,000
			30	2,295	$ 2,096,000
Rueger to Mill	**Relief Sewer (in)**	8	18	390	$ 209,000
		10	18	980	$ 437,000
		12	18	2,023	$ 1,169,000
			24	1,092	$ 624,000
Fulton to Mill	**Relief Sewer (in)**	12	12	491	$ 176,000
		15	15	180	$ 69,000
Longfield to Pigeon Creek	**Relief Sewer (in)**	21	30	157	$ 129,000
		24	36	640	$ 615,000
		36	42	2,233	$ 3,205,000
	Manhole Adjustment (seal MH)	(blank)	(blank)		$ 8,000
North 1st to 4th Street	**Relief Sewer (in)**	15	18	3,540	$ 2,328,000
Northpark PS	**New Pump Station (MGD)**	(blank)	13.24		$ 3,499,000
Grand Total				**16,624**	**$ 16,174,000**

Basin	Northpark (W-8)
Storm	5 year - 24 Hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
1st & Mill to Longfield	**Relief Sewer (in)**	12	24	1,860	$ 905,000
		15	24	41	$ 30,000
			30	3,157	$ 2,738,000
		(blank)	36	157	$ 143,000
Rueger to Mill	**Relief Sewer (in)**	8	18	390	$ 209,000
		10	18	980	$ 437,000
		12	18	1,793	$ 1,070,000
			24	1,322	$ 763,000
Fulton to Mill	**Relief Sewer (in)**	8	15	300	$ 138,000
		12	12	491	$ 182,000
		15	15	180	$ 69,000
Longfield to Pigeon Creek	**Relief Sewer (in)**	21	30	157	$ 129,000
		24	42	640	$ 686,000
		36	42	2,233	$ 3,205,000
	Manhole Adjustment (seal MH)	(blank)	(blank)		$ 8,000
North 1st to 4th Street	**Relief Sewer (in)**	15	18	3,748	$ 2,488,000
Northpark PS	**New Pump Station (MGD)**	(blank)	15.52		$ 3,788,000
Grand Total				**17,449**	**$ 16,988,000**

North Park (W-8) Basin Capacity Improvement Projects, 2012 Flows

Basin	Northpark (W-8)
Storm	10 year - 24 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
1st & Mill to Longfield	**Relief Sewer (in)**	12	24	1,700	$ 996,000
		15	24	41	$ 30,000
			30	3,157	$ 2,738,000
		(blank)	36	157	$ 143,000
Rueger to Mill	**Relief Sewer (in)**	8	18	390	$ 209,000
		10	18	980	$ 437,000
		12	18	1,793	$ 1,070,000
			24	1,322	$ 763,000
Fulton to Mill	**Relief Sewer (in)**	12	12	491	$ 182,000
		15	15	691	$ 296,000
Longfield to Pigeon Creek	**Relief Sewer (in)**	21	30	157	$ 129,000
		24	36	640	$ 615,000
		36	42	2,233	$ 3,205,000
	Manhole Adjustment (seal MH)	(blank)	(blank)		$ 8,000
North 1st to 4th Street	**Relief Sewer (in)**	15	24	4,559	$ 2,912,000
Northpark PS	**New Pump Station (MGD)**	(blank)	17.7		$ 4,064,000
Grand Total				**18,311**	**$ 17,797,000**

North Park (W-8) Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	North Park - W8
Storm	2y24h

Project Name	Description	Existing Size		Proposed Size	Values: Sum of Pipe Length (ft)	Sum of Capital Cost	
1st and Mill Road to Longfield	**Upsize sewer (in)**		12	24	1,710	$	943,000
			15	24	904	$	530,000
				30	2,295	$	1,814,000
			21	30	157	$	110,000
			24	36	640	$	530,000
1st and Rueger to Mill Rd	**Upsize sewer (in)**		8	18	390	$	209,000
			10	18	980	$	422,000
			12	18	2,023	$	1,202,000
				24	1,082	$	610,000
Fulton and Mill Rd	**Upsize sewer (in)**		8	12	491	$	172,000
				15	180	$	69,000
Idlewild Drive	**Upsize sewer (in)**		15	18	2,414	$	1,745,000
Longfiield to Pigeon Creek	**MH Adjustment - seal MH**	(blank)	-		0	$	10,000
	Upsize sewer (in)		36	36	173	$	119,000
				42	2,537	$	3,365,000
North 4th to 1st	**Upsize sewer (in)**		15	18	4,833	$	2,966,000
Northpark PS	**New PS (mgd)**		0	13.24	0	$	3,498,000
Grand Total					**20,808**	**$**	**18,314,000**

Basin	North Park - W8
Storm	5y24h

Project Name	Description	Existing Size		Proposed Size	Values: Sum of Pipe Length (ft)	Sum of Capital Cost	
1st and Mill Road to Longfield	**Upsize sewer (in)**		12	24	1,710	$	943,000
			15	24	41	$	26,000
				30	3,157	$	2,368,000
			21	30	157	$	110,000
			24	42	640	$	592,000
1st and Rueger to Mill Rd	**Upsize sewer (in)**		8	18	390	$	209,000
			10	18	980	$	422,000
			12	18	1,793	$	1,070,000
				24	1,312	$	749,000
Fulton and Mill Rd	**Upsize sewer (in)**		8	12	491	$	177,000
				15	671	$	248,000
Idlewild Drive	**Upsize sewer (in)**		15	18	2,684	$	1,900,000
Longfiield to Pigeon Creek	**MH Adjustment - seal MH**	(blank)	-		0	$	10,000
	Upsize sewer (in)		36	36	173	$	119,000
				42	2,537	$	3,365,000
North 4th to 1st	**Upsize sewer (in)**		15	18	4,833	$	2,966,000
Northpark PS	**New PS (mgd)**		0	15.52	0	$	3,788,000
Grand Total					**21,569**	**$**	**19,062,000**

North Park (W-8) Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	North Park - W8
Storm	10y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
1st and Mill Road to Longfield	**Upsize sewer (in)**	12	24	1,710	$ 943,000
		15	24	41	$ 26,000
			30	3,157	$ 2,368,000
		21	36	157	$ 124,000
		24	42	640	$ 592,000
1st and Rueger to Mill Rd	**Upsize sewer (in)**	8	18	390	$ 209,000
		10	18	980	$ 422,000
		12	18	1,793	$ 1,070,000
			24	1,312	$ 749,000
Fulton and Mill Rd	**Upsize sewer (in)**	8	12	491	$ 177,000
			15	681	$ 257,000
		12	15	201	$ 81,000
Idlewild Drive	**Upsize sewer (in)**	15	18	2,684	$ 1,900,000
Longfiield to Pigeon Creek	**MH Adjustment - seal MH**	(blank)	-	0	$ 10,000
	Upsize sewer (in)	36	36	173	$ 119,000
			42	2,537	$ 3,365,000
North 4th to 1st	**Upsize sewer (in)**	15	24	4,833	$ 3,136,000
Northpark PS	**New PS (mgd)**	0	17.7	0	$ 4,064,000
Grand Total				**21,780**	**$ 19,612,000**

D2 - Capital Cost Summary Tables for Condition Improvement Projects

W-8 Basin Condition Improvement Projects

Basin	North Park (W-8)

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Inflow Reduction					
F/C replacements	530	110			$ 451,000
Inlet Separation	531	21	2,100		$ 677,000
Manhole Rehabilitation					
Construct Benchwall	532	76			$ 77,000
F/C replacements	533	12			$ 49,000
Manhole Lining Rehabilitation	535	71			$ 777,000
Grout Joint/Void (Number of Repairs)	534	9			$ 4,000
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	536			4	$ 37,000
Sewer Main Rehabitilation					
CIPP	528		19,210		$ 2,147,000
Point Repair	529		60		$ 28,000
Grand Total		**299**	**21,370**	**4**	**$ 4,247,000**

D3 – SSES Quantities

Basin	Subbasin	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining*	Grout Joint/Void	Project ID
W-8 (North Park)	W-8-1	8963	---	---	---	---	---	
W-8 (North Park)	W-8-4	9357	---	---	---	1	---	539
W-8 (North Park)	W-8-1	8961	---	---	---	1	---	539
W-8 (North Park)	W-8-2	9087	---	---	---	1	---	539
W-8 (North Park)	W-8-4	9294	1	---	---	1	---	536, 539
W-8 (North Park)	W-8-5	9286	---	---	---	1	---	539
W-8 (North Park)	W-8-8	10239	1	---	---	1	---	536, 539
W-8 (North Park)	W-8-8	10240	---	---	---	1	---	539
W-8 (North Park)	W-8-8	10637	---	---	---	1	---	539
W-8 (North Park)	W-8-4	9366	---	---	---	1	---	539
W-8 (North Park)	W-8-8	9372	---	---	---	---	---	
W-8 (North Park)	W-8-8	9371	---	---	---	1	---	539
W-8 (North Park)	W-8-8	10226	1	---	---	1	---	536, 539
W-8 (North Park)	W-8-6	3808	1	---	---	---	---	536
W-8 (North Park)	W-8-6	9166	1	---	---	1	---	536, 539
W-8 (North Park)	W-8-7	9229	---	---	---	1	---	539
W-8 (North Park)	W-8-7	9253	---	---	---	1	---	539
W-8 (North Park)	W-8-7	9260	1	---	---	---	---	536
W-8 (North Park)	W-8-7	9267	---	---	---	1	---	539
W-8 (North Park)	W-8-7	9225	1	---	---	1	---	536, 539
W-8 (North Park)	W-8-4	38307	---	---	---	1	---	539
W-8 (North Park)	W-8-4	3729	---	---	---	1	---	539
W-8 (North Park)	W-8-4	3727	---	---	---	1	---	539
W-8 (North Park)	W-8-4	8988	---	---	---	1	---	539
W-8 (North Park)	W-8-5	3800	---	---	---	1	---	539
W-8 (North Park)	W-8-3	3818	---	---	---	1	---	539
W-8 (North Park)	W-8-3	96919	---	---	---	---	1	538
W-8 (North Park)	W-8-4	8986	---	---	---	1	---	539
W-8 (North Park)	W-8-7	10666	---	---	---	1	---	539
W-8 (North Park)	W-8-1	9025	---	---	---	1	---	539
W-8 (North Park)		3525	---	---	---	1	---	539
W-8 (North Park)		3529	---	---	---	1	---	539
W-8 (North Park)		3536	1	---	---	1	---	536, 539
W-8 (North Park)		3746	---	---	---	1	---	539
W-8 (North Park)		3753	1	---	---	---	---	536
W-8 (North Park)		3764	---	---	---	1	---	539
W-8 (North Park)		3785	---	---	---	1	---	539
W-8 (North Park)		3786	1	---	---	---	---	536
W-8 (North Park)		3791	---	---	---	1	---	539
W-8 (North Park)		3824	---	---	1	1	---	537
W-8 (North Park)		4045	---	---	---	1	---	539
W-8 (North Park)		4051	1	---	---	---	---	536
W-8 (North Park)		4061	1	---	---	1	---	536, 539
W-8 (North Park)		4063	1	---	---	---	---	536
W-8 (North Park)		4064	1	---	---	---	---	536
W-8 (North Park)		4066	1	---	---	---	---	536
W-8 (North Park)		4067	---	---	1	---	---	537
W-8 (North Park)		4068	1	---	1	1	---	536, 537, 539
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W-8 (North Park)		4115	1	---	---	---	---	536
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W-8 (North Park)		4117	---	---	1	---	---	537
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W-8 (North Park)		4124	1	---	---	---	---	536
W-8 (North Park)		4125	1	---	---	---	---	536
W-8 (North Park)		4850	1	---	---	---	---	536
W-8 (North Park)		8951	1	---	---	---	---	536
W-8 (North Park)		8960	1	---	---	---	---	536
W-8 (North Park)		8968	1	---	---	1	---	536, 539
W-8 (North Park)		9002	---	---	1	---	---	537
W-8 (North Park)		9003	---	---	---	---	1	538
W-8 (North Park)		9005	---	---	---	---	1	538
W-8 (North Park)		9012	---	---	1	1	---	537, 539
W-8 (North Park)		9014	---	---	---	1	---	539
W-8 (North Park)		9031	1	---	---	---	---	536
W-8 (North Park)		9116	1	---	---	---	---	536
W-8 (North Park)		9118	1	---	---	---	---	536
W-8 (North Park)		9119	1	---	---	---	---	536
W-8 (North Park)		9182	1	---	---	---	---	536
W-8 (North Park)		9188	1	---	---	---	---	536

W-8 (North Park)		9199	1	---	---	1	---	536, 539
W-8 (North Park)		9201	1	---	---	---	---	536
W-8 (North Park)		9208	---	---	---	1	---	539
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W-8 (North Park)		9213	---	---	---	1	---	539
W-8 (North Park)		9223	---	---	---	1	---	539
W-8 (North Park)		9227	1	---	---	---	---	536
W-8 (North Park)		9228	1	---	---	1	---	536, 539
W-8 (North Park)		9230	---	---	---	1	---	539
W-8 (North Park)		9239	1	---	---	---	---	536
W-8 (North Park)		9241	---	---	---	1	---	539
W-8 (North Park)		9248	1	---	---	---	---	536
W-8 (North Park)		9252	---	---	---	1	---	539
W-8 (North Park)		9259	1	---	---	---	---	536
W-8 (North Park)		9273	1	---	---	---	---	536
W-8 (North Park)		9274	---	---	---	1	---	539
W-8 (North Park)		9300	---	---	---	1	---	539
W-8 (North Park)		9311	---	---	---	---	1	538
W-8 (North Park)		9312	---	---	---	1	---	539
W-8 (North Park)		9334	---	---	---	1	---	539
W-8 (North Park)		9341	---	---	---	1	---	539
W-8 (North Park)		9344	---	---	---	1	---	539
W-8 (North Park)		9358	---	---	---	1	---	539
W-8 (North Park)		9382	1	---	---	---	---	536
W-8 (North Park)		9383	---	---	---	1	---	539
W-8 (North Park)		9471	---	---	---	1	---	539
W-8 (North Park)		9474	1	---	---	---	---	536
W-8 (North Park)		9482	1	---	---	---	---	536
W-8 (North Park)		9483	1	---	---	---	---	536
W-8 (North Park)		9485	1	---	---	---	---	536
W-8 (North Park)		9497	1	---	---	---	---	536
W-8 (North Park)		9523	---	---	---	1	---	539
W-8 (North Park)		9524	1	---	---	---	---	536
W-8 (North Park)		9525	---	---	---	1	---	539
W-8 (North Park)		9530	1	---	---	---	---	536
W-8 (North Park)		9533	1	---	---	1	---	536, 539
W-8 (North Park)		9534	1	---	---	1	---	536, 539
W-8 (North Park)		9535	1	---	---	---	---	536
W-8 (North Park)		9536	1	---	---	1	---	536, 539
W-8 (North Park)		9537	1	---	---	---	---	536
W-8 (North Park)		9539	1	---	---	---	---	536
W-8 (North Park)		9540	1	---	---	---	---	536
W-8 (North Park)		9541	1	---	---	---	---	536
W-8 (North Park)		9542	1	---	---	---	---	536
W-8 (North Park)		9543	1	---	---	---	---	536
W-8 (North Park)		9544	1	---	---	---	---	536
W-8 (North Park)		9546	1	---	---	---	---	536
W-8 (North Park)		10623	1	---	---	---	---	536
W-8 (North Park)		10644	---	---	---	---	1	538
W-8 (North Park)		10645	---	---	---	---	1	538
W-8 (North Park)		10645	1	---	---	---	---	536
W-8 (North Park)		10650	---	---	---	1	---	539
W-8 (North Park)		10666	1	---	---	---	---	536
W-8 (North Park)		10699	---	---	---	1	---	539
W-8 (North Park)		10705	1	---	---	---	---	536
W-8 (North Park)		10709	1	---	---	---	---	536
W-8 (North Park)		14403	---	---	---	1	---	539
W-8 (North Park)		14411	---	---	1	---	---	537
W-8 (North Park)		14413	---	---	---	---	1	538
W-8 (North Park)		14414	---	---	---	---	1	538
W-8 (North Park)		14418	---	---	---	1	---	539
W-8 (North Park)		14419	---	---	---	---	1	538
W-8 (North Park)		96917	1	---	---	---	---	536
W-8 (North Park)		121182	---	---	---	1	---	539
W-8 (North Park)		121254	1	---	1	1	---	536, 537, 539
W-8 (North Park)		122226	1	---	---	---	---	536
W-8 (North Park)		122401	---	---	---	1	---	539
W-8 (North Park)		123402	1	---	---	---	---	536
W-8 (North Park)		123754	1	---	---	---	---	536
W-8 (North Park)		124546	1	---	---	---	---	536
W-8 (North Park)		124551	1	---	---	---	---	536
W-8 (North Park)		9131A	---	---	1	---	---	537
W-8 (North Park)		9276	---	---	1	---	---	537
		TOTAL	**76**	**0**	**12**	**71**	**9**	

Note:

[a]Assumes an average depth of 10 VLF per manhole

[b]Measured depth of manhole used for University Heights lining quantities

Segment Identification			Summary Statistics						Segment Recommendations		
Basin	Subbasin	Pipe Facility ID	Diameter (in.)	Material	Length (ft)	Average Depth (ft)	Visible Infiltration Rate (gpd)	Number of Lateral Reconnections	Priority	Action	Project Number
W-8	W-8-1	6502	10	Truss	281	8.5	---	0	2	CIPP	523
W-8	W-8-1	6514	8	Truss	193	11.1	---	4	2	CIPP	523
W-8	W-8-7	10067	8	VCP	585	9	30	3	3	CIPP	523
W-8	W-8-7	10067	8	VCP	585	9	---	4	3	CIPP	532
W-8	W-8-6	10719	8	VCP	485	5.1	---	4	2	CIPP	523
W-8	W-8-3	11128	8	CIPP	233	5.5	---	0	3	Point Repair	523
W-8	W-8-3	11415	8	PVC/VCP	341	6.8	---	5	3	CIPP	523
W-8	W-8-4	11436	8	VCP	39	7.1	---	0	3	Point Repair	523
W-8	W-8-2	11437	8	CIPP	567	9.95	60	1	2	Point Repair	523
W-8	W-8-1	11438	8	Truss	273	3.8	---	1	2	CIPP	523
W-8	W-8-4	11463	8	Truss	396	10.85	---	0	2	CIPP	523
W-8	W-8-4	11516	8	VCP	290	6.3	---	3	2	CIPP	523
W-8	W-8-4	11519	8	VCP	221	3.8	---	0	3	CIPP	523
W-8	W-8-4	11519	8	VCP	221	3.8	---	1	3	CIPP	523
W-8	W-8-3	11542	8	VCP	414	7.6	---	10	3	CIPP	523
W-8	W-8-3	11543	10	VCP	233	6	---	4	2	CIPP	523
W-8	W-8-3	11543	10	VCP	233	6	---	0	2	CIPP	523
W-8	W-8-3	11544	10	VCP	311	6.8	---	6	3	CIPP	523
W-8	W-8-3	11546	10	VCP	315	6	---	6	2	CIPP	523
W-8	W-8-3	11547	10	VCP	201	6.1	---	4	3	CIPP	523
W-8	W-8-3	11554	8	VCP	212	6.5	---	5	3	CIPP	523
W-8	W-8-3	11555	8	VCP	162	6.7	---	2	3	CIPP	523
W-8	W-8-3	11555	8	VCP	162	6.7	---	1	3	CIPP	523
W-8	W-8-3	11557	8	VCP	223	6	---	6	2	CIPP	523
W-8	W-8-3	11580	8	VCP	198	5.6	---	6	3	CIPP	523
W-8	W-8-3	11581	8	VCP	155	5.6	---	6	2	CIPP	523
W-8	W-8-3	11583	8	VCP	228	6.6	---	5	3	CIPP	523
W-8	W-8-3	11583	8	VCP	228	6.6	---	0	3	CIPP	523
W-8	W-8-3	11586	8	VCP	252	7.2	---	9	2	CIPP	523
W-8	W-8-3	11589	8	VCP	242	5.9	---	5	3	Point Repair	523
W-8	W-8-3	11601	8	VCP	179	5.6	---	6	2	CIPP	523
W-8	W-8-6	11605	8	VCP	145	5.7	1	10	2	CIPP	523
W-8	W-8-3	11621	8	VCP	341	---	60	11	3	CIPP	523
W-8	W-8-3	11633	10	VCP	252	---	---	0	3	CIPP	523
W-8	W-8-6	11695	8	VCP	252	4.1	---	8	2	CIPP	523
W-8	W-8-6	11696	10	VCP	350	6	1	8	2	CIPP	523
W-8	W-8-7	11718	8	VCP	205	8.7	30	15	3	CIPP	523
W-8	W-8-6	11741A	8	VCP	377	5.6	2	7	3	CIPP	523
W-8	W-8-6	11861	8	VCP	134	8.7	---	11	2	CIPP	523
W-8	W-8-4	11871	8	VCP	260	4.6	---	3	2	CIPP	523
W-8	W-8-4	11872	8	VCP	151	4.4	90	1	3	CIPP	523
W-8	W-8-4	11873	8	VCP	148	6.2	1	0	2	CIPP	523
W-8	W-8-4	11876	8	VCP	145	9.4	32	2	3	CIPP	523
W-8	W-8-4	11878	8	VCP	169	6.2	6	9	3	CIPP	523
W-8	W-8-4	11881	8	VCP	260	5.3	120	0	2	CIPP	523
W-8	W-8-4	11885	8	VCP	337	8	1	1	3	CIPP	541
W-8	W-8-4	11886	8	VCP	307	7.4	---	0	3	CIPP	523
W-8	W-8-7	11924	8	VCP	474	6.9	34	10	3	CIPP	523
W-8	W-8-7	11954	8	VCP	367	5.5	120	5	3	CIPP	541
W-8	W-8-7	11955	8	VCP	209	4	186	3	3	CIPP	543
W-8	W-8-7	11973	8	VCP	340	5.4	---	0	3	CIPP	523
W-8	W-8-7	11973	8	VCP	340	5.4	---	0	3	CIPP	523
W-8	W-8-6	12007	8	CIPP	330	5.8	---	3	2	Point Repair	523
W-8	W-8-7	12015	8	VCP	90	8.4	---	10	2	CIPP	523
W-8	W-8-7	12018	8	VCP	204	8.5	5	11	2	CIPP	523
W-8	W-8-7	12018	8	VCP	204	8.5	66	4	2	CIPP	523
W-8	W-8-7	12025	8	VCP	310	8.4	---	9	3	CIPP	523
W-8	W-8-7	12025	8	VCP	310	8.4	2	3	3	CIPP	523
W-8	W-8-5	12568	8	VCP	239	7.2	---	0	2	CIPP	523
W-8	W-8-4	12573	8	VCP	208	5.9	---	0	3	CIPP	523
W-8	W-8-3	12674	8	VCP	208	6.7	120	2	3	CIPP	523
W-8	W-8-7	12833	8	VCP	63	5.3	---	0	2	CIPP	523
W-8	W-8-7	12835	8	VCP	288	12.2	---	0	2	CIPP	523
W-8	W-8-1	14323	12	VCP	393	4.8	---	9	2	CIPP	523
W-8	W-8-7	15442	12	VCP	334	10.8	---	1	2	CIPP	523
W-8	W-8-6	15443	12	VCP	91	10.4	30	0	2	CIPP	540
W-8	W-8-3	15930	15	VCP	172	3.6	---	0	3	CIPP	523
W-8	W-8-5	21869	8	VCP	287	6.4	2	2	2	CIPP	523
W-8	W-8-5	21871	8	VCP	204	4.7	2	4	3	CIPP	523
W-8	W-8-2	23004	15	RCP	273	7.4	31	0	2	CIPP	523
W-8	W-8-3	23324	8	VCP	310	10.5	3	4	2	CIPP	523
W-8	W-8-3	23325	8	VCP	137	14.5	---	1	3	CIPP	523
W-8	W-8-3	23326	8	VCP	327	5.4	---	2	3	CIPP	523
W-8	W-8-3	23328	8	VCP	212	6	---	1	2	CIPP	540
W-8	W-8-3	23330	8	VCP	272	7.2	122	4	2	CIPP	523
W-8	W-8-3	23330a	8	VCP	N/A	7.4	3	4	2	CIPP	523
W-8	W-8-4	23550	8	VCP	127	7.4	---	1	2	CIPP	540

W-8	W-8-4	23551	8	VCP	127	6.6	1	1	2	CIPP	523
W-8	W-8-4	23552	8	VCP	59	7.7	30	1	3	CIPP	523
W-8	W-8-6	23756a	10	VCP	N/A	7.5	---	1	3	Point Repair	541
W-8	W-8-6	23757	10	VCP	312	6.5	---	4	2	CIPP	523
W-8	W-8-6	23758A	10	VCP	N/A	6.9	---	0	2	CIPP	523
W-8	Nearest to W-8-1	32845A	36	RCP	254	N/A	61	0	2	CIPP	523
W-8	W-8-3	11412A	8	VCP	54	4.8	61	1	3	CIPP	523

W-8 (North Park)—Inflow Reduction (Inlet Disconnect Projects)

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Subbasin	Number of Inlets*	Number of Manholes	12" Storm Sewer (LF)	Project Numbers
W-8 (North Park)	W-8-1	1	1	100	535
W-8 (North Park)	W-8-3	6	6	550	535
W-8 (North Park)	W-8-6	10	10	1000	535
W-8 (North Park)	W-8-7	4	4	400	535

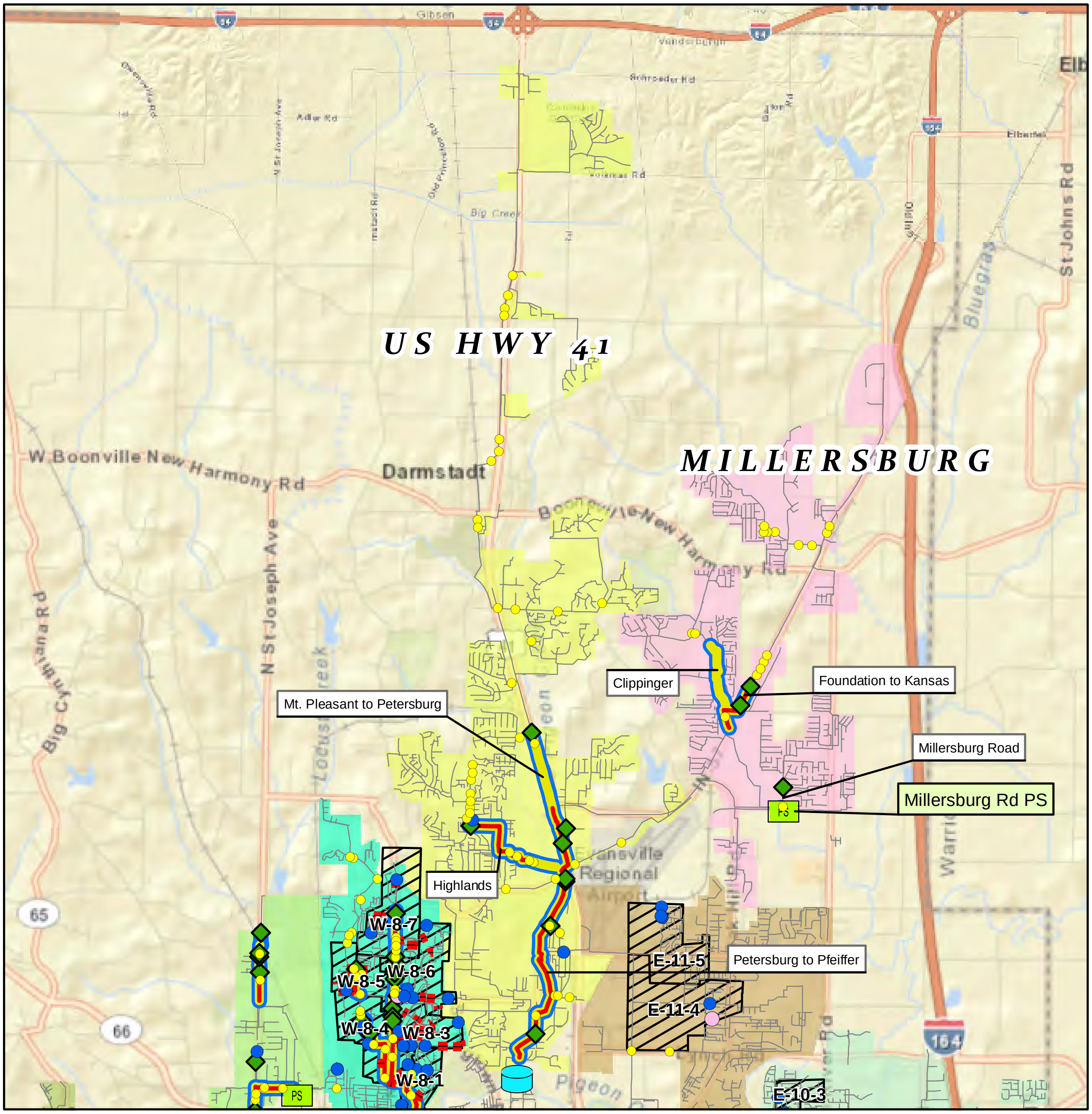
Note:
*Quantities do not include private inlet relocations

APPENDIX E

Millersburg/US Hwy 41 Basin

This appendix includes supporting data used to develop the capital costs for capacity and condition improvement projects identified in the Millersburg/US Hwy 41Basin. Data is organized in following manner:

Section	Title	Description
Capacity Improvement Projects		
E1	Capital cost summary tables	These tables include project names, descriptions, and summaries of quantities for each storm event, for existing and future flows.
Condition Improvement Projects		
E2	Capital cost summary tables	These tables include project names, descriptions, project IDs, and summaries of quantities.
E3	SSES Quantities	These tables summarize results of field investigations conducted during the SSES



LEGEND

- Inflow Reduction Projects
- Manhole Rehabilitation Projects
- Manhole Seal
- Recurring Wet-Weather SSOs in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- Added Storage Basin
- PS Added Pumping Capacity
- Sewer Main Rehabilitation
- Added Pipe Capacity (2-Year 24-Hour)
- Added Pipe Capacity (5-Year 24-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

0 3,500 7,000
Feet

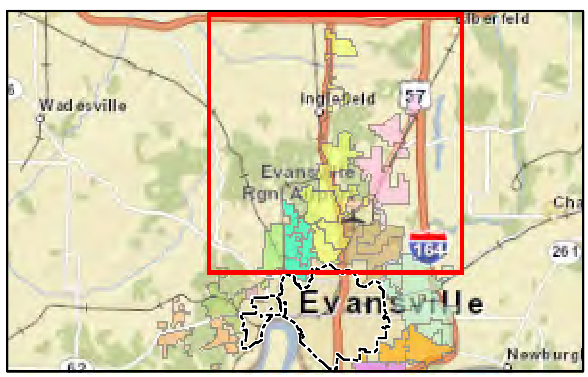
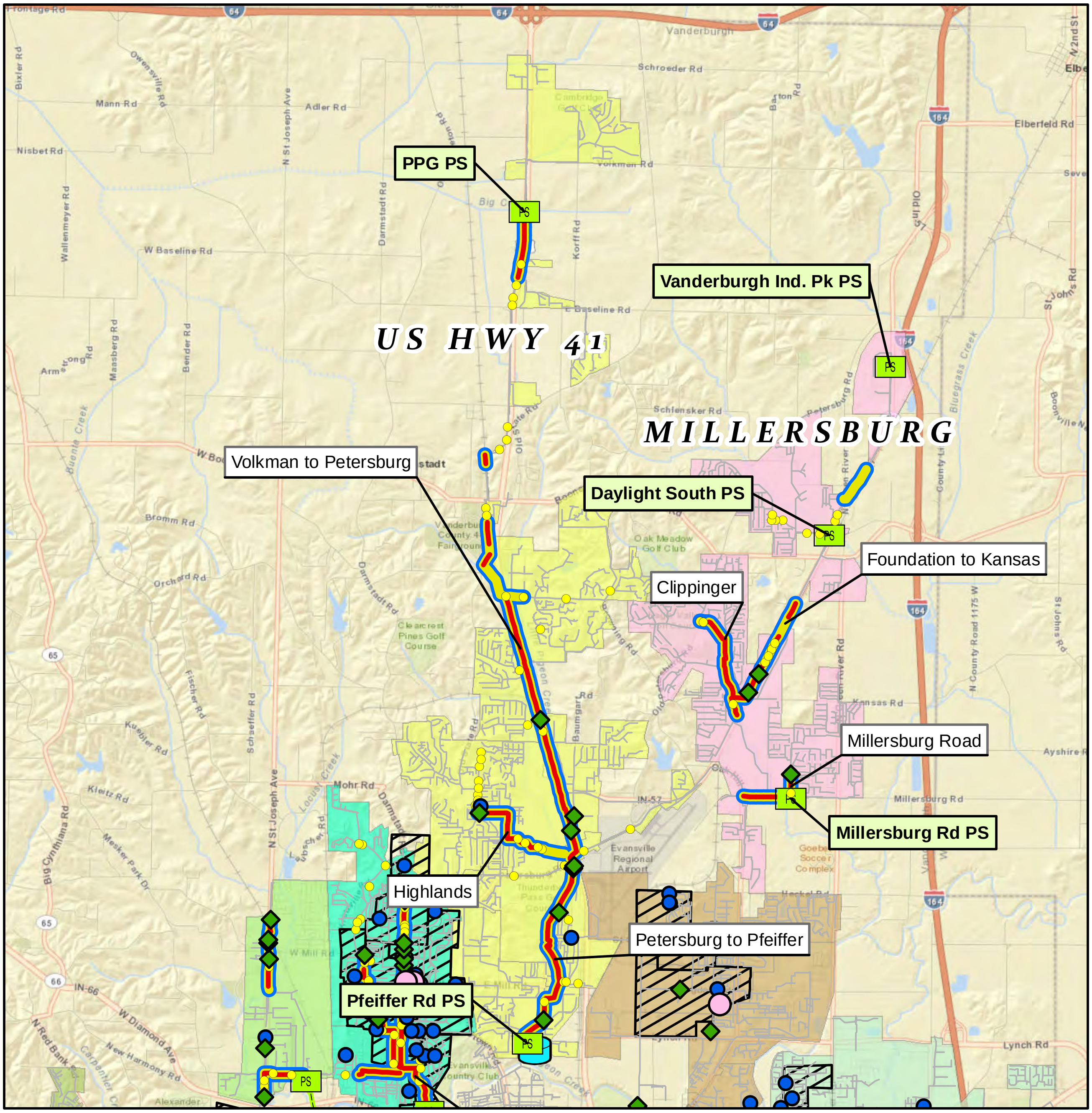


FIGURE E-1

US-41 and Millersburg Basins, Proposed Capacity Projects–All Storms, 2012 Flows

Sanitary Sewer Remedial Measures Plan, May 2013



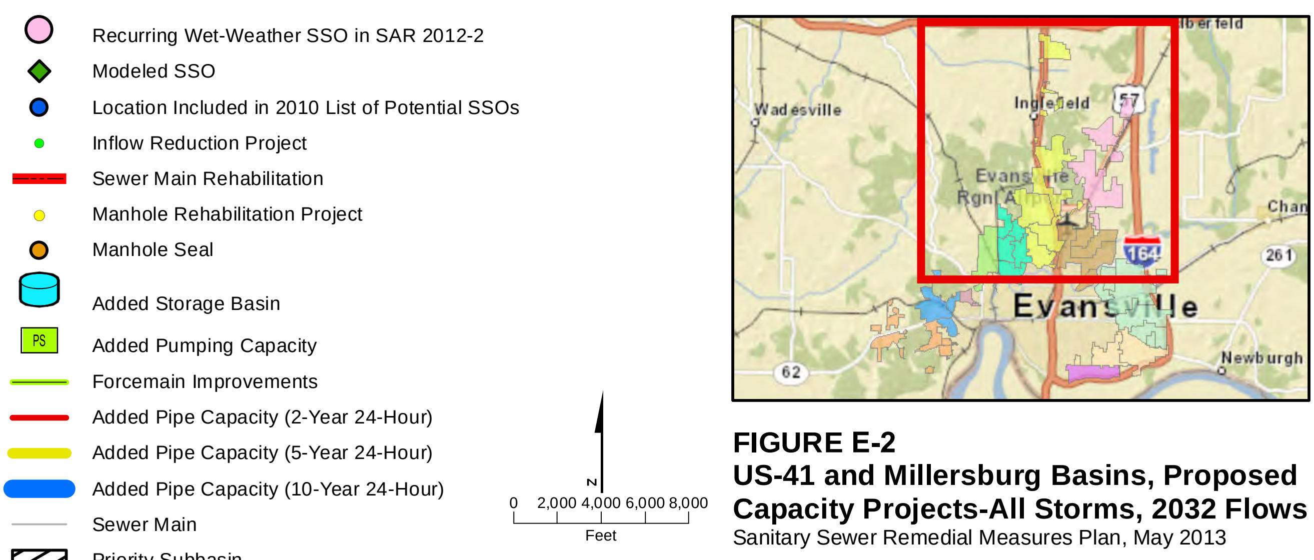


FIGURE E-2
US-41 and Millersburg Basins, Proposed Capacity Projects-All Storms, 2032 Flows
Sanitary Sewer Remedial Measures Plan, May 2013

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E1 - Capital Cost Summary Tables for Capacity Improvement Projects

Millersburg/US Hwy 41 Basin Capacity Improvement Projects, 2012 Flows

Basin	Millersburg - Hwy 41
Storm	2 year - 24 Hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Millersburg Rd PS	**Additional Pumping Capacity (MGD)**	(blank)	11.14		$ 1,792,000
Pfeiffer Rd Storage	**New storage basin (MG)**	(blank)	4.5		$ 13,054,000
Clippinger	**Relief Sewer (in)**	10	15	398	$ 289,000
		12	15	3,533	$ 2,624,000
Foundation to Kansas	**Relief Sewer (in)**	10	30	143	$ 109,000
		12	30	2,064	$ 1,572,000
		15	30	988	$ 770,000
Millersburg Road	**Relief Sewer (in)**	12	30	149	$ 213,000
US41 - Highland	**Relief Sewer (in)**	12	18	3,221	$ 2,154,000
		15	18	2,062	$ 1,182,000
US41 - Petersburg to Pfeiffer	**Relief Sewer (in)**	8	30	132	$ 88,000
		10	30	125	$ 83,000
		12	30	62	$ 31,000
		15	30	281	$ 175,000
		18	30	355	$ 214,000
		30	54	8,228	$ 11,259,000
			48	377	$ 453,000
		33	54	3,056	$ 4,727,000
Volkman (Mt Pleasant) to Petersburg	**Relief Sewer (in)**	24	48	1,549	$ 1,804,000
		27	48	2,099	$ 2,259,000
Grand Total				**28,822**	**$ 44,852,000**

Basin	Millersburg - Hwy 41
Storm	5 year - 24 Hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Millersburg Rd PS	**Additional Pumping Capacity (MGD)**	(blank)	12.91		$ 1,906,000
Pfeiffer Rd Storage	**New storage basin (MG)**	(blank)	6.1		$ 16,929,000
Clippinger	**Relief Sewer (in)**	10	15	398	$ 289,000
		12	15	3,533	$ 2,624,000
Foundation to Kansas	**Relief Sewer (in)**	10	30	143	$ 109,000
		12	30	2,064	$ 1,572,000
		15	30	988	$ 770,000
Millersburg Road	**Relief Sewer (in)**	12	30	149	$ 213,000
US41 - Highland	**Relief Sewer (in)**	12	18	3,221	$ 2,154,000
		15	18	3,250	$ 1,767,000
US41 - Petersburg to Pfeiffer	**Relief Sewer (in)**	8	30	132	$ 88,000
		10	30	125	$ 83,000
		12	30	62	$ 31,000
		15	30	281	$ 175,000
		18	30	355	$ 214,000
		30	54	8,228	$ 11,259,000
			48	377	$ 453,000
		33	54	3,056	$ 4,727,000
Volkman (Mt Pleasant) to Petersburg	**Relief Sewer (in)**	24	30	218	$ 173,000
			42	4,055	$ 4,454,000
			48	1,549	$ 1,804,000
		27	54	494	$ 594,000
			48	1,604	$ 1,716,000
Grand Total				**34,283**	**$ 54,104,000**

Millersburg/US Hwy 41 Basin Capacity Improvement Projects, 2012 Flows

Basin	Millersburg - Hwy 41
Storm	10 year - 24 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Millersburg Rd PS	**Additional Pumping Capacity (MGD)**	(blank)	14.35		$ 2,000,000
Pfeiffer Rd Storage	**New storage basin (MG)**	(blank)	7.5		$ 20,172,000
Clippinger	**Relief Sewer (in)**	10	15	398	$ 289,000
		12	15	3,412	$ 2,534,000
Foundation to Kansas	**Relief Sewer (in)**	10	30	143	$ 109,000
		12	30	1,983	$ 1,498,000
			36	81	$ 82,000
		15	36	988	$ 867,000
Millersburg Road	**Relief Sewer (in)**	12	30	149	$ 213,000
US41 - Highland	**Relief Sewer (in)**	12	18	3,022	$ 2,032,000
			24	199	$ 129,000
		15	24	3,250	$ 1,871,000
US41 - Petersburg to Pfeiffer	**Relief Sewer (in)**	8	30	132	$ 88,000
		10	30	125	$ 83,000
		12	30	62	$ 31,000
		15	30	281	$ 175,000
		18	30	355	$ 214,000
		30	54	8,605	$ 11,753,000
		33	54	3,056	$ 4,727,000
Volkman (Mt Pleasant) to Petersburg	**Relief Sewer (in)**	24	30	218	$ 173,000
			42	4,055	$ 4,454,000
			48	1,549	$ 1,804,000
		27	54	494	$ 594,000
			48	1,604	$ 1,716,000
Grand Total				**34,162**	**$ 57,608,000**

Millersburg/US Hwy 41 Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	US HWY 41 - Millersburg
Storm	2y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Clippinger	**Upsize sewer (in)**	10	15	370	$ 256,000
		12	15	3,998	$ 2,911,000
			30	114	$ 81,000
Foundation to Kansas	**Upsize sewer (in)**	10	30	143	$ 109,000
		12	30	1,715	$ 1,327,000
		15	18	845	$ 461,000
			30	3,382	$ 2,371,000
		33	54	175	$ 258,000
	Upsize PS (mgd)	1.96	2.43	0	$ 1,163,000
		3	4.62	0	$ 1,436,000
Millersburg Road	**Upsize sewer (in)**	8	12	370	$ 190,000
		10	12	2,221	$ 946,000
			18	1,031	$ 748,000
		12	30	149	$ 213,000
	Upsize PS (mgd)	3	11.14	0	$ 1,792,000
Highland	**Upsize sewer (in)**	12	18	3,221	$ 2,108,000
		15	18	2,062	$ 1,126,000
Peterburg to Pfeiffer	**Upsize sewer (in)**	8	30	88	$ 50,000
		10	30	125	$ 81,000
		12	30	62	$ 31,000
		15	30	318	$ 198,000
		18	30	318	$ 199,000
		33	54	3,056	$ 4,727,000
		30	54	8,228	$ 11,259,000
		8.04	30	44	$ 32,000
	Upsize PS (mgd)	7.6	15	0	$ 1,937,000
	Storage (MG)	0	1.7	0	$ 6,272,000
Volkman to Petersburg	**Upsize sewer (in)**	10	18	462	$ 252,000
		12	15	956	$ 584,000
			18	2,656	$ 1,851,000
		15	18	1,942	$ 1,234,000
		24	30	7,465	$ 6,455,000
			48	1,613	$ 1,846,000
			42	4,055	$ 4,432,000
		30	48	50	$ 57,000
		27	48	2,126	$ 2,277,000
	Upsize PS (mgd)	2.33	3.324	0	$ 827,000
	MH Adjustment - weir length (ft)	1.75	1.75	0	$ 10,000
Grand Total				**53,360**	**$ 62,107,000**

Millersburg/US Hwy 41 Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	US HWY 41 - Millersburg
Storm	5y24h

				Values	
Project Name	**Description**	**Existing Size**	**Proposed Size**	**Sum of Pipe Length (ft)**	**Sum of Capital Cost**
Clippinger	**Upsize sewer (in)**	10	15	370	$ 256,000
		12	15	3,998	$ 2,911,000
			30	114	$ 81,000
Foundation to Kansas	**Upsize sewer (in)**	10	30	438	$ 289,000
		12	18	2,066	$ 1,110,000
			30	3,183	$ 2,365,000
		15	30	4,227	$ 2,943,000
			54	175	$ 258,000
		33	30	143	$ 109,000
	Upsize PS (mgd)	1.96	2.49	0	$ 1,167,000
		3	4.81	0	$ 1,448,000
Millersburg Road	**Upsize sewer (in)**	8	12	370	$ 190,000
		10	12	2,221	$ 933,000
			18	1,031	$ 725,000
		12	30	149	$ 213,000
	Upsize PS (mgd)	3	12.91	0	$ 1,907,000
Highland	**Upsize sewer (in)**	12	18	3,221	$ 2,154,000
		15	18	3,250	$ 1,767,000
Peterburg to Pfeiffer	**Upsize sewer (in)**	8	30	88	$ 50,000
		10	30	125	$ 81,000
		12	30	62	$ 31,000
		15	30	318	$ 198,000
		18	30	318	$ 199,000
		33	54	3,056	$ 4,727,000
		30	54	8,228	$ 11,259,000
		8.04	30	44	$ 32,000
	Upsize PS (mgd)	7.6	15	0	$ 1,937,000
	Storage (MG)	0	4.1	0	$ 12,085,000
Volkman to Petersburg	**Upsize sewer (in)**	10	15	311	$ 155,000
			18	462	$ 262,000
		12	15	1,736	$ 1,088,000
			18	2,656	$ 1,878,000
		15	18	1,942	$ 1,244,000
		18	24	2,847	$ 2,130,000
		24	30	7,465	$ 6,526,000
			48	1,613	$ 1,885,000
			42	4,055	$ 4,454,000
		30	48	50	$ 78,000
		27	48	2,126	$ 2,316,000
	Upsize PS (mgd)	2.33	3.547	0	$ 842,000
	MH Adjustment - weir length (ft)	1.75	1.75	0	$ 10,000
Grand Total				**62,457**	**$ 74,293,000**

Millersburg/US Hwy 41 Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	US HWY 41 - Millersburg
Storm	10y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Clippinger	**Upsize sewer (in)**	12	15	4,853	$ 3,424,000
Foundation to Kansas	**Upsize sewer (in)**	10	30	581	$ 398,000
		12	30	1,983	$ 1,498,000
			36	81	$ 82,000
		15	18	2,066	$ 1,110,000
			30	4,010	$ 2,741,000
			36	988	$ 844,000
		33	54	175	$ 258,000
	Upsize PS (mgd)	1.96	2.6	0	$ 1,174,000
		3	5.23	0	$ 1,475,000
Millersburg Road	**Upsize sewer (in)**	8	12	370	$ 190,000
		10	12	2,221	$ 933,000
			18	1,031	$ 725,000
		12	30	149	$ 213,000
	Upsize PS (mgd)	3	14.35	0	$ 2,000,000
Highland	**Upsize sewer (in)**	12	18	3,022	$ 2,032,000
			24	199	$ 129,000
		15	18	2,211	$ 1,128,000
			24	1,039	$ 676,000
Peterburg to Pfeiffer	**Upsize sewer (in)**	8	30	88	$ 50,000
		10	30	125	$ 81,000
		12	30	62	$ 31,000
		15	30	318	$ 198,000
		18	30	318	$ 199,000
		33	54	3,056	$ 4,727,000
		30	54	8,228	$ 11,259,000
		8.04	30	44	$ 32,000
	Upsize PS (mgd)	7.6	15	0	$ 1,937,000
	Storage (MG)	0	7.4	0	$ 15,234,000
Volkman to Petersburg	**Upsize sewer (in)**	10	15	311	$ 155,000
			18	462	$ 262,000
		12	15	1,736	$ 1,088,000
			18	2,656	$ 1,878,000
		15	18	1,942	$ 1,244,000
		18	24	2,847	$ 2,130,000
		24	30	7,465	$ 6,526,000
			48	1,613	$ 1,885,000
			42	4,055	$ 4,454,000
		30	54	50	$ 83,000
		27	54	521	$ 653,000
			48	1,604	$ 1,716,000
	Upsize PS (mgd)	2.33	3.931	0	$ 866,000
	MH Adjustment - weir length (ft)	1.75	1.75	0	$ 10,000
Grand Total				**62,479**	**$ 77,728,000**

E**2** - Capital Cost Summary Tables for Condition Improvement Projects

Millersburg/US Hwy 41 Basin Condition Improvement Projects

Basin	Millersburg/HWY 41

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Manhole Rehabilitation					
Construct Benchwall	537	3			$ 3,000
F/C replacements	538	2			$ 8,000
Manhole Lining Rehabilitation	540	40			$ 438,000
Grout Joint/Void (Number of Repairs)	539	19			$ 9,000
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	541			3	$ 28,000
Grand Total		**64**		**3**	**$ 486,000**

E3 – SSES Quantities

Basin	Subbasin	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining*	Grout Joint/Void	Project ID
Millersburg/US HWY 41	arest to W-10	10844	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-15	280399	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-18	10606	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-18	10608	1	---	---	1	---	537, 540
Millersburg/US HWY 41	W-10-18	10603	1	---	---	1	---	537, 540
Millersburg/US HWY 41	W-10-13	13688	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-14	13001	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-7	10928	---	---	---	---	1	539
Millersburg/US HWY 41	W-10-7	10929	---	---	---	---	2	539
Millersburg/US HWY 41	W-10-7	10941	---	---	---	---	1	539
Millersburg/US HWY 41	W-10-7	10932	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-7	10934	---	---	---	1	---	540
Millersburg/US HWY 41	W-16-3	15405	---	---	---	---	1	539
Millersburg/US HWY 41	W-10-9	14857	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-13	10748	---	---	---	---	1	539
Millersburg/US HWY 41	W-10-4	9813	---	---	---	1	---	540
Millersburg/US HWY 41	W-16-6	12762	---	---	---	1	---	540
Millersburg/US HWY 41	W-16-6	12765	---	---	---	1	---	540
Millersburg/US HWY 41	W-16-6	12763	---	---	---	---	1	539
Millersburg/US HWY 41	W-16-6	12764	---	---	---	---	2	539
Millersburg/US HWY 41	W-16-9	13208	---	---	---	1	---	540
Millersburg/US HWY 41	W-16-9	13207	---	---	---	---	1	539
Millersburg/US HWY 41	W-16-10	13224	---	---	---	---	1	539
Millersburg/US HWY 41	W-16-9	13220	---	---	---	1	---	540
Millersburg/US HWY 41	W-16-10	13223	---	---	---	---	1	539
Millersburg/US HWY 41	W-16-10	15265	---	---	---	1	---	540
Millersburg/US HWY 41	W-16-9	13227	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-9	10738	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-3	9701	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-9	14853	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-9	14850	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-9	14854	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-9	14860	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-9	13700	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-4	10820	---	---	---	---	2	539
Millersburg/US HWY 41	W-10-4	9673	---	---	---	---	1	539
Millersburg/US HWY 41	W-10-4	9674	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-4	9677	---	---	1	---	1	538, 539
Millersburg/US HWY 41	W-16-8	12811	---	---	---	1	---	540
Millersburg/US HWY 41	W-16-7	12847	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-17	10876	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-6	11091	1	---	---	1	---	537, 540
Millersburg/US HWY 41	W-10-6	11091A	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-18	10855	---	---	1	1	---	538, 540
Millersburg/US HWY 41	W-10-14	10865	---	---	---	1	---	540
Millersburg/US HWY 41	W-11-1	90156	---	---	---	1	---	540
Millersburg/US HWY 41	W-11-1	90155	---	---	---	---	1	539
Millersburg/US HWY 41	W-11-1	90152	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-6	10912	---	---	---	---	2	539
Millersburg/US HWY 41	W-16-2	15309	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-7	10950	---	---	---	1	---	540
Millersburg/US HWY 41	W-11-1	90127	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-9	14858	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-18	10829	---	---	---	1	---	540
Millersburg/US HWY 41	W-10-18	10828	---	---	---	1	---	540
		TOTAL	**3**	**0**	**2**	**40**	**19**	

Note:

*Assumes an average depth of 10 VLF per manhole

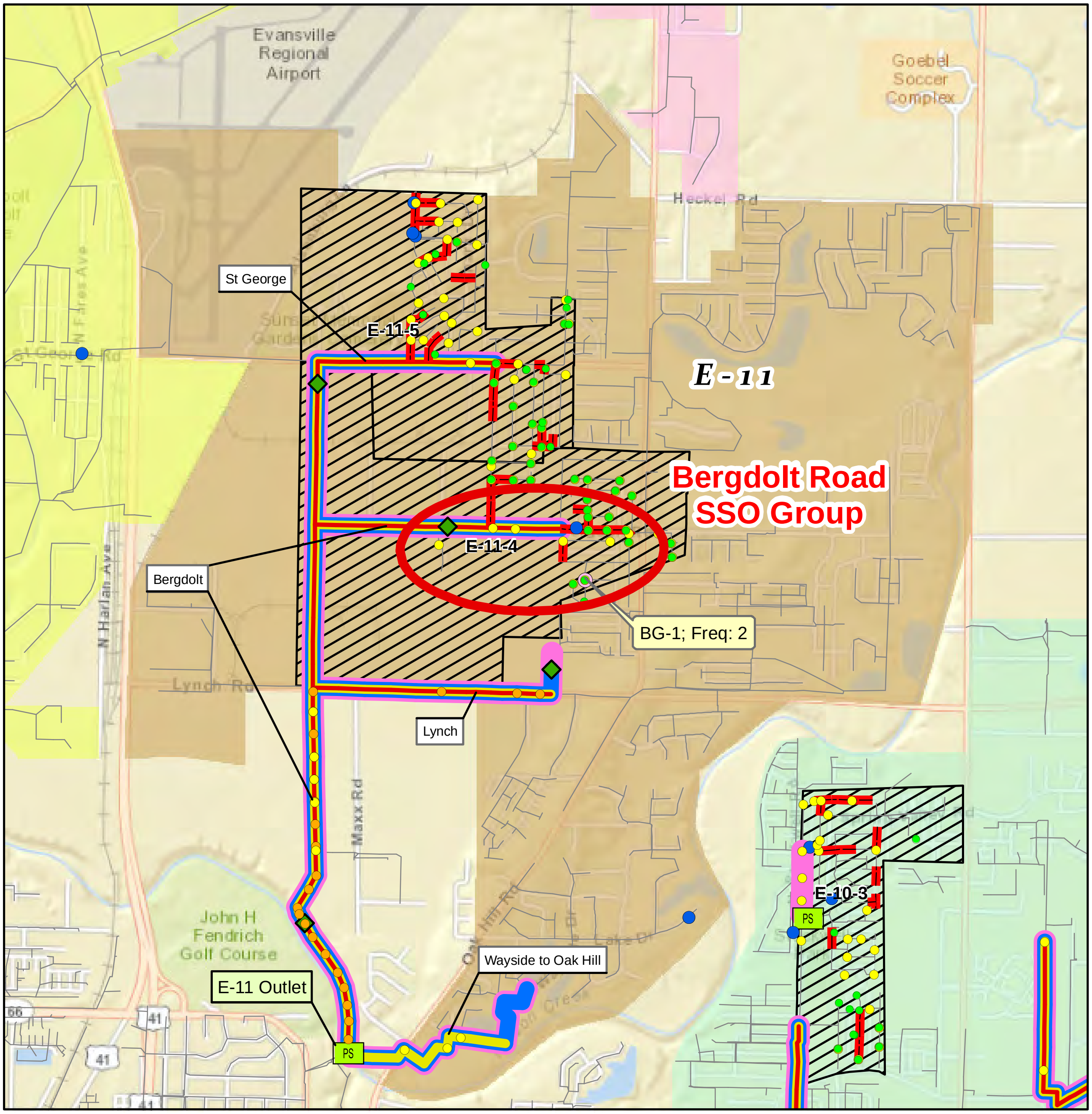
[b]Measured depth of manhole used for University Heights lining quantities

APPENDIX F

E-11 Basin

This appendix includes supporting data used to develop the capital costs for capacity and condition improvement projects identified in the E-11 Basin. Data is organized in following manner:

Section	Title	Description
Capacity Improvement Projects		
F1	Capital cost summary tables	These tables include project names, descriptions, and summaries of quantities for each storm event, for existing and future flows.
Condition Improvement Projects		
F2	Capital cost summary tables	These tables include project names, descriptions, project IDs, and summaries of quantities.
F3	SSES Quantities	These tables summarize results of field investigations conducted during the SSES



LEGEND

- Inflow Reduction Projects
- Manhole Rehabilitation Projects
- Manhole Invert Change
- Recurring Wet-Weather SSOs in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- PS Added Pumping Capacity
- Sewer Main Rehabilitation
- Added Pipe Capacity (2-Year 3-Hour)
- Added Pipe Capacity (5-Year 3-Hour)
- Added Pipe Capacity (10-Year 3-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

0 1,000 2,000
Feet

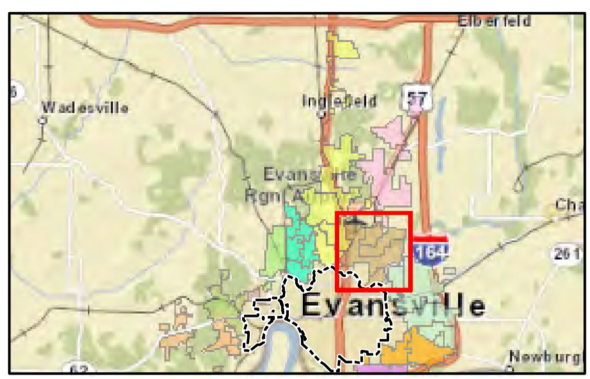


FIGURE F-1

E-11 Basin, Proposed Capacity Projects for All Storms, 2012 Flows

Sanitary Sewer Remedial Measures Plan, May 2013

renew EVANSVILLE

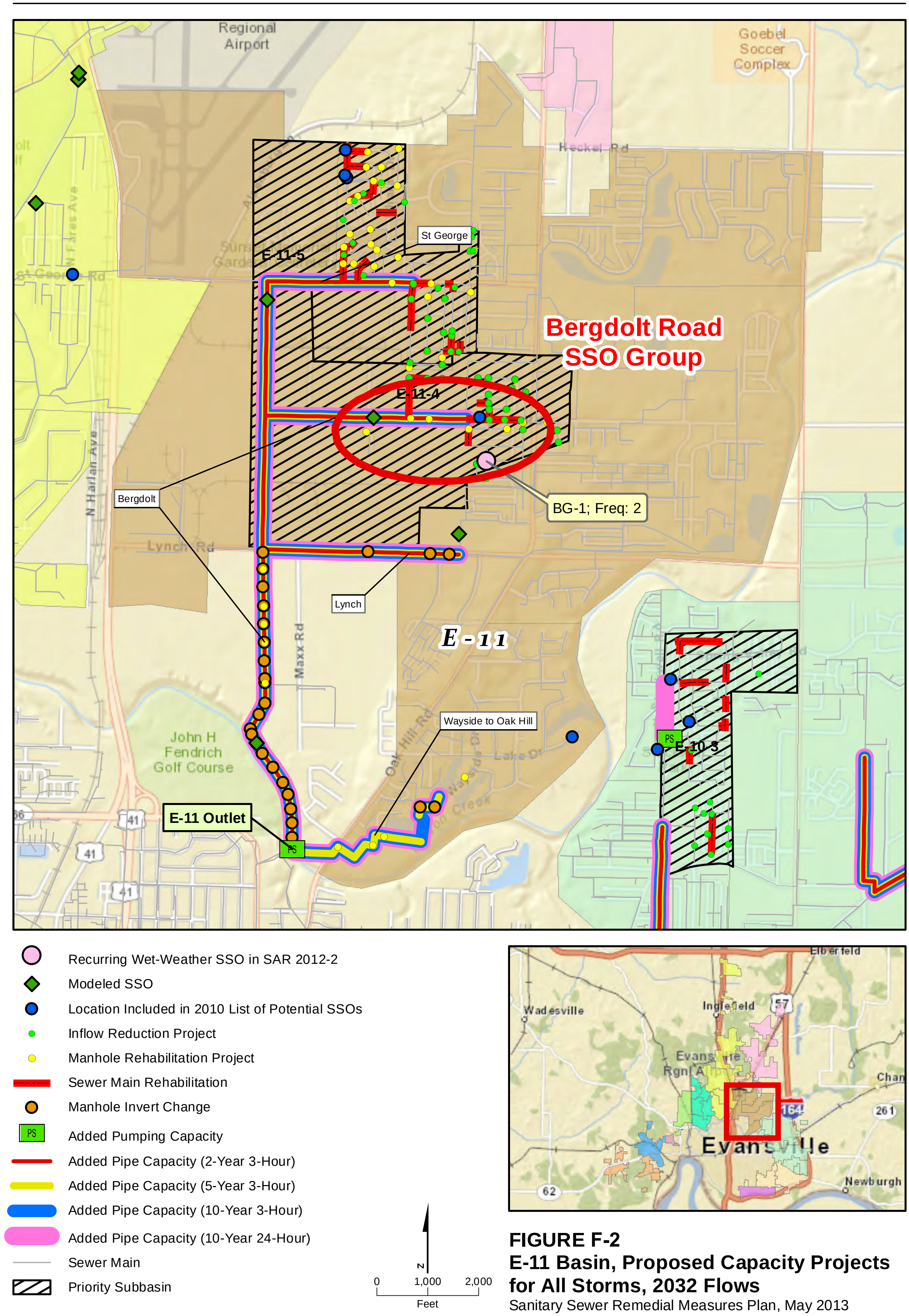


FIGURE F-2

E-11 Basin, Proposed Capacity Projects for All Storms, 2032 Flows

Sanitary Sewer Remedial Measures Plan, May 2013

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F1 - Capital Cost Summary Tables for Capacity Improvement Projects

E-11 Basin Capacity Improvement Projects, 2012 Flows

Basin	E-11
Storm	2 year - 3 Hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Bergdolt	**Manhole Adjustment (elevation)**	357.507	356.68		$ 14,000
		359.443	357.52		$ 14,000
		359.364	358.28		$ 10,000
		359.277	359.12		$ 15,000
		361.224	360.88		$ 11,000
		363.925	361.88		$ 7,000
		365.811	362.57		$ 5,000
		368.091	363.41		$ 14,000
		370.675	364.39		$ 15,000
		370.743	365.131		$ 14,000
		371.515	367.509		$ 14,000
		373.623	372.826		$ 9,000
		359.239	359.86		$ 14,000
		372.248	369.582		$ 13,000
		371.934	368.543		$ 14,000
		372.68	370.613		$ 10,000
		372.971	371.662		$ 12,000
		373.287	372.686		$ 11,000
		370.965	366.287		$ 16,000
		371.084	366.478		$ 15,000
		367.273	363.11		$ 8,000
	Relief Sewer (in)	15	18	1,904	$ 925,000
			21	2,050	$ 991,000
		18	24	367	$ 194,000
		21	24	2,251	$ 1,231,000
		24	30	4,805	$ 4,410,000
		26	30	1,078	$ 1,212,000
Bergdolt Pump Station	**New Pump Station (MGD)**	0	11.7		$ 3,322,000
Lynch Road	**Relief Sewer (in)**	10	12	198	$ 79,000
		12	18	968	$ 446,000
		15	18	2,873	$ 1,550,000
St. George Road	**Relief Sewer (in)**	10	18	230	$ 88,000
			21	398	$ 261,000
		12	12	347	$ 201,000
			18	1,347	$ 613,000
		15	12	247	$ 94,000
			21	1,245	$ 502,000
			24	379	$ 185,000
		16	21	389	$ 171,000
		18	18	366	$ 177,000
Grand Total				**21,441**	**$ 16,907,000**

E-11 Basin Capacity Improvement Projects, 2012 Flows

Basin	E-11
Storm	5 year - 3 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Bergdolt	**Manhole Adjustment (elevation)**	357.507	356.68		$ 14,000
		359.443	357.52		$ 14,000
		359.364	358.28		$ 10,000
		359.277	359.12		$ 15,000
		361.224	360.88		$ 11,000
		363.925	361.88		$ 7,000
		365.811	362.57		$ 5,000
		368.091	363.41		$ 14,000
		370.675	364.39		$ 15,000
		370.743	365.131		$ 14,000
		371.515	367.509		$ 14,000
		373.623	372.826		$ 9,000
		359.239	359.86		$ 14,000
		372.248	369.582		$ 13,000
		371.934	368.543		$ 14,000
		372.68	370.613		$ 10,000
		372.971	371.662		$ 12,000
		373.287	372.686		$ 11,000
		370.965	366.287		$ 16,000
		371.084	366.478		$ 15,000
		367.273	363.11		$ 8,000
	Relief Sewer (in)	10	12	627	$ 316,000
		12	15	601	$ 383,000
			18	2,036	$ 1,025,000
			21	218	$ 100,000
		15	18	1,904	$ 925,000
			21	3,505	$ 1,801,000
			24	522	$ 230,000
		18	30	367	$ 218,000
		21	30	383	$ 262,000
		24	30	1,007	$ 957,000
Bergdolt Pump Station	**New Pump Station (MGD)**	0	14.4		$ 3,665,000
Lynch Road	**Relief Sewer (in)**	10	12	198	$ 79,000
		12	15	407	$ 195,000
		15	24	1,133	$ 455,000
		16	24	389	$ 175,000
		24	30	1,667	$ 1,357,000
		26	30	1,078	$ 1,212,000
St. George Road	**Manhole Adjustment (elevation)**	376.58	377.11		$ 8,000
	Relief Sewer (in)	24	30	2,415	$ 2,329,000
Grand Total				**18,456**	**$ 15,947,000**

E-11 Basin Capacity Improvement Projects, 2012 Flows

Basin	E-11
Storm	10 year - 3 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Bergdolt	**Manhole Adjustment (elevation)**	357.507	356.68		$ 14,000
		359.443	357.52		$ 14,000
		359.364	358.28		$ 10,000
		359.277	359.12		$ 15,000
		361.224	360.88		$ 11,000
		363.925	361.88		$ 7,000
		365.811	362.57		$ 5,000
		368.091	363.41		$ 14,000
		370.675	364.39		$ 15,000
		370.743	365.131		$ 14,000
		371.515	367.509		$ 14,000
		373.623	372.826		$ 9,000
		372.248	369.582		$ 13,000
		371.934	368.543		$ 14,000
		372.68	370.613		$ 10,000
		372.971	371.662		$ 12,000
		373.287	372.686		$ 11,000
		370.965	366.287		$ 16,000
		359.24	359.86		$ 14,000
		371.08	366.48		$ 15,000
		367.27	363.11		$ 8,000
	Relief Sewer (in)	15	18	1,904	$ 925,000
			24	1,775	$ 880,000
		18	30	367	$ 218,000
		21	30	2,251	$ 1,384,000
		24	30	4,805	$ 4,410,000
		26	30	1,078	$ 1,212,000
Bergdolt Pump Station	**New Pump Station (MGD)**	0	15.6		$ 3,817,000
Lynch Road	**Relief Sewer (in)**	10	15	198	$ 80,000
		12	15	400	$ 149,000
			21	968	$ 421,000
		15	21	2,873	$ 1,564,000
St. George Road	**Manhole Adjustment (elevation)**	376.58	377.11		$ 8,000
	Relief Sewer (in)	10	18	617	$ 257,000
		12	15	230	$ 83,000
			18	1,418	$ 768,000
		15	24	1,881	$ 793,000
		16	15	398	$ 246,000
		18	24	745	$ 364,000
Grand Total				**21,908**	**$ 17,834,000**

E-11 Basin Capacity Improvement Projects, 2012 Flows

Basin	E-11
Storm	10 year - 24 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Bergdolt	**Manhole Adjustment (elevation)**	357.507	356.68		$ 14,000
		359.443	357.52		$ 14,000
		359.364	358.28		$ 10,000
		359.277	359.12		$ 15,000
		361.224	360.88		$ 11,000
		363.925	361.88		$ 7,000
		365.811	362.57		$ 5,000
		368.091	363.41		$ 14,000
		370.675	364.39		$ 15,000
		370.743	365.131		$ 14,000
		371.515	367.509		$ 14,000
		373.623	372.826		$ 9,000
		372.248	369.582		$ 13,000
		371.934	368.543		$ 14,000
		372.68	370.613		$ 10,000
		372.971	371.662		$ 12,000
		373.287	372.686		$ 11,000
		370.965	366.287		$ 16,000
		359.24	359.86		$ 14,000
		371.08	366.48		$ 15,000
		367.24	363.11		$ 8,000
	Relief Sewer (in)	12	15	160	$ 141,000
			18	218	$ 97,000
		15	18	1,832	$ 885,000
			21	2,050	$ 991,000
		18	24	366	$ 185,000
		21	30	2,251	$ 1,384,000
		24	30	4,479	$ 4,173,000
		26	30	1,078	$ 1,212,000
Bergdolt Pump Station	**New Pump Station (MGD)**	0	14.9		$ 3,728,000
Lynch Road	**Relief Sewer (in)**	10	12	596	$ 313,000
		12	18	340	$ 155,000
			21	411	$ 203,000
		15	18	73	$ 40,000
			21	2,630	$ 1,490,000
			24	247	$ 101,000
St. George Road	**Manhole Adjustment (elevation)**	376.58	377.11		$ 8,000
	Relief Sewer (in)	10	12	230	$ 82,000
		12	15	263	$ 100,000
			18	2,036	$ 1,025,000
		15	24	1,625	$ 692,000
		16	24	389	$ 175,000
		18	30	367	$ 218,000
		24	30	325	$ 237,000
Grand Total				**21,963**	**$ 17,890,000**

E-11 Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	E-11
Storm	2y3h

				Values	
Project Name	**Description**	**Existing Size**	**Proposed Size**	**Sum of Pipe Length (ft)**	**Sum of Capital Cost**
Bergdolt	**Upsize sewer (in)**	15	24	3,625	$ 1,193,000
		21	30	2,251	$ 998,000
		24	30	5,089	$ 3,764,000
		26	30	1,078	$ 1,028,000
	MH Adjustment - new invert (El.)	357.507	356.68	0	$ 5,000
		359.443	357.52	0	$ 5,000
		359.364	358.28	0	$ 5,000
		359.277	359.12	0	$ 5,000
		361.224	360.88	0	$ 5,000
		363.925	361.88	0	$ 5,000
		365.811	362.57	0	$ 5,000
		368.091	363.41	0	$ 5,000
		370.675	364.39	0	$ 5,000
		370.743	365.13	0	$ 5,000
		371.515	367.51	0	$ 5,000
		373.623	372.83	0	$ 5,000
		359.239	359.86	0	$ 5,000
		372.248	369.58	0	$ 5,000
		371.934	368.54	0	$ 5,000
		372.68	370.61	0	$ 5,000
		372.971	371.66	0	$ 5,000
		373.287	372.69	0	$ 5,000
		370.965	366.29	0	$ 5,000
		371.084	366.48	0	$ 5,000
		367.273	363.11	0	$ 5,000
Bergdolt PS	**New PS (mgd)**	0	14.2	0	$ 3,639,000
Lynch Road	**Upsize sewer (in)**	12	18	968	$ 443,000
		15	18	2,873	$ 1,533,000
St George Road	**Upsize sewer (in)**	10	12	825	$ 254,000
		12	18	2,036	$ 664,000
		15	21	1,871	$ 446,000
		16	21	389	$ 105,000
		18	24	366	$ 125,000
Eagles PS	**Upsize PS (mgd)**	1.4	2	0	$ 1,066,000
Grand Total				**21,370**	**$ 15,363,000**

E-11 Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	E-11
Storm	5y3h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Bergdolt	**Upsize sewer (in)**	15	24	3,955	$ 1,986,000
		18	30	367	$ 248,000
		21	30	2,251	$ 1,570,000
		24	30	1,933	$ 1,992,000
			36	3,155	$ 3,219,000
		26	30	1,078	$ 1,350,000
	MH Adjustment - new invert (El.)	357.507	356.68	0	$ 5,000
		359.443	357.52	0	$ 5,000
		359.364	358.28	0	$ 5,000
		359.277	359.12	0	$ 5,000
		361.224	360.88	0	$ 5,000
		363.925	361.88	0	$ 5,000
		365.811	362.57	0	$ 5,000
		368.091	363.41	0	$ 5,000
		370.675	364.39	0	$ 5,000
		370.743	365.13	0	$ 5,000
		371.515	367.51	0	$ 5,000
		373.623	372.83	0	$ 5,000
		359.239	359.86	0	$ 5,000
		372.248	369.58	0	$ 5,000
		371.934	368.54	0	$ 5,000
		372.68	370.61	0	$ 5,000
		372.971	371.66	0	$ 5,000
		373.287	372.69	0	$ 5,000
		370.965	366.29	0	$ 5,000
		371.084	366.48	0	$ 5,000
		367.273	363.11	0	$ 5,000
Bergdolt PS	**New PS (mgd)**	0	16.8	0	$ 3,969,000
Lynch Road	**Upsize sewer (in)**	12	21	968	$ 462,000
		15	21	2,873	$ 1,606,000
St George Road	**Upsize sewer (in)**	10	12	825	$ 254,000
		12	18	2,036	$ 664,000
		15	21	1,121	$ 243,000
			24	751	$ 210,000
		16	24	389	$ 108,000
		18	24	366	$ 125,000
Eagles PS	**Upsize PS (mgd)**	1.4	2.5	0	$ 1,099,000
Grand Total				**22,067**	**$ 19,210,000**

E-11 Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	E-11
Storm	10y3h

				Values	
Project Name	**Description**	**Existing Size**	**Proposed Size**	**Sum of Pipe Length (ft)**	**Sum of Capital Cost**
Bergdolt	**Upsize sewer (in)**	15	24	3,955	$ 1,986,000
		18	36	367	$ 248,000
		21	36	2,251	$ 1,570,000
		24	36	5,089	$ 5,211,000
		26	36	1,078	$ 1,350,000
	MH Adjustment - new invert (El.)	357.507	356.68	0	$ 5,000
		359.443	357.52	0	$ 5,000
		359.364	358.28	0	$ 5,000
		359.277	359.12	0	$ 5,000
		361.224	360.88	0	$ 5,000
		363.925	361.88	0	$ 5,000
		365.811	362.57	0	$ 5,000
		368.091	363.41	0	$ 5,000
		370.675	364.39	0	$ 5,000
		370.743	365.13	0	$ 5,000
		371.515	367.51	0	$ 5,000
		373.623	372.83	0	$ 5,000
		359.239	359.86	0	$ 5,000
		372.248	369.58	0	$ 5,000
		371.934	368.54	0	$ 5,000
		372.68	370.61	0	$ 5,000
		372.971	371.66	0	$ 5,000
		373.287	372.69	0	$ 5,000
		370.965	366.29	0	$ 5,000
		371.084	366.48	0	$ 5,000
		367.273	363.11	0	$ 5,000
Bergdolt PS	**New PS (mgd)**	0	19.7	0	$ 4,338,000
Lynch Road	**Upsize sewer (in)**	12	21	968	$ 462,000
		15	21	2,873	$ 1,606,000
St George Road	**Upsize sewer (in)**	10	15	825	$ 268,000
		12	18	2,036	$ 664,000
		15	21	1,121	$ 243,000
			24	751	$ 210,000
		16	24	389	$ 108,000
		18	24	366	$ 125,000
Eagles PS	**Upsize PS (mgd)**	1.4	2.9	0	$ 1,125,000
Grand Total				**22,067**	**$ 19,619,000**

E-11 Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	E-11
Storm	10y24h

				Values	
Project Name	**Description**	**Existing Size**	**Proposed Size**	**Sum of Pipe Length (ft)**	**Sum of Capital Cost**
Bergdolt	**Upsize sewer (in)**	15	24	3,955	$ 1,986,000
		18	30	367	$ 218,000
		21	30	2,251	$ 1,384,000
		24	30	1,933	$ 1,774,000
			36	3,155	$ 3,219,000
		26	30	1,078	$ 1,212,000
	MH Adjustment - new invert (El.)	357.507	356.68	0	$ 5,000
		359.443	357.52	0	$ 5,000
		359.364	358.28	0	$ 5,000
		359.277	359.12	0	$ 5,000
		361.224	360.88	0	$ 5,000
		363.925	361.88	0	$ 5,000
		365.811	362.57	0	$ 5,000
		368.091	363.41	0	$ 5,000
		370.675	364.39	0	$ 5,000
		370.743	365.13	0	$ 5,000
		371.515	367.51	0	$ 5,000
		373.623	372.83	0	$ 5,000
		359.239	359.86	0	$ 5,000
		372.248	369.58	0	$ 5,000
		371.934	368.54	0	$ 5,000
		372.68	370.61	0	$ 5,000
		372.971	371.66	0	$ 5,000
		373.287	372.69	0	$ 5,000
		370.965	366.29	0	$ 5,000
		371.084	366.48	0	$ 5,000
Bergdolt PS	**New PS (mgd)**	0	14.5	0	$ 3,678,000
Lynch Road	**Upsize sewer (in)**	12	21	968	$ 462,000
		15	21	2,873	$ 1,606,000
St George Road	**Upsize sewer (in)**	10	12	825	$ 254,000
		12	18	2,036	$ 664,000
		15	21	1,871	$ 446,000
		16	21	389	$ 105,000
		18	24	366	$ 125,000
Eagles PS	**Upsize PS (mgd)**	1.4	2.8	0	$ 1,118,000
Grand Total				**22,067**	**$ 18,351,000**

F2 - Capital Cost Summary Tables for Condition Improvement Projects

E-11 Basin Condition Improvement Projects

Basin	E-11

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Inflow Reduction					
F/C replacements	544	38			$ 156,000
Inlet Separation	545	11	2,600		$ 1,755,000
Manhole Rehabilitation					
Construct Benchwall	546	16			$ 16,000
Manhole Lining Rehabilitation	549	14			$ 153,000
Reset F/C	547	3			$ 12,000
Grout Joint/Void (Number of Repairs)	548	23			$ 17,000
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	550			4	$ 37,000
Sewer Main Rehabitilation					
CIPP	542		9,125		$ 1,070,000
Point Repair	543		80		$ 35,000
Grand Total		**105**	**11,805**	**4**	**$ 3,251,000**

F3 – SSES Quantities

Basin	Subbasin	MH Type	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining[a]	Grout Joint/Void	Project ID
E-11	E-11-4	Trunk MH	7005	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	7297	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	7531	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	6996	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	7001	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	7384	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Trunk MH	7495	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	7532	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	7533	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	7535	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	14316	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Trunk MH	37294	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Trunk MH	7383A	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Trunk MH	83064	- - -	- - -	- - -	1	- - -	549
E-11	E-11-4	Collector MH	7388	- - -	1	- - -	- - -	- - -	547
E-11	E-11-4	Collector MH	7391	1	- - -	- - -	- - -	- - -	546
E-11	E-11-4	Collector MH	7392	1	- - -	- - -	- - -	- - -	546
E-11	E-11-4	Collector MH	7393	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Collector MH	7414	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Collector MH	7422	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7423	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7433	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Collector MH	7434	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7445	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7449	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7452	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7489	- - -	- - -	- - -	1	- - -	549
E-11	E-11-5	Collector MH	7491	- - -	- - -	- - -	1	- - -	549
E-11	E-11-5	Collector MH	7501	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7502	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Collector MH	7507	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Collector MH	7510	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7512	1	- - -	- - -	- - -	- - -	546
E-11	E-11-4	Collector MH	7528	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	7567	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	11067	- - -	- - -	- - -	1	- - -	549
E-11	E-11-5	Collector MH	11072	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Collector MH	11073	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	11078	- - -	1	- - -	1	- - -	547, 549
E-11	E-11-5	Collector MH	11079	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Collector MH	11082	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	11084	1	- - -	- - -	- - -	- - -	546
E-11	E-11-5	Collector MH	11085	- - -	- - -	- - -	1	- - -	549
E-11	E-11-5	Collector MH	12601	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Collector MH	12602	- - -	- - -	- - -	1	- - -	549
E-11	E-11-4	Collector MH	14429	- - -	- - -	- - -	1	- - -	549
E-11	E-11-4	Collector MH	15106	- - -	1	- - -	- - -	- - -	547
E-11	E-11-4	Collector MH	83341	- - -	- - -	- - -	1	- - -	549
E-11	E-11-5	Collector MH	83681	- - -	- - -	- - -	1	- - -	549
E-11	E-11-5	Collector MH	11083A	- - -	- - -	- - -	- - -	1	548
E-11	E-11-4	Collector MH	7380A	- - -	- - -	- - -	1	- - -	549
E-11	E-11-4	Collector MH	7417A	- - -	- - -	- - -	- - -	1	548
E-11	E-11-5	Collector MH	7423A	- - -	- - -	- - -	1	- - -	549
E-11	E-11-4	Collector MH	7528A	- - -	- - -	- - -	1	- - -	549
			TOTAL	**16**	**3**	**0**	**13**	**23**	

Note:

[a]Assumes an average depth of 10 VLF per manhole

[b]Measured depth of manhole used for University Heights lining quantities

Segment Identification			Summary Statistics						Segment Recommendation		
Basin	Subbasin	Pipe Facility ID	Diameter (in.)	Material	Length (ft)	Average Depth (ft)	Visible Infiltration Rate (gpd)	Number of Laterals	Priority	Action	Project Number
E-11	E-11-5	8090	12	RCP	283	12.0	12.0	6	3	CIPP	542
E-11	E-11-5	8093	8	VCP	300	6.9	48.0	6	3	CIPP	542
E-11	E-11-5	8098	8	VCP	377	8.9	41.0	8	2	CIPP	542
E-11	E-11-5	8102	8	VCP	290	8.9	36.0	7	2	CIPP	542
E-11	E-11-5	8103	8	VCP	140	10.2	9.0	4	2	CIPP	542
E-11	E-11-5	8106	12	RCP	177	4.7	15.0	2	2	CIPP	542
E-11	E-11-4	8442	8	VCP	350	8.2	56.0	7	3	CIPP	542
E-11	E-11-5	8447	10	VCP	321	21.0	25.0	6	2	CIPP	542
E-11	E-11-5	8448	10	VCP	333	21.0	25.0	6	2	CIPP	542
E-11	E-11-5	8451	8	VCP	199	3.6	35.0	3	2	CIPP	542
E-11	E-11-5	8452	8	VCP	145	8.0	17.0	---	2	CIPP	542
E-11	E-11-5	8453	8	VCP	282	6.3	52.0	7	2	CIPP	542
E-11	E-11-5	8458	8	VCP	200	3.6	32.0	---	2	CIPP	542
E-11	E-11-4	8482	10	VCP	375	7.8	51.0	2	2	CIPP	542
E-11	E-11-4	8637	12	VCP	332	6.6	13.0	---	2	CIPP	542
E-11	E-11-5	8655	8	VCP	143	5.6	18.0	3	2	CIPP	542
E-11	E-11-5	8658	10	VCP	305	16.3	15.0	6	2	CIPP	542
E-11	E-11-5	8659	8/10	VCP	171	6.5	31.0	2	3	CIPP	542
E-11	E-11-5	8661	10	VCP	372	17.9	7.0	4	3	CIPP	542
E-11	E-11-4	11067	10	VCP	407	7.4	37.0	---	3	CIPP/Point Repair	542, 543
E-11	E-11-5	12575	12	RCP	268	11.6	5.0	6	2	CIPP	542
E-11	E-11-4	14736	8	VCP	301	6.6	- - -	---	2	CIPP	542
E-11	E-11-4	14737	8	VCP	326	6.4	17.0	1	3	CIPP	542
E-11	E-11-4	20666	8	VCP	62	5.7	5.0	---	3	Point Repair	543
E-11	E-11-5	22291	8	VCP	402	6.8	44.0	13	3	CIPP/Point Repair	542, 543
E-11	E-11-5	22498	8	VCP	114	7.7	29.0	1	3	CIPP/Point Repair	542, 543
E-11	E-11-5	22502	8	VCP	186	5.5	38.0	2	3	CIPP/Point Repair	542, 543
E-11	E-11-5	22627	8	VCP	146	8.8	23.0	4	3	CIPP/Point Repair	542, 543
E-11	E-11-5	22628	8	VCP	205	9.0	28.0	6	3	CIPP/Point Repair	542, 543
E-11	E-11-5	22633	8	VCP	128	9.3	5.0	2	2	CIPP	542
E-11	E-11-5	22634	8	VCP	108	8.7	15.0	1	2	CIPP	542
E-11	E-11-5	22635	8	VCP	234	7.5	28.0	6	2	CIPP	542
E-11	E-11-5	22636	8	VCP	351	8.1	27.0	9	3	CIPP	542
E-11	E-11-5	22646	8	VCP	223	7.9	1.0	---	3	Point Repair	543
E-11	E-11-5	22649	8	VCP	176	7.6	9.0	1	2	CIPP	542
E-11	E-11-4	22850	8	VCP	220	7.0	25.0	3	2	CIPP	542
E-11	E-11-4	22852	8	VCP	221	7.1	2.0	3	2	CIPP	542
E-11	E-11-4	23036	8	VCP	237	6.6	1.0	1	2	CIPP	542

E-11 Basin—Inflow Reduction (Inlet Disconnection Projects)

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Subbasin	Number of Inlets	Number of Manholes	12" RCP	15" RCP	Project Number
E-11	E-11-5	4	7	---	2,600	545

Table G-2 East Service Area—Inflow Reduction

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
E-11	Inlet	5911 Twickingham Dr	8106	---	7,000	545
E-11	Manhole	5720 Oak Ridge	8118	---	2,000	544
E-11	Manhole	5810 Oak Ridge	8122	---	2,000	544
E-11	Inlet	5100 Memory Ln	8458	---	668,000	545
E-11	Manhole	2830 Turnberry Ln	12145	---	2,000	544
E-11	Manhole	2908 Eastbrooke Dr	21968	---	2,000	544
E-11	Inlet	5707 Twickingham Dr	22502	---	186,000	545
E-11	Inlet	4606 Twickingham Dr	22628	---	668,000	545
E-11	Manhole	---	---	7331	28,000	544
E-11	Manhole	---	---	7332	28,000	544
E-11	Manhole	---	---	7391	28,000	544
E-11	Manhole	---	---	7395	2,000	544
E-11	Manhole	---	---	7396	28,000	544
E-11	Manhole	---	---	7398	28,000	544
E-11	Manhole	---	---	7401	2,000	544
E-11	Manhole	---	---	7402	7,000	544
E-11	Manhole	---	---	7404	28,000	544
E-11	Manhole	---	---	7405	28,000	544
E-11	Manhole	---	---	7406	28,000	544
E-11	Manhole	---	---	7410	28,000	544
E-11	Manhole	---	---	7411	28,000	544
E-11	Manhole	---	---	7414	28,000	544
E-11	Manhole	---	---	7418	16,000	544
E-11	Manhole	---	---	7419	16,000	544
E-11	Manhole	---	---	7420	28,000	544
E-11	Manhole	---	---	7422	7,000	544
E-11	Manhole	---	---	7425	7,000	544
E-11	Manhole	---	---	7426	7,000	544
E-11	Manhole	---	---	7430	7,000	544
E-11	Manhole	---	---	7433	7,000	544
E-11	Manhole	---	---	7434	7,000	544
E-11	Manhole	---	---	7435	7,000	544
E-11	Manhole	---	---	7438	7,000	544
E-11	Manhole	---	---	7444	7,000	544
E-11	Manhole	---	---	7447	7,000	544
E-11	Manhole	---	---	7448	4,000	544
E-11	Manhole	---	---	11068	11,000	544
E-11	Manhole	---	---	82718	7,000	544
E-11	Manhole	---	---	83341	7,000	544
E-11	Manhole	---	---	83681	7,000	544
E-11	Manhole	---	---	169153	28,000	544
E-11	Manhole	---	---	7511A	11,000	544

Table A- Private I&I Removal

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
E-11	Downspout	2220 Heritage Ave	8090	---	7,000	
E-11	Downspout	5418 Memory Ln	8655	---	2,000	
E-11	Downspout	2601 Saint George Rd	8660	---	2,000	
E-11	Downspout	2601 Saint George Rd	8660	---	4,000	
E-11	Downspout	5507 Walsh Rd	22635	---	7,000	

Note:

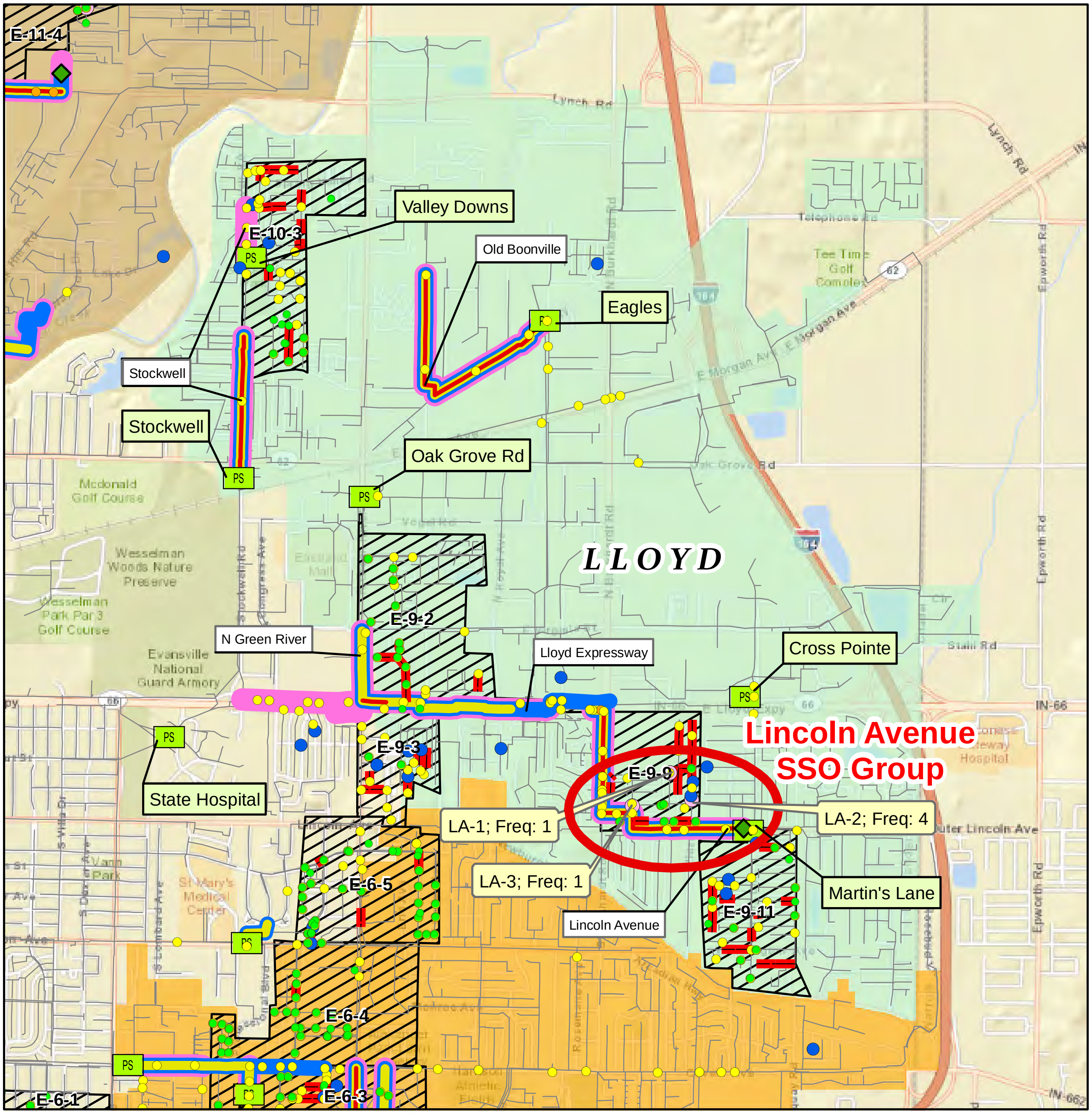
Private I&I Removal Projects were not included in Cost Estiamte and were not assigned Project Numbers

APPENDIX G

Lloyd Expressway Basin

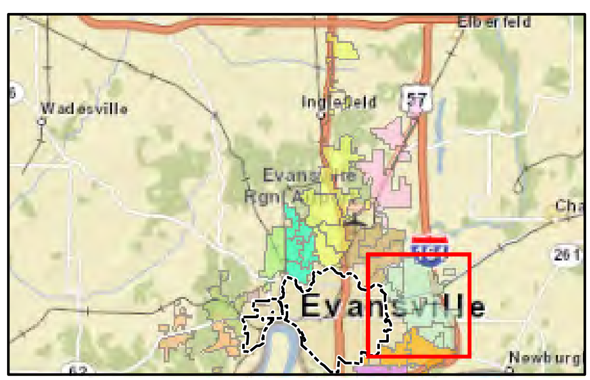
This appendix includes supporting data used to develop the capital costs for capacity and condition improvement projects identified in the Lloyd Expressway Basin. Data is organized in following manner:

Section	Title	Description
Capacity Improvement Projects		
G1	Capital cost summary tables	These tables include project names, descriptions, and summaries of quantities for each storm event, for existing and future flows.
Condition Improvement Projects		
G2	Capital cost summary tables	These tables include project names, descriptions, project IDs, and summaries of quantities.
G3	SSES Quantities	These tables summarize results of field investigations conducted during the SSES



LEGEND

- Inflow Reduction Projects
- Manhole Rehabilitation Projects
- Manhole Invert Change
- Recurring Wet-Weather SSOs in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- PS Added Pumping Capacity
- Sewer Main Rehabilitation
- Added Pipe Capacity (2-Year 3-Hour)
- Added Pipe Capacity (5-Year 3-Hour)
- Added Pipe Capacity (10-Year 3-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin



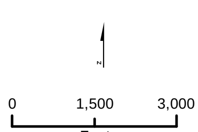
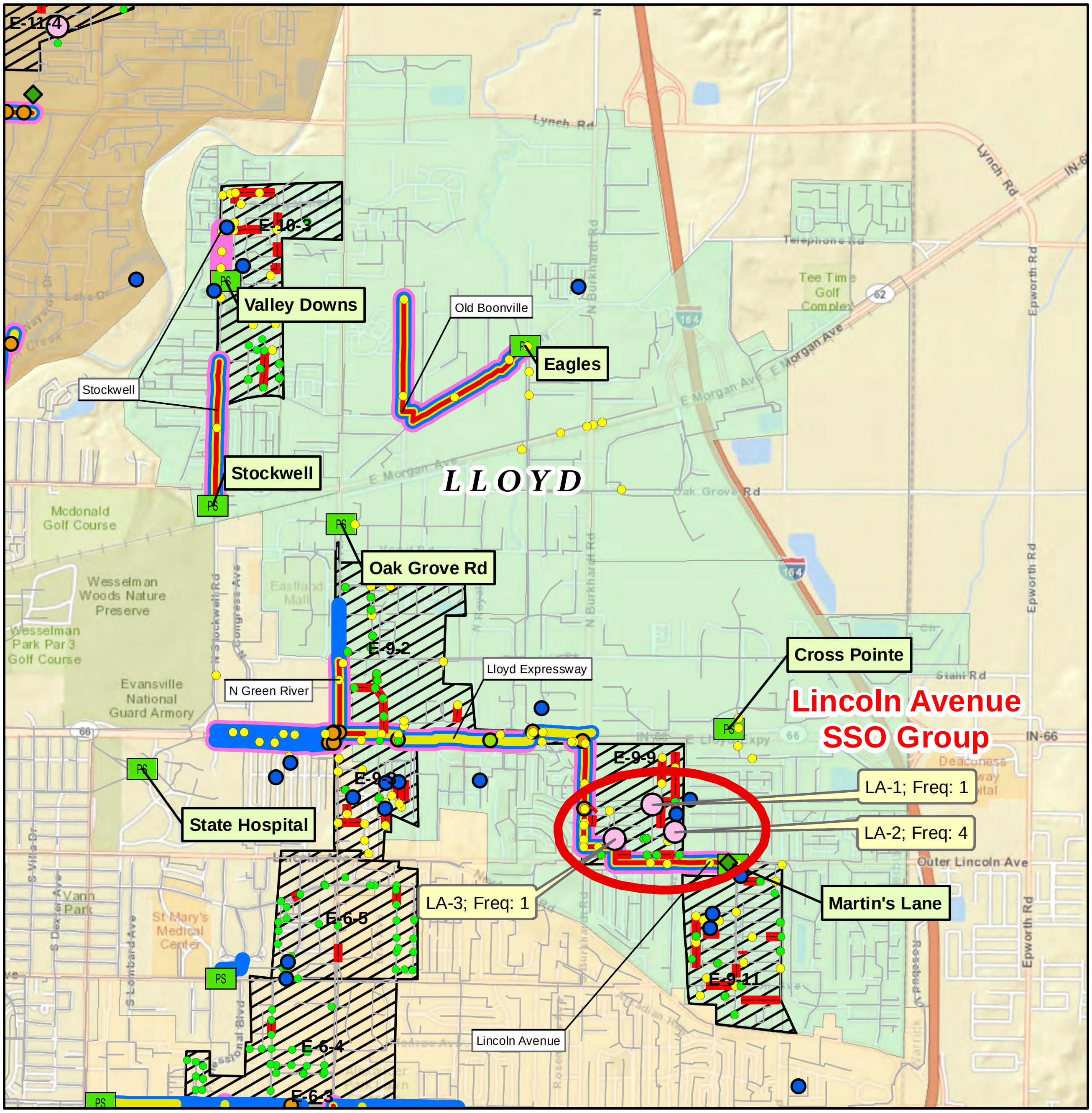


FIGURE G-1

Lloyd Basin, Proposed Capacity Projects for All Storms, 2012 Flows

Sanitary Sewer Remedial Measures Plan, May 2013



- Recurring Wet-Weather SSO in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- Inflow Reduction Project
- Manhole Rehabilitation Project
- Sewer Main Rehabilitation
- Manhole Invert Change
- PS Added Pumping Capacity
- Added Pipe Capacity (2-Year 3-Hour)
- Added Pipe Capacity (5-Year 3-Hour)
- Added Pipe Capacity (10-Year 3-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

N

0 1,000 2,000
Feet

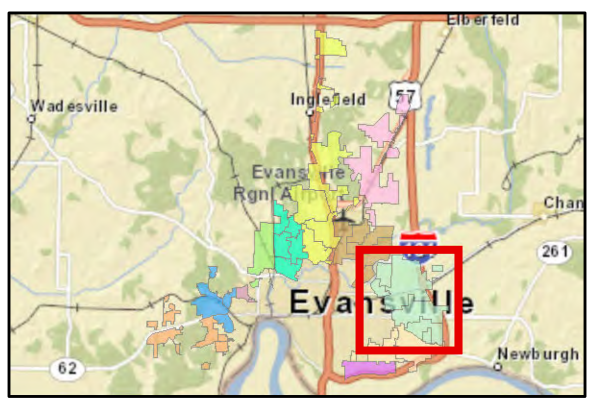


FIGURE G-2
Lloyd Basin, Proposed Capacity Projects for All Storms, 2032 Flows
Sanitary Sewer Remedial Measures Plan, May 2013

renew EVANSVILLE

G1 - Capital Cost Summary Tables for Capacity Improvement Projects

Lloyd Expressway Basin Capacity Improvement Projects, 2012 Flows

Basin	Lloyd
Storm	2 year - 3 Hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Eagles Pump Station	**Additional Pumping Capacity (MGD)**	1.4	1.6		$ 1,040,000
Lincoln Ave	**Manhole Adjustment (elevation)**	383.934	382.79		$ 8,000
		379.594	380.68		$ 11,000
	Relief Sewer (in)	15	24	1,690	$ 1,084,000
		18	24	4,054	$ 2,080,000
		24	24	248	$ 165,000
Lloyd Expressway	**Relief Sewer (in)**	21	24	519	$ 526,000
	Manhole Adjustment (seal MH)	(blank)	(blank)		$ 5,000
Lloyd Outfall Pump Station	**New Pump Station (MGD)**	(blank)	10.2		$ 3,132,000
Old Boonville	**Relief Sewer (in)**	12	15	5,715	$ 3,281,000
		18	24	73	$ 88,000
Stockwell	**Relief Sewer (in)**	12	15	176	$ 143,000
		15	18	2,862	$ 2,039,000
Stockwell Pump Station	**New Pump Station (MGD)**	(blank)	3.1		$ 2,231,000
Martins Lane Pump Station	**Additional Pumping Capacity (MGD)**	3.1	3.2		$ 1,144,000
Grand Total				**15,338**	**$ 16,977,000**

Basin	Lloyd
Storm	5 year - 3 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Eagles Pump Station	**Additional Pumping Capacity (MGD)**	1.4	2		$ 1,066,000
Lincoln Ave	**Manhole Adjustment (elevation)**	383.934	382.79		$ 8,000
		379.594	380.68		$ 11,000
	Relief Sewer (in)	15	24	1,690	$ 1,086,000
		18	24	4,054	$ 2,080,000
		24	24	249	$ 156,000
Lloyd Expressway	**Manhole Adjustment (elevation)**	377.81	377.49		$ 11,000
	Relief Sewer (in)	21	30	519	$ 585,000
		24	30	2,947	$ 3,061,000
Lloyd Outfall Pump Station	**New Pump Station (MGD)**	(blank)	12		$ 3,360,000
North Green River Road	**Relief Sewer (in)**	21	24	1,517	$ 1,017,000
Old Boonville	**Relief Sewer (in)**	12	15	5,715	$ 3,796,000
		18	24	73	$ 88,000
Stockwell	**Relief Sewer (in)**	15	18	3,330	$ 2,313,000
Stockwell Pump Station	**New Pump Station (MGD)**	(blank)	3.4		$ 2,269,000
Cross Pointe Pump Station	**Additional Pumping Capacity (MGD)**	1.7	2		$ 1,066,000
Grand Total				**20,094**	**$ 21,973,000**

Lloyd Expressway Basin Capacity Improvement Projects, 2012 Flows

Basin	Lloyd
Storm	10 year - 3 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Eagles Pump Station	**Additional Pumping Capacity (MGD)**	1.4	2.4		$ 1,092,000
Lincoln Ave	**Manhole Adjustment (elevation)**	383.93	382.79		$ 8,000
		379.59	380.68		$ 11,000
	Relief Sewer (in)	15	24	5,993	$ 3,322,000
Lloyd Expressway	**Manhole Adjustment (elevation)**	377.81	377.49		$ 13,000
	Relief Sewer (in)	18	21	1,264	$ 603,000
		21	30	519	$ 585,000
		24	30	3,843	$ 3,701,000
Lloyd Outfall Pump Station	**New Pump Station (MGD)**	(blank)	13.6		$ 3,563,000
North Green River Road	**Relief Sewer (in)**	21	24	1,517	$ 1,017,000
Old Boonville	**Relief Sewer (in)**	12	15	5,715	$ 3,796,000
		18	24	73	$ 88,000
Stockwell	**Relief Sewer (in)**	15	18	3,034	$ 2,118,000
			21	217	$ 88,000
		18	18	62	$ 58,000
Stockwell Pump Station	**New Pump Station (MGD)**	(blank)	3.9		$ 2,333,000
Cross Pointe Pump Station	**Additional Pumping Capacity (MGD)**	1.7	2.4		$ 1,092,000
Martins Lane Pump Station	**Additional Pumping Capacity (MGD)**	3.1	3.3		$ 1,150,000
Oak Grove Pump Station	**Additional Pumping Capacity (MGD)**	0.5	0.6		$ 950,000
Valley Downs Pump Station	**Additional Pumping Capacity (MGD)**	1.4	1.6		$ 1,040,000
Grand Total				**22,237**	**$ 26,628,000**

Lloyd Expressway Basin Capacity Improvement Projects, 2012 Flows

Basin	Lloyd
Storm	10 year - 24 hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
Eagles Pump Station	**Additional Pumping Capacity (MGD)**	1.4	2.5		$ 1,099,000
Lincoln Ave	**Manhole Adjustment (elevation)**	383.93	382.79		$ 8,000
		379.59	380.68		$ 11,000
	Relief Sewer (in)	15	24	5,707	$ 3,322,000
Lloyd Expressway	**Manhole Adjustment (elevation)**	377.806	377.494		$ 14,000
		376.835	375.99		$ 14,000
		376.263	375.66		$ 15,000
		376.53	375.746		$ 16,000
		376.406	375.882		$ 14,000
		376.333	375.864		$ 14,000
	Relief Sewer (in)	12	12	107	$ 87,000
		21	30	519	$ 588,000
		24	24	723	$ 650,000
			30	3,843	$ 3,701,000
		27	30	2,640	$ 2,554,000
Lloyd Outfall Pump Station	**New Pump Station (MGD)**	(blank)	13.8		$ 3,589,000
North Green River Road	**Relief Sewer (in)**	21	24	1,517	$ 1,017,000
Old Boonville	**Relief Sewer (in)**	12	15	5,539	$ 3,680,000
		18	24	73	$ 88,000
Stockwell	**Relief Sewer (in)**	12	15	795	$ 445,000
			18	377	$ 256,000
		15	15	234	$ 172,000
			18	2,719	$ 1,920,000
Stockwell Pump Station	**New Pump Station (MGD)**	(blank)	3.2		$ 2,244,000
Cross Pointe Pump Station	**Additional Pumping Capacity (MGD)**	1.7	2.3		$ 1,086,000
Martins Lane Pump Station	**Additional Pumping Capacity (MGD)**	3.1	3.2		$ 1,144,000
Oak Grove Pump Station	**Additional Pumping Capacity (MGD)**	0.5	0.6		$ 950,000
Grand Total				**24,793**	**$ 28,698,000**

Lloyd Expressway Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	Lloyd
Storm	2y3h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Lincoln Avenue	**Upsize sewer (in)**	15	24	1,648	$ 1,025,000
		18	24	4,054	$ 1,791,000
		24	24	249	$ 135,000
	MH Adjustment - new invert (El.)	383.934	382.79	0	$ 4,000
		379.594	380.68	0	$ 4,000
Lloyd Expressway	**Upsize sewer (in)**	21	24	519	$ 454,000
Lloyd PS	**New PS (mgd)**	0	10.6	0	$ 3,183,000
N Green River Road	**Upsize sewer (in)**	21	24	1,517	$ 873,000
Old Boonville	**Upsize sewer (in)**	12	15	5,715	$ 3,281,000
		18	24	73	$ 88,000
Stockwell	**Upsize sewer (in)**	15	15	1,800	$ 815,000
			18	1,566	$ 965,000
Stockwell PS	**Upsize PS (mgd)**	2.9	3.1	0	$ 2,231,000
Grand Total				**17,142**	**$ 14,849,000**

Basin	Lloyd
Storm	5y3h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Lincoln Avenue	**Upsize sewer (in)**	15	24	1,690	$ 1,086,000
		18	24	4,054	$ 2,080,000
		24	24	249	$ 156,000
Lloyd Expressway	**Upsize sewer (in)**	18	24	1,480	$ 703,000
		21	27	519	$ 561,000
		24	27	3,664	$ 3,436,000
Lloyd PS	**New PS (mgd)**	0	12.4	0	$ 3,411,000
N Green River Road	**Upsize sewer (in)**	21	24	1,517	$ 873,000
Old Boonville	**Upsize sewer (in)**	12	15	5,715	$ 3,281,000
		18	24	73	$ 88,000
Stockwell	**Upsize sewer (in)**	15	18	3,366	$ 2,116,000
			30	391	$ 350,000
Stockwell PS	**Upsize PS (mgd)**	2.9	3.4	0	$ 2,270,000
Cross Pointe PS	**Upsize PS (mgd)**	1.7	2	0	$ 1,099,000
Grand Total				**22,719**	**$ 21,510,000**

Lloyd Expressway Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	Lloyd
Storm	10y3h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Lincoln Avenue	**Upsize sewer (in)**	15	24	1,690	$ 1,086,000
		18	24	4,054	$ 2,080,000
		24	24	249	$ 156,000
Lloyd Expressway	**Upsize sewer (in)**	18	24	1,480	$ 703,000
		21	30	519	$ 588,000
		24	27	2,910	$ 2,627,000
			30	2,472	$ 2,551,000
		27	30	3,505	$ 3,536,000
Lloyd PS	**New PS (mgd)**	0	14.4	0	$ 3,665,000
N Green River Road	**Upsize sewer (in)**	18	24	1,201	$ 683,000
		21	24	1,517	$ 1,017,000
Old Boonville	**Upsize sewer (in)**	12	15	5,715	$ 3,281,000
		18	24	73	$ 88,000
Stockwell	**Upsize sewer (in)**	15	18	3,391	$ 2,200,000
		27	30	366	$ 266,000
Stockwell PS	**Upsize PS (mgd)**	2.9	3.9	0	$ 2,332,000
Cross Pointe PS	**Upsize PS (mgd)**	1.7	2.5	0	$ 1,099,000
Martins Lane PS	**Upsize PS (mgd)**	3.1	3.3	0	$ 2,256,000
Oak Grove PS	**Upsize PS (mgd)**	0.5	0.7	0	$ 1,920,000
Valley Downs PS	**Upsize PS (mgd)**	1.4	1.6	0	$ 2,041,000
Grand Total				**29,142**	**$ 34,175,000**

Basin	Lloyd
Storm	10y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Lincoln Avenue	**Upsize sewer (in)**	15	24	1,690	$ 1,086,000
		18	24	4,054	$ 2,080,000
		24	24	249	$ 156,000
Lloyd Expressway	**Upsize sewer (in)**	21	30	519	$ 588,000
		24	30	5,326	$ 5,223,000
		(blank)	24	221	$ 123,000
			27	437	$ 319,000
			30	20	$ 32,000
		27	30	3,505	$ 3,536,000
Lloyd PS	**New PS (mgd)**	0	14.5	0	$ 3,678,000
N Green River Road	**Upsize sewer (in)**	21	24	1,517	$ 1,017,000
Old Boonville	**Upsize sewer (in)**	12	15	5,715	$ 3,281,000
		18	24	73	$ 88,000
Stockwell	**Upsize sewer (in)**	12	15	1,028	$ 617,000
		15	18	3,096	$ 2,176,000
		27	30	391	$ 349,000
Stockwell PS	**Upsize PS (mgd)**	2.9	3.2	0	$ 2,245,000
Cross Pointe PS	**Upsize PS (mgd)**	1.7	2.5	0	$ 1,099,000
Oak Grove PS	**Upsize PS (mgd)**	0.5	0.7	0	$ 1,920,000
Grand Total				**27,841**	**$ 29,613,000**

G2 - Capital Cost Summary Tables for Condition Improvement Projects

Lloyd Expressway Basin Condition Improvement Projects

Basin	Lloyd

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Inflow Reduction					
Replace MH Frame/Cover	553	41			$ 168,000
Manhole Rehabilitation					
Construct Benchwall	554	13			$ 13,000
Manhole Lining Rehabilitation	557	31			$ 402,000
Reset MH Frame/Cover	555	16			$ 65,000
Grout Joint/Void (Number of Repairs)	556	66			$ 49,000
Replace MH Frame/Cover	555	6			$ 25,000
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	558			6	$ 55,000
Sewer Main Rehabitilation					
CIPP	551		14,355		$ 1,579,000
Point Repair	552		170		$ 86,000
Grand Total		**173**	**14,525**	**6**	**$ 2,442,000**

G3 – SSES Quantities

Basin	Subbasin	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining*	Grout Joint/Void	Project ID
Lloyd	E-9-2	81200	- - -	- - -	1	- - -	1	555, 556
Lloyd	E-10-3	5791	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	5792	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	5793	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	5867	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	5930	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	5972	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6093	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6094	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	6108	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	6110	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6126	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6134	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6150	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6180	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6248	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	6321	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	6327	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	6332	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	6372	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	6415	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-11	7098	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-11	7104	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-11	7112	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-11	7164	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-11	7207	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-11	7210	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	7212	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	7228	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	7252	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	13877	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	13979	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	14188	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	38949	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	40096	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	73816	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	81076	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	81202	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	81534	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	81578	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	99093	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	5801A	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6199A	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	5776	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	7257A	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	40100	- - -	1	- - -	1	- - -	555, 557
Lloyd	E-10-3	4421	- - -	- - -	- - -	1	- - -	557
Lloyd	E-10-3	5667	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	5970	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	5976	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-2	6147	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	6260	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	6261	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	6368	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	6374	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	6375	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-9	40097	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	40099	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	40100A	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-9	5967	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	5969	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-2	13881	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	6105	- - -	- - -	1	- - -	- - -	555
Lloyd	E-9-3	6371	- - -	- - -	1	- - -	- - -	555

Lloyd	E-9-11	7099	- - -	- - -	1	- - -	- - -	555
Lloyd	E-9-9	5889	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-9	5891	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-9	5910	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-9	5911	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-9	5917	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-2	81073	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-11	3178	- - -	- - -		1	- - -	557
Lloyd	E-10-3	5736	- - -	- - -		1	- - -	557
Lloyd	E-9-9	5846	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-2	279459	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-3	6024	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-9	14055	- - -	- - -	- - -	1	- - -	557
Lloyd	E-10-3	15121	- - -	- - -	- - -	1	- - -	557
Lloyd	E-10-3	4334	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-11	7073	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-9	7239	- - -	- - -	- - -	1	- - -	557
Lloyd	E-9-9	13952	- - -	- - -	- - -	1	- - -	557
Lloyd	E-10-3	5740	- - -	- - -		1	- - -	557
Lloyd	E-9-2	13942	- - -	1	- - -	- - -	1	555, 556
Lloyd	E-10-3	5798	- - -	1	- - -	- - -	1	555, 556
Lloyd	E-10-3	4372	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	4373	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	5784	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	4333	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	4370	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	7234	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	5575	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	4367	- - -	- - -	- - -	- - -	1	556
Lloyd	E-10-3	5758	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-11	7090	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-11	7101	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-3	6054	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	14056	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-9	14058	- - -	- - -	- - -	- - -	1	556
Lloyd	E-9-2	6116	- - -	- - -		- - -	1	556
Lloyd	E-9-2	6117	- - -	- - -		- - -	1	556
Lloyd	E-9-2	6159	- - -	- - -	1	- - -	1	555, 556
Lloyd	E-9-2	6185	- - -	- - -		- - -	1	556
Lloyd	E-9-2	6186	- - -	- - -		1	- - -	557
Lloyd	E-9-2	13918	- - -	- - -	1	1	- - -	555, 557
Lloyd	E-9-2	13919	1	- - -		- - -	1	554, 556
Lloyd	E-9-3	6278	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-11	3180	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-11	3187	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-3	6058	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-3	6060	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-3	6276	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-9	7009	- - -	1	- - -	- - -	- - -	555
Lloyd	E-9-11	7593	1	- - -	- - -	- - -	- - -	554
Lloyd	E-10-3	5797	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-11	7065	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-3	6281	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-3	6282	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-11	7059	1	- - -	- - -	- - -	- - -	554
Lloyd	E-10-3	5795	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-9	5842	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-3	6057	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-3	6061	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-3	6263	1	- - -	- - -	- - -	- - -	554
Lloyd	E-9-3	6279	1	- - -	- - -	- - -	- - -	554
		TOTAL	**13**	**16**	**6**	**31**	**66**	

Note:

[*]Assumes an average depth of 10 VLF per manhole

[b]Measured depth of manhole used for University Heights lining quantities

Segment Identification			Summary Statistics						Segment Recommendation		
Basin	Subbasin	Pipe Facility ID	Diameter (in.)	Material	Length (ft)	Average Depth (ft)	Visible Infiltration Rate (gpd)	Number of Laterals	Priority	Action	Project Number
Lloyd	E-9-9	5604	8	RPM	324	---	1.0	8	2	CIPP	551
Lloyd	E-9-9	5605	8	RPM	340	---	65.0	8	3	CIPP/Point Repair	551, 552
Lloyd	E-9-9	5606	8	VCP	61	8.6	90.0	---	3	CIPP	551
Lloyd	E-9-9	5608	8	RPM	248	7.3	60.0	8	3	Point Repair	552
Lloyd	E-9-9	5609	8	RPM	301	5.6	182.0	6	3	CIPP	551
Lloyd	E-9-9	5612	8	RPM	332	9.4	60.0	8	3	Point Repair	552
Lloyd	E-9-3	6727	8	VCP	515	6.0	69.0	5	3	CIPP	551
Lloyd	E-9-2	6788	8	VCP	456	6.7	14.0	7	2	CIPP	551
Lloyd	E-9-2	6789	10	VCP	84	7.8	61.0	---	3	CIPP/Point Repair	551, 552
Lloyd	E-9-2	6790	10	VCP	380	8.2	34.0	---	3	CIPP	551
Lloyd	E-9-2	6807	10	VCP	193	8.0	275.0	---	2	CIPP	551
Lloyd	E-9-3	6884	8	VCP	113	7.4	10.0	---	2	CIPP	551
Lloyd	E-9-3	6887	8	VCP	444	7.9	62.0	11	2	CIPP	551
Lloyd	E-9-2	6897	10	VCP	390	10.4	123.0	2	3	CIPP/Point Repair	551, 552
Lloyd	E-9-9	6966	8	VCP	280	6.8	3.0	2	2	CIPP	551
Lloyd	E-9-9	6989	8	RPM	251	6.1	152.0	8	3	CIPP/Point Repair	551, 552
Lloyd	E-9-9	6993	8	RPM	85	4.7	60.0	9	2	Point Repair	552
Lloyd	E-10-3	7014	8	RPM	307	2.9	8.0	5	2	CIPP	551
Lloyd	E-9-11	7029	8	VCP	335	7.2	22.0	4	3	CIPP/Point Repair	551, 552
Lloyd	E-10-3	7393	8	RPM	138	3.1	8.0	2	3	CIPP	551
Lloyd	E-10-3	7394	8	RPM	115	3.4	4.0	3	3	CIPP	551
Lloyd	E-10-3	7402	10	RPM	449	8.2	4.0	---	3	CIPP	551
Lloyd	E-10-3	7410	8	RPM	139	4.0	4.0	2	3	CIPP	551
Lloyd	E-9-11	7863	8	VCP	319	---	3.0	1	2	CIPP	551
Lloyd	E-9-11	7881	8	VCP	317	7.5	42.0	6	2	CIPP	551
Lloyd	E-10-3	7967	8	VCP	408	4.1	36.0	16	2	CIPP	551
Lloyd	E-10-3	7968	8	VCP	405	5.0	19.0	18	2	CIPP	551
Lloyd	E-10-3	8205	8	VCP	104	5.6	15.0	4	2	CIPP	551
Lloyd	E-10-3	8206	8	VCP	174	5.3	10.0	3	2	CIPP	551
Lloyd	E-10-3	8207	8	VCP	337	4.6	11.0	10	2	CIPP/Point Repair	551, 552
Lloyd	E-10-3	8208	8	VCP	347	3.6	23.0	13	2	CIPP	551
Lloyd	E-10-3	8209	8	VCP	246	7.2	42.0	6	3	CIPP	551
Lloyd	E-10-3	8211	8	RPM	362	3.1	2.0	5	2	CIPP	551
Lloyd	E-10-3	8216	8	RPM	345	5.0	5.0	6	2	CIPP	551
Lloyd	E-10-3	8217	10	VCP	248	7.0	4.0	---	2	CIPP	551
Lloyd	E-9-2	11334	8	RPM	382	---	60.0	1	3	Point Repair	552
Lloyd	E-9-2	11336	8	RPM	165	5.3	2.0	3	3	CIPP	551
Lloyd	E-9-11	13537	8	VCP	350	6.9	94.0	14	3	CIPP	551
Lloyd	E-9-9	14395	8	VCP	356	4.3	16.0	10	2	CIPP	551
Lloyd	E-9-3	21643	8	RPM	198	4.9	1.0	2	3	CIPP/Point Repair	551, 552
Lloyd	E-9-9	22106	8	DIP	402	12.4	61.0	1	3	CIPP	551
Lloyd	E-9-9	22108	8	VCP	285	5.9	12.0	9	2	CIPP	551
Lloyd	E-9-9	22109	8	VCP	303	---	10.0	8	2	CIPP	551
Lloyd	E-9-9	22505	8	VCP	377	5.8	10.0	8	2	CIPP	551
Lloyd	E-9-3	22777	8	VCP	313	6.8	42.0	5	2	CIPP	551
Lloyd	E-9-3	22779	8	VCP	159	7.1	375.0	2	3	CIPP/Point Repair	551, 552
Lloyd	E-9-3	22780	8	VCP	144	6.0	11.0	3	3	CIPP/Point Repair	551, 552
Lloyd	E-9-3	22783	8	VCP	303	6.0	17.0	3	2	CIPP	551
Lloyd	E-9-11	22795	8	VCP	300	5.0	120.0	10	3	Point Repair	552
Lloyd	E-9-11	22801	8	VCP	69	5.5	4.0	4	2	CIPP/Point Repair	551, 552
Lloyd	E-9-11	23304	8	VCP	196	5.3	40.0	7	2	CIPP	551
Lloyd	E-9-11	23305	8	VCP	233	6.1	172.0	6	2	CIPP	551
Lloyd	E-9-11	23306	8	VCP	416	4.4	91.0	14	3	CIPP	551
Lloyd	E-9-11	23510	8	VCP	427	6.6	2.0	5	2	Point Repair	552
Lloyd	E-9-11	23517	8	VCP	350	7.6	212.0	12	2	CIPP	551
Lloyd	E-9-11	23526	8	VCP	261	6.3	5.0	5	2	Point Repair	552
Lloyd	E-9-11	23527	8	VCP	241	6.7	3.0	3	2	CIPP	551
Lloyd	E-9-11	7032A	8	VCP	183	6.7	19.0	2	2	CIPP	551

Table G-2 East Service Area—Inflow Reduction

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Lloyd	Manhole	---	---	3174	28,000	553
Lloyd	Manhole	---	---	3176	28,000	553
Lloyd	Manhole	---	---	3178	7,000	553
Lloyd	Manhole	---	---	5432	28,000	553
Lloyd	Manhole	---	---	5736	4,000	553
Lloyd	Manhole	---	---	5738	28,000	553
Lloyd	Manhole	---	---	5740	28,000	553
Lloyd	Manhole	---	---	5760	28,000	553
Lloyd	Manhole	---	---	5863	36,000	553
Lloyd	Manhole	---	---	6062	28,000	553
Lloyd	Manhole	---	---	6116	7,000	553
Lloyd	Manhole	---	---	6117	7,000	553
Lloyd	Manhole	---	---	6153	7,000	553
Lloyd	Manhole	---	---	6167	16,000	553
Lloyd	Manhole	---	---	6168	7,000	553
Lloyd	Manhole	---	---	6179	7,000	553
Lloyd	Manhole	---	---	6185	7,000	553
Lloyd	Manhole	---	---	6186	7,000	553
Lloyd	Manhole	---	---	6267	28,000	553
Lloyd	Manhole	---	---	7066	28,000	553
Lloyd	Manhole	---	---	7077	28,000	553
Lloyd	Manhole	---	---	7087	28,000	553
Lloyd	Manhole	---	---	7094	28,000	553
Lloyd	Manhole	---	---	7111	28,000	553
Lloyd	Manhole	---	---	7230	28,000	553
Lloyd	Manhole	---	---	7250	28,000	553
Lloyd	Manhole	---	---	7253	36,000	553
Lloyd	Manhole	---	---	7255	28,000	553
Lloyd	Manhole	---	---	13916	11,000	553
Lloyd	Manhole	---	---	13917	11,000	553
Lloyd	Manhole	---	---	13919	11,000	553
Lloyd	Manhole	---	---	14052	36,000	553
Lloyd	Manhole	---	---	168294	4,000	553
Lloyd	Manhole	2514 Hialeah Dr	7401	---	6,000	553
Lloyd	Manhole	3450 N Green River Dr	12558	---	6,000	553
Lloyd	Manhole	7609 E Mulberry St	13535	---	38,000	553
Lloyd	Manhole	25 Cullen Ave	15050	---	2,000	553
Lloyd	Manhole	25 S Cullen Ave	15050	---	2,000	553
Lloyd	Manhole	2500 Saratoga Dr	22589	---	2,000	553
Lloyd	Manhole	2520 Saratoga Dr	22590	---	2,000	553
Lloyd	Manhole	815 Kirkwood Dr	23299	---	0	553

Table A- Private I&I Removal

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Lloyd	Downspout	2805 Boxwood Ln	7402	---	7,000	
Lloyd	Downspout	2315 Hialeah Dr	7968	---	7,000	
Lloyd	Downspout	2319 Hialeah Dr	7968	---	7,000	
Lloyd	Downspout	901 Park Plaza Dr	23527	---	21,000	

Note:

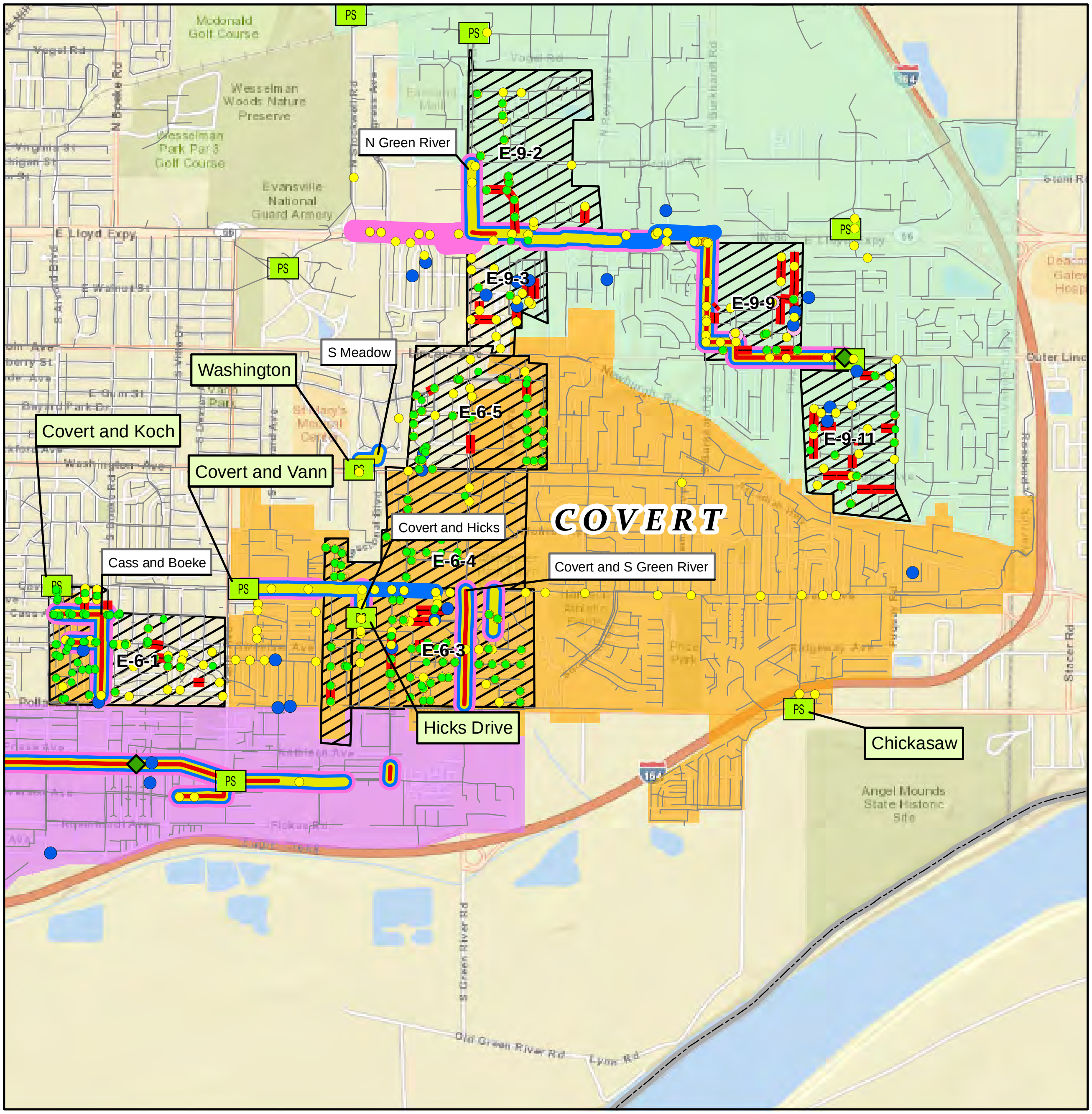
Private I&I Removal Projects were not included in Cost Estiamte and were not assigned Project Numbers

APPENDIX H

Covert Basin

This appendix includes supporting data used to develop the capital costs for capacity and condition improvement projects identified in the Covert Basin. Data is organized in following manner:

Section	Title	Description
Capacity Improvement Projects		
H1	Capital cost summary tables	These tables include project names, descriptions, project IDs, and summaries of quantities for each storm event, for existing and future flows.
Condition Improvement Projects		
H2	Capital cost summary tables	These tables include project names, descriptions, project IDs, and summaries of quantities.
H3	SSES Quantities	These tables summarize results of field investigations conducted during the SSES



LEGEND

- Inflow Reduction Projects
- Manhole Rehabilitation Projects
- Manhole Invert Change
- Recurring Wet-Weather SSOs in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- Added Pumping Capacity
- Sewer Main Rehabilitation
- Added Pipe Capacity (2-Year 3-Hour)
- Added Pipe Capacity (5-Year 3-Hour)
- Added Pipe Capacity (10-Year 3-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

0 1,500 3,000
Feet

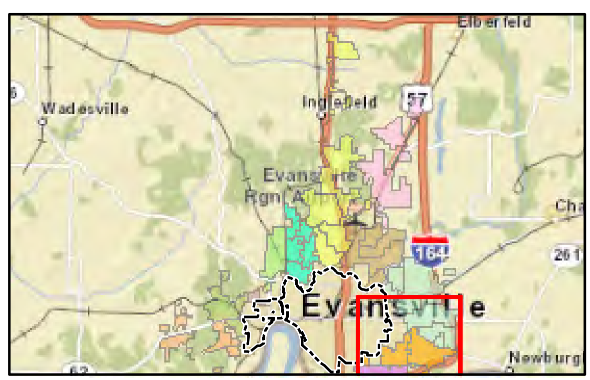
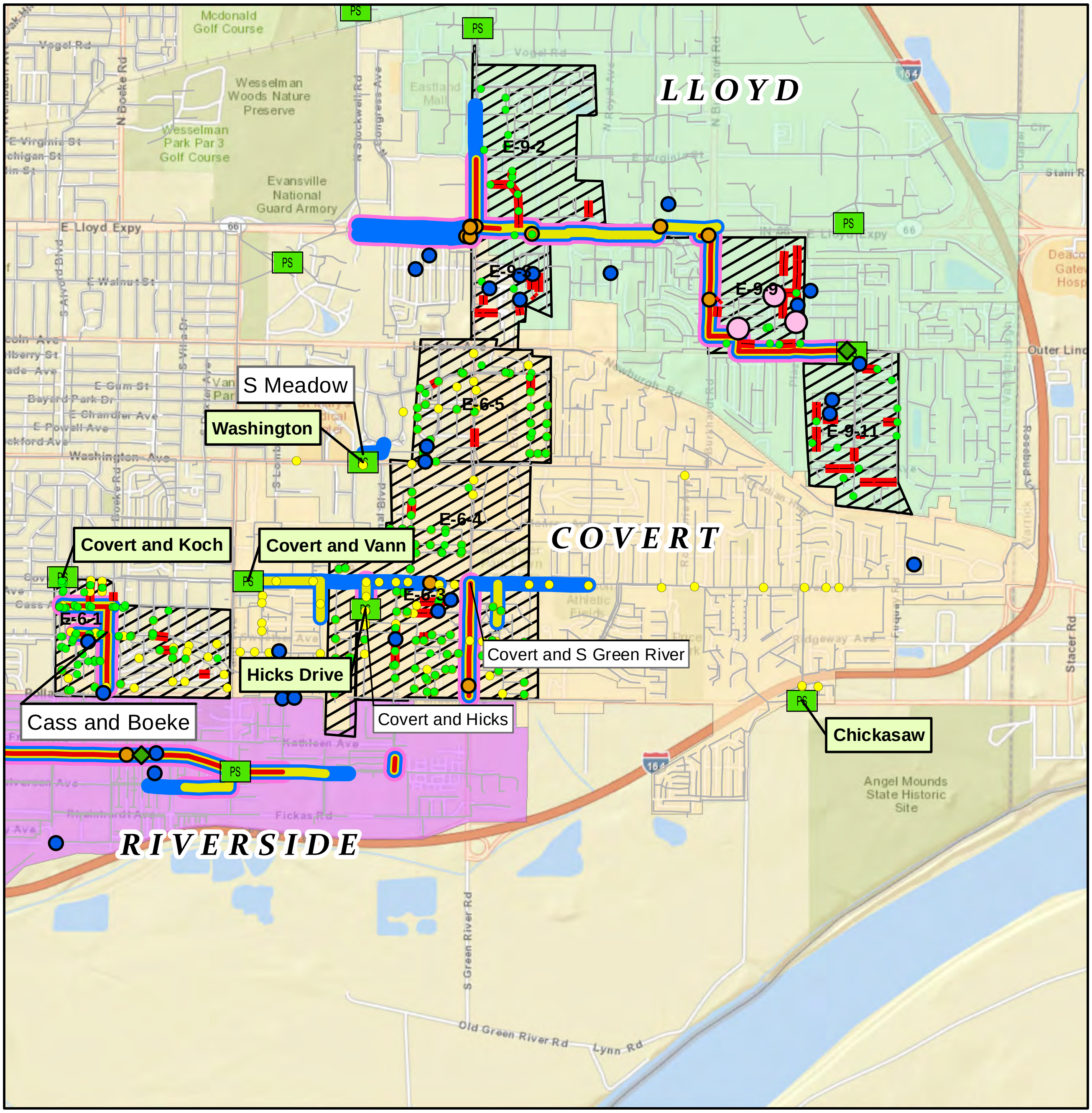


FIGURE H-1

Covert Basin, Proposed Capacity Projects for All Storms, 2012 Flows

Sanitary Sewer Remedial Measures Plan, May 2013

renew EVANSVILLE



LEGEND

- Recurring Wet-Weather SSO in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- Manhole Invert Change
- PS Added Pumping Capacity
- Added Pipe Capacity (2-Year 3-Hour)
- Added Pipe Capacity (5-Year 3-Hour)
- Added Pipe Capacity (10-Year 3-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

N

0 1,000 2,000

Feet

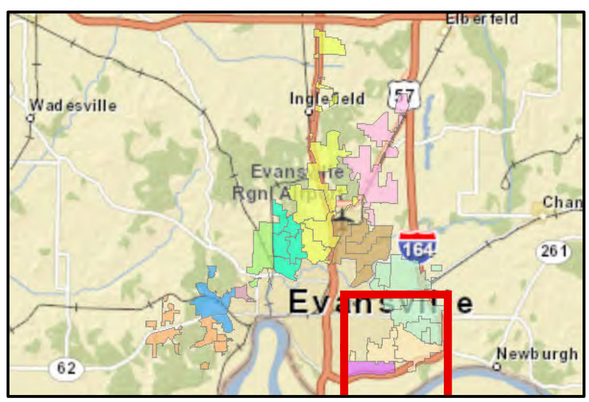


FIGURE H-2
Covert Basin, Proposed Capacity Projects for All Storms, 2032 Flows
Sanitary Sewer Remedial Measures Plan, May 2013

H1 - Capital Cost Summary Tables for Capacity Improvement Projects

Covert Basin Capacity Improvement Projects, 2012 Flows

Basin	Covert
Storm	2 year - 3 Hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost	
Cass & Boeke	**Relief Sewer (in)**	8	18	1,802	$	701,000
		10	18	543	$	233,000
		12	18	463	$	259,000
			24	271	$	114,000
		15	24	301	$	148,000
Covert_1 Outfall	**New Pump Station (MGD)**	(blank)	9.9		$	3,094,000
Covert_2 Outfall	**New Pump Station (MGD)**	(blank)	9.4		$	3,030,000
Covert & South Green River Road	**Relief Sewer (in)**	12	15	2,518	$	1,139,000
Hicks Drive Pump Station	**Additional Pumping Capacity (MGD)**	0.2	0.5		$	907,000
Washington Pump Station	**Additional Pumping Capacity (MGD)**	1.3	2.7		$	787,000
Grand Total				**5,898**	**$**	**10,412,000**

Basin	Covert
Storm	5 year - 3 hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost	
Cass & Boeke	**Relief Sewer (in)**	8	18	1,802	$	701,000
		10	18	543	$	234,000
		12	18	692	$	347,000
			24	271	$	118,000
		15	18	260	$	116,000
			24	301	$	148,000
Chicksaw Pump Station	**Additional Pumping Capacity (MGD)**	0.4	0.6		$	950,000
Covert_1 Outfall	**New Pump Station (MGD)**	(blank)	12.4		$	3,411,000
Covert_2 Outfall	**New Pump Station (MGD)**	(blank)	11.9		$	3,348,000
Covert & South Green River Road	**Relief Sewer (in)**	12	15	870	$	454,000
			18	2,518	$	1,201,000
Covert & Hicks	**Relief Sewer (in)**	10	12	563	$	455,000
		30	36	2,834	$	2,844,000
Hicks Drive Pump Station	**Additional Pumping Capacity (MGD)**	0.2	0.7		$	979,000
Washington Pump Station	**Additional Pumping Capacity (MGD)**	1.3	3.3		$	825,000
South Meadow	**Relief Sewer (in)**	12	18	189	$	122,000
		15	18	599	$	380,000
Grand Total				**11,443**	**$**	**16,633,000**

Covert Basin Capacity Improvement Projects, 2012 Flows

Basin	Covert
Storm	10 year - 3 hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
Cass & Boeke	**Relief Sewer (in)**	8	18	1,802	$ 701,000
		10	18	543	$ 234,000
		12	18	692	$ 347,000
			24	271	$ 118,000
		15	18	260	$ 116,000
			24	301	$ 148,000
Chicksaw Pump Station	**Additional Pumping Capacity (MGD)**	0.4	0.7		$ 979,000
Covert_1 Outfall	**New Pump Station (MGD)**	(blank)	14.4		$ 3,665,000
Covert_2 Outfall	**New Pump Station (MGD)**	(blank)	14.5		$ 3,678,000
Covert & South Green River Road	**Relief Sewer (in)**	12	15	870	$ 454,000
			18	2,518	$ 1,201,000
Covert & Hicks	**Relief Sewer (in)**	10	18	236	$ 170,000
			36	26	$ 45,000
		30	18	647	$ 483,000
			36	4,275	$ 4,604,000
Hicks Drive Pump Station	**Additional Pumping Capacity (MGD)**	0.2	0.8		$ 997,000
Washington Pump Station	**Additional Pumping Capacity (MGD)**	1.3	3.7		$ 851,000
South Meadow	**Relief Sewer (in)**	12	18	189	$ 122,000
		15	18	599	$ 380,000
Grand Total				**13,228**	**$ 19,293,000**

Basin	Covert
Storm	10 year - 24 hour

Row Labels	Description	Existing Size	Proposed Size	Values Sum of Length	Total Capital Cost
Cass & Boeke	**Relief Sewer (in)**	8	18	1,802	$ 701,000
		10	18	543	$ 234,000
		12	18	692	$ 347,000
			24	271	$ 118,000
		15	18	260	$ 116,000
			24	301	$ 148,000
Chicksaw Pump Station	**Additional Pumping Capacity (MGD)**	0.4	0.6		$ 950,000
Covert_1 Outfall	**New Pump Station (MGD)**	(blank)	9.3		$ 3,018,000
Covert_2 Outfall	**New Pump Station (MGD)**	(blank)	4.7		$ 2,434,000
Covert & South Green River Road	**Relief Sewer (in)**	12	15	870	$ 454,000
			18	2,518	$ 1,201,000
Covert & Hicks	**Relief Sewer (in)**	10	15	563	$ 474,000
		30	36	1,625	$ 1,552,000
Hicks Drive Pump Station	**Additional Pumping Capacity (MGD)**	0.2	0.7		$ 979,000
Washington Pump Station	**Additional Pumping Capacity (MGD)**	1.3	1.9		$ 735,000
Grand Total				**9,445**	**$ 13,461,000**

Covert Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	Covert
Storm	2y3h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Cass and Boeke	**Upsize sewer (in)**	8	18	1,802	$ 678,000
		10	18	543	$ 230,000
		12	18	463	$ 259,000
			24	271	$ 118,000
		15	24	301	$ 148,000
Chickasaw	**New PS (mgd)**	0.4	0.5	0	$ 907,000
Covert_1 PS	**New PS (mgd)**	0	10.1	0	$ 3,119,000
Covert_2 PS	**New PS (mgd)**	0	9.4	0	$ 3,030,000
Green River	**Upsize sewer (in)**	12	15	2,518	$ 1,137,000
Hicks PS	**Upsize PS (mgd)**	0.2	0.6	0	$ 1,864,000
Washiington PS	**Upsize PS (mgd)**	1.3	2.7	0	$ 787,000
Grand Total				**5,898**	**$ 12,277,000**

Basin	Covert
Storm	5 year - 3 hour

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Total Capital Cost
Green River Road Capacity Improvement Projects	**Storage Basin (MG)**	0	1.6	0	$ 6,136,000
	Storage Dewatering (MGD)	0	0.53	0	$ 1,381,000
Clayton Ave Capacity Improvement Projects	**Storage Basin (MG)**	0	0.3	0	$ 2,925,000
	Storage Dewatering (MGD)	0	0.15	0	$ 846,000
Grand Total				**0**	**$ 11,288,000**

Covert Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	Covert
Storm	10y3h

Project Name	Description	Existing Size	Proposed Size	Sum of Pipe Length (ft)	Sum of Capital Cost
Cass and Boeke	**Upsize sewer (in)**	8	18	1,802	$ 678,000
		10	18	543	$ 230,000
		12	18	692	$ 344,000
			24	271	$ 118,000
		15	18	260	$ 116,000
			24	301	$ 148,000
Chickasaw	**Upsize PS (mgd)**	0.4	0.7	0	$ 979,000
Covert_1 PS	**New PS (mgd)**	0	14.5	0	$ 3,678,000
Covert_2 PS	**New PS (mgd)**	0	14.5	0	$ 3,678,000
Green River	**Upsize sewer (in)**	12	18	3,387	$ 1,677,000
		27	30	3,089	$ 3,549,000
Hicks	**Upsize sewer (in)**	10	18	563	$ 485,000
		12	18	814	$ 486,000
		30	36	4,482	$ 4,821,000
Hicks PS	**Upsize PS (mgd)**	0.2	0.8	0	$ 1,957,000
Washiington PS	**Upsize PS (mgd)**	1.3	3.7	0	$ 851,000
South Meadow	**Upsize sewer (in)**	15	18	599	$ 380,000
Grand Total				**16,804**	**$ 24,175,000**

Basin	Covert
Storm	10y24h

Project Name	Description	Existing Size	Proposed Size	Sum of Pipe Length (ft)	Sum of Capital Cost
Cass and Boeke	**Upsize sewer (in)**	8	18	1,802	$ 678,000
		10	18	543	$ 230,000
		12	18	463	$ 259,000
			24	271	$ 118,000
		15	24	301	$ 148,000
Chickasaw	**Upsize PS (mgd)**	0.4	0.6	0	$ 950,000
Covert_1 PS	**New PS (mgd)**	0	9.2	0	$ 3,005,000
Covert_2 PS	**New PS (mgd)**	0	4.7	0	$ 2,434,000
Green River	**Upsize sewer (in)**	12	15	2,518	$ 1,211,000
Hicks	**Upsize sewer (in)**	10	18	563	$ 485,000
Hicks PS	**Upsize PS (mgd)**	0.2	0.6	0	$ 1,864,000
Washiington PS	**Upsize PS (mgd)**	1.3	1.9	0	$ 735,000
Grand Total				**6,461**	**$ 12,117,000**

H2 - Capital Cost Summary Tables for Condition Improvement Projects

Covert Basin Condition Improvement Projects

Basin	Covert

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Inflow Reduction					
F/C replacements	561	118			$ 483,000
Inlet Separation	562	21	660		$ 651,000
Manhole Rehabilitation					
Construct Benchwall	563	38			$ 39,000
Manhole Lining Rehabilitation	566	21			$ 230,000
Reset F/C	564	9			$ 37,000
Grout Joint/Void (Number of Repairs)	565	52			$ 39,000
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	567			3	$ 28,000
Sewer Main Rehabitilation					
CIPP	559		4,566		$ 511,000
Point Repair	560		130		$ 120,000
Grand Total		**259**	**5,356**	**3**	**$ 2,138,000**

H3 – SSES Quantities

Basin	Subbasin	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining*	Grout Joint/Void	Project ID
Covert	E-6-3	10033	- - -	- - -	- - -	- - -	1	565
Covert	E-6-1	3977	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10053	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10049	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	2943	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	2944	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	2945	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	9942	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	2939	- - -	- - -	- - -	- - -	1	565
Covert	E-6-4	3031	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	3039	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	3201	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	3203	- - -	- - -	- - -	- - -	1	565
Covert	E-6-5	3299	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	3482	- - -	- - -	- - -	- - -	1	565
Covert	E-6-5	6929	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	9951	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	9976	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	9992	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10106	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10110	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10155	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10158	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10464	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10559	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10564	- - -	- - -	- - -	- - -	1	565
Covert	E-6-5	14209	- - -	- - -	- - -	- - -	1	565
Covert	E-6-4	71020	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	14112A	- - -	- - -	- - -	1	- - -	566
Covert	E-6-1	2761A	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	10050	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	10052	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	10111	- - -	- - -	- - -	1	- - -	566
Covert	E-6-1	67495	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	280539	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	9976A	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	2946	- - -	- - -	- - -	1	- - -	566
Covert	E-6-1	3372	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	9929	- - -	1	- - -	- - -	- - -	564
Covert	E-6-3	9931	- - -	1	- - -	- - -	- - -	564
Covert	E-6-3	9933	- - -	1	- - -	- - -	- - -	564
Covert	E-6-3	9980	- - -	1	- - -	- - -	- - -	564
Covert	E-6-3	14110	- - -	1	- - -	- - -	- - -	564
Covert	E-6-4	69707	- - -	1	- - -	- - -	- - -	564
Covert	E-6-3	280537	- - -	1	- - -	- - -	- - -	564
Covert	E-6-5	6958A	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	3411A	1	- - -	- - -	- - -	- - -	563
Covert	E-6-4	2682	1	- - -	- - -	- - -	- - -	563
Covert	E-6-4	2683	- - -	- - -	- - -	1	- - -	566
Covert	E-6-4	70779	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	70123	- - -	- - -	- - -	- - -	1	565
Covert	E-6-1	67497	1	- - -	- - -	- - -	- - -	563
Covert	E-3-1	50139	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	39819	- - -	1	- - -	- - -	- - -	564
Covert	E-6-3	14271	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	14270	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10114	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10100	- - -	- - -	- - -	- - -	1	565
Covert	E-6-4	3018	- - -	- - -	- - -	- - -	1	565
Covert	E-6-4	3019	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	3022	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	3043	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10086	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	3099	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	3105	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10061	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	10060	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	10058	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	3405	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	10035	- - -	1	- - -	- - -	- - -	564
Covert	E-6-1	9919	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	9915	- - -	- - -	- - -	1	- - -	566
Covert	E-6-1	9914	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	9886	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	9877	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	9875	1	- - -	- - -	- - -	- - -	563
Covert	E-6-5	6975	1	- - -	- - -	- - -	- - -	563
Covert	E-6-5	6974	1	- - -	- - -	- - -	- - -	563
Covert	E-6-5	6971	1	- - -	- - -	- - -	- - -	563
Covert	E-6-4	3953	- - -	- - -	- - -	- - -	1	565
Covert	E-6-5	6950	- - -	- - -	- - -	- - -	1	565
Covert	E-6-1	3988	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	4011	1	- - -	- - -	- - -	- - -	563

Covert	E-6-5	6514	1	- - -	- - -	- - -	- - -	563
Covert	E-6-5	6513	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	4014	1	- - -	- - -	- - -	- - -	563
Covert	E-6-5	6446	1	- - -	- - -	- - -	- - -	563
Covert	E-6-5	6458	- - -	- - -	- - -	- - -	1	565
Covert	E-6-5	6460	- - -	- - -	- - -	- - -	1	565
Covert	E-6-5	6461	- - -	- - -	- - -	1	- - -	566
Covert	E-6-5	6441	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	4012	1	- - -	- - -	- - -	- - -	563
Covert	E-6-5	6946	- - -	- - -	- - -	1	- - -	566
Covert	E-6-1	3995	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	3987	1	- - -	- - -	1	- - -	563, 566
Covert	E-6-1	3980	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	10036	- - -	- - -	- - -	1	- - -	566
Covert	E-6-1	3411	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	10046	- - -	- - -	- - -	- - -	1	565
Covert	E-6-1	3397	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10055	- - -	- - -	- - -	1	- - -	566
Covert	E-6-1	3378	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	3365	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	3364	1	- - -	- - -	- - -	- - -	563
Covert	E-6-1	3362	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	10062	1	- - -	- - -	- - -	- - -	563
Covert	E-6-3	10071	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10073	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10076	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10080	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	10084	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10089	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	3041	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	3040	- - -	- - -	- - -	1	- - -	566
Covert	E-6-3	10090	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	10091	- - -	- - -	- - -	- - -	1	565
Covert	E-6-3	14235	- - -	- - -	- - -	- - -	1	565
Covert	E-6-1	2696	1	- - -	- - -	- - -	- - -	563
Covert	E-6-4	70782	- - -	- - -	- - -	- - -	1	565
		TOTAL	**38**	**9**	**0**	**21**	**52**	

Note:

[a]Assumes an average depth of 10 VLF per manhole

[b]Measured depth of manhole used for University Heights lining quantities

Segment Identification			Summary Statistics						Segment Recommendation		
Basin	Subbasin	Pipe Facility ID	Diameter (in.)	Material	Length (ft)	Average Depth (ft)	(gpd)	Number of Laterals	Priority	Action	Number
Covert	E-6-3	5567	8	CP	340	4.9	11.0	5	2	CIPP	559
Covert	E-6-3	5575	8	RPM	298	3.2	1.0	1	2	CIPP	559
Covert	E-6-1	12626	8	VCP	253	7.0	51.0	9	2	CIPP	559
Covert	E-6-1	12680	8	VCP	264	7.0	38.0	11	2	CIPP	559
Covert	E-6-1	12691	8	VCP	263	8.4	20.0	10	2	CIPP	559
Covert	E-6-1	21483	8	VCP	300	6.1	10.0	7	2	CIPP	559
Covert	E-6-5	23261	10	CSU	194	---	1.0	0	2	CIPP	559
Covert	E-6-3	23292	10	VCP	374	4.2	12.0	11	2	CIPP	559
Covert	E-6-3	5577	8	RPM	325	4.4	8.0	9	3	CIPP	559
Covert	E-6-5	6701	8	VCP	71	7.0	1.0	0	3	CIPP	559
Covert	E-6-1	5556	8	VCP	238	9.0	1081.0	8	3	CIPP/Point Repair	559, 560
Covert	E-6-3	5565	8	VCP	378	5.4	55.0	7	3	CIPP/Point Repair	559, 560
Covert	E-6-3	5576	8	RPM	298	4.0	- - -	9	3	CIPP/Point Repair	559, 560
Covert	E-6-1	6127	8	VCP	232	---	32.0	5	3	CIPP/Point Repair	559, 560
Covert	E-6-3	6140	8	VCP	298	2.7	45.0	6	3	CIPP/Point Repair	559, 560
Covert	E-6-3	6141	8	CP	253	4.8	7.0	2	3	CIPP/Point Repair	559, 560
Covert	E-6-3	23037	8	VCP	187	6.8	579.0	6	3	CIPP/Point Repair	559, 560
Covert	E-6-5	7305	8	RPM	388	9.6	1.0	2	3	Point Repair	560
Covert	E-6-4	11160	8	RPM	252	8.1	5.0	7	3	Point Repair	560
Covert	E-6-1	11362	8	VCP	367	---	2.0	6	3	Point Repair	560
Covert	E-6-5	22656	8	VCP	362	6.4	29.0	8	3	Point Repair	560
Covert	E-6-5	23163	8	RPM	167	3.6	4.0	1	3	Point Repair	560
Covert	E-6-5	23164	8	RPM	215	5.3	1.0	0	3	Point Repair	560

Covert Basin—Inflow Reduction (Inlet Disconnection Projects)

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Subbasin	Number of Inlets	Number of Manholes	12" RCP	15" RCP	Project Number
Covert	E-6-1	4	3	140	---	562
Covert	E-6-3	4	2	140	---	562
Covert	E-6-4	3	2	280	---	562
Covert	E-6-5	2	1	100	---	562

Table G-2 East Service Area—Inflow Reduction

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Covert	Inlet	2457 Sweetser Ave	6653	---	186,000	562
Covert	Inlet	4600 Taylor Ave	6667	---	668,000	562
Covert	Inlet	5200 Bellemeade Ave	7279	---	668,000	562
Covert	Manhole	2619 Cass Ave	11359	---	0	561
Covert	Inlet	4601 Taylor Ave	11376	---	38,000	562
Covert	Inlet	---	21475	---	186,000	562
Covert	Inlet	---	21475	---	186,000	562
Covert	Inlet	705 S Hoosier Ave	22656	---	668,000	562
Covert	Manhole	4500 Washington Ave	23163	---	7,000	561
Covert	Manhole	4801 Lincoln Ave	23266	---	668,000	561
Covert	Manhole	1901 Broadmoor Ave	23295	---	7,000	561
Covert	Manhole	1901 S Taft Ave	24499	---	668,000	561
Covert	Manhole	---	---	2648	28,000	561
Covert	Manhole	---	---	2682	28,000	561
Covert	Manhole	---	---	2683	28,000	561
Covert	Manhole	---	---	2686	2,000	561
Covert	Manhole	---	---	2726	16,000	561
Covert	Manhole	---	---	2729	28,000	561
Covert	Manhole	---	---	2785	14,000	561
Covert	Manhole	---	---	3018	7,000	561
Covert	Manhole	---	---	3019	7,000	561
Covert	Manhole	---	---	3022	4,000	561
Covert	Manhole	---	---	3043	7,000	561
Covert	Manhole	---	---	3046	14,000	561
Covert	Manhole	---	---	3053	28,000	561
Covert	Manhole	---	---	3054	28,000	561
Covert	Manhole	---	---	3056	28,000	561
Covert	Manhole	---	---	3099	7,000	561
Covert	Manhole	---	---	3100	7,000	561
Covert	Manhole	---	---	3101	7,000	561
Covert	Manhole	---	---	3102	7,000	561
Covert	Manhole	---	---	3105	7,000	561
Covert	Manhole	---	---	3107	11,000	561
Covert	Manhole	---	---	3198	11,000	561
Covert	Manhole	---	---	3313	28,000	561
Covert	Manhole	---	---	3315	7,000	561
Covert	Manhole	---	---	3370	278,000	561
Covert	Manhole	---	---	3381	11,000	561
Covert	Manhole	---	---	3401	11,000	561
Covert	Manhole	---	---	3404	11,000	561
Covert	Manhole	---	---	3405	14,000	561
Covert	Manhole	---	---	3506	2,000	561
Covert	Manhole	---	---	3509	28,000	561
Covert	Manhole	---	---	3510	28,000	561
Covert	Manhole	---	---	3511	28,000	561
Covert	Manhole	---	---	3512	28,000	561
Covert	Manhole	---	---	3514	28,000	561
Covert	Manhole	---	---	3515	28,000	561
Covert	Manhole	---	---	3516	28,000	561
Covert	Manhole	---	---	3517	28,000	561
Covert	Manhole	---	---	3865	14,000	561
Covert	Manhole	---	---	3952	28,000	561
Covert	Manhole	---	---	3953	28,000	561
Covert	Manhole	---	---	3954	28,000	561

Covert	Manhole	---	---	3955	28,000	561
Covert	Manhole	---	---	3956	28,000	561
Covert	Manhole	---	---	3979	111,000	561
Covert	Manhole	---	---	3988	18,000	561
Covert	Manhole	---	---	4004	28,000	561
Covert	Manhole	---	---	4007	28,000	561
Covert	Manhole	---	---	4008	28,000	561
Covert	Manhole	---	---	4011	28,000	561
Covert	Manhole	---	---	4014	16,000	561
Covert	Manhole	---	---	6446	14,000	561
Covert	Manhole	---	---	6448	28,000	561
Covert	Manhole	---	---	6455	28,000	561
Covert	Manhole	---	---	6456	28,000	561
Covert	Manhole	---	---	6458	28,000	561
Covert	Manhole	---	---	6459	28,000	561
Covert	Manhole	---	---	6460	28,000	561
Covert	Manhole	---	---	6461	28,000	561
Covert	Manhole	---	---	6462	28,000	561
Covert	Manhole	---	---	6463	28,000	561
Covert	Manhole	---	---	6489	28,000	561
Covert	Manhole	---	---	6490	28,000	561
Covert	Manhole	---	---	6516	28,000	561
Covert	Manhole	---	---	6941	28,000	561
Covert	Manhole	---	---	6943	7,000	561
Covert	Manhole	---	---	6946	14,000	561
Covert	Manhole	---	---	6948	14,000	561
Covert	Manhole	---	---	6951	14,000	561
Covert	Manhole	---	---	6952	28,000	561
Covert	Manhole	---	---	6954	14,000	561
Covert	Manhole	---	---	6955	28,000	561
Covert	Manhole	---	---	6957	14,000	561
Covert	Manhole	---	---	6958	14,000	561
Covert	Manhole	---	---	6968	28,000	561
Covert	Manhole	---	---	6970	28,000	561
Covert	Manhole	---	---	6976	28,000	561
Covert	Manhole	---	---	6979	28,000	561
Covert	Manhole	---	---	9881	28,000	561
Covert	Inlet	3100 Conlin Ave	---	9888	668,000	562
Covert	Manhole	---	---	10005	7,000	561
Covert	Manhole	---	---	10006	7,000	561
Covert	Manhole	---	---	10032	7,000	561
Covert	Manhole	---	---	10036	4,000	561
Covert	Manhole	---	---	10044	4,000	561
Covert	Manhole	---	---	10046	4,000	561
Covert	Manhole	---	---	10047	4,000	561
Covert	Manhole	---	---	10048	4,000	561
Covert	Manhole	---	---	10055	36,000	561
Covert	Manhole	---	---	10056	4,000	561
Covert	Manhole	---	---	10062	4,000	561
Covert	Manhole	---	---	10071	2,000	561
Covert	Manhole	---	---	10073	11,000	561
Covert	Manhole	---	---	10074	2,000	561
Covert	Manhole	---	---	10075	2,000	561
Covert	Manhole	---	---	10076	11,000	561
Covert	Manhole	---	---	10078	32,000	561
Covert	Manhole	---	---	10079	14,000	561
Covert	Manhole	---	---	10080	11,000	561
Covert	Manhole	---	---	10083	11,000	561
Covert	Manhole	---	---	10084	11,000	561

Covert	Manhole	---	---	10087	2,000	561
Covert	Manhole	---	---	10088	11,000	561
Covert	Manhole	---	---	10089	2,000	561
Covert	Manhole	---	---	10090	2,000	561
Covert	Manhole	---	---	10091	2,000	561
Covert	Manhole	---	---	10092	11,000	561
Covert	Manhole	---	---	14235	14,000	561
Covert	Manhole	---	---	69701	7,000	561
Covert	Manhole	---	---	69702	14,000	561
Covert	Inlet	4531 Greencove Ave	---	70121	668,000	562
Covert	Inlet	4530 Greencove Ave	---	70121	668,000	562
Covert	Inlet	1745 Burdette Ave	---	70137	186,000	562
Covert	Inlet	1745 Burdette Ave	---	70137	371,000	562
Covert	Manhole	---	---	70755	28,000	561
Covert	Inlet	1109 S Green River Rd	---	70776	668,000	562
Covert	Manhole	---	---	70781	28,000	561
Covert	Manhole	---	---	70782	32,000	561
Covert	Manhole	---	---	71049	28,000	561

Table A- Private I&I Removal

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Covert	Downspout	---	6522	---	7,000	
Covert	Downspout	---	6522	---	7,000	
Covert	Downspout	4606 Jackson Ave	6669	---	7,000	
Covert	Downspout	1916 S Parker Dr	7089	---	7,000	
Covert	Downspout	2024 S Parker Dr	14519	---	7,000	
Covert	Downspout	1824 S Fairlawn Ave	22117	---	7,000	
Covert	Downspout	1931 Euclid Dr	22605	---	7,000	
Covert	Downspout	844 S Hoosier Ave	22653	---	2,000	
Covert	Downspout	2301 Conlin Ave	23297	---	7,000	
Covert	Downspout	4619 Cass Ave	---	10108	0	

Note:

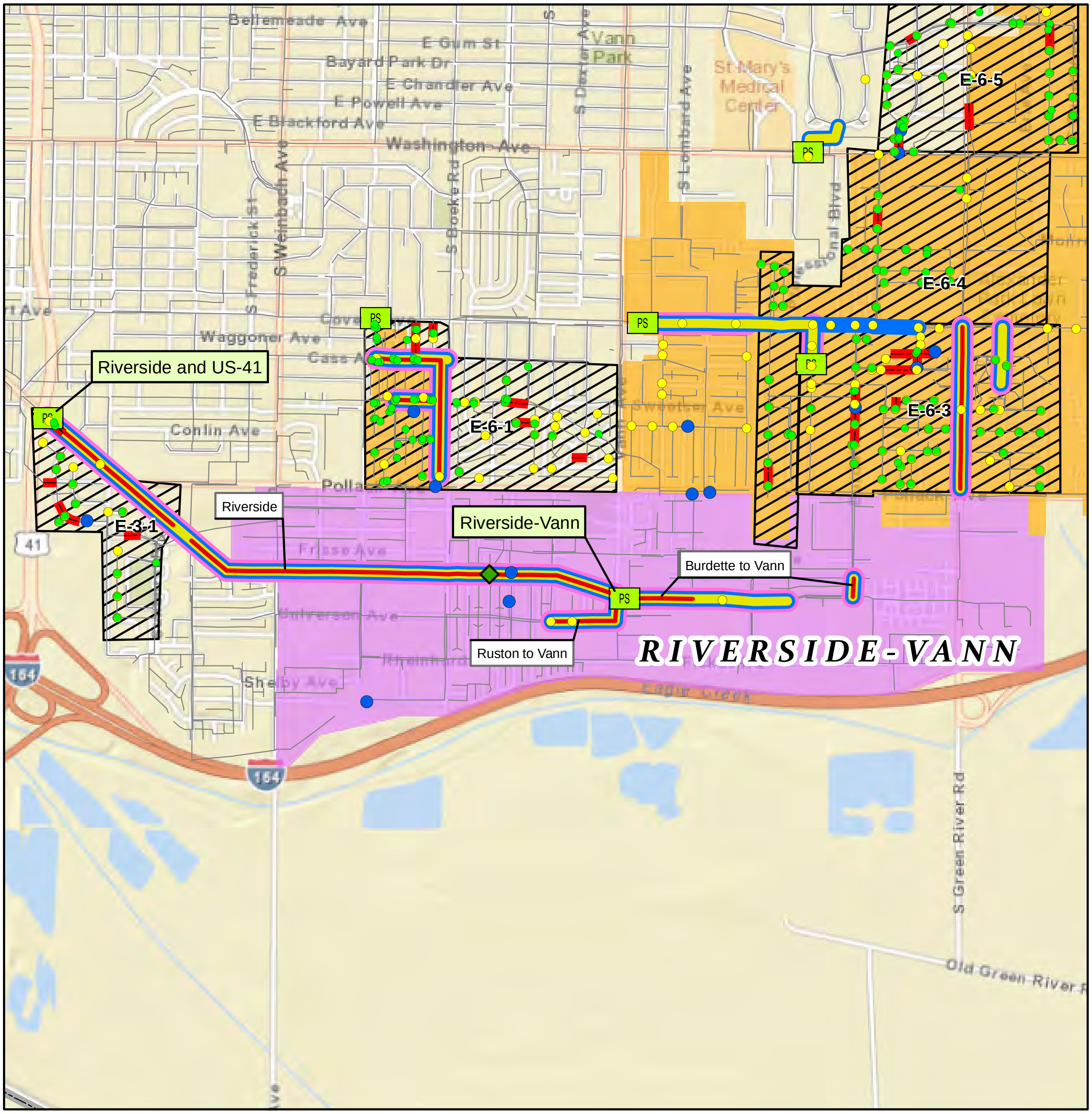
Private I&I Removal Projects were not included in Cost Estiamte and were not assigned Project Numbers

APPENDIX I

Riverside-Vann Basin

This appendix includes supporting data used to develop the capital costs for capacity and condition improvement projects identified in the Riverside-Vann Basin. Data is organized in following manner:

Section	Title	Description
Capacity Improvement Projects		
I1	Capital cost summary tables	These tables include project names, and summaries of quantities for each storm event, for existing and future flows.
Condition Improvement Projects		
I2	Capital cost summary tables	These tables include project names, descriptions, project IDs, and summaries of quantities.
I3	SSES Quantities	These tables summarize results of field investigations conducted during the SSES



LEGEND

- Inflow Reduction Projects
- Manhole Rehabilitation Projects
- Manhole Invert Change
- Recurring Wet-Weather SSOs in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- PS Added Pumping Capacity
- Sewer Main Rehabilitation
- Added Pipe Capacity (2-Year 3-Hour)
- Added Pipe Capacity (5-Year 3-Hour)
- Added Pipe Capacity (10-Year 3-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

0 1,000 2,000
Feet

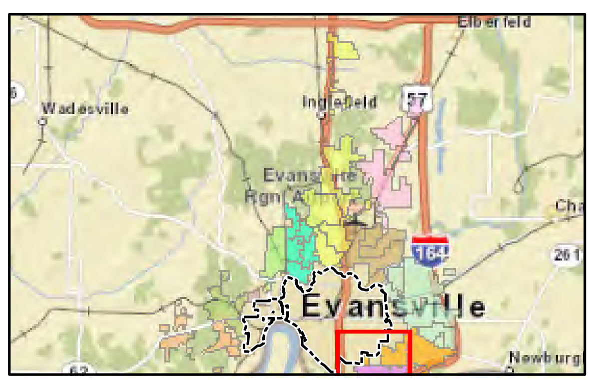
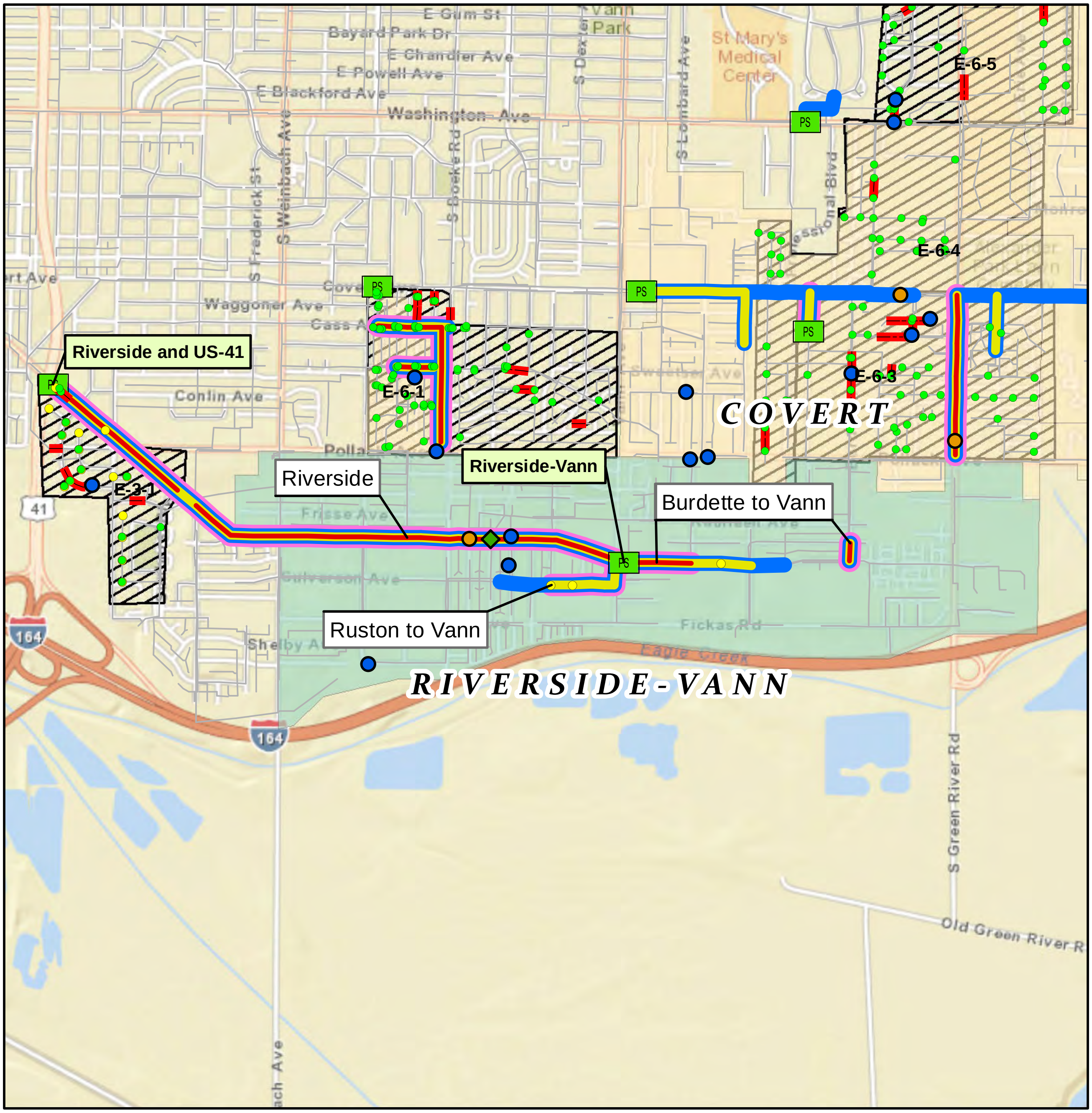


FIGURE I-1

Riverside-Vann Basin, Proposed Capacity Projects for All Storms, 2012 Flows

Sanitary Sewer Remedial Measures Plan, May 2013



- Recurring Wet-Weather SSO in SAR 2012-2
- Modeled SSO
- Location Included in 2010 List of Potential SSOs
- Inflow Reduction Project
- Manhole Rehabilitation Project
- Sewer Main Rehabilitation
- Manhole Invert Change
- PS Added Pumping Capacity
- Added Pipe Capacity (2-Year 3-Hour)
- Added Pipe Capacity (5-Year 3-Hour)
- Added Pipe Capacity (10-Year 3-Hour)
- Added Pipe Capacity (10-Year 24-Hour)
- Sewer Main
- Priority Subbasin

N

0 1,000 2,000
Feet

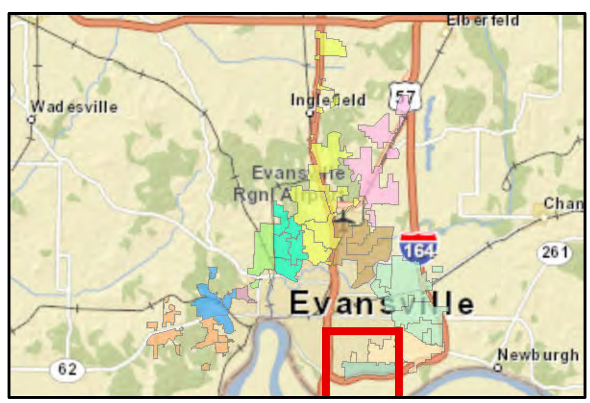


FIGURE I-2
Riverside-Vann Basin, Proposed Capacity Projects for All Storms, 2032 Flows
Sanitary Sewer Remedial Measures Plan, May 2013

renew EVANSVILLE

I1 - Capital Cost Summary Tables for Capacity Improvement Projects

Riverside-Vann Basin Capacity Improvement Projects, 2012 Flows

Basin	Riverside - Vann
Storm	2 year - 3 Hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Riverside Outfall Pump Station	**New Pump Station (MGD)**	(blank)	10.7		$ 2,942,000
Riverside - Vann Pump Station	**Additional Pumping Capacity (MGD)**	3.2	5		$ 1,260,000
Burdette to Vann	**Relief Sewer (in)**	10	12	281	$ 165,000
		15	18	1,063	$ 876,000
		18	27	534	$ 301,000
Riverside	**Relief Sewer (in)**	18	27	2,146	$ 1,109,000
		21	27	2,667	$ 2,216,000
		24	27	1,506	$ 1,259,000
		27	36	2,580	$ 3,055,000
Rouston to Vann	**Relief Sewer (in)**	12	15	1,457	$ 1,326,000
Grand Total				**12,232**	**$ 14,509,000**

Basin	Riverside - Vann
Storm	5 year - 3 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Riverside Outfall Pump Station	**New Pump Station (MGD)**	(blank)	10.9		$ 3,221,000
Riverside - Vann Pump Station	**Additional Pumping Capacity (MGD)**	3.2	6		$ 1,325,000
Burdette to Vann	**Relief Sewer (in)**	10	12	281	$ 165,000
		15	18	1,477	$ 1,226,000
			21	1,063	$ 911,000
		18	27	534	$ 301,000
		27	36	372	$ 291,000
Riverside	**Relief Sewer (in)**	18	27	2,146	$ 1,109,000
		21	30	1,307	$ 1,100,000
			27	1,360	$ 1,137,000
		24	36	1,506	$ 1,446,000
		27	36	2,580	$ 3,085,000
Rouston to Vann	**Relief Sewer (in)**	12	15	1,457	$ 1,326,000
Grand Total				**14,082**	**$ 16,643,000**

Riverside-Vann Basin Capacity Improvement Projects, 2012 Flows

Basin	Riverside - Vann
Storm	10 year - 3 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Riverside Outfall Pump Station	**New Pump Station (MGD)**	(blank)	12.4		$ 3,411,000
			10.7		$ 3,043,000
Riverside - Vann Pump Station	**Additional Pumping Capacity (MGD)**	3.2	6.2		$ 1,338,000
Burdette to Vann	**Relief Sewer (in)**	10	12	281	$ 165,000
		15	21	2,540	$ 2,169,000
		18	27	534	$ 301,000
		27	36	372	$ 291,000
Riverside	**Relief Sewer (in)**	18	27	2,146	$ 1,109,000
		21	30	1,307	$ 1,100,000
			27	1,360	$ 1,137,000
		24	36	1,506	$ 1,446,000
		27	36	2,580	$ 3,085,000
Rouston to Vann	**Relief Sewer (in)**	12	15	1,457	$ 1,326,000
Grand Total				**14,082**	**$ 19,921,000**

Basin	Riverside - Vann
Storm	10 year - 24 hour

				Values	
Row Labels	**Description**	**Existing Size**	**Proposed Size**	**Sum of Length**	**Total Capital Cost**
Riverside - Vann Pump Station	**Additional Pumping Capacity (MGD)**	3.2	6		$ 1,325,000
Burdette to Vann	**Relief Sewer (in)**	10	12	281	$ 165,000
		15	18	1,477	$ 1,228,000
			21	1,063	$ 876,000
		18	27	534	$ 301,000
		27	36	372	$ 417,000
Riverside	**Relief Sewer (in)**	18	27	2,146	$ 1,109,000
		21	30	1,307	$ 1,100,000
			27	1,360	$ 1,137,000
		24	36	1,506	$ 1,446,000
		27	36	2,580	$ 3,085,000
Rouston to Vann	**Relief Sewer (in)**	12	15	1,457	$ 1,326,000
Grand Total				**14,082**	**$ 13,515,000**

Riverside-Vann Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	Riverside-Vann
Storm	2y3h

				Values	
Project Name	**Description**	**Existing Size**	**Proposed Size**	**Sum of Pipe Length (ft)**	**Sum of Capital Cost**
Riverside PS	**New PS (mgd)**	0	8.8	0	$ 2,955,000
Riverside-Vann PS	**Upsize PS (mgd)**	3.2	5	0	$ 1,260,000
Burdette to Vann	**Upsize sewer (in)**	10	12	281	$ 165,000
		15	18	1,063	$ 876,000
Riverside	**Upsize sewer (in)**	18	27	3,315	$ 2,288,000
		21	27	1,296	$ 929,000
			36	1,434	$ 1,773,000
		24	27	1,073	$ 701,000
		27	27	1,149	$ 947,000
			36	1,146	$ 1,282,000
Grand Total				**10,755**	**$ 13,176,000**

Basin	Riverside-Vann
Storm	5y3h

				Values	
Project Name	**Description**	**Existing Size**	**Proposed Size**	**Sum of Pipe Length (ft)**	**Sum of Capital Cost**
Riverside PS	**New PS (mgd)**	0	11.1	0	$ 3,247,000
Riverside-Vann PS	**Upsize PS (mgd)**	3.2	6	0	$ 1,325,000
Burdette to Vann	**Upsize sewer (in)**	10	12	281	$ 165,000
		15	21	2,010	$ 1,810,000
		27	36	372	$ 291,000
Riverside	**Upsize sewer (in)**	18	27	2,679	$ 1,410,000
		21	27	1,360	$ 1,137,000
			30	1,307	$ 1,100,000
		24	36	1,506	$ 1,446,000
		27	36	2,580	$ 3,055,000
Ruston to Vann	**Upsize sewer (in)**	12	15	1,457	$ 1,326,000
Grand Total				**13,551**	**$ 16,312,000**

Riverside-Vann Basin Capacity Improvement Project Summaries, 2032 Flows

Basin	Riverside-Vann
Storm	10y3h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Riverside PS	**New PS (mgd)**	0	12.6	0	$ 3,436,000
Riverside-Vann PS	**Upsize PS (mgd)**	3.2	6.4	0	$ 1,351,000
Burdette to Vann	**Upsize sewer (in)**	10	12	281	$ 165,000
		15	21	2,010	$ 1,810,000
		27	36	372	$ 291,000
Riverside	**Upsize sewer (in)**	18	27	2,679	$ 1,410,000
		21	27	1,360	$ 1,137,000
			30	1,307	$ 1,100,000
		24	36	1,506	$ 1,446,000
		27	36	2,580	$ 3,055,000
Ruston to Vann	**Upsize sewer (in)**	12	15	2,262	$ 2,177,000
Grand Total				**14,356**	**$ 17,378,000**

Basin	Riverside-Vann
Storm	10y24h

Project Name	Description	Existing Size	Proposed Size	Values Sum of Pipe Length (ft)	Sum of Capital Cost
Riverside PS	**New PS (mgd)**	0	9.4	0	$ 3,030,000
Riverside-Vann PS	**Upsize PS (mgd)**	3.2	5	0	$ 1,260,000
Burdette to Vann	**Upsize sewer (in)**	10	12	281	$ 165,000
		15	21	1,063	$ 911,000
		27	36	372	$ 291,000
Riverside	**Upsize sewer (in)**	18	27	2,679	$ 1,410,000
		21	27	2,667	$ 2,216,000
		24	30	1,506	$ 1,281,000
		27	36	2,580	$ 3,055,000
Ruston to Vann	**Upsize sewer (in)**	12	15	1,457	$ 1,326,000
Grand Total				**12,604**	**$ 14,945,000**

I2 - Capital Cost Summary Tables for Condition Improvement Projects

Riverside-Vann Basin Condition Improvement Projects

Basin	Riverside-Vann

Row Labels	Project ID	Values Number of Structures	Pipe Length (LF)	Number of Flow Monitors	Total Capital Cost
Inflow Reduction					
F/C replacements	570	11			$ 61,000
Inlet Separation	571	2	280		$ 210,000
Manhole Rehabilitation					
Construct Benchwall	572	7			$ 7,000
Manhole Lining Rehabilitation	574	3			$ 33,000
Grout Joint/Void (Number of Repairs)	573	2			$ 1,000
Post Construction Flow Monitoring					
Flow Monitoring (3 months)	575	0		1	$ 9,000
Sewer Main Rehabitilation					
CIPP	568		1,875		$ 213,000
Point Repair	569		10		$ 5,000
Grand Total		**25**	**2,165**	**1**	**$ 539,000**

I3 – SSES Quantities

Basin	Subbasin	Manhole Facility ID	Construct Benchwall	Reset Frame/Cover	Replace Frame/Cover	Full Depth Lining*	Grout Joint/Void	Project ID
Riverside-Vann	E-3-1	2680	- - -	- - -	- - -	- - -	1	573
Riverside-Vann	E-3-1	2592	- - -	- - -	- - -	- - -	1	573
Riverside-Vann	E-3-1	37066	- - -	- - -	- - -	1	- - -	574
Riverside-Vann	E-3-1	1726	- - -	- - -	- - -	1	- - -	574
Riverside-Vann	E-3-1	50135	- - -	- - -	- - -	1	- - -	574
Riverside-Vann	E-3-1	1737	1	- - -	- - -	- - -	- - -	572
Riverside-Vann	E-3-1	1829A	1	- - -	- - -	- - -	- - -	572
Riverside-Vann	E-3-1	1800	1	- - -	- - -	- - -	- - -	572
Riverside-Vann	E-3-1	50141	1	- - -	- - -	- - -	- - -	572
Riverside-Vann	E-3-1	1599	1	- - -	- - -	- - -	- - -	572
Riverside-Vann	E-3-1	50130	1	- - -	- - -	- - -	- - -	572
Riverside-Vann	E-3-1	50144	1	- - -	- - -	- - -	- - -	572
		TOTAL	**7**	**0**	**0**	**3**	**2**	

Note:

*Assumes an average depth of 10 VLF per manhole

[b]Measured depth of manhole used for University Heights lining quantities

Riverside_Vann—Sanitary Sewer Main Rehabilitation

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Segment Identification			Summary Statistics						Segment Recommendation		
Basin	Subbasin	Pipe Facility ID	Diameter (in.)	Material	Length (ft)	Average Depth (ft)	Visible Infiltration Rate (gpd)	Number of Laterals	Priority	Action	Project Number
Riverside	E-3-1	7901	8	VCP	480	4.7	68.0	20	3	CIPP	568
Riverside	E-3-1	11054	10	VCP	254	8.7	25.0	6	2	CIPP	568
Riverside	E-3-1	23153	8	CSU	358	6.4	3.0	6	3	CIPP/Point Repair	568, 569
Riverside	E-3-1	24563	8	VCP	549	5.8	208.0	17	3	CIPP	568
Riverside	E-3-1	24567	8	VCP	234	6.0	64.0	2	2	CIPP	568

Riverside-Vann Basin—Inflow Reduction (Inlet Disconnection Projects)

Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Subbasin	Number of Inlets	Number of Manholes	12" RCP	15" RCP	Project Number
Riverside	E-3-1-A	2	---	---	280	571

Table G-2 East Service Area—Inflow Reduction

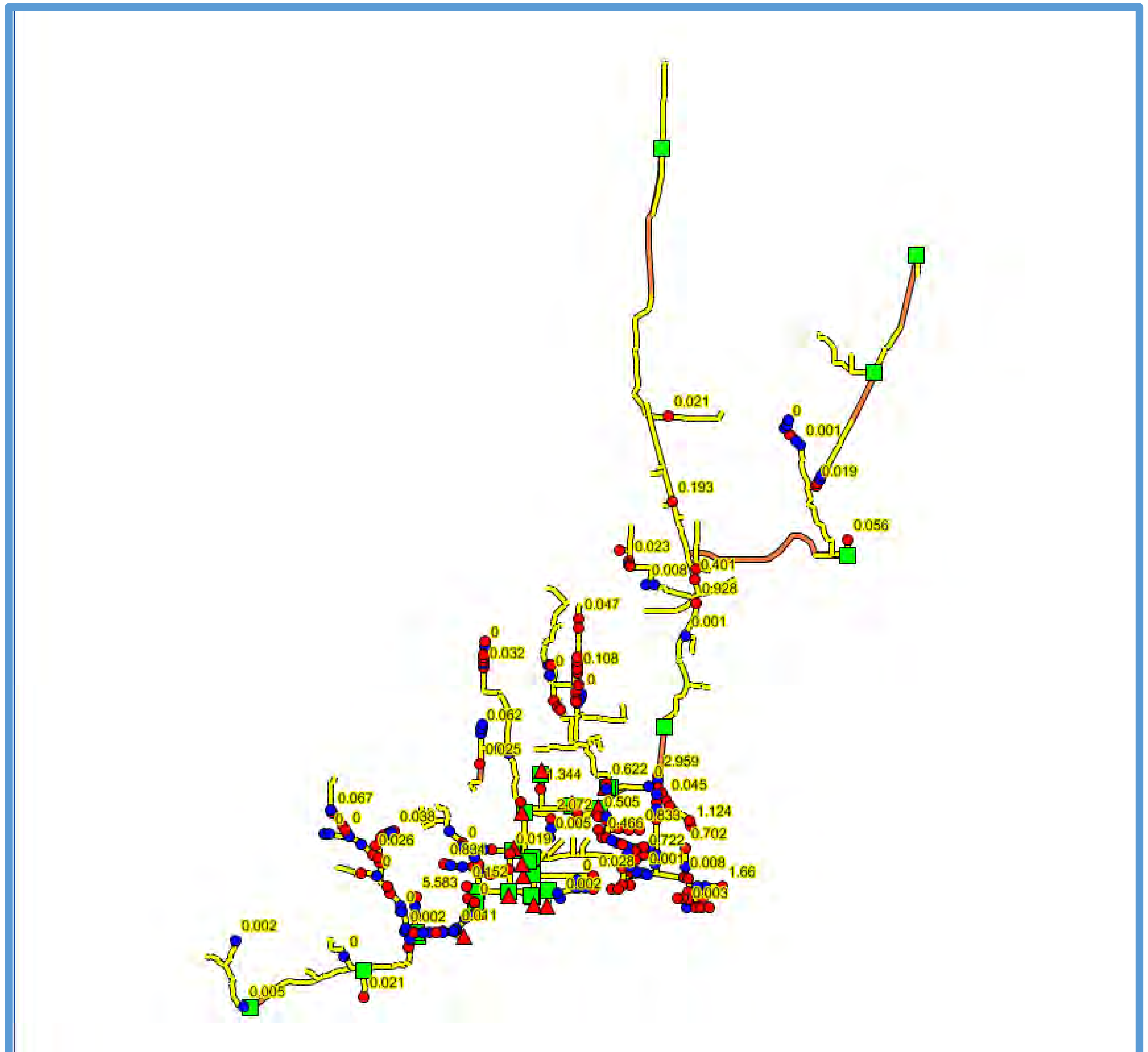
Evansville, IN – Sanitary Sewers Remedial Measures Plan

Basin	Defect Type	Street Address	Pipe Facility ID	Manhole Facility ID	Inflow Reduction (gpd)	Project Number
Riverside	Inlet	1225 E Riverside Dr	23153	---	668,000	571
Riverside	Inlet	1222 E Riverside Dr	23153	---	668,000	571
Riverside	Manhole	---	---	1616	28,000	570
Riverside	Manhole	---	---	1737	84,000	570
Riverside	Manhole	---	---	1800	84,000	570
Riverside	Manhole	---	---	2310	28,000	570
Riverside	Manhole	---	---	2311	28,000	570
Riverside	Manhole	---	---	2312	28,000	570
Riverside	Manhole	---	---	50140	84,000	570
Riverside	Manhole	---	---	50141	84,000	570
Riverside	Manhole	---	---	50143	91,000	570
Riverside	Manhole	---	---	79141	84,000	570
Riverside	Manhole	---	---	1829A	28,000	570

APPENDIX J

Interaction between the CSS and SSS

West Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)



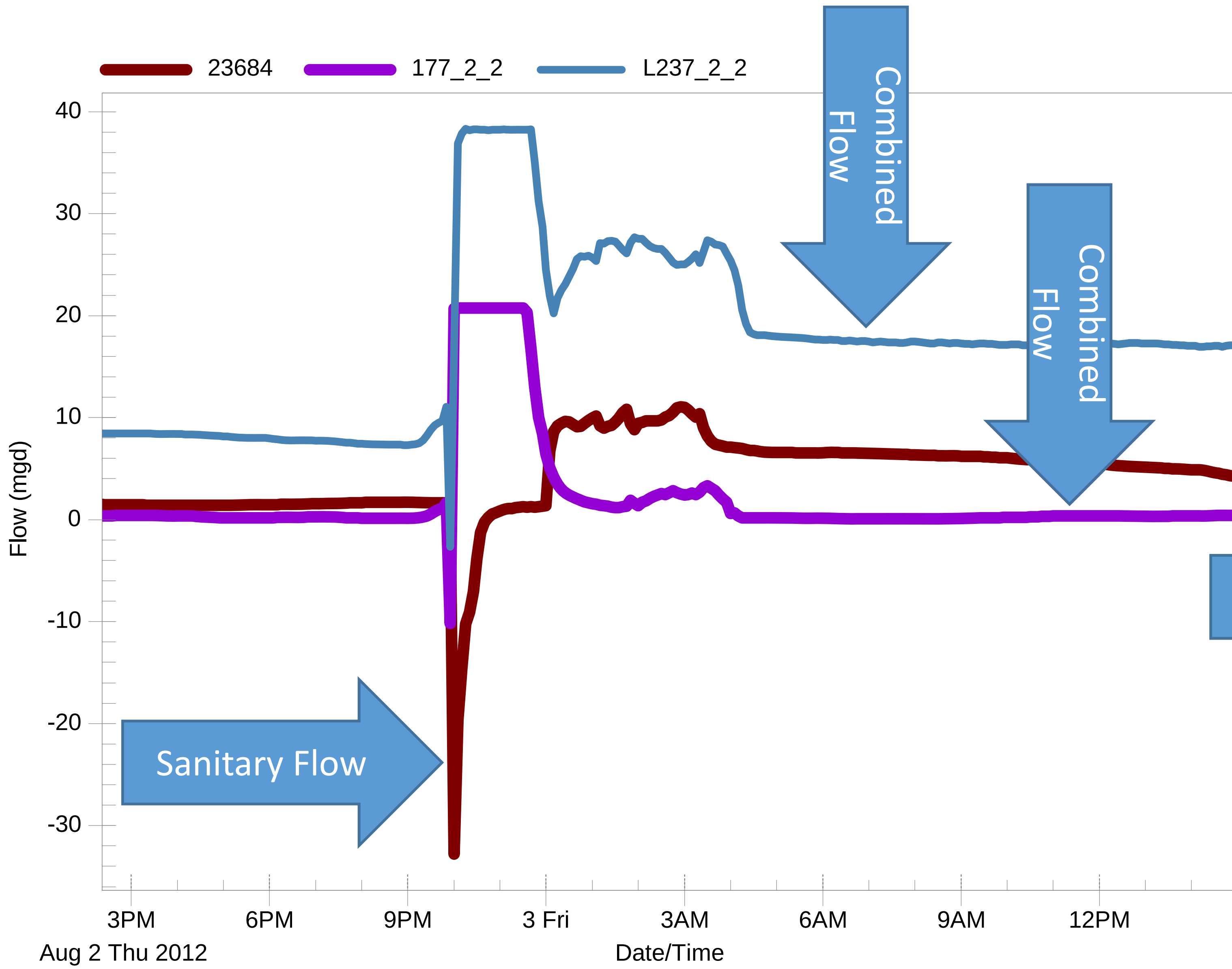
The map and (HGL) profiles show the results of the West Basin Sanitary and Combined System model run for the August 2, 2012 rainfall event.

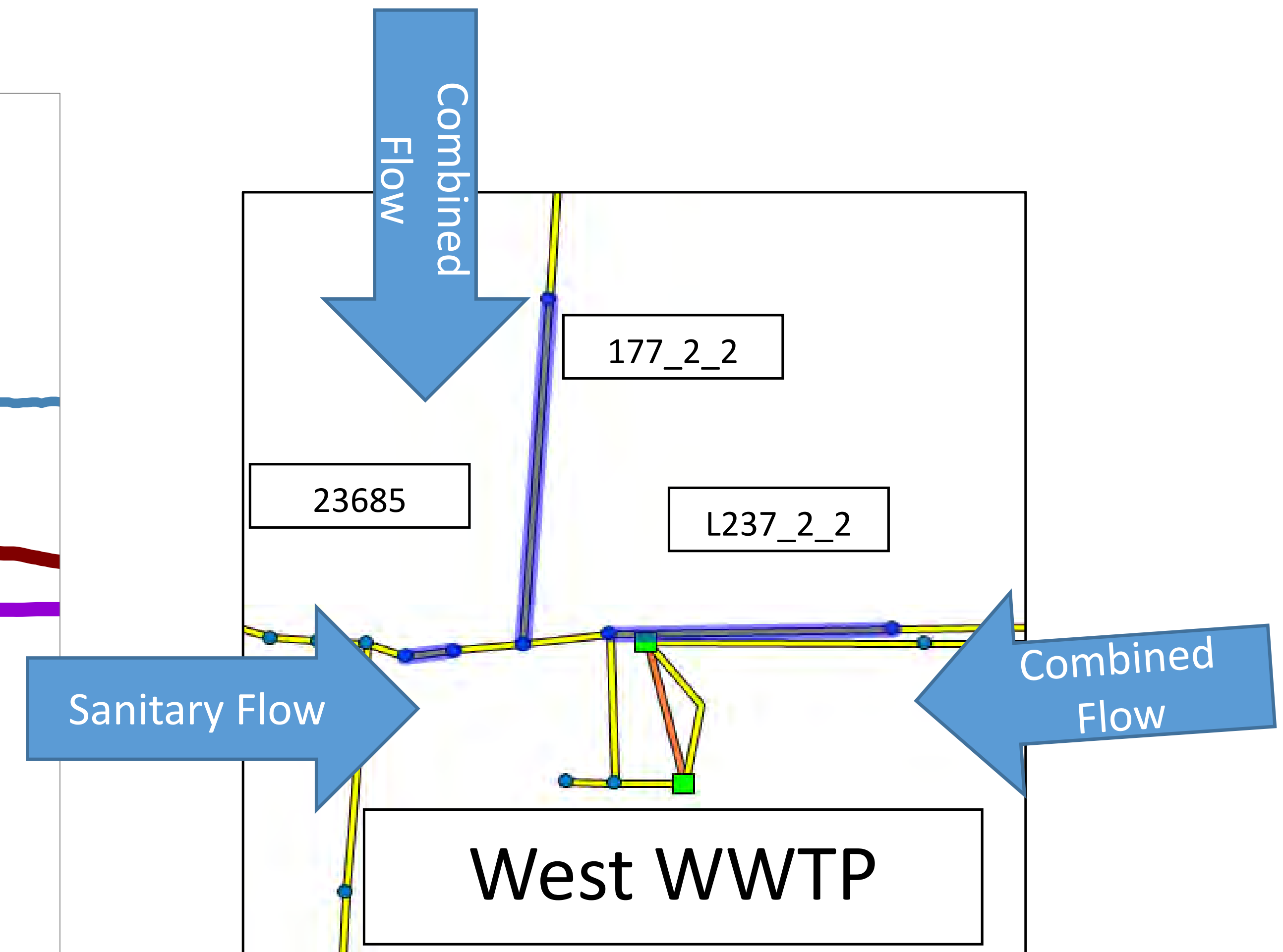
The red and blue dots indicate manholes where the system is overflowing. The red dots represent locations where the modeled volume leaving the system is greater than .01 MG and the blue represent locations where the modeled volume leaving the system is less than .01 MG.

The HGL profiles show three scenarios:

- Dry weather flow
- Wet weather flow with a normal flow depth boundary condition (to illustrate the sanitary system impact)
- Wet weather flow with the actual combined sewer system boundary condition (to illustrate the combined system impact)

West Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)

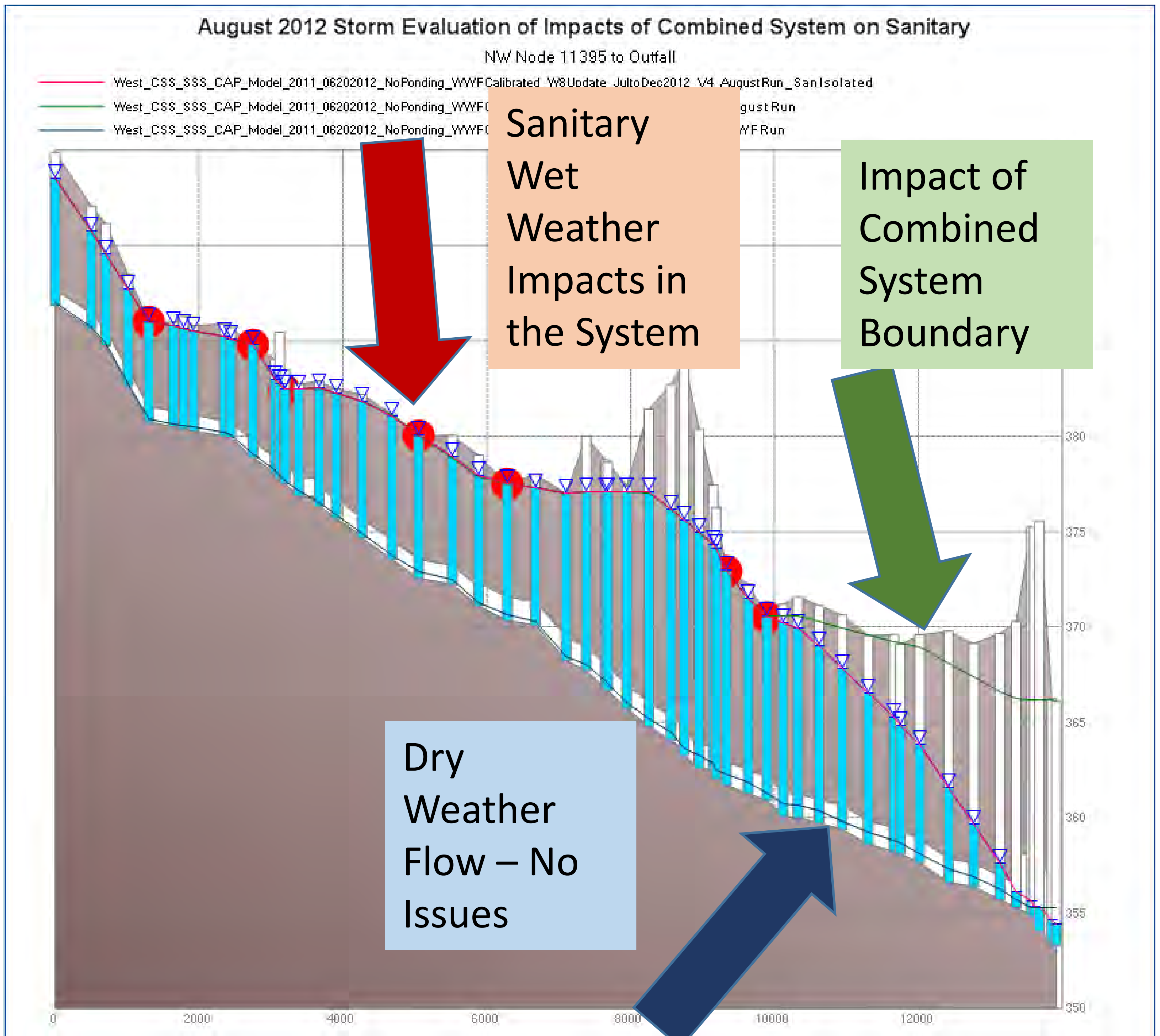


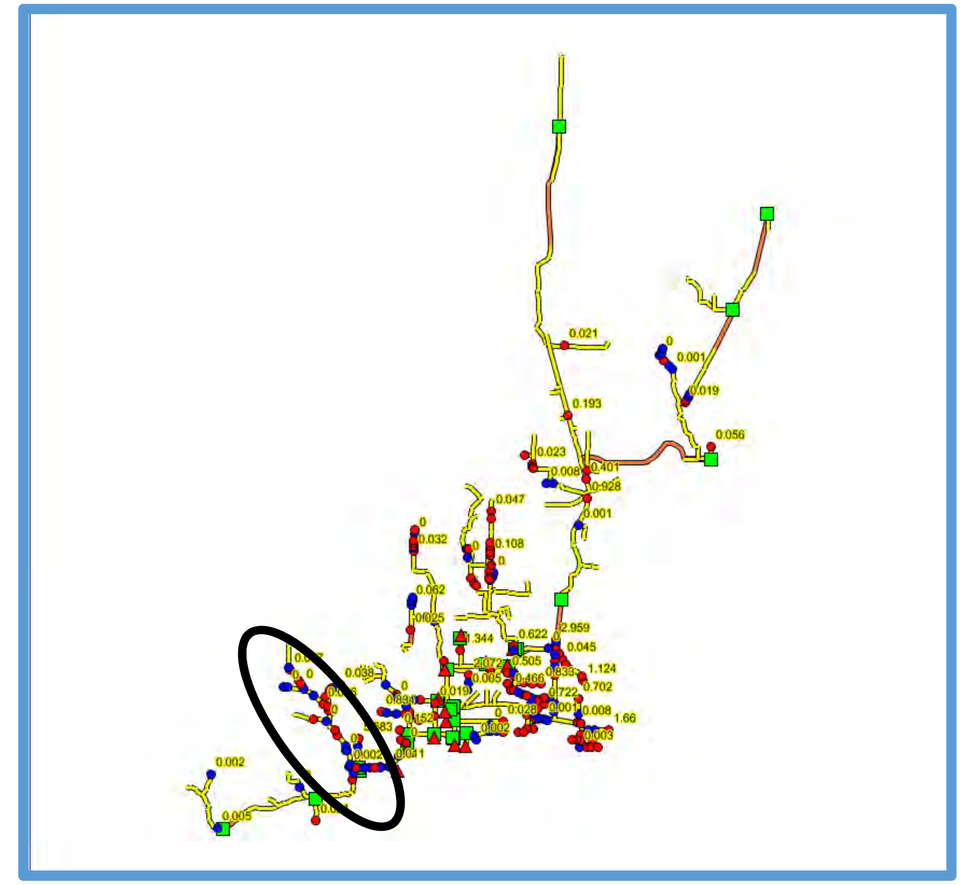


The Combined flow (Blue and Purple) is greater than the Sanitary flow (Red), causing the sanitary flow to reverse (shown as negative flow in the model).

NW Basin

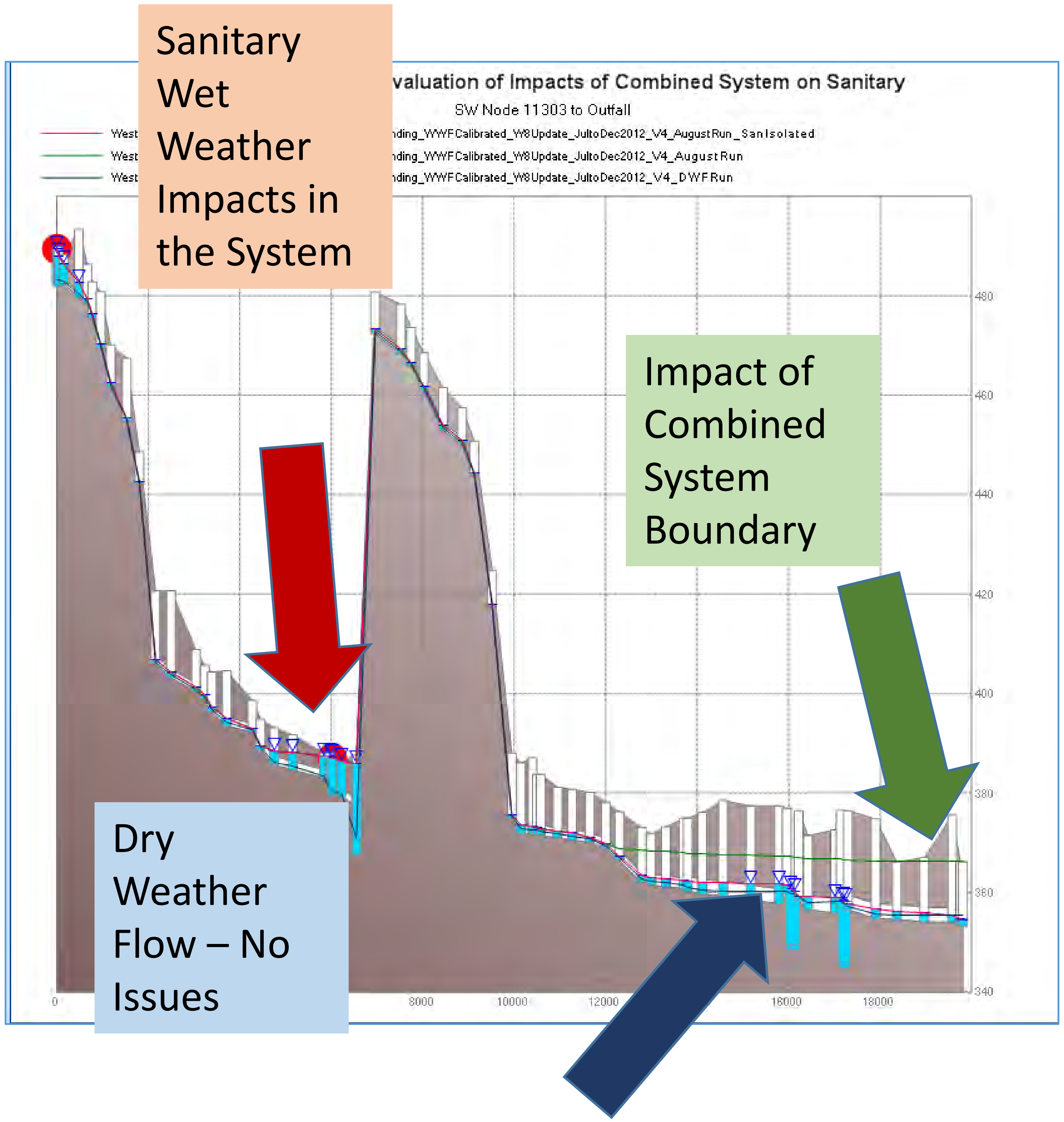
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)

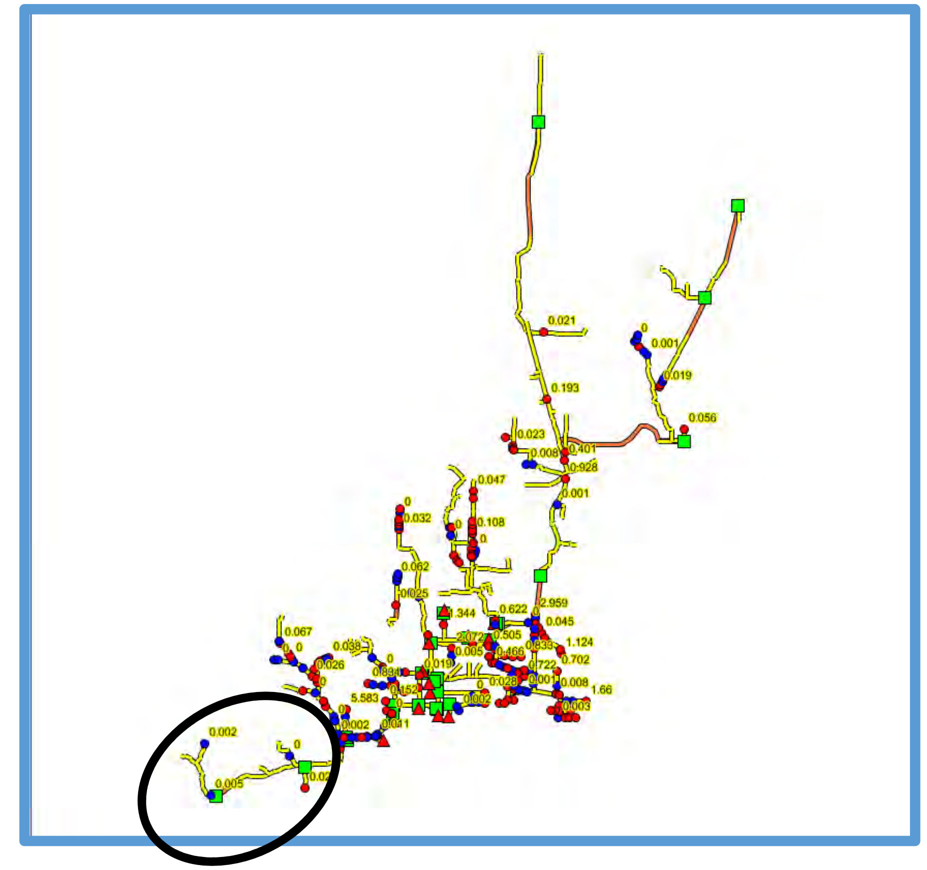




The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, green HGL, on the sanitary system. The blue HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow and results in modeled overflows (red dots).

SW Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)

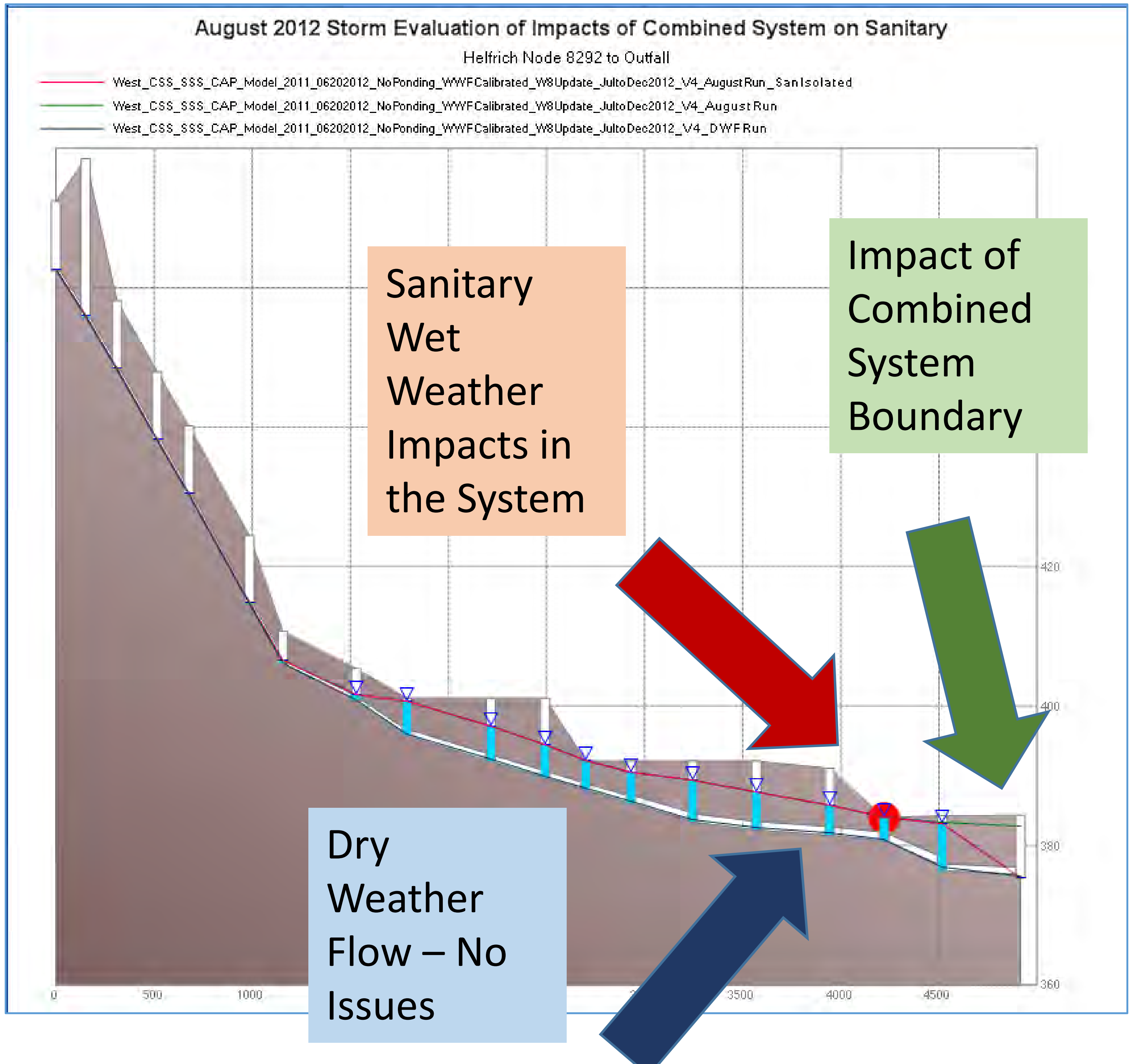


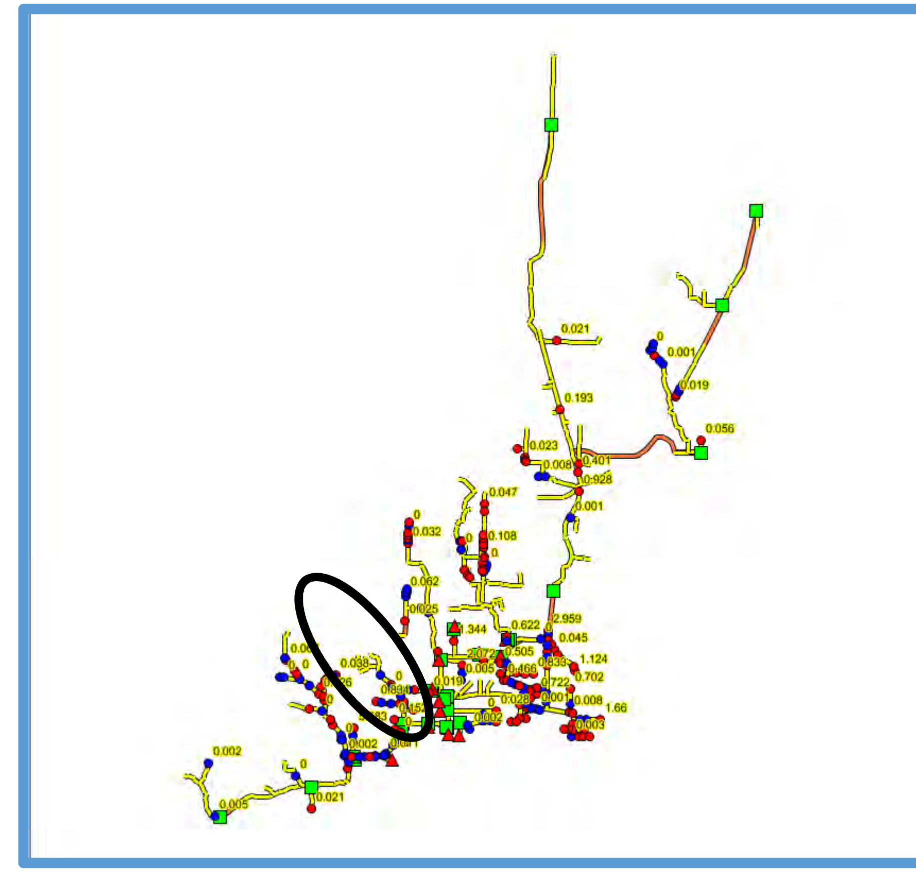


The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, green HGL, on the sanitary system. The blue HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow. For the SW basin the modeled overflows upstream are a result of limited pump station capacity.

Helfrich Basin

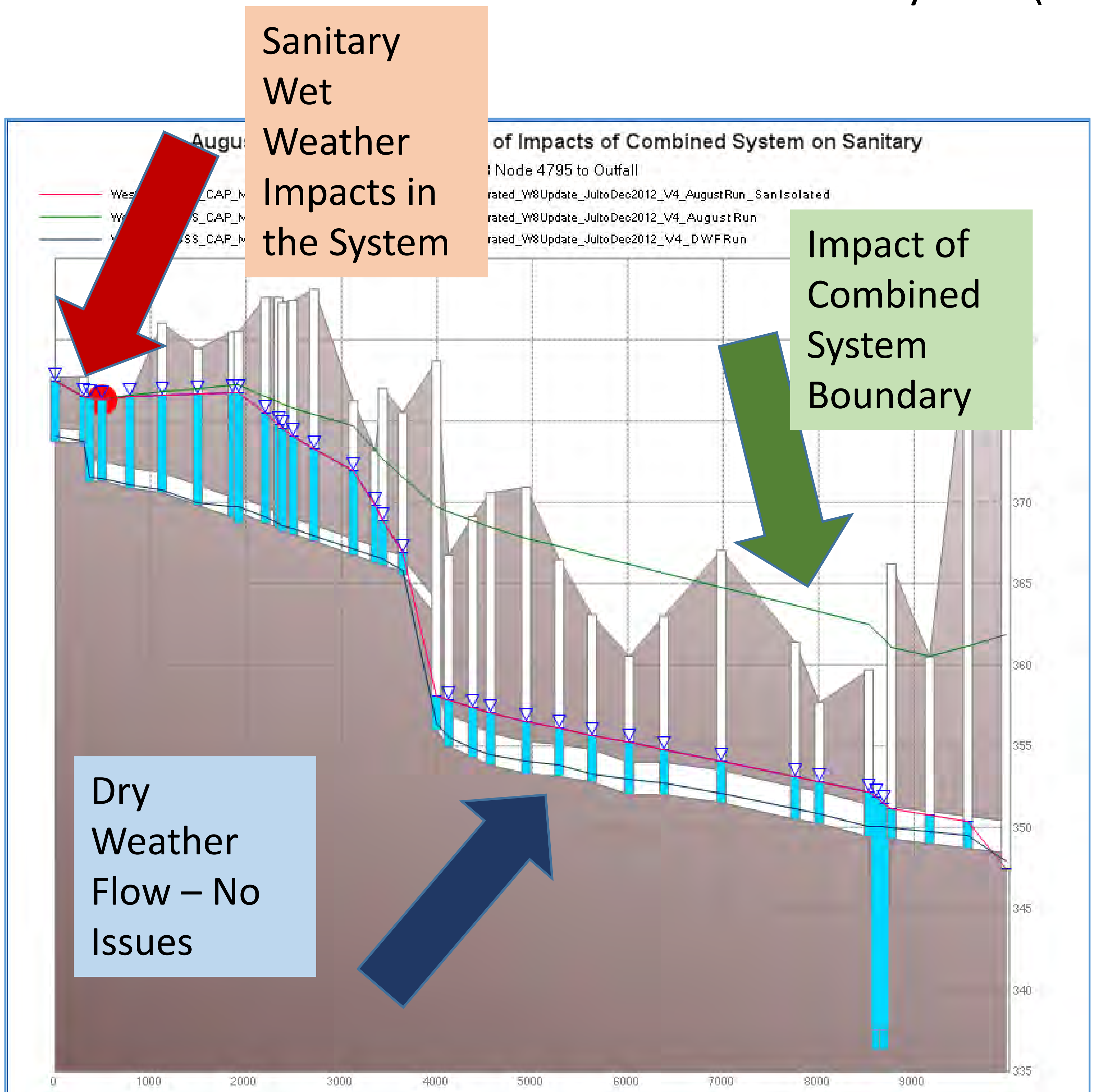
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)

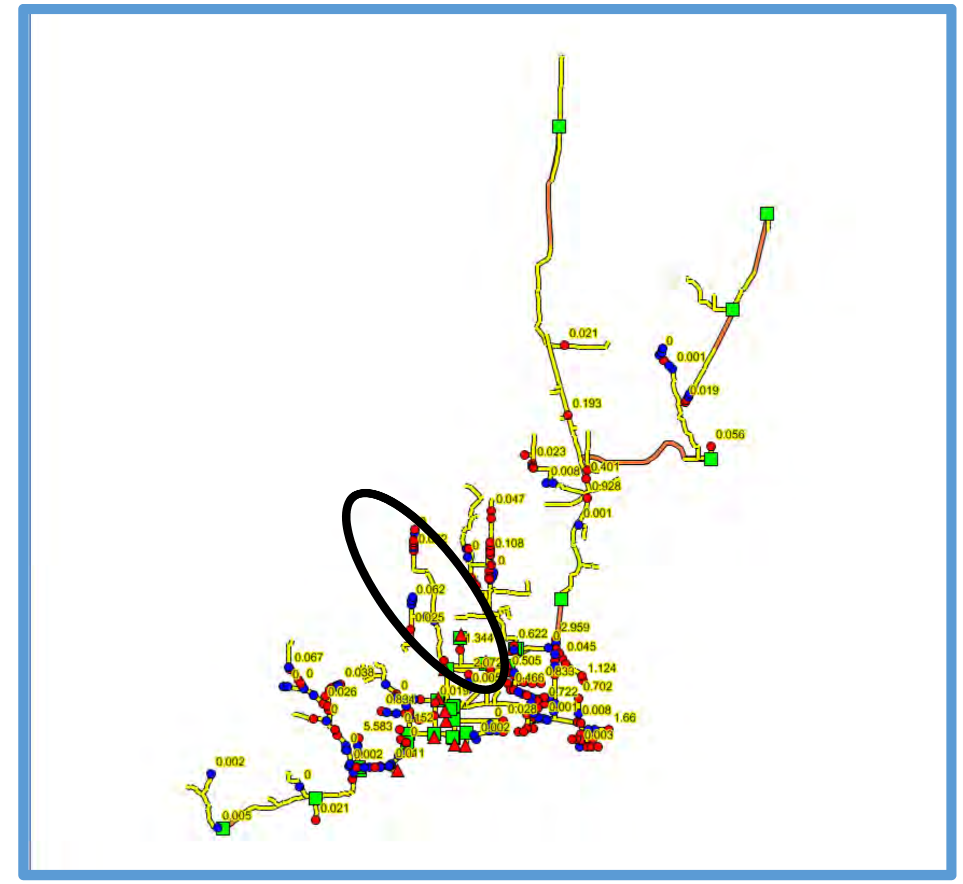




The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, green HGL, on the sanitary system. The blue HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow and results in modeled overflows (red dots).

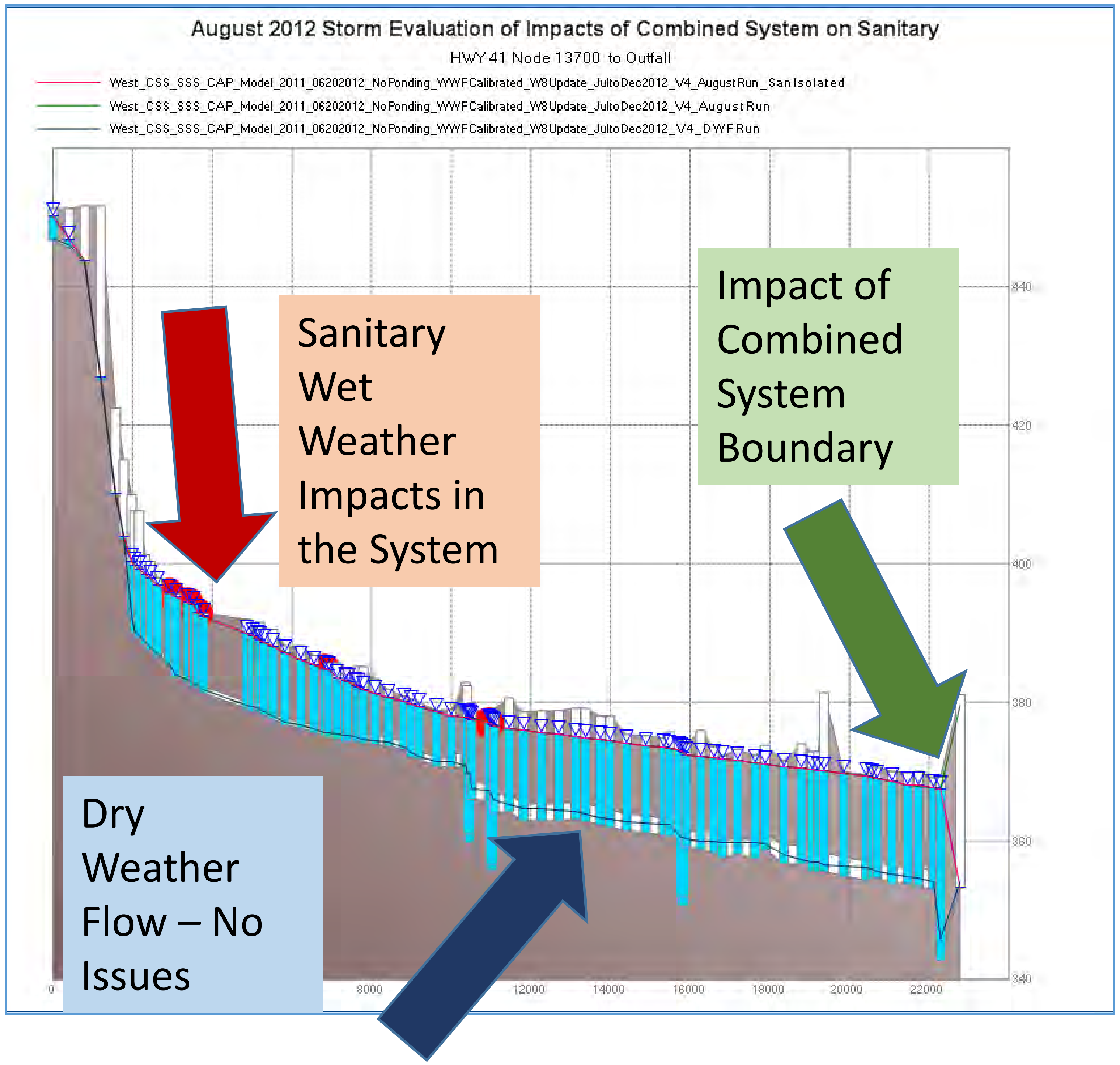
W8 (Northpark) Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)

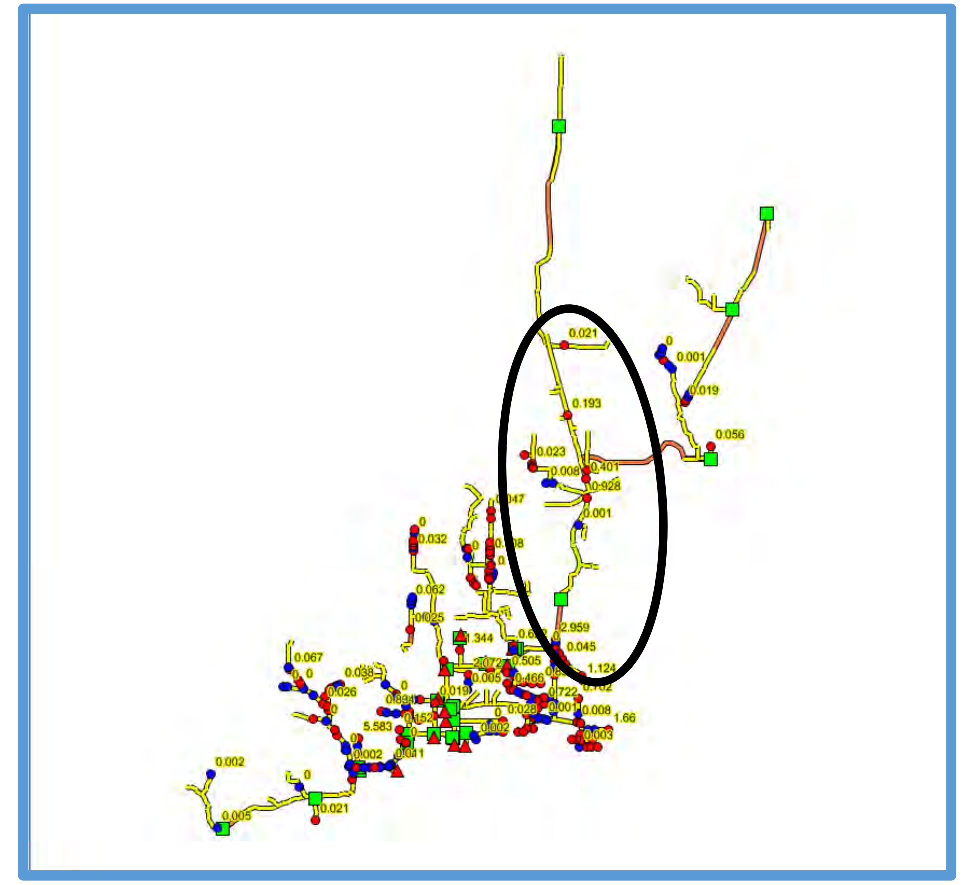




The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, green HGL, on the sanitary system. The blue HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow and results in modeled overflows (red dots). Sanitary manholes are sealed which allows the system to surcharge and the combined system HGL to rise above the ground.

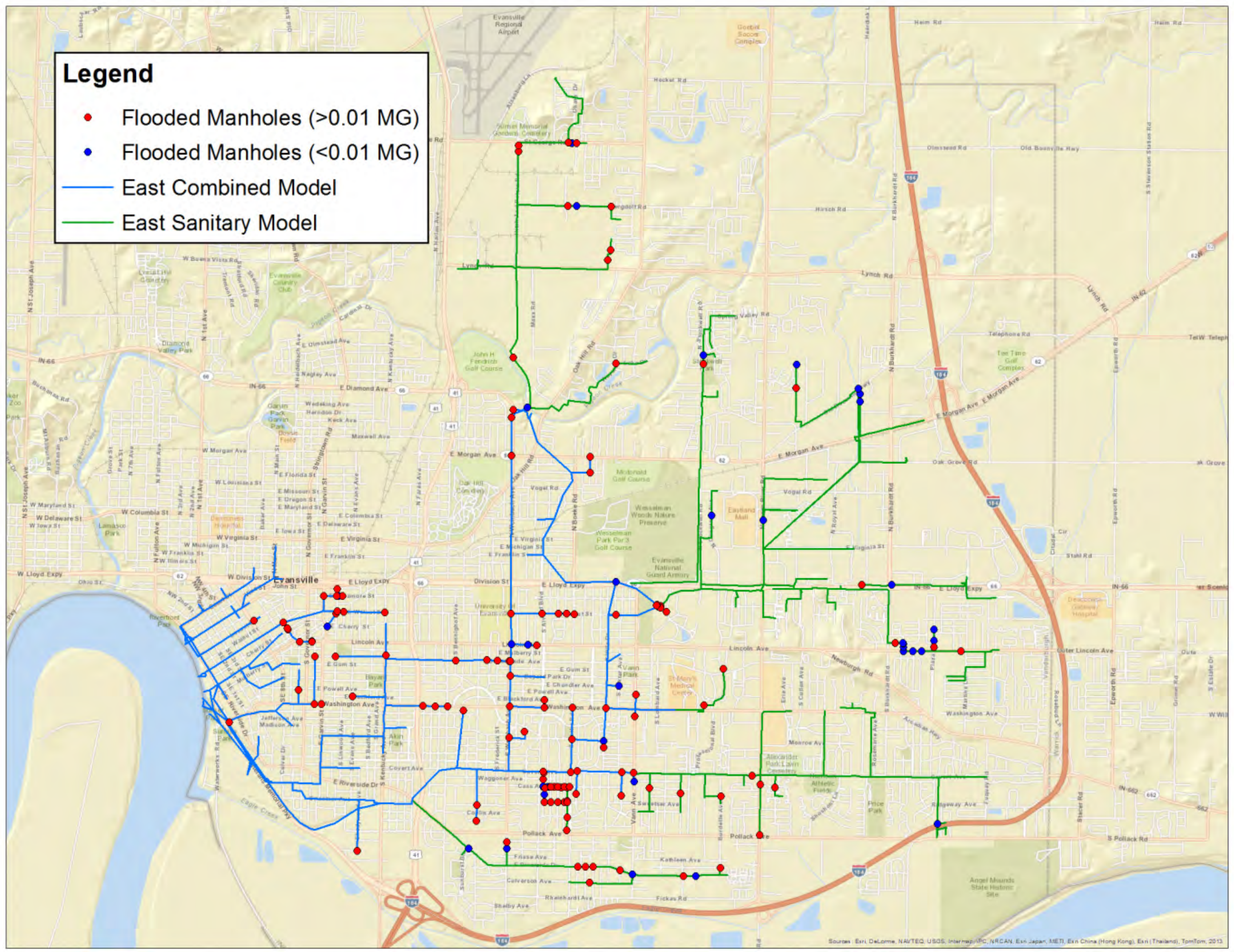
US Highway 41 / Millersburg Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)





The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, green HGL, on the sanitary system. The blue HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow and results in modeled overflows (red dots). The combined system impact is limited as a result of a pump station located at the downstream end of the basin.

East Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)



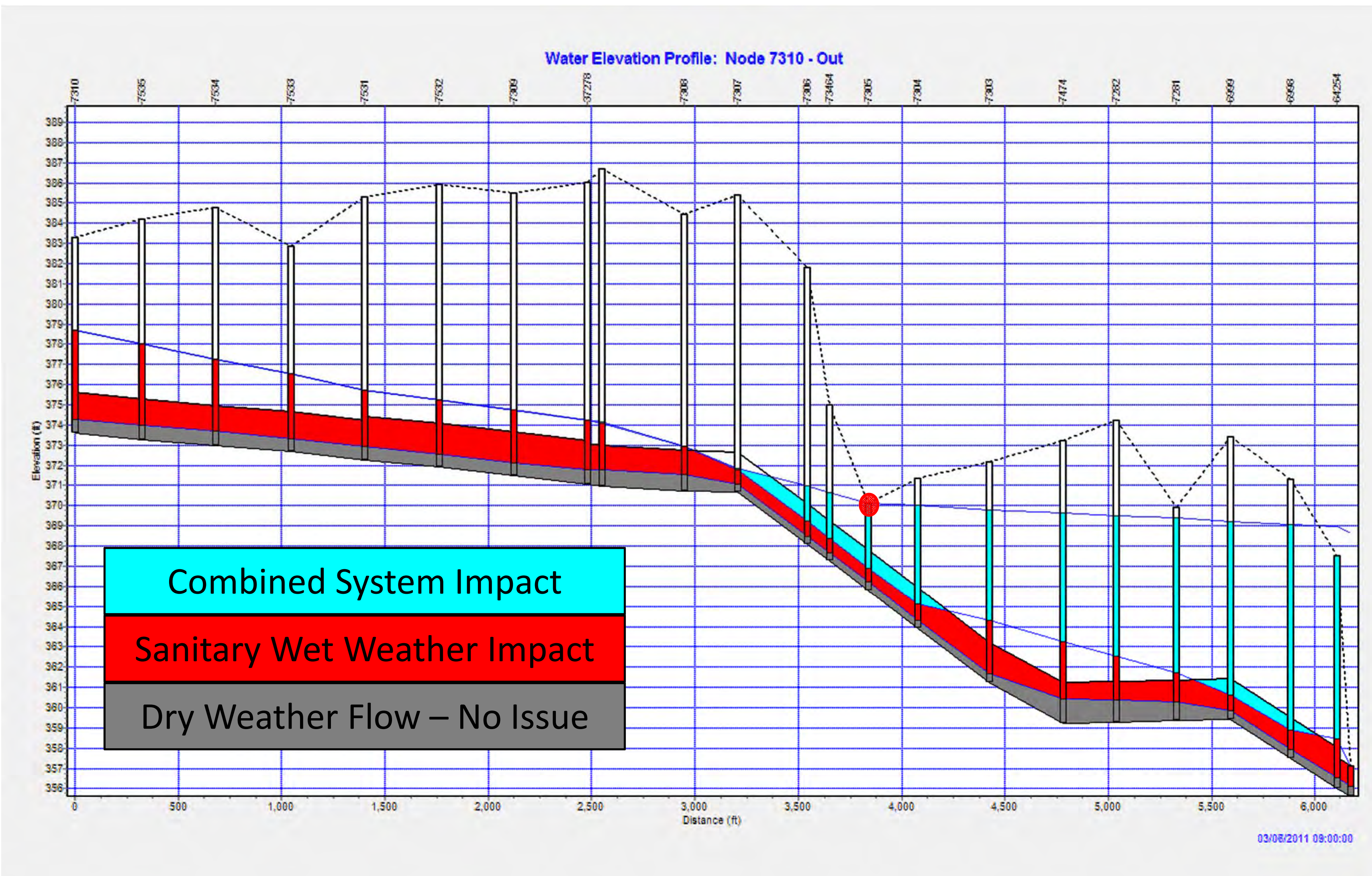
The map and HGL profiles show the results of the East Basin Sanitary and Combined System model run for the 2-year 3-hour design storm.

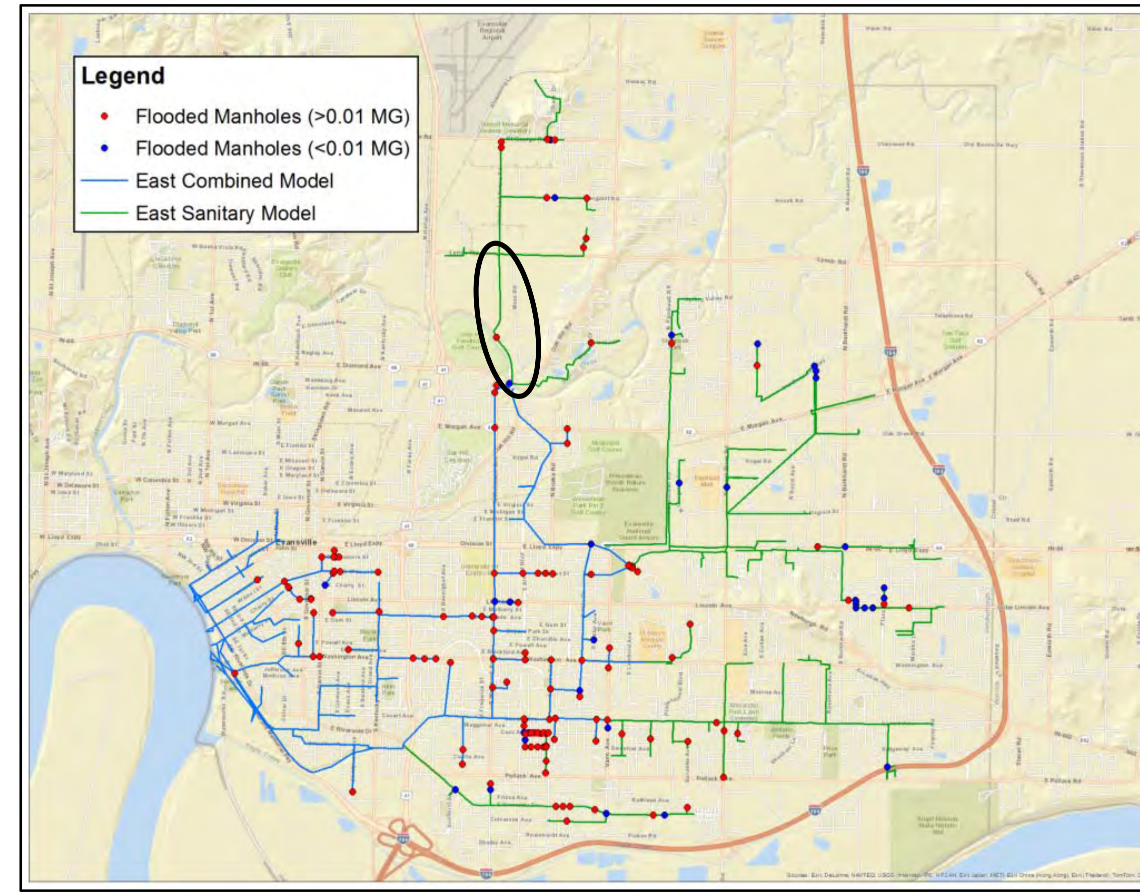
The red and blue dots indicate manholes where the system is overflowing. The red dots represent locations where the modeled volume leaving the system is greater than .01 MG and the blue represent locations where the modeled volume leaving the system is less than .01 MG.

The HGL profiles show three scenarios:

- Dry weather flow
- Wet weather flow with a normal flow depth boundary condition (to illustrate the sanitary system impact)
- Wet weather flow with the actual combined sewer system boundary condition (to illustrate the combined system impact)

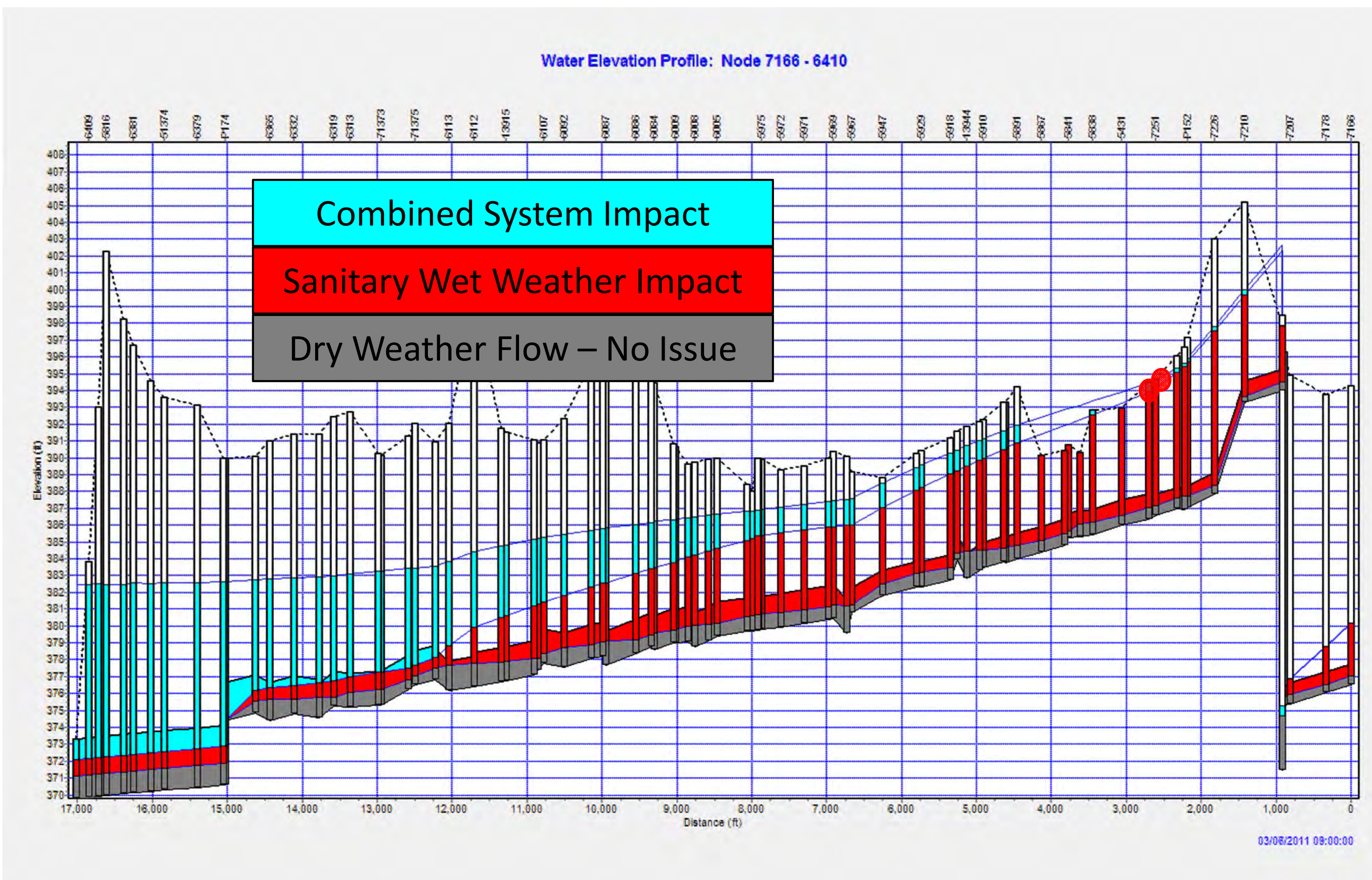
E-11 Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)

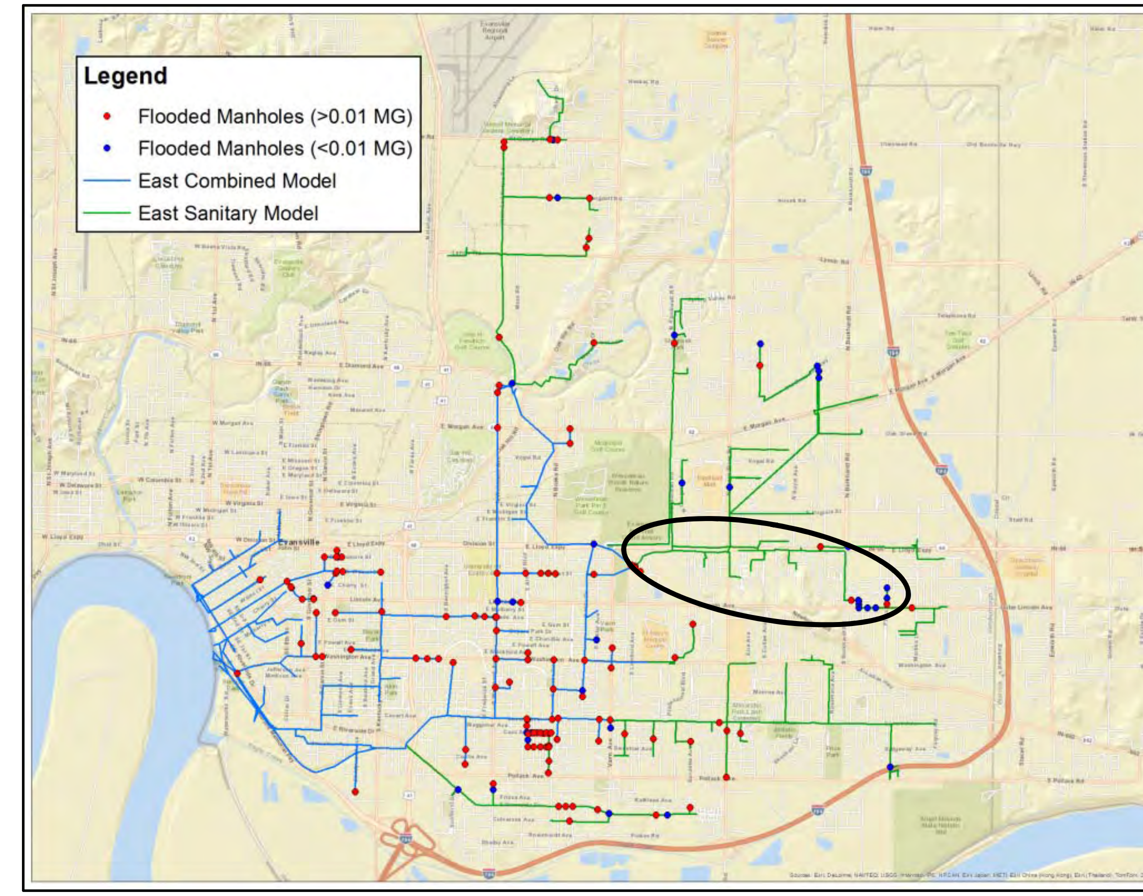




The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, blue HGL, on the sanitary system. The grey HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow and results in modeled overflows (red dots).

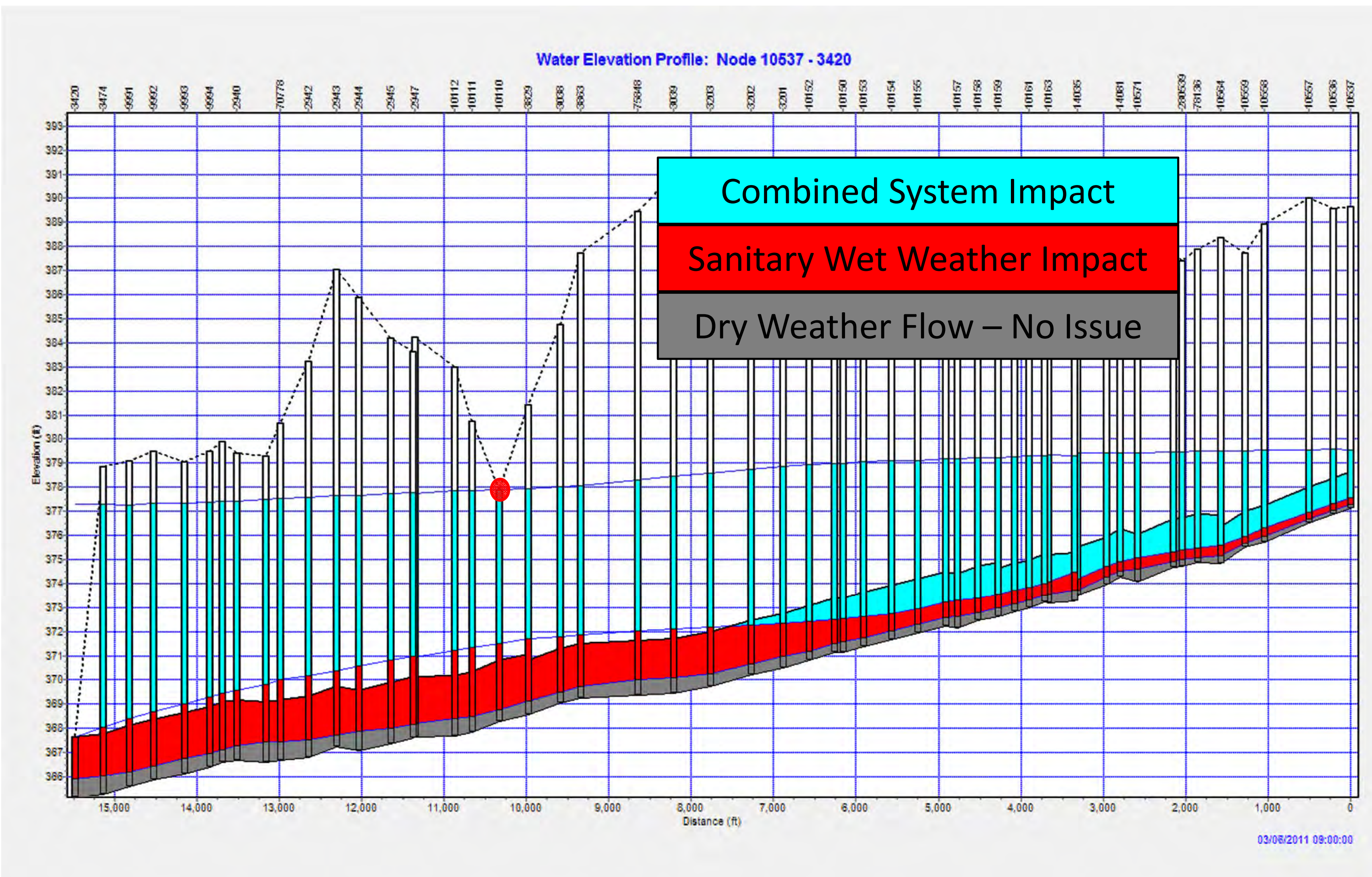
Lloyd Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)

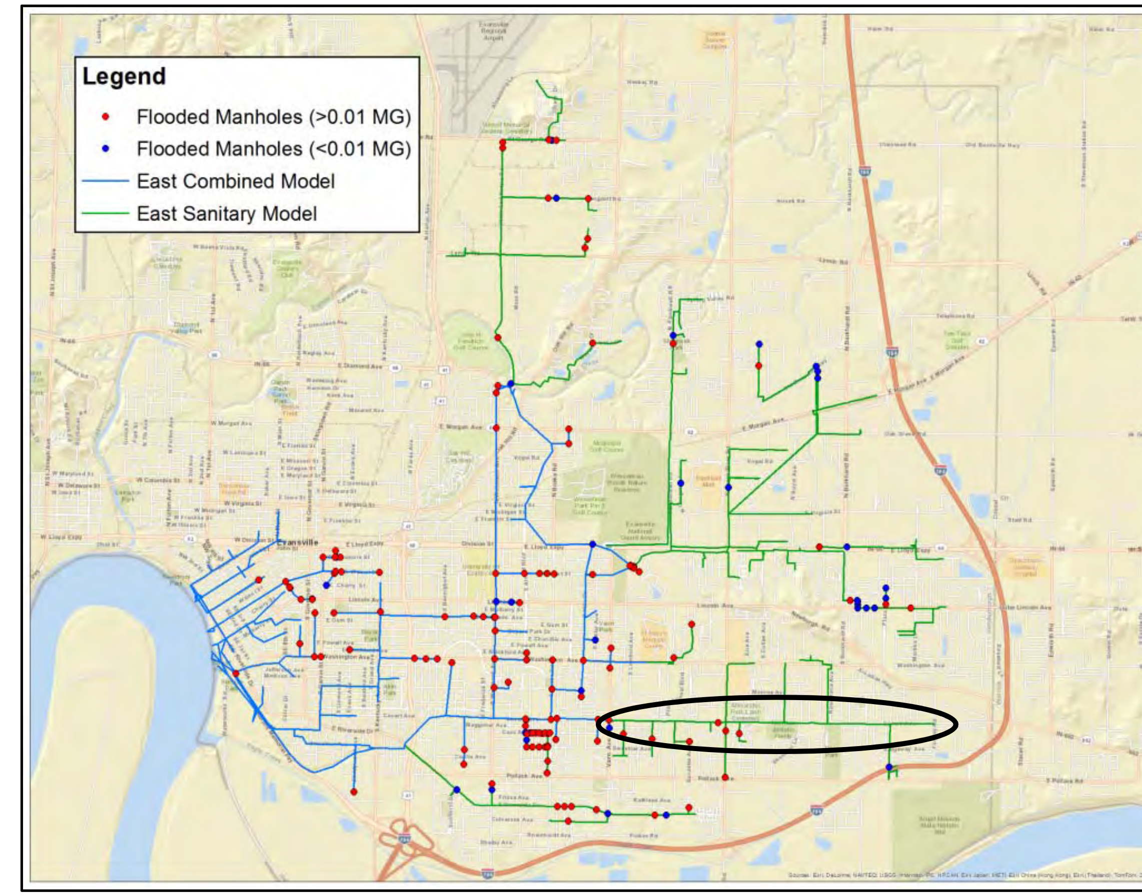




The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, blue HGL, on the sanitary system. The grey HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow and results in modeled overflows (red dots).

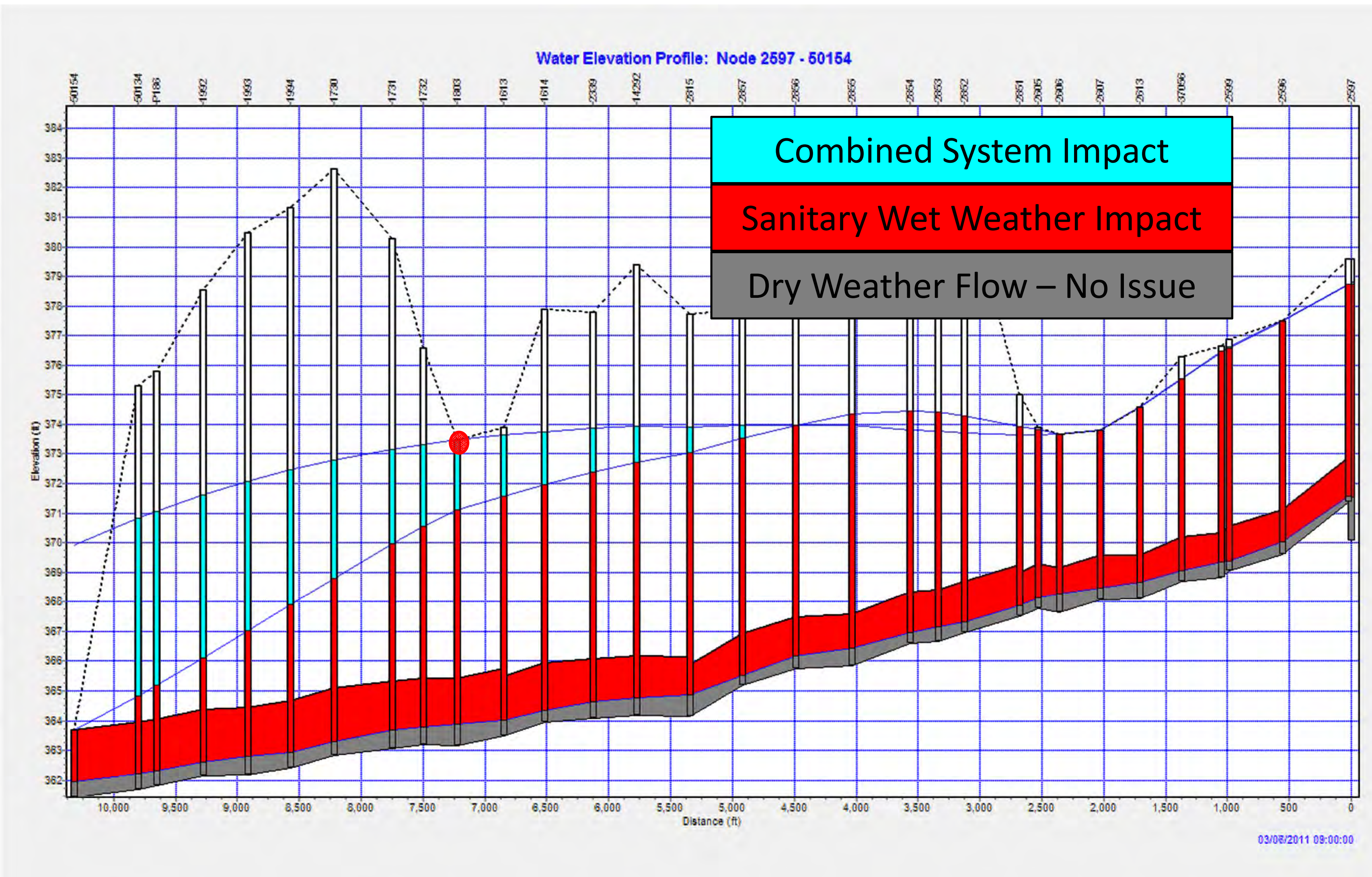
Covert Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)

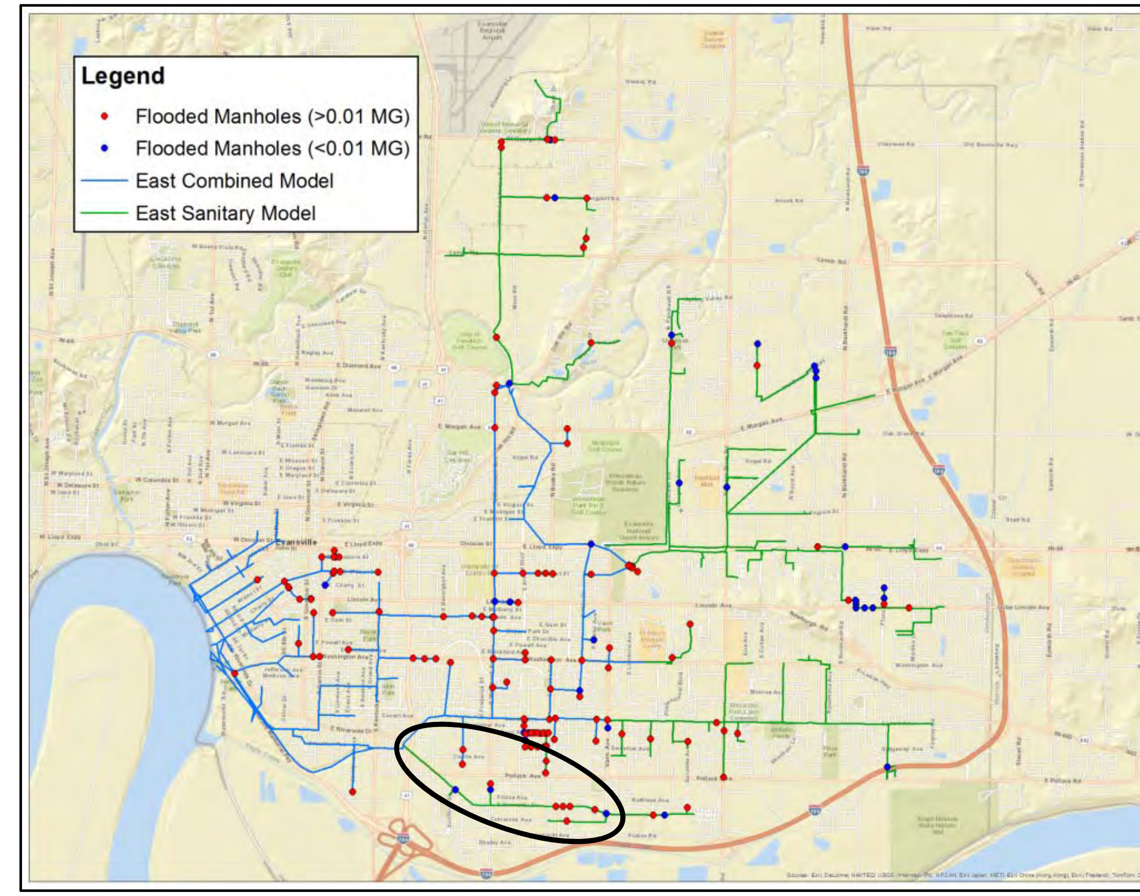




The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, blue HGL, on the sanitary system. The grey HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow and results in modeled overflows (red dots).

Covert Basin
Interaction between the Combined Sewer System (CSS) and the Sanitary Sewer System (SSS)





The sanitary flow does not have a free outfall into the combined system which results in modeled overflows. The profile shows the impact of the combined system flow, blue HGL, on the sanitary system. The grey HGL is representative of the dry weather flow, which is contained with in the sanitary sewer. The red HGL represents the sanitary wet weather flow, which includes the impact of the combined system flow and results in modeled overflows (red dots).

APPENDIX K

Cost Performance Databases

(to be provided in electronic format only)

TABLE 8
Alternative Benefit Scoring

Score Description
4 Very Good
3 Good
2 Neutral
1 Poor
0 Adverse

Alternative	Technologies	Fatally Flawed	Reduces combined sewer overflow volume	Reduces runoff volume	Reduces frequency of untreated discharges	Reduces wet weather flows in system	Reduces suspended solids	Reduces bacteria	Reduces floatables/trash	Enhances Nine Minimum Controls	Maximizes use of existing infrastructure	Reliability	Flexibility (possibility of future expansion)	Land requirements	Constructability	Simplicity of operation and maintenance	Implementation time	Synergy with other needs/projects	Human health & safety (exposure, basement backups, street flooding, etc.)	Emergency Response Time (street flooding, etc.)	Protection of historical and cultural resources	Protection of environmental resources	Short-term (noise, truck traffic, siting, etc.)	Long-term (open space creation, recreational opportunities, aesthetic improvements, etc.)	Performance Score	Implementation and Operation	Safety	Community Impacts	Total	Rank
Screening Category:			Performance Factors							Implementation and Operation Factors									Safety		Community Impacts									
Screening Category Weight:			40%							30%									10%		20%									
Screening Criterion Weight:			25%	15%	25%	15%	5%	10%	5%	15%	20%	15%	5%	5%	5%	15%	5%	15%	75%	25%	25%	40%	10%	25%						
Maximum Criterion Score (of the 4 point total technology score):			0.4	0.24	0.4	0.24	0.08	0.16	0.08	0.18	0.24	0.18	0.06	0.06	0.06	0.18	0.06	0.18	0.3	0.1	0.2	0.32	0.08	0.2						
West 1-45	Storage/HRT		4	2	4	2	3	3	4	3	2	3	4	2	3	2	3	2	4	3	2	3	1	2	1.30	0.75	0.38	0.46	2.89	1
West 1-60	Parallel PCI Relief		4	2	4	2	3	4	4	4	2	4	0	0	0	2	1	2	4	3	2	3	1	2	1.34	0.68	0.38	0.46	2.85	3
West Tunnel	West Tunnel		4	2	4	2	3	4	4	4	2	4	0	1	1	2	1	2	4	3	2	3	1	2	1.34	0.71	0.38	0.46	2.88	2
East 1	Storage/HRT		4	3	4	3	3	4	4	3	2	3	4	2	3	2	3	2	4	3	2	3	1	2	1.46	0.75	0.38	0.46	3.05	4
East 3-40	Storage/HRT/Wetland		4	3	4	3	3	3	4	4	2	3	1	2	2	2	3	2	4	3	2	3	1	4	1.42	0.74	0.38	0.56	3.09	1
East 3-68	Storage/HRT/Wetland		4	3	4	3	3	3	4	4	2	3	1	2	2	2	3	2	4	3	2	3	1	4	1.42	0.74	0.38	0.56	3.09	1
East Tunnel	East 3-40 with downtown storage replaced by tunnel		4	3	4	3	3	3	4	4	2	4	0	1	1	2	1	2	4	3	2	3	1	4	1.42	0.71	0.38	0.56	3.06	3

TABLE 9

Alternative Benefit Scoring - Sensitivity Analysis 1

Weighting of criteria with equal scores reduced to zero (shown by yellow highlighting), and overall weighting adjusted to total 100%.

Reduces bacteria more heavily weighted than reduces runoff volume and reduces wet weather flows in system.

Score Description

- 4 Very Good
- 3 Good
- 2 Neutral
- 1 Poor
- 0 Adverse

Screening Category:			**Performance Factors**							**Implementation and Operation Factors**									**Safety**		**Community Impacts**									
Screening Category Weight:			35%							35%									0%		30%									
Screening Criterion Weight:			0%	30%	0%	30%	0%	40%	0%	25%	0%	25%	10%	10%	10%	0%	20%	0%	0%	0%	0%	0%	0%	100%						
Maximum Criterion Score (of the 4 point total technology score):			0	0.42	0	0.42	0	0.56	0	0.35	0	0.35	0.14	0.14	0.14	0	0.28	0	0	0	0	0	0	1.2						
Alternative	**Technologies**	**Fatally Flawed**	**Reduces combined sewer overflow volume**	**Reduces runoff volume**	**Reduces frequency of untreated discharges**	**Reduces wet weather flows in system**	**Reduces suspended solids**	**Reduces bacteria**	**Reduces floatables/trash**	**Enhances Nine Minimum Controls**	**Maximizes use of existing infrastructure**	**Reliability**	**Flexibility (possibility of future expansion)**	**Land requirements**	**Constructability**	**Simplicity of operation and maintenance**	**Implementation time**	**Synergy with other needs/projects**	**Human health & safety (exposure, basement backups, street flooding, etc.)**	**Emergency Response Time (street flooding, etc.)**	**Protection of historical and cultural resources**	**Protection of environmental resources**	**Short-term (noise, truck traffic, siting, etc.)**	**Long-term (open space creation, recreational opportunities, aesthetic improvements, etc.)**	**Performance Score**	**Implementation and Operation**	**Safety**	**Community Impacts**	**Total**	**Rank**
West 1-45	Storage/HRT		4	2	4	2	3	3	4	3	2	3	4	2	3	2	3	2	4	3	2	3	1	2	0.84	1.05	0.00	0.60	2.49	1
West 1-60	Parallel PCI Relief		4	2	4	2	3	4	4	4	2	4	0	0	0	2	1	2	4	3	2	3	1	2	0.98	0.77	0.00	0.60	2.35	3
West Tunnel	West Tunnel		4	2	4	2	3	4	4	4	2	4	0	1	1	2	1	2	4	3	2	3	1	2	0.98	0.84	0.00	0.60	2.42	2
East 1	Storage/HRT		4	3	4	3	3	4	4	3	2	3	4	2	3	2	3	2	4	3	2	3	1	2	1.19	1.05	0.00	0.60	2.84	4
East 3-40	Storage/HRT/Wetland		4	3	4	3	3	3	4	4	2	3	1	2	2	2	3	2	4	3	2	3	1	4	1.05	1.00	0.00	1.20	3.25	1
East 3-68	Storage/HRT/Wetland		4	3	4	3	3	3	4	4	2	3	1	2	2	2	3	2	4	3	2	3	1	4	1.05	1.00	0.00	1.20	3.25	1
East Tunnel	East 3-40 with downtown storage replaced by tunnel		4	3	4	3	3	3	4	4	2	4	0	1	1	2	1	2	4	3	2	3	1	4	1.05	0.84	0.00	1.20	3.09	3

TABLE 10

Alternative Benefit Scoring - Sensitivity Analysis 2

Weighting of criteria with equal scores reduced to zero (shown by yellow highlighting), and overall weighting adjusted to total 100%.

Reduces bacteria more heavily weighted than reduces runoff volume and reduces wet weather flows in system.

Heaviest weighting assigned to Implementation and Operation Factors that has greatest scoring differentiation between alternatives.

Score	Description
4	Very Good
3	Good
2	Neutral
1	Poor
0	Adverse

Alternative	Technologies	Fatally Flawed	Reduces combined sewer overflow volume	Reduces runoff volume	Reduces frequency of untreated discharges	Reduces wet weather flows in system	Reduces suspended solids	Reduces bacteria	Reduces floatables/trash	Enhances Nine Minimum Controls	Maximizes use of existing infrastructure	Reliability	Flexibility (possibility of future expansion)	Land requirements	Constructability	Simplicity of operation and maintenance	Implementation time	Synergy with other needs/projects	Human health & safety (exposure, basement backups, street flooding, etc.)	Emergency Response Time (street flooding, etc.)	Protection of historical and cultural resources	Protection of environmental resources	Short-term (noise, truck traffic, siting, etc.)	Long-term (open space creation, recreational opportunities, aesthetic improvements, etc.)	Performance Score	Implementation and Operation	Safety	Community Impacts	Total	Rank
Screening Category:			**Performance Factors**							**Implementation and Operation Factors**										**Safety**		**Community Impacts**									
Screening Category Weight:			20%							50%										0%		30%									
Screening Criterion Weight:			0%	30%	0%	30%	0%	40%	0%	25%	0%	25%	10%	10%	10%	0%	20%	0%	0%	0%	0%	0%	0%	100%						
Maximum Criterion Score (of the 4 point total technology score):			0	0.24	0	0.24	0	0.32	0	0.5	0	0.5	0.2	0.2	0.2	0	0.4	0	0	0	0	0	0	1.2						
West 1-45	Storage/HRT		4	2	4	2	3	3	4	3	2	3	4	2	3	2	3	2	4	3	2	3	1	2	0.48	1.50	0.00	0.60	2.58	1
West 1-60	Parallel PCI Relief		4	2	4	2	3	4	4	4	2	4	0	0	0	2	1	2	4	3	2	3	1	2	0.56	1.10	0.00	0.60	2.26	3
West Tunnel	West Tunnel		4	2	4	2	3	4	4	4	2	4	0	1	1	2	1	2	4	3	2	3	1	2	0.56	1.20	0.00	0.60	2.36	2
East 1	Storage/HRT		4	3	4	3	3	4	4	3	2	3	4	2	3	2	3	2	4	3	2	3	1	2	0.68	1.50	0.00	0.60	2.78	4
East 3-40	Storage/HRT/Wetland		4	3	4	3	3	3	4	4	2	3	1	2	2	2	3	2	4	3	2	3	1	4	0.60	1.43	0.00	1.20	3.23	1
East 3-68	Storage/HRT/Wetland		4	3	4	3	3	3	4	4	2	3	1	2	2	2	3	2	4	3	2	3	1	4	0.60	1.43	0.00	1.20	3.23	1
East Tunnel	East 3-40 with downtown storage replaced by tunnel		4	3	4	3	3	3	4	4	2	4	0	1	1	2	1	2	4	3	2	3	1	4	0.60	1.20	0.00	1.20	3.00	3

Technology Screening Criteria Weighting

	Draft	Final						
Performance Factors	40%	%		60	40	40	40	40
Neighborhood Impacts	20%			5	20	20	30	20
Safety	10%			0	10	10	10	10
Implementation and Operation Factors	30%		100%	35	30	30	20	30

Perfo	**Reduces water-in-basement**	0%			9	4	3	3		M
	Reduces street flooding and damage to structures	0%			6	3	4			M
Performance Factors	**Reduces Combined Sewer Overflow volume**	25%			3	1	1	1	1	H
	Reduces runoff volume	15%			7	6			3	M
	Reduces frequency of untreated discharges	25%			2	2	2	2		H
	Reduces wet weather flows in system	15%			5	7			2	M
	Reduces suspended solids	5%			8	8				L
	Reduces bacteria	10%			1	5	5	4		M
	Reduces floatables/trash	5%			4	9				L
	Other…			100%						
Community Impacts	**Protection of historical and cultural resources**	25%			4	2	2	4	2	M
	Protection of environmental resources	40%			1	3	1	1	3	H
	Short-term (noise, truck traffic, siting, etc.)	10%			3	4	4	3	4	L
	Long-term (open space creation, recreational opportunities, aesthetic improvements, etc.)	25%		100%	2	1	3	2	1	M
	Other…									
Safety	**Human health & safety (basement backups, street flooding, etc.)**	**75%**								
	Emergency Response Time (street flooding, etc.)	**25%**		100%						
Implementation and Operation	**Enhances Nine Minimum Controls**	20%			1	2	3	1	2	H
	Reliability	20%			3	3	2	3	3	H
	Flexibility (possibility of future expansion)	5%			4	5	5	6	5	L
	Land requirements	5%			6	7	7	7	8	L
	Constructability	5%			5	6	8	2	6	L
	Simplicity of operation and maintenance	20%			2	4	1	5	4	M
	Implementation time	5%			7	8	4	4	7	L
	Synergy with other needs	20%		100%	8	1	6	8	1	H

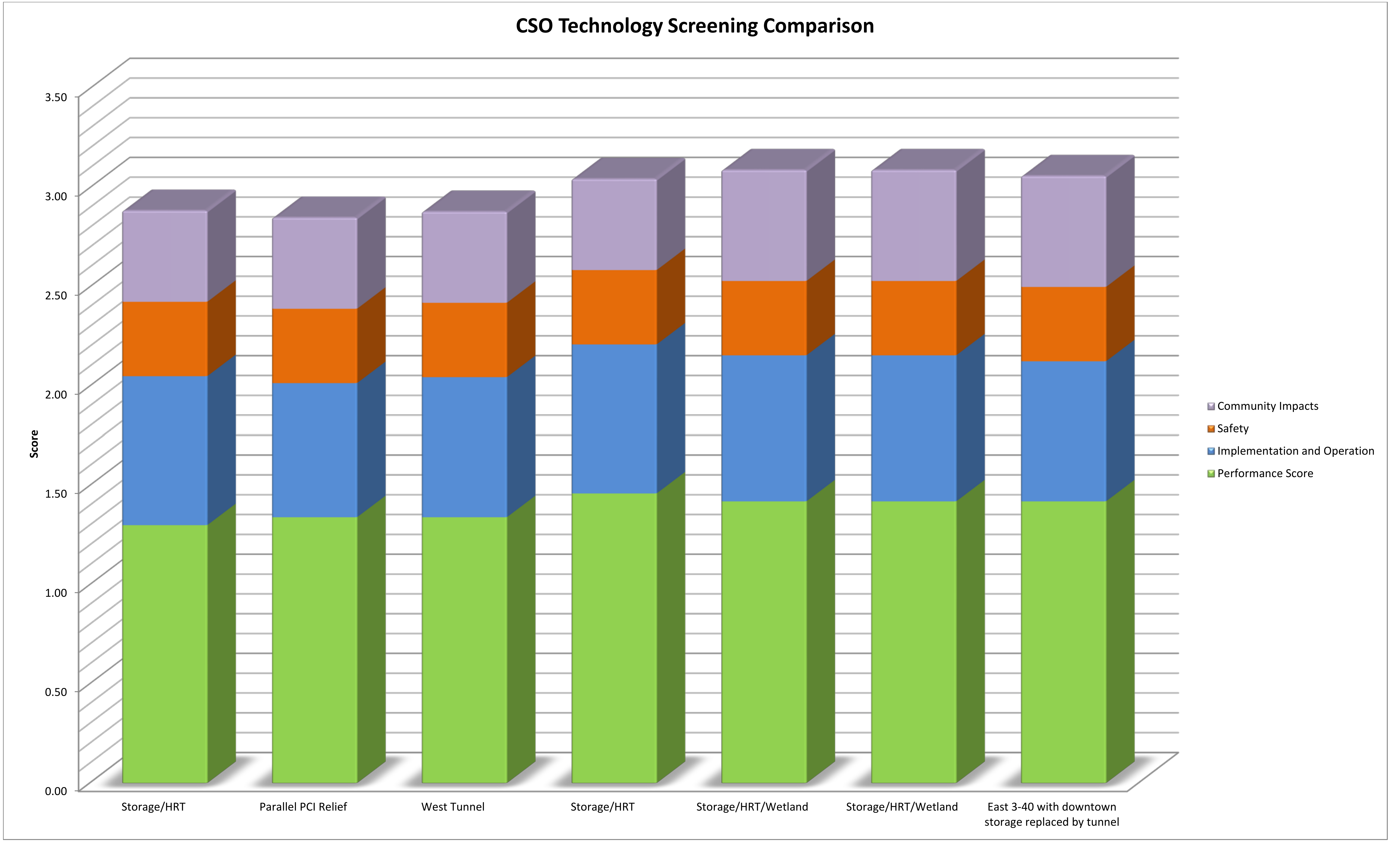
To test sensitivity of any particular category or weight, modify the weighting values in red font. Scores will recalculate automatically.

Technology Screening Scoring Matrix

Screening Category:			Performance Factors							Implementation and Operation Factors									Safety		Community Impacts				Performance Score	Implementation and Operation	Safety	Community Impacts	Total
Screening Category Weight:			10%							10%									30%		40%								
Screening Criterion Weight:			25%	15%	25%	15%	5%	10%	5%	15%	20%	15%	5%	5%	5%	15%	5%	15%	75%	25%	25%	40%	10%	25%					
Maximum Criterion Score (of the 4 point total technology score):			0.1	0.06	0.1	0.06	0.02	0.04	0.02	0.06	0.08	0.06	0.02	0.02	0.02	0.06	0.02	0.06	0.9	0.3	0.4	0.64	0.16	0.4					
Score Description 4 Very Good 3 Good 2 Neutral 1 Poor 0 Adverse			Reduces Combined Sewer Overflow volume	Reduces runoff volume	Reduces frequency of untreated discharges	Reduces wet weather flows in system	Reduces suspended solids	Reduces bacteria	Reduces floatables/trash	Enhances Nine Minimum Controls	Maximizes use of existing infrastructure	Reliability	Flexibility (possibility of future expansion)	Land requirements	Constructability	Simplicity of operation and maintenance	Implementation time	Synergy with other needs/projects	Human health & safety (exposure, basement backups, street flooding, etc.)	Emergency Response Time (street flooding, etc.)	Protection of historical and cultural resources	Protection of environmental resources	Short-term (noise, truck traffic, siting, etc.)	Long-term (open space creation, recreational opportunities, aesthetic improvements, etc.)					
Technology Classification	Technologies	Fatally Flawed																											
Inflow Reduction	Stormwater Management/Green Infrastructure		3	3	3	3	3	3	3	2	3	3	4	2	2	2	1	3	3	3	2	2	1	3	0.30	0.26	0.90	0.86	2.32
	Industrial Pretreatment/Other Source Controls		2	2	2	2	3	3	3	4	2	3	4	4	4	3	1	2	3	2	2	3	3	1	0.22	0.29	0.83	0.90	2.23
	Partial Sewer Separation		3	2	1	3	0	3	0	2	3	2	1	2	1	2	1	2	2	2	1	2	0	2	0.21	0.21	0.60	0.62	1.63
	Complete Sewer Separation	X	4	2	1	3	0	3	0	2	3	2	1	2	1	2	0	2	2	2	1	2	0	2	0.23	0.20	0.60	0.62	1.65
Sewer System Modification	Flow Redirection		4	2	3	2	3	3	3	4	3	3	2	4	4	3	4	2	2	2	2	3	3	2	0.30	0.31	0.60	1.00	2.21
	Infiltration Reduction		2	2	2	2	2	2	2	2	3	1	2	3	2	2	1	2	2	2	2	2	1	2	0.20	0.21	0.60	0.76	1.77
	Interceptor Sewer Construction		3	2	3	2	2	2	2	3	2	3	2	1	2	2	2	2	3	2	2	2	1	2	0.25	0.23	0.83	0.76	2.06
	Relief Sewer Construction		2	2	3	2	2	2	2	3	2	3	2	2	2	2	2	2	3	3	2	2	2	2	0.23	0.23	0.90	0.80	2.16
	Relocation of CSO Outfalls	X	2	2	2	2	2	2	2	2	1	3	2	1	1	3	2	2	2	2	2	2	1	1	0.20	0.20	0.60	0.66	1.66
	Outfall Consolidation		2	2	2	2	2	2	2	3	2	3	3	3	3	3	3	2	2	2	2	2	2	2	0.20	0.27	0.60	0.80	1.87
	Pump Station Modifications		2	2	3	2	2	2	2	3	2	3	2	1	1	2	3	2	3	4	3	3	2	2	0.23	0.23	0.98	1.06	2.49
	Static Flow Control		3	2	3	2	2	2	3	3	3	3	3	3	3	4	3	2	3	2	2	2	2	2	0.26	0.30	0.83	0.80	2.18
	Variable Flow Control		3	2	3	2	3	3	3	3	3	2	3	3	3	1	2	2	3	2	2	2	2	2	0.27	0.24	0.83	0.80	2.13
	Real-Time Flow Control		3	2	3	2	3	3	3	4	3	3	4	3	3	0	2	2	3	2	2	2	2	2	0.27	0.26	0.83	0.80	2.15
Storage	Open Basins and Tanks		4	2	4	4	3	3	3	2	3	4	3	0	3	1	0	2	2	2	0	2	0	1	0.35	0.23	0.60	0.42	1.60
	Closed Storage Tanks		4	2	4	4	3	3	3	2	3	4	1	2	3	1	1	2	2	4	0	2	0	1	0.35	0.23	0.75	0.42	1.75
	Storage Conduits		4	2	4	4	3	3	3	2	3	4	4	1	1	2	1	2	3	4	1	2	1	2	0.35	0.25	0.98	0.66	2.23
	Storage Tunnels		4	2	4	4	3	3	3	2	3	4	0	0	1	2	0	2	3	4	1	2	1	2	0.35	0.22	0.98	0.66	2.20
	Existing Tunnels or Conduits (Abandoned)	X	4	2	4	4	3	3	3	2	4	4	0	4	4	2	3	2	3	4	2	2	2	2	0.35	0.29	0.98	0.80	2.41
Physical/ Chemical Satellite Treatment	Floatables Control (Screening)		2	2	3	2	2	2	3	3	2	3	2	1	1	1	1	2	3	2	2	2	1	2	0.23	0.20	0.83	0.76	2.02
	Swirl Concentrators and Vortex Separators		2	2	4	2	4	3	3	2	2	3	2	1	3	1	0	2	3	2	1	2	1	2	0.28	0.19	0.83	0.66	1.95
	Sedimentation		2	2	3	2	3	3	4	2	2	3	2	1	1	0	1	2	3	2	2	2	0	2	0.25	0.17	0.83	0.72	1.97
	Compressed Media Filtration		2	2	3	2	3	3	4	2	2	3	2	1	1	0	1	2	3	2	2	2	0	2	0.25	0.17	0.83	0.72	1.97
	High Rate Treatment/Ballasted Flocculation		2	2	3	2	3	3	4	2	2	3	2	1	1	0	1	2	3	2	2	2	0	2	0.25	0.17	0.83	0.72	1.97
	Disinfection/Dechlorination		2	2	3	2	3	3	4	2	2	3	2	1	1	0	1	2	3	2	2	2	0	2	0.25	0.17	0.83	0.72	1.97
Biological Treatment	New Secondary or Advanced WWTPs	X	3	2	3	2	3	3	3	2	3	4	3	1	2	3	0	1	3	3	2	3	1	2	0.27	0.24	0.90	0.92	
	Increased Treatment Capacities at Existing Facilities		3	2	3	2	3	3	3	2	3	4	3	2	3	3	2	1	3	3	2	3	3	2	0.27	0.26	0.90	1.00	2.43
	Constructed Treatment Wetlands		3	2	3	2	3	3	3	2	3	4	3	1	2	3	2	2	3	2	1	3	1	3	0.27	0.27	0.83	0.92	2.28

Note: Any technology considered adverse for safety will be considered fatally flawed and eliminated.

Note: Alll of the physical/chemical/satellite treatment include disinfection (and dechlorination if necessary).


CSO Technology Screening Comparison
Score
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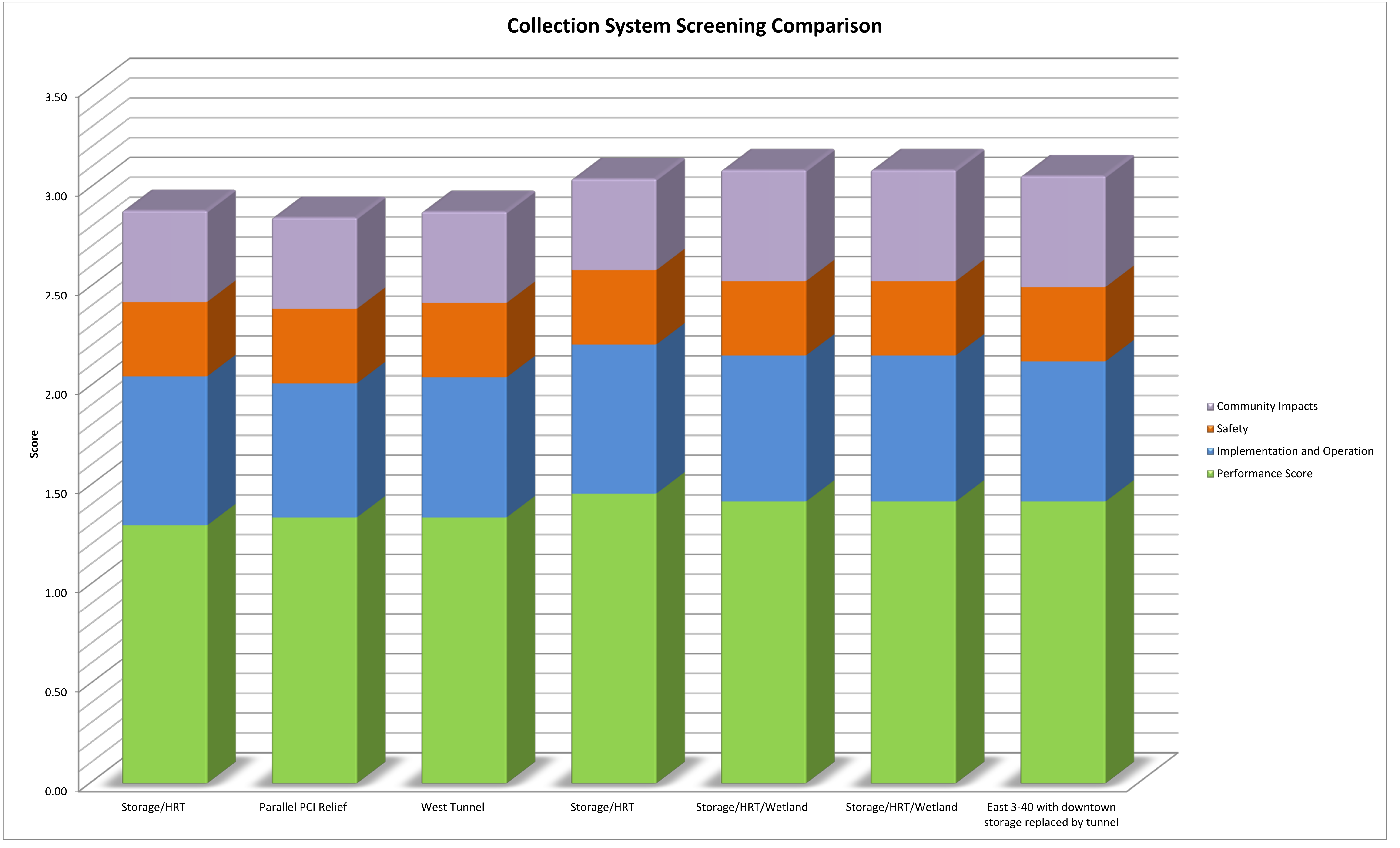
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Storage/HRT
Parallel PCI Relief
West Tunnel
Storage/HRT
Storage/HRT/Wetland
Storage/HRT/Wetland
East 3-40 with downtown storage replaced by tunnel
Community Impacts
Safety
Implementation and Operation
Performance Score


Collection System Screening Comparison
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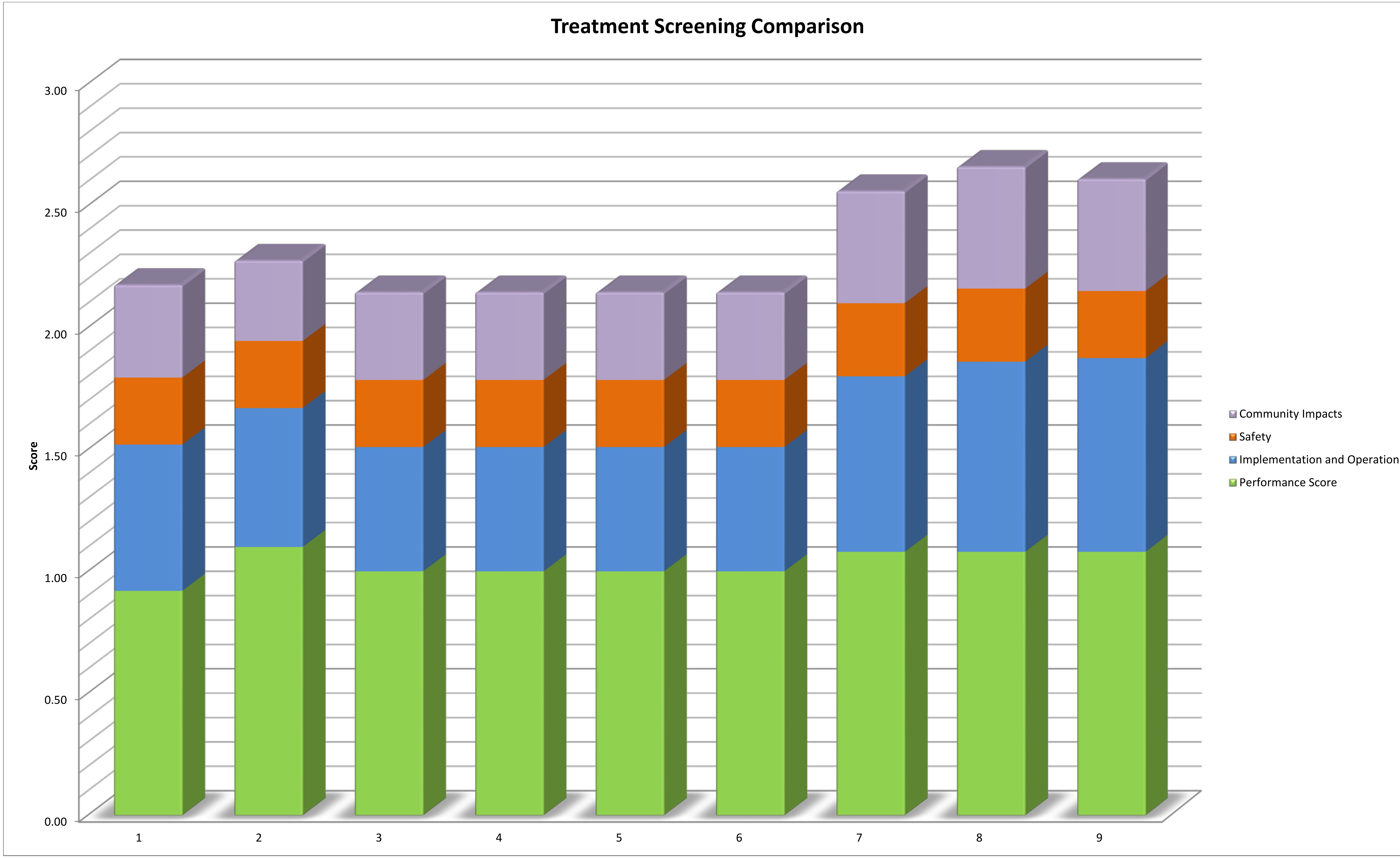
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Score
Storage/HRT
Parallel PCI Relief
West Tunnel
Storage/HRT
Storage/HRT/Wetland
Storage/HRT/Wetland
East 3-40 with downtown storage replaced by tunnel
Community Impacts
Safety
Implementation and Operation
Performance Score



Treatment Screening Comparison
Score
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1
2
3
4
5
6
7
8
9
Community Impacts
Safety
Implementation and Operation
Performance Score

Category	Criterion	Question
Performance Factors	**Reduces Combined Sewer Overflow volume**	When this technology is implemented, does the system's CSO volume decrease?
	Reduces runoff volume	Does this technology help reduce the service area's runoff volume?
	Reduces frequency of untreated discharges	Will this technology reduce the number of CSOs, SSOs, or CSS releases?
	Reduces wet weather flows in system	Does this technology keep the wet weather flows from getting into the sewer system?
	Reduces suspended solids	Does implementation of this technology reduce the suspended solids being released into the water bodies, or at the plant?
	Reduces bacteria	Does this technology reduce the amount of bacteria that enter the water bodies?
	Reduces floatables/trash	Does this technology keep the floatables and trash from getting into the sewer system?
	Other…	
Community Impacts	**Protection of historical and cultural resources**	Would this technology keep a historic area from flooding? Would the area the technolgy is being built in have an effect on historic landmarks?
	Protection of environmental resources	Will this technology help the environment when implemented (both flora and fauna, animals, water)?
	Short-term (noise, truck traffic, siting, etc.)	Does this technology have construction requirements that would disrupt a neighborhood?
	Long-term (open space creation, recreational opportunities, aesthetic improvements, etc.)	Does this technology leave the community a better place than before it was implemented? What visual impact will it have?
	Other…	
Safety	**Human health & safety (basement backups, street flooding, etc.)**	Does this technology decrese human exposure to raw sewage? Are there public safety issues associated, such as exposure to chemicals?
	Emergency Response Time (street flooding, etc.)	Does this technology affect the emergency response time to a certain area?
Implementation and Operation	**Enhances Nine Minimum Controls**	Does this alternative contribute to achieving the Nine Minimum Controls (1.Proper operation and regular maintenance programs for the sewer system and the CSOs 2.Maximum use of the collection system for storage 3.Review and modification of pretreatment requirements to assure CSO impacts are minimized 4.Maximization of flow to the publicly owned treatment works for treatment 5.Prohibition of CSOs during dry weather 6.Control of solid and floatable materials in CSOs 7.Pollution prevention 8.Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts 9.Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls)?
	Reliability	Is this technology tested in other similar situations? Is the equipment mechanically reliable?
	Flexibility (possibility of future expansion)	Would future expansion of technology be possible?
	Land requirements	How much land does this require?
	Constructability	How difficult is the construction of this technology?
	Simplicity of operation and maintenance	Will operations require more staff or additional certifications or equipment? How often does it need to be maintained?
	Implementation time	How long from start until technology is fully functional?
	Synergy with other needs	Can this project be conducted with another department? Does it correspond to another city goal? Is there a project currently on the shelf using this technology?

APPENDIX L

Typical Year Rainfall and 2-YR 24-HR Design Storm Comparison for West Sewer System Model

Typical Year Rainfall and 2-YR 24-HR Design Storm Comparison for West Sewer System Model

PREPARED FOR: Evansville Water and Sewer Utility

PREPARED BY: CH2M HILL

DATE: March 29, 2013

1. Purpose

The following memorandum documents the typical year rainfall and comparison to the 2-year 24-hour design storm for the west service area dynamic hydrologic and hydraulic model for Evansville Water and Sewer Utility (Utility).

2. Background

For the Utility's west sewer system, the CSS system-wide improvement evaluation is based on the typical year rainfall, while the Sanitary Sewers Remedial Measures Plan (SSRMP) is based on 2-year 24-hour, 5-year 24-hour, and 10-year 24-hour design storms (Critical Storm Events). For analysis purposes, a storm similar to the 2 –year 24 hour design storm from the typical year rainfall dataset was sought. The West SSS and CSS are integrated into one SWMM dataset and using the typical year rainfall data for the analysis of the West SSS and CSS will be beneficial in terms of understanding the interactions between the CSS and the SSS.

Rainfall Analysis

Exhibit 1 shows the 2-year 24-hour design storm table for the West system. The 2-year 24-hour design storm has a total rainfall of 3.27 inches. Exhibit 2 shows the typical year rainfall plot for the West system. Year 2000 was selected as the typical year rainfall, which is attached in Appendix A, Typical Precipitation Year Evaluation Report, CSO Long Term Control Plan, February 2008.

EXHIBIT 1
2-year 24-hour Design Storm
West System

Time	Cumulative Rainfall (in)	Rainfall Depth (in)	Time	Cumulative Rainfall (in)	Rainfall Depth (in)
0:00	0.00	0.00	13:12	1.37	0.29
1:12	0.07	0.07	14:24	1.80	0.43
2:24	0.16	0.09	15:36	2.26	0.46
3:36	0.26	0.10	16:48	2.58	0.32
4:48	0.39	0.13	18:00	2.81	0.23
6:00	0.46	0.07	19:12	2.98	0.17
7:12	0.56	0.10	20:24	3.07	0.09
8:24	0.65	0.09	21:36	3.14	0.07
9:36	0.75	0.10	22:48	3.20	0.06
10:48	0.88	0.13	24:00	3.27	0.07
12:00	1.08	0.20			

EXHIBIT 2
Typical Year Rainfall
Year 2000

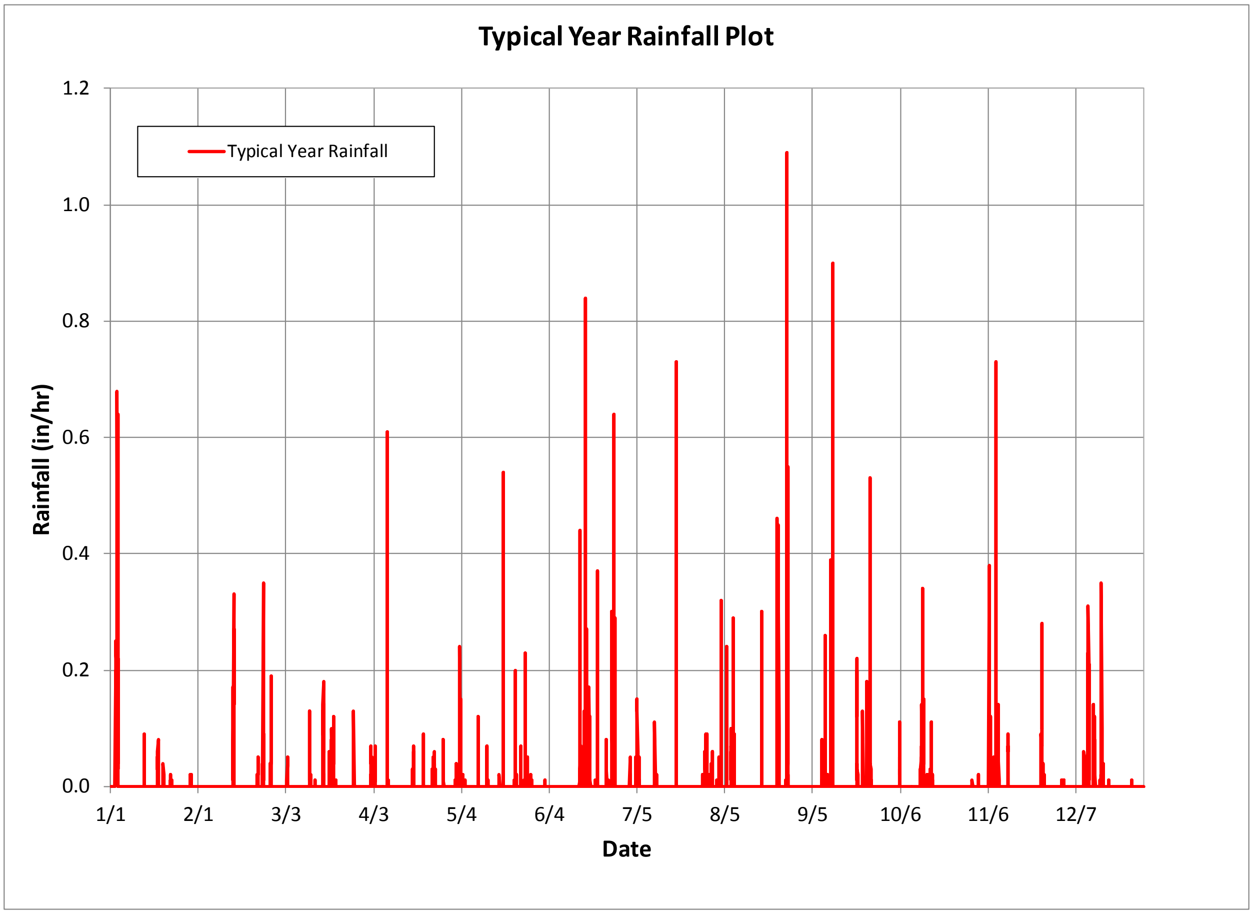


Exhibit 3 summarizes the characteristics of the typical year rainfall events. Sixty-seven events were identified using the PCSWMM rainfall analysis tool with an inter-event time of 24 hours. The rainfall on January 2nd has a duration of 24-hour and the highest total rainfall, 3.74 inches. The total rainfall and duration of the January 2nd storm appears to be similar to the 2-year 24-hour storm. None of the other storms appear to be equivalent to or higher than the 2-year 24-hour storm. Therefore, the following section further evaluates the January 2nd storm distributions.

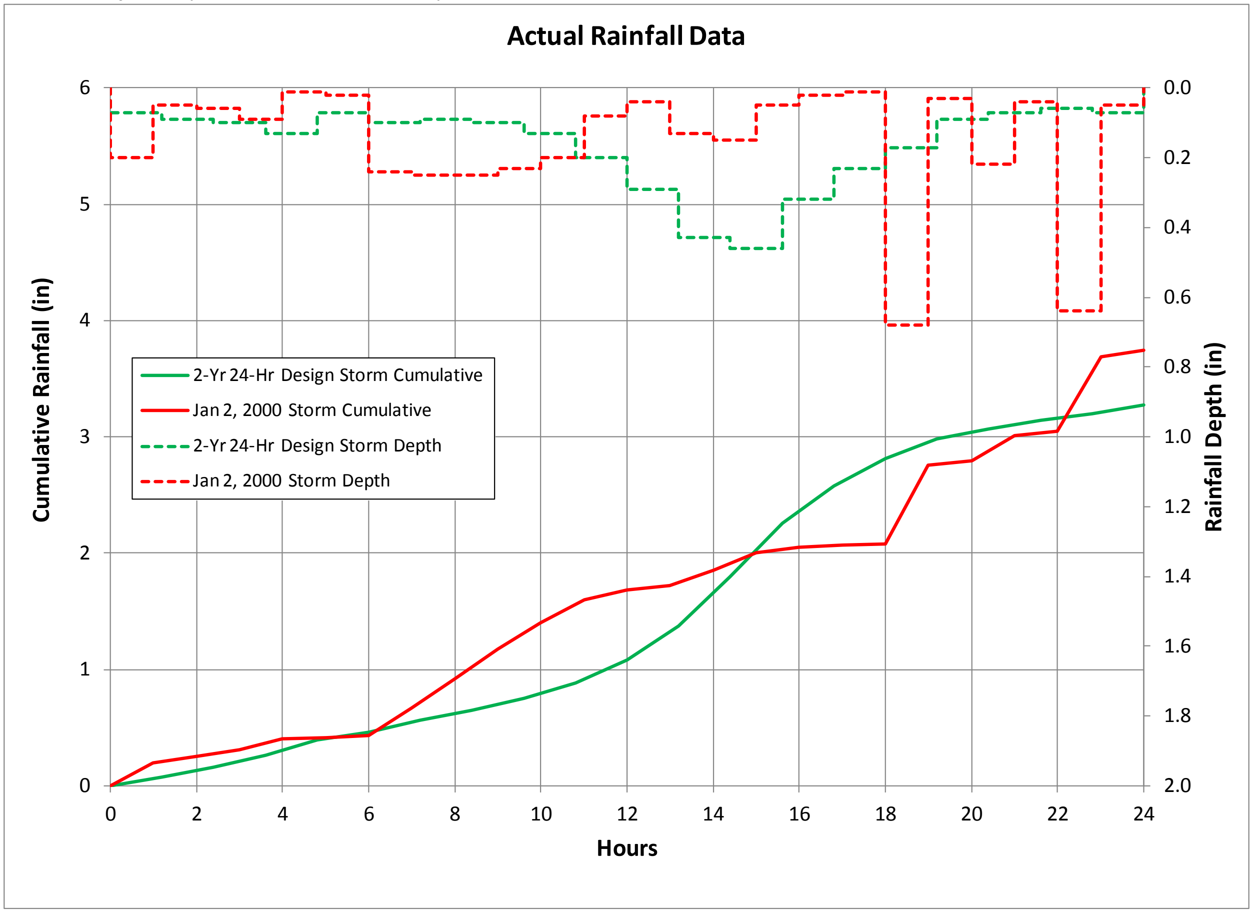
EXHIBIT 3
Rainfall Events
Summary

Event	Date	Duration (hr)	Maximum Rainfall (in/hr)	Mean Rainfall (in/hr)	Total Rainfall (in)
1	1/2/2000 17:00	24	0.68	0.16	3.74
2	1/12/2000 22:00	1	0.09	0.09	0.09
3	1/17/2000 15:00	6	0.08	0.05	0.29
4	1/19/2000 17:00	2	0.04	0.03	0.06
5	1/22/2000 5:00	10	0.02	0.01	0.08
6	1/29/2000 5:00	12	0.02	0.01	0.09
7	2/13/2000 6:00	11	0.33	0.13	1.43
8	2/21/2000 23:00	3	0.05	0.03	0.09
9	2/23/2000 17:00	10	0.35	0.08	0.79
10	2/26/2000 7:00	17	0.19	0.06	1.09
11	3/3/2000 8:00	6	0.05	0.03	0.16
12	3/11/2000 6:00	13	0.13	0.03	0.42
13	3/13/2000 8:00	1	0.01	0.01	0.01
14	3/16/2000 0:00	13	0.18	0.09	1.20
15	3/18/2000 8:00	59	0.12	0.02	1.14
16	3/26/2000 21:00	4	0.13	0.07	0.28
17	4/1/2000 21:00	44	0.07	0.01	0.47
18	4/7/2000 16:00	9	0.61	0.11	1.03
19	4/16/2000 14:00	14	0.07	0.01	0.19
20	4/20/2000 13:00	1	0.09	0.09	0.09
21	4/23/2000 18:00	23	0.06	0.02	0.48
22	4/27/2000 15:00	3	0.08	0.03	0.10
23	5/1/2000 22:00	11	0.04	0.01	0.08
24	5/3/2000 12:00	42	0.24	0.01	0.46
25	5/9/2000 18:00	2	0.12	0.09	0.18
26	5/12/2000 22:00	11	0.07	0.02	0.22
27	5/17/2000 10:00	1	0.02	0.02	0.02
28	5/18/2000 21:00	2	0.54	0.30	0.60
29	5/22/2000 14:00	19	0.20	0.02	0.30
30	5/24/2000 23:00	4	0.07	0.03	0.11
31	5/26/2000 5:00	64	0.23	0.01	0.63
32	6/2/2000 13:00	1	0.01	0.01	0.01
33	6/14/2000 17:00	10	0.44	0.06	0.60
34	6/16/2000 12:00	49	0.84	0.06	2.79
35	6/20/2000 4:00	24	0.37	0.02	0.57
36	6/24/2000 1:00	19	0.08	0.01	0.20
37	6/26/2000 2:00	31	0.64	0.05	1.69
38	7/2/2000 11:00	4	0.05	0.02	0.07
39	7/4/2000 12:00	32	0.15	0.02	0.52

Event	Date	Duration (hr)	Maximum Rainfall (in/hr)	Mean Rainfall (in/hr)	Total Rainfall (in)
40	7/11/2000 8:00	15	0.11	0.01	0.16
41	7/18/2000 22:00	4	0.73	0.26	1.05
42	7/28/2000 6:00	80	0.09	0.01	0.73
43	8/2/2000 5:00	38	0.32	0.01	0.42
44	8/5/2000 14:00	1	0.24	0.24	0.24
45	8/7/2000 5:00	30	0.29	0.02	0.70
46	8/18/2000 0:00	4	0.30	0.20	0.79
47	8/23/2000 8:00	21	0.46	0.08	1.70
48	8/26/2000 12:00	21	1.09	0.08	1.75
49	9/8/2000 6:00	96	0.90	0.02	2.39
50	9/20/2000 16:00	7	0.22	0.09	0.64
51	9/22/2000 19:00	71	0.53	0.03	2.00
52	10/5/2000 16:00	5	0.11	0.04	0.21
53	10/13/2000 5:00	26	0.34	0.08	2.15
54	10/15/2000 13:00	44	0.11	0.01	0.37
55	10/31/2000 12:00	1	0.01	0.01	0.01
56	11/2/2000 14:00	1	0.02	0.02	0.02
57	11/6/2000 8:00	14	0.38	0.04	0.60
58	11/8/2000 1:00	43	0.73	0.04	1.65
59	11/13/2000 1:00	5	0.09	0.05	0.25
60	11/24/2000 20:00	26	0.28	0.04	0.91
61	12/2/2000 2:00	17	0.01	0.00	0.06
62	12/9/2000 22:00	3	0.06	0.04	0.13
63	12/11/2000 6:00	11	0.31	0.15	1.60
64	12/13/2000 6:00	14	0.14	0.05	0.72
65	12/15/2000 16:00	29	0.35	0.04	1.08
66	12/18/2000 13:00	2	0.01	0.01	0.02
67	12/26/2000 18:00	1	0.01	0.01	0.01

Exhibit 4 compares the January 2nd storm with the 2-year 24-hour design storm for rainfall depth and cumulative rainfall depth. The cumulative plots show similar trends between both storms. However, the rainfall depth plots do not show a comparable pattern.

EXHIBIT 4
January 2nd and 2-year 24-hour Design Storm Comparison
Actual Rainfall Depth and Cumulative Depth



The Alternating Block Hyetograph method is typically used to define IDF relationships and to develop design rainfall hyetographs. The IDF relationships can be found at http://dipper.nws.noaa.gov/hdsc/pfds/. This TM uses this method to normalize the 2-year 24-hour storm and the January 2nd typical year storm so that they can be compared side by side. The process of developing the Alternating Blocks is summarized below:

1. Determine the time interval (1 and 1.2 hours for the typical year storm and design storm, respectively)—each time interval represents one block.
2. Compute the incremental rainfall for each block.
3. Pick the highest incremental rainfall (maximum block) and rank it as #1.
4. Pick the higher block from the two blocks immediately before and after the first block and rank it as #2.
5. Pick the higher block from the two blocks immediately before and after the first and second blocks, and rank it as #3.
6. Repeat the above step until all blocks have been ranked.

7. Sort the ranks starting from #1 with the incremental rainfall associated with each block.
8. Calculate the cumulative rainfall from the sorted data and plot the cumulative rainfall.

Exhibit 5 shows the cumulative hyetographs for the January 2nd storm and the 2-year 24-hour design storm using the Alternating Block method. Exhibit 6 lists the rainfall frequency of each block for the January 2nd storm. In general, the rainfall is close to the 2-year design storm for the first six blocks. The rainfall is lower than the 2-yr storm for blocks 7–14, but is higher for blocks 16–24. Overall, the January 2nd storm from the typical year rainfall is reasonably equivalent to the 2-year 24-hour design storm.

EXHIBIT 5
January 2nd and 2-year 24-hour Design Storm Comparison
Alternating Block Hyetograph

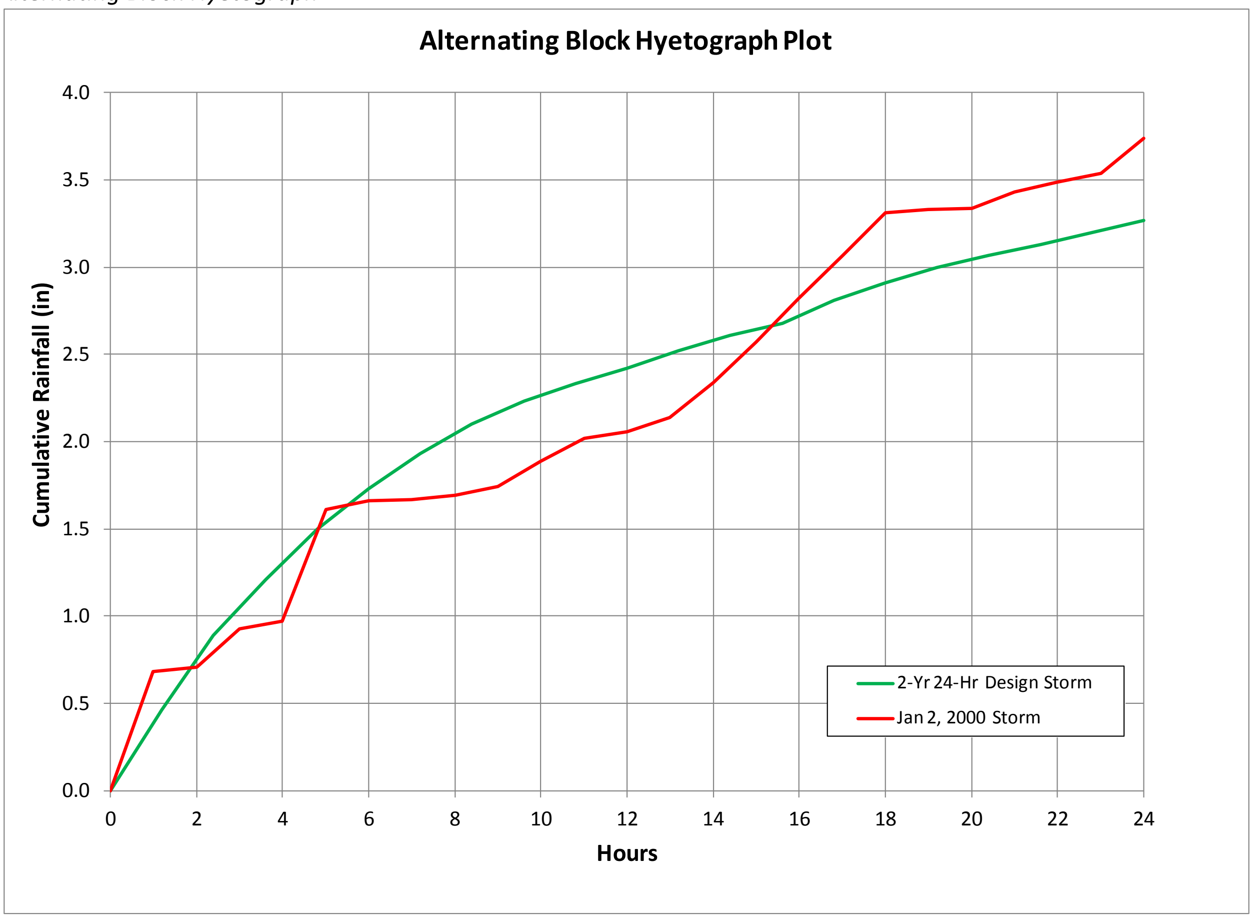


EXHIBIT 6
January 2nd Rainfall Frequency
Compared with the 2-year 24-hour Storm

Block Number	Frequency
1	>2-yr 24-hr
2	2-yr 24-hr
3	<2-yr 24-hr
4	<2-yr 24-hr
5	2-yr 24-hr
6	2-yr 24-hr
7	<2-yr 24-hr
8	<2-yr 24-hr
9	<2-yr 24-hr
10	<2-yr 24-hr
11	<2-yr 24-hr
12	<2-yr 24-hr
13	<2-yr 24-hr
14	<2-yr 24-hr
15	2-yr 24-hr
16	>2-yr 24-hr
17	>2-yr 24-hr
18	>2-yr 24-hr
19	>2-yr 24-hr
20	>2-yr 24-hr
21	>2-yr 24-hr
22	>2-yr 24-hr
23	>2-yr 24-hr
24	>2-yr 24-hr

3. Summary and Conclusions

This analysis was performed to evaluate if the typical year rainfall contained an event similar to the 2-year 24-hour design storm. Of the 67 events during the typical year, the January 2nd event has the largest cumulative precipitation, 3.74-inches, which is close to the design storm cumulative total of 3.27-inches. Comparisons were made using the Alternating Block Hyetograph method. Results showed that the January 2nd storm is similar to the 2-year 24-hour design storm. The sanitary system improvement evaluations based on the typical year simulation will produce projects that convey or store flows similar to the 2-year 24 hour design storm. Projects will also be developed to convey or store the 5-year and 10 –year 24 hour design storms.

Appendix A
Typical Precipitation Year Evaluation Report
CSO Long Term Control Plan, February 2008

Clark Dietz
ENGINEERS

Typical Precipitation Year Evaluation Report

CSO Long Term Control Plan

February 2008

Evansville Water and Sewer Utility
Evansville, IN

Clark Dietz, Inc.
9000 Keystone Crossing, Suite 350
Indianapolis, Indiana
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LIST OF APPENDICES

1.0 BACKGROUND AND PURPOSE

The City of Evansville is currently in the process of updating its previously submitted Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP). The City has developed hydraulic models of its East and West combined sewer systems. Two model calibration reports for the East System have been prepared and submitted to U.S. EPA as part of the Consent Decree negotiations (Preliminary Modeling Report, Combined Sewer – East System, November 2006, Clark Dietz, Inc., report revised and re-issued in November 2007). The West System model calibration is ongoing and will be submitted to U.S. EPA under a separate report.

The hydraulic models will be used to analyze CSO control alternatives and ultimately select a set of improvements for implementation. EPA CSO Control Policy expects CSO communities to consider a reasonable range of alternatives, such as zero overflow events per year, an average of one to three, four to seven, and eight to twelve overflow events per year.

To carry out this task, it is necessary to define a "typical year", as rainfall can vary significantly from year to year. A statistical analysis of historical hourly precipitation was performed to select a typical year for use in the hydraulic modeling of CSO controls. The statistical analysis considered factors such as average annual precipitation, average monthly precipitation, number of storm events per year, distribution of storm events by depth and intensity, and other factors.

This report documents the procedure and the results obtained in the statistical analysis of the historical precipitation data for Evansville.

2.0 PRECIPITATION DATA SOURCES

Longer term precipitation data is available for the Evansville area from two sources: the NOAA National Climactic Data Center (NCDC) weather center at Evansville Regional Airport (http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~StnSrch~StnID~20006102) and the USGS gauge at Dress Plaza (http://waterdata.usgs.gov/in/nwis/uv?03322000). Figure 1 shows the Evansville Regional Airport in relation to the combined sewer area in Evansville, as well as the location of the USGS gauge. The NOAA NCDC gauge has been collecting hourly precipitation data since July of 1948. The USGS has been collecting precipitation data at its gauge since 1987.

Since the NOAA NCDC data at Evansville Regional Airport has a much long period of record, it was used to perform the statistical analyses needed to select a typical precipitation year. The data was purchased and downloaded from the above website. It provided 58 *complete* years of hourly precipitation data (1949-2006) with a 0.01-inch precision. The data from 1948 and 2007 were not used, as the dataset for these two years covered only portions of each year.

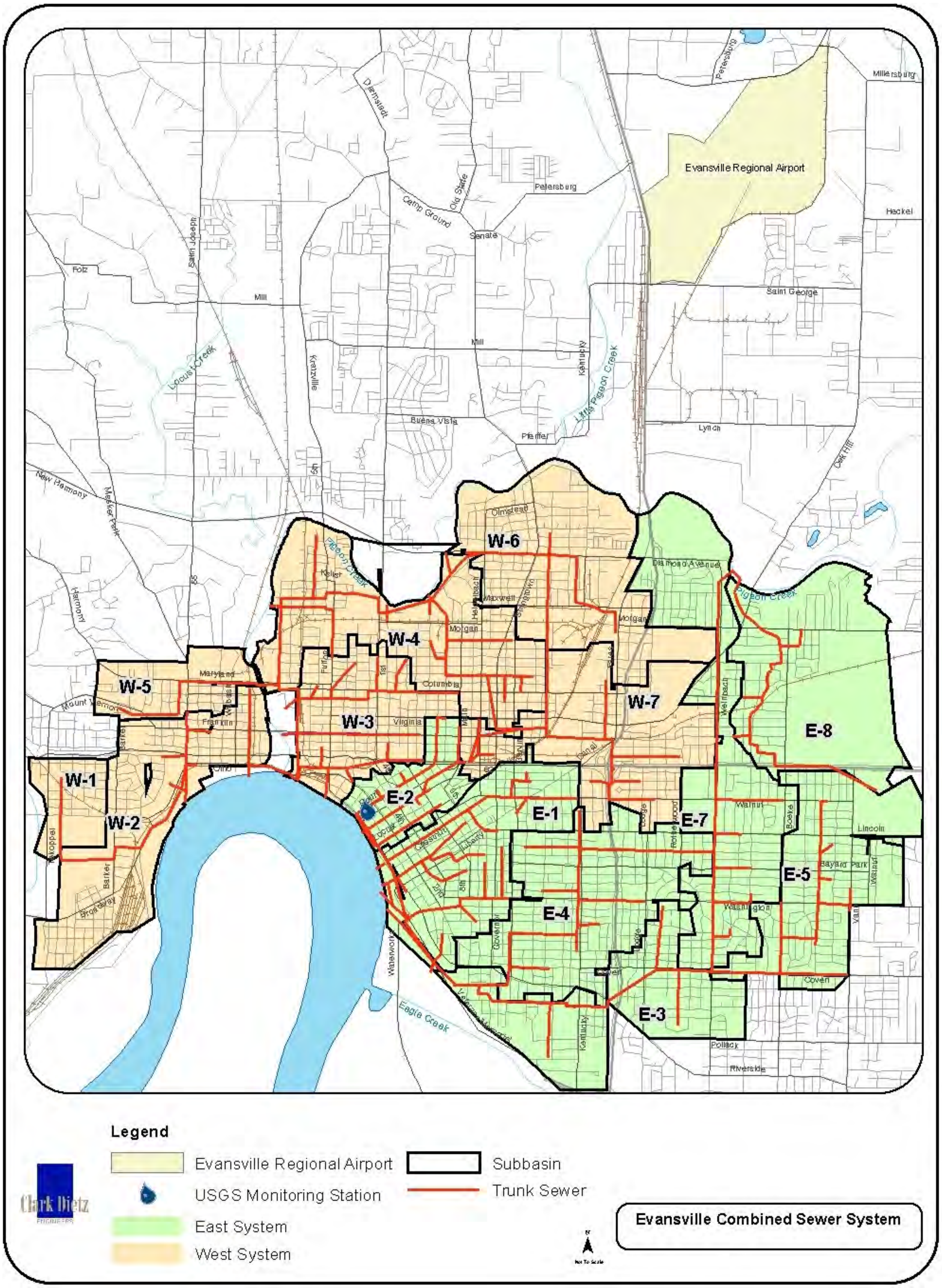

Figure 1 - Evansville Combined Sewer System and Long Term Rainfall Data Locations

3.0 STATISTICAL ANALYSIS APPROACH

The data was imported from ASCII text files into MS Excel worksheets. In terms of defining a storm event for use in data analysis, an "Inter-Event Time" (IET) period of 12 hours was chosen based on the recommendation of Kansas City, Missouri (KCMO) overflow control program study(1). That is, an event was considered a "separate" event if there was a period of 12 hours or more with no rainfall.

3.1 Total Annual Precipitation Results

Annual precipitation totals for the 58 year record of 1949-2006 are shown in Figure 2a. Figure 2b shows the same dataset ranked from highest to lowest total annual precipitation. The **average (mean)** annual precipitation for the 58 years of record was found to be **44.22 inches**. The **median** annual total precipitation was found to be **43.25 inches**. Fifteen out of the 58 years had precipitation above the 75th percentile (49.05 inches) and 15 years were below the 25th percentile (38.6 inches). There were 28 years where the total precipitation was between the 25th and 75th percentiles. The maximum value of 65.95 inches occurred in 2006 and was 22.7 inches above median. The minimum value of 27.61 inches occurred in Year 1963 and was 15.64 inches below median.

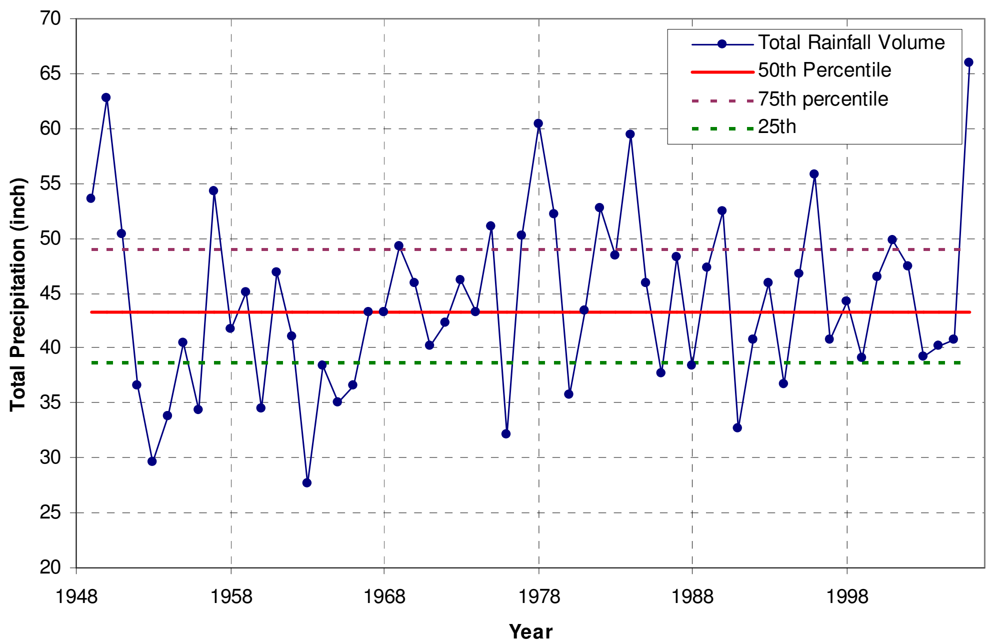

Figure 2a - Annual Total Precipitation per Year

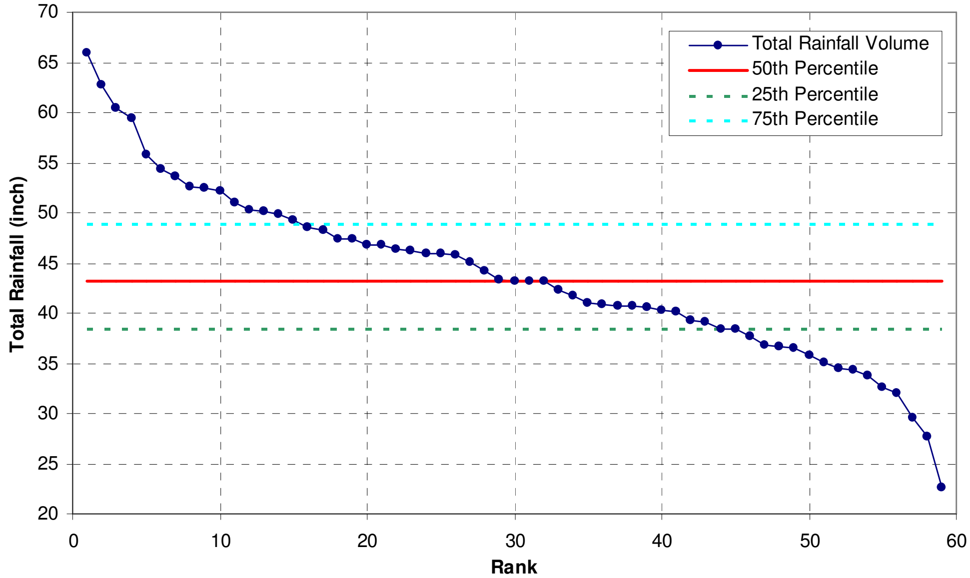

Figure 2b - Ranked Annual Total Precipitation

3.2 Annual Event "Bin" Results

Precipitation events within the entire full year historical dataset (1949-2006) were delineated based upon IET of 12 hours. Precipitation depths and durations were tabulated for each storm event. The storm events were then sorted by size and "binned" into ranges as shown in Table 1 in Appendix A (all statistical results tables are provided in Appendix A). The green shaded rows show the results grouped into 10-year periods. The blue shaded rows show the results 20-year periods. The yellow shaded rows show the results for the entire period of record (1949 to 2006). The results are shown for the full year as well as the recreation season (April – October), which is a more critical period for water quality parameters like *E. coli* and dissolved oxygen[(2)].

For the entire 58-year dataset (full year basis), an average of seven events exceed 1.5 inches, four events exceed 2 inches, two events exceed 2.5 inches, and one event exceeds 3 inches. The largest storms (greater than 3 inches) nearly always occur during the recreational season (convective storms). These statistics provide a sense of the types of storms that must be controlled to yield the desired level of control (i.e. number of overflow events per year).

The last ten years of record were examined to determine if a particular year matched fairly well with the long term average storm events by depth bins, as well as other factors. Using more recent precipitation years allows for validation with other more recent rainfall data sources such as the USGS gauge at Dress Plaza. Table 2 provides a comparison of the last ten years of storm events, sorted by bin depths as well as averages for the periods of 1949 to 2006 (entire dataset) and 1997 to 2006 (last 10 years).

The results show the last 10 years to be slighter wetter than the average for the 58-year historical dataset. However, the data are skewed somewhat by 2006, which was the wettest year (65.95 inches) in the 58-year dataset.

The data for 1993 are also shown in Table 2. The data for 1993 was included because this year was used in the previously submitted LTCP (2002) as a "typical year". Minimal documentation was included in the 2002 LTCP as to why 1993 was selected, other than the annual total precipitation depth and monthly averages matched the long term record well. The analysis in the 2002 LTCP also used the Evansville Regional Airport NOAA gauge data.

In selecting candidates for a typical precipitation year, it is appropriate to place more weight in matching the number of storms in the higher bin depths, as these storm events will dictate the level of CSO control (i.e. zero overflow events per year, an average of one to three, four to seven, and eight to twelve overflow events per year). Overall, the selected typical year should also match fairly well on total annual precipitation (i.e. not abnormally wet or dry year).

In viewing the results in Table 2, the years 2005, 2001, and 2000, are potential candidates for use as a typical year (purple shaded cells in Table 2). For 2005, the larger bin events match fairly closely to the full year and recreational season long term averages (1949 to 2006). However, the >2.5" and >3.0" bins are double the long term average. The total annual precipitation is also somewhat low (3.47 inches below long term average annual precipitation). The year 2001 would represent a conservative (somewhat higher than normal) selection, with all bins being about two storms above the long term average, and total annual precipitation being 5.57 inches above the average annual precipitation. The year 2000 is high in the >1.0" bin (17 versus 13). The >1.5" bin matches exactly, and the >2", >2.5", and >3.0" bins are off by one (two are high and one is low). The total annual precipitation of 46.44 is 2.22 inches above the long term average annual precipitation.

Of the three candidate years, none perfectly match the long term average, but 2000 most closely matches the higher bin depths as well as average annual precipitation.

3.3 Monthly Peak Intensity Results

Peak hourly rainfall intensities are also an important factor in selecting a typical year as these intensities correspond to peak flow rates that would be used to size CSO control conveyance facilities (gravity sewers, pumps, force mains, screening, and treatment facilities). A partial data series was constructed for the statistical analyses using the peak hourly rainfall intensity for each month in the 1949 - 2006 dataset.

Table 3 shows the average peak hourly intensity by month for the 58 year dataset as well as the peak monthly intensities for each year in the 10 year period of 1997 to 2006. On average, the peak hourly intensity storms occur in the months of June, July, and August, when convective thunderstorms are more common. The highest intensity for each year is highlighted in yellow. The peak hourly intensities over the last 10 year period range from 0.75 to 1.91 inches per hour, with an average of 1.18 inches per hour. This compares fairly closely to the Bulletin 71[(3)] published statistical 1-year, 1-hour value of 1.30 inches per hour.

The peak hourly intensities for each month of the 58 year dataset (696 values) were also sorted by 0.2 inch/hour bins (0.0 to 0.2 up to 2.8 to 3 for total of 15 bins) and the number of months experiencing intensities in each bin range was recorded. The results of this analysis are shown in Table 4.

The peak hourly intensity in each month for the years 1997 to 2006 are also sorted by bins in Table 4 (for both full year and recreation season only). The past 10 years of data show more storms on average in the 0.8 to 1.0 and 1.0 to 1.2 inch per hour bins. In the last 10 years, only 4 events exceeded a peak hourly intensity of 1.2 inches per hour. The highest was 1.91 inches per hour, which occurred on April 21, 2002.

The full hourly data set (not just the peak hourly in a month) for the years 1997 to 2006 was also grouped by "bins". Table 5 presents these results. The analysis was performed to determine whether any of the typical year candidates exhibited any anomalies in terms of peak hourly intensity. The table shows the total number of hourly rainfall depths by peak intensity bins. On average, there are 564 hours in a year (out of the total of 8760 hours in a given year) that have some measurable precipitation (0.01 or more inches). Approximately 91 percent of those hours have less than 0.2 inches. In the higher intensity bins, 6 out of the 10 years have one storm in the 1.0 to 1.2 inch range, so any typical year selected should have at least one storm in this bin. Only four hours in the 10-year period had in excess of 1.2 inches, with the highest hour being in 2002 (April 21st). Since peak hourly intensities above 1.2 inches per hour are relatively rare, the selected typical year should not include such intensity.

The bins with the closest number of events as compared to the 10-year average are noted in Table 5 with a bold table cell border. As shown in the table, no particular year matches perfectly against the average. Either 2000 or 2001 match up fairly well over the 10-year average. Where they are deviate from the 10-year average, the deviation is generally slightly above average (more conservative if used for CSO modeling).

The 58-year averaged data by bins (1949 to 2006) was plotted along with the individual years for the 10-year period between 1997 to 2006 as shown in Figures 3a (full year) and Figure 3b (recreational season). Though there is some variation from year to year, overall, the peak intensities track the long term averaged peak intensities fairly well.

3.4 Monthly Total Precipitation Results

The final statistic used to assist in selection of a typical year was the total monthly precipitation. Total precipitation for each month over the period of 1949-2006 was compiled and an average for each month computed. An average was also developed for just the past 10 years (1997 to 2006). Table 6 presents the monthly precipitation averages for the 1949-2006 and 1997-2006 periods, along with monthly totals for years 1997 to 2006. The monthly averages for the two periods match fairly closely. The average for June and August are wetter the past 10 years as compared to the entire dataset of 1949 to 2006.

However, when examining the year by year monthly totals, significant variation from the average exists. This point is graphically illustrated in Figure 4, which is a graph of each year for 1997 to 2006 plotted along with the long term (1949-2006) monthly average precipitation.

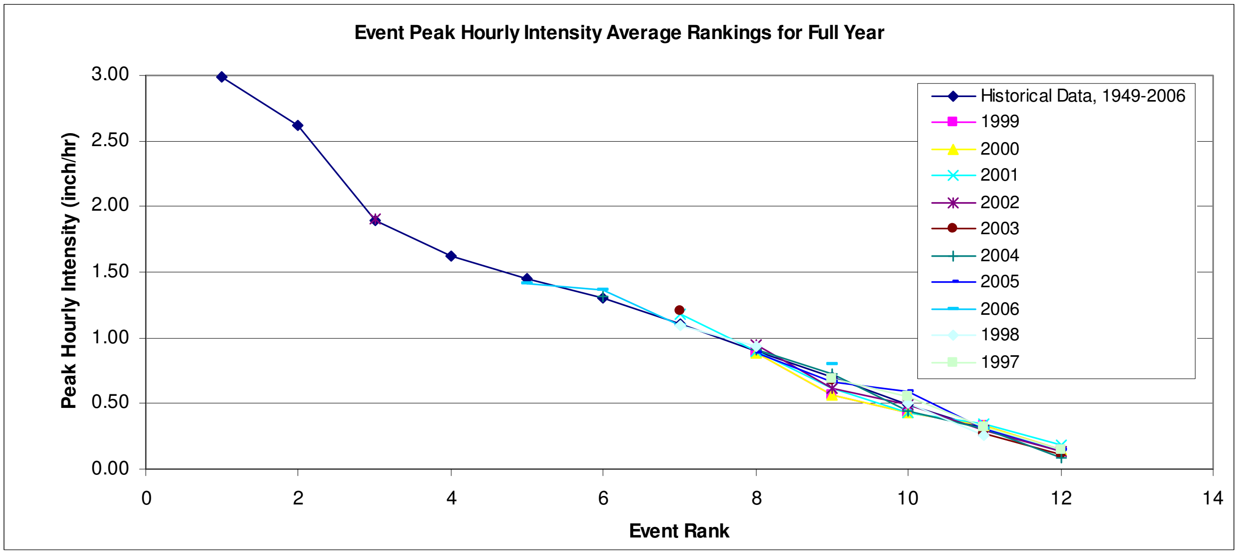

Figure 3a - Ranked Hourly Peak Intensities for Full Year

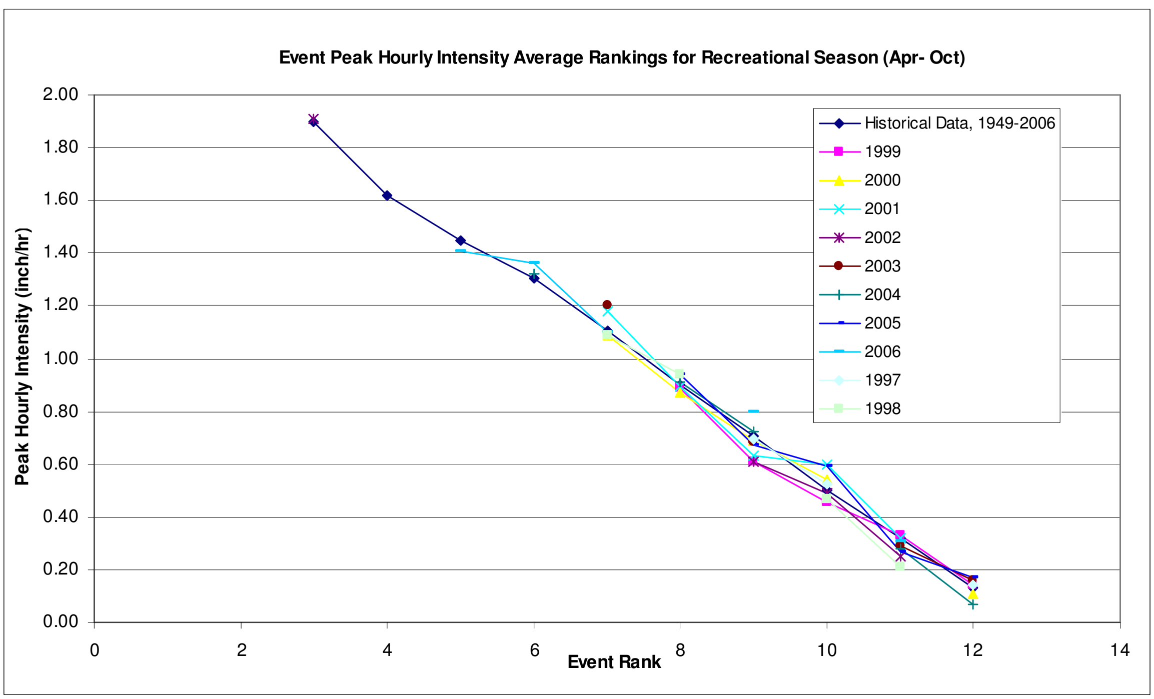

Figure 3b - Ranked Hourly Peak Intensities for Recreational Season

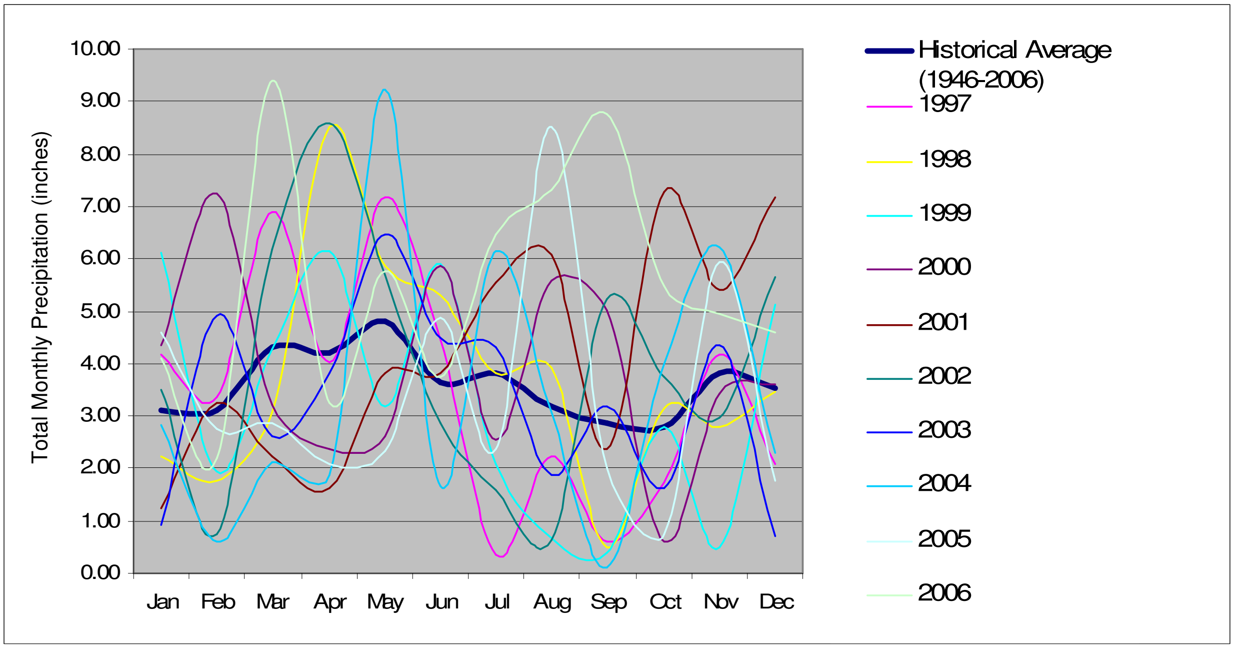

Figure 4 – Actual Monthly Compared to Average Monthly Precipitation (1997-2006)

The graphs in Figure 4 illustrate the large variability in monthly total precipitation from year to year, as compared to the average over the long term. The conclusion from this analysis is that this statistical parameter is not meaningful for selection of a typical year. Other statistics presented in this report such as total storm depth and peak intensities by "bins" as well as average annual precipitation are more relevant in terms of capturing CSO events and making sure facilities are sized for the appropriate peak hourly flow rate.

4.0 SELECTION OF A TYPICAL PRECIPITATION YEAR

Based on the statistical analyses of 58 years of historic precipitation data from the NOAA NCDC rain gauge at Evansville Regional Airport, the year 2000 is selected as the typical year for use in the modeling and alternatives analysis for the Evansville LTCP. The year 2000 matches the long term average in terms of the number of storms by bin depth (particularly for the larger storms, which will dictate the level of CSO control), the peak hourly intensities, and the overall annual precipitation. One modification to the dataset is proposed. The largest bin (>3.0") has two storm events in 2000 (3.74 inches over 19 hours on 01/03/2000 and 3.86 inches over 25 hours on 02/17-18/2000). The long term average is one storm per year greater than 3.0 inches. It is proposed that the larger of the two storms (3.86 inches) be removed from the typical year to be more representative of the long-term average.

Table 7 in Appendix A presents the year 2000 storm events (rainfall depth and duration) in chronological order. Table 8 lists the "Top 12" storms in the year 2000 (excluding the 3.86 inch rain discussed above). Figure 5 shows the storms plotted chronologically to better visualize the magnitude and distribution of the storm events throughout the year.

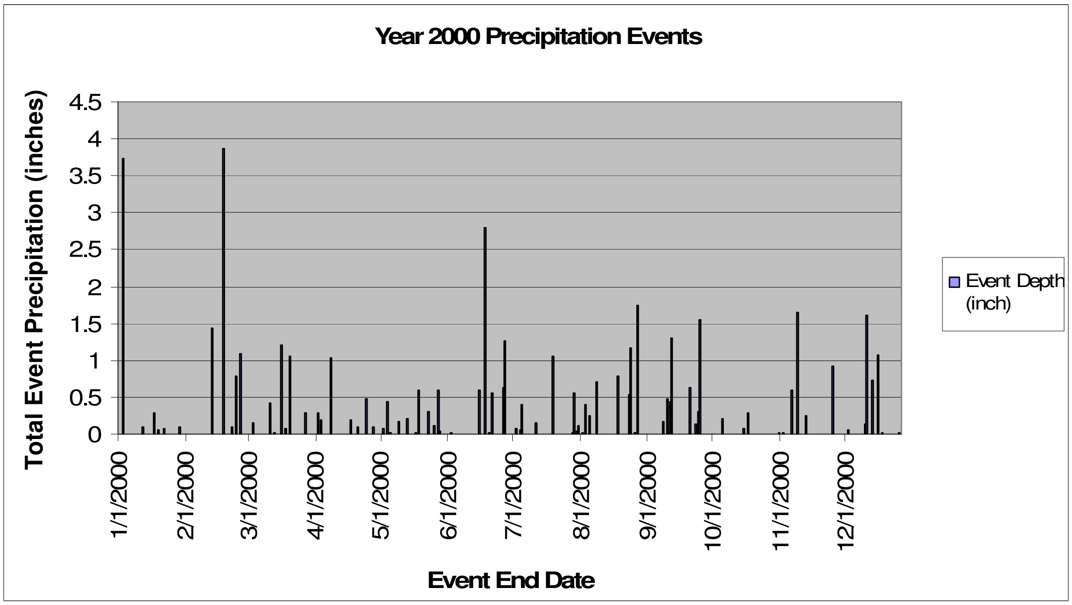

Figure 5 – Year 2000 (Selected Typical Year) Storm Events

5.0 CSO CONTROL ALTERNATIVES MODELING APPROACH USING TYPICAL YEAR

Alternatives will be initially evaluated (i.e. different levels of CSO control) using design storms from Bulletin 71[3]. Based on review of the top 12 storms in the typical year, a 12-hour duration event may be appropriate for initial evaluation of alternatives (especially volumes). For alternatives driven by peak flow design criteria, shorter duration, higher intensity events will be used (see section 3.3 of this report for typical monthly intensities). The 12-hour duration design storms for initial alternatives evaluation include:

1-month storm (~12 overflow events per year on average)	(to be extrapolated)
2-month storm (~6 overflow events per year on average)	1.32 inches
3-month storm (~4 overflow events per year on average)	1.54 inches
6-month storm (~2 overflow events per year on average)	1.94 inches
12-month storm (~1 overflow events per year on average)	2.40 inches

After initial sizing using design storms, alternatives will be refined using continuous simulation of the typical year of storms to verify the level of CSO control.

References

1. Technical Memorandum, Kansas City Missouri Overflow Control Program, "Summary Of Design Storms For CSS Areas", May 24, 2006.
2. Technical Memorandum, Kansas City Missouri Overflow Control Program, "Summary Of Design Year For CSS Analysis", July 28, 2006.
3. Bulletin 71, Rainfall Frequency Atlas of the Midwest, Floyd A. Huff and James R. Angel, Midwestern Climate Center, Illinois State Water Survey, 1992.

APPENDIX A

STATISTICAL ANALYSIS RESULTS TABLES

Table 1
Long-Term Average Annual Rainfall Events by Depth "Bins"
Evansville, Indiana

Season	Time Period	Average Number of Events Exceeding Rainfall Depth Per Year / Recreational Season (Jan-Dec / Apr- Oct)							Average Total Annual Precipitation (inches)
		>0.25"	>0.5"	>1.0"	>1.5"	>2.0"	>2.5"	>3.0"	
Full Year	1949-1958	42	29	13	7	4	3	2	43.78
Recreational Season		24	16	7	3	2	1	1	
Full Year	1959-1968	35	26	11	5	3	1	1	39.14
Recreational Season		24	15	7	3	2	1	1	
Full Year	1969-1978	44	29	14	7	4	2	1	46.08
Recreational Season		26	18	9	5	3	2	1	
Full Year	1979-1988	43	29	13	7	5	3	1	46.21
Recreational Season		27	18	8	5	3	1	1	
Full Year	1989-1998	43	30	13	7	4	2	1	44.35
Recreational Season		26	17	8	4	3	1	1	
Full Year	1999-2006	44	30	16	7	5	3	1	46.11
Recreational Season		27	17	9	4	3	2	0	
Full Year	1949-1968	39	27	12	6	3	2	2	41.46
Recreational Season		24	16	7	3	2	1	1	
Full Year	1969-1988	43	29	14	7	4	2	1	46.08
Recreational Season		27	18	8	5	3	1	1	
Full Year	1949-2006	42	29	13	7	4	2	1	44.22
Recreational Season		26	17	8	4	2	1	1	

Table 2
Average Annual Rainfall Events by Depth "Bins" for Period of 1997 to 2006
Evansville, Indiana

Season	Time Period	Average Number of Events Exceeding Rainfall Depth Per Year / Recreational Season (Jan-Dec / Apr-Oct)							Total Annual Precipitation
		>0.25"	>0.5"	>1.0"	>1.5"	>2.0"	>2.5"	>3.0"	
Full Year	1949-2006	42	29	13	7	4	2	1	44.22
Recreational Season		26	17	8	4	2	1	1	
Full Year	1997-2006	44	30	15	7	4	3	1	45.39*
Recreational Season		26	17	9	4	3	2	0	
Full Year	2006	50	37	23	13	11	6	3	65.95
Recreational Season		29	12	8	4	4	2	0	
Full Year	2005	38	24	11	7	4	4	2	40.75
Recreational Season		24	14	7	4	3	3	1	
Full Year	2004	41	27	12	5	3	2	1	40.18
Recreational Season		27	17	8	3	2	2	1	
Full Year	2003	43	27	15	4	2	1	0	39.25
Recreational Season		26	17	10	3	1	1	0	
Full Year	2002	51	37	19	9	4	1	1	47.38
Recreational Season		31	21	11	4	3	0	0	
Full Year	2001	44	31	15	9	6	4	1	49.79
Recreational Season		27	19	10	7	4	2	0	
Full Year	2000	44	31	17	7	3	3	2	46.44
Recreational Season		28	18	8	3	1	1	0	
Full Year	1999	44	28	14	4	3	2	0	39.12
Recreational Season		24	17	7	2	2	1	0	
Full Year	1998	43	30	12	7	5	3	0	44.25
Recreational Season		27	20	9	6	4	3	0	
Full Year	1997	44	28	11	7	2	2	0	40.79
Recreational Season		21	11	7	4	1	1	0	
Full Year	1993**	45	33	16	8	4	1	1	45.84
Recreational Season		29	21	10	5	3	0	0	

* Average would be 43.11 inches if 2006 (wettest year on record – 65.95 inches) were excluded
**1993 was used in the original 2002 LTCP as the typical year

Table 3
Averaged Peak Hourly Intensities by Month
Evansville, Indiana

Month	Peak Monthly Intensity (inch/hr)										
	1949-2006	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Jan	0.31	0.69	0.23	0.41	0.68	0.19	0.34	0.23	0.36	0.32	0.35
Feb	0.34	0.33	0.22	0.20	0.87	0.43	0.13	0.21	0.10	0.16	0.45
Mar	0.43	0.60	0.25	0.32	0.18	0.36	0.34	0.36	0.23	0.39	1.10
Apr	0.55	0.50	0.98	0.44	0.61	0.32	1.91	0.23	0.28	0.22	1.15
May	0.67	0.75	0.94	0.61	0.54	0.60	0.53	0.68	1.32	0.33	1.12
Jun	0.75	0.55	0.89	0.89	0.84	1.18	0.48	0.67	0.77	0.94	0.80
Jul	0.77	0.18	0.45	0.52	0.73	0.94	0.61	1.20	0.91	0.59	1.02
Aug	0.74	0.64	1.09	0.26	1.09	0.87	0.25	0.70	0.73	0.67	1.36
Sep	0.56	0.08	0.21	0.08	0.9	0.87	0.52	0.35	0.07	0.25	1.41
Oct	0.41	0.17	0.48	0.39	0.11	0.63	0.44	0.16	0.67	0.17	0.31
Nov	0.45	0.31	0.57	0.15	0.73	0.42	0.95	0.24	0.44	0.83	0.31
Dec	0.29	0.17	0.38	0.35	0.35	0.35	0.26	0.07	0.34	0.10	0.41

Table 4
Monthly Peak Hourly Intensities Sorted in "Bins" for years 1997-2006
Evansville, Indiana

Bin	Intensity Range (in/hr)	Total No of events during 1949-2006		No of Events per year (Full Year)		Number of Events per year																			
						1997		1998		1999		2000		2001		2002		2003		2004		2005		2006	
		Full Year	Rec Sea	1949-2006	1997-2006	Full Year	Rec Sea	Full Year	Rec Sea	Full Year	Rec Sea	Full Year	Rec Sea	Full Year	Rec Sea	Full Year	Rec Sea	Full Year	Rec Sea	Full Year	Rec Sea	Full Year	Rec Sea	Full Year	Rec Sea
1	**2.8 < x ≤ 3.0**	1	1	0.0172	0.00																				
2	**2.6 < x ≤ 2.8**	1	1	0.0172	0.00																				
3	**2.4 < x ≤ 2.6**	0	0	0.0000	0.00																				
4	**2.2 < x ≤ 2.4**	0	0	0.0000	0.00																				
5	**2.0 < x ≤ 2.2**	0	0	0.0000	0.00																				
6	**1.8 < x ≤ 2.0**	5	5	0.0862	0.10											1	1								
7	**1.6 < x ≤ 1.8**	1	1	0.0172	0.00																				
8	**1.4 < x ≤ 1.6**	9	9	0.1552	0.10																			1	1
9	**1.2 < x ≤ 1.4**	15	15	0.2586	0.20															1	1			1	1
10	**1.0 < x ≤ 1.2**	24	19	0.4138	0.80			1	1			1	1	1	1			1	1					4	3
11	**0.8 < x ≤ 1.0**	59	53	1.0172	1.40			3	3	1	1	3	2	3	3	1				1	1	2	1		
12	**0.6 < x ≤ 0.8**	104	80	1.7931	1.80	3	2			1	1	4	2	1	1	1	1	3	3	3	3	1	1	1	1
13	**0.4 < x ≤ 0.6**	166	102	2.8621	2.10	3	2	3	2	3	2	1	1	3	1	4	4			1		1	1	2	
14	**0.2 < x ≤ 0.4**	223	94	3.8448	3.70	2		5	1	4	2	1		3	1	4	1	6	2	4	1	5	3	3	1
15	**0.0 < x ≤ 0.2**	88	26	1.5172	1.80	4	3			3	1	2	1	1		1		2	1	2	1	3	1		

Table 5
All Peak Hourly Intensities Sorted in "Bins" for years 1997-2006
Evansville, Indiana

Intensity Range (in/hr)	Average Number of Peak Intensity Events Per Year (1997 - 2006)	Hourly Intensities by Bin Range - All Hours in Given Year Receiving Precipitation (>0.01 inch/hour)									
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2.8 < x ≤ 3.0	0.0	0	0	0	0	0	0	0	0	0	0
2.6 < x ≤ 2.8	0.0	0	0	0	0	0	0	0	0	0	0
2.4 < x ≤ 2.6	0.0	0	0	0	0	0	0	0	0	0	0
2.2 < x ≤ 2.4	0.0	0	0	0	0	0	0	0	0	0	0
2.0 < x ≤ 2.2	0.0	0	0	0	0	0	0	0	0	0	0
1.8 < x ≤ 2.0	0.1	0	0	0	0	0	1	0	0	0	0
1.6 < x ≤ 1.8	0.0	0	0	0	0	0	0	0	0	0	0
1.4 < x ≤ 1.6	0.1	0	0	0	0	0	0	0	0	0	1
1.2 < x ≤ 1.4	0.2	0	0	0	0	0	0	0	1	0	1
1.0 < x ≤ 1.2	0.9	0	1	0	1	1	0	1	1	0	4
0.8 < x ≤ 1.0	2.0	0	4	1	3	4	1	0	2	3	2
0.6 < x ≤ 0.8	4.5	5	3	3	6	5	2	5	3	3	10
0.4 < x ≤ 0.6	8.6	9	10	6	9	11	9	3	8	10	11
0.2 < x ≤ 0.4	34.9	32	29	35	40	34	44	28	34	27	46
0.0 < x ≤ 0.2	512.8	533	542	462	479	503	527	567	451	509	555

[box] Indicates values that most closely match the average for 1997 - 2006

Table 6
Averaged Monthly Total Precipitation for years 1997 to 2006
Evansville, Indiana

Month	1949 to 2006	1997 to 2006	Monthly Total Precipitation (inch)									
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Jan	3.12	3.41	4.18	2.24	6.12	4.35	1.23	3.51	0.91	2.84	4.59	4.09
Feb	3.13	2.88	3.34	1.75	1.94	7.26	3.26	0.74	4.92	0.59	2.77	2.19
Mar	4.31	4.29	6.90	3.07	4.28	3.21	2.22	6.20	2.60	2.13	2.86	9.40
Apr	4.22	4.23	4.04	8.50	6.15	2.36	1.61	8.58	3.81	1.86	2.08	3.26
May	4.81	5.22	7.18	5.87	3.18	2.60	3.82	5.70	6.48	9.24	2.33	5.77
Jun	3.63	4.29	4.45	5.29	5.89	5.86	3.82	2.86	4.50	1.66	4.88	3.73
Jul	3.82	3.52	0.36	3.83	2.07	2.53	5.54	1.58	4.30	6.15	2.37	6.46
Aug	3.18	3.99	2.23	3.91	0.66	5.60	6.09	0.63	1.88	3.08	8.51	7.30
Sep	2.88	2.81	0.59	0.49	0.39	5.03	2.37	5.22	3.17	0.09	2.00	8.75
Oct	2.80	3.11	1.73	3.13	2.80	0.59	7.27	3.75	1.61	4.00	0.73	5.46
Nov	3.82	4.07	4.17	2.78	0.51	3.43	5.40	2.97	4.36	6.23	5.93	4.95
Dec	3.52	3.65	2.07	3.48	5.13	3.62	7.16	5.64	0.71	2.31	1.76	4.59

Table 7
Year 2000 Storm Events (Selected Typical Year)
Evansville, Indiana

Event End Date	Event Depth (inch)	Storm Duration (hr)	
1/3/2000	3.74	19	
1/12/2000	0.09	1	
1/17/2000	0.29	5	
1/19/2000	0.06	1	
1/22/2000	0.08	9	
1/29/2000	0.09	11	
2/13/2000	1.43	10	
2/18/2000	3.86	25	*Proposed to be excluded*
2/22/2000	0.09	2	
2/24/2000	0.79	9	
2/26/2000	1.09	16	
3/3/2000	0.16	5	
3/11/2000	0.42	12	
3/13/2000	0.01	1	
3/16/2000	1.20	12	
3/18/2000	0.07	2	
3/20/2000	1.06	23	
3/20/2000	0.01	1	
3/27/2000	0.28	3	
4/2/2000	0.28	12	
4/3/2000	0.19	7	
4/8/2000	1.03	8	
4/17/2000	0.19	13	
4/20/2000	0.09	1	
4/24/2000	0.48	22	
4/27/2000	0.10	2	
5/2/2000	0.08	10	
5/4/2000	0.45	22	
5/5/2000	0.01	1	
5/9/2000	0.18	1	
5/13/2000	0.22	10	
5/17/2000	0.02	1	
5/18/2000	0.60	1	
5/23/2000	0.30	18	
5/25/2000	0.11	3	
5/27/2000	0.60	33	

Table 7 (continued)

5/28/2000	0.03	8
6/2/2000	0.01	1
6/15/2000	0.60	9
6/18/2000	2.79	48
6/20/2000	0.01	1
6/21/2000	0.56	2
6/26/2000	0.63	29
6/27/2000	1.26	11
7/2/2000	0.07	3
7/4/2000	0.05	1
7/5/2000	0.41	3
7/5/2000	0.06	2
7/11/2000	0.16	14
7/19/2000	1.05	3
7/28/2000	0.02	1
7/29/2000	0.56	20
7/30/2000	0.04	1
7/31/2000	0.11	8
8/2/2000	0.01	1
8/3/2000	0.41	20
8/5/2000	0.24	1
8/8/2000	0.70	29
8/18/2000	0.79	3
8/23/2000	0.54	1
8/24/2000	1.16	6
8/26/2000	0.01	1
8/27/2000	1.74	8
9/8/2000	0.18	5
9/10/2000	0.47	27
9/11/2000	0.44	6
9/12/2000	1.30	3
9/20/2000	0.64	6
9/23/2000	0.14	10
9/24/2000	0.31	9
9/25/2000	1.55	16
10/5/2000	0.21	4
10/15/2000	0.08	4
10/17/2000	0.29	20
10/31/2000	0.01	1
11/2/2000	0.02	1
11/6/2000	0.60	13
11/9/2000	1.65	42
11/13/2000	0.25	4

Table 7 (continued)

11/25/2000	0.91	25
12/2/2000	0.06	16
12/10/2000	0.13	2
12/11/2000	1.60	10
12/13/2000	0.72	13
12/16/2000	1.08	28
12/18/2000	0.02	1
12/26/2000	0.01	1
Total	**46.44**	

Table 8
Year 2000 "Top 12" Storm Events* (Selected Typical Year)
Evansville, Indiana

Event End Date	Total Rainfall (inches)	Storm Duration (hours)
1/3/2000	3.74	19
6/18/2000	2.79	48
8/27/2000	1.74	8
11/9/2000	1.65	42
12/11/2000	1.60	10
9/25/2000	1.55	16
2/13/2000	1.43	10
9/12/2000	1.30	3
6/27/2000	1.26	11
3/16/2000	1.20	12
8/24/2000	1.16	6
2/26/2000	1.09	16

* Excluding 3.86 inch storm event proposed to be excluded