Group Two Sanitary Sewer System and WWTP Remedial Measures Plan

Submittal to the United States Environmental Protection Agency and the Kentucky Department for Environmental Protection

from

Lexington-Fayette Urban County Government

April 13, 2012

Lexington-Fayette Urban County Government
DEPARTMENT OF ENVIRONMENTAL QUALITY & PUBLIC WORKS

Jim Gray
Mayor

Richard Moloney
Acting Commissioner

April 13, 2012

RE: Civil Action No. 5:06-cv-386
Lexington-Fayette Urban County Government – Kentucky
Group Two Sanitary Sewer System and WWTP Remedial Measures Plan

Chief, Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
Box 7611 Ben Franklin Station
Washington, D.C. 20044-7611
DOJ No. 90-5-1-1-08858

Chief
Water Programs Enforcement Branch
Environmental Protection Agency Region 4
61 Forsyth Street
Atlanta, Georgia 30303

Dear Sir / Madam:

In accordance with the provisions of Section VII, Paragraph 15.G.(i) of the above referenced document, the Lexington-Fayette Urban County Government (LFUCG) is providing the Group Two Sanitary Sewer System and WWTP Remedial Measures Plan (RMP). This plan is the work product of various professional engineering firms that compiled the required information via independent contracts with LFUCG. The team of Hazen and Sawyer, CDM, and Stantec Consulting Services prepared this report under the direction of LFUCG.

LFUCG is requesting that consideration be given to the tentative nature of the Figure 5-5 Implementation Plan. It is LFUCG's recommendation that the overall project schedule be revised upon completion and approval of all three RMP documents so that an integrated, system-wide implementation may occur so that:

- Individual, prioritized SSO elimination may proceed expeditiously without artificial delay created by the advance prioritization of the grouped watersheds,
- SSO elimination may occur in a logical sequence that follows a predictable and manageable cash flow model, thus minimizing rate payer exposure to widely variable rate hikes, and

- Capital project sequences occur in a manner that allows the construction market to adapt, rather than flooding the market with capital projects in a way that overwhelms the current market conditions.

If you should have any questions, please contact me at (859) 425-2400.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signed

4-13-12
Date

Charles H. Martin, P.E., Director
Division of Water Quality
Lexington-Fayette Urban County Government

cc: Director of the Division of Enforcement
Department for Environmental Protection
300 Fairs Oaks Lane
Frankfort, KY 40601

Janet Graham, LFUCG, Commissioner of Law
Richard Moloney, LFUCG, Acting Commissioner of Environmental Quality & Public Works

Enclosure

2 copies – Water Programs Enforcement Branch
1 copy – all other addresses

The following listing is submitted with this report to facilitate the reviewer. The requirements of the Consent Decree Part VII.15.G.are included below with a reference to the specific area of the report that fulfills the requirement.

	Consent Decree Requirement (from VII.15.G Sanitary Sewer System and WWTP Remdial Measures Plan)	**Location in RMP Report**
ii	The Sanitary Sewer System and WWTP Remedial Measures Plan (RMP) shall identify all measures necessary to achieve adequate capacity. If insufficient capacity to accommodate projected Peak Flows exists in any portion of the system, identify and propose measures to provide adequate capacity.	Section 3
iii	The RMP shall identify all WWTP upgrades and repair measures necessary to achieve WWTP compliance with all NPDES permit limitations for LFUCG's WWTPs and requirements and to eliminate wet weather Unpermitted Bypasses.	Section 3F
iv	The RMP shall identify the degree to which sources of Excessive I/I shall be removed, the degree to which Excessive I/I removal is expected to alleviate capacity constraints, and propose specific remedial measures that will address those capacity limitations not expected to be addressed by Excessive I/I removal.	Section 4
v	The RMP shall identify all measures necessary to eliminate all cross-connections, and Recurring SSOs caused by physical degradation of sewers, inadequate Pumping Stations capacities, or inadequate Pumping Station reliability.	Section 3
vi	The RMP shall, for purposes of developing schedules, prioritize the remedial measures based upon:	Section 5
	a relative likely human health and environmental impact risks	
	b Recurring SSO frequencies of activations	
	c total annual Recurring SSO volumes	
	LFUCG may also take into account cost-effectiveness and risks associated with implementation. The RMP shall provide a description of the methodology used to apply the above factors	
vii	The RMP shall provide estimated capital, O&M, and present value costs for each identified remedial measure. The RMP shall provide an expeditious schedule for design, construction, and placement in service of all proposed measures that is in no even later than eleven years from the Effective Date of the CD, or in the event that remedial measures include a WWTP upgrade, thriteen years from the Effective Date of the CD only for such WWTP upgrade and other remedial measures associated with the WWTP upgrade.	Figure 5-5

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Appendix 1

Disposition of Group Two Appendix A SSOs

Project Data Sheets

List of Tables

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List of Figures

* Figures without page numbers follow their respective section of text.

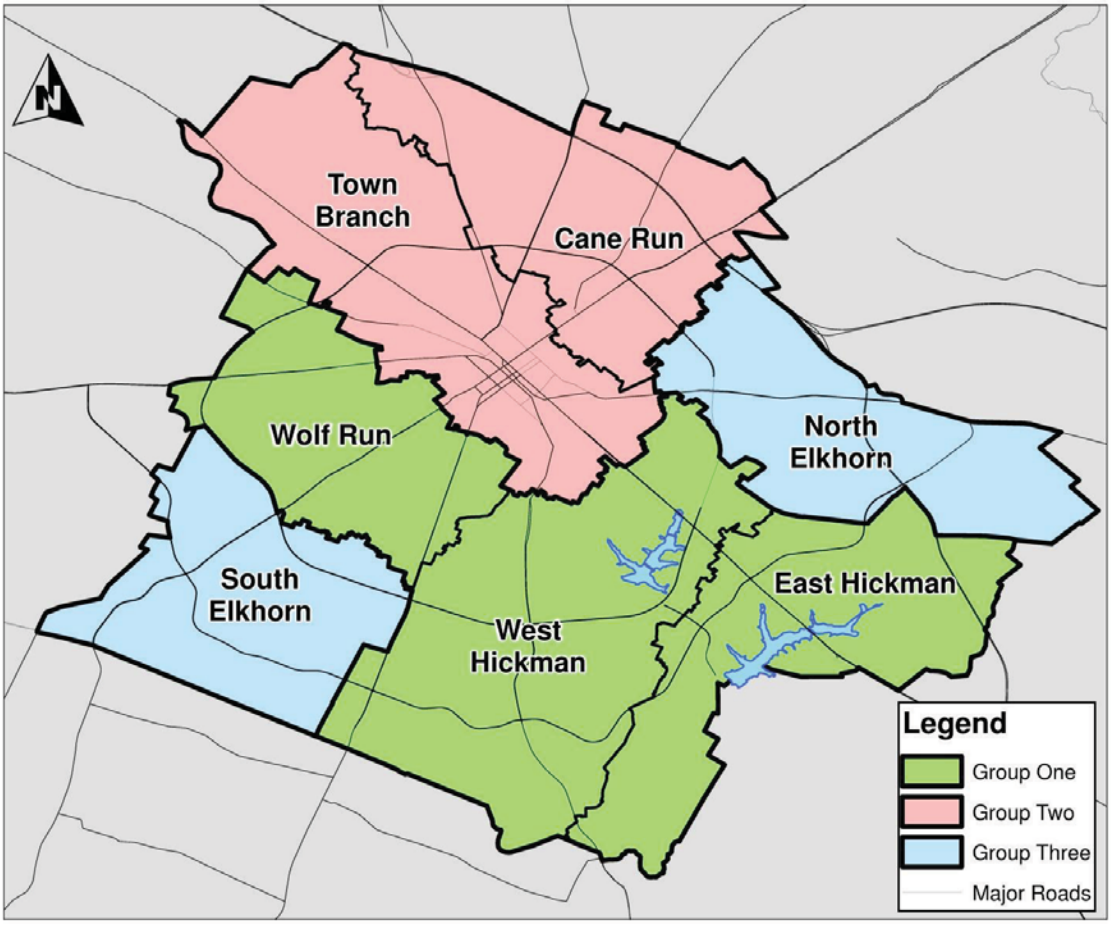
Executive Summary

A. Background

The Sanitary Sewer System and WWTP Remedial Measures Plans (RMPs) are being developed pursuant to Paragraph VII.15.G (Sanitary Sewer System and WWTP Remedial Measures Plan) of the Consent Decree (CD) for the Lexington-Fayette Urban County Government (LFUCG). The CD was lodged on March 14, 2008 and became effective on January 3, 2011. The RMP is organized according to the major sewersheds within the LFUCG service area as defined in the CD and shown on Figure ES-1:

- Group One: West Hickman, East Hickman, and Wolf Run watersheds (includes the West Hickman WWTP). The Group One RMP was submitted to EPA and Kentucky EPPC on October 14, 2011.
- Group Two: Cane Run and Town Branch (includes the Town Branch WWTP). The Group Two RMP is outlined in this report.
- Group Three: The Group Three RMP addressing North Elkhorn and South Elkhorn is to be submitted to EPA and Kentucky EPPC by October 14, 2012.

Figure ES-1: Sewershed Groups (includes Future Expansion Areas)



The CD requires that LFUCG eliminate recurring sanitary sewer overflows (SSOs) and unpermitted bypasses at the wastewater treatment plant within 11 to 13 years of the effective date of the CD. This report summarizes the RMP for the Group Two Sewersheds, which includes the Town Branch WWTP. It presents the evaluation methodology, solution development process, project development, a prioritized implementation plan, and capital cost estimates.

B. Alternatives and Major Issues

SSOs are caused by capacity restrictions, sewer line blockages, and/or deteriorating sewers. They occur most frequently (but not always) during heavy rainfall events when stormwater enters the sanitary sewer system through pipe defects (infiltration and inflow, or I/I) or illegal private connections and the resulting flow exceeds the capacity of the sewer collection and pumping systems. SSO elimination efforts typically involve increasing system capacity and/or repairing the system to reduce the amount of rainwater entering the sewer system. In the development of this RMP the following "general solutions" were evaluated:

- Increasing system capacity by upsizing pipes, pump stations, and/or the WWTP
- Rehabilitating (repairing) the system, including disconnecting illegal private connections, to reduce I/I such that system capacity is not exceeded
- Providing equalization (EQ) storage for the excess flows during rain events

Analyses of these "toolbox options" were conducted to develop cost-effective solutions for SSO elimination. During the RMP development the following major decisions were made that affected the recommended solutions:

- The Level of Control (LOC), also referred to as the Level of Service, is a critical program decision. This decision sets the performance criteria of the program (i.e. the intensity and duration of storm event for which no capacity-related SSOs would be expected to occur). After much deliberation and public scrutiny, the 2-year, 24-hour storm event was selected for the LOC. Resolution No. 389-2011 passed on September 15, 2011 by the Urban County Council adopted the 2-year, 24-hour storm event as the design storm to form the basis of the LFUCG Sanitary Sewer System and WWTP Remedial Measures Plan. Consideration was also given to developing RMP solutions to eliminate "surcharged conditions" as defined in Paragraph VII.16.B of the Consent Decree for all new facilities and in all areas downstream of likely new development and redevelopment areas. Where solutions were required to eliminate existing/future SSOs, they were designed to avoid system surcharging that would occur for the 2-year, 24-hour storm event.
- LFUCG's experience with obtaining I/I reduction through rehabilitation and repairs, measured by pre-construction and post-construction flow monitoring, has not been encouraging. While system rehabilitation has been and will continue to be an element of significant investment for LFUCG (currently budgeted at $5 million per year), it was decided that system rehabilitation would not be an integral part of the RMP solutions. Instead, I/I reduction obtained through system rehabilitation will in effect increase the

LOC above the selected 2-year, 24-hour storm event. All proposed system improvements were designed based on an assumption that there will be no I/I reduction resulting from rehabilitation and other capacity management, operation and maintenance (CMOM) activities.

- Evaluations of LFUCG's two wastewater treatment plants indicate that they both can treat approximately 70 million gallons per day (MGD) while meeting permitted discharge limits. Their peak capacity listed on their NPDES discharge permits is 64 MGD. For the purpose of the RMP both WWTPs are assumed to have peak capacities of 70 MGD, which will reduce the volume of EQ storage required as compared to limiting the peak capacities to 64 MGD. Improvements included in this document for the WWTPs consist of reliability and redundancy improvements and do not include any capacity expansions. However, a subsequent WWTP planning process will evaluate potential capacity increases to identify the most cost-effective combination of storage and treatment capacity.
- In general, the number of EQ basins and tanks should be kept to a minimum, as these facilities require cleaning and maintenance and would not be welcomed additions to established residential neighborhoods.
- Sanitary sewer improvements necessary for the development of Expansion Area 3 (in the northern portion of the Cane Run Sewershed) are included in the RMP in accordance with LFUCG's current 201 Facilities Plan. The Expansion Area 3 improvements will include new trunk sewers to facilitate the elimination of recurring SSOs that occur at three pump stations (Shandon Park 2, Thoroughbred Acres, and Winburn).

C. Proposed Remedial Measures

Capital construction necessary to eliminate recurring SSOs in the two Group Two sewersheds is shown on Figures ES-2 and ES-3. Table ES-1 summarizes the infrastructure to be constructed and the estimated capital costs of these improvements.

Table ES-1: Proposed Infrastructure and Estimated Capital Costs

Sewershed	Cane Run	Town Branch
Pipelines – new or replaced	49,000 LF	23,000 LF
EQ Basin/tank location(s)	2	1
EQ Basin/tank volume	11 MG	44 MG
WWTP Upgrade – estimated cost	-	$27 million
Total estimated capital costs	$78 million	$154 million
Total estimated capital costs for Group Two = $232 million		

The proposed improvements were divided into discrete projects (see Figures ES-2 and ES-3, for the locations of these projects), and each project was prioritized based on frequency and severity of SSOs and potential health risks to the public. An Implementation Plan was developed based on the priorities, while considering necessary "predecessor" projects. Predecessor projects are projects that should be completed prior to the subject project. Typically they are downstream of the subject project and are needed to increase capacity so that SSOs are not relocated or new SSOs are not created. The proposed Implementation Plan shows the currently proposed schedule for design and construction of each project and is shown in Figure ES-4 and detailed in Section 5 of this report. The project phasing is based on anticipated cash flow from LFUCG's financial modeling. It should be noted that this schedule is considered tentative until the RMP for Group Three is developed and the capital projects for the entire city can be prioritized and scheduled.

D. Near-term Action Items

This Group Two Sanitary Sewer System and WWTP Remedial Measures Plan is being submitted to the US EPA for review and approval. While EPA is reviewing the document, LFUCG will be proceeding with the following items:

1. Implementing a streamlined process for procurement of engineering and construction services
2. Implementing a streamlined process for property and easement acquisition
3. Proceeding with collection system I/I removal and rehabilitation efforts
4. Initiating certain capital projects within this RMP that are not anticipated to be altered by the regulatory review process.

Cane Run Solution

Proposed Remedial Measures *(Different Colors Signify Separate "Projects")*

Upsize Existing Line
New Trunk Sewer
New Force Main

New Pump Station
New Equalization Tank

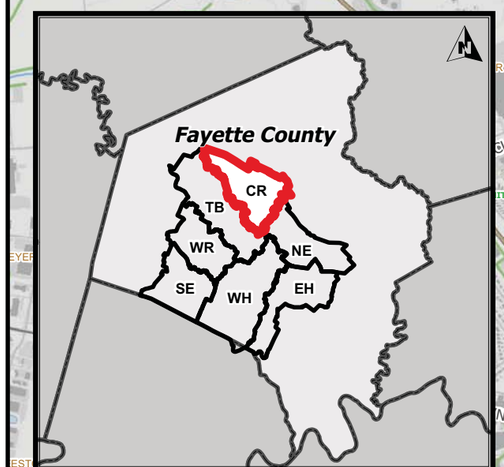
Monitoring List SSO
Appendix A SSO
Existing Pump Station
Existing Trunk Sewer
Existing Forcemain
Major Sewershed

1 " = 2,300 '

ES - 2

List of Projects

1. Lower Cane Run EQ
2. Expansion Area 3 PS
3. Expansion Area 3 FM
4. Expansion Area 3 Trunk
5. Shandon Park Trunks
6. Winburn Trunk
7. Thoroughbred Acres Trunk
8. Sharon Village PS and FM
9. Lower Griffin Gate Trunk
10. Upper Cane Run EQ
11. Cane Run Trunk
12. Lexmark Trunk A
13. Lexmark Trunk B
14. New Circle Trunk A
15. New Circle Trunk B
16. Griffin Gate Rehab



1 10.2 MG
2 9.5 MGD
3
4
5
6
7
8 1.5 MGD
9
10 0.8 MG
11
12
13
14
15
16

Town Branch Solution

(Different Colors Signify Separate "Projects")

Proposed Remedial Measures

- Upsize Existing Line
- New Trunk Sewer
- New Force Main
- New Pump Station
- New Equalization Tank

- Monitoring List SSO
- Appendix A SSO
- Existing Pump Station
- Existing Trunk Sewer
- Existing Forcemain
- Major Sewershed

Town Branch WWTP (71 MGD)

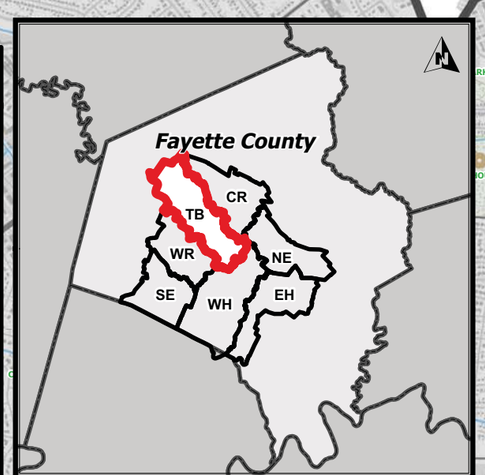
1 44 MG

PS 2 0.5 MGD

3 4 5 6 7 8 9 10

List of Projects

1. TB WWTP EQ
2. Town Branch PS and FM
3. Tie-in Lower Cane Run FM
4. UK Trunk A
5. UK Trunk B (Newtown Pike Ext.)
6. UK Trunk C
7. UK Trunk D
8. UK Trunk E
9. Georgetown Road Trunk
10. Midland Avenue Trunk



1 " = 2,300 '

ES - 3

Section 1 Background

The Group Two Sanitary Sewer System and WWTP Remedial Measures Plan (RMP) consists of specific projects that, when implemented, will result in adequate capacity in the Group Two portions of the sanitary sewer system and the Town Branch Wastewater Treatment Plant (TBWWTP). Provision of adequate capacity for these facilities will eliminate recurring Sanitary Sewer Overflows (SSOs). In addition, wet-weather related Unpermitted Bypasses and overloading of the TBWWTP resulting in current NPDES permit noncompliance will be eliminated for conditions that do not exceed the selected design wet-weather event described in Section 2.

A. Consent Decree

The RMP was developed pursuant to Paragraph VII.15.G (Sanitary Sewer System and WWTP Remedial Measures Plan) of the Consent Decree (CD) for the Lexington-Fayette Urban County Government (LFUCG). The CD was lodged on March 14, 2008 and became effective on January 3, 2011. The RMP is organized according to the major sewersheds within the LFUCG service area as defined in the CD and shown on Figure 1-1:

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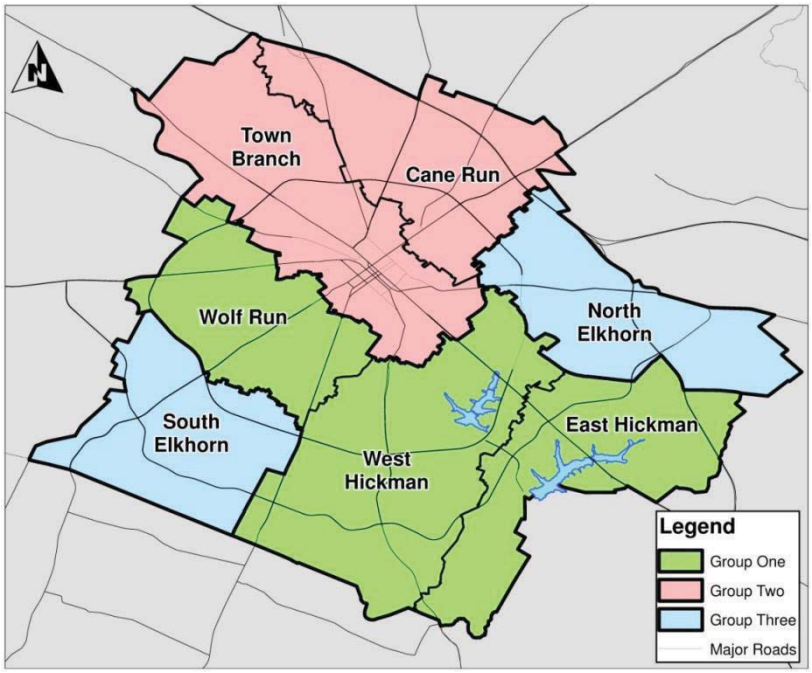


This report summarizes the RMP for the Group Two Sewersheds. It presents the evaluation methodology, solution development process, project development, a prioritized implementation plan and cost estimates.

B. Specific Sanitary Sewer System and WWTP Remedial Measures Plan Requirements

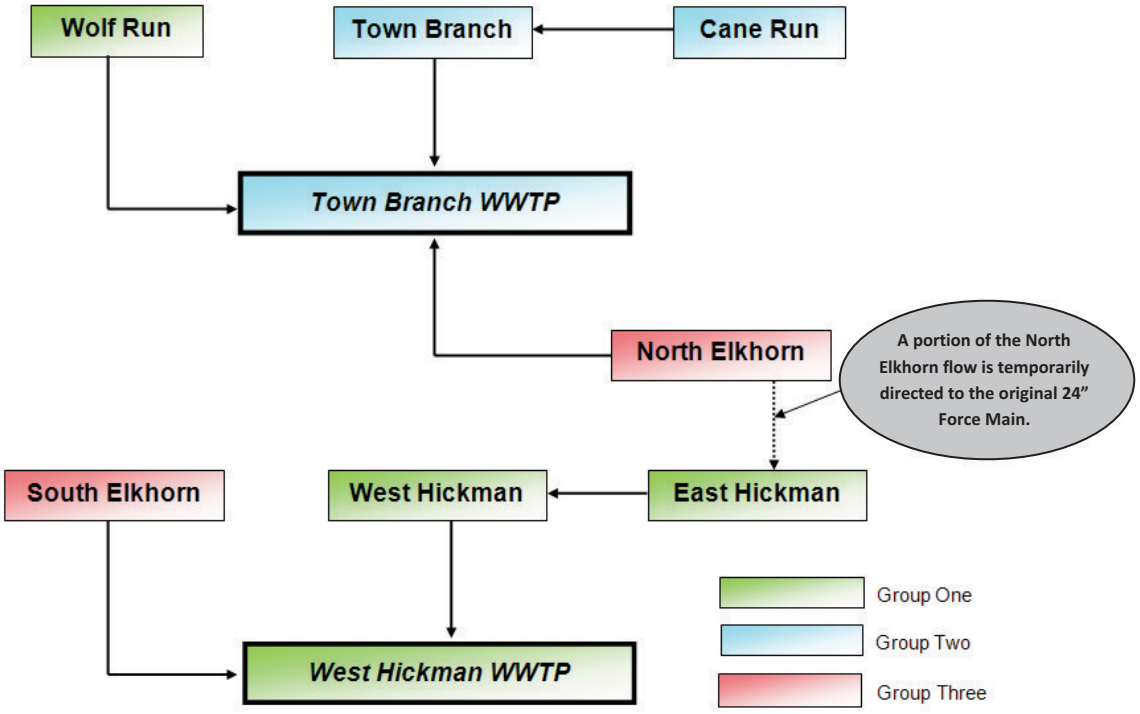
Specific requirements of the CD (Section VII.15.G) related to the RMP are listed below:

- Specific measures and schedules that will result in adequate capacity such that recurring SSOs, unpermitted WWTP bypasses, and NPDES permit noncompliance are eliminated.
- Peak flows shall include conditions considered in the Sewer System Assessment; identify and propose measures to provide adequate capacity.
- Identify all WWTP upgrades and repairs necessary for permit compliance and wet-weather bypass elimination.
- Identify the degree to which excessive inflow and infiltration (I/I) shall be removed, the degree to which I/I removal will alleviate capacity constraints, and propose remedial measures to address capacity limitations not addressed by I/I removal.
    a) Anticipated I/I removal rates shall be per industry standards and local experience.
    b) May include increases in pump station (PS) and sewer capacity, equalization (EQ) basins, or WWTP capacity increases.
- Eliminate all cross connections and recurring SSOs resulting from physical degradation of sewers, inadequate PS capacity, or inadequate PS reliability.
- Prioritize the remedial measures based on the following and include a description of prioritization methodology related to these factors:
    a) Human health and environmental impacts
    b) SSO frequency
    c) SSO volume
    c) Cost-effectiveness and “risks associated with implementation”
- Provide estimated capital, O&M, and present value costs for each remedial measure using year-specific dollars.
- Provide an expeditious schedule for design, construction, and placement in service.
    a) No later than 11 years from effective date of the CD, except that the upgrades can extend to 13 years if WWTP work is to be done.
    d) Include milestone dates for each project: preliminary design, final design, permitting, contract award, begin construction, and end construction.
- There shall be no restrictions on LFUCG implementing interim remedial measures prior to RMP approval.

The SSOs that are discussed and addressed as part of this RMP are the 111 SSOs listed in Appendix A of the CD. Within those, there are 9 cross connections, 7 basement backups, and 12 maintenance-related SSOs. The remaining 83 SSOs are at manholes and pump stations and will be eliminated by the implementation of remedial measures implemented over the next 11 to 13 years. The explicit removal of cross connections is another objective of all three RMPs. The basement backups will be addressed by a combination of increased system capacity, long-term I/I reduction, and the installation of backtrap valves.

A schematic of the flow paths comprising the LFUCG Sewersheds is provided in Figure 1-2. The flow paths have recently undergone major changes. One major change includes the redirection of most of the North Elkhorn Pump Station effluent from the East Hickman gravity sewer system to a direct discharge at the Town Branch WWTP. Another change is the redirection of flow from South Elkhorn Pump Station from the West Hickman gravity sewer system to a direct discharge at the West Hickman WWTP. These flow redirections provided significant additional capacity in the portions of the gravity sewer system that had previously received the pump station discharges.

Figure 1-2: Existing Sewershed Flow Routing



C. Related Studies

The following related reports were prepared in accordance with the requirements of the Consent Decree and were submitted for review by EPA and the DOW:

- *Sanitary Sewer Assessment Work Plan (June 2008)* – Documents the procedures and schedule for completing a condition assessment and performance evaluation of the Sanitary Sewer System.
- *Hydraulic Model Report (July 2008)* – Documents the selection of the hydrologic and hydraulic model of the wastewater collection system. This model was used to complete a capacity assessment and to develop all proposed remedial measures.
- *Capacity Assessment Work Plan (September 2008)* – Documents the assumptions, tools and protocols to be used to determine the hydraulic capacities of the Sanitary Sewer System, and to compare these capacities to flow conditions resulting from existing and projected future flows under dry and wet-weather conditions.
- *Group One Sewer System Assessment Report (April 2011)* – Documents the results of the sanitary sewer assessment field investigations and capacity assessment of the Group One Sewersheds. This report includes documentation of the sanitary sewer field activities and results, pumping station design, capacity, and equipment adequacy evaluation, hydraulic model development, the estimation of future flows, hydrologic and hydraulic calibration, capacity assessment results, and improvements completed during the SSA studies.
- *Group One Remedial Measures Plan (October 2011)* – Describes the methodology and results of a master plan to eliminate recurring SSOs in the Group One sewersheds. This plan included a draft Implementation Plan for conveyance and storage facilities that will be updated and revised as plans for the other two groups are completed.
- *Group Two Sewer System Assessment Report (October 2011)* – Documents the results of the sanitary sewer assessment field investigations and capacity assessment of the Group Two Sewersheds with a methodology and presentation similar to the Group One SSA Report. The Group Two hydraulic models continued to be improved during the course of developing this RMP, as described in Section 2.

D. Projects Completed to Date or In-Progress

LFUCG has initiated several capacity enhancement projects and activities in advance of initiating this RMP. These projects are described in Section 7 of the Group Two Sewer System Assessment Report (October 2011). Major capital projects are summarized below:

1) Status of Projects from CD Paragraph VII.15.A

The following projects were stipulated in the Consent Decree with defined completion dates.

a) North Elkhorn Force Main Diversion

At the time of lodging, the flow from the North Elkhorn Pump Station discharged to gravity sewers in the East Hickman sewershed. To restore hydraulic capacity at the East Hickman Pump Station and allow for a capacity upgrade at the North Elkhorn Pump Station, the majority of the North Elkhorn Pump Station flow was diverted to the Town Branch WWTP.

Minimal flow has been maintained in the existing 24-inch force main to maintain hydraulic integrity of other discharges into the 24-inch force main. This project included upgrading the pump station to 13,400 gpm and the installation of approximately 7 miles of new 30- and 36-inch force main.

The North Elkhorn Pump Station currently pumps approximately 75% of its total flow through the newly constructed force main to the Town Branch WWTP. The remaining 25% of the flow is pumped through the pre-existing 24-inch force main to the East Hickman sewershed. Force mains from other pump stations manifold into this pre-existing 24" force main and the portion of flow from the North Elkhorn Pump Station is required to maintain hydraulic integrity. This force main will remain in service at least temporarily and used to aid in distribution of flows to reduce overflow risk in the system.

This project was required to be completed within 24 months from lodging date of the Consent Decree; the deadline was therefore March 14, 2010. The pump station was upgraded first and put into service prior to the force main installation. With a completion date of October 2009, this project was finished within the directed timeframe.

b) South Elkhorn Pump Station and Force Main

Due to high rates of infiltration and inflow in the contributing sewershed, the South Elkhorn Pump Station has had a very high incidence of SSOs. In order to eliminate this recurring SSO, the pump station and its associated force main were upgraded to a new capacity of 12,000 gpm. This expansion included the installation of a new wet well, five pumps, and seven miles of 36-inch force main to transport flow directly to the West Hickman WWTP.

This project was required to be completed within 30 months from lodging date of the Consent Decree; the deadline was therefore September 14, 2010. With a completion date of September 2010, this project was finished within the directed timeframe.

c) Deep Springs Pump Station

The Deep Springs Pump Station is to be replaced with a new pump station that will have an increased capacity. The force main will also be upgraded to manifold into the new North Elkhorn force main.

This project was required to be complete within 30 months of the completion date of the North Elkhorn Force Main Diversion Project, which would be April 2012, but no later than 54 months from the lodging date of the Consent Decree, (September 14, 2012); the deadline is therefore April 2012. This project was put into service in March 2012, within the directed timeframe.

d) Dixie Pump Station

The Dixie Pump Station was upgraded to include an increase in the firm pumping capacity. The force main was also upgraded to manifold into the new North Elkhorn force main.

This project was required to be complete within 30 months within the completion date of the North Elkhorn Force Main Diversion Project, which would be April 2012, but no later than 54 months from the lodging date of the Consent Decree, which would be September 14, 2012; the deadline is therefore April 2012. This project was completed and placed into service February 3, 2012, within the directed timeframe.

2) Early Capital Improvement Projects to Address Recurring SSOs

The following projects were not specifically identified in the Consent Decree, but have been initiated by LFUCG prior to RMP submission to address recurring SSOs.

a) Wolf Run Pump Station

The Wolf Run Pump Station has an estimated capacity of less than 10 MGD based on drawdown testing from September 2008 and is a recurring SSO. This pump station will be relocated downstream and the capacity increased to 20 MGD. A new force main that discharges to the Town Branch WWTP is included in this work. The design for this project is complete. Construction bids for the pump station are scheduled to open in April 2012.

b) Expansion Area 2A Pump Station

The Expansion Area 2A Pump Station has been designed to eliminate four smaller pump stations in the North Elkhorn sewershed and to provide expansion capacity to a developing section of the service area. The four pump stations being eliminated are: Man O' War, Blackford, Greenbriar #1, and Gleneagles. The Man O' War and Greenbriar #1 pump stations are listed as recurring SSOs. The flow to these existing pump stations will flow by gravity to the new Expansion Area 2A Pump Station, which will have a capacity of 7400 gpm. The design for this project is complete. Construction is expected to commence in the near future, pending easement acquisition.

c) Bluegrass Airport Pump Station (Complete)

The Bluegrass Airport Pump Station was a recurring SSO due to a combination of inadequate wet weather capacity and electrical/mechanical failures. This pump station had a design operating condition of 192 gpm; however, drawdown testing showed that the pumps were producing a flow of approximately 95 gpm. Although this pump station only runs infrequently, it receives runway runoff during de-icing operations (high glycol concentration events) and requires a higher flow capacity. The upgrades to the system included the addition of a wetwell, two new pumps rated for 429 gpm, a new valve vault, a new generator for back-up power, and a new 6" force main (approximately 9000 linear feet). This project has been completed and placed in service.

3) Other Capital Improvement Projects

The following project was not specifically identified in the Consent Decree, but has been completed by LFUCG to address operation and maintenance issues. The project does not specifically address a recurring SSO, but was considered when developing/sizing RMP solutions.

a) Griffin Gate Pump Station (Complete)

The Griffin Gate Pump Station had a design operating condition of 150 gpm and LFUCG staff noted that the pumps were unreliable and experienced extreme short cycling. The pumps and wet wells have been replaced and the new rated capacity is 188 gpm. This project was completed in June 2011.

E. Definitions and Acronyms

In order to provide a clear understanding of terms used, some of the more common and significant definitions and acronyms are provided. They are organized into terms that are defined in the CD where applicable.

1) Definitions included in the Consent Decree

The following definitions and acronyms are included in the CD (Introduction) and are relevant to capacity assessment activities:

"Building Backup" shall mean a subcategory of SSOs which occurs when a wastewater backup occurs into a building and is caused by blockages, malfunctions, or flow conditions in the Sanitary Sewer System. A wastewater backup that is caused by a blockage or other malfunction of a Private Lateral is not a Building Backup.

"Capacity, Management, Operations, and Maintenance" or "CMOM" shall mean, for the purpose of the Consent Decree only, a flexible program of accepted industry practices to properly manage, operate and maintain sanitary wastewater collection, transmission and treatment systems, investigate capacity-constrained areas of these systems, and respond to SSO events.

"Consent Decree" or "Decree" shall mean the United States of America and the Commonwealth of Kentucky v. Lexington-Fayette, Civil Action No. 5:06-cv-386 and all its attachments.

"Day" (whether or not capitalized) shall mean a calendar day unless expressly stated to be a working day. In computing due dates under the Consent Decree, where the last day would fall on a Saturday, Sunday, or federal holiday, the period shall run until the close of business of the next working day.

"EPA" shall mean the United States Environmental Protection Agency and any successor departments or agencies of the United States.

"EPPC" shall mean the Environmental and Public Protection Cabinet of the Commonwealth of Kentucky. (Note: the EPPC has been replaced by the Energy & Environment Cabinet or EEC).

"Excessive Inflow/Infiltration" Or "Excessive I/I" shall mean the Inflow/Infiltration (I/I) that LFUCG determines can be cost-effectively eliminated as determined by a cost-effectiveness analysis that compares the costs of eliminating the I/I with the total costs for transportation and treatment of the I/I (including capital costs of increasing transmission and treatment capacity, and resulting operating costs).

"Force Main" (FM) shall mean all sanitary sewer lines that operate under pressure due to pumping of sanitary wastewater at a pump station except for those sanitary sewer lines that serve a single structure or building.

"Gravity Sewer Line" shall mean a pipe that receives, contains and conveys wastewater not normally under pressure, but is intended to flow unassisted under the influence of gravity. Gravity sewers are typically not intended to flow full under normal operating conditions.

"I/I" shall mean the total quantity of water from Infiltration and Inflow without distinguishing the source.

"Infiltration" as defined by 40 C.F.R. § 35.2005(b)(20) shall mean water other than wastewater that enters a sanitary sewer system (including sewer service connections and foundation drains) from the ground through such means as defective pipes, pipe joints, connections, or manholes.

"Inflow" as defined by 40 C.F.R. § 35.2005(b)(21) shall mean water other than wastewater that enters a sanitary sewer system (including sewer service connections) from sources such as, but not limited to, roof leaders, cellar drains, yard drains, area drains, drains from springs and swampy areas, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, storm water, surface runoff, street wash waters, or drainage.

"LFUCG" shall mean the Lexington-Fayette Urban County Government, a municipality within the meaning of that term in CWA, established under the laws of the Commonwealth of Kentucky.

"LFUCG's WWTPs" shall mean West Hickman Creek WWTP and the Town Branch WWTP.

"Major Gravity Line" shall mean any of the following: all Gravity Sewer Lines that are twelve inches in diameter or larger; all eight inch Gravity Sewer Lines that are necessary to accurately

represent flow attributable to a service area in each of the sewersheds; all Gravity Sewer Lines that convey wastewater from one Pumping Station service area to another pumping station service area; and all Gravity Sewer Lines that substantially contribute, or that LFUCG knows will likely substantially contribute, to recurring SSOs.

"One Hour Peak Flow" as that term is used in Paragraph 16.B of the CD for the CMOM Capacity Assurance Program only, shall mean the greatest flow in a sewer averaged over a sixty (60) minute period at a specific location expected to occur as a result of a representative 2-year 24-hour storm event.

"Paragraph" shall mean a portion of the Consent Decree identified by an Arabic numeral.

"Parties" shall mean the parties to this Consent Decree: the United States, the Commonwealth, and LFUCG.

"Peak Flow" as that term is used in Subparagraphs 15.D – 15.G of the CD, shall be determined based upon sound engineering judgment and commonly accepted design practice.

"Private Lateral" shall mean that portion of a sanitary sewer conveyance pipe, including that portion in the public right of way, that extends from the wastewater main to the single-family, multi-family, apartment, other dwelling unit, business, industry, institution or structure to which wastewater service is or has been provided. Private Laterals do not include connector joints at LFUCG's sewer line.

"Pumping Station" (PS) shall mean all pumping stations owned or operated by LFUCG except for pump stations that serve a single structure or building, and except for the pump station serving Southland Christian Church in Jessamine County.

"Recurring SSO" shall mean, for the purpose of the Consent Decree only, an SSO that occurs in the same location more than once per twelve (12) month rolling period.

"Reporting Year" shall mean each annual period commencing at the start of LFUCG's fiscal year on July 1 of each year.

"Reporting Year Covered by the Consent Decree." A Reporting Year is covered by this Consent Decree if any part of the Reporting Year falls after the Effective Date of, and before the termination of this Decree.

"Sanitary Sewer Overflow" or "SSO" shall mean, for the purpose of the Consent Decree only, any discharge to waters of the United States from the Sanitary Sewer System through point sources not specified in any KPDES permit (otherwise known as "unpermitted Discharges"), as well as any release of wastewater from the Sanitary Sewer System to public or private

property that does not reach waters of the United States, such as a release to a land surface or structure that does not reach waters of the United States; provided, however, that releases or wastewater backups into buildings that are caused by blockages, flow conditions, or malfunctions in a Private Lateral, or other piping or conveyance system that is not owned or operationally controlled by LFUCG are not SSOs. SSOs include any cross-connections between LFUCG's Sewer System and its MS4 which allow wastewater to pass from the Sanitary Sewer System to the MS4, but do not include exfiltration that does not reach waters of the United States, or land surface or structures.

"Sanitary Sewer System" shall mean the wastewater collection and transmission systems (WCTS) owned or operated by LFUCG designed to collect and convey municipal sewage (domestic, commercial and industrial) to a WWTP. The Sanitary Sewer System does not include LFUCG's MS4.

"Section" shall mean a portion of the Consent Decree identified by a Roman numeral.

"Sewershed" shall mean a section of LFUCG's WCTS that is a distinct drainage or wastewater collection area and designated as such by LFUCG. For purposes of this Consent Decree, the sewersheds have been grouped as follows: Group One consists of West Hickman, East Hickman, and Wolf Run Sewersheds; Group Two consists of Cane Run and Town Branch Sewersheds; and Group Three consists of North Elkhorn and South Elkhorn Sewersheds.

"Ten States Standards" shall mean the applicable edition, incorporated by reference by Kentucky Regulation 401 KAR 5:005 § 29, of the "Recommended Standards for Wastewater Facilities: Policies for the Design, Review, and Approval of Plans and Specifications for Wastewater Collection and Treatment Facilities, Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers."

"Town Branch WWTP" shall mean the wastewater treatment plant located at 301 Lisle Industrial Avenue, Lexington, Kentucky, owned and operated by LFUCG, which discharges to Town Branch Creek from outfall 001 and pursuant to KPDES Permit No. KY0021491.

"Unpermitted Bypass" shall mean any discharge to the waters of the United States from any of LFUCG's WWTPs which constitutes a prohibited bypass as defined in 40 C.F.R. § 122.41(m), and 401 KAR 5:065 Section 1(13).

"Wastewater Collection and Transmission Systems" or "WCTS" shall mean the municipal sanitary wastewater collection and transmission systems, including all pipes, force mains, gravity sewer lines, lift stations, pumping stations, manholes and appurtenance thereto, which are owned or operated by LFUCG.

"WWTP" shall mean wastewater treatment plant.

"West Hickman Creek WWTP" shall mean the wastewater treatment plant located at 645 West Hickman Plant Road/Ash Grove Pike, Nicholasville, Jessamine County, Kentucky, owned and operated by LFUCG, which discharges to West Hickman Creek from outfall 001 and pursuant to KPDES Permit No. KY0021504.

2) Additional Definitions and Acronyms

The following additional definitions and acronyms are used in this report:

"Average Daily Flow" (ADF) shall mean the total flow over a given period, divided by the number of days in the period.

"BWWF" or "Base Wastewater Flow" is domestic (or sanitary) wastewater from residential, commercial, institutional (schools, churches, hospitals, etc.) sources, and industrial wastewater sources.

"CAP" shall mean Capacity Assurance Program.

"CAWP" shall mean Capacity Assessment Work Plan.

"gpcd" means gallons per capita per day and refers to wastewater generation rate per person.

"GWI" means Groundwater Infiltration which is defined as the groundwater entering the collection system through defective pipes, pipe joints, and manhole walls.

"HMR" shall mean Hydraulic Model Report

"RDI/I" means rainfall-dependent infiltration/inflow.

"RMP" means Sanitary Sewer System and WWTP Remedial Measures Plan(s).

"SSAWP" shall mean the Sanitary Sewer Assessment Work Plan.

"TBWWTP" shall mean Town Branch Wastewater Treatment Plant.

"WHWWTP" shall mean West Hickman Wastewater Treatment Plant.

Section 2 Methodology

A. Modeling

The hydraulic models utilized for the development of the Group Two Sanitary Sewer System and WWTP Remedial Measures Plan (RMP) were developed and calibrated as part of the Capacity Assessment. Future growth conditions were assumed in the model when evaluating RMP project alternatives. A detailed summary of model assumptions, methodology, and results was documented in the Sanitary Sewer Hydraulic Modeling Report (HMR), dated July 2008, and the Group Two Sanitary Sewer Assessment Report (SSA Report), submitted in October 2011. The following subsections summarize refinements to the model since submission of the Group Two Capacity Assessment Report. Additionally, a summary of key assumptions with respect to development of future condition sewer flows is also provided.

1) Model Recalibration

a) 2010 Flow Monitoring

Calibration of the hydraulic models used for the Group Two Capacity Assessment were based on flow monitoring in the sewer system performed in the spring of 2009. A total of 49 flow meters and 11 rain gages were utilized in the Group Two sewersheds during the 2009 flow monitoring period.

Subsequent flow monitoring was performed in the Group Two sewersheds in the spring of 2010. The 2010 flow monitoring included a total of 62 flow meters and 12 rain gages located within the Group Two sewersheds. The 2010 flow monitoring was performed to further isolate inflow and infiltration (I/I) within the collection system and guide prioritization of SSA field investigation activities. Flow data collected during the 2010 monitoring period was provided in the Group Two SSA Report, dated October 14, 2011.

b) Sewer System Improvements

LFUCG has completed several early SSO reduction projects since the publication of the Capacity Assessment Report and hydraulic model development. These projects include the replacement of the South Elkhorn Pump Station and Force Main and construction of the North Elkhorn Pump Station and Force Main Diversion. Construction of the North Elkhorn Pump Station and Force Main Diversion relocated a large portion of the discharge from the North Elkhorn pump station from the East Hickman sewershed (and ultimately the West Hickman WWTP) to the Town Branch WWTP.

c) Supplemental Surveying

Supplemental surveying was performed in areas where model calibration was poor. Pipe inverts and sizes were field surveyed and compared with those in the hydraulic model. Additionally, in areas of where manhole inspections and closed circuit television (CCTV) inspection had been performed, collected data was similarly used to verify sewer dimensions and grades in the hydraulic model.

d) Updated Land Use

Future land use conditions were further refined since publication of the Capacity Assessment Report, based on discussions with LFUCG Division of Planning staff and was coordinated with the 2007 Lexington-Fayette County Comprehensive Plan. New pump stations and sewers were added and sized to accommodate the needs of the Urban Service Area expansion. The model was updated to reflect these changes during the development of the Remedial Measures.

e) Revised Capacity Assessment Results

The hydraulic model was refined and recalibrated based on 2010 flow data, physical changes presented by the North Elkhorn Pump Station and Force Main Diversion, supplemental surveying, and updated land use information. The 2010 flow monitoring season was one of the wettest springs on record in Lexington and recalibration of the hydraulic model resulted in an increased overall wet weather response predicted at the Town Branch WWTP.

Figure 2-1 summarizes system surcharging and SSO locations in the Group Two sewersheds predicted by the recalibrated models for the future year (2035) condition. Model results indicate that approximately 54 percent of the modeled trunk sewers in the Cane Run sewershed would experience overflows or surcharging for the future population (2035), 2-year, 24-hour storm event. In the Town Branch sewershed, approximately 24 percent of modeled trunk sewers would experience overflows or surcharging for the future population (2035), 2-year, 24-hour storm event.

The recalibrated models and results presented in Figure 2-1 were used as the baseline for evaluating RMP solutions.

2) <u>Modeled Sewer Flows (Future Conditions)</u>

The hydraulic capacity of the wastewater system was evaluated under existing and projected future conditions. The methodology for developing sewer flows for future conditions was summarized in the Group One Sanitary Sewer System and WWTP Remedial Measures Plan (October 2011), the Capacity Assessment Report, and in the Hydraulic Modeling Report (July 2008). This same methodology was adopted in the Group Two sewersheds. A brief summary of the key assumptions follows.

- Future conditions were defined as the year 2035.
- Future residential development was projected from Traffic Analysis Zone (TAZ) data provided by LFUCG's Division of Planning.
- Dry weather flows assumed 15 gpcd for groundwater infiltration (GWI) and 65 gpcd of sanitary flow for all new residential areas.
- Existing diurnal normalized patterns were assumed for future infill and redevelopment areas.

- Rainfall dependent inflow/infiltration (RDI/I) for future development areas utilized RTK parameters observed in existing Lexington neighborhoods approximately 5 to 10 years old.
- A population density of 9 persons per acre was assumed in undeveloped areas.

B. Corrective Actions Toolbox

The following measures were considered in the development of the RMP. A more detailed description of each measure can be found in the Group One RMP Report.

- Sewer rehabilitation as a means of restoring existing sewer capacity by reducing infiltration and inflow.
- Equalization storage to reduce downstream peak flows.
- Increased conveyance capacity through gravity sewer construction or pump station/force main upgrades.
- Increased wastewater treatment capacity through existing process expansion, optimization, or the use of other wet-weather treatment processes.
- Diversion of flows to other sewersheds with sufficient capacity, typically via pumping.

C. Solution Development Process

Remedial measures plan solutions were evaluated (and sized) using the hydraulic model assuming future conditions. Remedial measures solutions were developed using a two-step process that involved first evaluating a generalized solution that consisted solely of conveyance upgrades and equalization storage. The generalized solution was then evolved it into a detailed solution. A similar approach was used in the development of the Group One RMP. A detailed explanation of the solution development process was presented in the Group One RMP report. An abbreviated summary of the approach follows.

1) <u>General Solutions</u>

A solution set comprised solely of upsizing existing trunk sewers was evaluated with the hydraulic model to understand the extent of conveyance upgrades necessary to eliminate SSOs and sewer surcharge conditions. The sewer surcharge condition was defined as no surcharging greater than 24 inches above the top of pipe or within 3 feet of the rim of the manhole for the one-hour peak flow, as defined in Section VII.16.B of the Consent Decree. The conveyance approach did not consider I/I removal. A storage tank at the downstream boundary condition in each sewershed was assumed to capture excess wet weather flows. The downstream boundary condition in each sewershed and its existing capacity are summarized in Table 2-1.

Table 2-1: General Solution Boundary Conditions

Sewershed	Boundary Condition	Maximum Capacity
Cane Run	Lower Cane Run Pump Station	17.5 MGD
Town Branch	Town Branch WWTP	71 MGD

The conveyance solution was then revised to include localized storage/equalization tanks. Storage tank locations were selected based on proximity to SSOs and hydraulic bottlenecks, as well as locations where property acquisition could reasonably be assumed. Hydraulic modeling of storage alternatives was used to determine their effectiveness at reducing the extents of the conveyance solution and to develop initial estimates of tank volumes needed.

The costs of the general solutions were then calculated and summarized. The results provided an understanding of the magnitude of the individual RMP solution and planning-level program costs.

2) Detailed Solutions

The conveyance and storage General Solutions provided the basic framework for development of the Detailed Solutions. Other factors were also considered when developing detailed solutions. These considerations included:

- ***SSA Field Data.*** The condition of the pipes in the system played a role in evaluating the benefits of conveyance solutions versus storage solutions. For example, choosing a conveyance solution (i.e. pipe upsizing or construction of a relief sewer) is likely more cost-effective than a storage tank in an area where the trunk sewer is in very poor structural condition and in need of replacement. In this case, both solutions would include the cost of trunk sewer replacement, but the local storage option would also include the cost of a storage tank. Closed-circuit television (CCTV) inspection data collected during SSA field activities was used as the basis for determining trunk sewer condition. In areas, where CCTV inspection was not performed during the SSA, CCTV inspection data collected as part of the Trunk Studies performed from 1998 to 2001 was used. A graphical summary of trunk sewer condition is presented in Section 3C.
- ***LFUCG Storage Preferences.*** LFUCG indicated an overall preference to minimize regional or remote storage unless there was a potential for significant cost savings over increasing downstream sewer capacity through upsizing or parallel relief sewers.
- ***Flow Monitoring Data.*** The decision to provide storage or upsize a pipe can be affected by the proposed I/I reduction strategy (see Section 4). For example, construction of equalization can be done in a phased manner to allow for an adaptive approach where the effectiveness of I/I removal can be assessed over time. This might result in lower ultimate EQ volumes. Conversely, construction of conveyance pipes is not as adaptive. It would be very risky to design a new pipe assuming a certain I/I removal rate only to learn that I/I removal was not as successful as projected. If that were the case, additional pipe construction would be required to provide the required capacity. Therefore, the flow data was useful to identify where a long term I/I removal strategy could reasonably be expected to provide cost savings in potential storage volumes and pipe construction.

- ***Cost Effectiveness.*** Each solution alternative was sized to meet the 2-year, 24-hour Level of Control (LOC) under future growth conditions. Competing alternatives from the Corrective Action Toolbox (i.e. storage tanks, conveyance upgrades, flow diversions, WWTP upgrades, and I/I removal) were evaluated. Planning-level cost estimates were prepared for each competing alternative to aid in the evaluation. Only cost-effective alternatives that met the established LOC were selected.
- ***Other key factors.*** Other key strategic and local condition factors were taken into account when developing the detailed solutions. These factors are based on current commitments, previous planning, and other issues. These factors are summarized in the following subsection.

These factors plus the general solutions results were used to define a set of detailed solution alternatives for each watershed. Section 3 summarizes the general and detailed solutions.

D. Key Factors and Critical Decisions for Screening Solutions

Several design constraints were provided by LFUCG to guide development of the detailed solutions. These constraints are summarized by sewershed.

1) <u>All Sewersheds</u>

Improvements are sized assuming no I/I removal. While I/I is a critical long term strategy for LFUCG, proposed remedial measures projects were developed assuming no I/I reduction. There is an inherent risk in sizing sewer improvements and equalization facilities assuming a specific I/I removal rate. Historic collection system rehabilitation efforts by LFUCG to reduce I/I have had limited success. In addition, the actual amount of I/I that can be reduced through sewer rehabilitation has the potential for significant variability and uncertainty. Conservative procedures for including I/I removal in new conveyance capacity improvements is a systematic process that involves construction of collection system rehabilitation/repairs, post-rehabilitation flow monitoring, and subsequent determination of the remaining conveyance capacity necessary to eliminate SSOs and sewer surcharging. The short time frame for elimination of recurring overflows within the Consent Decree schedule does allow for an evaluation of I/I removal effectiveness before construction of conveyance improvements. Assuming zero I/I reduction in sizing conveyance and storage improvements provides a higher probability of successfully meeting or exceeding the program goals within the RMP implementation period.

The overall long term I/I removal strategy is described in Section 4. Some utilities, including LFUCG, have elected to size RMP improvements and provide the selected level of control (LOC) without relying on I/I reduction. I/I reduction through sewer rehabilitation would increase the LOC that LFUCG could provide above the selected design storm. For instance, facilities originally designed for a two-year return period would accommodate larger storm events

(without SSO or surcharging) as a result of the reduction in wet weather flows from sewer rehabilitation.

Pipe replacement was assumed for additional conveyance in all areas where upsizing was needed. When providing additional conveyance capacity, there are two options. The first option is to provide a new pipe with the ability to convey the peak flows alone. The other option is to construct a parallel relief sewer that, when combined with the capacity of the existing sewer, provides the total needed conveyance capacity. Detailed assessment is necessary to determine the costs associated with upsizing/replacement versus construction of a parallel sewer. Factors such as existing pipe condition, pipe location, bypass pumping costs, asset management goals, vicinity to creeks, traffic, etc. all play a role in the decision. These factors will be evaluated during the final design of RMP improvements. Estimated costs for RMP conveyance improvements in this report assumed that existing sewers were replaced with larger pipes (i.e. upsized).

All Improvements to be constructed within the current Urban Service Area unless shown otherwise in the approved Regional Facilities Plan. In 1958, the Lexington-Fayette County initiated an Urban Service Boundary as a tool to limit development to urban areas served by sanitary sewers. Planning and zoning restrictions, including minimum lot sizes, exist to limit development outside the Urban Service Boundary. The boundary serves to protect the pastoral nature of the area surrounding Lexington by encouraging land development within the Urban Service Area (USA), or that area within the Urban Service Boundary. LFUCG is committed to maintaining the USA in accordance with the Comprehensive Plan and construction or installation of the RMP improvements outside of the USA was not considered. One exception to this constraint is the proposed trunk sewers in Expansion Area 3. The proposed sewers follow the topographical drains in the area and require a portion of the new trunk sewer to be constructed outside of the USA boundary. The proposed route is consistent with the approved 201 Facilities Plan.

All improvements should be sized to meet future Capacity Assurance Program criteria**.** Based on the requirements in the Consent Decree, LFUCG must implement a Capacity Assurance Program, or CAP (Section VII.16.B). Terms of the Consent Decree prohibit new connections to the sanitary sewer system where sewers do not have adequate capacity to pass wet weather flows where a surcharge condition exists, unless a banking credit system is utilized. A surcharged condition is defined as sewer surcharging from the one-hour peak flow greater than 24 inches above the top of the pipe or within 36 inches of the manhole rim.

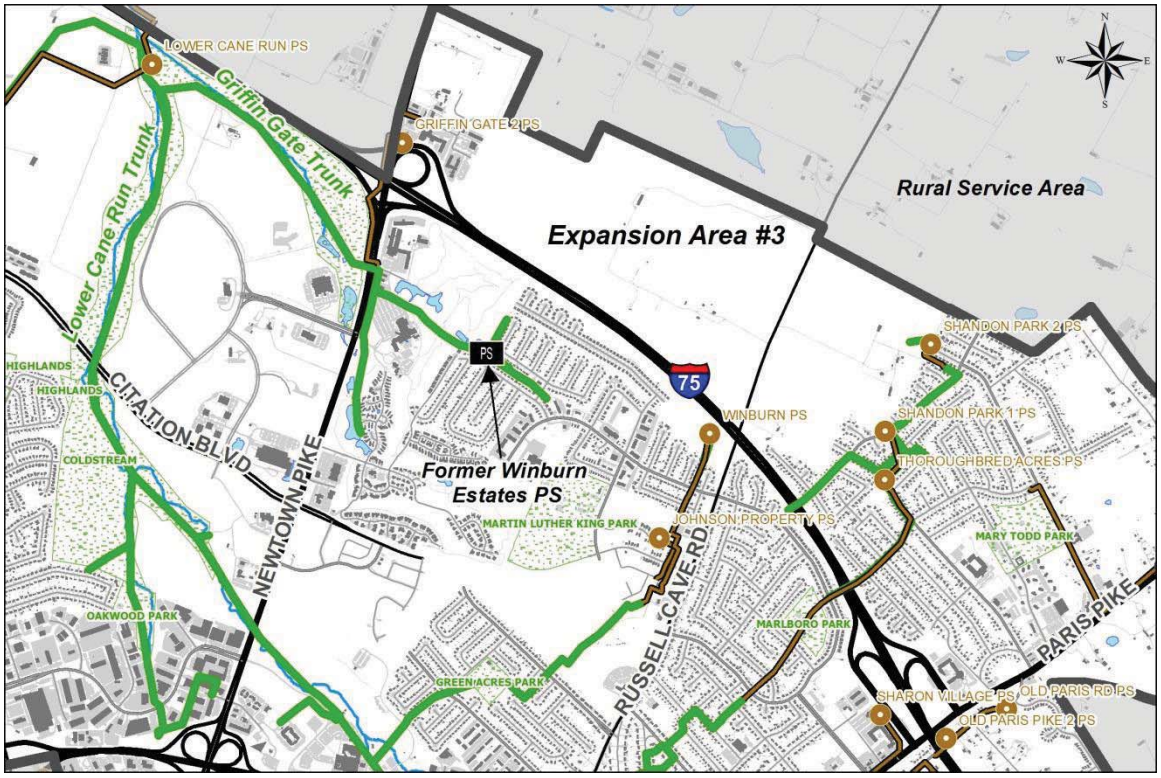
LFUCG identified that, in general, proposed RMP improvements should be sized to eliminate the surcharged condition as defined in the Consent Decree. Exceptions were permitted, with LFUCG approval, in areas where surcharge conditions were predicted by the hydraulic model but the existing facilities are in acceptable condition and there was no reasonable anticipation of future development. Areas within the Group Two sewersheds where sewer surcharge

conditions are predicted to occur after implementation of the RMP improvements are summarized in Section 3C.

2) Cane Run Sewershed

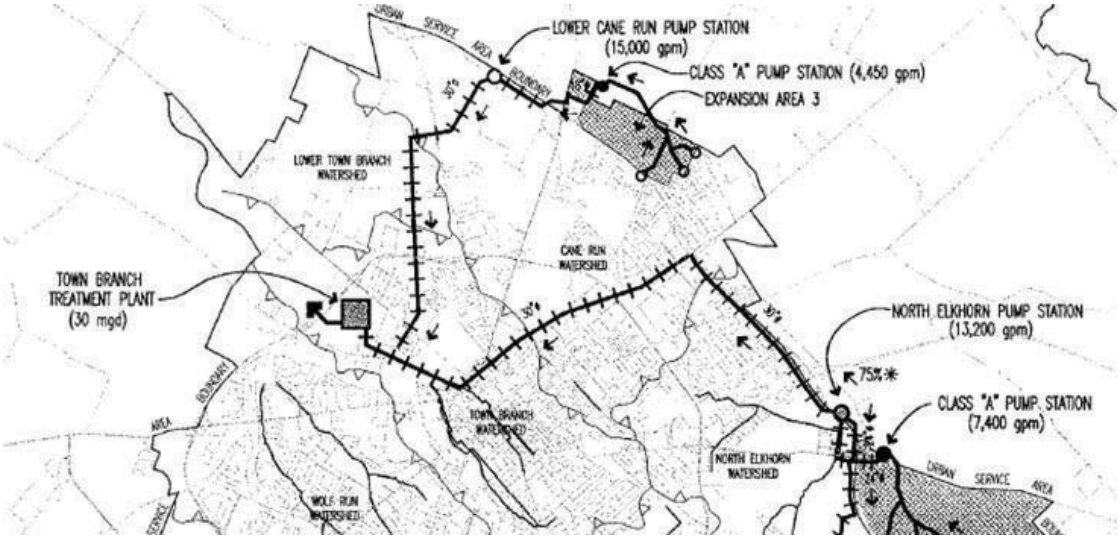
A map illustrating existing sewer assets discussed below is provided in Figure 2-2.

Figure 2-2: Existing Sewer Assets – Expansion Area 3



Expansion Area No. 3 (EA3) - LFUCG revised the Urban Service Boundary in 1996 to allow for growth within approximately 500 acres of land north of I-75 between Newtown Pike and Russell Cave Road. The area is immediately adjacent to the Winburn, Shandon Park #1, and Shandon Park #2 pump stations. Topographically, the service areas for these pump stations drain through EA3 and the pump stations were originally constructed prior to the expansion of the Urban Service Boundary and creation of EA3. LFUCG's last approved 201 Facilities Plan Update included the elimination of these three pump stations through construction of new gravity sewers through EA3 and a new pump station. The new EA3 pump station would be located on the west end of the expansion area and discharge to the Lower Cane Run Pump Station. Two of the existing pump stations are SSOs and identified in Appendix A of the Consent Decree. It was agreed that RMP improvements would include elimination of these pump stations in general accordance with recommended solution identified the Facilities Plan. A map illustrating the proposed pump station eliminations excerpted from LFUCG's last approved Facilities Plan is presented in Figure 2-3.

Figure 2-3: EA3 Solution from LFUCG's Facilities Plan



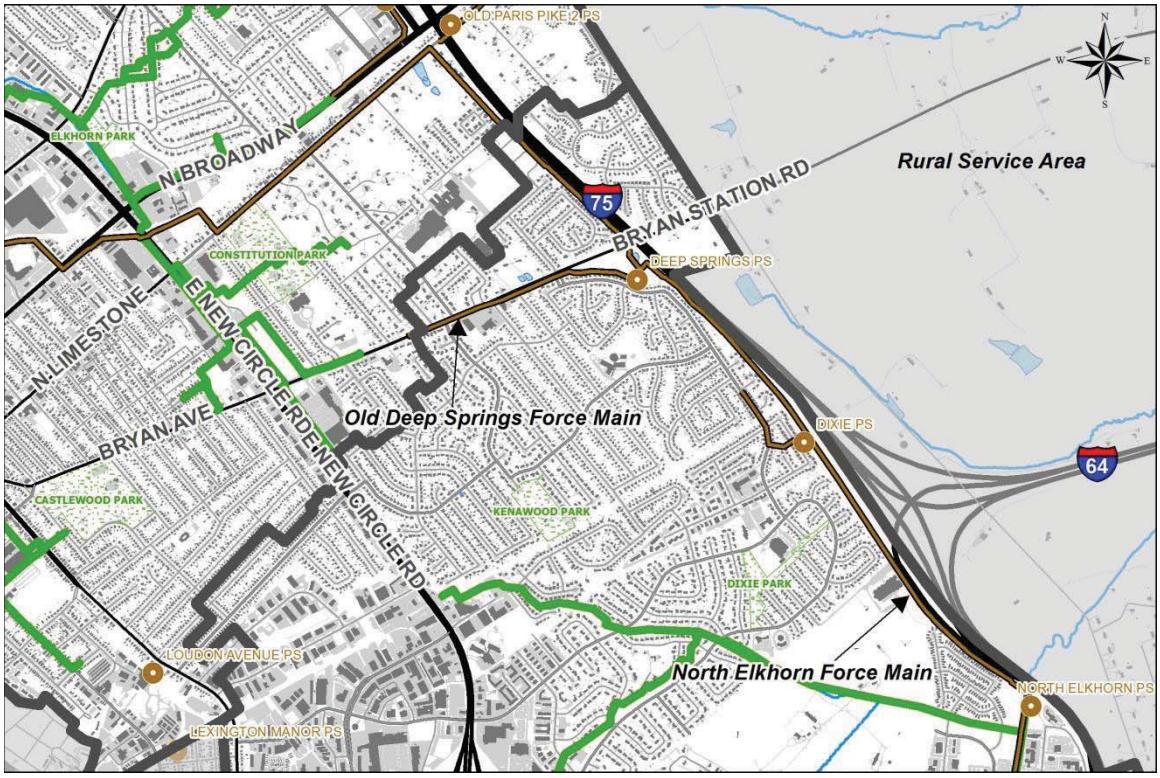
Thoroughbred Acres Pump Station Elimination **-** The Thoroughbred Acres Pump Station is located near EA3 and receives flows from both the Shandon Park #1 and #2 pump stations. The pump station is located in a floodplain area and presents access issues for LFUCG maintenance staff during wet weather periods. Additionally, the pump station experiences recurring SSOs and is identified in Appendix A of the Consent Decree. The proposed gravity sewers and pump station in EA3 provide an opportunity to eliminate the Thoroughbred Acres pump station. The elimination of the pump station is proposed to be accomplished by construction of a gravity sewer to EA3.

Lower Cane Run Pump Station and Force Main **-** The Lower Cane Run Pump Station was evaluated as part of the Pump Station Design, Capacity, and Equipment Adequacy Evaluation. The pump station had adequate ratings in all design categories except wet weather capacity and emergency pumping facilities. LFUCG has indicated that they intend to keep this pump station in service for the foreseeable future. Rather than upgrading/replacing the existing pump station and force main to increase hydraulic capacity, it is proposed that wet weather flows in excess of pump station capacity will be diverted to a proposed equalization facility to be located near the pump station.

Dixie and Deep Spring Pump Station and Force Main Replacements **-** The Dixie and Deep Springs pump stations are located in the North Elkhorn sewershed. Sewer flows to the old Dixie and Deep Springs pump stations discharged to the Cane Run sewershed. Both pump stations were identified as SSOs in Appendix A of the Consent Decree. The Dixie and Deep Springs pump stations were replaced in 2012 and new force mains for both pump stations were constructed that connect to the recently completed force main for the North Elkhorn pump station and discharge directly to the Town Branch WWTP. RMP improvements were designed assuming that Dixie and Deep Springs pump station discharges were diverted to the

North Elkhorn force main. A map illustrating the location of the improved Dixie and Deep Springs pump stations and force mains is presented in Figure 2-4.

Figure 2-4: Dixie and Deep Springs Pump Stations and Force Mains



Griffin Gate Trunk Sewer - The Griffin Gate trunk sewer was constructed in early 2000 as a means to eliminate the Winburn Estates Pump Station. The Winburn Estates Pump Station (also shown in Figure 2-2) discharged to the existing Winburn Pump Station. Both pump stations experienced frequent overflows during wet weather events. In addition to eliminating a recurring SSO, elimination of the Winburn Estates Pump Station also provided hydraulic relief to the Winburn Pump Station.

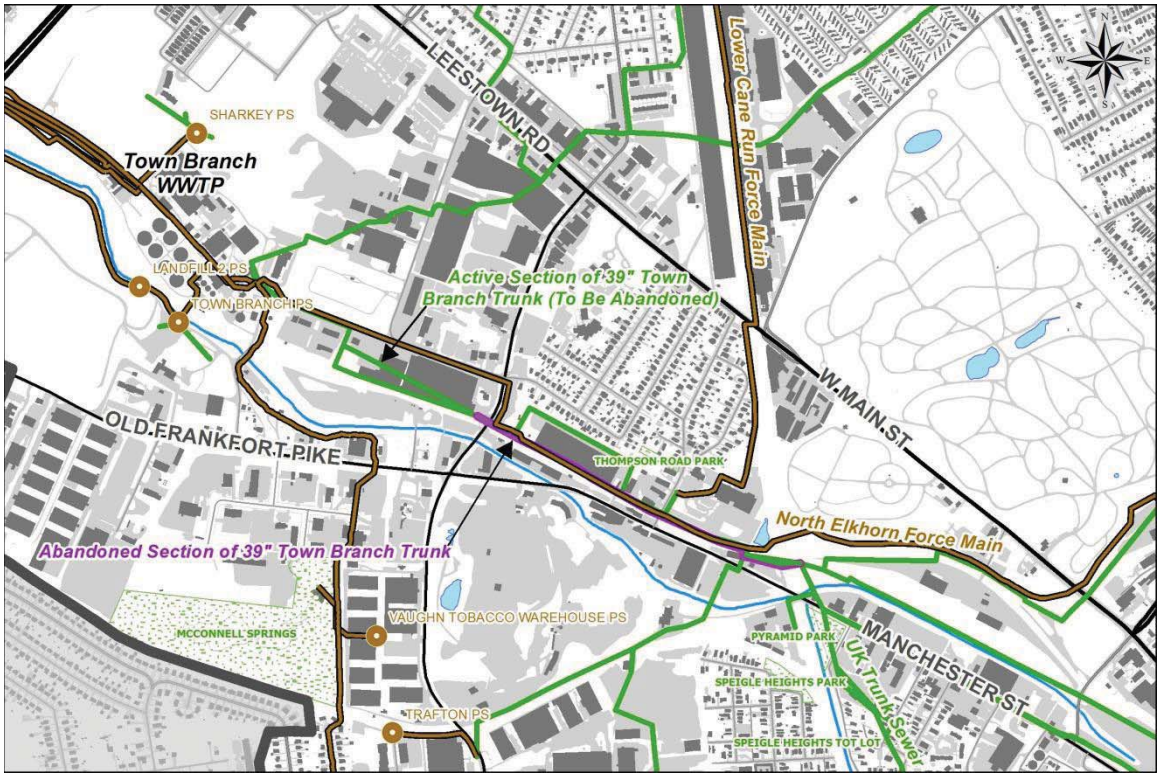
Hydraulic modeling of the Griffin Gate trunk sewer under future conditions and the established LOC predicts that manhole overflows will occur. Due to the relatively good condition of the sewer and its location, LFUCG has indicated that upsizing of the existing sewer or construction of a parallel relief sewer is not preferred. Programmatic I/I removal and rehabilitation efforts are to be focused in this area in lieu of construction of trunk sewer improvements.

Johnson Property Pump Station - The Johnson Property Pump Station was constructed in conjunction with recent development along Russell Cave Road (refer to Figure 2-2). Preliminary review of topographic relief in the area indicates that the pump station can be eliminated by a gravity sewer draining to the north (and through EA3). The Johnson Property

Pump Station and upstream service area does not experience recurring SSOs; however, it is anticipated that in the future the pump station will be eliminated and flows diverted to EA3. Elimination of the Johnson Property Pump Station was not considered as an RMP improvement, but flows from the pump station service area were assumed to drain to EA3 in the hydraulic model used for sizing/evaluating RMP improvements.

3) Town Branch Sewershed –
A map illustrating existing sewer assets discussed below is provided in Figure 2-5.

Figure2-5: Existing Sewer Assets – Town Branch



Town Branch Pump Station Replacement - The Town Branch Pump Station is identified as an SSO in Appendix A of the Consent Decree and was evaluated as part of the Pump Station Design, Capacity, and Equipment Adequacy Evaluation. Based on this evaluation and its history of SSOs, LFUCG has elected to replace the existing pump station and force main. RMP improvements are to include replacement of the pump station and force main with sufficient capacity to eliminate SSOs for the established LOC.

Town Branch Main Trunk Sewer - The primary trunk sewer for the Town Branch WWTP was originally a 39-inch trunk sewer located along Manchester Street. The 39-inch trunk sewer was constructed in the early 1900s and was constructed of clay tile. Prior pipe inspections of the trunk sewer indicated it was in poor condition. In the early 1990s, LFUCG completed construction of a parallel 54-inch reinforced concrete pipe and abandoned a large portion of the original 39-inch trunk sewer. Presently, approximately 1,100 feet of original 39-inch trunk sewer remains in service near the entrance to the Town Branch WWTP. LFUCG intends to plug and abandon this remaining portion of the original trunk sewer. During evaluation of RMP improvements, it was assumed that the parallel 39-inch trunk sewer was not in service.

UK Trunk Sewer - The UK trunk sewer extends from the Chevy Chase neighborhood (upper end) to the Town Branch Main Trunk Sewer at Manchester Street (lower end). The central portion of the trunk extends through the main campus of the University of Kentucky. The existing trunk sewer alignment is located under two university buildings. Re-alignment of the trunk sewer outside the building footprints was to be considered when evaluating RMP improvements for the UK trunk sewer.

North Elkhorn Pump Station and Force Main - The North Elkhorn Pump Station and Force Main was completed in October 2009. Evaluation of RMP improvements assume that 100 percent of the discharge from the pump station is to the new force main that terminates at the Town Branch WWTP.

Lower Cane Run Pump Station Force Main - Design of the recently completed force main for the North Elkhorn pump station included provisions for connecting the force main for the Lower Cane Run Pump Station near Thompson Road. Presently, the Lower Cane Run Force Main terminates to a gravity sewer (also on Thompson Road.) To restore hydraulic capacity in the existing 54-inch Town Branch trunk sewer, RMP improvements include connecting the two force mains.

E. Costing Tool

At the onset of the RMP process it was acknowledged that a consistent and credible basis for establishing costs was essential to the decision-making process. As such, it was determined that a costing tool would be developed to assure that consistent and justifiable planning-level costs are applied to RMP alternatives. Therefore, a custom Microsoft Access based costing tool was utilized to develop and compare and manage multiple solutions for consideration.

The base costing tool was developed from a similar tool used for developing the RMP for another EPA Region 4 community. This baseline tool was refined to meet the needs of the LFUCG RMP. The accuracy of the individual estimates was based upon the Association for the Advancement of Cost Engineering (AACE), Class 4 standards, which is appropriate for planning-level cost estimates. The cost curves included in the costing tool were originally developed using a “bottom-up” costing

procedure for a range of facility types and facility sizes. Cost curves were developed for the following facilities that comprise RMP improvements:

- Gravity sewers
- Pump stations
- Force mains
- Equalization storage
- Storage/conveyance tunnel
- Tunnel shafts

The construction cost estimates and cost curves/equations were then confirmed and refined through a variety of sources including:

1. Recent bid information from LFUCG;
2. Recent bid information for equalization tanks used for SSO control;
3. Planning level cost information developed by the consulting team for other studies; and,
4. EPA Technology Fact Sheets, WERF studies and similar reference material.

The initial construction costs were then converted to full capital costs to be used for remedial measures project estimates. The Kentucky USDA/Rural Development Utility Program Fee Schedule was used for estimating fees for professional engineering services and resident project representative services as a percentage of initial construction costs. These costs are commonly referred to as basic design and inspection costs respectively. The total capital cost also includes other factors as a percentage of the initial construction cost and possible land acquisitions where it was deemed as a necessity. The total capital costs were developed by applying these aforementioned factors to the initial construction costs; these factors are shown in Table 2-2 below.

Table 2-2: Capital Cost Factors

Item	Percentage	Notes
Basic Design	6.4% to 14%	Of Initial Construction Cost; based on Rural Development Fee Curve (RD 1942-19)
Inspection	3.05% to 13%	Of Initial Construction Cost; based on Rural Development Fee Curve (RD 1942-19)
Land Acquisition	--	$100k purchase or $1k easement / acre
Contingency	30%	Of Initial Construction Cost
Administration	1%	Of Initial Construction Cost
Legal/Finance	5%	Of Initial Construction Cost

Annual operation and maintenance costs were developed by applying a percentage to the capital cost. These percentages are based on previous experience and are as follows:

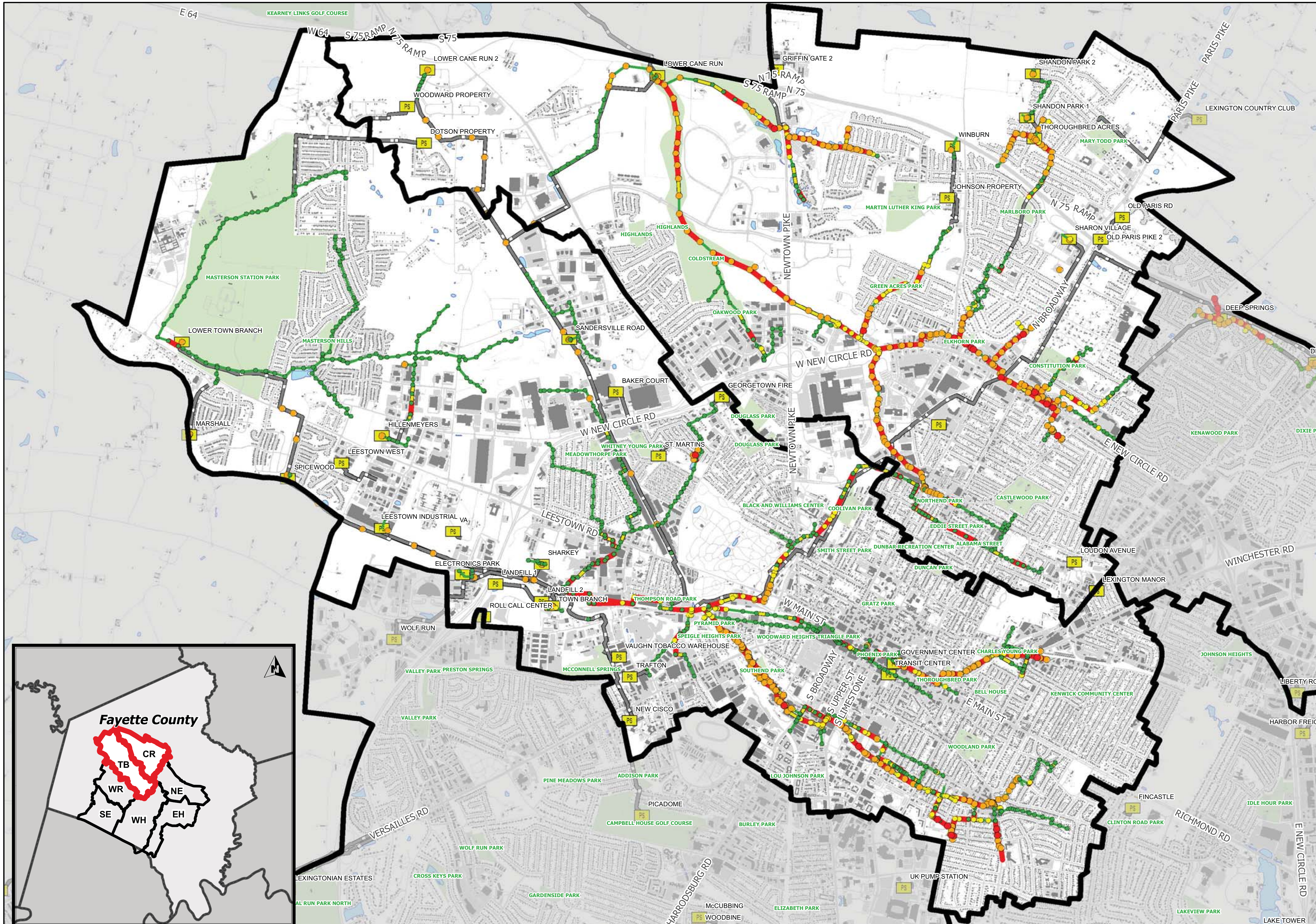
- Gravity Sewers: 1% of construction costs
- Equalization Tanks: 2% of construction costs
- Force Mains: 2% of construction costs
- Pump Stations: 3.5% of construction costs

F. Public Involvement

Throughout the work conducted for the SSA field investigations, the preparation of the Group One and Group Two SSSA Reports, the Group One Remedial Measures Plan and this Group Two Remedial Measures Plan, LFUCG has consistently kept the public informed of the Consent Decree compliance process and progress. They have also solicited input from the public, community stakeholders, and public policymakers related to key decisions required for the RMP development. The following meetings were held as part of this public involvement process:

- Fayette County Neighborhood Association – January 27, 2011
- Fayette County Public Schools – February 3, 2011
- Lexington Homebuilders Association – February 10, 2011
- Commerce Lexington (Chamber of Commerce) – February 24, 2011
- LFUCG Stormwater Stakeholders – March 4, 2011
- Public information meetings for residents – March 7, 14 and 21, 2011
- LFUCG Environmental Quality Commission presentations:
    - January 18, 2011
    - April 19, 2011
    - June 21, 2011
- LFUCG Mayor and Chief Administrative Officer – June 22, 2011
- LFUCG Council Committee of the Whole – August 23, 2011
- Presentation of the Group Two RMP to the University of Kentucky – December 16, 2011
- Presentation of the Group One RMP to residents – September 12 and 19, 2011
- Presentation of the Group Two RMP to residents – February 27 and March 5, 2012
- Presentation of the Group Two RMP to Lexmark International – March 12, 2012

In addition to the meetings listed above, a web page was established within the Lexington government website to provide access to critical information and documents, and to allow the public to view the progress of the various initiatives. This website (*http://www.lexingtonky.gov/RemedialMeasures*) will be maintained throughout the implementation of the remedial measures, so that residents and other stakeholders are informed of work anticipated or under way in their neighborhoods.



2035 2 Year 24 Hour Design Storm - Group 2

Modeled Manholes

- Not Surcharged
- Surcharged < 24" Over Pipe Crown
- Surcharged >= 24" Over Pipe Crown
- Overflow

Modeled Pipes

- Not Surcharged
- Near Capacity (> 75%)
- Surcharged

- Pump Station
- Force Main
- Major Sewershed

1 " = 3,200 '

2 - 1

Section 3 Remedial Measures Development

This section summarizes the development of the Remedial Measures Plan. The section includes:

- Selection of the level of control
- General solution results
- Detailed solution development and analysis
- Cross connections
- Pump station reliability and capacity upgrades
- Wastewater treatment plant upgrades

A. Selection of Level of Control (LOC)

One of the most important decisions in developing the RMP is to decide on the target Level of Control (LOC). The LOC refers to conditions within the collection system that are considered acceptable under specified situations. For example, a LOC might be defined as having no overflows resulting from a 2-year return period design storm model simulation. An LOC may be defined by something other than overflows; for example, the level of control may be defined by a level of surcharging in the collection system.

While evaluating the appropriate target LOC for the LFUCG, key definitions and requirements contained within the Consent Decree were considered. Following are some key definitions from the Consent Decree:

- **One Hour Peak Flow (Capacity Assurance Program Only)**: The greatest flow in a sewer averaged over a sixty minute period at a specific location expected to occur as a result of a representative 2-year 24-hour storm event.
- **Peak Flow (Capacity Assessment and RMP)**: Shall be determined based upon sound engineering judgment and commonly accepted design practice.
- **Recurring SSO:** An SSO that occurs in the same location more than once per twelve month rolling period.
- **Unpermitted Bypass**: Any discharge to the Waters of the United States from any of LFUCG's WWTPs which constitutes a prohibited bypass as defined in 40 CFR 122.41(m) and 401 KAR 5:065 Section 1(13).
- **Surcharged Condition (Capacity Assurance Program Only):** The condition that exists when the supply of wastewater resulting from the One-Hour Peak Flow is greater than the capacity of the pipes to carry it and the surface of the wastewater in manholes rises to an elevation greater than 24 inches above the top of the pipe or within 36 inches of the manhole rim.

The Consent Decree requires LFUCG to develop the RMP to eliminate Recurring SSOs and Unpermitted Bypasses. In the selection of the target LOC for LFUCG it is important to consider the following:

- It is fiscally impractical to completely eliminate all SSOs and unpermitted bypasses under all conditions.

- KRS 224.16-040 sets forth factors that must be considered when reviewing the RMP. These factors include cost-effectiveness, which is a component of this plan.

LOC selection considered cost-effectiveness, Consent Decree requirements, stakeholder preference, and LOCs adopted by other Region 4 utilities. A detailed evaluation of these considerations was included in the Group One RMP Report.

After careful deliberation and public scrutiny, Resolution No. 389-2011 was passed by the Lexington-Fayette Urban County Council on September 15, 2011. The resolution formally adopted the 2-year, 24-hour storm event as the LOC for the LFUCG Sanitary Sewer System and WWTP Remedial Measures Plan. This LOC will be adopted for all three sewershed Groups. A copy of the resolution is presented in Figure 3-1.

Figure 3-1: Resolution formally adopting a 2-year, 24-hour Level of Control

RESOLUTION NO. 389 -2011

A RESOLUTION APPROVING THE RECOMMENDATION OF THE DIVISION OF WATER QUALITY TO SELECT A "TWO-YEAR/24 HOUR" STORM EVENT AS THE "DESIGN STORM" TO FORM THE BASIS OF IMPLEMENTATION OF THE LFUCG SANITARY SEWER SYSTEM REMEDIAL MEASURES PLANS REQUIRED BY THE U.S. EPA CONSENT DECREE.

WHEREAS, the Urban County Government, the United States Environmental Protection Agency ("EPA"), and the Commonwealth of Kentucky have entered into a Consent Decree in a case styled *United States, et al. v. Lexington-Fayette Urban County Government*, United States District Court for the Eastern District of Kentucky, Case No. 5:06-CV-00386 ("Consent Decree"), wherein the Urban County Government is required to develop Remedial Measure Plans to address wet weather overflows and sewer capacity related issues; and

WHEREAS, the Consent Decree requires the Urban County Government to eliminate Sanitary Sewer Overflows (SSOs) with 11 to 13 years of January 3, 2011; and

WHEREAS, pursuant to the Consent Decree failure to meet the SSO elimination criteria will result in significant, recurring, and cumulative financial penalties; and

WHEREAS, failure to meet the requirements of the Consent Decree is likely to result in further legal action by the United States Department of Justice; and

WHEREAS, the Consent Decree requires three separate "Remedial Measures Plans" (Group 1, Group 2, and Group 3) broken down by watershed; and

WHEREAS, each Remedial Measures Plan (RMP) must recommend a "design" storm to provide a basis for sizing of sanitary sewer infrastructure (pipes, pump stations, storage tanks, and treatment plants); and

WHEREAS, the Group 1 Remedial Measures Plan is due to be sent to the EPA in October 2011; and

WHEREAS, the Division of Water Quality has employed expert engineering services to study the appropriate design standards for LFUCG's sanitary sewer system, held numerous public meetings to gain input from Fayette County residents, and otherwise considered the appropriate "design" storm to

Figure 3-1: Resolution formally adopting a 2-year, 24-hour Level of Control *(cont.)*

form the basis of the Remedial Measures Plans to comply with the Consent Decree; and

WHEREAS, the Division of Water presented the Urban County Council with detailed information related to costs and benefits of various "design storms" and has recommended that a "Two-Year/24 Hour" storm event is the appropriate "design storm" to form the basis of the sanitary sewer system Remedial Measures Plans to comply with the requirements of the Consent Decree; and

WHEREAS, after consideration the Urban County Council agrees with the recommendation of the Division of Water Quality;

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT:

Section 1 - That the recommendation of the Division of Water Quality that a "Two-Year/24 Hour" storm event is the appropriate "design storm" to form the basis of the LFUCG sanitary sewer system Remedial Measures Plans to comply with the requirements of the Consent Decree be and hereby is approved.

Section 2 - That a "Two-Year/24 Hour" storm event be and hereby is adopted as the "design storm" to form the basis of the LFUCG Sanitary Sewer System Remedial Measures Plans required to be implemented by the Consent Decree.

Section 3 - That this Resolution shall become effective on the date of its passage.

PASSED URBAN COUNTY COUNCIL: September 15, 2011

MAYOR

ATTEST:

CLERK OF URBAN COUNTY COUNCIL

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RMP improvement alternatives were developed to eliminate all recurring SSOs and unpermitted bypasses for the established LOC. Additionally, improvement alternatives were developed, to the extent practical, to eliminate surcharged conditions (as defined in the Consent Decree) within the sewer system. Surcharged conditions were defined in the Capacity Assurance Program (CAP) portion of the Consent Decree and RMP improvement alternatives are not required to meet CAP criteria. In most cases, RMP improvements eliminated surcharged conditions in the Group Two sewersheds for the established LOC. It should be noted that for some sewer segments it was impractical to eliminate sewer surcharging due to adverse pipe slopes, backwater from the WWTP, and other localized issues. These areas were generally small in length and isolated to only a few pipe segments. Areas where surcharged conditions persist are summarized in Section 3C.

B. General Solutions

General Solutions were developed for the Cane Run and Town Branch sewersheds and consisted of exploring two generalized alternatives as described in Section 2. They were:

- **General Solutions 1 (GS1) - Conveyance Improvements.** Increasing hydraulic capacity of gravity sewers (i.e. through upsizing or parallel relief sewers) to the extent necessary to eliminate SSOs and sewer surcharging for the established LOC. A regional equalization (EQ) tank at the sewershed boundary was sized to capture excess wet weather flows.
- **General Solutions 2 (GS2) - Local Storage/Equalization.** Evaluation of equalization basins/storage tanks at selected locations where storage could reasonably be considered to eliminate SSOs and sewer surcharging (CAP criteria) for the established LOC. Proposed locations for local storage/equalization were vetted by LFUCG to determine reasonableness of property acquisition and constructability. The intent of the GS2 solution was to identify required storage volumes necessary to meet the established LOC and areas where conveyance improvements could be reduced through construction of localized storage facilities.

For both General Solutions options, improvements were sized to eliminate SSOs and sewer surcharging (CAP criteria) for the established LOC under future year (2035) conditions.

1) Cane Run Sewershed General Solutions

The Cane Run Sewershed includes ten (10) of the seventy-one (71) manhole SSOs and one (1) of the nine (9) cross-connections identified in Appendix A of the Consent Decree. Cross-connections are discussed in more detail in Section 3. D. The disposition of Appendix A SSOs and cross-connections is presented in Appendix 1. The boundary condition considered for the Cane Run sewershed was the Lower Cane Run Pump Station. Flows to the pump station in excess of 17.5 MGD were assumed to be diverted to a proposed equalization tank (EQ) located adjacent to the pump station for both the GS1 and GS2 alternatives. Additionally, both alternatives assumed that the capacities of SSO pump stations (except Lower Cane Run) were increased to meet the established LOC. There are five (5) SSO pump stations in the Cane Run sewershed identified in Appendix A of the Consent Decree and includes: Thoroughbred Acres, Shandon Park #2, Winburn, Sharon Village, and Lower Cane Run pump stations.

Projects to replace the existing Dixie and Deep Springs pump stations and force mains in the North Elkhorn sewershed are substantially complete. Prior to construction of these projects, the Dixie Pump Station discharged to the service area for the Deep Spring Pump Station which, in turn, discharged to the eastern end of the Cane Run sewershed. New force mains for each pump station have been constructed that will redirect discharges from each pump station directly into the recently completed force main for the North Elkhorn Pump Station. With the completion of these projects, the approximately 480 acres of urban service area served by these pump stations are removed from the Cane Run sewershed and discharge directly to the Town Branch WWTP. Both the conveyance and localized storage general solutions assumed that both the Dixie and Deep Spring pump station and force main projects were complete.

The GS1 (conveyance alternative) included upsizing upstream trunk sewers and increasing pump station capacities at SSO pump stations necessary to convey flows from the 2-year, 24-hour design storm without overflow or system surcharging (CAP criteria). A graphical summary of the pipes that require upsizing under the GS1 alternative is presented in Figure 3-2.

The GS2 (localized storage alternative) included the sizing and placement of local equalization tanks that have the goal of reducing or eliminating downstream conveyance upsizing. The locations of the equalization tanks were determined based on a detailed review of locations where siting was feasible, proximity to SSOs and hydraulic bottlenecks, and other areas where opportunities to reduce the extent of conveyance upgrades appeared reasonable. A graphical summary of the GS2 (localized storage alternative) is presented in Figure 3-3. The figure illustrates the conveyance improvement solution overlain with the locations of storage facilities that were evaluated.

Figure 3-2: Conveyance Improvements General Solution – Cane Run

Figure 3-3: Localized Storage General Solution – Cane Run

2) Town Branch Sewershed General Solutions

The Town Branch Sewershed includes four (4) of the seventy-one (71) manhole and seven (7) of the nine (9) cross-connections identified in Appendix A of the Consent Decree. Cross-connections are discussed in more detail in Section 3.D. The disposition of Appendix A SSOs and cross-connections is presented in Appendix 1. The boundary condition considered in the general solutions was the Town Branch WWTP. Flows to the WWTP in excess of the wet weather capacity of the plant (70 MGD) were assumed to be diverted to a proposed equalization tank located at the WWTP for both the GS1 and GS2 alternatives. Additionally, both alternatives assumed that the capacity of the Town Branch pump station on Old Frankfort Pike was increased to meet the established LOC. The Town Branch Pump Station is

the only SSO pump station in the Town Branch sewershed identified in Appendix A of the Consent Decree.

The North Elkhorn Pump Station and Force Main Project was completed in October 2009. The project resulted in diversion of approximately 75 percent of pump station flows to the Town Branch WWTP. The remaining 25 percent of pump station flows are diverted to the original force main that discharges to the East Hickman sewershed. Upon the completion of the EA2 pump station, which is anticipated to begin construction in 2012, the original force main will be abandoned and 100 percent of North Elkhorn Pump Station flows will discharge to the Town Branch WWTP. For both the conveyance and localized storage general solutions, the North Elkhorn Pump Station was assumed to discharge 100 percent of its flow to the Town Branch WWTP.

Similarly, both the conveyance and localized storage general solutions assumed that both the Dixie and Deep Spring pump station and force main projects were complete.

The GS1 (conveyance alternative) included upsizing upstream trunk sewers and increasing the Town Branch Pump Station capacity necessary to convey flows from the 2-year, 24-hour design storm without overflow or system surcharging (CAP criteria). A graphical summary the pipes that require upsizing under the GS1 alternative is presented in Figure 3-4.

The GS2 (localized storage alternative) included the sizing and placement of local equalization tanks that have the goal of reducing or eliminating downstream conveyance upsizing. The locations of the equalization tanks were determined based on a detailed review of locations where siting was feasible, proximity to SSOs and hydraulic bottlenecks, and other areas where opportunities to reduce the extent of conveyance upgrades appeared reasonable. A graphical summary of the GS2 (localized storage alternative) is presented in Figure 3-5. The figure illustrates the conveyance improvement solution overlain with the locations of storage facilities that were evaluated.

Figure 3-4: Conveyance Improvements General Solution – Town Branch

Figure 3-5: Localized Storage General Solution – Town Branch

C. Detailed Solutions

Results from the General Solutions were used to aid in formulating RMP improvements. Detailed solutions were developed based on applying the methodology and criteria outlined in Section 2. For both sewersheds, proposed RMP improvements were divided into discrete projects and entered into the costing tool to develop planning-level cost estimates. Preliminary field investigations and desktop reviews were performed, as necessary, to determine project feasibility and screen for potential fatal flaws.

For proposed tank locations, preliminary dimensions were established assuming above-ground tank (pump in, gravity discharge) structures with a maximum tank height of 25 feet. Preliminary tank dimensions were then compared to determine the land footprint required. It should be clarified that while storage tanks were assumed to above-ground structures for RMP development, actual tank configurations will be determined during final design. Below ground storage tank and/or open-air equalization basin configurations may be considered by LFUCG.

For conveyance improvements, preliminary field investigations were performed to evaluate if improvements to sewer alignment were warranted and identify major constructability concerns. In general, preference was given to utilizing existing sewer alignments. This approach was primarily adopted to avoid potential delays associated with new property/easement acquisition. Several opportunities for sewer realignment were identified to avoid constructability concerns, improve existing sewer alignment, or reduce hydraulic inefficiencies. When these occurred, the existing sewer alignment and an alternate alignment were provided. The preferred alignment will be determined by LFUCG during final design. For costing purposes in the RMP, conveyance improvement projects were estimated assuming sewer replacement along the existing alignment.

The following sub-sections briefly summarize highlights of the detailed solution and key decisions for each Group Two sewershed.

1) Cane Run Sewershed Detailed Solutions

Trunk Sewer Condition

CCTV inspection was performed during SSA field activities on approximately 17 percent of the sewers in the Cane Run sewershed. In areas where CCTV inspection was not performed during SSA field activities, CCTV inspection information collected during the 1998 – 2001 Sewer Trunk Studies was utilized. Sewer condition information from both CCTV efforts was reviewed and used to identify major structural defects within the modeled trunk sewers. Major structural defects were defined as those with a Grade of 4 or 5 according to the Pipeline Assessment Certification Program (PACP). Pipe deformation in high-density polyethylene (HDPE) or polyvinyl chloride (PVC) pipes were omitted from the major defects category. CCTV performed during the 1998-2001 Trunk Studies was not coded to PACP. CCTV logs from these activities were reviewed manually and defects with an equivalent PACP Grade 4 or 5 were identified.

CCTV inspection information was utilized to gain a general understanding of sewer condition and salvage value. Sewer condition was considered in decision making between competing RMP improvement alternatives. For example, when a localized storage tank was considered to avoid upsizing downstream trunk sewers, the condition of the downstream sewer was reviewed. If the downstream sewer was in need of replacement, then it was sized for the design flow and the need for the storage tank was eliminated.

A map showing proposed conveyance improvements in the recommended Remedial Measures Plan and trunk sewer condition is presented in Figure 3-6. Sewers identified with major defects that will not be replaced by RMP conveyance improvements will be addressed by LFUCG as part of the annual rehabilitation/asset renewal activities outlined in their Capacity, Management, Operation and Maintenance (CMOM) program.

Figure 3-6: Trunk Sewer Condition with Detailed Solution – Cane Run

Recommended RMP Improvements

The following is a summary of the proposed RMP improvements in the Cane Run Sewershed.

1. Lower Cane Run Equalization - Construction of a 10.2 MG storage tank adjacent to the existing Lower Cane Run Pump Station. Proposed storage avoids replacement/upgrade of the

Lower Cane Run Pump Station and eliminates SSOs at the pump station for 2-year level of control. The proposed storage will be designed to reduce the hydraulic grade line sufficient to eliminate sewer surcharged conditions (as defined in Section VII.16.B of the Consent Decree) in the trunk sewers just upstream of the Lower Cane Run Pump Station.

2. Expansion Area #3 Pump Station - Construction of a new 9.5 MGD pump station to convey EA3 flows to the Lower Cane Run Pump Station and EQ tank. The pump station was adequately sized to accommodate the elimination of the Winburn, Shandon Park #1, Shandon Park #2, and Thoroughbred Acres pump stations, the elimination or replacement of the Sharon Village Pump Station, and the potential elimination of the Johnson Property Pump Station.

3. Expansion Area #3 Force Main - Construction of approximately 8,960 linear feet of 30-inch diameter force main from the proposed Expansion Area 3 Pump Station to the existing Lower Cane Run Pump Station.

4. Expansion Area #3 Trunk - Construction of new gravity sewers (450 linear feet of 24-inch diameter, 7,100 linear feet of 30-inch diameter) to serve EA3 development and facilitate elimination of six upstream pump stations.

5. Shandon Park Trunk - Construction of new gravity sewers (1,570 linear feet of 10-inch diameter, 40 linear feet of 12-inch diameter, 2,140 linear feet of 21-inch diameter, and 1,870 linear feet of 24-inch diameter) extending from three existing pump stations (Shandon Park #1, Shandon Park #2, and Thoroughbred Acres) to the proposed Expansion Area #3 Trunk Sewer. The project includes the elimination of the three pump stations.

6. Winburn Trunk - Construction of new gravity sewers (1,100 linear feet of 12-inch diameter and 2,150 of 15-inch diameter) from the existing Winburn Pump Station to the proposed Expansion Area #3 Trunk. Project includes elimination of the Winburn Pump Station.

7. Thoroughbred Acres Trunk - Upsize replacement of the existing trunk sewers in the Thoroughbred Acres neighborhood (940 linear feet of 12-inch diameter, 1,430 linear feet of 15-inch diameter, 770 linear feet of 18-inch diameter, and 260 of 21-inch diameter). Project must be completed before elimination/replacement of the Sharon Village Pump Station.

8. Sharon Village Pump Station and Force Main - Construction of 2,130 linear feet of 8-inch force main and replace the existing Sharon Village Pump Station with a new 1.5 MGD pump station. The proposed force main alignment will terminate at manhole CR4_323 and drain to the Thoroughbred Acres Trunk Sewer and Expansion Area #3 Pump Station. During RMP development, preliminary evaluation of eliminating the Sharon Village Pump Station with a gravity sewer draining to EA3 was performed. Both alternatives will be evaluated further during detailed design of this project. Both alternatives were technically feasible and would eliminate recurring SSOs at the Sharon Village Pump Station.

9. Lower Griffin Gate Trunk - Upsize replacement of 1,670 linear feet of existing sewers to 21-inch diameter. This project does not have any predecessor projects. This project is necessary to avoid SSOs under future conditions.

10. Upper Cane Run Equalization - Construction of a 0.8 MG tank near the Old Cane Run Pump Station at Lexmark International. Construction of storage tank eliminates the need to upsize the Lower Cane Run trunk sewer extending from the proposed storage tank location to the Lower Cane Run Pump Station. The Lower Cane Run trunk sewer was constructed in the mid-1990s. Some pipe deformation of this HDPE trunk sewer was observed during CCTV inspection as part of SSA field activities, but it is otherwise in good structural condition.

11. Cane Run Trunk - Upsize replacement of 1,660 linear feet of existing trunk sewer to 36-inch diameter.

12. Lexmark Trunk A - Upsize replacement of 2,340 linear feet of existing sewer to 18-inch diameter and 640 linear feet to 21-inch diameter.

13. Lexmark Trunk B - Upsize replacement of 2,000 linear feet of existing sewer to 18-inch diameter.

14. New Circle Trunk A - Upsize replacement of 2,230 linear feet of existing sewer to 24-inch diameter and 2,400 linear feet to 30-inch diameter trunk sewer.

15. New Circle Trunk B - Upsize replacement of 1,390 linear feet of existing sewer to 24-inch diameter, 750 linear feet to 18-inch diameter, 1,980 linear feet to 15-inch diameter, and 670 linear feet to 12-inch diameter.

16. Griffin Gate Collection System Rehabilitation - Rehabilitation and I/I removal in the wastewater collection system upstream of the Griffin Gate trunk sewer. The area is nearly all residential property and sewers are predominantly vitrified clay pipe. The project is included in the RMP but work will be performed by LFUCG as part of their annual rehabilitation/asset renewal program. Capital costs for this project are not reflected in Table 3-1 or Section 5.

Estimated Remedial Measures Plan Costs

A capital cost summary of recommended Remedial Measures Plan improvements is presented in Table 3-1. Capital costs in the table include costs for preliminary study, land acquisition, design, inspection, administration, contingency, and legal/finance, based on the percentages outlined in Section 2E.

Table 3-1: Proposed RMP Improvements and Capital Cost – Cane Run

Sewershed	Cane Run
Pipelines – new or replaced	49,000 LF
EQ Basin/tank location(s)	2
EQ Basin/tank volume	11 MG
WWTP Upgrades – estimated cost	-
Total Capital Cost for Remedial Measures Plan – Cane Run	$78 million

The total estimated capital cost to implement the Cane Run detailed solution is approximately $78 million. This cost does not include capital costs for collection system rehabilitation upstream of the Griffin Gate trunk sewer necessary to reduce I/I and avoid trunk sewer replacement.

A detailed summary of the capital costs for proposed individual RMP projects in the Cane Run sewershed, along with a preliminary schedule for completion, is presented in Section 5.

Sewer Surcharged Conditions

Proposed RMP improvement projects were developed to eliminate SSOs for a 2-year level of control. Consideration was given, to the extent practical, to eliminate sewer surcharged conditions (as defined in Section VII.16.B of the Consent Decree) as well. Sewer surcharging was evaluated with the hydraulic model. With the implementation of the proposed RMP projects, nearly all of the trunk sewers in the Cane Run sewershed will not exhibit surcharged conditions for the 2-year, 24-hour storm event. Figure 3-7 at the end of this section illustrates those areas within the Cane Run sewershed that will experience sewer surcharging for the 2-year, 24-hour storm event. The surcharged sewers shown in the figure generally occurred in areas where there is limited opportunity for upstream growth and redevelopment to a higher population density is not anticipated. Each of the surcharge areas identified in Figure 3-7 are summarized below.

1. **Trunk Sewers just upstream of the Lower Cane Run Pump Station (seven manholes between CR8_1 to CR8_5 and CR8_411 and CR8_412).** Backwater from the Lower Cane Run Pump Station results in surcharging in the upstream trunk sewers excess of 24 inches above the pipe crown. The proposed equalization tank at the Lower Cane Run Pump Station will be designed to reduce the backwater at the pump station to reduce/eliminate sewer surcharging.
2. **Upper Griffin Gate Trunk Sewer (manholes CR2_155A, CR2_163, and CR2_164).** The Griffin Gate Trunk Sewer exhibits surcharging in excess of 24 inches above the pipe crown for the design storm. This area is targeted for rehabilitation and I/I removal as part of this RMP. A reduction in wet weather flows is anticipated that will

reduce/eliminate sewer surcharging. Additional development upstream of these manholes is not anticipated.

3. **Manhole CR3_72A at North Limestone and Idaho Ave.** Sewer surcharging in excess of 24-inches above the pipe crown occurs at a single manhole on this sewer. There are opportunities to improve the vertical alignment in the pipe segment immediately downstream of the surcharge location and reduce/eliminate sewer surcharging. Opportunities for development upstream of this manhole are limited.
4. **Manhole CR5_18 in Constitution Park between Bryan Station Road and Old Paris Road.** Sewer surcharging in excess of 24-inches above the pipe crown occurs at a single manhole on this sewer. There are opportunities to improve the vertical alignment in the pipe segment immediately downstream of the surcharge location and reduce/eliminate sewer surcharging. Opportunities for development upstream of this manhole are limited.

2) Town Branch Sewershed Detailed Solutions

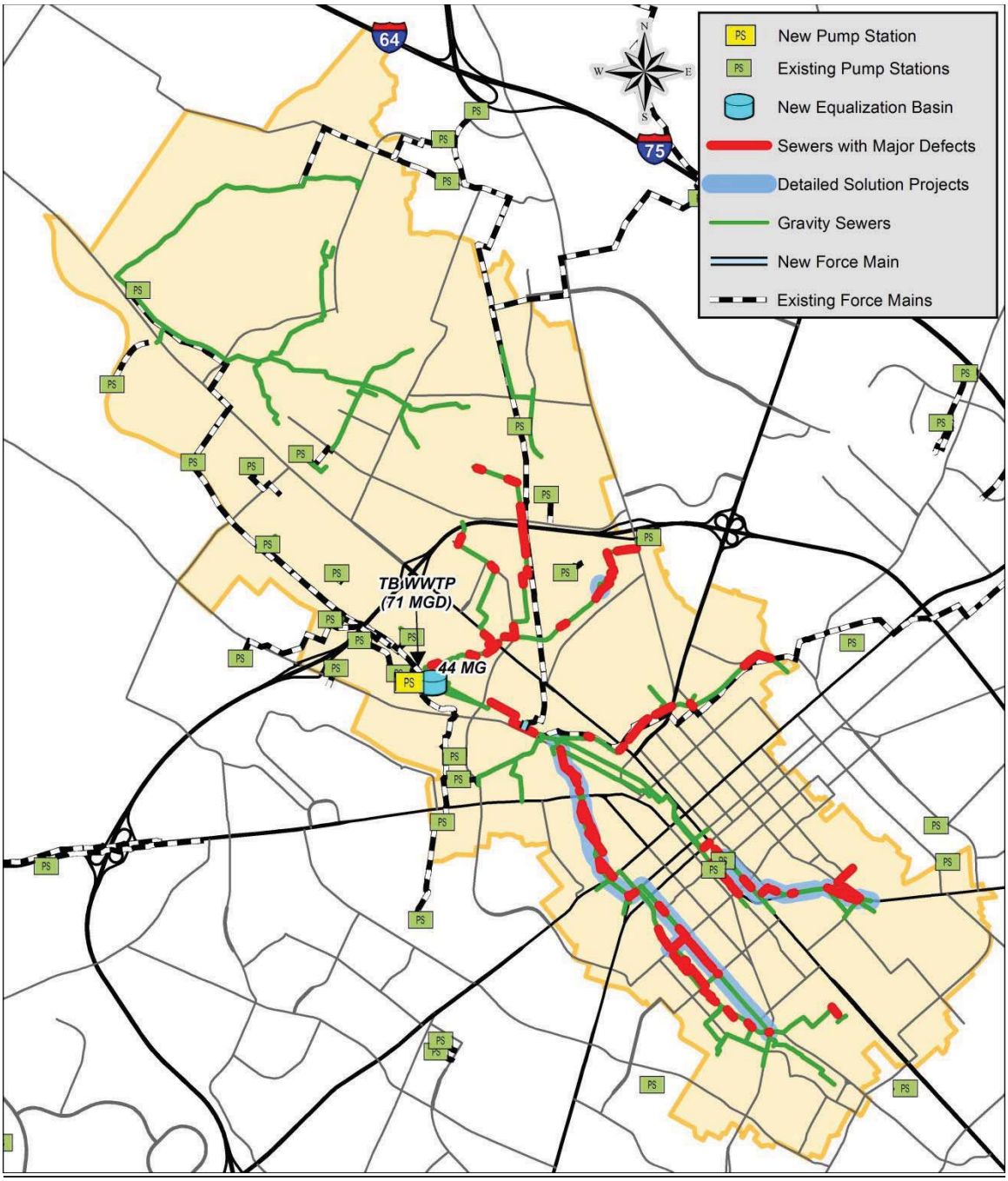
Trunk Sewer Condition

CCTV inspection was performed during SSA field activities on approximately 19 percent of the sewers in the Town Branch sewershed. In areas where CCTV inspection was not performed during SSA field activities, CCTV inspection information collected during the 1998-2001 Sewer Trunk Studies was utilized. Sewer condition information from both CCTV efforts was reviewed and used to identify major structural defects within the modeled trunk sewers. Major structural defects were defined as those with a Grade of 4 or 5 according to the Pipeline Assessment Certification Program (PACP). Pipe deformation in high-density polyethylene (HDPE) or polyvinyl chloride (PVC) pipes were omitted from the major defects category. CCTV performed during the 1998-2001 Trunk Studies was not coded to PACP. CCTV logs from these activities were reviewed manually and defects with an equivalent PACP Grade 4 or 5 were identified.

CCTV inspection information was utilized to gain a general understanding of sewer condition and salvage value. Sewer condition was considered in decision making between competing RMP improvement alternatives. For example, when a localized storage tank was considered to avoid upsizing downstream trunk sewers, the condition of the downstream sewer was reviewed.

A map showing proposed conveyance improvements in the recommended Remedial Measures Plan and trunk sewer condition is presented in Figure 3-8. Sewers identified with major defects that will not be replaced by RMP conveyance improvements will be addressed by LFUCG as part of the annual rehabilitation/asset renewal activities outlined in their Capacity, Management, Operation and Maintenance (CMOM) program.

Figure 3-8: Trunk Sewer Condition with Detailed Solution – Town Branch



Recommended RMP Improvements

The following is a summary of the proposed RMP improvements in the Town Branch Sewershed.

1. Town Branch WWTP Equalization - Construction of a 44 MG equalization storage facility at the Town Branch WWTP. A master planning effort at the Town Branch WWTP will be conducted in the near future. Forty-four million gallons is based upon a WWTP peak capacity

of 71 MGD. The master planning effort may result in WWTP upgrades to increase capacity and reduce the equalization volume required. Additionally, proposed equalization facilities at the Wolf Run Pump Station, North Elkhorn Pump Station, and Lower Cane Run Pump Station may be increased to offset the equalization needed at the WWTP. Capital costs included in this report are based on construction of a 44 MG equalization facility at Town Branch WWTP. The proposed equalization tank at the WWTP will be designed to reduce the hydraulic grade line at the plant headworks sufficient to reduce/eliminate sewer surcharged conditions (as defined in Section VII.16.B of the Consent Decree) in the upstream trunk sewers.

2. Town Branch Pump Station Replacement - Replacement of the existing Town Branch Pump Station with a new 0.5 MGD pump station and approximately 1,060 linear feet of 6-inch force main. During final design, an alternative alignment will be considered to relocate the force main terminus to the existing Picadome Force Main rather than its existing location.

3. Lower Cane Run Force Main Extension - Design considerations for accommodating the flow from the Lower Cane Run Pump Station were made during the construction of the recently completed North Elkhorn Force Main. The Lower Cane Run Force Main will be extended by 210 linear feet of 30-inch diameter force main to connect to the existing North Elkhorn Force Main and discharge directly to the Town Branch WWTP.

4. UK Trunk A - Upsize replacement of 400 linear feet of existing trunk sewer to 27-inch diameter; 110 linear feet to 30-inch diameter; and 1,810 linear feet to 36-inch diameter.

5. UK Trunk B (Newtown Pike Extension) - Upsize replacement of an existing 18-inch trunk sewer to 27-inch diameter. The project is being completed as part of the Newtown Pike roadway extension project and costs for sewer improvements were not included in Table 3-6 or Section 5.

6. UK Trunk C - Upsize replacement of 1,800 linear feet of existing trunk sewer to 24-inch diameter.

7. UK Trunk D - Construction of relief sewer just upstream of the University of Kentucky campus at Rose Street and potential abandonment of the existing trunk sewer through the UK campus extending between Rose Street and South Limestone Street. The project includes construction of 940 linear feet of 15-inch diameter sewer and construction of 2,520 linear feet of 24-inch diameter trunk sewer. The proposed relief sewer will result in the potential abandonment of the existing trunk sewer under UK's Fine Arts and Student Center buildings.

8. UK Trunk E - Construction of relief sewer along Euclid Avenue to eliminate need for upsize replacement of the existing trunk sewer extending along an easement between Tates Creek Road and Rose Street. The project includes construction of 1,920 linear feet of 18-inch diameter sewer and 2,800 linear feet of 21-diameter sewer. The proposed relief sewer avoids constructability issues of existing trunk sewer replacement.

9. Georgetown Road Trunk - Upsize replacement of 70 linear feet of existing sewer to 10-inch diameter and 240 linear feet to 12-inch diameter. This project has no predecessor projects and is necessary to eliminate a Recurring SSO near Price Road.

10. Midland Avenue Trunk - Upsize replacement of 270 linear feet of existing sewer to 10-inch diameter; 430 linear feet to 12-inch diameter; 1,170 linear feet to 15-inch diameter; 380 linear feet to 18-inch diameter; 3,290 linear feet to 21-inch diameter; 30 linear feet to 24-inch diameter; and 20 linear feet to 27-inch diameter.

Estimated Remedial Measures Plan Costs

A capital cost summary of recommended Remedial Measures Plan improvements is presented in Table 3-2. Capital costs in the table include costs for preliminary study, land acquisition, design, inspection, administration, contingency, and legal/finance, based on the percentages outlined in Section 2E.

Table 3-2: Proposed RMP Improvements and Capital Cost – Town Branch

Sewershed	Town Branch
Pipelines – new or replaced	23,000 LF
EQ Basin/tank location(s)	1
EQ Basin/tank volume	44 MG
WWTP Upgrades – estimated cost	$27 million
Total Capital Cost for Remedial Measures Plan – Town Branch	$154 million

The total estimated capital cost to implement the Town Branch detailed solution is approximately $154 million. Approximately two-thirds of the total Group Two RMP cost in the Town Branch sewershed is associated with the equalization/storage tank located at the WWTP. It should also be noted that the costs in the table do not include capital costs for trunk sewer improvements associated with the Newtown Pike Extension Project. Sewer improvements associated with that project are being completed outside the Remedial Measures Plan.

A detailed summary of capital costs for proposed individual RMP projects in the Town Branch sewershed, along with a preliminary schedule for completion, is presented in Section 5.

Sewer Surcharged Conditions

Proposed RMP improvement projects were developed to eliminate Recurring SSOs for a 2-year level of control. Consideration was given, to the extent practical, to eliminating sewer surcharged conditions (as defined in Section VII.16.B of the Consent Decree) as well. Sewer surcharging was evaluated with the hydraulic model. With the implementation of the proposed RMP projects, nearly all of the trunk sewers in the Town Branch sewershed will not

exhibit surcharged conditions for the 2-year, 24-hour storm event. Figure 3-7 at the end of this section illustrates those areas within the Town Branch sewershed that will experience sewer surcharging for the 2-year, 24-hour storm event. The surcharged sewers shown in the figure generally occurred in areas where there is limited opportunity for upstream growth and redevelopment to a higher population density is not anticipated. Each of the surcharge areas identified in Figure 3-7 are summarized below.

1. **Lower Meadowthorpe Trunk Sewer just upstream of the Town Branch WWTP (eight manholes between TB1_77 and TB1_87).** The trunk sewer exhibits sewer surcharging less than 24-inches above the pipe crown, but is within 3 feet of the manhole rim. Surcharging is the result of backwater from the Town Branch WWTP. The proposed equalization tank at the WWTP will be designed to reduce the hydraulic grade line at the headworks to reduce/eliminate sewer surcharging.
2. **Upper Meadowthorpe Trunk Sewer at Leestown Road (manholes TB1_42 and TB1_43).** The trunk sewer exhibits sewer surcharging greater than 24-inches above the pipe crown and is influenced by backwater from the Town Branch WWTP. Upsize of the pipe segments between TB1_41 to TB1_37 from 15-inch to 18-inch will reduce sewer surcharging to less than 24 inches above the pipe crown. Opportunities for development upstream of these manholes are limited.
3. **Manchester Street Collector Sewer (manholes TB1_154, TB1_155A, TB1_155B).** The collector sewer exhibits surcharging less than 24-inches above the pipe crown, but is within 3 feet of the manhole rim. Surcharging is caused by backwater from the 54-inch trunk sewer located immediately downstream. Flows in the 54-inch trunk sewer are below the pipe crown for the design storm. The collector sewer could be re-aligned to locate manholes outside the roadway and the rim elevations raised to satisfy the minimum 3 feet freeboard requirement. Opportunities for development upstream of these manholes are limited.
4. **Versailles Road Trunk Sewer (manhole TB1_752).** The trunk sewer exhibits surcharging less than 24-inches above the pipe crown, but is within 3 feet of the manhole rim. Surcharging is caused by backwater from the 54-inch trunk sewer located immediately downstream. Flows in the 54-inch trunk sewer are below the pipe crown for the design storm. The rim elevation at manhole TB1_752 could be raised to satisfy the minimum 3 feet freeboard requirement. Opportunities for development upstream of these manholes are not anticipated.
5. **Sunset Drive Collector Sewer (manholes TB5_103 and TB5_102).** The collector sewer exhibits surcharging less than 24-inches above the pipe crown, but is within 3 feet of the manhole rim. There are opportunities to improve the vertical alignment in the pipe segment immediately downstream of the surcharge location and reduce/eliminate sewer surcharging. There are plans by the property owner to relocate the sewer. Improvements to the vertical alignment and/or raising the manhole rim elevations will be performed to satisfy the minimum 3 feet freeboard requirement.

6. **Walton Avenue Collector Sewer (manhole TB3_442).** Sewer surcharging in excess of 24-inches above the pipe crown occurs at a single manhole on this sewer. There are opportunities to improve the vertical alignment in the pipe segment immediately downstream of the surcharge location and reduce/eliminate sewer surcharging. Opportunities for development upstream of this manhole are limited.
7. **Buck Lane Collector Sewer (manhole TB7_28).** Sewer surcharging is less than 24-inches above the pipe crown, but is within 3 feet of the manhole rim elevation. There are opportunities to improve the vertical alignment in the pipe segment immediately downstream of the surcharge location and reduce/eliminate sewer surcharging. Opportunities for development upstream of this manhole are limited.

D. Cross Connections

Of the nine (9) cross connections listed in Appendix A of the CD, eight (8) are located in the Group Two sewersheds. They include:

- 410 Rose Lane (TB5_43) – eliminated in October 2007
- 457 Woodland (TB5_46A) – eliminated in October 2007
- 146 McDowell Road (TB5_326) – eliminated in October 2007
- 1004 Slashes Road (TB5_344) – eliminated in October 2007
- 772 North Broadway (CR3_51)
- 441 Park Avenue (TB5_14)
- 443 Oldham Avenue (TB5_17)
- 648 South Broadway (TB2_33)

It should be noted that during follow-up field investigation activities, it was determined that the address for the cross connection identified in Appendix A at 443 Oldham Avenue (TB5_17) is incorrect. The cross connection is actually located at 512 Woodland Avenue (TB5_28).

The disposition of each of the cross connection SSOs identified in Appendix A is summarized in Section 5 of this report.

E. Pump Station Reliability and Capacity Upgrades

To satisfy the requirements of Section VII(15)(C) of the CD, LFUCG completed a Pumping Station Design, Capacity, and Equipment Condition Adequacy Evaluation for the pump stations listed in Appendix H of the CD. Pump stations in the Group Two sewersheds included in the Adequacy Evaluation included:

- Lower Cane Run Pump Station
- Shandon Park #2 Pump Station
- Sharon Village Pump Station
- Thoroughbred Acres Pump Station
- Town Branch Pump Station
- Winburn Pump Station

Three (3) of these pump stations (Shandon Park #2, Thoroughbred Acres, and Winburn) will be eliminated as part of the RMP implementation in the near future and therefore do not require reliability upgrades. The Town Branch Pump Station will be replaced as part of the RMP improvements. Additionally, the RMP improvements will include either the replacement or elimination of the Sharon Village Pump Station. The decision to replace or eliminate the Sharon Village Pump Station will be further evaluated during final design efforts. No improvements are anticipated for the Lower Cane Run Pump Station. A proposed equalization tank will be constructed adjacent to the pump station to accommodate wet weather flows in excess of pump station capacity.

LFUCG has evaluated pump station reliability in accordance with Section VII(16)(E) in their Sanitary Sewer Pumping Station Operation Plan for Power Outage. Any recommended pump station improvements from this plan will be implemented by LFUCG separate from the RMP implementation and are not included in the RMP projects summarized in Section 5 of this report.

F. Wastewater Treatment Plant Upgrades

The Town Branch wastewater treatment plant (WWTP) was originally constructed in 1916 and consisted of Imhoff tanks, trickling filters, and drying beds. In 1935, sludge digesters and pretreatment screens were constructed and in 1947, two additional sludge digesters were added. In 1960, the first major plant expansion doubled the capacity to 12 MGD followed by an expansion to 18 MGD in 1971. In 1981 a Process Alternative Study included recommendations for a single stage aeration system. Due to the size of the project, the design and construction were phased with the plant being completed in 1987. This expansion increased the plant rated capacity to its current 30 MGD average daily and 64 MGD peak hour capacities.

The current WWTP is classified as a single stage conventional activated sludge system. Since 1987, there have been several non-capacity related improvements including the replacement of the original fine screens, the replacement of the primary effluent screw pumps with centrifugal pumps, replacement of the digester transfer pumps, replacement of the gravity thickener transfer pumps, and most recently the installation of a redundant power feed to the WWTP. Currently, a large scale upgrade and replacement of electrical and SCADA equipment is under design.

The current NPDES discharge limits for the Town Branch WWTP are as follows:

Table 3-3: Town Branch WWTP Effluent Limitations

Effluent Characteristics[4]	Discharge Limitations			
	Lbs/day		Other Units (specify)	
	Monthly Average	Weekly Average	Monthly Average	Weekly Average
Flow, design (30.0 MGD)	N/A	N/A	Report	Report [3]
Biochemical Oxygen Demand (5-Day), Carbonaceous	2,502	3,753	10 mg/L	15 mg/L
Total Suspended Solids	7,506	11,259	30 mg/L	45 mg/L
Fecal Coliform Bacteria, N/100	N/A	N/A	200	400
Ammonia (as N)	500 1,751	751 2,627	2 mg/L [1] 7 mg/L [2]	3 mg/L [1] 10.5 mg/L [2]
Total residual Chlorine (TRC)	N/A	N/A	0.010 mg/L	0.019 mg/L [3]
*Biomonitoring shall not exceed 1.00 chronic toxicity units.				

[1]Effective May 1 – October 31
[2]Effective November 1 – April 30
[3]Daily maximum limitations
[4]Additionally the plant is required to monitor phosphorus, lead copper, zinc and cadmium.

The current Town Branch WWTP includes the following equipment and process units:

- One (1) Mechanical Coarse Bar Screen (catenary)
- Three (3) Mechanically Cleaned Fine Bar Screens (step type)
- Two (2) Grit Basins with Dewatering Equipment (Pista grit type)
- Twelve (12) Primary Clarifiers
- One (1) Scum Pump Station
- One (1) Primary Effluent Pump Station with Six (6) Centrifugal Pumps
- Two (2) Primary Sludge Pump Stations
- Twenty (20) Aeration Basins
- Eight (8) Final Clarifiers
- Two (2) Chlorine Contact Basins
- Two (2) Dechlorination Chambers
- One (1) Post Aeration Ladder (20 steps)
- Two (2) Primary Sludge Gravity Thickeners
- Two (2) Waste Activated Sludge Thickeners (centrifuges)
- Three (3) Anaerobic Digesters (primary)
- Four (4) Secondary Digesters (one out of service)

- Four (4) Belt Filter Presses (2.5 meter)

In 2011 the average daily flow to the WWTP was approximately 20.8 MGD and the average daily influent Carbonaceous Biochemical Oxygen Demand (CBOD) concentration was 127 mg/l. At this average daily flow and CBOD concentration, the average CBOD load to the plant in 2011 was approximately 22,030 pounds per day. During the peak day flow event of 2011, a 75.8 MG flow diluted the CBOD concentration to approximately 55 mg/l which corresponds to a peak CBOD load of approximately 34,770 pounds per peak day.

The peak hydraulic capacity of the Town Branch WWTP is limited by the hydraulic detention time of the chlorine contact basins at a flow of 64 MGD (derived from a 15 minute detention time with both basins in service). The second most limiting process in the treatment train is the primary clarifiers with a peak hydraulic capacity of approximately 68 MGD, followed by the primary effluent pumping station effluent channel at approximately 70 MGD. WWTP staff recently relocated the chlorine injection point to provide additional chlorine contact volume and allow for more throughput in the basins. Other minor modifications are proposed to the clarifiers and effluent channel; therefore, a peak capacity of 71 MGD was used for the modeling of potential equalization basin volumes.

The WWTP staff make several operational adjustments during high flow events in order to protect against unpermitted bypasses. Currently, the return activated sludge (RAS) is returned to the process at the channel downstream from the Primary Effluent Pumping Station. One operator adjustment is the reduction of the RAS pumping rate to minimize overtopping of the primary effluent pumping station effluent channel. Additionally, the waste activated sludge (WAS) is currently wasted back to the head of the plant for removal by the primary clarifiers. Another operator adjustment is to redirect the WAS from the head of the plant to the centrifuge (or primary digesters) for thickening and waste. Additionally, the operators need to adjust the isolation gates to and from the aeration basins to ensure flow balancing.

An evaluation of the Town Branch WWTP determined the need for remedial projects to maintain the reliability of the treatment processes while continuing to limit the risk for any unpermitted bypasses or NPDES non-compliance events.

As with any WWTP, the process equipment and structures have a limited useful service life. The majority of the existing equipment, piping, and concrete is over 25 years old. LFUCG has replaced select equipment such as pumps, aeration diffusers, and screens as needed, but additional equipment replacement and modifications are recommended to maintain both equipment and treatment reliability under peak flow and loading conditions to enable the plant to consistently meet NPDES permit requirements. Additionally, changing regulatory requirements may require process changes or improvements to meet future NPDES limits. Site investigations of the Town Branch WWTP and work sessions with both management and operations and maintenance staff were conducted to discuss areas of concern for not only today's needs, but also for required replacement of equipment nearing the end of their useful service life.

Several remedial projects are recommended to maintain current equipment and treatment reliability to treat wet weather flows from a 2-year, 24-hour storm (supplemented by a storage facility) without an unpermitted bypass. Many of these improvements are recommended to be completed within the next 5 years. These recommendations address maintaining equipment and treatment reliability for a peak capacity of 71MGD and do not address any issues related to increasing the WWTP treatment capacity. Potential improvements that increase peak flow treatment capacity are being considered and may be included in future analyses.

Headworks – The headworks process consists of a coarse screen (1), fine screens (3), and grit collectors (2). The plant influent is conveyed into the coarse screen channel via a 54-inch gravity sewer transmission main. The coarse screen is a 6-foot wide by 7-foot deep catenary bar screen with 1-inch bar spacing. Influent flows below approximately 45 MGD pass through the coarse screen. When the influent flow exceeds approximately 45 MGD, the level in the channel increases to the level of the bypass channel weir and excess flow bypasses the coarse screen and enters the influent channel for the fine screens. Because most coarse solids are captured in the "first flush" of a high flow event, the unscreened bypass does not have a noticeable impact on the fine screens or other downstream process units; therefore, the capacity of the coarse screen does not limit the peak capacity of the WWTP. However, because the screen is limited to approximately 45 MGD, a second screen is recommended to maintain reliability and match the peak hour flow capacity of the WWTP.

The 1987 plant expansion included the construction of the two 50 MGD grit removal units. The grit pumps and concentrators associated with these units are near the end of their useful service life. Because the diminished performance and capacity of the grit system impacts the wear and performance of much of the downstream processes, it is recommended that all of the grit equipment (pumps, concentrators, and mixing equipment) be replaced to maintain reliability and effective removal of grit.

Primary Clarifiers – Currently, there are twelve (12) primary clarifiers arranged in two clusters of six clarifiers each. All of the primary clarifier equipment has been in service for over 25 years and requires excessive maintenance to remain serviceable. The drives, chains, flights, tracks, and scum troughs are near the end of their useful service life and should be replaced to maintain reliable treatment. Additionally, the influent gates are near the end of their useful life and the primary sludge pumps are exhibiting diminished performance; therefore, the gates and pumps should be replaced along with the other primary clarifier equipment.

Aeration Basins – There are a total of twenty (20) aeration tanks. Tanks 1 - 12 each have volumes of 328,000 gallons while tanks 13 - 20 have volumes of 669,000 gallons each. All tanks except 5 - 8 and 11 - 12 have been converted to fine bubble diffusers. The aeration basins are supplied by four (4) 1,250 HP Roots single stage centrifugal blowers. Fine bubble diffusers provide higher transfer efficiency allowing the current oxygen demand to be met with a single blower except during extremely hot days. During the extremely hot days a

smaller, 150 HP blower is used for channel aeration, removing this demand from the larger blower. The blowers are over 25 years old and require frequent maintenance and repairs. It is recommended that two of the blowers be replaced with new blowers (with turndown capability) of appropriate capacity to match the design treatment demands. The two existing blowers in the best operational condition should be retained as back-up to the two replacement blowers. It is further recommended that the remaining aeration basins be converted to fine bubble diffusers and the existing fine bubble diffuser membranes and PVC piping be replaced. Finally, the influent gates on basins 1 - 12 are difficult to operate, are at the end of their useful service life, and therefore should be replaced. LFUCG staff are currently installing electric operators on each of the influent gates.

Final Clarifiers – The eight (8) final clarifiers are arranged in two pods of four clarifiers each. The clarifiers have been in service for over 25 years and are exhibiting excessive wear and deterioration of the metal components. The drives, rakes, skimmers, and support structures are all nearing the end of their useful service life and should be replaced. The replacement of all clarifier equipment is recommended to maintain reliability of the process. The flow control splitter box gates are becoming increasingly difficult to operate due to wear. Therefore, it is recommended that these gates be replaced along with the other clarifier equipment.

Return Activated Sludge (RAS) Pumping Station – The RAS Pumping Station is equipped with four (4) 12,000 gpm pumps. The current RAS pumps have reduced efficiency due to excessive wear and cannot achieve their design flow rates. The RAS pumping station was built around the pumps in such a way that pump removal/replacement will be extremely difficult. Therefore, it is recommended that each of the RAS pumps be taken apart for evaluation and rebuilt accordingly to restore performance and reliability to the RAS pumping system.

Waste Activated Sludge (WAS) Pumping Station – The WAS Pumping Station is equipped with three (3) 650 gpm pumps. WWTP staff have recently replaced two of the pumps; however the third pump is at the end of its useful service life and can no longer achieve the specified design performance. Therefore, the remaining pump should be replaced in order to restore the pumping station performance and reliability.

Gravity Thickeners – The two (2) gravity sludge thickeners have been in service for over 25 years and are showing advanced deterioration and excessive wear on the drives, rakes, and skimmers. It is recommended that the thickener equipment be replaced and an additional gravity thickener constructed for thickening the WAS. The two existing WAS thickening centrifuges are at the end of their useful service life with both units currently out of service. The plant operators currently return the WAS to the primary clarifiers where it is mixed with the primary sludge prior to being pumped to the gravity thickener. This results in an overload condition of the gravity sludge thickeners during higher flows. A new gravity thickener will provide the plant operators additional operational flexibility as well as meet the need to replace the thickening centrifuges.

Disinfection – The disinfection system consists of two (2) chlorine contact basins that can process a peak hourly flow rate of approximately 64 MGD at a 15 minute detention time. This system provides disinfection utilizing gaseous chlorine. It is recommended that an additional chlorinator be installed to provide system redundancy. If additional throughput is desired, then additional chlorine contact volume will be required. In an effort to increase throughput in the basin, WWTP staff recently relocated the chlorine injection point to allow for additional chlorine contact volume.

Non-Potable Water Pump Station – The Non-Potable Water Pump Station is over 25 years old but is in satisfactory operating condition. However, the duplex strainer on the pump station suction line is at the end of its useful service life and therefore needs to be replaced.

Primary Digesters – The three (3) primary digesters' equipment is over 25 years old. The concrete structures are in good condition and piping is adequate; however, it is recommended that the mixing system, covers, boilers, heat exchangers, and waste gas flare all be replaced. There are frequent releases of odorous gas from the failing vents and valves. These releases are potentially responsible for recent odor complaints and issues related to air quality. A new mixing system and boilers/heat exchangers will increase reliability and lower operating costs by improving efficiency.

Secondary Digesters/Sludge Holding and Blending Tanks – There are two (2) secondary digesters, one (1) sludge holding, and one (1) blending tank. The concrete tanks are in good condition; however, the tank covers are extremely deteriorated and should be replaced. The new covers will minimize the release of fugitive odorous gases.

Dewatering – The four (4) belt filter presses (BFPs) for dewatering solids are over 25 years old. The BFPs are all at the end of their useful service life and deteriorated to the point that it is rare that more than two of the BFPs are available for service at any one time. Therefore, it is recommended that the BFPs be replaced with new mechanical dewatering equipment to restore reliable and efficient sludge dewatering.

Sludge Loading Conveyors – The existing sludge loading conveyors are in poor condition and have reached the end of their useful service life. A project to replace the conveyor equipment is currently in design, therefor, no additional improvements are recommended.

Scum Facility – The scum collection facility on the primary clarifiers is over 25 years old, is at the end of its useful service life, and cannot reliably meet the volume of scum produced. Therefore, it is recommended that the scum facility be replaced and expanded to meet the current and future volumes of scum produced by the primary clarifiers.

Emergency Electrical Power – The installation of a redundant power feed to the WWTP was completed in 2008. Therefore, no additional improvements are recommended for emergency electrical power.

Miscellaneous Site Improvements – The existing HVAC system in the administration building has reached the end of its useful life and has become unreliable. Therefore, it is recommended that the HVAC system be replaced with a new high efficiency system. Additionally, the roads and parking areas in and around the WWTP are in poor condition; therefore, it is further recommended that the roads and parking areas throughout the plant site be resurfaced.

Table 3-4: Estimate of Capital Cost for Town Branch WWTP Upgrades

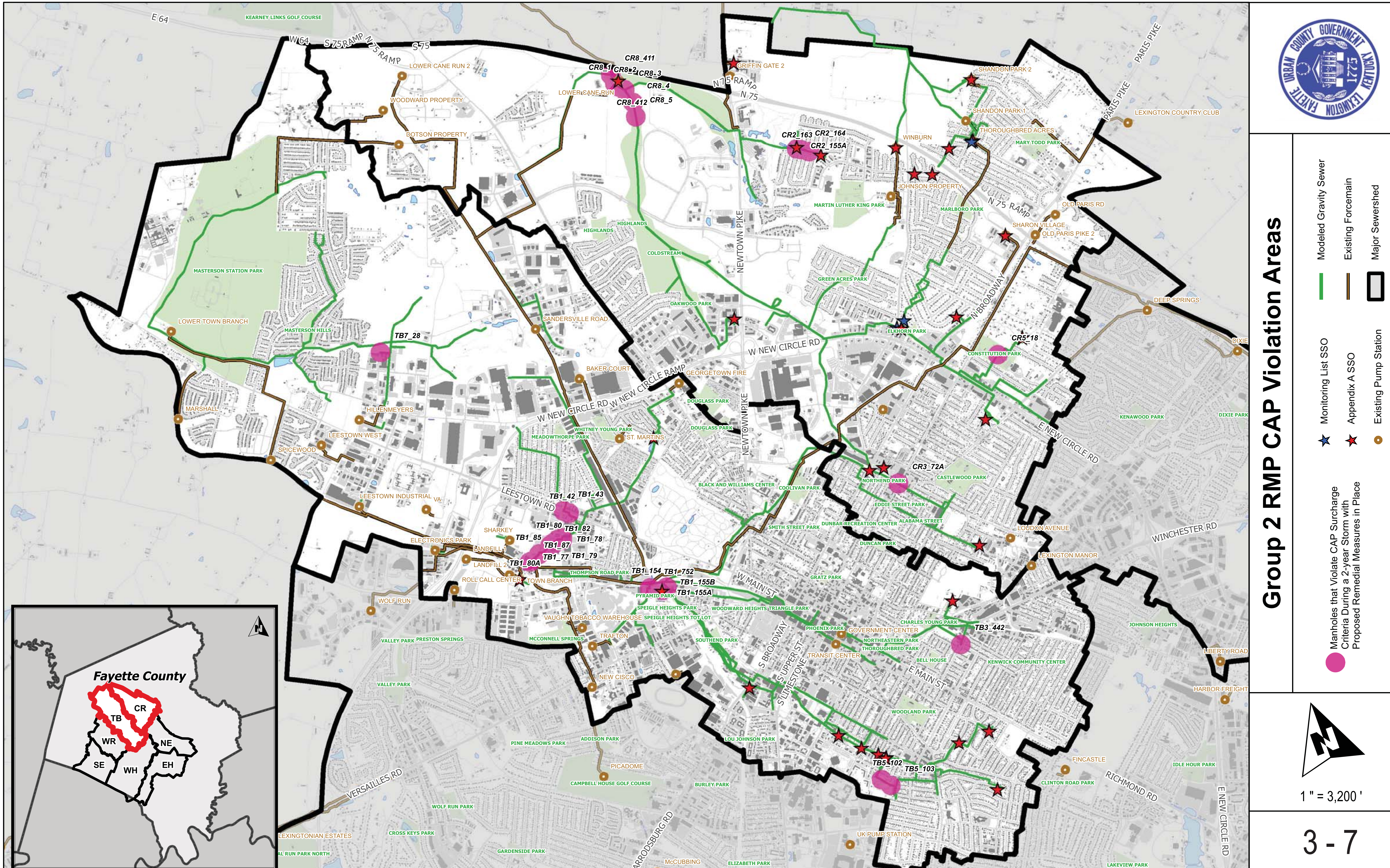
Facility	Component	Estimated Cost
Headworks	Replace Coarse Bar Screen Additional Bar Screen with Structure	$1,000,000
	Grit Removal Equipment, pumps, concentrators (2)	$1,400,000
Primary Clarifier Equipment	Influent Gates (12), with Electric Actuators	$425,000
	Drives, Sludge Collectors, and Scum Troughs	$2,750,000
	Sludge Pumps	$400,000
Aeration Basins	Diffusers and PVC piping	$1,750,000
	Blowers	$2,400,000
	Influent Gates (1 – 12)	$300,000
Final Clarifier Equipment	Drives, Rakes, and Walkways	$2,850,000
	Gates in Flow Splitter Box	$150,000
RAS Pump Station	Rehabilitate RAS Pumps	$550,000
WAS Pump Station	WAS Pump (1)	$40,000
Gravity Thickeners	Drives, Rakes and Motor Control Center (2)	$350,000
	New Sludge Thickener	$300,000
Disinfection	New Chlorinator	$100,000
Non-Potable Water Pump Station	New Duplex Strainer	$35,000
Primary Digesters	New Mixing Systems (3)	$3,525,000
	New Covers (3)	
	New Boiler with Heat Exchangers (3)	
	Gas Flare	
Secondary Digesters / Sludge Holding	Covers	$350,000
	Odor Control	$650,000
Dewatering	Polymer Feed System	$250,000
	New Mechanical Dewatering	$2,550,000
Scum Facility	Replace Scum Facility	$400,000
Site	Miscellaneous Site improvements	$600,000
	Design, Inspection, Admin, Legal, and Finance	**$4,225,000**
	Total (incl. contingencies)	**$27,350,000**

G. Group Two Detailed Solutions Summary

Table 3-5 below summarizes the preferred solutions and associated costs for each sewershed.

Table 3-5: Detailed Solutions Summary

Item	Quantities	
	Cane Run	Town Branch
≤15" (ft)	10,269	3,113
18"-24" (ft)	16,476	13,543
27"-36" (ft)	11,156	5,574
42"-54" (ft)	0	0
Force Main (ft)	11,094	1,268
Subtotal Pipe (ft)	**48,995**	**23,498**
PS Improvements (MGD)	11	0.5
EQ (MG)	11	44
WWTP Improvements (ea)	-	$27 million
Total Capital Cost ($M)	**$78 million**	**$154 million**


Group 2 RMP CAP Violation Areas
Modeled Gravity Sewer
Existing Forcemain
Major Sewershed
Monitoring List SSO
Appendix A SSO
Existing Pump Station
Manholes that Violate CAP Surcharge Criteria During a 2-year Storm with Proposed Remedial Measures in Place
1 " = 3,200 '
3 - 7
Fayette County
CR
TB
WR
NE
SE
WH
EH
CR8_411
CR8_1
CR8_2
CR8_3
CR8_4
CR8_5
CR8_412
CR2_163
CR2_164
CR2_155A
CR5_18
CR3_72A
TB7_28
TB1_42
TB1_43
TB1_80
TB1_82
TB1_85
TB1_87
TB1_78
TB1_77
TB1_79
TB1_80A
TB1_154
TB1_752
TB1_155B
TB1_155A
TB3_442
TB5_102
TB5_103
W NEW CIRCLE RD
NEWTOWN PIKE
LEESTOWN RD
W MAIN ST
E MAIN ST
N BROADWAY
S BROADWAY
S UPPER ST
S LIMESTONE
E NEW CIRCLE RD
WINCHESTER RD
RICHMOND RD
VERSAILLES RD
HARRODSBURG RD
PARIS PIKE
N 75 RAMP
S 75 RAMP
E 64
W 64

Section 4 Inflow/Infiltration (I/I) Program Strategy and Prioritization

A. Background

Flow monitoring was performed in the Group Two sewersheds as part of the Capacity Assessment and the Sanitary Sewer Assessment (SSA) to fulfill the requirements in Paragraph VII.15.B(vi) of the Consent Decree. Flow monitoring locations were selected to quantify the wet weather response from the collection system and identify those areas with excessive inflow and infiltration.

SSA flow monitoring was performed for a four (4) month period from February 2, 2010 to June 2, 2010. A total of 62 fixed location meters were installed in the Group Two sewersheds.

Monitoring locations were selected, to the extent practical, to provide complete coverage of the collection system, encompass a minimum upstream collection system length of 10,000 linear feet, and concentrate meters in areas upstream of known sanitary sewer overflows (SSOs) and areas where previous Capacity Assessment flow monitoring (Spring 2009) indicated a significant wet weather response.

Hydraulic models of the trunk sewers in the Group Two sewersheds were developed and calibrated in accordance with the requirements outlined in Paragraph VII15.E(i) of the Consent Decree. The models identify hydraulic performance of the trunk sewer system for the 2-year, 24-hour storm under both existing and future development conditions.

Flow monitoring results from the 2010 monitoring period, as well as a summary of the hydraulic modeling results were published in a report entitled Group Two Sanitary Sewer System Assessment Report, dated October 13, 2011. This report was submitted to the EPA per the requirements outlined in Paragraph VII.15.F of the Consent Decree.

B. Wet Weather Response Prioritization

Inflow and infiltration (I/I) reduction through sewer rehabilitation provides a means of restoring wet weather capacity in sanitary sewer systems. Prioritization of areas within the collection system is necessary to focus rehabilitation efforts where I/I removal benefits will be maximized and capital expenditures will be most cost-effective.

Prioritization of collection system areas in the Group Two sewersheds was performed based on the wet weather response observed during the 2010 flow monitoring period. A summary of the flow monitoring locations and their contributing collection system areas (metersheds) utilized in the 2010 monitoring period is presented in Figure 4-1, which is located at the end of this section.

General priorities were established for each of the metersheds depicted in Figure 4-1. Metersheds were assigned a priority of High, Medium, or Low. Priorities were assigned based on:

- Magnitude of the difference between the dry weather and wet weather peak flows
- Proximity to known sanitary sewer overflows (SSOs)

General priorities based on wet weather response and proximity to known SSOs in each of the two Group Two sewersheds are presented in Figure 4-2 (located at the end of this section).

C. Level of Control Prioritization

The Sanitary Sewer System and WWTP Remedial Measures Plan (RMP) identifies those capital projects and system improvements that are necessary to address capacity issues within the Group Two sewersheds for a 2-year level of control. The occurrence of wet weather events in excess of the selected level of control may result in SSOs within the system.

To minimize the potential for SSOs resulting from wet weather events in excess of the selected level of control, collection system rehabilitation can be prioritized based on their proximity to potential SSO locations. I/I removal in these areas can be effective at increasing the level of control in these areas and eliminating a non-recurring wet weather SSO.

The hydraulic models for the Group Two sewersheds were used to predict SSO locations for a rainfall event with a 5-year return interval and assuming that all conveyance and storage improvement projects identified within the RMP have been constructed. A graphical summary of the SSO locations predicted by the hydraulic model under these two conditions (and assuming the future growth condition) is presented in Figure 4-3, which is located at the end of this section.

Six (6) SSO clusters were predicted in the Group Two sewersheds resulting from the occurrence of a 5-year rainfall event for the future (2035) conditions and with the assumption that all conveyance and storage improvements (designed for a 2-year level of control) were in place. An SSO cluster was predicted at each sewershed outlet - one SSO cluster at the proposed equalization basin/storage tank at the Lower Cane Run Pump Station, and the other at the proposed equalization facility at the Town Branch WWTP. The remaining four SSO clusters occur at manholes within the conveyance system, with three occurring in the Cane Run sewershed and the other in Town Branch sewershed.

Prioritization of collection system rehabilitation by level of control yields two collection system areas (both in the Cane Run sewershed) where I/I removal could be effective at eliminating a potential SSO resulting from rainfall events in excess of the selected 2-year level of control. These two collection system areas are depicted in Figure 4-4 (located at the end of this section). The two areas were selected as those areas upstream of the model predicted SSOs that occurred in the conveyance system during a 5-year storm. Predicted SSOs at the storage tank adjacent to the pump station, at the Town Branch WWTP, and the remaining two SSO locations within the sewershed were not included in the proposed rehabilitation because the areas upstream of these SSOs encompass too large a portion of the collection system to be considered useful for prioritization.

D. Strategy

Determining the effectiveness of proposed collection system rehabilitation at reducing the wet weather response in the system is uncertain. Historically achieved I/I removal rates vary widely, both locally and across the nation. Reliance on a prescribed I/I removal effectiveness when sizing conveyance and storage improvements presents an inherent risk. If targeted I/I reductions are not achieved, conveyance and storage improvements will be too small to restore adequate wet weather capacity in the system.

In order to ensure an achievable level of control from implementation of the Remedial Measures Plan in the Group Two sewersheds, I/I removal within the collection system was not considered when sizing conveyance and storage improvements. Conveyance and storage improvements were designed to completely restore adequate capacity in the system for the 2-year, 24-hour rainfall event with no assumed I/I reduction in the collection system.

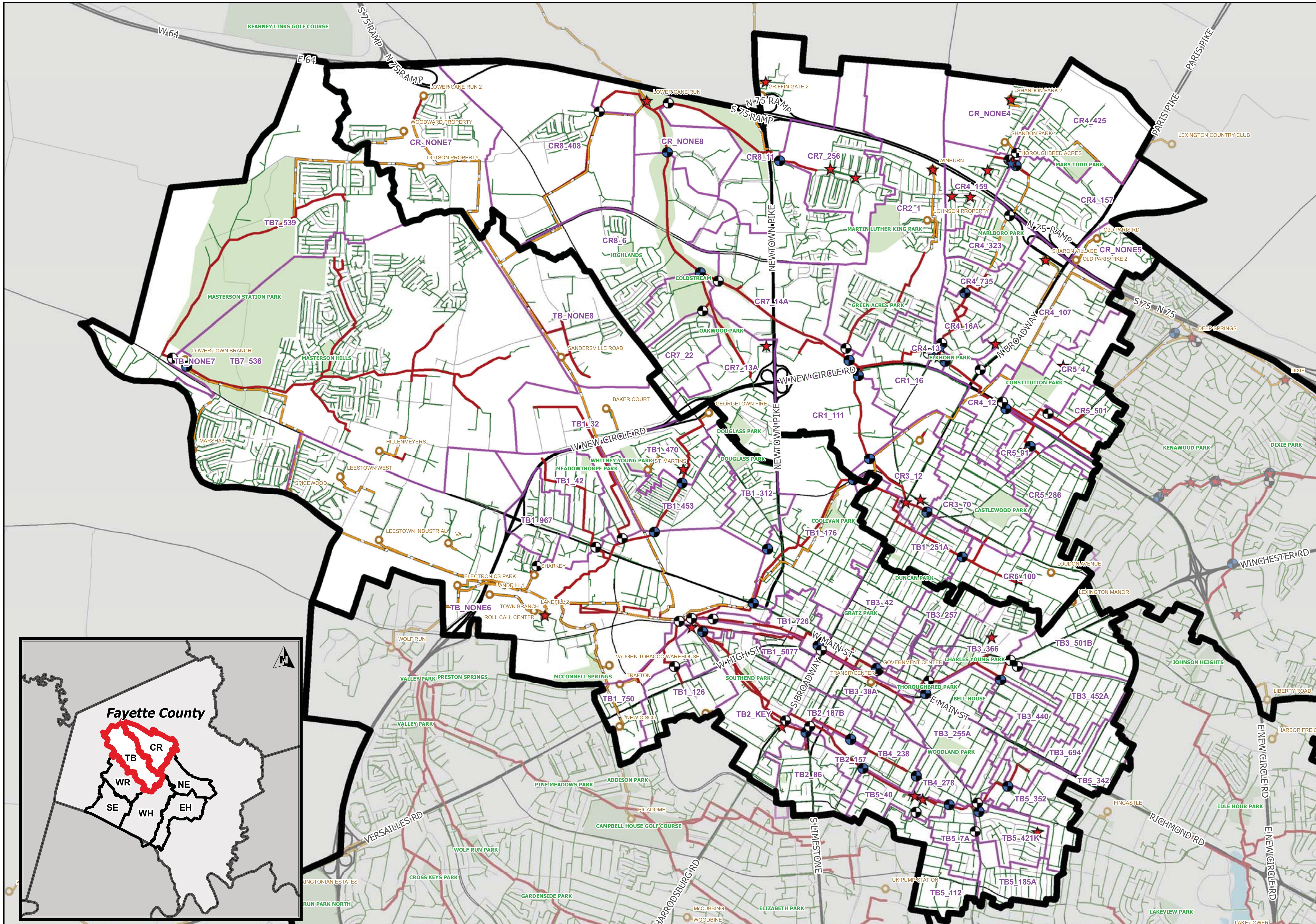
LFUCG intends to aggressively pursue collection system rehabilitation on a programmatic basis concurrent with implementation of the conveyance and storage improvements outlined in the RMP. Beginning in FY2013, LFUCG intends to increase their annual budget for collection system rehabilitation from $1.5 million to $5 million and intends to maintain this funding level over the life of the RMP implementation.

An extensive amount of field inspections in the wastewater collection system in the Group Two sewersheds was conducted as part of the SSA field activities. Field activities included closed circuit television (CCTV) inspection of approximately 320,000 linear feet of sewer pipe; over 5,600 manhole inspections; and smoke testing of approximately 1,203,000 linear feet of sewer pipe. Collected defect information on the sewer system's condition will be used by LFUCG to develop rehabilitation recommendations in prioritized collection system areas. Additional sewer inspection information collected by LFUCG as part of their Gravity Line Preventative Maintenance Program (GLPMP) efforts will also be considered when developing rehabilitation recommendations.

Flow monitoring was also performed as part of the SSA to aid in identifying the wet weather I/I contribution within the collection system areas of the Group Two sewersheds. Wet weather response data will be used by LFUCG to identify opportunities for private property I/I removal.

In February 2012, LFUCG passed an ordinance (#13-2012, Article VIII, Chapter 16) that provides LFUCG with the statutory authority to inspect private property for improper connections and stormwater sources to the sanitary sewer system. The ordinance also allows LFUCG to levy financial penalties to customers who refuse the inspection or fail to disconnect improper connections. The resolution will allow LFUCG to take a more comprehensive approach to removing I/I in targeted collection system areas.

The wet weather and level of control prioritizations outlined above in Sections 4B and 4C will be used as the basis for prioritizing LFUCG's programmatic collection system rehabilitation efforts. The results of these efforts will very likely yield an increase in level of control for Remedial Measures improvements above that of a two-year design storm.

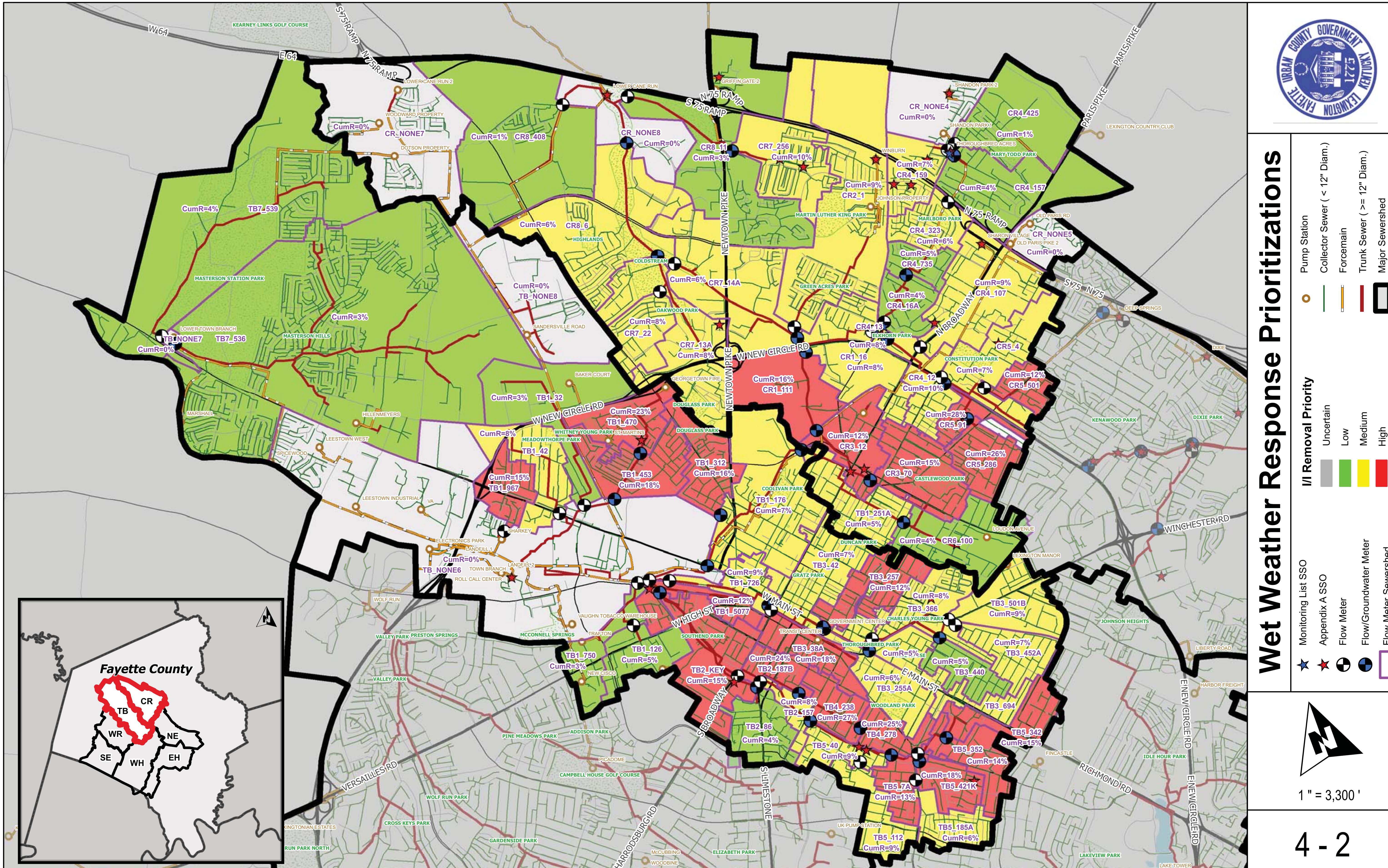


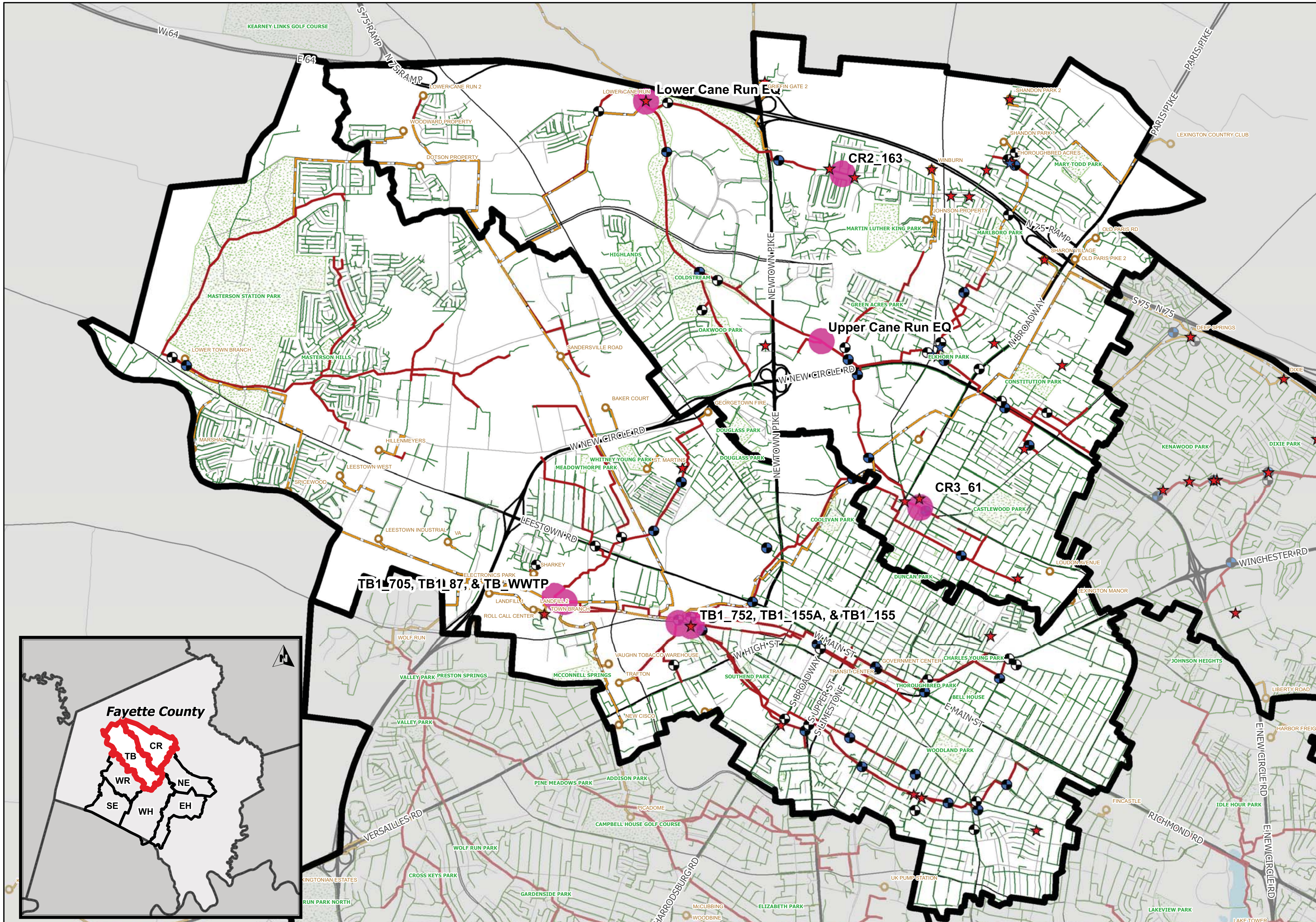
2009 Flow Monitoring Locations

- Pump Station
- Collector Sewer (< 12" Diam.)
- Force Main
- Trunk Sewer (>= 12" Diam.)
- Major Sewershed
- Flow Meter
- Flow/Groundwater Meter
- Flow Meter Sewershed
- Monitoring List SSO
- Appendix A SSO

1 " = 3,300 '

4 - 1


Wet Weather Response Prioritizations
Pump Station
Collector Sewer (< 12" Diam.)
Forcemain
Trunk Sewer (>= 12" Diam.)
Major Sewershed
I/I Removal Priority
Uncertain
Low
Medium
High
Monitoring List SSO
Appendix A SSO
Flow Meter
Flow/Groundwater Meter
Flow Meter Sewershed
1 " = 3,300 '
4 - 2
Fayette County
CR
TB
WR
NE
SE
WH
EH

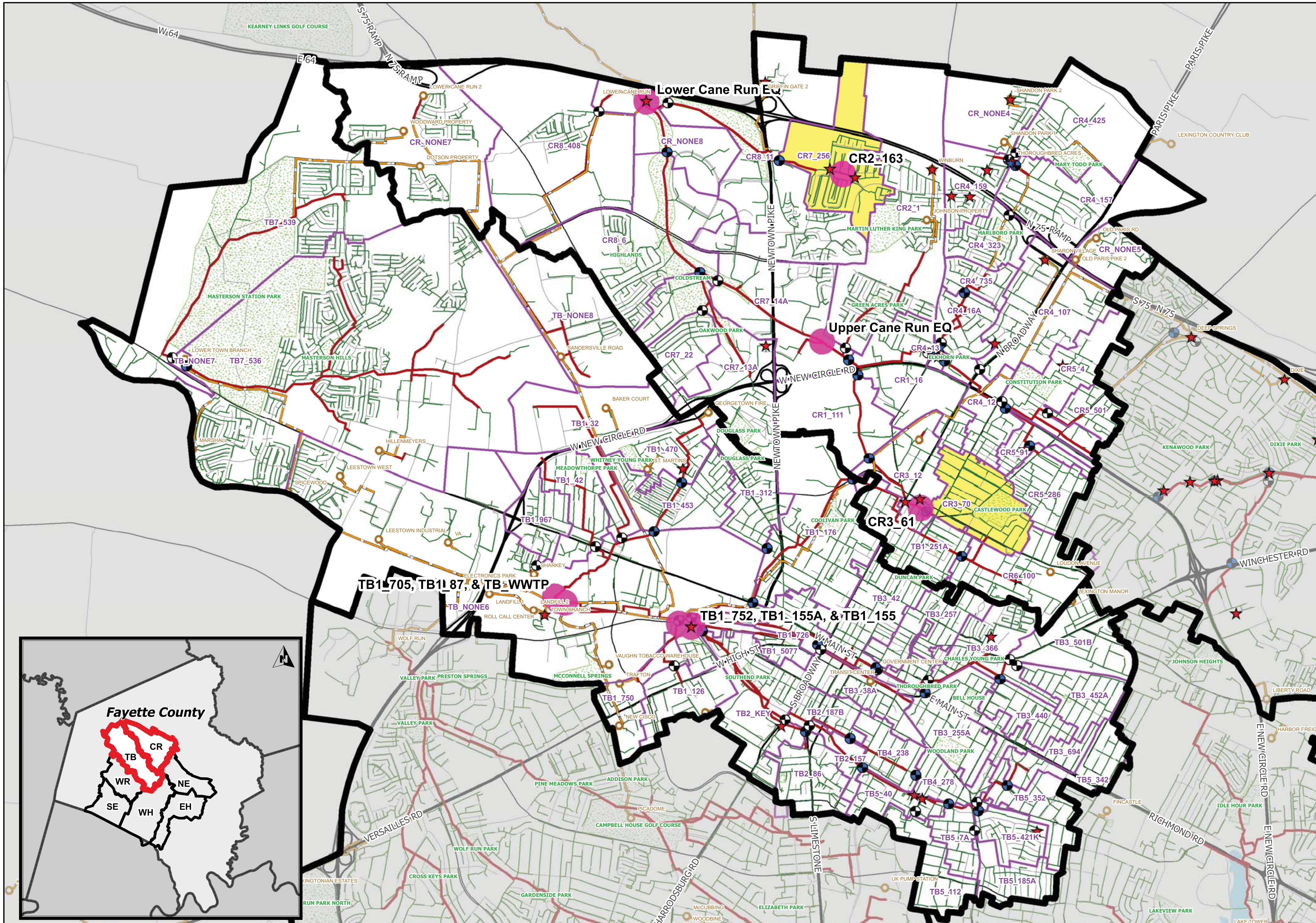


SSO Locations for 5-year Storm and 2-year LOS

- Pump Station
- Collector Sewer (< 12" Diam.)
- Force Main
- Trunk Sewer (>= 12" Diam.)
- Major Sewershed
- Flow Meter
- Flow/Groundwater Meter
- Monitoring List SSO
- Appendix A SSO
- Model Predicted SSO Locations for 5-year Rainfall Event with 2-year Level of Service Remedial Measures Plan

1 " = 3,300 '

4 - 3



Level of Service (LOS) Prioritizations

- Pump Station
- Collector Sewer (< 12" Diam.)
- Force Main
- Trunk Sewer (>= 12" Diam.)
- Major Sewershed
- Model Predicted SSO Locations for 5-year Rainfall Event with 2-year Level of Service Remedial Measures Plan
- High Priority I/I Removal Metersheds
- Monitoring List SSO
- Appendix A SSO
- Flow Meter
- Flow/Groundwater Meter

1 " = 3,300 '

Section 5 Prioritization and Schedule

A. Prioritization Process

1) Project Prioritization Process Overview

The Group Two Sanitary Sewer System and WWTP Remedial Measures Plan consists of projects to be implemented to address capacity issues within the Group Two sewersheds. These projects will provide improvements to the sanitary sewer system and result in the elimination of recurring SSOs, wet-weather unpermitted bypasses at the WWTP, and recurring NPDES permit violations related to excess flow for a 2-year, 24-hour storm.

The development of the RMP is being done in accordance with the requirements of Paragraph VII.15.G of the Consent Decree. Specifically, Paragraph VII.15.G(vi) identifies criteria to prioritize the sanitary sewer system remedial measures as follows:

a) Relative likely human health and environmental impact risks
b) Recurring SSO frequencies of activation
c) Total annual recurring SSO volumes
d) May also take into account cost-effectiveness and risks associated with implementation

The tasks of prioritizing the Group Two RMP projects and developing a detailed implementation plan were conducted in a four-step process described below. This process was designed to comply with the requirements of the CD and fit within LFUCG's estimated annual capital expenditure budget.

2) Prioritization Methodology

The prioritization of the RMP in **Step 1** incorporates many factors into the methodology of determining priority and schedule. These factors include:

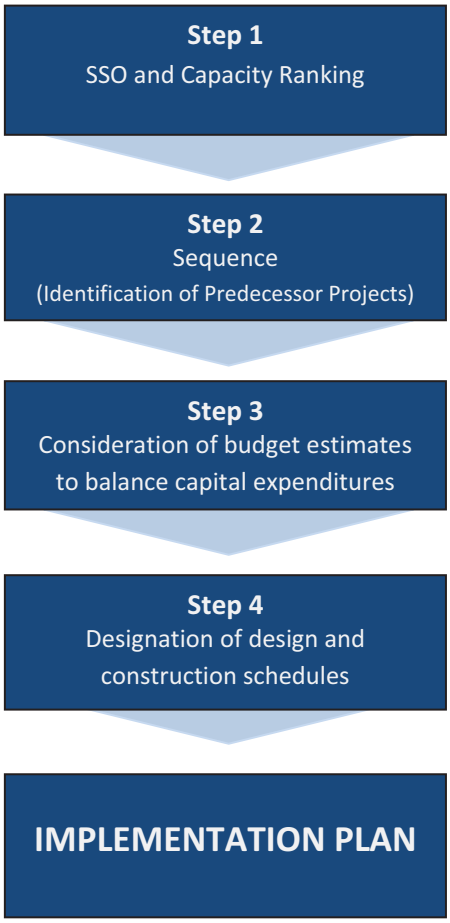
- Frequency and volume of SSOs
- Capacity restrictions in the collection system
- Logical sequence (necessary predecessor projects)
- Cash flow (balancing capital costs with annual expenditure budgets)

A prioritization methodology chart is provided to illustrate the process in Figure 5-1. SSOs (identified in Appendix A of the Consent Decree and/or shown by the hydraulic model as surcharging or overflowing during a 2-year, 24-hour storm) were grouped into clusters with other SSOs in close proximity. Proposed capital projects were developed that addressed each cluster and individual wet-weather SSO. The hydraulic model results provided information related to the frequency and volume of SSOs for each cluster. A database was created and populated with the following information:

- Total number of SSOs in each cluster
- Total number of Appendix A SSOs in each cluster
- Total volume overflowed during the 2-year storm

- Frequency of overflows in a 2-year period (i.e. an SSO estimated to occur during a 6-month storm would have a 2-year frequency of 4, whereas an SSO estimated to overflow only during a 5-year storm would have a frequency of 0.4)
- Subject project (the specific project that would eliminate the Recurring SSO cluster)
- Predecessor projects, generally downstream of the subject project

Figure 5-1: Prioritization and Implementation Methodology



Each cluster was ranked first by frequency, then by the sum of the rankings for total volume, total SSOs, and Appendix A SSOs. The resulting list consisted of the Step 1 rankings. The highest priority projects involve the elimination of frequent and high-volume SSOs; the lowest priority projects do not eliminate SSOs, but increase collection system capacity such that surcharging is eliminated in the 2-year storm. The SSO cluster prioritizations/rankings are provided in Table 5-1, located at the end of this Section. A map identifying the SSO clusters is presented in Figure 5-2.

B. Implementation Plan Methodology

Once the projects were prioritized based on frequency, volume, and numbers of SSOs, **Step 2** consisted of sorting the projects according to logical sequence by considering the required predecessor projects. This consisted of identifying any projects which should be completed prior to initiating the subject project (i.e. adequate downstream conveyance is needed before upstream conveyance is increased or SSOs could be "relocated"). In the development of the implementation plan the predecessor projects were scheduled to occur before their subject projects.

In a separate exercise, LFUCG conducted a financial impact study based on initial RMP cost estimates for the entire sewer system. This financial study identified feasible annual rate increases, which were based on assumed annual expenditures. **Step 3** incorporated consideration of the resulting annual capital budgets in determining the appropriate timeframe for each improvement project. The ranked projects from Step 2 were distributed across the 13-year implementation period in a manner that balances capital expenditures with LFUCG budgeting. While some early predecessor projects will not result in the elimination of SSOs, other early projects will address high-priority SSOs. Implementation of the RMP projects in accordance with this schedule will result in the elimination of all recurring SSOs, as required by the Consent Decree

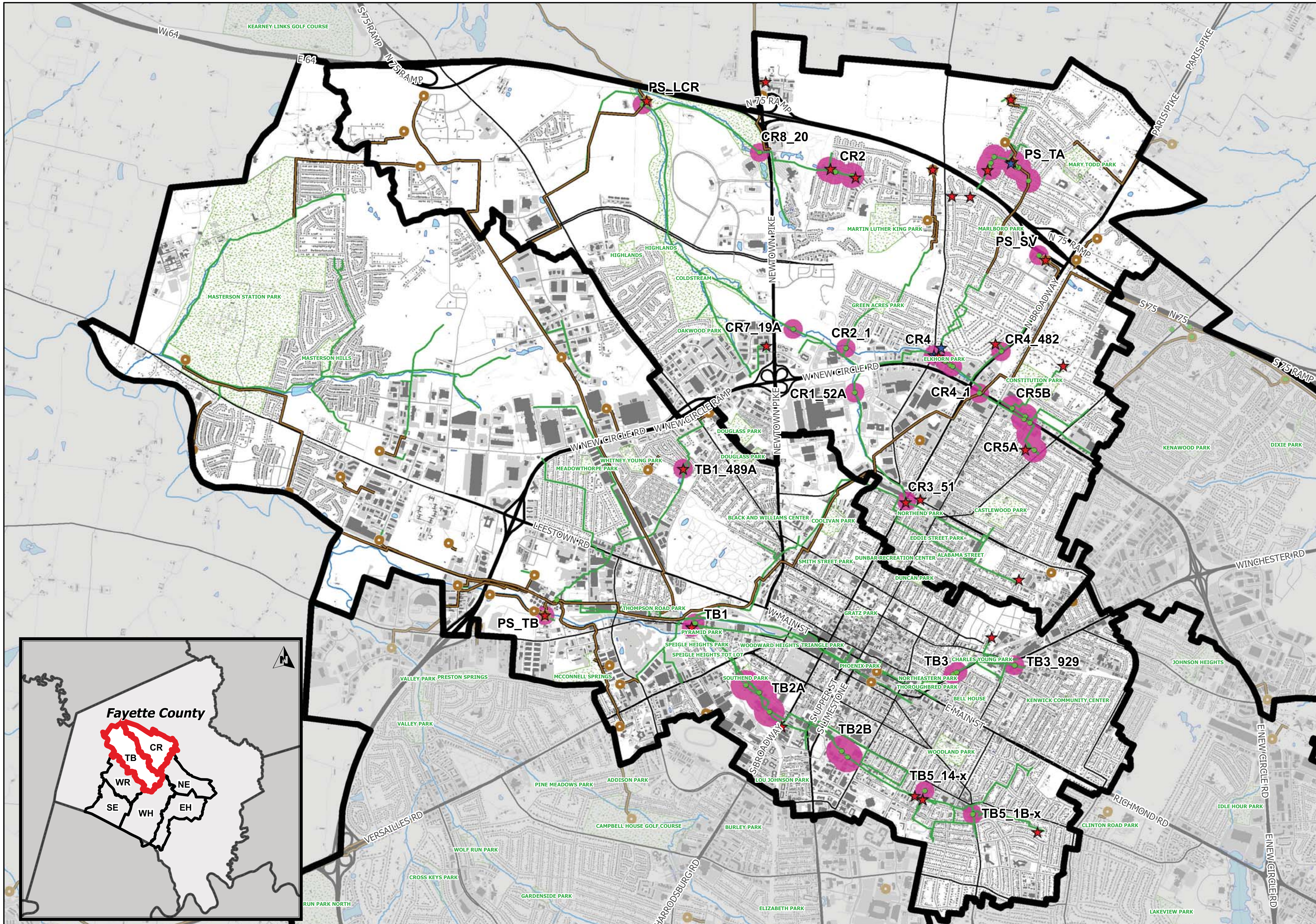
Step 4 consisted of determining the specific schedule for the design and construction of each project. For the purpose of the RMP, design and construction phases ranged from one to two year durations, except for the Town Branch WWTP and Lower Cane Run equalization basins. These large projects will be split into separate phases so that the final storage volume can be adjusted based on potential I/I removal accomplished during other RMP projects, as well as LFUCG's annual rehabilitation projects. The developed implementation schedules are included in Figure 5-5, located at the end of this section. Overview maps that summarize the projects in each of the sewersheds are also located at the end of this section as Figures 5-3 and 5-4. Appendix 1 of this report includes Project Detail Sheets, which are one-page summaries for each project.

C. Incorporation of Remedial Measures for Group Three

The Implementation Plans developed for Group One (submitted in October 2011) and Group Two, described in this document, are tentative and will be reevaluated during the preparation of the Group Three RMP. Due to the inter-relationships between the sanitary sewer systems in different sewersheds, required improvements in all three groups should be considered before establishing the final, city-wide Sanitary Sewer System and WWTP Remedial Measures Plan. LFUCG will use this prioritization in the interim until the Remedial Measures for Group Three are developed.

Table 5-1. Group Two SSO Cluster Prioritization

Cumulative Priority	Cluster Name	2-year Frequency	Total 2-year SSO Volume (MG)	No. of Model-Predicted 2-year SSOs	No. of Appendix A SSOs	Cluster Ranking By SSO Volume	Cluster Ranking By No. of Model-Predicted SSOs	Cluster Ranking By No. of Appendix A SSOs	Sum of Cluster Rankings	Subject Project for SSO Cluster Disposition	Predecessor Projects
1	CR4	4.0	1.256	4	1	2	1	5	8	CR 14	CR 10-11
2	PS_TA	4.0	0.976	1	2	3	4	2	9	CR 5	CR 2-4
3	CR5A	4.0	0.269	3	1	7	2	5	14	CR 15	CR 10-11, CR 14
4	PS_SV	4.0	0.136	1	1	8	4	5	17	CR 8	CR 2-5, CR 7
5	PS_TB	4.0	0.123	1	1	9	4	5	18	TB 1	--
6	TB2B	4.0	0.597	2	0	6	3	14	23	TB 7	TB 4-6
7	TB5_14-x	2.0	0.707	1	3	4	4	1	9	TB 8	TB 4-7
8	PS_LCR	2.0	2.334	1	1	1	4	5	10	CR 1	--
9	TB1	2.0	0.700	1	1	5	4	5	14	TB 3	--
10	CR4_482	2.0	0.023	1	1	12	4	5	21	CR 15	CR 10-11, CR 14
11	CR4_1	2.0	0.016	1	0	14	4	14	32	CR 15	CR 10-11, CR 14
12	CR3_51	1.0	0.030	1	2	10	4	2	16	CR 13	CR 10-12
13	TB1_489A	1.0	0.021	1	1	13	4	5	22	TB 9	--
14	CR5B	1.0	0.024	1	0	11	4	14	29	CR 15	CR 10-11, CR 14
15	TB3_929	1.0	0.006	1	0	15	4	14	33	TB 10	--
16	CR8_20	1.0	0.001	1	0	16	4	14	34	CR 9	--
17	CR2	0.4	0.000	0	2	17	17	2	36	CR 16	--
18	TB2A	0.4	0.000	0	1	17	17	5	39	TB 6	TB 4-5
19	CR1_52A	0.4	0.000	0	0	17	17	14	48	CR 12	CR 10-11
20	CR2_1	0.4	0.000	0	0	17	17	14	48	CR 11	CR 10
21	CR7_19A	0.4	0.000	0	0	17	17	14	48	CR 10	--
22	TB3	0.4	0.000	0	0	17	17	14	48	TB 10	--
23	TB5_1B-x	0.4	0.000	0	0	17	17	14	48	TB 8	TB 4-7



Modeled SSO Clusters

Pump Station

Force Main

Modeled Gravity Sewers

Major Sewershed

Modeled SSOs/Bypasses

Modeled SSO Clusters

Monitoring List SSO

Appendix A SSO

1 " = 3,300 '

Cane Run Solution

Proposed Remedial Measures *(Different Colors Signify Separate "Projects")*

Upsize Existing Line
New Trunk Sewer
New Force Main
New Pump Station
New Equalization Tank

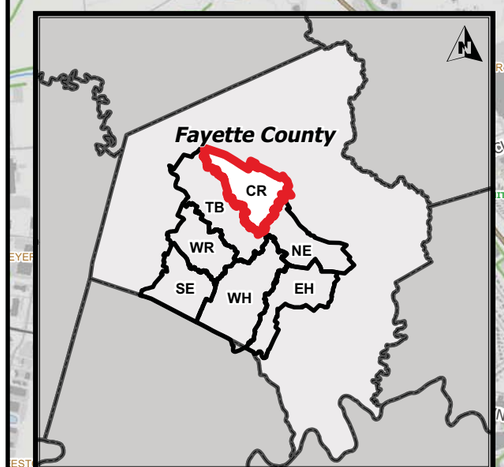
Monitoring List SSO
Appendix A SSO
Existing Pump Station
Existing Trunk Sewer
Existing Forcemain
Major Sewershed

1 " = 2,300 '

5 - 3

List of Projects

1. Lower Cane Run EQ
2. Expansion Area 3 PS
3. Expansion Area 3 FM
4. Expansion Area 3 Trunk
5. Shandon Park Trunks
6. Winburn Trunk
7. Thoroughbred Acres Trunk
8. Sharon Village PS and FM
9. Lower Griffin Gate Trunk
10. Upper Cane Run EQ
11. Cane Run Trunk
12. Lexmark Trunk A
13. Lexmark Trunk B
14. New Circle Trunk A
15. New Circle Trunk B
16. Griffin Gate Rehab



1 10.2 MG
2 9.5 MGD
3
4
5
6
7
8 1.5 MGD
9
10 0.8 MG
11
12
13
14
15
16

Town Branch Solution

(Different Colors Signify Separate "Projects")

Proposed Remedial Measures

- Upsize Existing Line
- New Trunk Sewer
- New Force Main
- New Pump Station
- New Equalization Tank

- Monitoring List SSO
- Appendix A SSO
- Existing Pump Station
- Existing Trunk Sewer
- Existing Forcemain
- Major Sewershed

Town Branch WWTP (71 MGD)

1 44 MG

PS 2 0.5 MGD

3

4

5

6

7

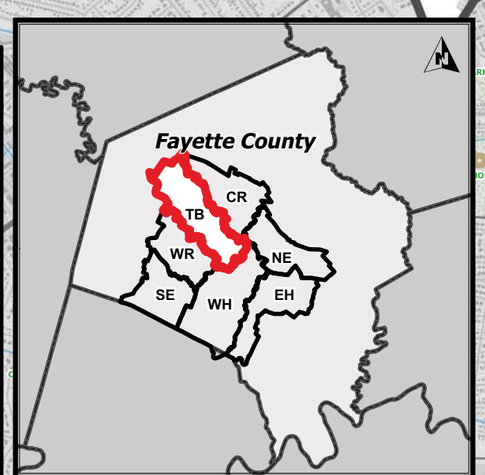
8

9

10

List of Projects

1. TB WWTP EQ
2. Town Branch PS and FM
3. Tie-in Lower Cane Run FM
4. UK Trunk A
5. UK Trunk B (Newtown Pike Ext.)
6. UK Trunk C
7. UK Trunk D
8. UK Trunk E
9. Georgetown Road Trunk
10. Midland Avenue Trunk



1 " = 2,300 '

5 - 4