Lee's Summit, Missouri
Wastewater Master Plan

NOVEMBER 2006

Prepared For:

Lee's Summit, Missouri

Prepared By:

Archer
CH2MHILL

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1 EXECUTIVE SUMMARY

1.1 MASTER PLAN PURPOSE AND FINDINGS

This Wastewater Master Plan provides the City of Lee's Summit (City) with a comprehensive plan for the development of its wastewater infrastructure to meet both the short-term and long-term growth of the City.

A major purpose of this master plan is to establish the plan for conveyance of all wastewater that will be generated within the City to the City's wastewater treatment providers, the Little Blue Valley Sewer District (LBVSD) and the Middle Big Creek Sub-District (MBC). Cooperation and proactive participation in master planning and the development of capital improvement plans for these wholesale treatment providers are critical to the ability of the City to serve its wastewater customers.

Another major purpose of this wastewater master plan is the identification of wastewater peak flows and the evaluation of the capacity of the existing collection and conveyance system to convey these peak flows without backups of wastewater into homes and businesses and without sanitary sewer overflows. The modeling of the entire system, owned by the City and that owned by the Little Blue Valley Sewer District, has provided the information to identify bottlenecks within the systems. From that modeling, improvements to the systems are recommended.

The identification of infiltration and inflow sources and the development of a plan for rehabilitation to reduce the extraneous wastewater from these sources, where cost-effective, has also been completed. Immediate attention to the primary source of inflow, illegal private connections, is recommended. This wastewater master plan also identifies the issues that the City must address related to the sustainability of the City's major wastewater asset, its collection system. Planning, for both infrastructure replacement and system maintenance, is critical to the long-term sustainability of this system.

Finally, this wastewater master plan provides the City with recommendations for capital improvements that are needed to achieve the major purposes identified above. These capital improvement recommendations are categorized into the two basic study periods. The first study period is from 2006 through 2015. The second study period is from 2016 through ultimate build-out of the City, estimated to take place after 2040. This Executive Summary also includes a prioritization of the capital improvements that are required in the next 5 years.

The highest priority projects are those that address the projected 2015 conveyance and collection system bottlenecks. Basement backups and/or sanitary sewer overflows could result if these capital improvements are not completed.

The next priority is the completion of additional sewer system evaluation studies and subsequent rehabilitation in areas where inflow is excessive and cost-effective to remove.

The third priority is comprised of recommended improvements to the City's conveyance system to accommodate projected growth. The projects are required to avoid future bottlenecks and potential risks of backups and overflow. The Capital Improvement Plan also includes an allowance for upsizing of future line extensions and allowances for sewer maintenance-related capital improvements and sewer relocations for future road projects.

The detailed capital improvement plan is provided to guide the City in implementation of the steps needed to complete its collection and conveyance infrastructure.

1.2 RECOMMENDATIONS

A. The first step in planning wastewater infrastructure needs for the City of Lee's Summit is to establish a plan to collect and convey the projected wastewater to a location for treatment.

   Figure 3-3 depicts the City's projection of its ultimate buildout land uses. Figure 5-2 shows the recommended wastewater conveyance plan.

B. A major component of the recommended conveyance plan is the plan to serve the West and South Prairie Lee Watersheds. Based on the conveyance plan for ultimate buildout of the City, it is recommended that the wastewater generated in these watersheds be collected, stored, and pumped in accordance with Figure 5-3. It is recommended that the City make improvements to change the current operation of splitting the pumped wastewater from these watersheds between the Maybrook and the Little Cedar Creek Watersheds to pumping all of the West and South Prairie Lee Watershed flow to the Little Cedar Creek Watershed.

C. It is recommended that the City support the Little Blue Valley Sewer District's plan to upgrade the capacity of its main interceptor. Specifically, the City should support the construction of an excess flow holding basin (EFHB) at a site near 103rd and I-470. This site previously served as a four-cell wastewater lagoon for the City of Kansas City, Missouri. In addition, the City should support an additional excess flow holding basin at a site in Raytown. Without these improvements, the LBVSD Interceptor will continue to be subject to excessive surcharging during wet weather, potentially surcharging parts of the City's wastewater system.

D. It is recommended that the City support a plan proposed by the LBVSD's Subcommittee on Growth and the MBC Board of Trustees to construct a regional wastewater treatment plant to serve the Middle Big Creek, Big Creek, and Duncan Branch Watersheds.

E. Based on an evaluation of previous studies and flow monitoring, it was determined that approximately 70 percent of the infiltration and inflow (I/I), entering the sanitary sewer system, comes from approximately 30 percent of the collection system. It was estimated that approximately 30 percent of the inflow can be cost-effectively removed. The following is recommended:

   - Investigate sources of I/I in high priority watersheds.
   - Budget approximately $23.3 million over next 9 years.

F. As part of a plan for collection system sustainability and compliance with EPA's Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM), the City should:

   - Assemble supporting data and documents referenced in the CMOM self audit.
   - Refine and set maintenance, performance, and reinvestment measures, as recommended in Section 7.
   - Refine reporting and data collection for sewer system overflows.
   - Continue ongoing collection system analysis and rehabilitation.
   - Measure effectiveness of I/I removal measures and adjust I/I removal program accordingly.

G. Related to private sector I/I:

   - Implement a private sector I/I removal program and evaluate regularly.
   - Develop a program to address legal and financial aspects of the program.

- Develop and implement a public awareness campaign relative to private sector I/I removal.
- Enforce construction standards and inspection procedures for new building laterals and for building's being sold.
    - Improved foundation drains, avoiding illegal use of sanitary sewers.
    - Trench checks outside of building excavations.
    - Inspection of basement floor drains and sump pumps prior to occupancy.

H. Consider the Capital Improvement Project for Years 2006 through 2015, as summarized in Table 8-1, for funding and implementation over the next nine years. Approximately 16% of these capital projects are related to the extension of the City's wastewater system into undeveloped areas and should be funded directly by developers. Approximately 19% of these capital improvements are associated with improvements planned by the City's wholesale conveyance and treatment providers, the Little Blue Valley Sewer District and the Middle Big Creek Sub-District. The remaining projects, totaling $68,714,100 (2006$), are recommended to address the existing and projected improvements to the City's collection and conveyance system through Year 2015 and will be funded by tap fees and user rates.

Of the City-funded projects, projects totaling $21,616,500, are recommended improvements to the City's existing wastewater system that are related to growth and new development. It is recommended that these projects be funded through the City's connection and/or tap fee revenues.

The remaining projects, totaling $47,097,600, are recommended improvements to the City's existing system. The improvements primarily represent rehabilitation projects that are needed to address excessive infiltration and inflow, as documented in previous sewer system flow metering and hydraulic evaluations. Other projects include parallel and/or replacement sewers in areas where the existing sewers lack sufficient capacity to convey the projected 2015 peak flows, without the risk of basement backup and/or sanitary sewer overflows.

Table 1-1 summarizes the highest priority projects. Locations of these projects are depicted on Figures 1-1 and 1-2. It is recommended that the City's Capital Improvement Plan include these projects for implementation during the next five years. Table 1-2 includes a brief description of each of these projects.

Table 1-1
Prioritized Capital Improvements
5 Year Plan

Improvement Number	Watershed	Project Description	Recommended Schedule	Opinion of Total Project Costs (2006$)					
				Total	City Funded			Developer Funded	LBVSD or MBC Funded
					Category 1	Category 2	Category 3		
1	**LBVSD**	103rd Street Excess Flow Holding Basin	2007-2008	$ 7,879,000					$ 7,879,000
2	**West Prairie Lee**	Todd George Road Wet Weather Pump Station	2007	$ 216,000		$ 216,000			
3	**West Prairie Lee**	Parallel Relief Lines (MH25-186 to MH18-076)	2007-2008	$ 256,000		$ 256,000			
		Parallel Relief Lines (MH24-069 to MH24-075)	2007-2008	$ 204,000		$ 204,000			
4	**South Prairie Lee**	Parallel Relief Lines (MH26-040 to MH26-085)	2007-2008	$ 255,000		$ 255,000			
		Parallel Relief Lines (MH65-020 to MH33-258)	2007-2008	$ 152,000		$ 152,000			
		Parallel Relief Lines (MH40-130 to MH40-127)	2007-2008	$ 36,000		$ 36,000			
		Parallel Relief Lines (MH40-110 to MH40-204)	2007-2008	$ 179,000		$ 179,000			
5	**West Prairie Lee**	SSES & I/I Rehabilitation (WP-08,WP-10, WP-06, WP-09, WP-11)	2007-2008	$ 2,773,000			$ 2,773,000		
6	**Cedar Creek**	SSES & I/I Rehabilitation (CC-17)	2007-2008	$ 314,300			$ 314,300		
7	**South Prairie Lee**	Legacy Wood/Summit Mill EFHB	2007-2009	$ 726,700	$ 650,700			$ 76,000	
8	**Middle Big Creek**	MBC/Mouse Creek EFHB and Relief Lines	2007-2009	$ 5,625,000	$ 5,625,000				
9	**Blue Springs**	Carp Lake Sewer Improvements	2007	$ 178,000		$ 178,000			
10	**City Wide**	Sanitary Sewer Maintenance Projects	2007-2011	$ 549,000		$ 549,000			
11	**City Wide**	Sanitary Sewer Relocation Projects	2007-2011	$ 1,206,000	$ 1,206,000				
12	**Cedar Creek**	Interceptor Improvements Segment 1	2007-2010	$ 3,090,000	$ 586,600	$ 2,503,400			
13	**West Prairie Lee**	SSES & I/I Rehabilitation (WP-06)	2009	$ 839,900			$ 839,900		
	Cedar Creek	SSES & I/I Rehabilitation (CC-17,CC-14,CC-20)	2009	$ 1,301,900			$ 1,301,900		
	South Prairie Lee	SSES & I/I Rehabilitation (SP-01,SP-04)	2009	$ 285,600			$ 285,600		
	Boggs Hollow	SSES & I/I Rehabilitation (BH-01)	2009	$ 186,800			$ 186,800		
14	**Little Cedar**	24" Parallel Forcemain along Tudor Road	2009-2010	$ 4,083,700	$ 4,083,700				
		Interceptor Improvements	2009-2010	$ 3,028,000	$ 3,028,000				
15	**West Prairie Lee**	Tudor PS Upgrade	2009-2010	$ 2,994,900	$ 2,994,900				
16	**South Prairie Lee**	Scruggs Road PS Improvements	2010-2015	$ 998,300	$ 998,300				
		Scruggs Road Forcemain to Tudor	2010-2015	$ 771,500	$ 771,500				
		Scruggs Road EFHB Improvements	2009-2010	$ 564,000	$ 564,000				
17	**Big Creek**	Ultrasonic Flow Metering	2007	$ 10,000		$ 10,000			
18	**MBCSD**	Improvements to Middle Big Creek Conveyence System	2010	$ 5,800,000					$ 5,800,000
		(May be replaced with treatment alternative)							
19	**Maybrook**	Parallel Relief Sewers	2007-2009	$ 615,000		$ 615,000			
20	**Mouse Creek**	Upsizing of New Trunk Lines	2007-2015	$ 300,000	$ 300,000				
	Middle Big Creek	Upsizing of New Trunk Lines	2007-2015	$ 300,000	$ 300,000				
	Maybrook	Upsizing of New Trunk Lines	2007-2015	$ 300,000	$ 300,000				
21	**West Prairie Lee**	SSES & I/I Rehabilitation (WP-09,WP-07,WP-02)	2010	$ 1,347,400			$ 1,347,400		
	Cedar Creek	SSES & I/I Rehabilitation (CC-21,CC-04,CC-19,CC-03)	2010	$ 1,421,600			$ 1,421,600		
22	**West Prairie Lee**	SSES & I/I Rehabilitation (WP-11)	2011	$ 1,151,600			$ 1,151,600		
	Cedar Creek	SSES & I/I Rehabilitation (CC-16)	2011	$ 1,805,600			$ 1,805,600		
23	**West Prairie Lee**	Prairie Lee LPS System	2011-2015	$ 2,954,000		$ 954,000		$ 2,000,000	
Total - All Improvements				**$ 54,698,800**	**$ 21,408,700**	**$ 6,107,400**	**$ 11,427,700**	**$ 2,076,000**	**$ 13,679,000**

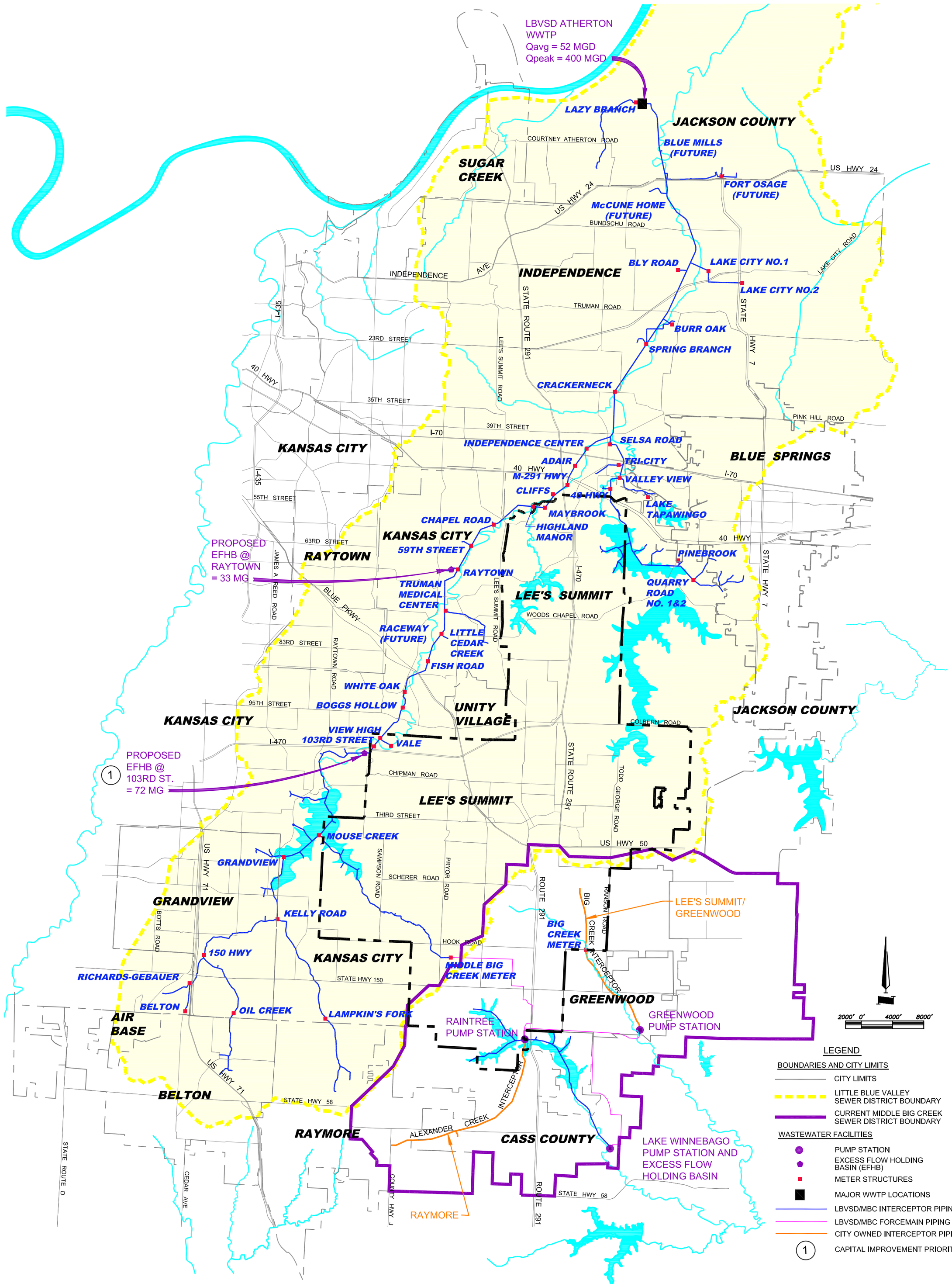
Notes
1 Category 1 : Growth related improvements to existing system. Funded by tap fee.
2 Category 2 : Improvements to existing sewers due to higher inflow than origionally projected. Funded by user rates.
3 Category 3 : Improvements associated with identification and removal of excess inflow. Funded by user rates.

Table 1-2
Project Descriptions

Improvement Number	Project Identification	Description
1	103rd Street EFHB	This project consists of the construction, by the Little Blue Valley Sewer District, of an excess flow holding basin at 103rd Street and I-470. The basin is designed to contain peak flows that exceed the downstream capacity of the District's Interceptor.
2	The Todd George Road Wet Weather Pump Station	The project consists of a wet weather pump station to serve a residential area north of the Tudor Road Pump Station. This pump station will eliminate potential sanitary sewer backups.
3	West Prairie Lee Parallel Relief Lines • MH25-186 to MH18-076 • MH24-069 to MH24-075	This project consists of the construction of sanitary sewer relief lines. The existing lines do not have capacity to convey the predicted peak sanitary sewer flows. Additionally, sanitary sewer backups have been reported on these lines.
4	South Prairie Lee Parallel Relief Lines • MH26-040 to MH26-085 • MH65-020 to MH33-258 • MH40-130 to MH40-127 • MH40-110 to MH40-204	This project consists of the construction of sanitary sewer relief lines. The existing lines do not have capacity to convey the predicted peak sanitary sewer flows. Additionally, sanitary sewer backups have been reported on these lines.
5	SSES and I/I Rehabilitation in Targeted Watersheds: WP-08, WP-10, WP-06, WP-11, & WP-09	This project consists of completing sewer system evaluation surveys in the identified subwatersheds. Improvements will be completed in subwatersheds WP-8 and WP-10.
6	SSES in Targeted Watersheds: CC-17, CC-21, & CC-16	This project consists of completing sewer system evaluation surveys in the identified subwatersheds.
7	Legacy Wood/Summit Mill EFHB	This project consists of the construction of an excess flow holding basin at the existing Legacy Wood Pump Station. The basin is designed to contain peak flows that exceed the downstream capacity of the existing facilities in the South Prairie Lee Watershed.
8	Middle Big Creek EFHB and Parallel Relief Sewer in Middle Big Creek Watershed	This project consists of an excess flow holding basin designed to contain excess flows that exceed the capacity of existing interceptors located under Raintree Lake. It includes the construction of sanitary sewer relief lines to the holding basin.

Improvement Number	Project Identification	Description
9	Carp Lake Sewer Improvements	This project consists of the installation of new sewer line with an alignment that will be outside the zone of influence of the Carp Lake Dam. The new alignment is intended to prevent further pipe failure due to instability of the Carp Lake Dam.
10	City Wide Sanitary Sewer Maintenance Projects	This project consist of miscellaneous sanitary sewer maintenance projects, previously identified.
11	City Wide Sanitary Sewer Relocation Projects	This project consists of miscellaneous sanitary sewer relocation projects associated with road projects.
12	Cedar Creek Interceptor Improvements - Segment 1	This project consists of the construction of sanitary sewer relief lines on the lower segments of the Cedar Creek Interceptor. The existing lines do not have capacity to convey the predicted peak sanitary sewer flows.
13	• SSES in Targeted Watersheds: BH-01,CC-14, CC-20, SP- 01, & SP-04 ,I/I • Rehabilitation in Targeted Watersheds: WP-06, CC-17, & BH-01	• This project consists of completing sewer system evaluation surveys in the identified subwatersheds. • This project consists of completing improvements in the identified subwatersheds.
14	• 24" Parallel Forcemain along Tudor Road • Little Cedar Creek Interceptor Improvements	This project consists of the construction of a new 24-inch force main along Tudor Road from M 291 Highway to near Douglas Road and upgrades to the Little Cedar Creek Interceptor. The improvements allow 24 million gallons per day to be conveyed to the Little Cedar Creek Watershed from West and South Prairie Lee Watersheds.
15	Tudor Road Pump Station Upgrade	This project consists of upgrading the Tudor Road Pump Station to a capacity of 24 million gallons per day. The existing extended shaft pumps will be replaced with dry pit submersible pumps.
16	• Scruggs Road PS Improvements • Scruggs Road Forcemain to Tudor • Scruggs Road EFHB Improvements	This project consists of upgrading the Scruggs Road Pump Station to a capacity of 16 million gallons per day, upgrade of the force main leading to the gravity interceptor to the Tudor Road Pump Station, and expansion of the Scruggs Road Excess Flow Holding Basin.

Improvement Number	Project Identification	Description
17	Ultrasonic Flow Metering	This project consists of the installation of a flow meter in the Little Blue Valley Sewer District's Big Creek Meter Structure. This meter will allow the City to evaluate peak flow produced within the Big Creek Watershed and time improvements with the Watershed.
18	Improvements to Middle Big Creek Conveyance System (may be replaced with treatment alternatives)	This project consists of expansion of the Middle Big Creek-owned conveyance system.
19	Parallel Relief Sewer in Maybrook Watershed	This project consists of the construction of sanitary sewer relief lines. The existing lines do not have capacity to convey the predicted peak sanitary sewer flows.
20	Upsizing Trunk Lines w/ New Sewer Pipe in Targeted Watersheds: • Mouse Creek • Middle Big Creek • Maybrook	This project consists of an allowance for the upsizing of new trunk sewers, to ultimate capacity, of developer-constructed new sewers to unsewered subwatersheds.
21	• SSES in Targeted Watersheds: WP-07, WP-02, CC-04, CC-19, & CC-03 • I/I Rehabilitation in Targeted Watersheds: WP-09 & CC-21	• This project consists of completing sewer system evaluation surveys in the identified subwatersheds. • This project consists of completing improvements in the identified subwatersheds.
22	I/I Rehabilitation in Targeted Watersheds: WP-11 & CC-16	This project consists of completing improvements in the identified subwatersheds.
23	Prairie Lee LPS System	This project consists of providing assistance to the residents of Prairie Lee Lake to provide a low pressure sewer system designed to eliminate all septic tanks within the area.



LITTLE BLUE VALLEY SEWER DISTRICT

PRIORITIZED CAPITAL IMPROVEMENTS

FIGURE 1-1

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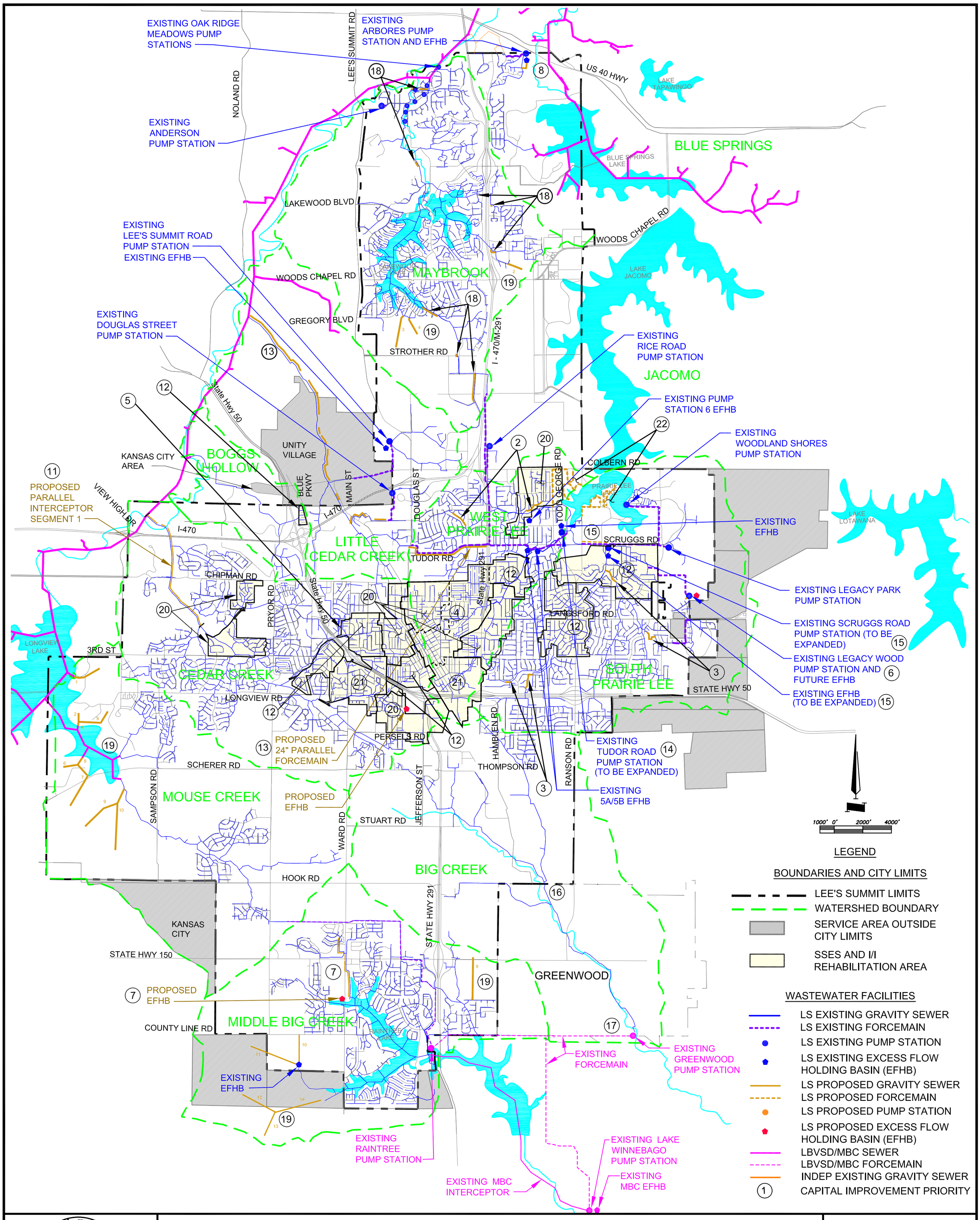

CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN
PRIORITIZED CAPITAL IMPROVEMENTS
FIGURE 1-2

Archer CH2MHILL

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2 INTRODUCTION

2.1 PURPOSE

The purpose of this document is to develop a comprehensive wastewater plan for the City of Lee's Summit, Missouri (City).

The Wastewater Master Plan provides the City with a document that addresses the City's wastewater needs and challenges for the next nine years (through 2015) as well as the ultimate build-out of the City. Specifically, the following tasks are addressed:

A. Estimate wastewater flows for Year 2015 and ultimate build-out based on the City's Comprehensive Development Plan.

B. Prepare a hydraulic model of the City's entire wastewater collection and conveyance system. Conduct system analysis of existing system, identifying bottlenecks. Identify solutions to correct areas where capacity issues result in potential sewer backups and overflows.

C. Identify sewer service recommendations related to growth to Year 2015 and to ultimate build-out. Utilize model to establish existing and future capital improvements related to projected growth.

D. Evaluate limitations and opportunities available from Little Blue Valley Sewer District and Middle Big Creek Sewer District in conveyance and treatment of the City’s wastewater.

E. Based on results of previous and current wastewater system evaluations, prepare recommendations related to reduction, rehabilitation, and/or conveyance of infiltration and inflow in the City's wastewater system. Make recommendations related to infiltration and inflow reduction on private property.

F. Review and make recommendations related to City's implementation of the Environmental Protection Agency's CMOM (Capacity, Management, Operation, and Maintenance) program.

G. Develop prioritized capital improvements with a schedule for improvements related to the Year 2015 and ultimate build-out growth conditions.

2.2 PLANNING PROCESS

The wastewater planning process is primarily driven by the City’s land use plan. In Lee’s Summit, the Comprehensive Plan is the document created and adopted by the City to guide future development decisions related to where to locate residential, commercial, and industrial land uses. It also provides guidance on population density within these land use types. This information is important in establishing future wastewater usage as the City develops to its ultimate build-out.

Once adopted by the Lee’s Summit Planning Commission, this Wastewater Master Plan becomes an integral part of the Comprehensive Development Plan. Likewise, the Wastewater Capital Improvement Plan, included in this Master Plan, will be reviewed and adopted by the Lee’s Summit City Council for use in its overall Capital Improvement Plan.

2.3 MASTER PLANNING CONSULTANT

The City contracted with the consulting team of Archer Engineers and CH2M Hill for the completion of the Wastewater Master Plan.

2.4 PREVIOUS REPORTS

The following reports, written prior to the Wastewater Master Plan, were utilized as reference for this master plan:

A. 1998 Wastewater System Evaluation, 1998, George Butler Assoc., Inc.
B. Lee's Summit Comprehensive Plan, 2004, City of Lee's Summit, Missouri
C. Interceptor Capacity Evaluation – Little blue Valley Sewer District, May 9, 2005, Archer Engineers
D. Scruggs Road Pump Station – Phase 11 Improvements – Preliminary Design Report – City of Lee's Summit, Missouri, October 2006, CTE.
E. Preliminary Engineering Report – Middle Big Creek Sub-District, September 22, 2006, Archer Engineers

2.5 ABBREVIATIONS AND ACRONYMS

The following list of abbreviations and acronyms is provided as a reference for common abbreviations used in this report:

cfs	Cubic Feet per Second
CIP	Capital Improvements Plan
City	City of Lee's Summit
CMOM	EPA's Capacity, Management, Operation, and Maintenance Program
EDU	Equivalent Dwelling Unit
EFHB	Excess Flow Holding Basin
EPA	United States Environmental Protection Agency
gpd	Gallons Per Day
gpm	Gallons Per Minute
I/I	Inflow and Infiltration
JCUWWD	Johnson County Unified Wastwater Districts
LBVSD	Little Blue Valley Sewer District
MBC	Middle Big Creek Sub-District
MDNR	Missouri Department of Natural Resources
mgd or MGD	Million Gallons per Day
PDWF	Peak Dry Weather Flow
PBF	Peak Base Flow
SSES	Sanitary Sewer Evaluation Study
SSO	Sanitary Sewer Overflow

3 EXISTING CONDITIONS AND PROJECTIONS

3.1 LAND PLANNING

This Wastewater Master Plan projects the needs of the City for two planning periods. First, an evaluation of wastewater needs for the period of Year 2006 through 2015 is considered, approximately 9 years. Second, the ultimate build-out of the City is evaluated. It is anticipated that this planning period is approximately 40 years.

3.2 LAND USE

Current and anticipated future land uses for the City are shown in the City's Comprehensive Plan, adopted by the Planning Commission in 2005. City staff worked with Archer/CH2M HILL during wastewater master planning workshops to further define these land uses as well as project land uses in areas outside of the current City Limits. In addition, Archer/CH2M HILL met with representatives of Unity Village to define land uses anticipated within the village limits. The Unity Village Land Use Plan was adopted in 2006.

3.2.1 EXISTING LAND USE

Figure 3-1 depicts property that is currently developed or in the process of being developed. This existing land use map for the City also shows the holdings of a major land holder, Property Reserve Incorporated (PRI), which is a real estate division of the Latter Day Saints (LDS) Church. PRI owns 1,100 acres of vacant property on the east side of I-470 north of Colbern Road. For the purpose of this master plan, this area will be referred to as PRI North. PRI also owns property in the south part of Lee's Summit, including over 3,000 acres of vacant land south of Longview Road. This area will be referred to as PRI South. PRI has stated to the City that they have no plans for development of either PRI North or PRI South within the next 25 years.

3.2.2 YEAR 2015 LAND USE

Figure 3-2 shows the anticipated developed properties and projected land use in the Year 2015. The land use and development projects added to the existing land use map, Figure 3-1, are primarily associated with the continuation of existing projects such as New Longview, Winterset Valley, Park Ridge, Arborwalk, Kensington Farm, and the areas around Legacy Park. It also includes the development of several new commercial areas such as the Summit Fair and City Walk projects. Growth into areas outside of the current city limits was not anticipated prior to 2015.

3.2.3 ULTIMATE LAND USE

Figure 3-3 depicts the ultimate land use plan included with the Comprehensive Plan. This plan anticipates the full development of the City, including the PRI property. The City commissioned a market study that recommended commercial-dominant mixed land use for the PRI North property. During the completion of the Comprehensive Plan, City staff and the Planning commission adopted a mix of land uses that should be allowed or required in the south/central area of the City, including the PRI South property. This mixed use is shown in Figure 3-3.

This ultimate land use plan also anticipates the growth of the City east along US 50 Highway and in the area south of County Line Road and west of Ward Road, as shown in Figure 3-3.

Wastewater planning is dependent upon the land uses and density of those land uses for the watershed service area. The projection of wastewater flows from a fully-developed city obviously requires improvements to the City's wastewater infrastructure. For the purpose of planning wastewater capital improvements, this master plan also considers the impact on the wastewater infrastructure if the PRI property does not develop. Figure 3-4 depicts the anticipated ultimate land use plan without the PRI property being developed.

Finally, Figure 3-5 shows the ultimate land use anticipated by Unity Village. The City of Lee's Summit provides facilities for conveyance of wastewater generated in Unity Village to the Little Blue Valley Sewer District's Interceptor.

3.3 DEMOGRAPHIC AND ECONOMIC DATA

3.3.1 Population and Commercial Uses

Population projections were prepared by the City's Planning and Development (P&D) Department and provided to the consultant's completing the City's water and wastewater master plans. The population projections are summarized in Table 3-1. In addition, the P&D Department provided projections of commercial uses, including retail, office, and industrial, to the consultants. Based on a FAR (floor area ratio) of 0.20, estimated building square footages of commercial uses were estimated for the various study periods.

Table 3-1
Population and Housing Forecasts

Scenario/Study Period	Population	Estimated
Current	88,700	34,100
Year 2015	111,600	42,900
Ultimate Buildout (without PRI)	163,600	62,900
Ultimate Buildout (with PRI)	191,100	73,500

3.3.2 Economic Data

General demographic information for the City of Lee's Summit was obtained from the Lee's Summit Economic Development Council and from the Mid-America Regional Council and is tabulated as follows:

- 66.5% of the population is 15 – 64, with 12% over the age of 65
- The median age is 36.1
- The median household income is $67,800
- The average number of people per household is 2.6

3.3.3 Forecasts of Flow

The population and commercial use projections provide the basis for projecting wastewater flows. Projected populations, along with projected residential density, were used to project the number of residential acres that will be developed in the 2006-2015 study period. Similar projections of commercial growth were completed for the same study period.

Section 6500 of the City of Lee's Summit's Design and Construction Manual, includes the methodology for converting residentially and commercially developed acreage into wastewater flows. Appendix 9.2 includes a copy of this methodology.

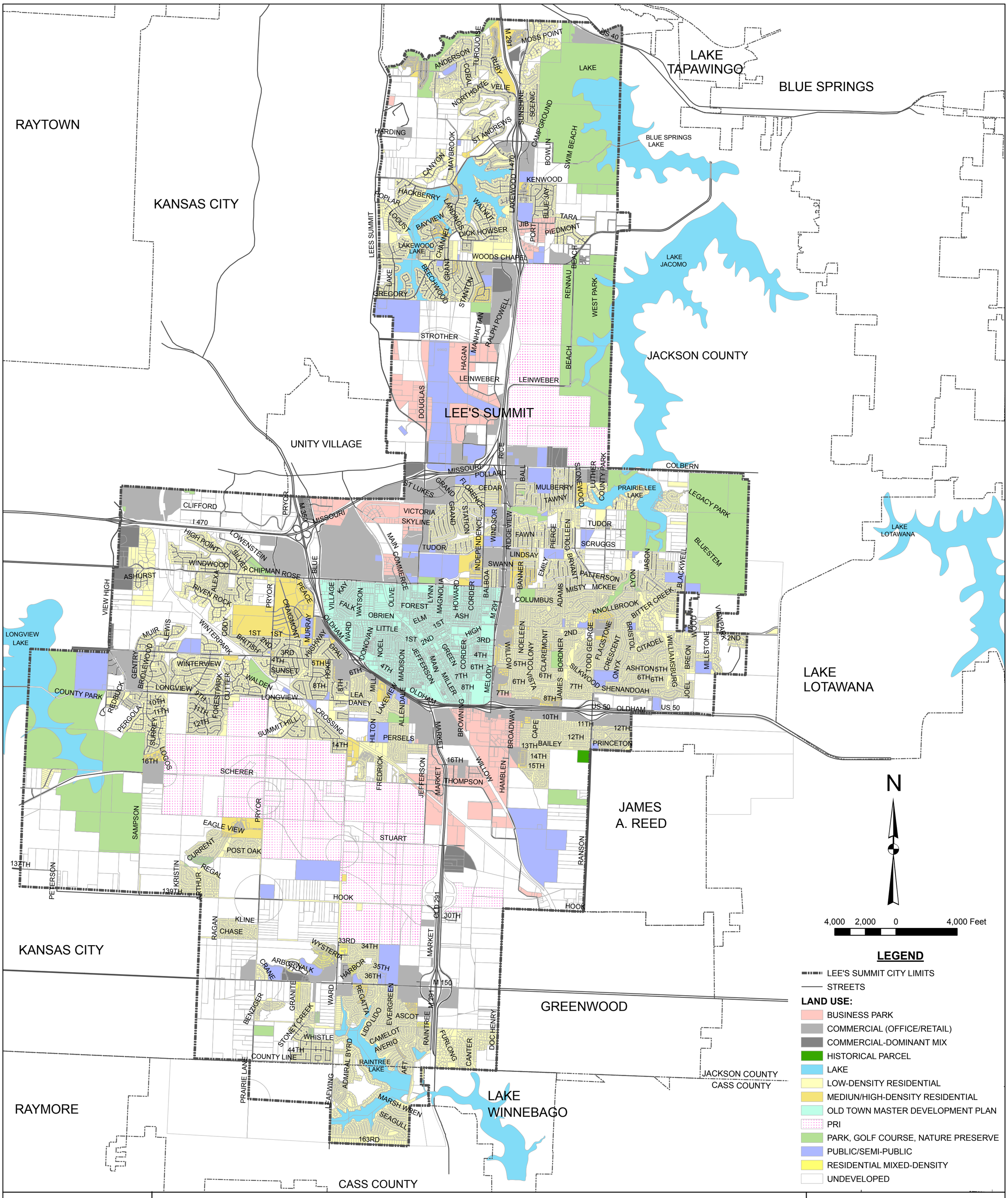
This methodology for flow projections was adopted by the City several years ago. Comparisons were completed between the City's methodology and the methodologies and projections utilized by the City of Independence, and the Johnson County Unified Wastewater Districts (JCUWWD). It was concluded that the City of Lee's Summit flow projection methodology was consistent with these other empirically-derived formulas.

The City's flow projection methodology requires sewer system design be completed on a watershed basis, with sewers sized for ultimate development. It recognizes the need to size these systems for the impact of extraneous flows that come from infiltration and inflow. As systems become older and/or flows from private systems increase, the peak flow in the sewer system can exceed the system capacities required by the Missouri Department of Natural Resources.

Under the City's methodology, peak base flow for residential land is equal to 1500 gal/day/acre plus peak infiltration of 500 gpd/acre plus a calculated value for peak inflow. The peak base flow for non-residential land is calculated using the equivalent dwelling unit (EDU) methodology. An EDU is a ratio of the flow produced by a single residential housing unit, which is 1.0 EDU and produces 300 gpd of peak daily flow. For different types of commercial and institutional developments, an EDU is assigned based on the parameters of the building, and the peak base flow is calculated based on the total number of EDUs for the site.

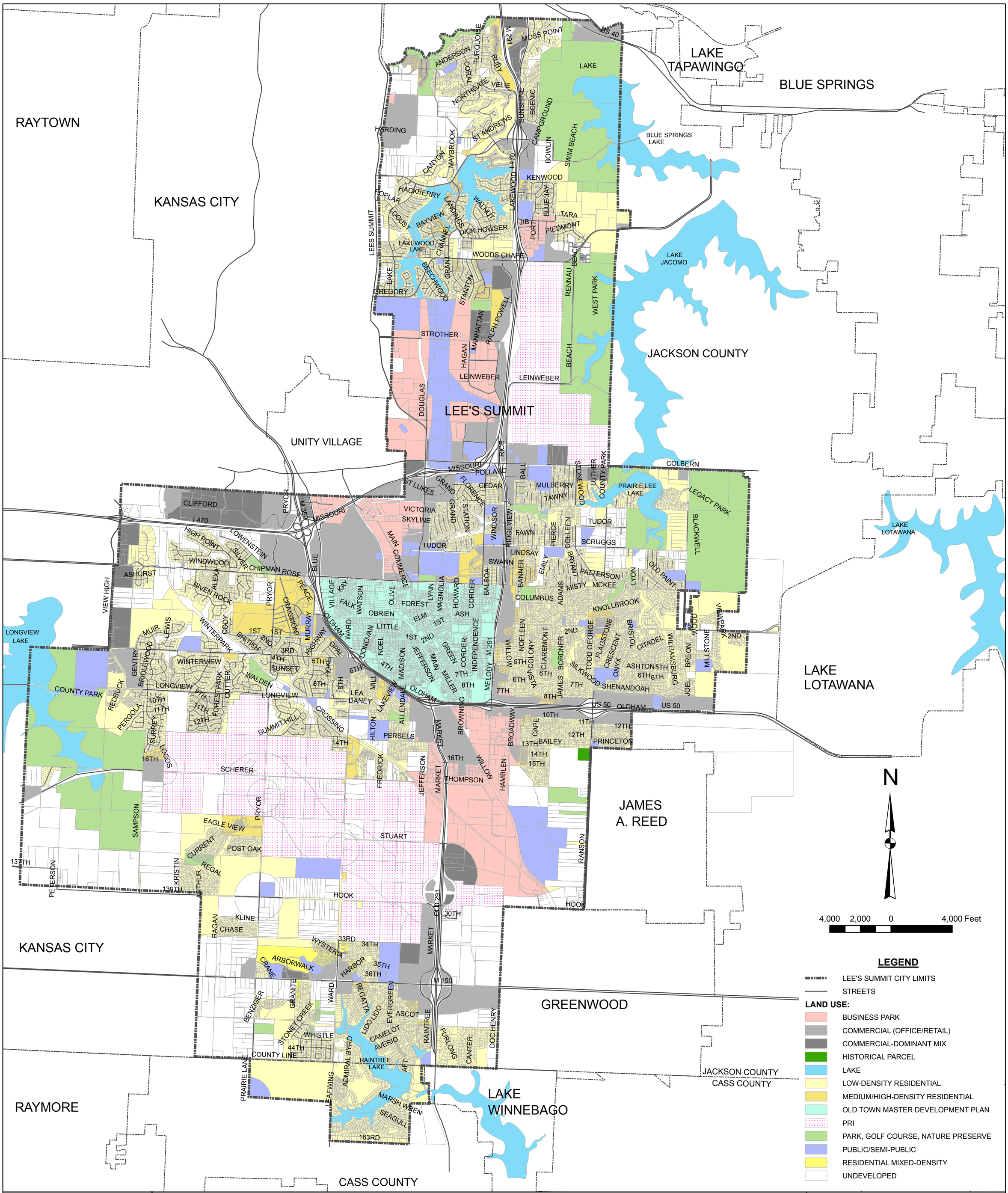
Finally, the largest peak rate component of the projected wastewater flow entering the City's wastewater collection system is from inflow. Inflow is rainfall-related flow entering the system through public and private sources. Public sources include sources such as manhole tops, creek crossings, and lateral connections. Private property inflow sources include leaking building sewers, foundation drains, sump pumps, yard drains, and downspouts. It is estimated that private sector inflow is the major source of inflow in the Lee's Summit collection system. Many of these sources are present at the time the sewer is initially constructed and provide the explanation as to why peak flows are excessive in new as well as older sewer systems.

The projection of the inflow component of the projected flows is based on a 50-year (2%) frequency storm event.



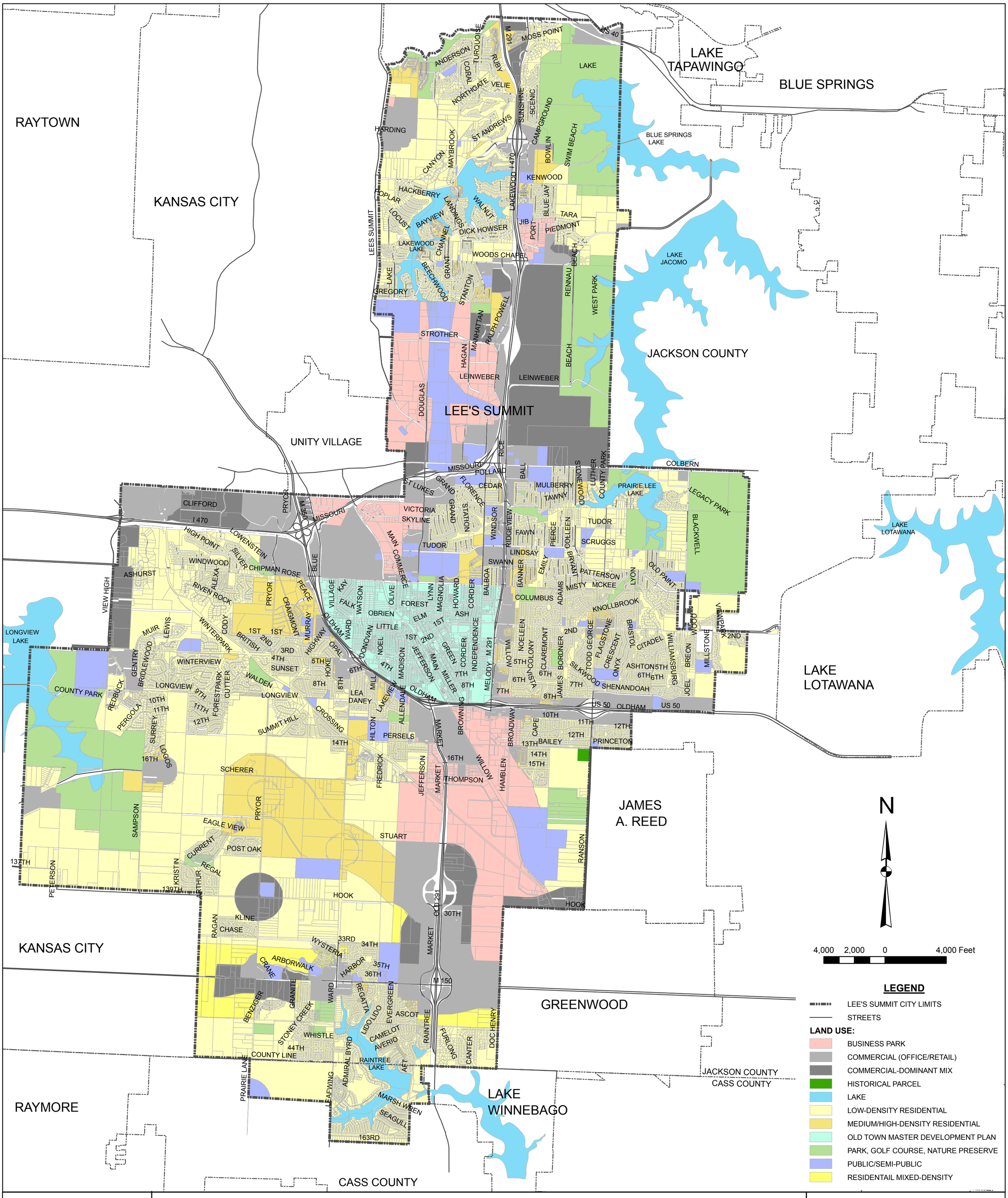
CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN
EXISTING LAND USE
FIGURE 3-1

P:\0300000327\ArcView\LnadUseMaps8-11-06\Figure 3-1_hs.mxd



CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN
2015 LAND USE
FIGURE 3-2

P:\0300000327\ArcView\LnadUseMaps8-11-06\Figure 3-2_hs.mxd



CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN
ULTIMATE LAND USE
FIGURE 3-3

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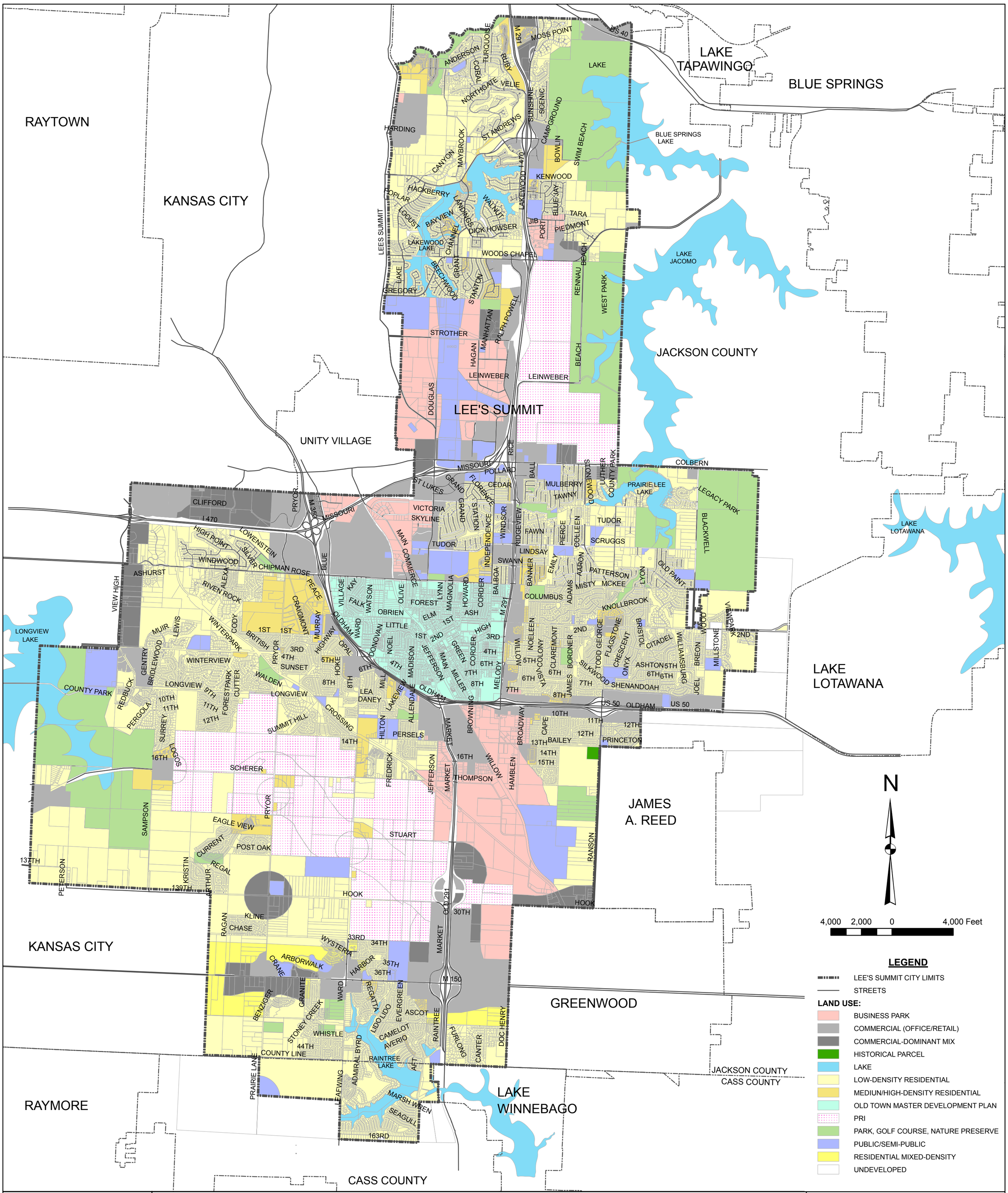

CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN
ULTIMATE LAND USE WITHOUT PRI
FIGURE 3-4

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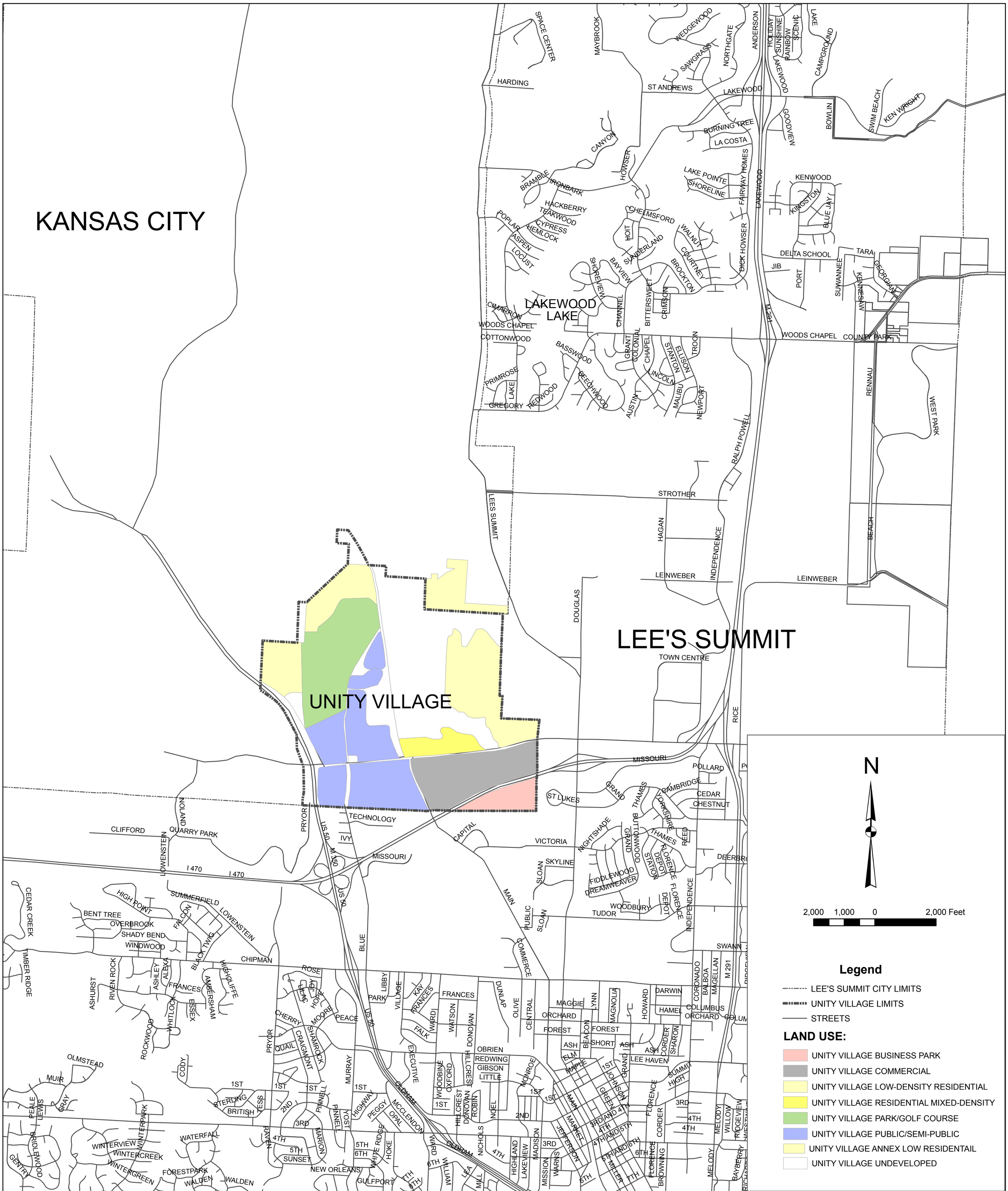


CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN
ULTIMATE LAND USE UNITY VILLAGE
FIGURE 3-5

P:\0300000327\ArcView\LnadUseMaps8-11-06\Figure 3-5_hs.mxd

4 EXISTING FACILITIES EVALUATION

The City is served by a combination of wastewater collection, conveyance, and treatment systems. The City owns and operates the collection system that collects wastewater from the majority of property owners. In addition, a few private collection systems discharge into the City's sewers. This wastewater is conveyed by a network of collection lines, trunk sewers, pump stations, force mains, and interceptors to facilities owned and operated by two regional sewer districts. Most of the City is located within the natural boundaries of the Little Blue River and its tributaries. The Little Blue Valley Sewer District (LBVSD), a wholesale sewer district that provides conveyance and treatment for wastewater within its boundaries, meters the wastewater at the connection of the City's collection system to the District's conveyance system. The remaining portion of the City falls in the natural watershed boundaries of Big Creek and Middle Big Creek. The Middle Big Creek Sub-District (sub-district to the Little Blue Valley Sewer District) provides pump stations, forcemains, and interceptors to convey the City's wastewater that is generated in the Big Creek and Middle Big Creek Watersheds to the LBVSD's conveyance system for treatment. The City owns no wastewater treatment facilities.

4.1 EXISTING COLLECTION AND CONVEYANCE SYSTEM

The Study Area consists of 11 major drainage basins or watersheds. Drainage basins define areas within the City where wastewater may be collected and conveyed downhill by gravity. As shown in Figure 4-1, nine of these basins drain north to the Little Blue River and the East Fork Little Blue River (under Lake Jacomo and Blue Springs Lake). These include the following watersheds: Blue Springs, Bogg's Hollow, Cedar Creek, Jacomo, Little Cedar Creek, Maybrook, Mouse Creek, South Prairie Lee, and West Prairie Lee. Two watersheds, Big Creek and Middle Big Creek, drain south.

4.1.1 City Owned

Gravity Collection and Conveyance System

The City owns and operates a sewer collection system consisting of approximately 11,000 manholes and over 2.6 million linear feet of sewer. Several subdivisions are currently served by private low-pressure grinder pump systems that collect wastewater and pump to a city-owned sewer. Table 4-1 represents an inventory of the gravity sewer lines by watershed within the City.

Table 4-1
Gravity Sewer Length by Watershed

Pipe Length (Feet)																		
Pipe Size (Inches)	6	8	10	12	14	15	16	18	20	21	24	27	30	36	42	48	54	**Totals**
Big Creek	0	47,557	4,586	12,174	0	9,448	400	7,609	0	1,463	3,852	0	0	0	0	0	0	**87,089**
Blue Springs	0	27,854	1,988	5,645	0	0	0	0	0	0	0	0	0	0	0	0	0	**35,487**
Bogg's Hollow	0	13,375	1,452	2,994	0	4,167	0	2,537	0	932	145	0	0	0	0	0	0	**25,602**
Cedar Creek	4,621	497,893	19,678	33,798	0	4,806	343	13,374	0	5,458	1,965	3,502	4,659	0	1,139	0	0	**591,235**
Jacomo	0	10,238	741	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10,979**
Little Cedar Creek	0	30,752	5,906	24,710	0	340	371	0	38	186	1,626	2,004	6,380	5,054	0	0	0	**77,367**
Maybrook	0	294,087	17,089	29,440	0	891	14,062	0	1,802	1,120	1,231	10,756	8,526	1,650	1,417	2,285	6,988	**391,345**
Middle Big Creek	0	422,257	14,468	15,721	3,369	5,147	2,695	8,791	9,464	0	5,119	873	0	0	0	0	0	**487,903**
Mouse Creek	1,127	100,720	1,972	12,465	0	7,517	161	1,469	0	0	3,162	0	5,378	5,187	15,766	0	0	**154,924**
South Prairie Lee	0	364,122	6,127	15,999	0	15,009	0	4,556	0	1,131	8,889	0	1,709	633	896	0	0	**419,070**
West Prairie Lee	8,269	280,135	16,656	26,812	0	7,463	0	5,478	1,243	284	8,489	0	4,056	0	0	0	0	**358,884**
Totals	**14,017**	**2,088,990**	**90,663**	**179,756**	**3,369**	**54,789**	**18,031**	**43,813**	**12,546**	**10,575**	**34,478**	**17,135**	**30,708**	**12,524**	**19,218**	**2,285**	**6,988**	**2,639,886**

Pump Station and Force Main Conveyance System

Although all of the major watersheds are served by gravity sewer systems, conveyance by gravity all the way to the LBVSD's interceptor system for several watersheds is not possible. The Blue Springs, Jacomo, South and West Prairie Lee, Middle Big Creek and Big Creek Watersheds are conveyed to a downstream location and pumped to another watershed for conveyance by gravity to the Little Blue Valley Sewer District system.

In the very northern portion of the Blue Springs Watershed, the City operates a pump station to serve the Arbores Subdivision.

The Jacomo Watershed terminates at Lake Jacomo. Since there are no sewers under or around Lake Jacomo, wastewater collected in this watershed is pumped to the Blue Springs and Maybrook watersheds and then is conveyed by gravity to the LBVSD's system. The only wastewater currently collected within this watershed is from the Post Office, library, and commercial buildings along Rice Road, just north of Colbern Road. This wastewater is collected in a pump station, which was constructed more than 40 years ago, and pumped south into the West Prairie Lee Watershed, where it is conveyed to the Tudor Road Pump Station for conveyance back to the Maybrook Watershed. Recently, another pump station was approved for construction in the Jacomo Watershed. This pump station will collect wastewater from the new Savannah Wood subdivision and future development property and convey it north to the Blue Springs Watershed and on to the LBVSD.

The West and South Prairie Lee Watersheds terminate at Prairie Lee Lake. Since there are no sewers under Prairie Lee Lake or Lake Jacomo, this wastewater is pumped to the Maybrook and Little Cedar Creek watersheds. Wastewater from Legacy Park, the new Legacy Wood development, and Woodland Shores subdivision have pump stations that convey wastewater west to the Scruggs Road Pump Station. This wastewater, along with wastewater from the South Prairie Lee Watershed, is collected and pumped by the Scruggs Road Pump Station northwest to the Tudor Road Pump Station. The Tudor Road Pump Station pumps this wastewater along with the wastewater collected in the West Prairie Lee Watershed to the west. Near the intersection of Scruggs Road and Highway 291, the pumped wastewater is split so that up to 16 million gallons per day can be pumped north to the Maybrook Watershed and up to 4 million gallons per day can be pumped west to the Little Cedar Creek Watershed. Excess flow holding basins at the Legacy Wood pump station, the Scruggs Road Pump Station, at the Tudor Road Pump Station and

the sites of several retired pump stations are used to temporarily store wastewater during wet weather events.

Within the Little Cedar Creek watershed, several gravity trunk lines pass through Unity Village for gravity conveyance to the Little Cedar Creek Interceptor. In addition, the Douglas Road and Lee's Summit Road Pump Stations convey wastewater to the Little Cedar Creek Interceptor. An excess flow holding basin is located at the Lee's Summit Road Pump Station.

Wastewater in the Big Creek and Middle Big Creek Watersheds is conveyed by gravity to pump stations owned by the Middle Big Creek Sub-District for conveyance to the Mouse Creek Interceptor and conveyance to LBVSD's facilities.

Finally, the City recently completed the construction of eight new pump stations in the very northern portion of the Maybrook Watershed to serve homes that are located below the hydraulic grade line of the LBVSD Interceptor in this area.

Figure 4-1 depicts the location of all of the City's existing pump stations. Table 4-2 summarizes all of the City's active pump stations and their capacities. The existing Summit Mill Pump Station will be retired when the sewers in the Legacy Wood subdivision extend to Summit Mill.

Table 4-2
Active Pump Stations
Summary

Active Pump Stations		
Pump Station Name	No. of Pumps	Station Capacity (GPM)
Tudor Road	6	16,667
Scruggs Road	4	6,458
Rice Road	2	180
Arbores Road	2	83
Douglas Road	2	550
Lee's Summit Road	2	1,650
Woodland Shores	2	800
Summit Mill	2	325
Legacy Wood	2	694
Anderson	2	125
Legacy Park	2	175
Oaks Ridge Meadows Pump Station 1	2	317
Oaks Ridge Meadows Pump Station 2	2	59
Oaks Ridge Meadows Pump Station 3	2	332
Oaks Ridge Meadows Pump Station 4	2	25
Oaks Ridge Meadows Pump Station 5	2	10
Oaks Ridge Meadows Pump Station 6	2	448
Oaks Ridge Meadows Pump Station 7	2	47
Oaks Ridge Meadows Pump Station 8	2	18

Excess Flow Holding Basin Storage System

Another component of the City's wastewater collection and conveyance system is a series of excess flow holding basins (EFHB). These basins are utilized to provide flow equalization during periods of peak wet weather flow to minimize and/or eliminate overloading of pump stations and gravity interceptors. The EFHB is designed to either limit or eliminate the discharge from the conveyance system upstream of the basin during the wet weather peak flow event. After the wet weather wastewater flows subside, the flow is drained from the EFHB. Table 4-3 summarizes the existing EFHBs in the City. A summary of the methodology for evaluating capacity and sizing excess flow holding basins is provided in Appendix 9.3.

Table 4-3
Excess Flow Holding Basins

Existing EFHB's	
Description	**Capacity (MG)**
Lift Station 6 EFHB	1.5
Tudor Road Pump Station EFHB	0.65
Scruggs Road Pump Station EFHB	1.4*
5A/5B EFHB	5.3
Lee's Summit Road EFHB	1.846
Kensington EFHB	1.13
Arbores EFHB	0.038

*Expansion Proposed

4.1.2 Little Blue Valley Sewer District Owned

The LBVSD is a wholesale district that provides conveyance and treatment of wastewater from the cities of Kansas City, Independence, Raytown, Blue Springs, Lee's Summit, Grandview, Raymore, and Belton as well as Jackson and Cass Counties. In addition, the LBVSD provides service to the Fort Osage School District and Lake City Army Ammunition Plant. The LBVSD also provides conveyance and treatment for the Middle Big Creek Sub-District. Figure 4-2 depicts the boundaries of the LBVSD, the boundaries of the various municipalities served by the District, and the boundaries of the Middle Big Creek Sub-District. The LBVSD's conveyance system consists of an interceptor, several connection lines, and meter structures. Residential and commercial wastewater is collected in systems belonging to customers of the LBVSD. This wastewater is conveyed by the customers through meter structures and into the LBVSD's Interceptor system. The interceptor is a gravity sewer that ranges in size from 21 through 126 inches in diameter.

The LBVSD operates a 52-million gallon per day wastewater treatment plant at a site near the discharge of the Little Blue River to the Missouri River. The LBLVSD's conveyance system is an interceptor that transports wastewater from its wastewater customers by gravity. The interceptor is located so that collection systems from both sides of the Little Blue River can be connected without pump stations and/or siphons. Meter structures are located (see Figure 4-2) at the connection points of the drainage basin collection systems serving its customers. The LBVSD operates a total of 37 meter structures. For the City of Lee's Summit, the LBVSD measures the City's wastewater flows at the downstream end of the Blue Springs, Maybrook, Little Cedar Creek, Bogg's Hollow, Cedar Creek, and the Mouse Creek Watersheds.

The flow from the South and West Prairie Lee Watersheds are pumped to the Maybrook and Little Cedar Creek Watersheds for conveyance and metering. Flows from the Jacomo Watershed are pumped to either the Maybrook or the Blue Springs Watershed for conveyance to the District's system.

The LBVSD's interceptor has a peak flow capacity under non-surcharged conditions of approximately 300 million gallons per day at the downstream end. Under low pressure conditions, the capacity is approximately 340 million gallons per day. The LBVSD projects that peak flow in 2020 will exceed 400 million gallons per day. The District's conveyance system has already experienced peak wet weather flows in excess of 360 million gallons per day (May 2004) that have caused significant surcharging of its interceptor and backups into collection systems owned by municipalities, including Lee's Summit. By the time the City reaches ultimate build out, the peak wet weather flow entering the District's interceptor will be even greater. It is projected that the

City's wastewater will discharge to the Little Blue interceptor at a peak rate of (50-years return frequency) 138 million gallons per day at ultimate buildout. The LBVSD's capital improvement plans include the construction of excess flow holding basins along its interceptor to equalize these peak flows and eliminate excessive surcharging. These proposed EFHB's are shown on Figure 4-2. Future improvements, as recommended in the District's Master Plan, include the construction of peak flow pump stations that will effectively cause the interceptor to operate as a force main to the plant, allowing it to deliver 400 million gallons per day to the plant.

4.1.3 Middle Big Creek Sub-District Owned

Prior to early 1990, the Cities of Lee's Summit, Raymore, Lake Winnebago, and Greenwood were served by a sewer district that operated a lagoon treatment system downstream of Lake Winnebago. The Middle Big Creek Sub-District (MBC) was formed in the early 1990's by petition as a sub-district of the Little Blue Valley Sewer District. This sub-district, which is ultimately governed by the Little Blue Valley Sewer District Board of Trustees, serves the cities of Lee's Summit, Greenwood, Raymore, and Lake Winnebago. It also serves two Cass County sewer district's, Dikeland and Mullendike. MBC has a Board of Trustees that provides recommendations to the LBVSD Board of Trustees for approval. LBVSD provides operation and maintenance to the MBC facilities. The boundaries of MBC are shown on Figure 4-3.

Wastewater collected in the cities and sewer districts served by the Middle Big Creek Sub-District are ultimately conveyed to the LBVSD for treatment at its wastewater treatment plant. The Middle Big Creek Sub-District facilities include:

A. Greenwood Pump Station and Force main: These facilities convey wastewater collected by Lee's Summit and Greenwood within the Big Creek Watershed and pump it to the Raintree Pump Station.

B. Lake Winnebago Pump Station and Excess Flow Holding Basin: This excess flow holding basin is the old Middle Big Creek Lagoons converted to serve as wet weather wastewater storage. Wastewater that exceeds the capacity of the Raintree Pump Station is diverted through the Lake Winnebago Interceptor, combines with the flow from Lake Winnebago and is stored in this basin until the wet weather subsides. The stored wastewater is then pumped by the Lake Winnebago Pump Station to the Raintree Pump Station for conveyance to the LBVSD's conveyance and treatment system. During dry weather, the Lake Winnebago Pump Station serves Lake Winnebago only by pumping its flow to the Raintree Pump Station.

C. Raintree Pump Station and Force main: The Raintree Pump Station and force main convey wastewater collected from the Middle Big Creek, Alexander Creek, and Big Creek Watersheds north and west to the Mouse Creek Interceptor in Lee' s Summit.

D. Mouse Creek Interceptor: The Mouse Creek Interceptor conveys the wastewater plus wastewater collected from the Mouse Creek Watershed in Lee's Summit to the LBVSD's Interceptor under Longview Lake. Although the Mouse Creek Interceptor is a Middle Big Creek facility, Lee's Summit contributed to the upsizing of the line to serve growth areas in the Mouse Creek Watershed. The capacity of this interceptor is limited at the discharge to the LBVSD due to the size of the District's interceptor under Longview Lake.

E. Raintree Lake and Lake Winnebago Interceptors: These interceptors are located under Raintree Lake and Lake Winnebago. They are used to convey wastewater collected by the Cities of Lee's Summit and Lake Winnebago to the pumping facilities owned by MBC. Both of these interceptors will operate under surcharge conditions to be able to serve future growth of the area served by Middle Big Creek Sub-District.

F. Alexander Creek Interceptor (City of Raymore): The City of Raymore owns the Alexander Creek Interceptor, which conveys wastewater from Raymore and from the Dikeland Sewer District to the Raintree Pump Station. This interceptor also conveys wastewater from a section of the collection system (owned by Lee's Summit) in the Raintree Lake Subdivision to the Raintree Pump Station.

MBC and LBVSD are currently evaluating the feasibility of expanding the Middle Big Creek facilities to address the growth in its member communities and to include the City of Pleasant Hill. Alternatives include: 1) expansion of the existing pumping facilities, and 2) construction of a regional wastewater treatment plant to serve the Sub-District.

4.2 EXISTING WASTEWATER TREATMENT FACILITIES

There are no wastewater treatment facilities located within the City. All wastewater collected in Lee's Summit is conveyed by City-owned, MBC-owned, and/or LBVSD-owned facilities to the LBVSD Wastewater Treatment Plant.

4.2.1 Little Blue Valley Sewer District

LBVSD recently completed the expansion of its wastewater treatment facilities to an average daily flow capacity of 52 million gallons per day and a peak wet weather flow capacity of 400 million gallons per day. It is anticipated, based on a facility plan completed in 2001, that this capacity, along with scheduled improvements in 2011, will be capable of meeting the District's growth plans through the Year 2020. A major component of the scheduled 2011 improvements is to provide improvements to the interceptor system, such as the proposed excess flow holding basins, so that peak flows will not result in backups into city-owned collection systems or become overflows to the Little Blue River. Another component is to upgrade the sludge disposal facilities. The Missouri Department of Natural Resources (MDNR) has promulgated new regulations that require all wastewater treatment facilities meet disinfection limits by 2013. This may require LBVSD to add these facilities to their plant in their 2011 project. Efforts are ongoing by LBVSD to obtain a waiver for this requirement since LBVSD discharges to the Missouri River. MDNR is also considering new limits for ammonia, which could impact future improvements to the District's treatment facility.

Future expansion of the LBVSD's wastewater treatment plant will be necessary to address growth beyond 2020. Recent growth planning by the District appears to indicate that growth, especially in MBC, is exceeding previous projections. With the growth anticipated in MBC, expansion prior to 2020 may be necessary unless separate treatment facilities are constructed in the MBC.

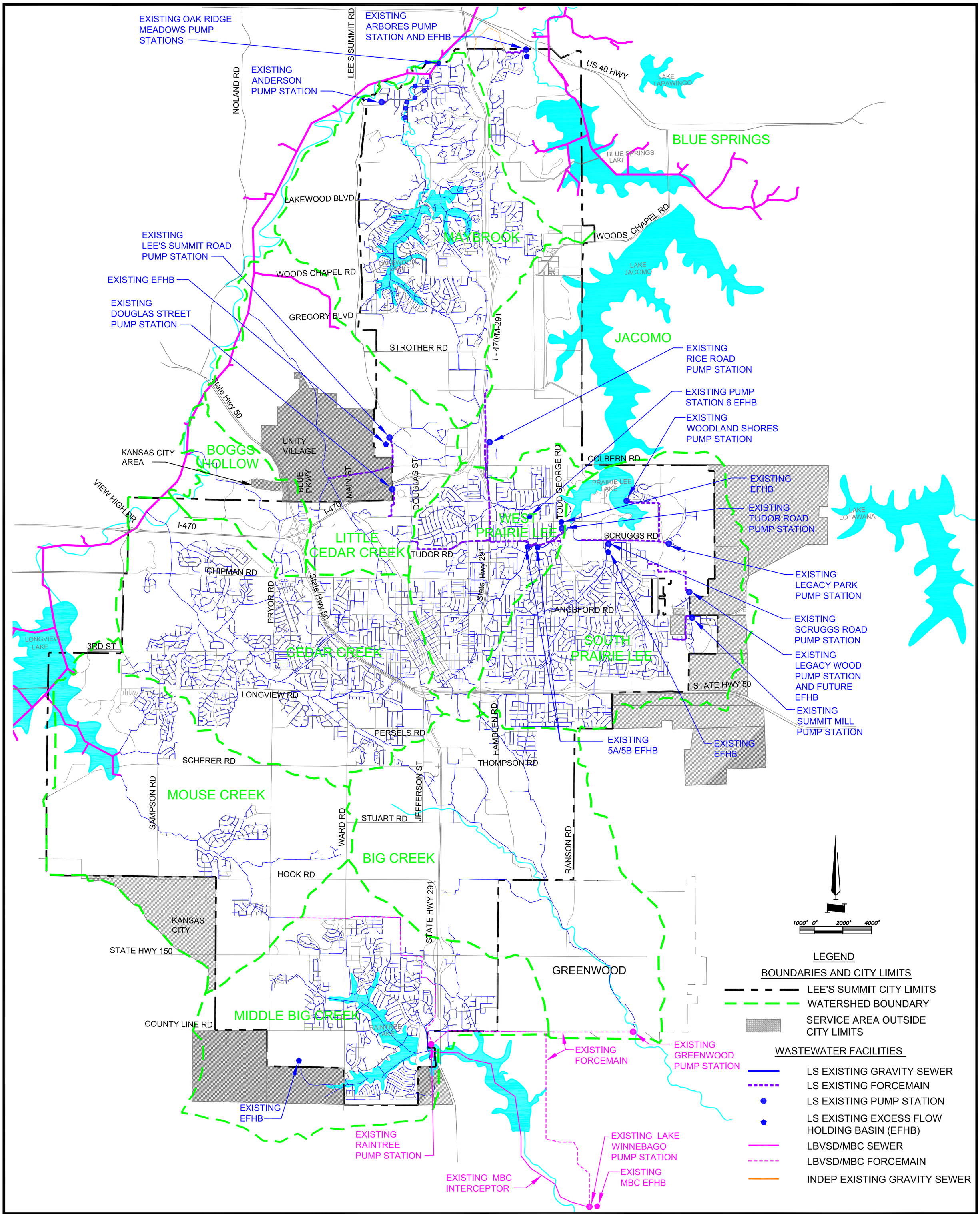
4.3 EVALUATION OF UNSEWERED AREAS

The City of Lee's Summit has several areas within the City that have developed but are not served by sewers.

One of these areas is the Prairie Lee Lake area. Homes were constructed prior to annexation by the City. Wastewater service is provided by septic tanks. As these septic tanks and lateral fields start to fail, leachate will eventually seep into the lake. The City is currently in discussions with the homeowners around Prairie Lee Lake in an effort to provide wastewater service to this area.

Another developed, unsewered area is the industrial area along Highway 291, south of 50 Highway. Septic tanks and temporary storage tanks are used for wastewater in this area. Property owners are responsible for hauling and final disposal of stored wastewater. The City has worked with property owners in this area in an effort to form a Neighborhood Improvement District to help finance collection system improvements. The effort has been unsuccessful.

Other unsewered areas include large estate lots in remote areas where collection system facilities are not available. Providing sewers to these areas as well as the undeveloped land left in the City will most likely become the responsibility of the developers of these areas. This Master Plan will provide the plan for location and sizing of these future collection system improvements.



CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

EXISTING COLLECTION AND CONVEYANCE SYSTEM

FIGURE 4-1

Archer CH2MHILL

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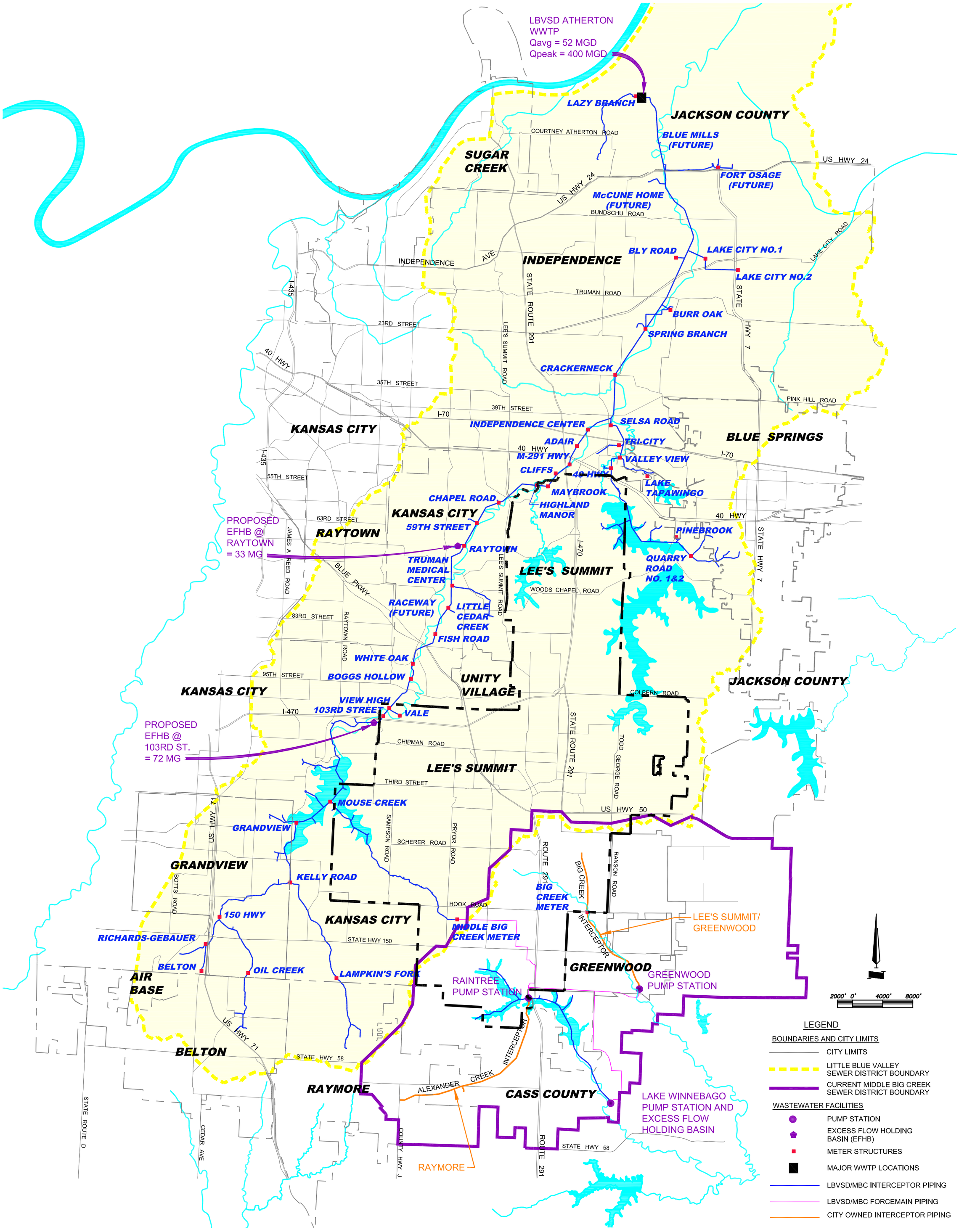

LITTLE BLUE VALLEY SEWER DISTRICT
WASTEWATER CONVEYANCE SYSTEM
FIGURE 4-2

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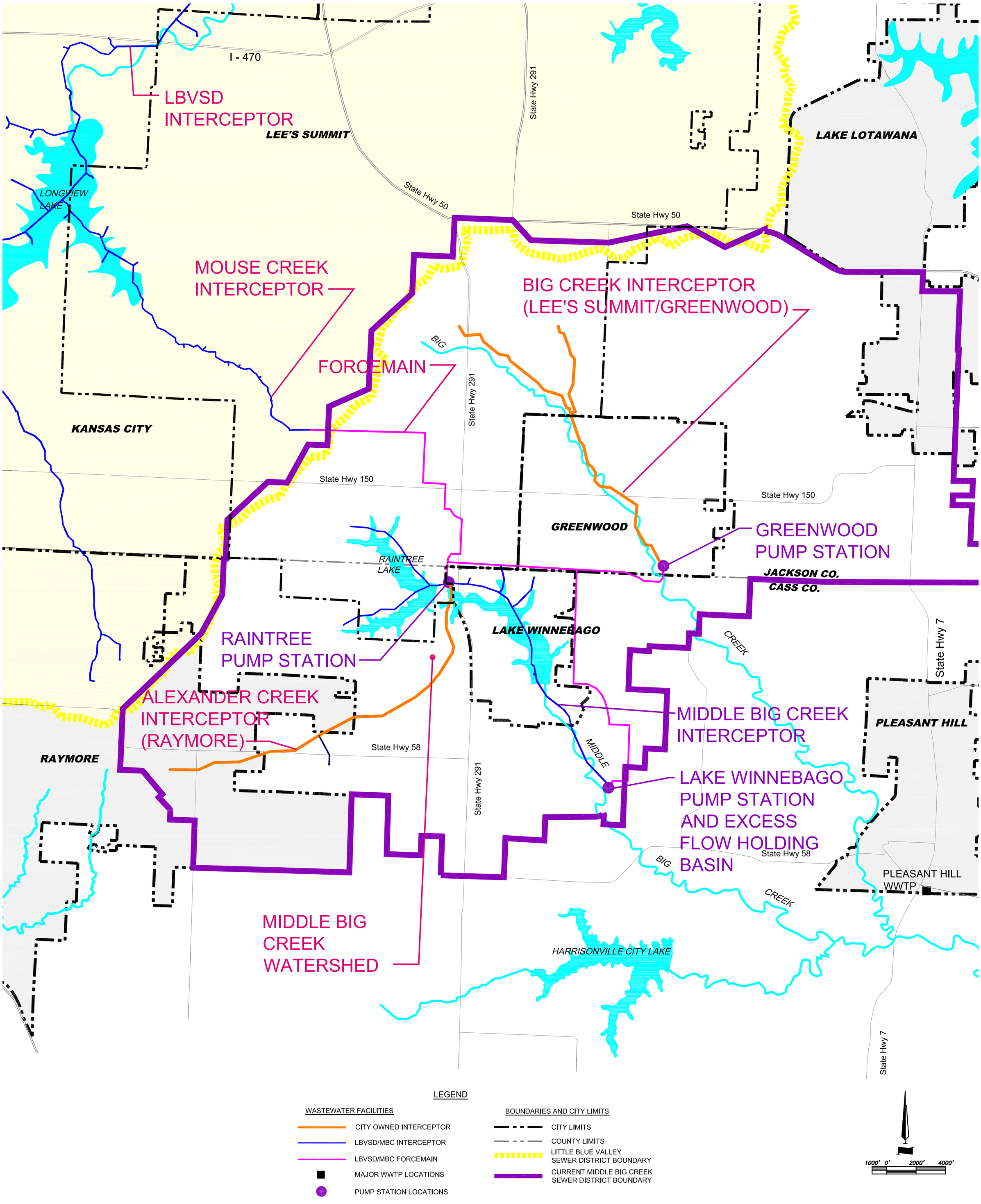


MIDDLE BIG CREEK SUB-DISTRICT
EXISTING FACILITIES
FIGURE 4-3

P:\0300000327-Lees summit wastewater Master plan\CAD\Exhibits\8-11-06\Figure 4-3.dwg

5 FUTURE FACILITY IMPROVEMENTS

This section of the Master Plan identifies the basis for planning wastewater collection and treatment facilities to serve the ultimate build out of the City of Lee's Summit. The basis of this effort is that all future improvements are made with the consideration of what is needed at the ultimate development condition. In some cases, the future improvements are new sewers and/or pumping facilities that will be sized for the ultimate growth at the time the facilities are constructed. However, many of improvements represent upgrades to existing facilities as these facilities play a significant role in serving the City at full build out. Phased improvements to match growth have been considered. The Master Plan also considers the anticipated growth that will take place in the City through the Year 2015 and reflects improvements to address this growth.

The City's hydraulic model was an important tool used to assess the impacts of growth on the existing facilities. This model was used to evaluate the impact of aging sewers, with increasing extraneous flow, as well as the impact of development of undeveloped land on the existing infrastructure. The same model was used to predict the size of facilities that will be constructed in the future to serve the ultimate growth condition. A summary of the City's model is included in the Appendix.

Finally, the master planning of Lee's Summit is not complete without consideration of the impacts that the City may have on the LBVSD and MBC, who convey and treat 100 percent of the wastewater generated within the City. Coordinated planning efforts for future growth within the City and these wholesale wastewater conveyance and treatment providers are critical to this long-term planning.

5.1 COLLECTION AND CONVEYANCE SYSTEM

Collection and conveyance system planning is based upon projected land use and wastewater flow rates generated by these land uses. The peak flow rates (experienced during wet weather storm events) are the most critical for pipe line sizing since the major purpose of the sewer network is to collect and convey wastewater from its sources to the location of storage and/or treatment facilities without causing overflows and sewer backups. Gravity collection and conveyance systems are designed to convey wastewater by gravity flow with no more than a full pipe. However, when the wastewater flow rate exceeds the full-pipe capacity of the system, the system becomes surcharged and the wastewater level builds up in the manholes to a level above the top of the pipe. Wastewater systems normally have the ability, due primarily to the pipelines depth, to withstand low to moderate surcharging. However, at some point, excessive surcharging of wastewater collection and conveyance systems may cause the back up of wastewater into residences and/or businesses connected to the system. Also, excessive surcharging may cause the wastewater to surcharge to a level at or above the tops of manholes and overflow into adjacent drainage courses. These are referred to as sanitary sewer overflows (SSO).

The proper design and operation of the City's wastewater collection system should allow the City to eliminate all excessive surcharging that could cause basement backups and sanitary sewer overflows. To that end, the City commissioned studies that generated a methodology for estimating the amount of flow for which the City's sewers should be sized to convey. Subsequently, Section 6500 of the City's Design and Construction Manual was adopted to require new sewers to be constructed based on specific design criteria. A copy of the portion of Section 6500 addressing sewer capacity is included in Appendix 9.2. As part of this master planning process, Archer/CH2M HILL compared the methodology adopted by the City to design criteria that has been established in other communities. The City of Independence, Missouri and the Johnson County Unified Wastewater Districts commissioned studies to flow monitor and to derive sizing criteria for sewers. Like Lee's Summit, these curves are based on ultimate build-out

of land and based on peak wet weather flow rates. Figure 5-1 provides a summary of the design curves for these three sewer systems.

It should be noted that the design curves in Independence and JCUWWD predict peak flows higher than the 50-year frequency curve that was derived for Lee's Summit.

Ultimately, all of the wastewater collected in the City is conveyed to regional conveyance facilities owned by LBVSD and MBC. Operation of the City's system is dependent upon the operation of these regional systems. Excessive surcharging within these systems has a direct impact on the operation of the City's system.

5.1.1 City Owned

The first step in planning wastewater collection and conveyance systems is to establish the conveyance plan for the City for the ultimate build-out condition. As stated earlier, layout and sizing of sewers today should consider ultimate conditions to avoid excessive surcharging and future limitations for growth. Figure 5-2 is the recommended wastewater conveyance plan for the City of Lee's Summit. Following is a description of the conveyance plan by watershed:

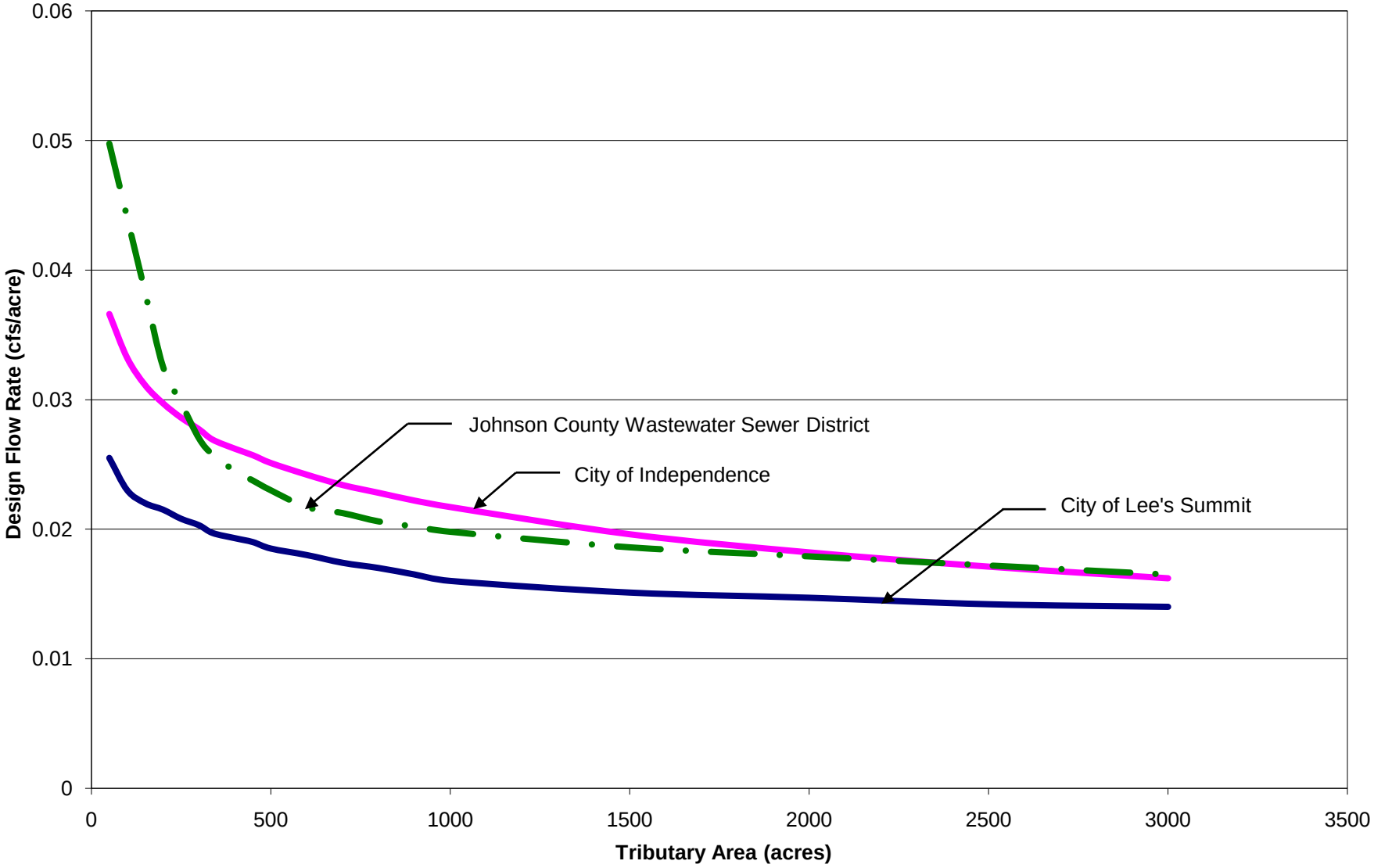
Blue Springs Watershed: Service to this watershed will continue to be provided by unmetered connections to the LBVSD's Interceptor under and downstream of Blue Springs Lake. It is recommended that the Arbores Pump Station be eliminated and a gravity connection be provided.

Maybrook Watershed**:** Wastewater collected in the Maybrook Watershed and pumped to this watershed from the Tudor Road Pump Station (West and South Prairie Lee Watersheds) is conveyed to the LBVSD Interceptor at the Maybrook Meter Structure. It is recommended that the West and South Prairie Lee wastewater be redirected to the Little Cedar Creek Watershed for ultimate conveyance to the LBVSD. A detailed evaluation supporting this recommendation is included in Section 6. Previous reports recommended that the City continue to pump 16 million gallons per day from the West and South Prairie Lee Watersheds to the Maybrook Watershed. This recommendation also included the construction of an excess flow holding basin in the Maybrook Watershed to decrease the peak flows to acceptable surcharge levels in the Maybrook Interceptor. Redirecting the flow to the Little Cedar Creek Watershed offers several long-term benefits to the City. First, the need to construct an excess flow holding basin in the Maybrook Watershed is eliminated. Due to the location of the Maybrook Interceptor, this basin would have to be located somewhere near I-470 and would most likely require the City to acquire relatively expensive commercial or industrial land for its construction. Second, pumping wastewater into the Maybrook Watershed presents higher risks of system overflows and corrosion to the interceptor under Lakewood, even with the use of an EFHB.

The City will continue to operate its pump stations in the north portion of this watershed during peak wet weather events to avoid potential surcharging from the LBVSD Interceptor. In the future, it may be necessary to construct an additional pump station near Lee's Summit Road to serve an area that cannot be served by a gravity sewer.

Jacomo Watershed: This watershed naturally drains towards Lake Jacomo. There are no lake bottom sewers under Lake Jacomo, such as the sewers constructed under Lakewood, Blue Springs Lake, Longview Lake and Raintree Lake. Therefore, it is recommended that wastewater collected in this watershed be collected and pumped to other watersheds. The Savannah Woods area is currently being developed with a pump station that will pump north into the Blue Springs Watershed. The remaining portion of the watershed, most of which is PRI property, will be conveyed by gravity to pump stations and excess flow holding basins located near the boundaries of Fleming Park. It is recommended that the wastewater from these pump stations be pumped into the Maybrook Watershed for conveyance to the LBVSD Interceptor. Due to limitations to the Maybrook Interceptor under Lakewood, it is

Figure 5-1
Peak Wastewater Flow (50-year)
Comparison



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recommended that each pump station be constructed with an EFHB that will allow the peak flows to be stored until capacity in the Maybrook Interceptor is available. It is recommended that an interceptor be extended to the site of the existing pump station near Rice Road as part of the ultimate wastewater conveyance improvements.

Little Cedar Creek Watershed: It is recommended for the ultimate wastewater service plan that the Little Cedar Creek Interceptor serve as the major conveyance system for the wastewater flows from the Little Cedar Creek, West Prairie Lee, and South Prairie Lee Watersheds to the LBVSD Interceptor. This interceptor connects to the LBVSD Interceptor at the Little Cedar Creek Meter Structure. This interceptor was upgraded in the 1990s to convey up to 4 million gallons per day from West and South Prairie Lee Watersheds. It is recommended that this system be upgraded for the ultimate plan to convey 24 million gallons per day from the West and South Prairie Lee Watersheds. This will require upgrades to the Little Cedar Creek Interceptor and the construction of a new 24-inch force main along Tudor Road from M 291 Highway to near Douglas.

West and South Prairie Lee Watersheds: Service to these two watersheds has been studied for more than 20 years. In the 1980s, a study was completed to evaluate the feasibility of constructing an interceptor under Prairie Lee Lake and Lake Jacomo to convey the wastewater to the LBVSD. At that time, the costs were significant. The major reason why this alternative is not feasible is the lack of capacity of the LBVSD Interceptor under Blue Springs Lake. Therefore, it would be necessary to construct pumping facilities at the downstream location of the proposed sewer under Lake Jacomo and several miles of force main to pump the peak flows to the LBVSD's main interceptor somewhere near its crossing of I-470. This is cost prohibitive and is not recommended.

A recent engineering study by CTE considered alternatives for these watersheds. After review of this study and completion of a cost comparison, it is recommended that the ultimate wastewater conveyance plan for the West and South Prairie Lee Watersheds be as shown in Figure 5-3 and as follows:

a. Serve the east portion (also referred to as the East Prairie Lee Watershed) of the South Prairie Lee Watershed by pumping the wastewater from the Woodland Shores, Legacy Park, and Legacy Wood Pump Stations west to the Scruggs Road Pump Station. Construct the Legacy Wood Excess Holding Basin as planned. Retire the Summit Mill Lift Station.

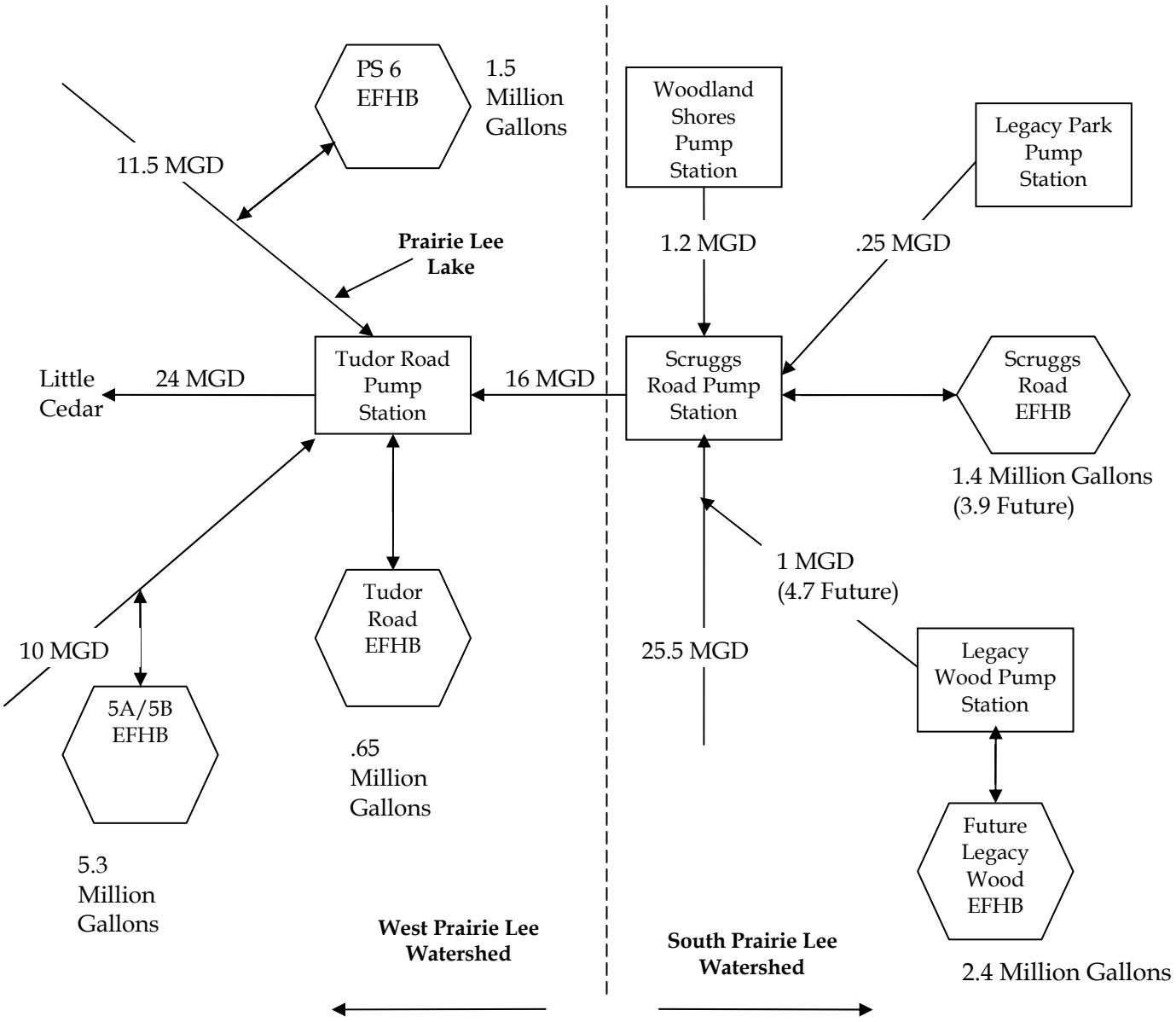
b. If the City annexes property east towards Lake Lotawana as shown on Figure 5-2, this wastewater should also be pumped west to the Scruggs Road Pump Station. An EFHB should be included to limit pumping to the Scruggs Road Pump Station during a peak flow event. Since this is outside the boundaries of the LBVSD, it is recommended that the City formally request permission to pump this wastewater into the District prior to annexation and development of this area.

c. Upgrade the Scruggs Road Pump Station to a capacity of 16 million gallons per day. Upgrade the force main and gravity interceptor from the pump station to the Tudor Road Pump Station to the same capacity. Expand the Scruggs Road EFHB so that pumped wastewater from the Scruggs Road Pump Station does not exceed 16 million gallons per day.

d. Upgrade the Tudor Road Pump Station to a capacity of 24 million gallons per day.

e. Provide assistance to the residents in the Prairie Lee Lake area to provide a low pressure sewer collection system to eliminate all septic tanks in this area.

Figure 5-3
West and South Prairie Lee Watershed
Pumping/Storage Schematic



Bogg's Hollow Watershed: This watershed is served by a gravity interceptor. In the past, the Cities of Kansas City and Lee's Summit have shared this interceptor. The City of Kansas City is currently in the process of constructing a new parallel interceptor to convey most of Kansas City's wastewater in the watershed to the LBVSD Interceptor. One Kansas City subdivision will remain connected to Lee's Summit's interceptor. It is recommended that Lee's Summit continue to convey wastewater from this watershed to the LBVSD Interceptor (Boggs Hollow Meter Structure) in the existing interceptor.

Cedar Creek: The Cedar Creek Watershed is served by a gravity collection and conveyance system. It is recommended that this conveyance plan be maintained. Wastewater is conveyed and connected to the LBVSD Interceptor at the Vale Meter Structure.

Mouse Creek Watershed: The Mouse Creek Watershed conveys wastewater collected in the southwest part of Lee's Summit and a portion of Kansas City, Missouri, south of Hook Road to the Little Blue Interceptor at Longview Lake. The interceptor is located under the Mouse Creek branch of Longview Lake. Wastewater is also pumped from the Middle Big Creek Sub-District to the Mouse Creek Interceptor for conveyance to the LBVSD wastewater treatment plant. It is recommended that the City continue to use this interceptor for conveyance of Mouse Creek Watershed wastewater to the Little Blue Valley Sewer District. As part of the Middle Big Creek Sub-District, the City should work with the other customers of the Sub-District to implement a plan for a regional wastewater treatment plant in the Middle Big Creek/Big Creek Watersheds.

Middle Big Creek Watershed: The Middle Big Creek Watershed is served by a gravity conveyance system that is located under Raintree Lake. The capacity of the interceptors under the lake is limited and expansion is not feasible. It is recommended that the City utilize EFHBs in the sub watershed areas upstream of the lakes to reduce peak wastewater flows and avoid excessive surcharging. It is recommended that the City proceed with the construction of the proposed EFHB west of Ward Road, serving the north branch of the conveyance system. In addition, EFHBs should be required of new developments west of Ward Road that contribute to the south branch of the conveyance system. One of these basins was recently constructed at Kensington Farms. Prior to developing, an EFHB should be constructed in the undeveloped part of the watershed south of Kensington Farms.

Conveyance facilities, including the Raintree Pump Station and force main and the Lake Winnebago Interceptor and Pump Station, owned by the MBC, are reaching capacity. It is recommended that the City work with the other MBC customers to implement a plan for a regional wastewater treatment plant in the Middle Big Creek/Big Creek Watersheds.

Big Creek Watershed: The portion of the City in the Big Creek Watershed is served by a gravity interceptor system that conveys wastewater from Lee's Summit and Greenwood to the Greenwood Pump Station, owned by the MBC. The City shared in the cost of the interceptor and "owns" 6 million gallons per day capacity in this pipe. It is recommended that the City provide EFHBs in the City upstream of Greenwood to limit Lee's Summit wastewater peak flow to this interceptor to the capacity owned by the City. It is recommended that the City work with the other Middle Big Creek Sub-District customers to implement a plan that upgrades the Greenwood Pump Station prior to the time that wastewater flow from Lee's Summit and Greenwood exceed the pump station capacity. In addition, it is recommended that the City work with the customers of the Sub-District to implement a plan for a new interceptor to replace the Greenwood pump station and to construct a regional wastewater treatment plant in the Middle Big Creek/Big Creek Watershed.

The City is considering annexation of land east along US 50 Highway. Some of this potential annexation land is located in the upper part of the Big Creek Watershed. Ultimately, development of the Big Creek Watershed, which is included in the legal boundary of the Middle Big Creek Sub-District, will include gravity interceptors to this property. However, since growth in the area is probably contingent upon future annexations of cities other than just Lee's Summit, it is recommended that the City plan for conveyance of this wastewater back to the north by pumping. It is recommended that sufficient storage

be provided at the pump station to restrict the flow being pumped into the South Prairie Lee Watershed during peak wet weather periods. Since this property falls outside of the boundaries of LBVSD, it is recommended that the City request approval of the District prior to annexation and development of this new area. In addition, other alternatives, such as sub-regional wastewater treatment and a gravity interceptor to the Middle Big Creek Sub-District facilities should be considered. Interim treatment facilities for that area within MBC should be evaluated.

5.1.2 Little Blue Valley Sewer District Owned

The Little Blue Valley Sewer District completed a master plan for its conveyance and treatment systems in 2000, a facility plan for the improvements in 2001, and an interceptor capacity evaluation in 2005. As a result, the District has initiated plans for expansion of the capacity of their conveyance systems to accommodate growth of its customers through the Year 2020. The Master Plan and Facility Plan recommended the construction of three peak flow pump stations along the interceptor starting in the year 2011. Upon completion of these pump stations, totaling approximately $30 million, the interceptor would be increased its capacity to convey wastewater from approximately 300 million gallons per day to approximately 400 million gallons per day.

During the wet weather experienced in the spring of 2004, peak flows exceeded 360 million gallons per day. As a result, a study to evaluate the use of storage as a way to reduce peak flows was completed. This study concluded that the most cost effective, phased approach to adding conveyance capacity was to construct excess flow holding basins at two locations along the interceptor. The first location is a site at 103rd Street and I-470, where Kansas City operated a four-cell lagoon treatment plant until it was retired in the 1970s. An EFHB at this site was the most cost- effective alternative for reducing peak flows by diverting all of the interceptor flow at that location during a peak event and then releasing it into the interceptor after the event. The next most cost-effective location was a site in Raytown. Again, Raytown operated lagoons at this location until the interceptor allowed the City to retire the plant in late 1970's.

The cost of these EFHBs was estimated to be less than $20 million. The LBVSD Technical Advisory Committee was in favor of further consideration of this solution for interceptor improvements. Discussions were held during the Technical Advisory Committee meeting related to the schedule of these improvements as it related to surcharging problems experienced by Lee's Summit during the 2004 peak flow events. The District is in the process of applying for a State Revolving Fund loan to provide for construction of the improvements, including the storage basins.

Future improvements to increase capacity of the District's interceptor system may include additional storage facilities and peak flow pump stations.

It is recommended that the City remain proactive in its support of the construction of the proposed EFHBs, as soon as possible, to limit the risk of excessive surcharging of the Little Blue Interceptor.

5.1.3 Middle Big Creek-Owned

Improvements to the Middle Big Creek Sub-District conveyance system will be required to accommodate the projected growth in the Big Creek and Middle Big Creek watersheds. Besides Lee's Summit, growth is projected in the Cities of Greenwood, Raymore, and Lake Winnebago. In addition, the City of Pleasant Hill is facing growth pressures and the need to expand its wastewater treatment facilities. If the Sub-District makes the decision to expand its conveyance system, it is projected that improvements will be required by 2010 for the Greenwood and Lake Winnebago Pump Stations; eventually, the Raintree Pump Station will need to be expanded; and a parallel force main from the Raintree pump station to its connection to the Mouse Creek Interceptor will need to be constructed. Expansion of the Middle Big Creek Sub-District conveyance facilities will be limited by capacity of the LBVSD Interceptor under Longview Lake and the Mouse Creek Interceptor in Lee's Summit. To accommodate the predicted peak flows, EFHBs will be required. Expansion of the Sub-District's EFHB southeast of Lake Winnebago

may also be required. In addition, an EFHB in the Mouse Creek Watershed and upgrading of the Mouse Creek Interceptor will be needed.

A preliminary engineering study has been completed by Archer Engineers for the Middle Big Creek Sub-District. This study evaluated the alternatives of expanding the existing conveyance system as well as several alternatives to expand the Sub-District to include Pleasant Hill and for the Sub-District to construct a regional wastewater treatment plant near Pleasant Hill. The Sub-District Board and customers are considering these alternatives. An application for State Revolving Fund loans to finance improvements to the Sub-District's system was submitted in November 2006.

It is recommended that the City work with the other customers of the Middle Big Creek Sub-District and the LBVSD to move forward with a plan for the construction of a regional wastewater treatment plant.

5.2 WASTEWATER TREATMENT FACILITIES

5.2.1 City-Owned

The City currently owns no wastewater treatment facilities. All wastewater that is collected in the City is conveyed to the LBVSD wastewater treatment plant. As the City considers alternatives to expand and annex to the east and south, expansion of its conveyance system is recommended as discussed in Article 5.1. However, as Lee's Summit's growth continues into the upper portions of the Big Creek and Sni-A-Bar (Lake Lotowana) Watersheds and due to limitations in capacity within the City's conveyance system, alternatives for sub-regional wastewater treatment should be considered.

5.2.2 Little Blue Valley Sewer District-Owned

LBVSD operates a wastewater treatment plant on an 80-acre site approximately one mile south of the Missouri River. The treatment plant was constructed in the early 1980s and was recently expanded to an average flow capacity of 52 million gallons per day with a peak flow capacity of 400 million gallons per day. Treated effluent from the plant is conveyed for discharge to the Missouri River.

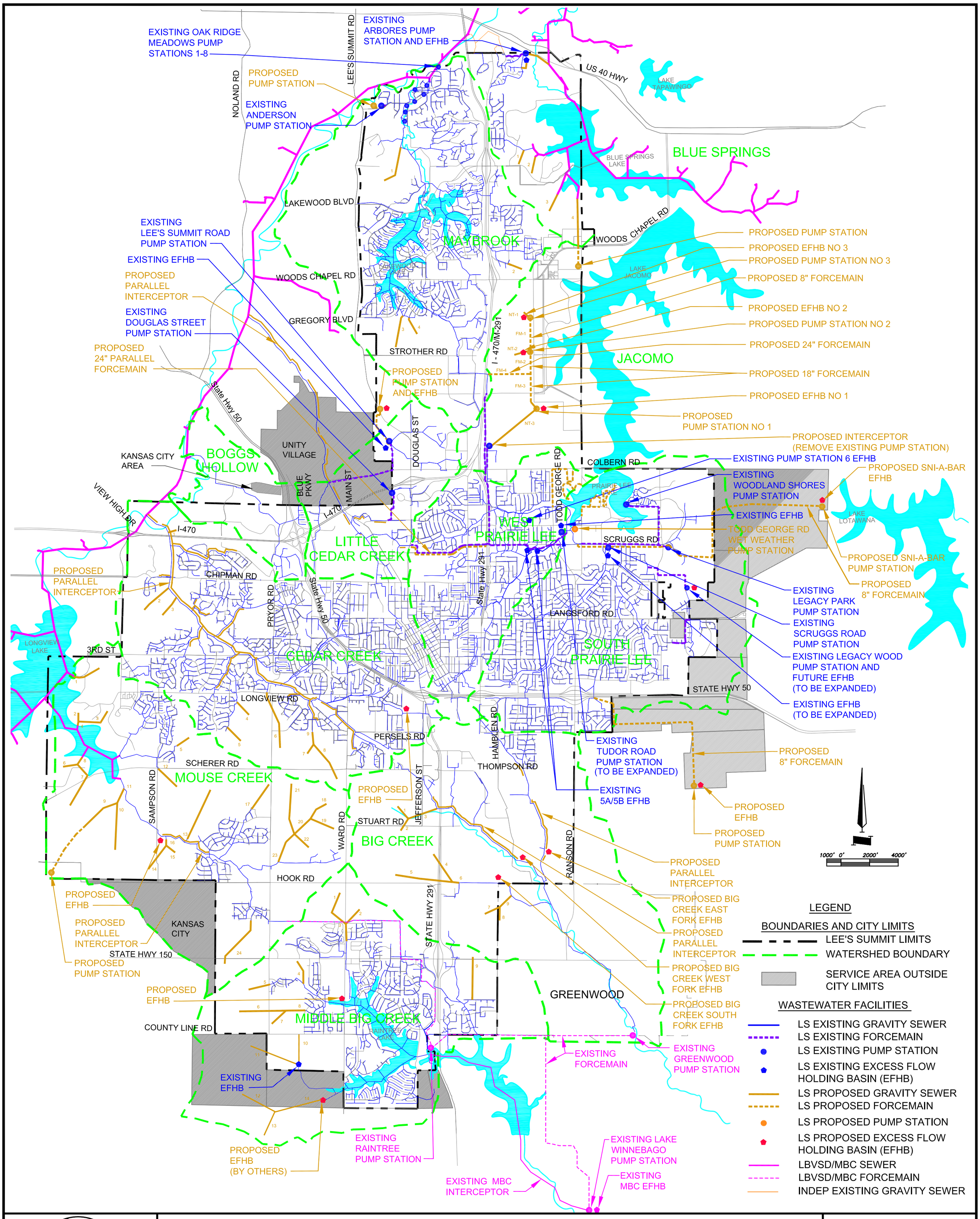
The current capacity was provided with the first phase of a two-phase project that resulted from the 2001 Facility Plan. The second phase of the plant improvements are scheduled to take place in 2011. These improvements include replacement of the sludge conditioning system with sludge drying equipment. The Phase 1 and 2 improvements are intended to provide treatment capacity for the LBVSD's customers through 2020.

As part of the 2001 Facility Plan, future expansion (beyond 2020) was considered. The treatment plant site has sufficient area to expand the average capacity of the plant to at least 100 million gallons per day. Peak flow treatment capacity beyond the current 400 mgd capacity is limited due to interceptor and influent pump station capacity.

Changing environmental regulations may force improvements at the LBVSD's treatment plant, regardless of the need to increase capacity. In the short term, disinfection and ammonia limits are being considered by the MDNR. In the long term, total nitrogen and phosphorus may be considered.

5.2.3 Middle Big Creek-Owned

The Middle Big Creek Sub-District currently pumps all of the wastewater collected within its service area to the Little Blue Valley Sewer District for treatment. The customers of the Sub-District are considering alternatives to address the growth within the Sub-District. One of the alternatives is to expand the Sub-District to include Pleasant Hill and to construct a regional wastewater treatment plant southeast of Pleasant Hill to serve the Sub-District. It is recommended that the City remain proactive in these discussions.



CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN
ULTIMATE CONDITION WASTEWATER CONVEYANCE PLAN
FIGURE 5-2

Archer CH2MHILL

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6 ALTERNATIVE EVALUATIONS

The preparation of this Wastewater Master Plan included the evaluation of alternatives for providing conveyance and treatment service to the City of Lee's Summit. As discussed in Section 5, alternatives for providing wastewater treatment in the Middle Big Creek Sub-District in lieu of expansion of the conveyance system to pump the wastewater to the LBVSD are currently being considered by the Sub-District's customers, including the City. Likewise, alternatives for providing peak flow capacity in the LBVSD Interceptor have been considered by the District's Technical Advisory Committee.

Alternatives for providing collection and conveyance facilities within the City were evaluated and discussed with the City's staff during master planning workshops. Following is a summary of these evaluations.

6.1 EVALUATION OF IMPROVEMENTS WITHOUT PRI DEVELOPMENT

The conveyance system plan, shown in Figure 5-2, was based on ultimate development of the entire city. Based on discussions between the City and PRI, a plan was developed showing the development of the conveyance system with the PRI property remaining undeveloped for an indefinite period. Figure 6-1 represents this alternative. The major difference in the alternatives for the ultimate wastewater conveyance facilities is the elimination of the interceptors, trunk lines, and pump stations that were recommended to serve the PRI property.

In the case of the PRI South property, the conveyance systems in the Cedar Creek, Mouse Creek, and Big Creek Watersheds can be reduced due to the elimination of projected flow from the PRI property.

The future pump stations and storage basins adjacent to Jacomo can be eliminated if the PRI North property is removed from conveyance system master planning. Under this alternative, the Rice Road Pump Station will remain as a permanent part of the Lake Jacomo Watershed conveyance facilities.

Capital improvement cost savings related to this alternative are addressed in Section 8.

6.2 EVALUATION OF CONVEYANCE ALTERNATIVE FOR MAYBROOK, SOUTH AND WEST PRAIRIE LEE, AND LITTLE CEDAR CREEK WATERSHEDS

Providing wastewater service to the Maybrook, South and West Prairie Lee, and Little Cedar Creek Watershed is complicated by the limitations provided by the location of Prairie Lee Lake, Lake Jacomo, and Lakewood Lake. There are no lake-bottom interceptors under Lake Jacomo or Prairie Lee Lake; and, the interceptor under Lakewood Lake has limited capacity. Pumping wastewater from the South and West Prairie Lee Watersheds to Maybrook (up to 16 million gallons per day) and Little Cedar Creek (up to 4 million gallons per day), was the most cost-effective alternative for the last 15-20 years due to available capacity in the Maybrook Interceptor. With the projected growth in the Maybrook Watershed, the ultimate wastewater service plan for these watersheds should be evaluated. Following is a description of the three alternative conveyance plans that were considered:

> Alternative No. 1: This alternative assumes that of the 24 million gallons per day conveyed from the West and South Prairie Lee Watersheds, 16 million gallons per day would be pumped to the Maybrook Watershed and 8 million gallons per day would be pumped to the Little Cedar Creek Watershed, all by the Tudor Road Pump Station. Specific improvements include:
>
> a. Upgrade of the Tudor Road Pump Station to include dry pit submersible pumps.
>
> b. Improvements to Little Cedar Creek Interceptor and Force Main.
>
> c. Upgrade the Scruggs Road Pump Station to 16 million gallons per day capacity.

d. Improvements to Scruggs Road force main.

e. Improvements to Scruggs Road EFHB.

f. New 12.8 million gallon EFHB in the Maybrook Watershed.

The estimated capital cost of this alternative is $14.5 million.

Alternative No. 2: This alternative assumes the same flow split to Maybrook and Little Cedar Creek Watersheds as Alternative No. 1, however, it recommends that the Scruggs Road Pump Station will be upgraded to 16 million gallons per day and a new force main will be constructed from the Scruggs Road Pump Station to the intersection of Highway 291 and Scruggs Road. Specific improvements include:

a. Upgrade of Scruggs Road Pump Station to 16 million gallons per day capacity.

b. New force main from Scruggs Road Pump Station to intersection of Highway 291 and Scruggs Road.

c. Improvements to Scruggs Road EFHB.

d. New 12.8 million gallon excess flow holding basin in Maybrook Watershed.

e. Improvements to Little Cedar Creek Interceptor and Force main.

The estimated capital cost of this alternative is $ 14.1 million.

Alternative No. 3: This alternative assumes that the 24 million gallons pumped from the West and South Prairie Lee Watersheds will be pumped entirely to the Little Cedar Creek Watershed, eliminating the need for an excess flow holding basin in the Maybrook Watershed. Specific improvements include the following:

a. Upgrade of the Tudor Road Pump Station to include dry pit submersible pumps.

b. Improvements to the Little Cedar Creek Force Main along Tudor Road.

c. Improvement to the Little Cedar Creek Interceptor.

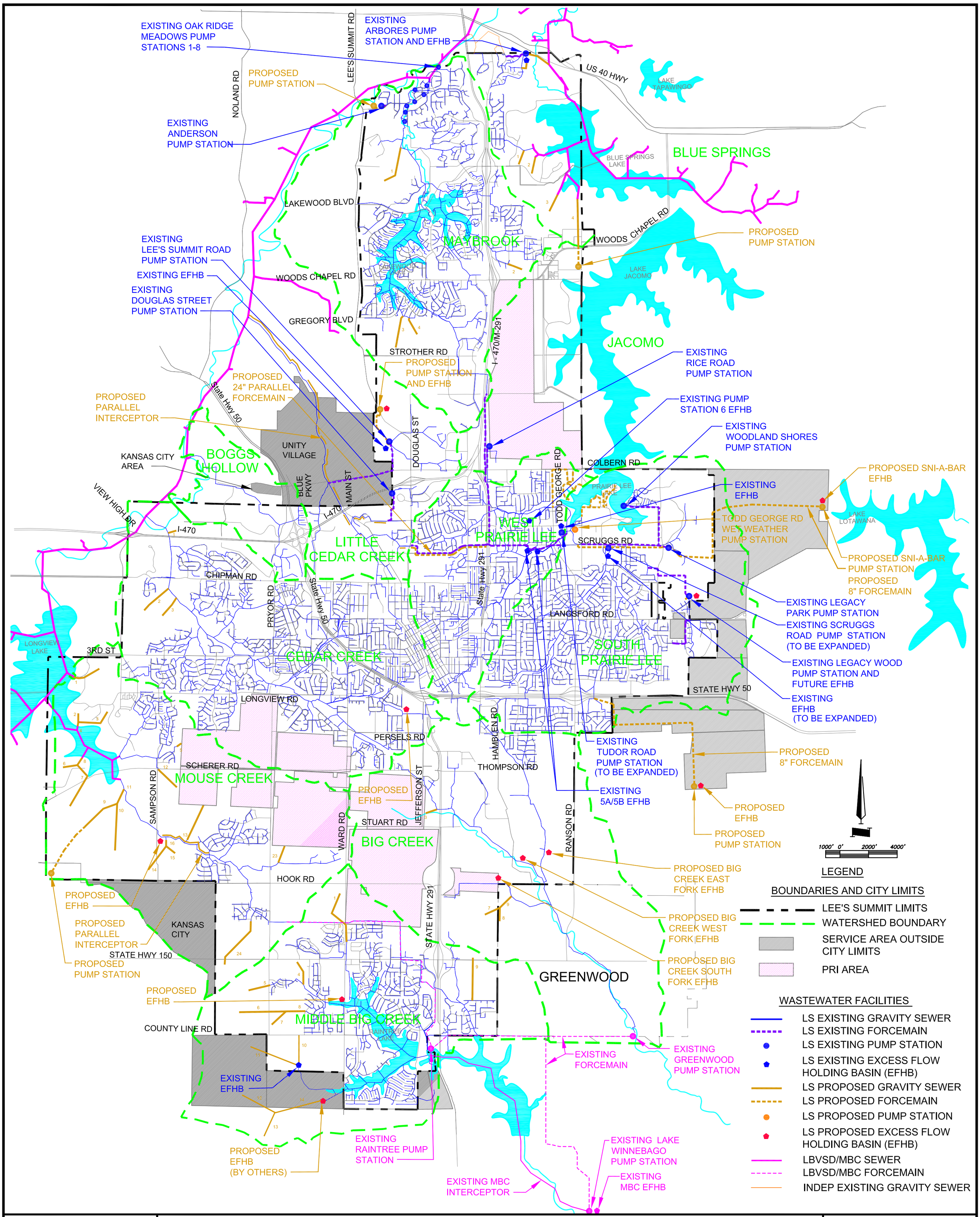
d. Upgrade of the Scruggs Road Pump Station to 16 million gallons per day capacity.

e. Improvements to Scruggs Road force main.

f. Improvements to Scruggs Road EFHB.

The estimated capital cost of this alternative is $ 12.8 million.

Based on this evaluation and after considering the long-term risks associated with odors, corrosion, and potential overflows into Lakewood, it is recommended that Alternative 3 be adopted as the long-term plan for conveyance of the watersheds included in this evaluation.



CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

ULTIMATE CONDITION WITHOUT PRI

FIGURE 6-1

Archer CH2MHILL

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7 COLLECTION SYSTEM SUSTAINABILITY

7.1 COLLECTION SYSTEM IMPROVEMENTS

7.1.1 Estimated Reinvestment for Replacement of Aging Sewers

The City is responsible for maintaining its sanitary sewer system. Aging and deteriorating infrastructure is a challenge facing utilities throughout the United States; a plan for adequate system reinvestment and renewal is crucial for sustainability of the collection system. The intent of this section of the Master Plan is to provide the City with an initial budget estimate for renewal and replacement of the City's collection system

How long pipes last depend on many factors including pipe material, soil conditions, outside forces such as construction, and other environmental factors. The concept of useful life can be used to estimate needed annual infrastructure renewal budget requirements. The useful life of a pipe system can be expressed as a survival function where the probability of survival decreases over time. In other words, as pipe systems age, more and more of the system will require repair and/or replacement. Different survival functions can be used to estimate the survival of a particular group or class of pipe. Survival functions were defined for groups of pipe based on literature values and known pipe condition data collected in the City's system. These survival functions used in concert with replacement costs were used to estimate annual reinvestment needs.

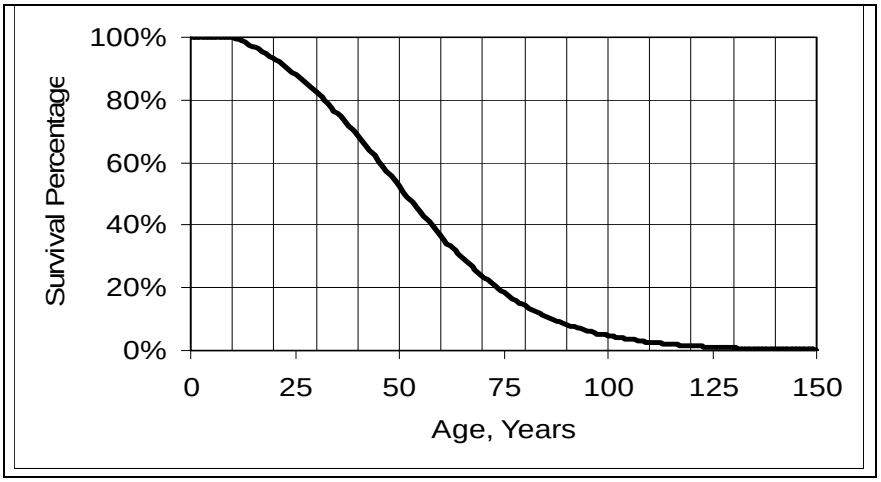
Pipeline reinvestment planning requires knowledge of the system inventory and condition. From this information, projections can be made for identified and unidentified reinvestment needs to maintain the system in good operating condition prior to failure. Specific tasks for pipeline planning include:

- Characterization of the system inventory.
- Collection and analysis of condition data.
- Definition of acceptable service level.
- Definition of pipe survival functions.
- Definition, costing, and prioritization of identified projects and unidentified projects.

Pipe Survival Functions

Pipes have a life-cycle with a beginning and an end. The beginning can be considered as the day the pipe is installed. Pipe degradation from this new condition to the end of its useful life can be estimated based on historical system information and information from ongoing research using survival functions. The life cycle analysis considers the structural life cycle only and does not consider functional obsolescence, which may come about due to increased hydraulic capacity needs due to growth. Aging and cohort survival models have been used to evaluate the probability of survival of infrastructure. The form of the survival function used for this analysis is known as a Herz survival function and is shown in Figure 7-1.

Figure 7-1 Survival Function of Pipes



Where:

$1 - F(t<=c) = 1$

$1 – F(t>c) = (a+1)/(a + \exp [b(t-c)])$

$1 – F (t = \text{infinity}) = 0$

with a, b, and c being aging parameters and t being time in years.

The aging parameters define the shape of the survival function as follows:

- a is the aging factor and determines how slowly the aging process begins
- b is the aging factor and determines how quickly the aging process progresses
- c is the resistance time (or elapsed time from construction to first failure) up to which no reinvestment is needed.

For the example shown in Figure 7-1, a equals 10, b equals 0.06, and c equals 10.

The Herz survival curves are generally classified by the average or median age of failure that corresponds to the 50 percent survival level. In Figure 7-1, the median survival age is 50 years. There is an uncertainty in reported pipe life durations, however. The appropriateness of survival functions used for an analysis can be evaluated if a long and continuous record of pipe performance is maintained. In lieu of this detailed information, estimated survival functions may be used, which is the case for this analysis.

For purposes of the pipeline replacement and renewal analysis, three groups of pipes were defined as shown in Table 7-1. The groups were based on a qualitative assessment of pipes by basin based on

experience of City personnel. Group 1 includes pipes with the lowest rate of deterioration, and represents pipes that are in generally good condition with minimal cracks and breaks. Group 2 includes pipes with medium rates of deterioration and represents pipes that show some cracks and pipe deformations. Group 3 includes pipes with highest rates of deterioration and represents pipes that generally show multiple cracks and pipe deformations.

Table 7-1
Pipe Length by Group

Group	1	2	3	Total
Pipe Length (Ft)	1,781,000	526,000	333,000	2,640,000
Defect Rate	Low	Medium	High	

There are no standards for associating pipe condition with corresponding life expectancy. By defining three groups, improved resolution relative to the overall system pipe life expectancy can be achieved. More or less groups can be defined based on judgment and available data; however, it is recommended at this time that three groups be used until additional data justifies a change.

Survival functions were based on literature values and a review of existing data. Estimates of mean pipe life reported in the literature have a wide variance but are generally expressed as a percent of pipe which "survives" up to a specified age. For this project, three life expectancy curves were selected that represent low, medium and high life expectancies. The three estimated life expectancy survival functions selected were defined as assigned to the three groups as follows:

- Group 1 is the lowest deterioration rate and is based on 50 percent of the pipe requiring replacement in 100 years
- Group 2 is the medium deterioration rate and is based on 50 percent of the pipe requiring replacement in 75 years
- Group 3 is the highest deterioration rate and is based on 50 percent of the pipe requiring replacement in 50 years

To estimate reinvestment needs, a uniform unit cost for replacement was used. Since the vast majority of the system is 8-inch diameter pipe, the construction cost of $125 per linear foot for replacement of pipe was used. Based on the survival functions and the average replacement construction cost, an estimated annual reinvestment need of about $2.75 million is determined in Table 7-2.

Table 7-2 Estimated Annual Reinvestment Need			
Pipe Group	**Pipe Replacement per Year (ft)**	**Construction Cost**	**Total Project Cost**
Group 1	8,900	$ 1,113,000	$ 1,558,000
Group 2	3,500	$ 439,000	$ 615,000
Group 3	3,300	$ 416,000	$ 582,000
Total	15,700	$ 1,968,000	$ 2,755,000
Note: Total project cost includes a 40-percent factor for engineering, contingency, and legal.			

The estimated reinvestment cost presented in Table 7-2 provides guidance for budgeting for reinvestment needs. Since removal of extraneous flows such as infiltration and inflow (I/I) is also a major need for the City's collection system, and removal of I/I in the public sector is a reinvestment that may involve replacement of some aging and deteriorated infrastructure, it is important that the plan consider both reinvestment due to condition of the system and cost for removal of I/I. The costs for I/I removal are analyzed in the following section which is then followed by development of a plan for overall system rehabilitation considering both aging infrastructure and I/I removal.

7.1.2 I/I Removal

Cost-effective removal of I/I is an important element of any collection system improvement program in areas that experience high groundwater and wet weather conditions. The City has conducted field inspection activities in the West Prairie Lee and South Prairie Lee basins including manhole inspections, line lamping, smoke testing, dyed water testing, and closed circuit television (CCTV) inspections which were summarized in previous reports by George Butler Associates (GBA).

In West Prairie Lee Basin 8, the GBA report projected that 71.8 percent of the inflow is originating from the private sector, 10 percent from the public sector, and the remaining inflow from unknown sources.

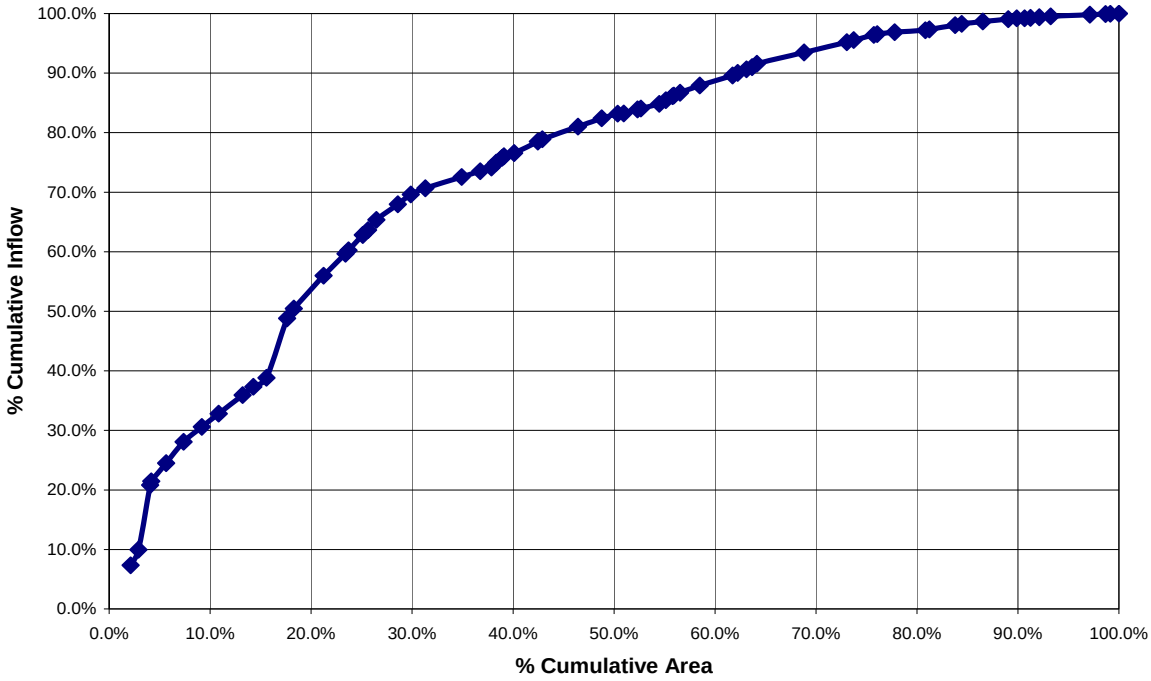
In the West Prairie Lee Basins 9 and 10, the GBA report projected that 62.4 percent of the inflow was from the private sector, 10 percent from the public sector, with the remaining inflow from unknown sources.

In the South Prairie Lee Basins 3 and 8, 99.1 percent of the inflow was unaccounted for.

An analysis was performed by Archer Engineers/CH2M Hill of each of the 69 basins for which flow data is available to identify areas that potentially should be considered for rehabilitation to remove I/I. The qualitative condition rating described in Section 7.1.1 and the inflow rate were used to prioritize basins. The resulting plot showing the cumulative inflow by cumulative area is shown in Figure 7-2.

Figure 7-2

Inflow Distribution in Monitored Basins



The data show that inflow is not uniformly distributed throughout the system and much of the inflow can be accounted for by a smaller proportion of area. The "knee" of the curve in Figure 7-2 shows that 70 percent of the inflow is derived from about 30 percent of the area. By focusing rehabilitation within the 30 percent high inflow areas, overall costs will be reduced and benefits maximized. The basins representing the high I/I areas are shown in Figure 7-3. If 100 percent of the I/I could be completely removed in these basins, system-wide removals would be about 70 percent. Removal of 100 percent however, is not possible and should not be planned on.

A total of 21 basins with 516,253 feet of pipe (31 percent of the monitored system and 20 percent of total current system), comprise the high I/I areas. These areas are shown in Figure 7-3. Based on $2.50/ft for sewer system evaluation surveys (SSES) plus 25% contingency in these areas, a total condition assessment cost of $1.6 million is estimated. Rehabilitation of these basins, including private sector rehabilitation, was estimated using an overall construction cost factor of $30 per linear foot of total sewer in the basin, with a 40-percent factor for design and contingency. Estimated rehabilitation capital cost for these areas is $ 21.7 million. Total I/I rehabilitation, including SSES work, is estimated at $ 23.3 million.

Cost-effective I/I removal requires that the cost for finding and fixing the system is less than the cost to transport and treat I/I flows. Hydraulic analyses were performed using the system computer model. The estimated additional conveyance capital cost to convey I/I without any removal is estimated to be $ 31.3 million. In addition to conveyance cost, additional storage, pumping and treatment capital costs of approximately $10.4 million would result. The total additional capital cost for conveying, storing, pumping and treating I/I without removal would be in the range of $41.7 million. Since the I/I removal costs are less than the costs to transport and treat the I/I flows, rehabilitation is recommended.

7.1.3 System Rehabilitation

Based on the I/I analysis, it is estimated that 30 percent of the inflow (43.6 percent in priority basins) can be effectively removed from the monitored system. Field investigations and system rehabilitation in both the public and private sectors for the basins shown in Figure 7-3 will be a cost-effective improvement to the system. In addition to the field investigations recommended to remove I/I, the City will identify other repairs necessary in other parts of the system through routine maintenance and unplanned improvements that can occur due to system failures. For budgeting purposes, it is recommended that the total estimated annual reinvestment of $2.8 million be targeted for both I/I removal and for other rehabilitation that is needed for replacement of aging infrastructure. The I/I program, if conducted over a 9-year period, will require an annual cost of $2.6 million leaving a balance for additional rehabilitation and replacement of $0.2 million. Planning level costs for sewer system evaluation surveys, design, and rehabilitation through 2015 are presented in Tables 7.3, 7.4, and 7.5.

7.1.4 Recommendations

Based on the reinvestment and I/I analysis, the following recommendations are made:

1. Review current condition assessment procedures and develop an approach to incorporate findings into the overall reinvestment needs.
2. Incorporate I/I removal into the overall system plan.
3. Investigate sources of I/I in the high priority basins and in newer areas
4. Investigate private sector I/I and the potential impact of removal in existing areas and control in planned areas, (see section 7.3.2).
5. Set year 2015 plan in place to address I/I.
6. Maintain total annual budget of $ 2.8 million for I/I removal and replacement of aging infrastructure and review on an annual basis.

Table 7-3

Sewer System Evaluation Survey – Projected Costs

Watershed	Sewer Footage	Basin	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
West Prairie Lee	41,684	WP-08	$130,000									$130,000
West Prairie Lee	14,615	WP-10	$46,000									$46,000
West Prairie Lee	19,991	WP-06	$62,000									$62,000
Boggs Hollow	4,140	BH-01	$13,000									$13,000
Cedar Creek	28,080	CC-17	$88,000									$88,000
West Prairie Lee	27,040	WP-09		$85,000								$85,000
Cedar Creek	29,501	CC-21		$92,000								$92,000
West Prairie Lee	27,418	WP-11		$86,000								$86,000
Cedar Creek	42,990	CC-16		$134,000								$134,000
Cedar Creek	20,045	CC-14			$63,000							$63,000
Cedar Creek	19,180	CC-20			$60,000							$60,000
South Prairie Lee	33,220	SP-01			$104,000							$104,000
Middle Big Creek	11,825	MB-04			$37,000							$37,000
South Prairie Lee	58,776	SP-04			$182,000							$182,000
West Prairie Lee	42,259	WP-07				$132,000						$132,000
Middle Big Creek	4,445	MB-05				$14,000						$14,000
West Prairie Lee	25,495	WP-02				$80,000						$80,000
Cedar Creek	10,201	CC-04				$32,000						$32,000
Little Cedar Creek	7,719	LC-04				$24,000						$24,000
Cedar Creek	25,106	CC-19				$78,000						$78,000
Cedar Creek	23,117	CC-03				$72,000						$72,000
	516,253		$339,000	$397,000	$446,000	$432,000						$1,614,000

NOTE: Costs include condition assessment and rehabilitation costs in both the private and public sectors of the system.

Table 7-4
Rehabilitation Plan – Projected Costs

Watershed	Sewer Footage	Basin	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
West Prairie Lee	41,684	WP-08		$1,751,000								$1,751,000
West Prairie Lee	14,615	WP-10		$614,000								$614,000
West Prairie Lee	19,991	WP-06			$840,000							$840,000
Boggs Hollow	4,140	BH-01			$174,000							$174,000
Cedar Creek	28,080	CC-17			$1,179,000							$1,179,000
West Prairie Lee	27,040	WP-09				$1,136,000						$1,136,000
Cedar Creek	29,501	CC-21				$1,239,000						$1,239,000
West Prairie Lee	27,418	WP-11					$1,152,000					$1,152,000
Cedar Creek	42,990	CC-16					$1,806,000					$1,806,000
Cedar Creek	20,045	CC-14						$842,000				$842,000
Cedar Creek	19,180	CC-20						$806,000				$806,000
South Prairie Lee	33,220	SP-01						$1,395,000				$1,395,000
Middle Big Creek	11,825	MB-04							$497,000			$497,000
South Prairie Lee	58,776	SP-04							$2,443,000			$2,443,000
West Prairie Lee	42,259	WP-07								$1,775,000		$1,775,000
Middle Big Creek	4,445	MB-05								$187,000		$187,000
West Prairie Lee	25,495	WP-02								$1,071,000		$1,071,000
Cedar Creek	10,201	CC-04									$428,000	$428,000
Little Cedar Creek	7,719	LC-04									$324,000	$324,000
Cedar Creek	25,106	CC-19									$1,054,000	$1,054,000
Cedar Creek	23,117	CC-03									$971,000	$971,000
	516,253		$0	$2,365,000	$2,193,000	$2,375,000	$2,958,000	$3,043,000	$2,940,000	$3,033,000	$2,777,000	$21,684,000

NOTE: Costs include condition assessment and rehabilitation costs in both the private and public sectors of the system.

Table 7-5
SSES and Rehabilitation – Estimated Costs

Watershed	Sewer Footage	Basin	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
West Prairie Lee	41,684	WP-08	$130,000	$1,751,000								$1,881,000
West Prairie Lee	14,615	WP-10	$46,000	$614,000								$660,000
West Prairie Lee	19,991	WP-06	$62,000		$840,000							$902,000
Boggs Hollow	4,140	BH-01	$13,000		$174,000							$187,000
Cedar Creek	28,080	CC-17	$88,000		$1,179,000							$1,267,000
West Prairie Lee	27,040	WP-09		$85,000		$1,136,000						$1,221,000
Cedar Creek	29,501	CC-21		$92,000		$1,239,000						$1,331,000
West Prairie Lee	27,418	WP-11		$86,000			$1,152,000					$1,238,000
Cedar Creek	42,990	CC-16		$134,000			$1,806,00					$1,940,000
Cedar Creek	20,045	CC-14			$63,000			$842,000				$905,000
Cedar Creek	19,180	CC-20			$60,000			$806,000				$866,000
South Prairie Lee	33,220	SP-01			$104,000			$1,395,000				$1,499,000
Middle Big Creek	11,825	MB-04			$37,000				$497,000			$534,000
South Prairie Lee	58,776	SP-04			$182,000				$2,443,000			$2,625,000
West Prairie Lee	42,259	WP-07				$132,000				$1,775,000		$1,907,000
Middle Big Creek	4,445	MB-05				$14,000				$187,000		$201,000
West Prairie Lee	25,495	WP-02				$80,000				$1,071,000		$1,151,000
Cedar Creek	10,201	CC-04				$32,000					$428,000	$460,000
Little Cedar Creek	7,719	LC-04				$24,000					$324,000	$348,000
Cedar Creek	25,106	CC-19				$78,000					$1,054,000	$1,132,000
Cedar Creek	23,117	CC-03				$72,000					$971,000	$1,043,000
	516,253		$339,000	$2,762,000	$2,639,000	$2,807,000	$2,958,000	$3,043,000	$2,940,000	$3,033,000	$2,777,000	$23,298,000

NOTE: Costs include condition assessment and rehabilitation costs in both the private and public sectors of the system.

7.2 CMOM - CAPACITY, MANAGEMENT, OPERATION AND MAINTENANCE

The Environmental Protection Agency (EPA) Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Program at Sanitary Sewer Collection Systems describes a well run collection system as one that practices the following:

- Operation and Maintenance (O&M) considerations during design and construction
- Knowing what comprises the system (inventory and physical attributes)
- Knowing where the system is (maps and locations)
- Knowing the condition of the system (assessment)
- Planning and scheduling work based on condition and performance
- Effective maintenance activities
- Repairing, replacing, and rehabilitating system components based on condition and performance
- Managing timely, relevant information to establish and prioritize appropriate CMOM activities
- Training of personnel

Each CMOM program is individually tailored to the municipality that is operating the collection system, however, the practices listed above are included in the key elements of the CMOM program: Capacity Evaluation, Management, Operation and Maintenance of the collection system. Current City practices comply with EPA expectations.

7.2.1 Capacity Assurance

Capacity assurance refers to the ability of the sewer system to safely convey system design flows. The capacity of the system should be evaluated periodically to ensure that capacity is adequate considering changes in population and system deterioration, which can increase levels of I/I.

The basic information for capacity assessment is listed below:

- Existing and future population served
- Inventory of collection system
- Flow data and response of flow to rainfall and groundwater for systems with infiltration and inflow

SSO locations, basement backups, surcharged pipes or other capacity restrictions should be identified. The capacity evaluation should include peak (design) flow estimation and an estimate of the capacity of system components. The evaluation is best performed through the use of a hydraulic model to identify areas with hydraulic limitations. Improvements necessary to provide adequate capacity should be identified and implemented prior to the actual need of the improvements.

MODELING

The purpose of hydraulic modeling of the collection system is to determine the capacity requirements of the system with respect to sewer design and structural conditions.

7.2.2 Management

The proper management of the collection system enables the municipality to put the appropriate programs in place for the operation and maintenance of the system. The goals of the management program should include:

- Protection of public health and prevention of unnecessary property damage

- Minimization of infiltration, inflow and exfiltration, and maximum conveyance of wastewater to the wastewater treatment plant (WWTP).
- Provision of prompt response to service interruptions
- Efficient use of allocated funds
- Identification of and remedy solutions to design, construction and operational deficiencies
- Performance of all activities in a safe manner to avoid injuries

ORGANIZATIONAL STRUCTURE

A well-developed CMOM Management program will include an effective organizational structure. This structure should include job descriptions for each position. The personnel in these positions should meet the position requirements. There should be a low turnover rate, and the current staffing levels should be adequate to ensure proper emergency response times. If work is contracted out, the contract should include the appropriate provisions for response times.

Operation and maintenance personnel should report to the same supervisor or director. This person should have overall responsibility for the collection system.

BUDGETING

The budget is one of the most important variables in the operation of a utility. A key component of a good budget is the ability to track costs through the budget cycle so that the annual budget will reflect the actual needs of the organization.

The budget should be divided into the operating budget and the capital budget. Operating budget items are preventive and corrective maintenance and major collection system repairs. The capital budget will include projects with 1-5 year cycles for completion.

TRAINING

The staff should be well trained, especially to include environmental awareness, specific equipment, policies and procedures and conducting maintenance activities. The effectiveness of this training should be demonstrated routinely through periodic testing, drills, demonstrations, or informal training, and the training should be improved routinely based upon this assessment.

INTERNAL COMMUNICATION

The form of communication in the municipality should be open, meaning top-down, bottom-up and laterally among the staff. Staff should receive information in timely manner, and procedures should be in place to facilitate this communication.

CUSTOMER SERVICE

Another form of communication is customer service. The municipality should have a robust system in place to respond to customer complaints. This is the most visible segment of any sewer operation. The personnel taking the calls should be trained in what to expect from the customers and how to respond and direct the field crews on how to evaluate and resolve the complaint. Collection system field crews influence the public's opinion and confidence in the City.

MANAGEMENT INFORMATION SYSTEMS

The management information system directly impacts the City's ability to effectively manage its collection system. Access to the most current information is an effort that involves all members of the collection system staff.

SSO NOTIFICATION PROGRAM

The City should maintain a written procedure for the notification of SSOs. This includes the entities that should be notified in the event of an SSO, such as drinking water suppliers, the public, health departments and the regulatory agency.

LEGAL AUTHORITY

The proper management of the utility should also include the selecting and enforcing of the legal authority necessary to regulate the flow into the collection system from its customers and unauthorized sources, such as I/I.

The City should prohibit materials that will cause harm to the collection system and treatment works through a robust pretreatment program. In addition, control over the connection of private laterals to the main sewer should be exercised to control I/I sources.

7.2.3 Operation and Maintenance

FLOW MONITORING

Flow and rainfall monitoring is important to establish system flows and system response to wet weather conditions. The monitoring program may include two types of monitoring;

- Permanent – these should be at key points in the system
- Temporary – these should be used for project level evaluations

Flow monitoring data should be processed to identify three components as follows:

- Base (wastewater production) flow
- Infiltration
- Inflow

SEWER SYSTEM INSPECTION AND TESTING

Smoke, dye, manhole, visual pipe, CCTV and building testing are techniques that are used to evaluate system condition and to identify I/I in the collection system.

SMOKE TESTING

Smoke testing consists of blowing smoke into the manholes and recording where the smoke leaves the sewer system. Smoke should come out of house vents and sanitary manholes. Smoke should not come out of downspouts, driveway drains, storm catch basins, area drains or the ground above the sanitary or storm lateral. The results of the smoke testing should be documented.

DYE TESTING

The appurtenances that smoked during the smoke test such as the downspouts, catch basins, driveway drains and area drains should all be verified with a dyed water test. This will show how the storm water is actually entering into the sanitary system.

MANHOLE INSPECTIONS

Manhole inspections should be undertaken on a regular basis. Manhole inspections include observing surface conditions around the manhole and the top and bottom condition of the manhole.

VISUAL PIPE INSPECTIONS

Visual pipe inspections can be conducted during internal manhole inspections. Visual pipe inspections involve looking down each pipe entering a manhole and observing the condition of observable pipe sections. Typically, about 20 – 30 feet of pipe can be observed which provide a good indication of the general condition of the pipe segment and provide justification for more intensive CCTV inspection.

CCTV INSPECTIONS

CCTV inspections (closed circuit television inspections) are performed by a remote television camera that provides a view of the entire pipe circumference above the water line and service lateral connections. Some CCTV cameras have a lens that can be controlled to provide a lateral view of the pipe and into the service lines. Pipe conditions are recorded by footage.

BUILDING INSPECTIONS

Building inspections are performed to locate illegal I/I connections from buildings. These illicit connections can include area drains, storm sump pumps, uncapped cleanouts, and foundation drains.

SEWER SYSTEM REHABILITATION

A rehabilitation program should be implemented. This program should be built using the evaluated pipe and manhole data.

SAMPLING AND MONITORING

The sampling and monitoring program in a collection system should encompass the industrial users, SSOs, and permit monitoring such as that required to comply with an NPDES permit, a 308 letter, administrative order, or a consent decree.

The sampling and monitoring program should include written procedures that should specify:

- Sampling location(s)
- Sample volumes, preservatives, and holding times
- Instructions for operating monitoring equipment
- Sampling frequency
- Sampling and analytical methodologies
- Laboratory Quality Assurance/Quality Control (QA/QC)

H2S CONTROL

Hydrogen sulfide (H2S) control is a not-so-subtle indicator of a poorly maintained and operated system. H2S generation is the result of sewers with low velocities and/or long detentions times, sewers subject to solids deposition, pump stations, turbulent areas such as drop manholes or force main discharges, or inverted siphon discharges.

The methods for prevention and control of H2S include proper design, use of chemicals to reduce the dissolved sulfide levels in the waste stream, sewer cleaning to remove deposited solids, installation and proper operation and maintenance of air relief valves in force mains.

The key is to understand the collection system so that vulnerable points can be inspected and the corrosion recognized and addressed quickly.

SAFETY

Safety program should be in place for the following areas:

- Confined spaces
- Chemical handling
- Trenching and excavations
- Material Safety Data Sheets
- Biological hazards in wastewater
- Traffic control and work site safety
- Lockout/Tag out
- Electrical and mechanical safety
- Pneumatic or hydraulic systems safety

The utility should have written procedures in place to handle the above issues, the staff should be trained, and procedures should be in place to enforce the programs.

EMERGENCY PREPAREDNESS AND RESPONSE

Procedures should be in place to handle both routine and catastrophic emergencies. Routine emergencies are manholes overflowing or sewers collapsing. A catastrophic emergency would be a tornado, flood, earthquake, widespread chemical spill or electrical outage. Staff should be trained on these procedures, and the procedures reviewed and updated at periodic intervals.

MAPPING

This aspect of maintaining and operating a collection system is one of the most important. Accurate and up to date maps are essential elements of the tool box. The maps should include the following:

- Main, trunk and interceptor sewers
- Building/house laterals
- Manholes
- Cleanouts
- Force mains
- Pump stations
- Service area boundaries
- Other landmarks (roads, water bodies, etc.)

An important issue here is that each manhole, cleanout, or junction must have a unique identifier.

NEW CONSTRUCTION

The utility should maintain strict control over new flows that come into the collection system. Newly constructed sewers and pump stations should be easy to maintain and operate.

PUMP STATIONS

Pump station operation and maintenance requires special electrical, hydraulic and mechanical expertise. The procedures for operating and maintaining pump stations should be in writing.

PLANNED AND UNPLANNED MAINTENANCE

The goal of a good maintenance program is to:

- Prevent overflows and backups
- Maximum service and reliability of the collection system
- Collection system sustainability

Detailed maintenance procedures should be in place. These procedures should include the maintenance and repair approach for the various systems and facilities.

The types of maintenance include planned and unplanned. Planned maintenance can be predictive or preventive. Predictive maintenance looks for signs of failure and makes timely repairs so that emergency maintenance is not needed. Preventive maintenance schedules the repairs on a regular basis.

Unplanned maintenance consists of two types, corrective and emergency. Corrective maintenance consists of scheduled repairs to problems found under planned or predictive maintenance. Emergency maintenance repairs are those that are necessary due to a serious failure where immediate action is necessary. The goal is to reduce corrective and emergency maintenance through planned and predictive maintenance.

MAINTENANCE BUDGETING

The maintenance budget is a large part of the operating budget. All maintenance costs, both internal and external, should be tracked throughout the year so that these costs can be adequately budgeted.

The goal for the maintenance budget is to adequately cover the costs associated with the age of the system. Emergency repairs should be a small (five to ten percent) of the budget. The backlog of work should also be considered in developing this type of budget.

SEWER CLEANING AND FATS, OILS, AND GREASE CONTROL

The causes of blockages in sewer pipes can be attributed to the following:

- Structural defects
- Poor design
- Poor construction
- Grease buildup
- Root intrusion
- Protruding laterals

There are three types of sewer cleaning; hydraulic, mechanical, and chemical. Hydraulic cleaning uses water, such as from a jet truck. Mechanical cleaning using physical devices to scrape or cut the material, such as a root cutter or a cleaning machine. Chemical cleaning refers to the use of chemical, such as for root intrusion or grease buildup.

An integral part of sewer cleaning is accurate record keeping. This will enable the evaluation of the results and planning for future cleaning.

The scheduling of sewer cleaning should take into account the type of system, the problem areas and the pipe material. For example PVC pipe needs to be cleaned less than vitrified clay pipe. An area with many restaurants may need to be cleaned for grease more often. The area with PVC pipe may be on a once every-five-years schedule, where the grease prone area may need to be cleaned every six months.

In addition to sewer cleaning, control of fats, oils, and greases (FOG) is an important part of collection system maintenance. FOG control can be achieved through education of restaurant owners regarding proper disposal of grease and grease trap use and cleaning.

PARTS AND EQUIPMENT INVENTORY

An inventory of spare parts, equipment, and supplies should be kept. The basis of the inventory should be the equipment manufacturer's recommendation and historical knowledge of the equipment.

A yard should be maintained to house equipment, supplies, pipes, spare parts. Equipment and personnel should be dispatched from the centrally located yard.

7.2.4 CMOM Audit

An EPA CMOM Self Audit form was completed by the City in an effort to identify CMOM gaps and make recommendations for improvement in system operations. The audit is a screening tool and identifies areas of strengths and weaknesses and addresses practices that EPA believes should be considered by most utilities. The CMOM self audit form is in the appendix to this document. The CMOM audit was completed by the City and reviewed by the Consultant team. The CMOM audit indicated that the City is implementing all the major elements of CMOM and is continuously looking for ways to improve system performance in a cost-effective manner. The CMOM audit for each major collection activity and the evaluation is presented in Table 7.6.

A review of the City's reinvestment history indicates that the annual reinvestment is slightly greater than the median reinvestment reported in the Water Environment Research Foundation's (WERF) study entitled, "Effective Practices for Sanitary Sewer and Collection System Operations and Maintenance" published in 2003. The median reinvestment of 29 utilities reported in this study was about $12,500/mile/year while the City's reinvestment during 2005 was about $13,200/mile/year.

Table 7.6 CMOM Self Audit Evaluation	
Activity	**Evaluation**
1. Engineering design	No gaps
2. Satelite communities and sewer use ordinance	No gaps
3. Organizational structure	No gaps
4. Internal communications	No gaps
5. Budgeting	No gaps
6. Training	No gaps
7. Safety	No gaps
8. Customer service	No gaps
9. Equipment and collection system maintenance	No gaps
10. Equipment parts inventory	No gaps
11. Management information systems	No gaps
12. System mapping	No gaps
13. Internal TV inspection	No gaps
14. Sewer cleaning	No gaps
15. Manhole inspections and assessment	No gaps
16. Pump stations	No gaps
17. Capacity assessment	No gaps
18. Tracking SSOs	No gaps
19. Overflow emergency response plan	No gaps
20. Smoke and dye testing	No gaps
21. Hydrogen sulfide monitoring and control	No gaps

PERFORMANCE AND MAINTENANCE MEASURES

Some additional considerations for an effective CMOM program for the City is to measure and annually track performance and maintenance measures. Performance measures which would be useful for the City to track as reported in the Effective Practices WERF reported cited above, include:

- Pipe failure rate
- Sanitary sewer overflows frequency

- Customer complaints (related to collection system performance) frequency
- Pump station failure frequency
- Peak hourly to average annual flow

Maintenance measures that would be useful for the City to track as reported in the Effective Practices WERF reported cited above, include:

- System cleaning frequency
- Pump station service frequency
- CCTV frequency
- Root removal frequency
- Flow monitoring
- Manhole inspections
- Smoke testing
- Dye water testing
- Private sector inspections
- System rehabilitation
- System capacity enhancements

7.2.5 Recommendations

Based on the CMOM self audit and sewer workshops with the City, the following recommendations are made:

- Assemble supporting data and documents referenced in the CMOM self audit.
- Refine and set maintenance, performance and reinvestment measures. Definitions should be developed that are easily understood by the City for clarity of reporting.
- Improve reporting and data collection for SSOs. This includes improved estimates of SSO volumes and actions to determine SSO causes.
- Continue ongoing collection system analysis and rehabilitation, and evaluate the impact of these activities on system flows and performance.
- Based on new flow data collected in rehabilitated and in newer construction, continue to review the appropriateness of the existing design flow curve.
- Regularly (annually) review and analyze performance and maintenance measures.
- Make CMOM program adjustments as appropriate to optimize the overall program effort and costs.

7.3 PRIVATE SEWER POLICIES

7.3.1 Private Sector I/I Magnitude

The City has conducted detailed flow monitoring and public sector inspections in West Prairie Lee Basins 8, 9, and 10. The magnitude of I/I in these basins indicates that there are likely many sources of I/I that can be cost-effectively removed from the system. Field inspections performed during the study of these basins include manhole inspections, visual pipe (line lamping), smoke testing, dyed water testing, and CCTV inspection. Of the tests performed, only smoke testing and dyed water testing identify I/I sources from the private sector. Furthermore, the flow that was monitored indicates that inflow is by far the more significant flow contributor during wet weather events. Inflow is a result of rainfall entering the system through system defects or illicit direct connections and lateral defects from the private sector.

Estimates of the distribution of inflow sources from the West Prairie Lee and South Prairie Lee studies projected that inflow originating from the private sector accounts for about 60 to 70 percent of the total inflow. However, only 3 to 15 percent (depending on the basin) of the inflow could be specifically located from the inspection activities. Based on these analyses and the experience of other communities around the country and locally, especially in Johnson County, Kansas, private sector inflow is likely a major contributor to the overall system inflow during wet weather events. Furthermore, it is unlikely that I/I can be reduced to acceptable standards without addressing the private sector I/I in a comprehensive manner.

7.3.2 Private Property Issues

Inspection, maintenance, and/or construction on private property will require both the authority to access private property and the responsibility to issue work orders for private property improvements.

ACCESSING PRIVATE PROPERTY

The City appears to have the authority under the City's Municipal Code to access private property for observation or inspection. *See* ***Section 32-248 Accessibility of Facilities for Inspection,*** *which states:*

> The service pipes, building sewers, and fixtures on the customer's premises shall be accessible to the Department for observation or inspection at reasonable hours.
> (Code 1988, § 32-248)

The City attorney should be consulted in order to develop a private sector program.

DAMAGES

If any damage is done to the property during the inspection, identification process or construction of improvements, most agencies accept the liability and either reimburse the property owner or repair the damage. Some cities have insurance that covers these costs.

Some cities have avoided legal responsibility by including a disclaimer on the right of entry form or by having third party contractors perform the work.

INSPECTION AND MAINTENANCE OF LATERALS

For municipalities, where the definition of private lateral includes the entire lateral all the way to the saddle on the main, which is the case in Lee's Summit, the property owner is normally responsible for any inspection and maintenance of the service lateral.

REHABILITATION

Responsibility for the rehabilitation of the lateral usually is the same as the responsibility for the maintenance and inspection.

IDENTIFICATION OF INFLOW SOURCES

The identification of inflow sources such as downspouts, driveway drains, area drains, stairwell drains and foundation drains is often the responsibility of the municipality. This is often accomplished as part of a larger identification and removal program and requires that the policy and legal aspects of a private sector I/I removal program be clearly defined.

REMOVAL OF INFLOW SOURCES

Municipalities that have established I/I identification and removal programs have several different methods for payment of this work. These options include:

- Municipality performing the work with private contractors and paying for the improvement
- Municipality performing the work with private contractors and billing the property owner

- Property owner performing the work with inspection by the municipality
- Property owner hiring private contractors to perform the work with inspection by the municipality

ENFORCEMENT

Enforcement measures are often necessary for successful removal of inflow and infiltration sources. Enforcement measures include:

- Disconnection of water service
- Fines
- Property liens
- Perform the work and bill the property owner using these mechanisms:
  - Monthly surcharge on utility bill
  - Adding the amount to the property tax
  - Summoning the property owner to court

PUBLIC FUNDS SPENT ON PRIVATE PROPERTY IMPROVEMENTS

Many municipalities do not have the authorization to spend public funds on private property; many of those that do have this authority have passed legislation for this approval. Some municipalities that have paid for the improvement are then faced with the responsibility of ongoing maintenance and replacement of the improvement. This issue should be addressed prior to the start of a removal program.

7.3.3 Johnson County, Kansas, Wastewater Experience

Johnson County Unified Wastewater District (JCUWWD) implemented a comprehensive private sector I/I removal program in the mid-1980s and continues this program today. The initial cost of this program was $11.2 million to remove about 15,600 private sector sources of I/I served by 742.6 miles of main sewer lines. JCUWWD has estimated that the private sector program has removed over 60 million gallons per day (mgd) of I/I under design conditions. I/I removal (both public and private) in JCUWWD's three largest service areas averages 57.3 percent. There has been a significant reduction in sewer backups. The focus of the program today is the backup prevention program and is referred to as BUPP (Back-up Prevention Program). JCUWWD has developed a private sector procedures manual, which they have made available to other utilities as requested. The manual covers all aspects of a private sector program including inspections, removal of sources, legal and follow-up.

JCUWWD has achieved 100 percent compliance with their private sector program. The JCUWWD private sector program is highlighted on EPA's web site location dealing with SSOs. JCUWWD reports that their private sector program has been significant in terms of achieving flow reduction. Through field work and responses to the BUPP questionnaires, JCUWWD has identified "cluster" areas of homes known to have problems with sewer backups. In some cases, JCUWWD installs backflow valves until a final, long-term solution can be found. The valve cost, including installation, is about $2,200 each.

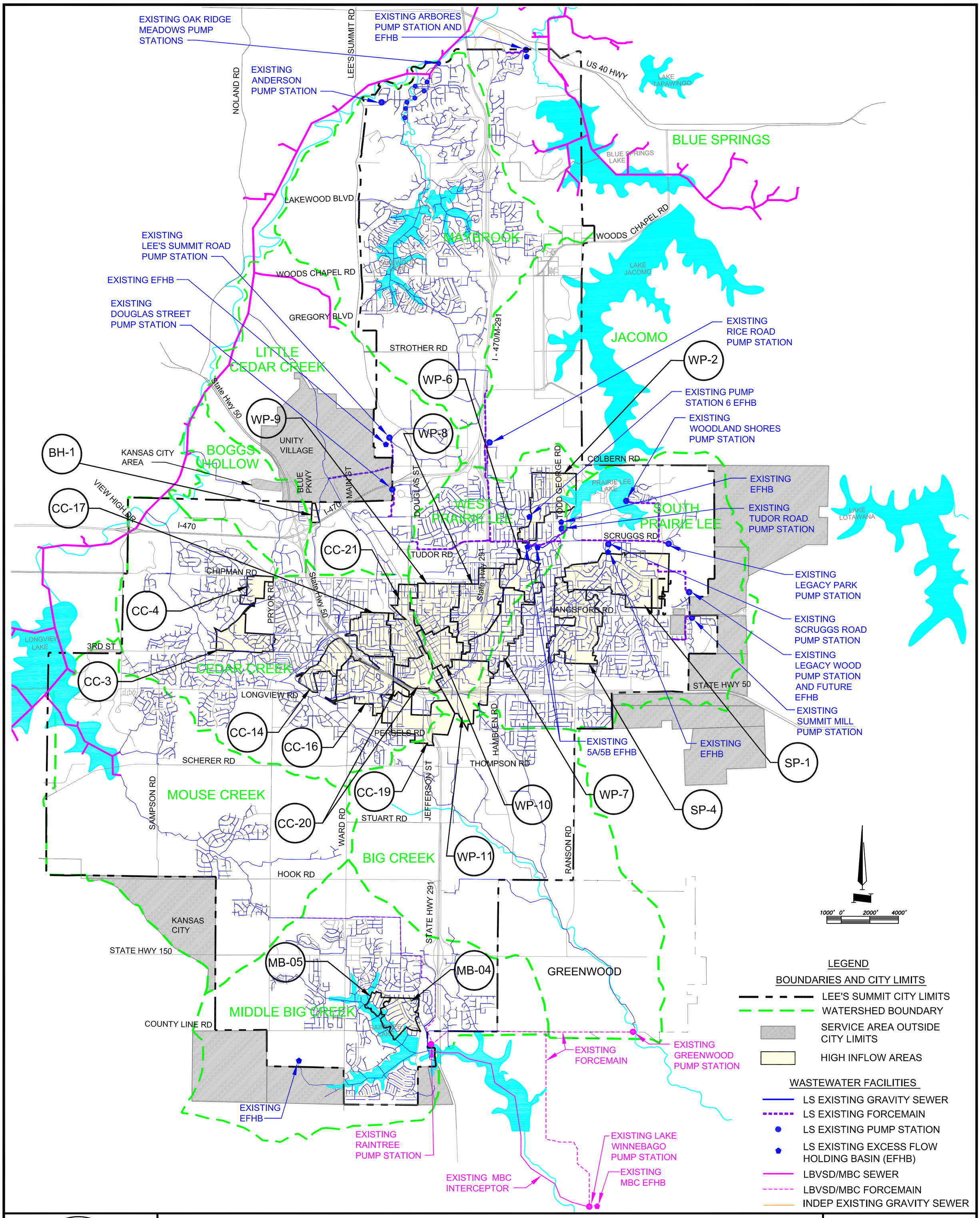
As part of the ongoing private sector I/I program, JCUWWD set a goal of re-inspection after 7 years from completion of the initial program. All new construction requires inspection to ensure that there are not illicit connections or other ways I/I can enter the collection system. New services are not allowed to connect to the main sewer until there is a roof on the structure or there is a plug in the service line. Each service line constructed is also inspected.

7.3.4 Recommendations

JCUWWD offers an excellent local resource of materials related to implementing a private sector I/I removal program. In addition, a recently-published research project by the Water Environment Research Foundation (WERF) entitled, "Methods for Cost-Effective Rehabilitation of Private Lateral Sewers,"

provides up-to-date information on financial, legal, and implementation aspects of a private sector I/I removal program. Based on the findings of this report and the experiences of other utilities, it is recommended that the City:

- Implement a private sector I/I removal program and regularly evaluate the effectiveness of this program.
- Develop a plan to address the legal and financial aspects of the program. Items that need to be considered are the legal and enforcement authority to require corrections on private property and the approach for paying for these improvements.
- Develop and implement a public awareness campaign relative to private sector I/I removal.
- Review construction standards and inspection procedures for new building laterals and for buildings being sold. Consider the following for all new construction:
    - Improved foundation drains that direct groundwater and inflow away from the building, avoiding the illegal use of sanitary sewers for drains,
    - Trench-checks outside the building excavation on the lateral line to avoid inflow from traveling along the lateral bedding material to the public sewers,
    - Inspection of basement floor drains and sump pumps prior to occupancy to eliminate illegal connections.



CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

HIGH INFLOW AREAS IN EXISTING SYSTEM

FIGURE 7-3

Archer CH2MHILL

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8 RECOMMENDED CAPITAL IMPROVEMENTS PLAN

Section 5 of this Master Plan described the ultimate plan for conveyance of wastewater for the City. Implementation of this plan will be a combination of improvements funded and constructed by the City, future developers, and the regional wholesale wastewater conveyance and treatment providers.

Many of the improvements identified in this Master Plan will be the responsibility of the developers of the undeveloped land remaining in the City and the potential annexation areas outside of the City. Major interceptors and trunk extensions, new pump stations and force mains, and collection systems to serve this undeveloped property will be needed as shown in Figure 5-2 to provide wastewater collection and conveyance from these areas. This Master Plan provides the conceptual plan for these future facilities and includes preliminary sizing (see Appendix 9.4 and Appendix 9.5) based on land use and the City's wastewater design criteria.

Other improvements, such as the improvements to the LBVSD's conveyance and treatment system and the conveyance and/or treatment improvements of the MBC, will be the responsibility of those government entities, of which Lee's Summit is a wholesale customer. Based on the current rate structures of the LBVSD and the MBC, capital improvements are incorporated into the rates paid by Lee's Summit and the other customers.

The remaining capital improvements will require City funding and are represented in three categories, based on the methodology used to finance these improvements.

Category 1 Improvements are those that are needed to upsize facilities to address growth of the City. These improvements include pump station and force main improvements, interceptor and trunk line improvements, and expansion or new excess flow holding basins to relieve overloading of existing trunk lines and interceptors. These improvements will be funded by the City's tap fee.

Category 2 Improvements are those that are needed to relieve overloaded collection and trunk sewers in fully-developed parts of the City. In most cases, these sewers were constructed based upon design criteria that did not account for the level of infiltration and inflow experienced in Lee's Summit's sewer system. The City's hydraulic model and current capacity design criteria were utilized to evaluate all of these existing sewers and determine the amount of overloading and surcharging that may be experienced during a peak wet weather event (50-year frequency). The modeling results were compared with the actual backup complaint history. This Master Plan includes recommendations for improvements to the lines that meet the criteria for excessive surcharging that could result in backups and/or overflows. It is assumed that these improvements will be funded by City funds and/or debt and paid for by user rates.

Category 3 Improvements are those associated with identifying and removing excessive inflow sources as described in Section 7, Table 7-5. These include costs for improvements on public and private property. It is assumed that these improvements will be funded by City funds and/or debt and paid for by user rates. Consideration should be given to private property owner participation in some of these costs.

8.1 2015 CAPITAL IMPROVEMENTS

Figure 3-2 depicts the projected growth and associated land use through the Year 2015. This projection of developed land and uses provided the basis for modeling the existing wastewater conveyance and collection system. Several assumptions related to the overall wastewater service plan are reflected in this model.

First, it was assumed that the recommended improvements to the Tudor Road, Scruggs Road Pump Station, and the Scruggs Road Excess Flow Holding Basin as well as the construction of the new force main from the intersection of Highway 291 and Scruggs Road to Douglas would be completed. For the 2015 condition, it was assumed that 8 million gallons per day would continue to be pumped to the Maybrook Interceptor during a peak flow event and that 16 million gallons per day would be pumped to the Little Cedar Creek Interceptor.

Second, it was assumed that the Middle Big Creek Sub-District would increase the Greenwood and Lake Winnebago pump stations' capacity to address growth in the Sub-District. It is assumed that approximately 6.0 million gallons per day will continue to be pumped from the Raintree Pump Station to the Mouse Creek Interceptor. If the Middle Big Creek Sub-District moves forward with the construction of a regional wastewater treatment facility, this flow would be eliminated and City improvements in the Mouse Creek Watershed would be reduced.

Figure 8-1 depicts the results of the modeling for the Year 2015 condition. Sewers shown in red within the City will experience excessive surcharging during the 50-year peak flow event.

Major improvements in the City's system to address the 2015 condition include:

A. Improvements to the West Prairie Lee and South Prairie Lee trunk sewers, pump stations and EFHBs.

B. Construction of a parallel force main along Tudor Road from 291 Highway to Douglas.

C. Improvements to the Little Cedar Creek Interceptor.

D. Improvements to the Bogg's Hollow Interceptor, including an excess flow holding basin.

E. Improvements to the Cedar Creek Interceptor.

F. Improvements to the Mouse Creek Interceptor.

G. Construction of the previously planned EFHB west of Ward Road in the Middle Big Creek Watershed, including trunk line improvements.

H. Construction of excess flow holding basins in the Big Creek Watershed.

I. Collection system upgrades in the South Prairie Lee, West Prairie Lee, and Cedar Creek Watersheds.

J. New sewer system serving the residents around Prairie Lee Lake.

Figure 8-2 shows the recommended improvements. These improvements are needed for year 2015 conditions but are sized to serve ultimate needs. Table 8-1 summarizes the projects and provides the estimated project costs by project. Detailed costs estimates are included in Appendix 9.6.

8.2 Ultimate Capital Improvements

Figure 3-3 represents the projected land use for the City of Lee's Summit at the ultimate build-out condition. This projection of developed land and uses provided the basis for modeling the existing wastewater conveyance and collection system. Several assumptions related to the overall wastewater service plan are reflected in this model.

First, it was assumed that the entire 24 million gallons per day pumped from the West and South Prairie Lee Watersheds would be directed to the Little Cedar Creek Watershed, leaving capacity for full development of the Maybrook Watershed with minimal improvements needed in the watershed.

Second, it was assumed that the MBC would increase its conveyance system capacity, including the Raintree Pump Station, to address growth. It was assumed that MBC would detain its peak wastewater flow as much as possible and pump to the Mouse Creek Interceptor after the peak wet weather event

subsides. Even with this assumption and due to capacity limitations in the Lake Winnebago Interceptor, the Raintree Pump Station would need to be upgraded to a capacity of 13.7 million gallons per day. This wastewater would be pumped to the Mouse Creek Interceptor, causing hydraulic overloading and surcharging of most of this interceptor. An EFHB in the Mouse Creek Watershed would be required. If the Middle Big Creek Sub-District moves forward with the construction of a regional wastewater treatment facility, this flow would be eliminated and City improvements in the Mouse Creek Watershed would be significantly reduced.

Figure 8-3 shows the results of the modeling for the ultimate condition. Red lines represent sewers within the City that will experience excessive surcharging during the 50-year peak flow event.

Major improvements in the City's system for the ultimate condition that were not needed under the 2015 condition include:

A. Additional improvements to the Little Cedar Creek Interceptor.

B. Additional improvements to the Mouse Creek Interceptor, including an EFHB.

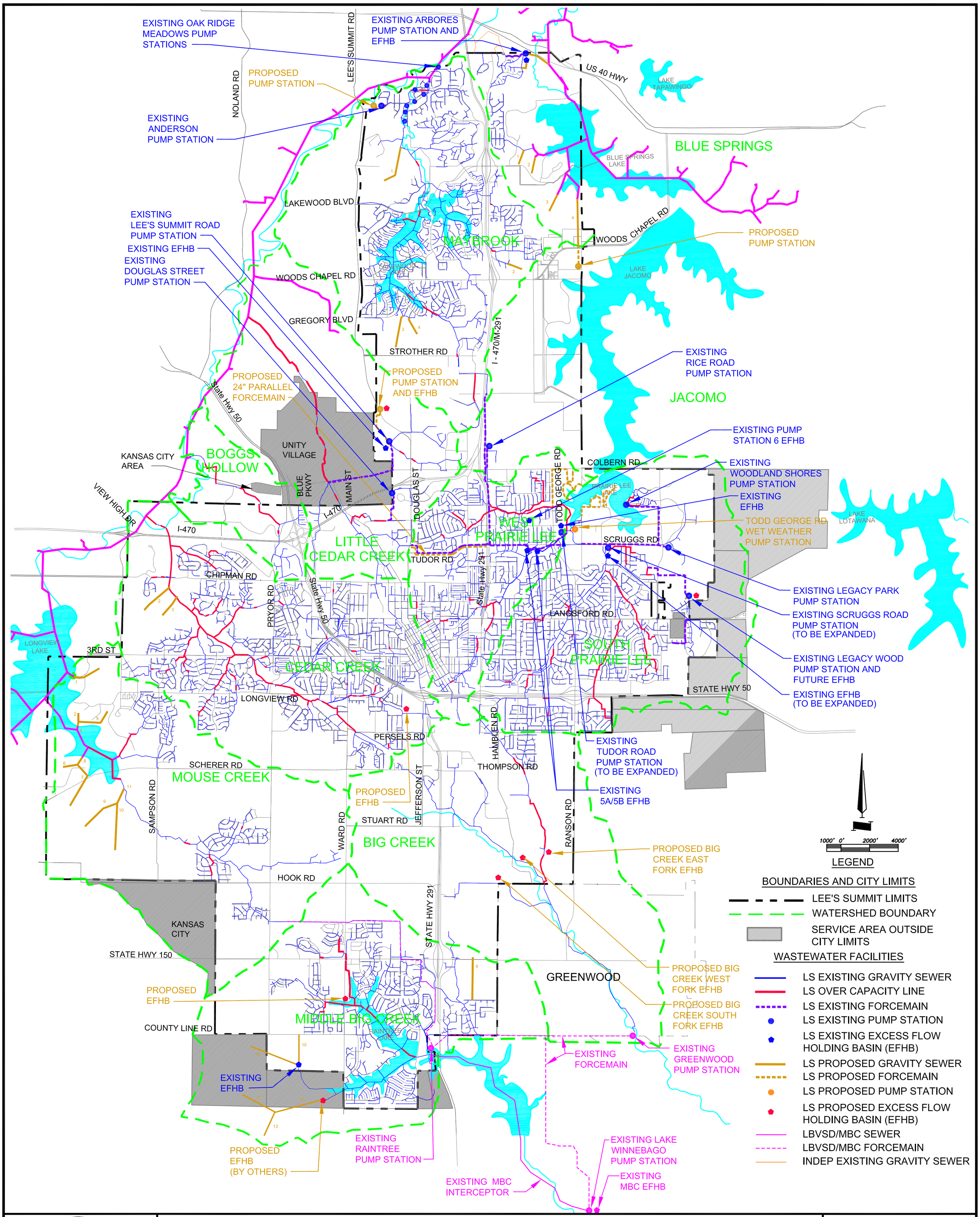
C. Additional improvements to the trunk lines serving the Big Creek Watershed.

Figure 8-4 shows all of the recommended improvements, including those recommended based on the ultimate land use plan. Table 8-2 summarizes the projects that are projected to be constructed after 2016 and provides the estimated project costs by project. Detailed cost estimates are included in Appendix 9.7.

8.3 ULTIMATE WITHOUT PRI

A land use plan and hydraulic model were completed for the ultimate condition with the assumption that the PRI property would never develop. Figure 3-4 depicts this land use and Figure 8-5 shows the results of the hydraulic model under this condition. Figure 8-6 shows the ultimate capital improvement plan for the ultimate condition without PRI.

The major difference in the recommended improvements relate to mostly future facilities that would be developer-funded. Due to the location of the PRI South property in the southwest part of the City, some of the recommended ultimate condition improvements could be scaled down if this property was removed from the projections of future wastewater flow. Table 8-3 represents the recommended capital improvements for this condition. The improvements required to serve the PRI North property are required only if this property develops. The projected costs are assumed to be funded by the developer(s).



CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

2015 CONDITION OF CONVEYANCE/COLLECTION SYSTEM BOTTLENECKS

FIGURE 8-1

Archer CH2MHILL

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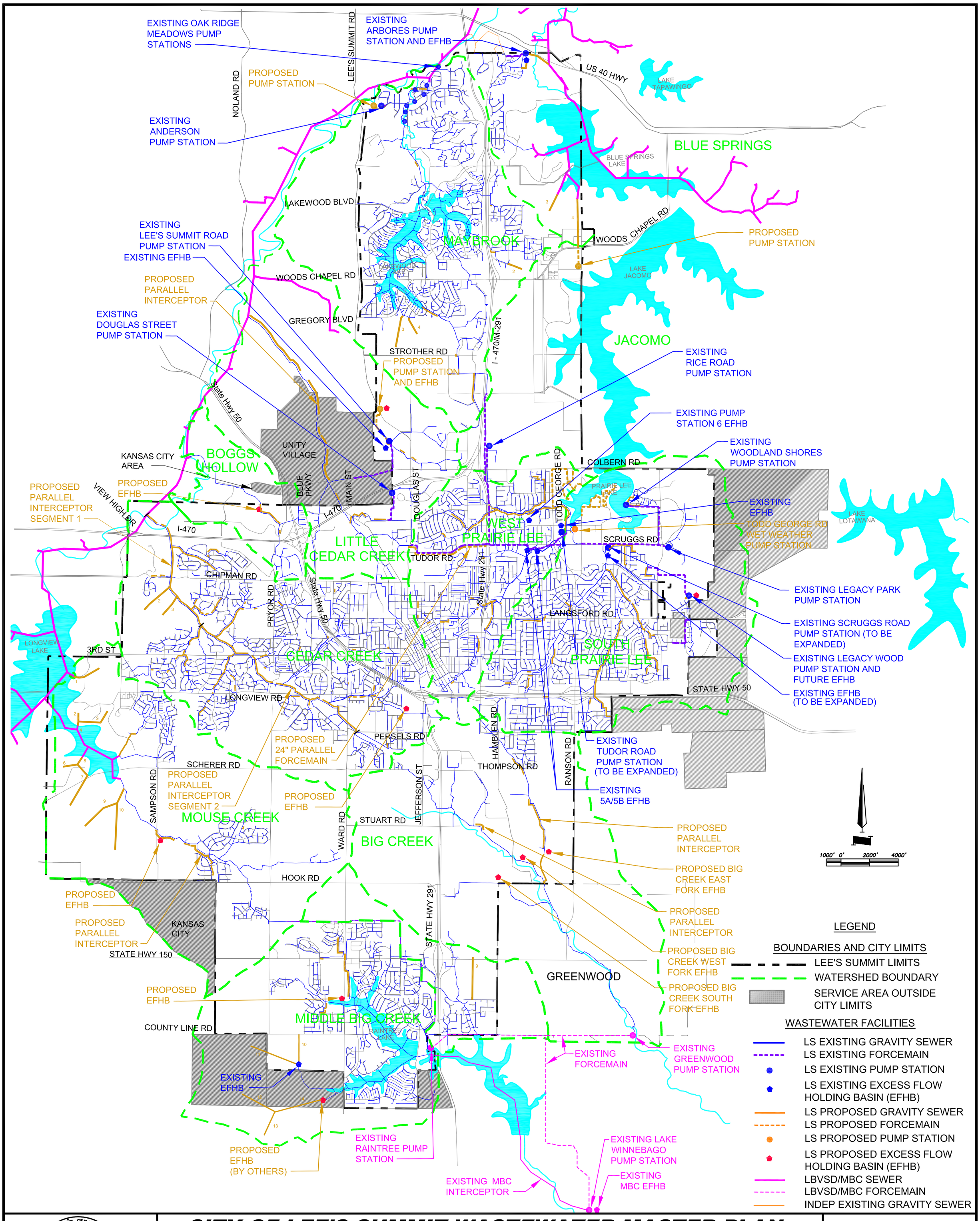

CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

2015 CONDITION

RECOMMENDED IMPROVEMENTS

FIGURE 8-2

Archer CH2MHILL

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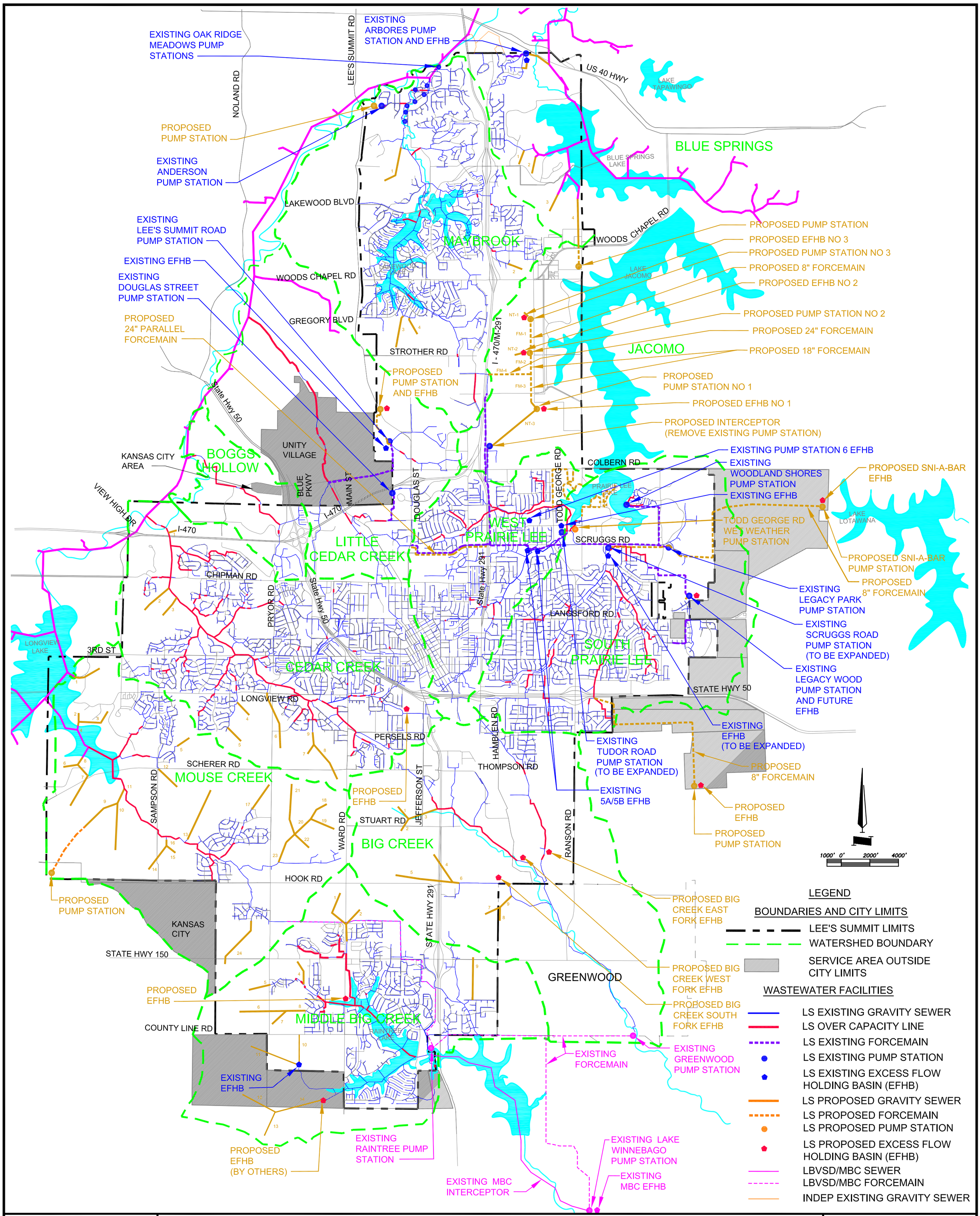

CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

ULTIMATE CONDITION CONVEYANCE/COLLECTION SYSTEM BOTTLENECKS

FIGURE 8-3

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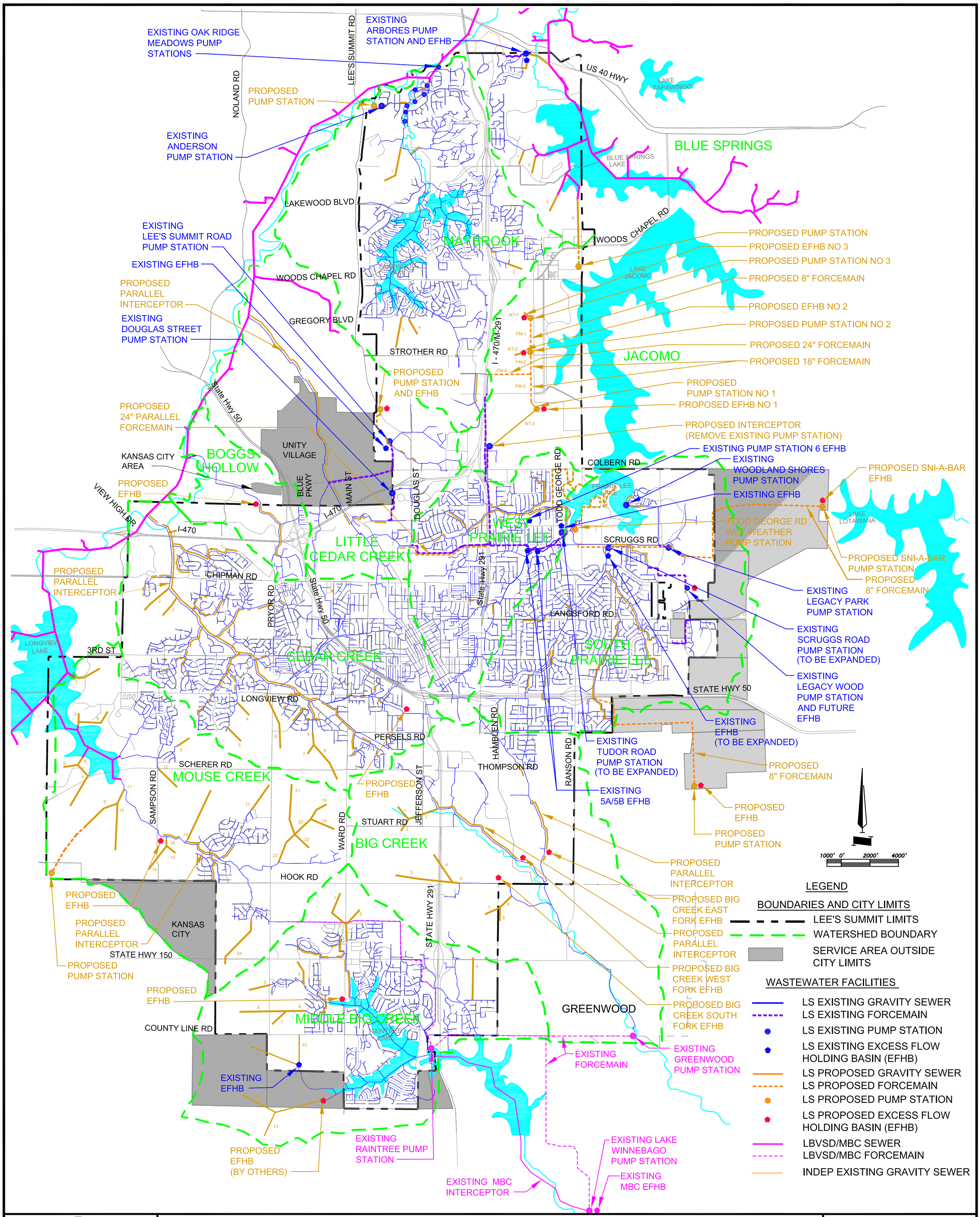

CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

ULTIMATE CONDITIONS RECOMMENDED IMPROVEMENTS

FIGURE 8-4

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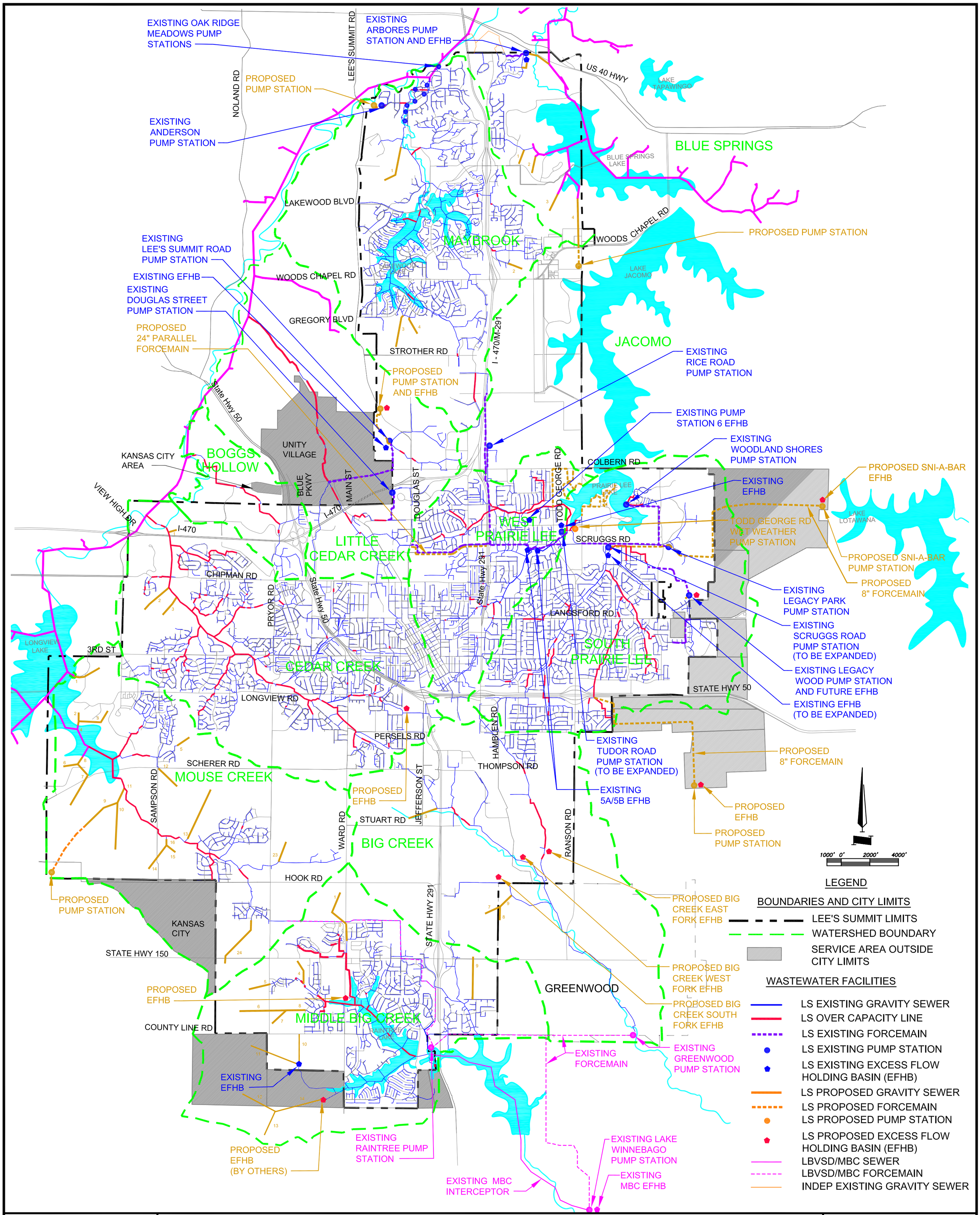

CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

ULTIMATE CONDITION CONVEYANCE/COLLECTION SYSTEM BOTTLENECKS WITHOUT PRI

FIGURE 8-5

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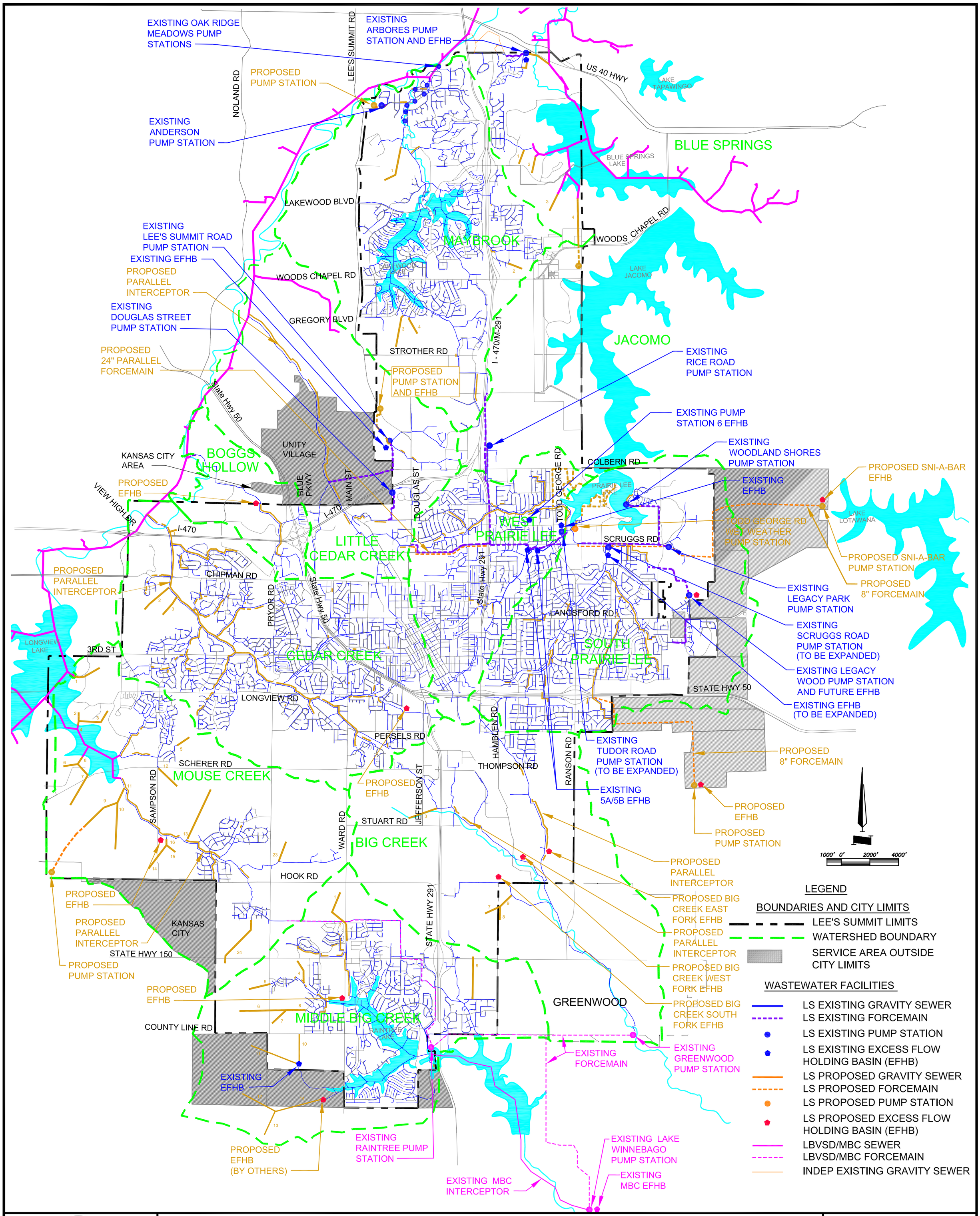

CITY OF LEE'S SUMMIT WASTEWATER MASTER PLAN

ULTIMATE CONDITIONS RECOMMENDED IMPROVEMENTS WITHOUT PRI

FIGURE 8-6

Archer CH2MHILL

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Table 8-1
Capital Improvement Projects for Years 2006 to 2015

Watershed	Project Description	Recommended Schedule	Opinion of Total Project Costs (2006$)					
			Total	City Funded			Developer Funded	LBVSD or MBC Funded
				Category 1	Category 2	Category 3		
West Prairie Lee	Todd George Road Wet Weather Pump Station	2007	$ 216,000		$ 216,000			
	Tudor PS Upgrade	2010-2015	$ 2,994,900	$ 2,994,900				
	Prairie Lee LPS System	2011-2015	$ 2,954,000		$ 954,000		2000000	
	Parallel Relief Lines (MH25-186 to MH18-076)	2007-2008	$ 256,000		$ 256,000			
	Parallel Relief Lines (MH24-069 to MH24-075)	2007-2008	$ 204,000		$ 204,000			
	Parallel Relief Lines	2010-2015	$ 3,125,000		$ 3,125,000			
	SSES & Rehabilitation	2007-2015	$ 8,960,000			$ 8,960,000		
	Total - West Prairie Lee		**$ 18,709,900**	**$ 2,994,900**	**$ 4,755,000**	**$ 8,960,000**	**$ 2,000,000**	**$ -**
South Prairie Lee								
	Scruggs Road PS Improvements *	2010-2015	$ 998,300	$ 998,300				
	Scruggs Road Forcemain to Tudor	2010-2015	$ 771,500	$ 771,500				
	Scruggs Road EFHB Improvements *	2007-2009	$ 564,000	$ 564,000				
	Legacy Wood/Summit Mills EFHB	2007-2009	$ 726,700	$ 650,700			$ 76,000	
	Parallel Relief Lines (MH26-040 to MH26-085)	2007-2008	$ 255,000		$ 255,000			
	Parallel Relief Lines (MH65-020 to MH33-258)	2007-2008	$ 152,000		$ 152,000			
	Parallel Relief Lines (MH40-130 to MH40-127)	2007-2008	$ 36,000		$ 36,000			
	Parallel Relief Lines (MH40-110 to MH40-204)	2007-2008	$ 179,000		$ 179,000			
	Parallel Relief Lines	2010-2015	$ 4,786,000		$ 4,786,000			
	SSES & Rehabilitation	2009-2013	$ 4,124,000			$ 4,124,000		
	Total - South Prairie Lee		**$ 12,592,500**	**$ 2,984,500**	**$ 5,408,000**	**$ 4,124,000**	**$ 76,000**	**$ -**
Little Cedar								
	Little Cedar 24" Forcemain	2007-2009	$ 4,083,700	$ 4,083,700				
	Interceptor Improvements	2007-2009	$ 3,028,000	$ 3,028,000				
	Parallel Relief Lines	2010-2015	$ 474,000		$ 474,000			
	SSES & Rehabilitation	2010-2015	$ 348,000			$ 348,000		
	West Pump Station, EFHB, and Forcemain	2007-2015	$ 463,000				$ 463,000	
	Total - Little Cedar		**$ 8,396,700**	**$ 7,111,700**	**$ 474,000**	**$ 348,000**	**$ 463,000**	**$ -**
Cedar Creek								
	FY 2015 Capital Improvements - Cedar Creek Sewer Total							
	Interceptor Improvements Segment 1	2007-2010	$ 3,090,000	$ 586,600	$ 2,503,400			
	Interceptor Improvements Segment 2	2010-2015	$ 3,128,000	$ 593,800	$ 2,534,200			
	Parallel Relief Lines	2010-2015	$ 4,648,000		$ 4,648,000			
	SSES & Rehabilitation	2007-2015	$ 8,944,000			$ 8,944,000		
	Future Interceptors	2007-2015	$ 680,000				$ 680,000	
	Total - Cedar Creek		**$ 20,607,200**	**$ 1,180,400**	**$ 9,685,600**	**$ 8,944,000**	**$ 797,200**	**$ -**
Jacomo								
	Rice Road Pump Station Improvements	2007-2008	$ 500,000				$ 500,000	
	Total - Jacomo		**$ 500,000**	**$ -**	**$ -**	**$ -**	**$ 500,000**	**$ -**
Mouse Creek								
	Interceptor Improvements**	2010-2015	$ 93,000	$ 93,000				
	Parallel Relief Lines	2010-2015	$ 727,000	$ 727,000				
	Future Interceptors	2007-2015	$ 3,556,000				$ 3,556,000	
	Upsizing Allowance	2007-2015	$ 300,000	$ 300,000				
	Total - Mouse Creek		**$ 4,676,000**	**$ 1,120,000**	**$ -**	**$ -**	**$ 3,556,000**	**$ -**
Big Creek								
	Ultrasonic @ Existing Meter Structure	2007	$ 10,000		$ 10,000			
	Interceptor Improvements (Based upon flow metering)	2012-2015	$ 1,007,000		$ 1,007,000			
	West Fork EFHB	2010-2015	$ 350,000				$ 350,000	

Table 8-1
Capital Improvement Projects for Years 2006 to 2015

Watershed	Project Description	Recommended Schedule	Opinion of Total Project Costs (2006$)					
			Total	City Funded			Developer Funded	LBVSD or MBC Funded
				Category 1	Category 2	Category 3		
	East Fork EFHB	2010-2015	$ 393,000				$ 393,000	
	FY 2015 Capital Improvements - Big Creek Sewer Total							
	Total - Big Creek		**$ 2,074,000**	**$ -**	**$ 1,017,000**	**$ -**	**$ 1,057,000**	**$ -**
Bogg's Hollow								
	Interceptor Improvements	2008-2010	$ 413,000				$ 413,000	
	EFHB	2008-2010	$ 75,400				$ 75,400	
	SSES & Rehabilitation	2007-2009	$ 187,000			$ 187,000		
	Total - Bogg's Hollow		**$ 675,400**	**$ -**	**$ -**	**$ 187,000**	**$ 488,400**	**$ -**
Blue Springs								
	FY 2015 Capital Improvements - Blue Springs Total							
	Carp Lake Improvements	2007	$ 178,000		$ 178,000			
	Future Interceptors	2007-2015	$ 274,000				$ 274,000	
	Total - Blue Springs		**$ 902,000**	**$ -**	**$ 178,000**	**$ -**	**$ 724,000**	**$ -**
Middle Big Creek								
	Ward Road EFHB	2007-2009	$ 4,500,000	$ 4,500,000				
	Parallel Relief Lines	2007-2009	$ 1,125,000	$ 1,125,000				
	SSES & Rehabilitation	2009-2010	$ 735,000			$ 735,000		
	South EFHB	2007-2015	$ 444,000				$ 444,000	
	Future Interceptors	2007-2015	$ 5,762,000				$ 5,762,000	
	Upsizing Allowance	2007-2015	$ 300,000	$ 300,000				
	Total - Middle Big Creek		**$ 12,866,000**	**$ 5,925,000**	**$ -**	**$ 735,000**	**$ 6,206,000**	**$ -**
Maybrook								
	Parallel Relief Lines	2007-2009	$ 615,000		$ 615,000			
	North Pump Station and Forcemain	2007-2015	$ 388,000				$ 388,000	
	Future Interceptors	2007-2015	$ 524,000				$ 524,000	
	Upsizing Allowance	2007-2015	$ 300,000	$ 300,000				
	Total - Maybrook		**$ 1,827,000**	**$ 300,000**	**$ 615,000**	**$ -**	**$ 912,000**	**$ -**
City Wide								
	Sanitary Sewer Maintenance Projects	2007-2012	$ 677,000		$ 677,000			
	Sanitary Sewer Relocation Projects	2007-2011	$ 1,206,000		$ 1,206,000			
	Total City Wide		**$ 1,883,000**		**$ 1,883,000**			
LBVSD								
	103rd Street Excess Flow Holding Basin	2007-2008	$ 7,879,000					$ 7,879,000
	Raytown Excess Flow Holding Basin	2010-2015	$ 6,425,000					$ 6,425,000
	Total - LBVSD		**$ 14,304,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 14,304,000**
MBCSD								
	Collection System Improvements - Phase 1	2009-2010	$ 5,800,000					$ 5,800,000
	Total - MBCSD		**$ 5,800,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 5,800,000**
	Total - All Watersheds		**$ 105,813,700**	**$ 21,616,500**	**$ 24,015,600**	**$ 23,298,000**	**$ 16,779,600**	**$ 20,104,000**

Notes
1 Category 1 : Growth related improvements to existing system. Funded by tap fee.
2 Category 2 : Improvements to existing sewers due to higher inflow than origionally projected. Funded by user rates.
3 Category 3 : Improvements associated with identification and removal of excess inflow. Funded by user rates.
* Cost identified in "Scruggs Road Pump Station Phase II Improvements" by CTE

Table 8-2
Capital Improvement Projects for Years 2016 to Ultimate

Watershed	Project Description	Opinion of Total Project Costs (2006$)					
		Total	City Funded			Developer Funded	LBVSD or MBC Funded
			Category 1	Category 2	Category 3		
West Prairie Lee	Parallel Relief Lines	$ 466,000		$ 466,000			
	Total - West Prairie Lee	**$ 466,000**	**$ -**	**$ 466,000**	**$ -**	**$ -**	**$ -**
South Prairie Lee	Parallel Relief Lines	$ 933,000		$ 933,000			
	East Annex Area Pump Station, EFHB, and Forcemain	$ 4,183,000				$ 4,183,000	
	50 Highway Annex Area Pump Station, EFHB, and Forcemain	$ 3,922,000				$ 3,922,000	
	Total - South Prairie Lee	**$ 9,038,000**	**$ -**	**$ 933,000**	**$ -**	**$ 8,105,000**	**$ -**
Little Cedar	Interceptor Improvements	$ 370,000	$ 370,000				
	Parallel Relief Lines	$ 28,000		$ 28,000			
	Total - Little Cedar	**$ 398,000**	**$ 370,000**	**$ 28,000**	**$ -**	**$ -**	**$ -**
Cedar Creek	Parallel Relief Lines	$ 2,455,000		$ 2,455,000			
	Future Interceptors	$ 2,371,000				$ 2,371,000	
	Total - Cedar Creek	**$ 4,826,000**	**$ -**	**$ 2,455,000**	**$ -**	**$ 2,371,000**	**$ -**
Jacomo	Gravity Lines, Pump Stations and EFHB 1, 2, &3, and Forcemains	$ 10,548,000				$ 10,548,000	
	Total - Jacomo	**$ 10,548,000**	**$ -**	**$ -**	**$ -**	**$ 10,548,000**	**$ -**
Mouse Creek	Interceptor Improvements*	$ 1,395,000	$ 1,395,000				
	EFHB*	$ 2,850,000	$ 2,850,000				
	Parallel Relief Lines	$ 842,000	$ 842,000				
	Southwest Pump Station and Forcemain	$ 669,000				$ 669,000	
	Future Interceptors	$ 5,777,000				$ 5,777,000	
	Total - Mouse Creek	**$ 11,533,000**	**$ 5,087,000**	**$ -**	**$ -**	**$ 6,446,000**	**$ -**
Big Creek	Interceptor Improvements	$ 1,548,000		$ 1,548,000			
	Future Interceptors	$ 3,144,000				$ 3,144,000	
	Total - Big Creek	**$ 4,692,000**	**$ -**	**$ 1,548,000**	**$ -**	**$ 3,144,000**	**$ -**
Blue Springs	Arbores Gravity Line	$ 481,000		$ 481,000			
	Future Interceptors	$ 360,000				$ 360,000	
	Total - Blue Springs	**$ 841,000**	**$ -**	**$ 481,000**	**$ -**	**$ 360,000**	**$ -**
Middle Big Creek	Parallel Relief Lines	$ 861,000	$ 861,000				
	Future Interceptors	$ 3,253,000				$ 3,253,000	
	Total - Middle Big Creek	**$ 4,114,000**	**$ 861,000**	**$ -**	**$ -**	**$ 3,253,000**	**$ -**
Maybrook	Parallel Relief Lines	$ 82,000		$ 82,000			
	Future Interceptors	$ 479,000				$ 479,000	

Table 8-2
Capital Improvement Projects for Years 2016 to Ultimate

Watershed	Project Description	Total	City Funded			Developer Funded	LBVSD or MBC Funded
			Category 1	Category 2	Category 3		
	Total - Maybrook	**$ 561,000**	**$ -**	**$ 82,000**	**$ -**	**$ 479,000**	**$ -**
LBVSD	Raytown Excess Flow Holding Basin/Interceptor Pump Stations	$ 30,000,000					$ 30,000,000
	Total - LBVSD	**$ 30,000,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 30,000,000**
MBCSD	Collection System Improvements - Phase 2	$ 31,200,000					$ 31,200,000
	Total - MBCSD	**$ 31,200,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 31,200,000**
	Total - All Watersheds	**$ 108,217,000**	**$ 6,318,000**	**$ 5,993,000**	**$ -**	**$ 34,706,000**	**$ 61,200,000**

Notes

1 Category 1 : Growth related improvements to existing system. Funded by tap fee.
2 Category 2 : Improvements to existing sewers due to higher inflow than origionally projected. Funded by user rates.
3 Category 3 : Improvements associated with identification and removal of excess inflow. Funded by user rates.
*Improvements could be reduced if less than 13.7 mgd is pumped from Middle Big Creek

Table 8-3
Capital Improvement Projects for Years 2016 to Ultimate without PRI

Watershed	Project Description	Opinion of Total Project Costs (2006$)					
		Total	City Funded			Developer Funded	LBVSD or MBC Funded
			Category 1	Category 2	Category 3		
West Prairie Lee	Parallel Relief Lines	$ 466,000		$ 466,000			
	Total - West Prairie Lee	**$ 466,000**	**$ -**	**$ 466,000**	**$ -**	**$ -**	**$ -**
South Prairie Lee	Parallel Relief Lines	$ 933,000		$ 933,000			
	East Annex Area Pump Station, EFHB, and Forcemain	$ 4,183,000				$ 4,183,000	
	50 Highway Annex Area Pump Station, EFHB, and Forcemain	$ 3,922,000				$ 3,922,000	
	Total - South Prairie Lee	**$ 9,038,000**	**$ -**	**$ 933,000**	**$ -**	**$ 8,105,000**	**$ -**
Little Cedar	Interceptor Improvements	$ 370,000	$ 370,000				
	Parallel Relief Lines	$ 28,000		$ 28,000			
	Total - Little Cedar	**$ 398,000**	**$ 370,000**	**$ 28,000**	**$ -**	**$ -**	**$ -**
Cedar Creek	Parallel Relief Lines	$ 1,251,000		$ 1,251,000			
	Future Interceptors	$ 94,000				$ 94,000	
	Total - Cedar Creek	**$ 1,345,000**	**$ -**	**$ 1,251,000**	**$ -**	**$ 94,000**	**$ -**
Mouse Creek	Interceptor Improvements*	$ 1,346,000	$ 1,346,000				
	EFHB*	$ 2,850,000	$ 2,850,000				
	Parallel Relief Lines	$ 612,000	$ 612,000				
	Southwest Pump Station and Forcemain	$ 669,000				$ 669,000	
	Future Interceptors	$ 3,400,000				$ 3,400,000	
	Total - Mouse Creek	**$ 8,877,000**	**$ 4,808,000**	**$ -**	**$ -**	**$ 4,069,000**	**$ -**
Big Creek	Interceptor Improvements	$ 212,000		$ 212,000			
	Future Interceptors	$ 1,227,000				$ 1,227,000	
	Total - Big Creek	**$ 1,439,000**	**$ -**	**$ 212,000**	**$ -**	**$ 1,227,000**	**$ -**
Blue Springs	Arbores Gravity Line	$ 481,000		$ 481,000			
	Future Interceptors	$ 360,000				$ 360,000	
	Total - Blue Springs	**$ 841,000**	**$ -**	**$ 481,000**	**$ -**	**$ 360,000**	**$ -**
Middle Big Creek	Parallel Relief Lines	$ 861,000	$ 861,000				
	Future Interceptors	$ 3,008,000				$ 3,008,000	
	Total - Middle Big Creek	**$ 3,869,000**	**$ 861,000**	**$ -**	**$ -**	**$ 3,008,000**	**$ -**
Maybrook	Parallel Relief Lines	$ 82,000		$ 82,000			
	Future Interceptors	$ 479,000				$ 479,000	
	Total - Maybrook	**$ 561,000**	**$ -**	**$ 82,000**	**$ -**	**$ 479,000**	**$ -**
LBVSD	Raytown Excess Flow Holding Basin/Interceptor Pump Stations	$ 30,000,000					$ 30,000,000
	Total - LBVSD	**$ 30,000,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 30,000,000**
MBCSD	Collection System Improvements - Phase 2	$ 31,200,000					$ 31,200,000
	Total - MBCSD	**$ 31,200,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 31,200,000**
	Total - All Watersheds	**$ 88,034,000**	**$ 6,039,000**	**$ 3,453,000**	**$ -**	**$ 17,342,000**	**$ 61,200,000**

Notes
1 Category 1 : Growth related improvements to existing system. Funded by tap fee.
2 Category 2 : Improvements to existing sewers due to higher inflow than origionally projected. Funded by user rates.
3 Category 3 : Improvements associated with identification and removal of excess inflow. Funded by user rates.
*Improvements could be reduced if less than 13.7 mgd is pumped from Middle Big Creek

9 APPENDIX

9.1 City of Lee's Summit Population Projection
9.2 City of Lee's Summit Design Criteria; Section 6500 – Sanitary Sewer
9.3 Excess Flow Hold Basin Sizing Methodology
9.4 Unsewered Areas – Interceptor Sizing
9.5 Proposed Excess Flow Holding Basins
9.6 Detailed Cost Estimate – 2015 Recommended Capital Improvements
9.7 Detailed Cost Estimate – Ultimate Recommended Capital Improvements
9.8 Detailed Cost Estimate – Ultimate (Without PRI) Recommended Capital Improvements
9.9 CMOM Audit
9.10 Computer Model Summary

Appendix 9.1

City of Lee's Summit Population Projection

Planning Area Demographics and Development Trends

The process of comprehensive planning almost always starts with a comprehensive analysis of the historical trend of growth and the existing conditions of the planning area. This analysis is intended to raise the awareness of the community and its elected officials of the overall well-being of the planning area.

This section of the Plan provides a summary of the comprehensive studies of the demographics and development trends for the planning area.

Population and Housing

Key Statistics - Lee's Summit 2004*

Total Area	64 Sq. Mi.
Population	82,528
Housing Units	32,084
Household Size	2.65

** Estimates using 2000 US Census as baseline figures.*

The current estimate of the January 1st 2004 population of Lee's Summit is approximately 82,528. There is an estimated housing stock of 32,084 living units. Lee's Summit, as one of the suburban communities of Kansas City, has experienced a steady growth over the past decades. In 1960, Lee's Summit had a population of 8,267. By 1970, the population almost doubled, to a total of 16,230. The next decade saw a population increase of about 77%, to a total of 28,741.

Table 1. Lee's Summit Population Growth by Census Tract Since 1980.

Census Tract*	1980 Census	1990 Census	2000 Census	2003 Estimate	2004 Estimate	Population Increase	
						80-90	90-00
135/604	1,793	2,963	5,348	6,479	7,313	1,170	2,385
136	4,861	5,727	10,088	12,254	13,184	866	4,361
137.01	993	2,125	3,703	4,728	5,046	1,132	1,578
137.02	3,440	3,915	3,714	3,745	3,745	475	(201)
137.03	5,266	5,836	5,381	5,569	5,590	570	(455)
137.04	3,985	4,133	5,726	5,876	5,976	148	1,593
138	3,870	10,195	13,090	14,021	14,188	6,325	2,895
139	1,130	5,068	12,830	13,437	13,675	3,938	7,762
141.04/141.03/141.07/142.02/141.04/143	134	184	2,245	2,601	2,675	50	2,061
142.01/142.03/142.04	3,269	6,272	8,575	10,805	11,136	3,003	2,303
Totals	28,741	46,418	70,700	79,515	82,528	17,677	24,282

*The tracts listed include 1980, 1990 and 2000 census redraws. However, the table compares identical geography.

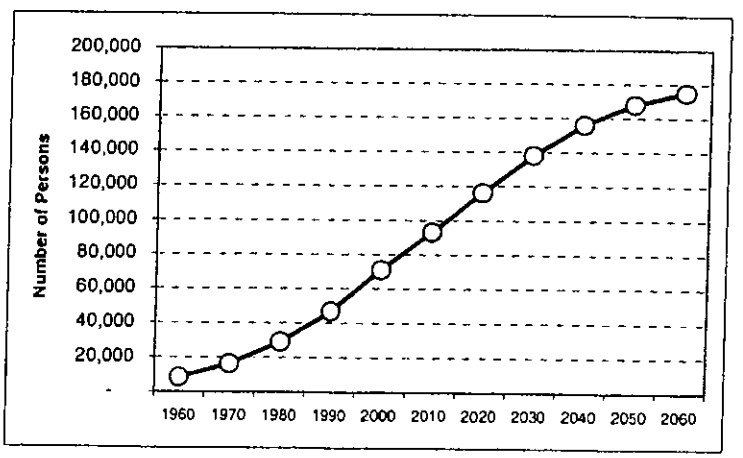
'forecasts' by using a regression model. Thus, these projections are both controlled by historical growth trend and the actual and projected land use statistics.

The projected buildout population is approximately 175,000 and the projected growth trend suggests that this population will be reached around the year 2060. The projected trend also suggests that the growth rate will gradually level off or the population will grow at a decreasing rate. The table and the chart below demonstrate the projection and the projected trend.

Table 10. Population projections

Year	Population
1960	**8,267**
1970	**16,230**
1980	**28,742**
1990	**46,486**
2000	**70,700**
2010	*93,000*
2020	*116,000*
2030	*138,000*
2040	*156,000*
2050	*168,000*
2060	*175,000*
Years in bold are Census Counts.	

Chart 1. Population Projection



It should be pointed out that many factors may potentially make the projected results invalid as time goes by. Constant

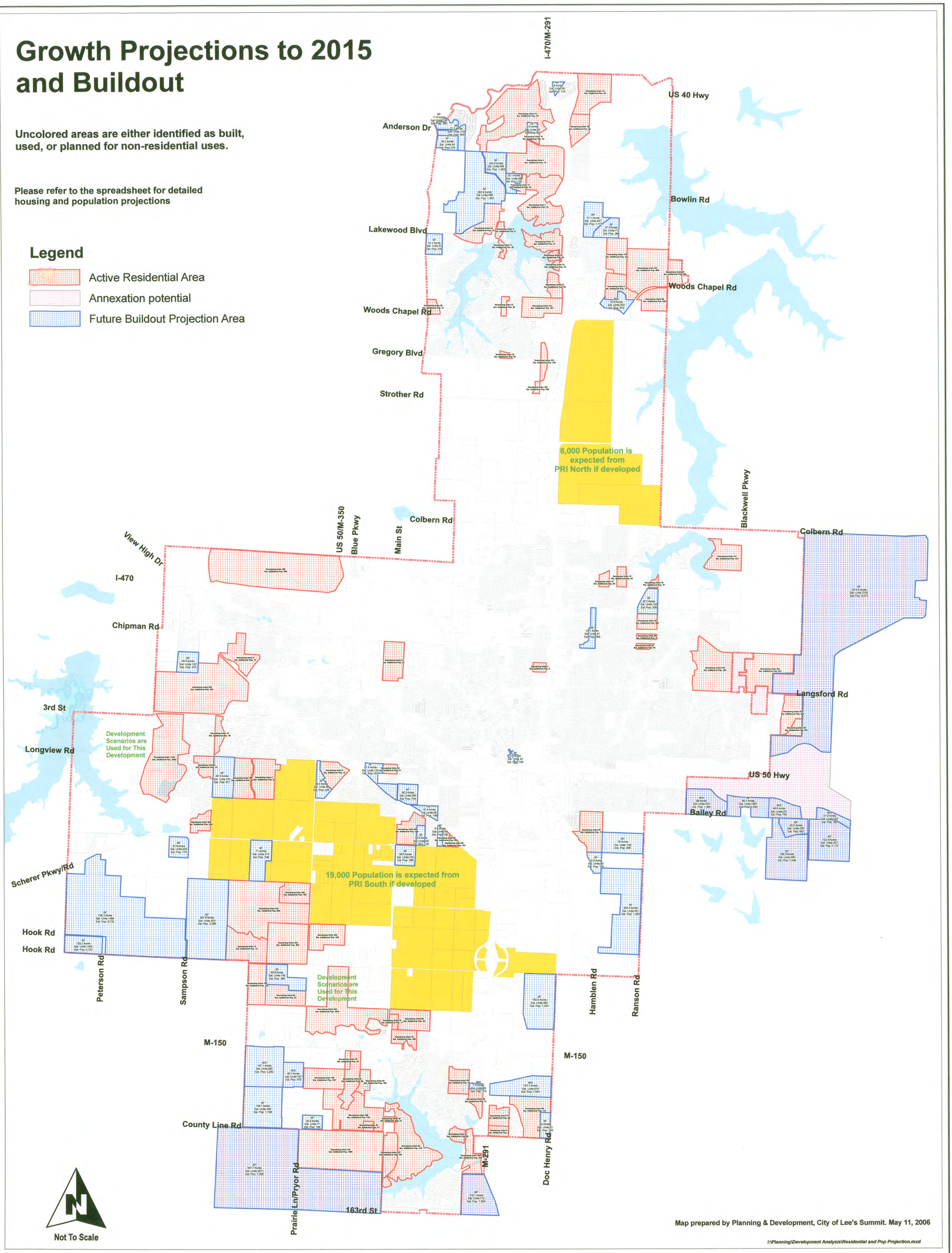
Growth Projections to 2015 and Buildout

Uncolored areas are either identified as built, used, or planned for non-residential uses.

Please refer to the spreadsheet for detailed housing and population projections

Legend

- Active Residential Area
- Annexation potential
- Future Buildout Projection Area



Map prepared by Planning & Development, City of Lee's Summit. May 11, 2006

I:\Planning\Development Analysis\Residential and Pop Projection.mxd

Appendix 9.2

City of Lee's Summit Design Criteria; Section 6500 – Sanitary Sewer

CITY OF LEE'S SUMMIT, MISSOURI
DESIGN CRITERIA

SECTION 6500 - SANITARY SEWERS

6501 DESIGN CRITERIA

A. General

1. The design standards presented in the City of Lee's Summit Design Criteria are the minimum standards to be followed in the design and construction of the Lee's Summit public sewerage system. These standards are not intended to be used as a substitute for actual construction specifications and design computations.

2. Deviations from the stated design standard shall be evaluated on a case-by-case basis by the City Engineer.

3. Figures and drawings referred to in the City of Lee's Summit Design Criteria are located at the end of the City of Lee's Summit Design Criteria unless otherwise indicated.

B. Design Factors

1. Sewerage systems that provide for a complete watershed shall be designed and sized for ultimate growth.

2. Sewerage systems that provide for only part of a complete watershed shall be sized to provide for the entire watershed for ultimate growth.

3. The City of Lee's Summit recognizes the impact that extraneous flows (infiltration and inflow) have on sewer capacities.

C. Capacities

1. Peak wastewater flows shall be used to design sanitary sewers and shall consist of the following three components:

   a. Peak Base Flow: Base flow is defined as the normal wastewater flow generated in the sanitary sewer system exclusive of infiltration and inflow.

      i. The peak base flow used for residential land in Lee's Summit is 1,500 gallons per day per acre (gpd/ac).

      ii. The peak base flow to be used for non-residential land Lee's Summit is calculated using the equivalent dwelling unit (EDU) methodology described in Paragraph 6501.C.3 of the City of Lee's Summit Design Criteria.

   b. Peak Infiltration: Infiltration is defined as groundwater entering the system through defective pipes, pipe joints, and manholes. Peak infiltration is considered

the maximum infiltration that occurs during the highest groundwater level period of the year.

i. The peak infiltration used for residential land in Lee's Summit is 500 gpd/ac.

ii. The peak infiltration to be used for non-residential land in Lee's Summit is 250 gpd/ac.

c. Peak Inflow: Inflow is defined as rainfall-related water entering the collection system from sources such as private building sewers, down spouts, foundation drains, sump pumps, and cross connections.

i. Peak inflow is determined by the following equation:

$$Q = KiA$$

where

Q = peak inflow, cubic feet per second (cfs)
K = inflow factor
i = rainfall intensity that corresponds to a tributary area's time of concentration, inch per hour (iph)
A = tributary area, acres (ac)

ii. Lee's Summit shall use a K = 0.006 and K = 0.003 for residential and non-residential land, respectively, and a 50-year storm event. Inflow is directly influenced by the intensity and duration of a storm event and is not a fixed quantity.

iii. The time of concentration can be calculated by the following equation:

$$T_c = 18.56\,(A)^{0.2524}$$

where

T_c = time of concentration, minutes (min)
A = tributary area, ac

d. The rainfall intensity can be determined using the table below and the tributary area's T_c as calculated above. Use interpolation to calculate rainfall intensities for T_c not listed in the table.

Year	Time of Concentration (min)									
	5	10	15	30	60	120	180	240	360	600
	Rainfall Intensity (iph)									
1	4.48	3.53	3.05	2.09	1.41	0.86	0.60	0.47	0.35	0.25
3	5.84	4.77	4.13	2.90	1.93	1.18	0.86	0.69	0.51	0.36
5	6.47	5.34	4.63	3.28	2.17	1.32	0.97	0.79	0.58	0.40
10	7.33	6.12	5.32	3.79	2.50	1.52	1.13	0.93	0.68	0.47
25	8.46	7.16	6.22	4.47	2.93	1.78	1.34	1.12	0.80	0.56
50	9.32	7.94	6.91	4.98	3.26	1.98	1.50	1.26	0.90	0.62
75	9.82	8.40	7.31	5.27	3.46	2.10	1.59	1.34	0.96	0.66
100	10.18	8.72	7.59	5.49	3.59	2.18	1.65	1.39	1.00	0.69

e. Peak Flow = Peak Base Flow + Peak Infiltration + Peak Inflow

2. Sewer capacity for residential land shall be calculated using the equations shown above or the design curves shown in Figures 6501-1 and 6501-2. For example, in Figure 6501-1, a tributary area of 450 acres corresponds to a design flow of 0.019 cfs/ac, or 5.53 million gallons per day (MGD). This design flow shall be used to size the sewer pipe.

3. Sewer capacity for commercial and industrial land that is less than 100 acres in total area shall be calculated using the EDU methodology described below:

   a. An EDU is a ratio of the flow produced by a particular land use compared to the flow produced by a single residential housing unit. A single residential unit is 1.0 EDU and produces 300 gallons per day (gpd) of peak daily flow. All other land uses are given EDU values that are a ratio to that 1.0 EDU value and are based on the anticipated flow rate.

   b. Table 1 lists common types of commercial and institutional developments. For each type of source, an EDU value is assigned based on the parameters of the building. Each EDU is estimated to produce 300 gpd of peak daily flow, which is based on the assumption of an average of 100 gpd per capita and 3 capita per residence. Calculating the total number of EDUs for a site establishes a value for the peak base flow.

   c. Using the EDU values in Table 6501-1 and the parameters defined for each source, the following formula shall be used to estimate the peak base flow for non-residential development ($PBF_{Non\text{-}res}$):

$$PBF_{Non\text{-}res} = \text{EDU} * \text{Building Area} * \text{Stories} * 300 \text{ gpd}$$

where

$PBF_{Non\text{-}res}$ = Peak base flow (gpd)

EDU = Equivalent development units per 1000 ft^2 (see Table 6501-1)

Building Area = Building footprint area in thousands of square feet (1000 ft^2)

Stories = Total building stories (see Table 6501-2)

This formula only applies to the sources listed in Table 6501-1 that have "per 1000 ft^2" indicated as the parameter. To calculate the $PBF_{Non\text{-}res}$ for other sources listed in the table, multiply the EDU for the parameter by the appropriate number, then multiply it by 300 gpd (e.g., an 100-bed hospital would have a $PBF_{Non\text{-}res}$ = [0.8 EDU/bed x 100 beds] * 300 gpd = 24,000 gpd).

d. Peak infiltration and peak inflow can be calculated using the values and equation for non-residential land found in Paragraph 6501.C.1. in the City of Lee's Summit Design Criteria. Alternatively, Figure 6501-3 shows a graph of the combined peak infiltration and inflow values. Figure 6501-3 should not be used for areas less than 8 acres. Note that Figure 3 **does not** include the peak base flow.

Peak Flow = $PBF_{Non\text{-}res}$ + Peak Infiltration + Peak Inflow

This design flow shall be used to size the sewer pipe for commercial developments less than 100 acres in size.

4. In cases where the above criteria are not applicable, an alternate design procedure may be submitted to the City Engineer. A description of the procedure used and a justification of the proposed modifications to the above-stated sanitary sewer design shall be included with the design analysis and plans submitted for approval.

D. Hydraulic Design

1. Minimum Pipe Size: No public sewer shall be less than 8 inches in diameter. The downstream sewer pipe shall have the same or larger nominal diameter as the upstream pipe, unless otherwise approved by the City Engineer. Building sewers and building sewer stubs for industrial, commercial, and residential development shall not be less than 4 inches in diameter.

2. Hydraulic Grade

a. Average Velocity: Sewers shall be designed to be free flowing with the hydraulic grade below the top of pipe and with hydraulic slopes sufficient to provide an average velocity when running full of not less than 2.25 feet per second (fps). Computations of velocity of flow shall be based on the following Manning's formula.

Table 6501-1. Equivalent Development Units

Source	EDU		Parameter
Institutional			
Hospital (not including ancillary services, i.e., cafeterias)	0.8	per	bed
Nursing Home	0.4	per	unit
Prison/Jail	0.4	per	inmate
Retirement Home	0.4	per	unit
Schools:			
Elementary	0.8	per	1000 ft^2
Middle and High	1.0	per	1000 ft^2
Commercial/Retail			
Office–General	0.3	per	1000 ft^2
Retail Stores	0.2	per	1000 ft^2
Warehouse (minimum 70% warehouse)	0.1	per	1000 ft^2
Shopping Centers and Stores	0.2	per	1000 ft^2
Restaurants:			
Drive-In	0.1	per	parking space
Fast Food (disposable patron wares)	1.6	per	1000 ft^2
Full Service	3.5	per	1000 ft^2
Animal Clinics	1.0	per	1000 ft^2
Auditoriums	0.6	per	1000 ft^2
Automobile Dealerships:			
Office Rate + Service Bays	office rate + 0.1 per service bay		
Automobile Service:			
Fast Service	0.5	per	service bay
Major Service	0.1	per	service bay
Bars and Cocktail Lounges	2.4	per	1000 ft^2
Banquet Rooms–food catered	0.5	per	1000 ft^2
Banquet Rooms–food prepared	1.1	per	1000 ft^2
Beauty Shop/Barber Shop	0.4	per	1000 ft^2
Body Shop	0.1	per	1000 ft^2
Bowling Alleys	0.4	per	lane
Car Wash:			
self-service	3.0	per	stall
automatic at service station	6.0	per	stall
tunnel, car pulled through	requires equipment specs, minimum 33		
Churches	0.5	per	1000 ft^2
Daycare/Nursery Schools	1.0	per	1000 ft^2
Dry Cleaners	0.3	per	1000 ft^2
Clubhouse (apartment)	1.0		
County Club			
private with golf course	3.0 + 2.2/1000 ft^2		
private without golf course	2.2	per	1000 ft^2
Exercise Area			
gym without showers	0.5	per	1000 ft^2
gym with showers	1.4	per	1000 ft^2
Fire Station	by water use		

Table 6501-1. Equivalent Development Units (continued)

Source	EDU		Parameter
Game Room/Arcade	0.8	per	1000 ft^2
Golf Course	3.0		
Greenhouse (area open to public)	0.2	per	1000 ft^2
Group Home	0.4	per	bed
Handball and Racquetball Courts	2.0	per	court
Hotel/Motel	0.3	per	room
Laundromat/Commercial Laundry	0.6/washer or 8.0/1000 ft^2		
Library (excluding book/file storage)	0.4	per	1000 ft^2
Locker Rooms	0.1	per	locker
Medical Offices/Outpatient Clinics	0.4	per	1000 ft^2
Meeting/Conference Rooms	0.6	per	1000 ft^2
Museum	0.4	per	1000 ft^2
Rifle/Handgun Ranges	0.2	per	lane
Roller Rink	1.2	per	1000 ft^2
Schools–Technical Vocational Institute, Junior College	0.9	per	1000 ft^2
Gas Station:			
with convenience center and without service bays	1.0 + 0.3/1000 ft^2		
without convenience center and without service bays	1.0		
Service Station:			
with 2 service bays	2.0		
with 2 service bays and car wash	8.0		
with 2 service bays and convenience center	2.0 + 0.3/1000 ft^2		
with 2 service bays, convenience center, and car wash	8.0 + 0.3/1000 ft^2		
Swimming Pools–public (private no charge)	1.1	per	1000 ft^2
Stadium/Arena	1.0/110 seats or 1.0/165 LF of bleachers		
Tanning Rooms/Centers	0.3	per	1000 ft^2
Tennis Courts–with shower facilities	2.0	per	court
Theater	1.2	per	1000 ft^2
Vacant Land	3.0	per	acre
Vehicle Garage	0.2	per	1000 ft^2
Yard Storage Buildings (excluding lumber storage) customer pick-up, no permanent employees	0.1	per	1000 ft^2
Industry	varies–industry specific		

Appendix 9.3

Excess Flow Hold Basin Sizing Methodology

A triangular-shaped hydrograph was used to evaluate and size future excess flow holding basins. The volume of flow entering the sanitary sewer system was estimated to be 1.5% of the total rain fall produced during a 50-year storm event for a given area. The 1.5% was derived from previous flow metering studies. Since the volume of flow is equal to the area under the assumed triangular hydrograph a total duration was calculated based upon:

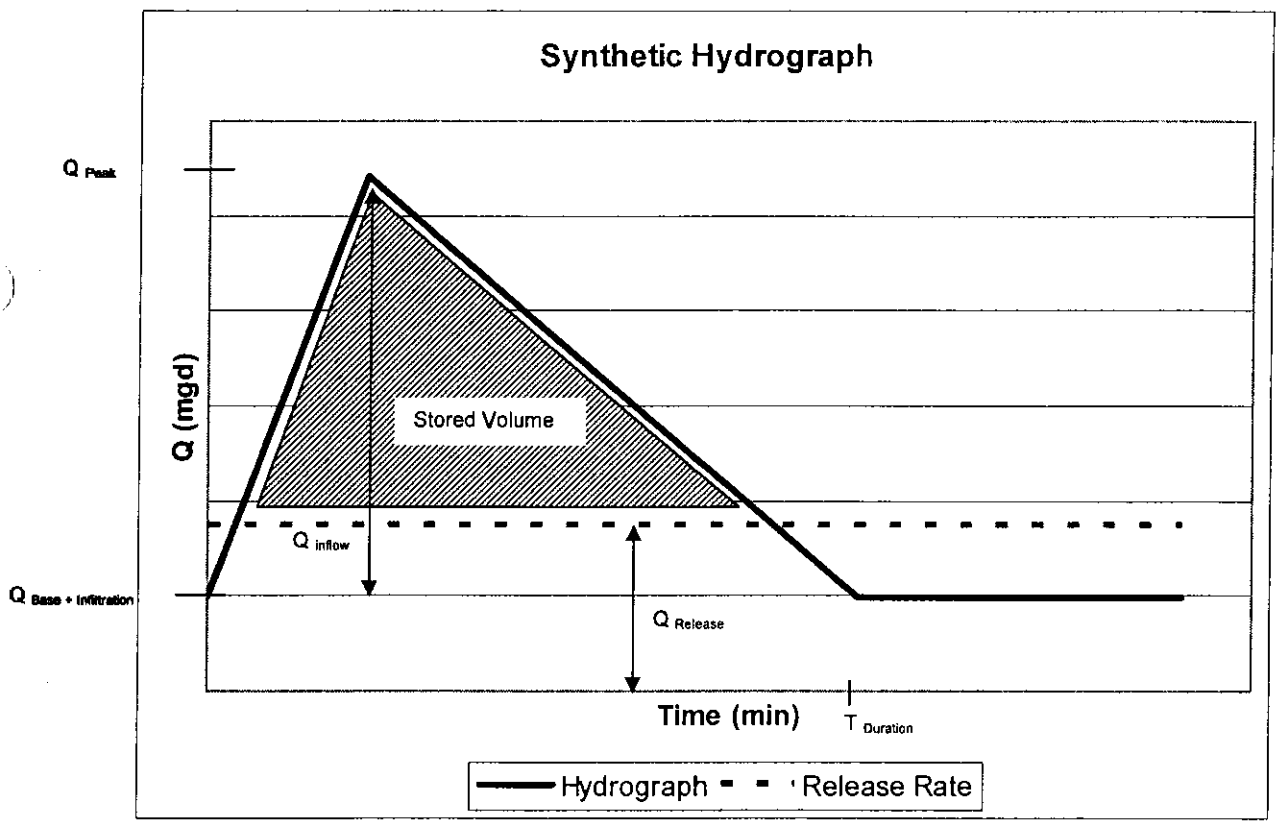
$$V_{total} = \frac{1}{2} \times Q_{peak} \times T_{duration}$$

Where:

V_{total} = Volume of flow entering the system

Q_{peak} = Peak wastewater flows consist of three components: Peak Base Flow, Peak Infiltration, Peak inflow.

$T_{duration}$ = Total Duration



The stored volume was then calculated based upon volume above the basin release rate and below the triangular hydrograph.

Appendix 9.4

Unsewered Areas – Interceptor Sizing

City of Lee's Summit Wastewater Master Plan
Unsewered Areas
Interceptor Sizing

Line	Q_{PEAK}, mgd	Q_{PEAK}, cfs	Mannings	Slope	Required Diameter, inches
Maybrook-1	0.83	1.28	0.013	0.22%	12
Maybrook-2	0.33	0.52	0.013	0.40%	8
Maybrook-3	1.68	2.61	0.013	0.12%	18
Maybrook-4	0.85	1.32	0.013	0.22%	12
Blue Springs-1	0.55	0.85	0.013	0.28%	10
Blue Springs-2	0.66	1.03	0.013	0.28%	10
Blue Springs-3	2.38	3.68	0.013	0.10%	21
Blue Springs-4	1.65	2.55	0.013	0.12%	18
Cedar Creek-1	0.27	0.41	0.013	0.40%	8
Cedar Creek-2	1.47	2.27	0.013	0.15%	15
Cedar Creek-3	1.47	2.27	0.013	0.15%	15
Cedar Creek-4	0.96	1.49	0.013	0.22%	12
Cedar Creek-5	1.52	2.36	0.013	0.15%	15
Cedar Creek-6	3.37	5.22	0.013	0.08%	24
Cedar Creek-7	1.68	2.60	0.013	0.12%	18
Cedar Creek-8	2.17	3.35	0.013	0.12%	18
Cedar Creek-9	3.58	5.54	0.013	0.08%	24
Mouse Creek-1	0.92	1.43	0.013	0.22%	12
Mouse Creek-2	0.65	1.01	0.013	0.28%	10
Mouse Creek-3	0.91	1.42	0.013	0.22%	12
Mouse Creek-4	3.01	4.66	0.013	0.10%	21
Mouse Creek-5	1.94	3.00	0.013	0.12%	16
Mouse Creek-6	0.66	1.03	0.013	0.28%	10
Mouse Creek-7	2.25	3.48	0.013	0.12%	18
Mouse Creek-8	5.63	8.71	0.013	0.05%	30
Mouse Creek-9	2.64	4.09	0.013	0.10%	21
Mouse Creek-10	3.44	5.32	0.013	0.08%	24
Mouse Creek-11	11.62	17.98	0.013	0.05%	42
Mouse Creek-12	2.34	3.62	0.013	0.12%	18
Mouse Creek-13	4.00	6.19	0.013	0.08%	24
Mouse Creek-14	2.11	3.27	0.013	0.12%	18
Mouse Creek-15	1.31	2.02	0.013	0.15%	15
Mouse Creek-16	6.58	10.19	0.013	0.05%	36
Mouse Creek-17	2.31	3.57	0.013	0.12%	18
Mouse Creek-18	1.35	2.09	0.013	0.15%	15
Mouse Creek-19	0.60	0.93	0.013	0.28%	10
Mouse Creek-20	4.10	6.34	0.013	0.08%	24
Mouse Creek-21	1.52	2.35	0.013	0.15%	15
Mouse Creek-22	1.22	1.69	0.013	0.15%	15
Mouse Creek-23	12.04	18.63	0.013	0.05%	42
Mouse Creek-24	2.98	4.59	0.013	0.10%	21
Big Creek-1	2.85	4.41	0.013	0.10%	21
Big Creek-2	1.67	2.58	0.013	0.12%	18
Big Creek-3	8.64	13.37	0.013	0.05%	36
Big Creek-4	1.49	2.31	0.013	0.15%	15
Big Creek-5	3.49	5.39	0.013	0.08%	24
Big Creek-6	9.51	14.71	0.013	0.05%	42
Big Creek-7	0.79	1.22	0.013	0.22%	12
Big Creek-8	0.00	0.00	0.013	0.40%	12
Big Creek-9	1.58	2.44	0.013	0.15%	15
Middle Big Creek-1	3.41	5.27	0.013	0.08%	24
Middle Big Creek-2	1.59	2.46	0.013	0.15%	15
Middle Big Creek-3	9.62	14.89	0.013	0.05%	42
Middle Big Creek-4	1.17	1.81	0.013	0.15%	15
Middle Big Creek-5	1.25	1.93	0.013	0.15%	15
Middle Big Creek-6	2.48	3.84	0.013	0.10%	21
Middle Big Creek-7	1.74	2.69	0.013	0.12%	18
Middle Big Creek-8	8.13	12.58	0.013	0.05%	36
Middle Big Creek-9	0.96	1.49	0.013	0.22%	12
Jacomo Gravity Interceptor-1	1.07	1.66	0.013	0.22%	12
Jacomo Gravity Interceptor-2	1.97	3.05	0.013	0.12%	18
Jacomo Gravity Interceptor-3	3.05	4.73	0.013	0.10%	21
Jacomo Forcemain-1	1.07	1.66	0.013	0.22%	12
Jacomo Forcemain-2	2.80	4.34	0.013	0.10%	21
Jacomo Forcemain-3	3.05	4.73	0.013	0.10%	21
Jacomo Forcemain-4	5.19	8.02	0.013	0.05%	30

Appendix 9.5

Proposed Excess Flow Holding Basins

Proposed EFHB's	
Description	**Capacity (MG)**
Big Creek East Fork EFHB	1.60
Big Creek West Fork EFHB	1.40
Big Creek South Fork EFHB	1.30
Middle Big Creek EFHB	1.10
Mouse Creek EFHB	29.58
City Walk EFHB	0.20
Boggs Hollow EFHB	0.30
Jacomo 1 EFHB	1.31
Jacomo 2 EFHB	0.50
Jacomo 3 EFHB	0.78
East Prairie Lee EFHB	1.80
East Prairie Lee Annex EFHB	1.60
Legacy Wood EFHB	2.36

Appendix 9.6

Detailed Cost Estimate – 2015
Recommended Capital Improvements

Mou Creek
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
42-002_42-005	42-002	42-005	0.432	8.6	18	$155	$54,157	$4,333	$6,499	$2,708	$68,000
42-005_42-006	42-005	42-006	0.319	6.7	15	$140	$33,432	$2,675	$4,012	$1,672	$42,000
42-006_42-007	42-006	42-007	0.432	7.6	15	$140	$23,562	$1,885	$2,827	$1,178	$29,000
42-007_42-008	42-007	42-008	0.572	8.4	18	$155	$54,312	$4,345	$6,517	$2,716	$68,000
42-008_42-009	42-008	42-009	0.695	9.0	18	$155	$23,684	$1,895	$2,842	$1,184	$30,000
42-009_42-010	42-009	42-010	0.834	9.7	18	$155	$46,733	$3,739	$5,608	$2,337	$58,000
42-010_42-011	42-010	42-011	0.430	6.6	15	$140	$43,106	$3,448	$5,173	$2,155	$54,000
42-011_42-012BS	42-011	42-012BS	1.077	10.7	18	$155	$33,341	$2,667	$4,001	$1,667	$42,000
49-013_49-012	49-013	49-012	4.818	18.7	21	$170	$74,134	$5,931	$8,896	$3,707	$93,000
50-111_50-094	50-111	50-094	1.164	9.6	15	$140	$29,165	$2,333	$3,500	$1,458	$36,000
50-015_50-005	50-015	50-005	7.034	17.5	21	$170	$37,553	$3,004	$4,506	$1,878	$47,000
50-041_50-015	50-041	50-015	5.313	15.3	18	$155	$51,065	$4,085	$6,128	$2,553	$64,000
50-042_50-041	50-042	50-041	4.191	13.1	18	$155	$18,640	$1,491	$2,237	$932	$23,000
50-069_50-042	50-069	50-042	1.264	6.8	12	$135	$29,816	$2,385	$3,578	$1,491	$37,000
50-117_50-112	50-117	50-112	2.748	11.4	18	$155	$57,003	$4,560	$6,840	$2,850	$71,000
50-118_50-117	50-118	50-117	1.919	9.8	15	$140	$27,336	$2,187	$3,280	$1,367	$34,000
50-119_50-118	50-119	50-118	1.697	9.7	18	$155	$19,071	$1,526	$2,289	$954	$24,000
Total											$820,000

Note: Parallel Pipe Diameters changed to reflect the required diameters for the Ultimate Flow Conditions

Litt[illegible]edar
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
00-004_00-005	00-004	00-005	7.286	18.4	24	$180	$70,524	$5,642	$8,463	$3,526	$88,000
00-005_00-006	00-005	00-006	18.375	24.4	30	$200	$100,174	$8,014	$12,021	$5,009	$125,000
00-006_00-007	00-006	00-007	14.887	21.5	24	$180	$66,389	$5,311	$7,967	$3,319	$83,000
00-007_00-008	00-007	00-008	26.710	31.2	36	$255	$58,683	$4,695	$7,042	$2,934	$73,000
00-008_00-009	00-008	00-009	25.788	29.5	36	$255	$42,713	$3,417	$5,126	$2,136	$53,000
00-009_00-010	00-009	00-010	30.446	34.6	36	$255	$28,101	$2,248	$3,372	$1,405	$35,000
00-010_00-011	00-010	00-011	11.621	18.9	21	$170	$10,979	$878	$1,317	$549	$14,000
00-011_00-012	00-011	00-012	17.589	23.4	30	$200	$14,204	$1,136	$1,704	$710	$18,000
00-012_00-013	00-012	00-013	17.680	23.5	30	$200	$54,682	$4,375	$6,562	$2,734	$68,000
00-013_00-014	00-013	00-014	7.035	14.9	18	$155	$51,486	$4,119	$6,178	$2,574	$64,000
00-015_00-016	00-015	00-016	15.294	21.3	24	$180	$51,140	$4,091	$6,137	$2,557	$64,000
00-016_00-017	00-016	00-017	15.103	21.2	24	$180	$72,254	$5,780	$8,670	$3,613	$90,000
00-018_00-019	00-018	00-019	26.046	29.6	36	$255	$62,580	$5,006	$7,510	$3,129	$78,000
00-019_00-020	00-019	00-020	26.482	29.8	36	$255	$58,803	$4,704	$7,056	$2,940	$74,000
00-023_00-024	00-023	00-024	17.286	22.3	24	$180	$52,267	$4,181	$6,272	$2,613	$65,000
00-024_00-025	00-024	00-025	17.550	22.4	24	$180	$89,955	$7,196	$10,795	$4,498	$112,000
00-025_00-026	00-025	00-026	17.516	22.4	24	$180	$44,894	$3,592	$5,387	$2,245	$56,000
00-026_00-027	00-026	00-027	16.972	22.2	24	$180	$39,982	$3,199	$4,798	$1,999	$50,000
00-027_00-028	00-027	00-028	12.605	22.6	24	$180	$50,263	$4,021	$6,032	$2,513	$63,000
00-028_00-030	00-028	00-030	17.207	26.4	30	$200	$75,150	$6,012	$9,018	$3,758	$94,000
00-030_00-031	00-030	00-031	16.144	25.8	30	$200	$91,548	$7,324	$10,986	$4,577	$114,000
00-034_00-035	00-034	00-035	13.927	24.4	30	$200	$100,694	$8,056	$12,083	$5,035	$126,000
00-035_00-036	00-035	00-036	13.473	24.1	30	$200	$71,642	$5,731	$8,597	$3,582	$90,000
00-036_00-037	00-036	00-037	14.346	24.7	30	$200	$28,032	$2,243	$3,364	$1,402	$35,000
00-037_00-038	00-037	00-038	12.594	26.8	30	$200	$97,698	$7,816	$11,724	$4,885	$122,000
00-038_00-039	00-038	00-039	11.041	25.5	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-039_00-040	00-039	00-040	13.085	27.2	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-040_00-041	00-040	00-041	11.041	25.5	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-041_00-042	00-041	00-042	13.085	27.2	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-042_00-043	00-042	00-043	14.146	28.0	36	$255	$127,500	$10,200	$15,300	$6,375	$159,000
00-043_00-044	00-043	00-044	14.146	28.0	36	$255	$127,500	$10,200	$15,300	$6,375	$159,000
00-044_00-045	00-044	00-045	37.582	#DIV/0!	42	$280	$162,400	$12,992	$19,488	$8,120	$203,000
00-045_00-046	00-045	00-046	25.953	40.0	42	$280	$70,000	$5,600	$8,400	$3,500	$88,000
16-009_16-008	16-009	16-008	1.179	8.1	8	$125	$47,745	$3,820	$5,729	$2,387	$60,000
16-021_16-011	16-021	16-011	2.059	12.6	15	$140	$6,644	$532	$797	$332	$8,000
16-022_16-021	16-022	16-021	1.420	10.4	10	$130	$13,425	$1,074	$1,611	$671	$17,000
16-023_16-022	16-023	16-022	1.553	11.3	12	$135	$26,164	$2,093	$3,140	$1,308	$33,000
22-038_00-001	22-038	00-001	5.114	19.1	30	$200	$99,284	$7,943	$11,914	$4,964	$124,000
23-046_23-045	23-046	23-045	1.106	9.4	10	$130	$52,046	$4,164	$6,245	$2,602	$65,000
23-047_23-046	23-047	23-046	1.263	10.5	10	$130	$52,035	$4,163	$6,244	$2,602	$65,000

Litt. :edar
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
23-125_23-124	23-125	23-124	2.867	12.5	12	$135	$14,772	$1,182	$1,773	$739	$18,000
23-126_23-125	23-126	23-125	2.658	12.2	12	$135	$47,937	$3,835	$5,752	$2,397	$60,000
23-127_23-126	23-127	23-126	1.688	9.3	8	$125	$15,668	$1,253	$1,880	$783	$20,000
23-128_23-127	23-128	23-127	1.437	8.8	8	$125	$17,086	$1,367	$2,050	$854	$21,000
23-129_23-128	23-129	23-128	1.375	8.8	8	$125	$38,494	$3,080	$4,619	$1,925	$48,000
Total											$3,502,000

Note: Parallel Pipe Diameters changed to reflect the required diameters for the Ultimate Flow Conditions

Bogg Hollow
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
21-086_21-085	21-086	21-085	3.217	14.9	15	$140	$6,100	$488	$732	$305	$8,000
21-087_21-086	21-087	21-086	2.630	13.1	15	$140	$54,058	$4,325	$6,487	$2,703	$68,000
21-088_21-087	21-088	21-087	2.409	10.5	10	$130	$15,222	$1,218	$1,827	$761	$19,000
21-089_21-088	21-089	21-088	2.214	10.3	10	$130	$38,475	$3,078	$4,617	$1,924	$48,000
21-090_21-089	21-090	21-089	2.451	9.5	10	$130	$47,445	$3,796	$5,693	$2,372	$59,000
21-091_21-090	21-091	21-090	1.987	8.6	10	$130	$47,692	$3,815	$5,723	$2,385	$60,000
21-092_21-091	21-092	21-091	1.872	8.6	10	$130	$51,076	$4,086	$6,129	$2,554	$64,000
22-001_21-092	22-001	21-092	1.371	7.4	8	$125	$40,966	$3,277	$4,916	$2,048	$51,000
22-048_22-047	22-048	22-047	1.097	8.7	10	$130	$28,795	$2,304	$3,455	$1,440	$36,000
Total											$413,000

Ced. _ Creek
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
20-002_20-001	20-002	82	15.004	32.6	42	$280	$114,752	$9,180	$13,770	$5,738	$143,000
20-003_20-002	20-003	20-002	14.798	32.4	42	$280	$104,412	$8,353	$12,529	$5,221	$131,000
20-005_20-004	20-005	20-004	14.730	32.3	42	$280	$104,280	$8,342	$12,514	$5,214	$130,000
20-006_20-001BS	20-006	20-001BS	31.802	37.9	48	$305	$99,766	$7,981	$11,972	$4,988	$125,000
20-007_20-006	20-007	20-006	39.685	#DIV/0!	36	$255	$89,480	$7,158	$10,738	$4,474	$112,000
20-008_20-007	20-008	20-007	24.784	30.3	36	$255	$127,653	$10,212	$15,318	$6,383	$160,000
20-009_20-008	20-009	20-008	11.019	20.1	30	$200	$95,740	$7,659	$11,489	$4,787	$120,000
20-010_20-009	20-010	20-009	24.620	31.9	42	$280	$141,014	$11,281	$16,922	$7,051	$176,000
20-011_20-010	20-011	20-010	24.434	31.8	42	$280	$138,692	$11,095	$16,643	$6,935	$173,000
20-012_20-011	20-012	20-011	24.522	31.9	42	$280	$140,308	$11,225	$16,837	$7,015	$175,000
20-013_20-012	20-013	20-012	29.546	42.0	54	$380	$186,960	$14,957	$22,435	$9,348	$234,000
20-015_20-008	20-015	20-008	1.574	8.8	15	$140	$24,024	$1,922	$2,883	$1,201	$30,000
20-016_20-015	20-016	20-015	3.339	18.5	30	$200	$77,226	$6,178	$9,267	$3,861	$97,000
20-017_20-016	20-017	20-016	1.868	8.2	15	$140	$44,219	$3,538	$5,306	$2,211	$55,000
20-018_20-017	20-018	20-017	1.479	7.2	15	$140	$31,248	$2,500	$3,750	$1,562	$39,000
20-019_20-018	20-019	20-018	3.125	11.7	18	$155	$35,177	$2,814	$4,221	$1,759	$44,000
20-020_20-019	20-020	20-019	1.329	6.7	12	$135	$43,744	$3,500	$5,249	$2,187	$55,000
20-021_20-020	20-021	20-020	1.549	7.5	12	$135	$53,933	$4,315	$6,472	$2,697	$67,000
20-022_20-021	20-022	20-021	1.518	7.4	12	$135	$41,513	$3,321	$4,982	$2,076	$52,000
20-034_20-032	20-034	20-032	0.193	5.2	10	$130	$19,757	$1,581	$2,371	$988	$25,000
21-001_20-022	21-001	20-022	0.772	5.1	10	$130	$34,943	$2,795	$4,193	$1,747	$44,000
21-002_21-001	21-002	21-001	1.109	6.2	12	$135	$43,430	$3,474	$5,212	$2,171	$54,000
21-042_21-041	21-042	21-041	0.928	8.8	15	$140	$12,565	$1,005	$1,508	$628	$16,000
21-047_21-042	21-047	21-042	0.408	5.7	10	$130	$19,790	$1,583	$2,375	$989	$25,000
21-049_21-047	21-049	21-047	0.413	5.9	12	$135	$20,918	$1,673	$2,510	$1,046	$26,000
21-051_21-050	21-051	21-050	0.331	5.4	10	$130	$29,640	$2,371	$3,557	$1,482	$37,000
21-052_21-051	21-052	21-051	0.248	4.7	10	$130	$43,537	$3,483	$5,224	$2,177	$54,000
21-053_21-052	21-053	21-052	0.173	4.0	10	$130	$31,447	$2,516	$3,774	$1,572	$39,000
27-001_27-015	27-001	27-015	25.187	32.2	42	$280	$59,430	$4,754	$7,132	$2,972	$74,000
27-002_27-001	27-002	27-001	20.744	26.3	36	$255	$127,566	$10,205	$15,308	$6,378	$159,000
27-003_27-002	27-003	27-002	23.875	29.9	36	$255	$109,660	$8,773	$13,159	$5,483	$137,000
27-004_27-003	27-004	27-003	23.772	29.8	36	$255	$109,665	$8,773	$13,160	$5,483	$137,000
27-005_27-004	27-005	27-004	22.848	31.0	42	$280	$129,027	$10,322	$15,483	$6,451	$161,000
27-015_20-013	27-015	20-013	21.361	30.3	36	$255	$12,559	$1,005	$1,507	$628	$16,000
27-016_27-015	27-016	27-015	1.620	10.1	15	$140	$53,200	$4,256	$6,384	$2,660	$67,000
27-017_27-016	27-017	27-016	1.105	7.5	12	$135	$9,165	$733	$1,100	$458	$11,000
27-022_27-021	27-022	27-021	0.736	6.5	10	$130	$38,624	$3,090	$4,635	$1,931	$48,000
27-006_27-005	27-006	27-005	22.880	31.1	42	$280	$139,882	$11,191	$16,786	$6,994	$175,000
27-007_27-006	27-007	27-006	19.634	25.7	36	$255	$127,653	$10,212	$15,318	$6,383	$160,000
27-008_27-007	27-008	27-007	18.511	26.1	36	$255	$127,842	$10,227	$15,341	$6,392	$160,000

Cec Creek
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
27-009_27-008	27-009	27-008	23.187	31.2	36	$255	$129,665	$10,373	$15,560	$6,483	$162,000
27-010_27-007	27-010	27-007	2.732	9.1	12	$135	$46,609	$3,729	$5,593	$2,330	$58,000
27-013_27-055	27-013	27-055	0.732	7.8	10	$130	$22,372	$1,790	$2,685	$1,119	$28,000
27-055_27-012	27-055	27-012	0.706	6.7	10	$130	$40,866	$3,269	$4,904	$2,043	$51,000
28-013_27-010	28-013	27-010	1.345	9.4	12	$135	$40,635	$3,251	$4,876	$2,032	$51,000
28-014_28-013	28-014	28-013	1.314	9.3	12	$135	$24,300	$1,944	$2,916	$1,215	$30,000
28-015_28-014	28-015	28-014	0.607	7.0	10	$130	$12,350	$988	$1,482	$618	$15,000
28-016_28-015	28-016	28-015	1.063	7.8	10	$130	$31,200	$2,496	$3,744	$1,560	$39,000
28-018_28-017	28-018	28-017	0.354	4.4	8	$125	$34,850	$2,788	$4,182	$1,743	$44,000
28-021_28-020	28-021	28-020	0.865	7.3	10	$130	$30,472	$2,438	$3,657	$1,524	$38,000
28-022_28-021	28-022	28-021	0.826	7.1	10	$130	$14,430	$1,154	$1,732	$722	$18,000
28-023_28-022	28-023	28-022	0.596	6.3	10	$130	$22,866	$1,829	$2,744	$1,143	$29,000
28-024_28-023	28-024	28-023	0.554	6.1	10	$130	$15,470	$1,238	$1,856	$774	$19,000
28-025_28-024	28-025	28-024	0.517	6.0	10	$130	$25,740	$2,059	$3,089	$1,287	$32,000
28-026_28-293	28-026	28-293	0.439	5.6	8	$125	$51,126	$4,090	$6,135	$2,556	$64,000
28-276_27-009	28-276	27-009	27.470	35.9	42	$280	$56,000	$4,480	$6,720	$2,800	$70,000
28-293_28-025	28-293	28-025	0.478	5.8	8	$125	$11,000	$880	$1,320	$550	$14,000
28-046_28-045	28-046	28-045	2.892	11.0	15	$140	$57,400	$4,592	$6,888	$2,870	$72,000
28-047_28-046	28-047	28-046	2.282	9.6	12	$135	$7,962	$637	$955	$398	$10,000
28-048_28-047	28-048	28-047	1.812	8.4	12	$135	$46,575	$3,726	$5,589	$2,329	$58,000
28-049_28-048	28-049	28-048	1.615	8.1	12	$135	$51,648	$4,132	$6,198	$2,582	$65,000
28-050_28-049	28-050	28-049	1.799	8.7	12	$135	$46,062	$3,685	$5,527	$2,303	$58,000
28-051_28-050	28-051	28-050	2.030	9.7	12	$135	$54,108	$4,329	$6,493	$2,705	$68,000
28-052_28-051	28-052	28-051	2.389	10.6	15	$140	$55,055	$4,404	$6,607	$2,753	$69,000
28-053_28-052	28-053	28-052	1.041	6.8	10	$130	$44,616	$3,569	$5,354	$2,231	$56,000
28-055_28-054	28-055	28-054	1.199	9.0	12	$135	$21,777	$1,742	$2,613	$1,089	$27,000
28-068_28-067	28-068	28-067	0.627	6.6	10	$130	$13,468	$1,077	$1,616	$673	$17,000
28-076_28-068	28-076	28-068	0.678	7.9	12	$135	$17,431	$1,394	$2,092	$872	$22,000
28-100_28-099	28-100	28-099	2.904	13.0	15	$140	$28,812	$2,305	$3,457	$1,441	$36,000
29-082_29-081	29-082	29-081	0.698	7.9	8	$125	$28,750	$2,300	$3,450	$1,438	$36,000
29-083_29-082	29-083	29-082	0.644	7.7	8	$125	$27,418	$2,193	$3,290	$1,371	$34,000
29-039_29-040	29-039	29-040	0.014	#DIV/0!	10	$130	$47,918	$3,833	$5,750	$2,396	$60,000
27-042_28-275	27-042	28-275	3.124	12.9	18	$155	$30,564	$2,445	$3,668	$1,528	$38,000
27-061_27-041	27-061	27-041	2.703	12.2	18	$155	$60,100	$4,808	$7,212	$3,005	$75,000
28-042_28-276	28-042	28-276	10.493	19.8	30	$200	$43,760	$3,501	$5,251	$2,188	$55,000
28-275_28-276	28-275	28-276	3.466	13.9	18	$155	$49,617	$3,969	$5,954	$2,481	$62,000
35-148_35-128	35-148	35-128	0.599	7.0	12	$135	$32,612	$2,609	$3,913	$1,631	$41,000
35-197_27-065	35-197	27-065	0.928	8.0	15	$140	$40,041	$3,203	$4,805	$2,002	$50,000
35-198_35-197	35-198	35-197	0.935	8.9	12	$135	$1,863	$149	$224	$93	$2,000
35-199_35-198	35-199	35-198	0.820	7.8	12	$135	$12,407	$993	$1,489	$620	$16,000

Ced_ Creek
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
35-200_35-199	35-200	35-199	0.767	7.6	10	$130	$15,305	$1,224	$1,837	$765	$19,000
35-201_35-200	35-201	35-200	0.752	7.6	10	$130	$19,087	$1,527	$2,290	$954	$24,000
35-203_35-201	35-203	35-201	0.699	7.4	10	$130	$18,435	$1,475	$2,212	$922	$23,000
35-204_35-203	35-204	35-203	0.682	7.3	10	$130	$15,600	$1,248	$1,872	$780	$20,000
35-205_35-204	35-205	35-204	0.523	6.6	10	$130	$11,700	$936	$1,404	$585	$15,000
35-206_35-205	35-206	35-205	0.347	5.7	10	$130	$21,875	$1,750	$2,625	$1,094	$27,000
28-043_28-042	28-043	28-042	19.105	26.4	36	$255	$127,561	$10,205	$15,307	$6,378	$159,000
28-044_28-043	28-044	28-043	19.207	26.4	36	$255	$130,200	$10,416	$15,624	$6,510	$163,000
28-045_28-044	28-045	28-044	2.469	10.0	12	$135	$58,343	$4,667	$7,001	$2,917	$73,000
28-105_28-044	28-105	28-044	7.489	16.3	24	$180	$81,000	$6,480	$9,720	$4,050	$101,000
28-106_28-105	28-106	28-105	8.671	17.6	24	$180	$90,792	$7,263	$10,895	$4,540	$113,000
28-107_28-106	28-107	28-106	17.097	23.7	30	$200	$107,000	$8,560	$12,840	$5,350	$134,000
28-108_28-107	28-108	28-107	14.827	22.0	30	$200	$102,296	$8,184	$12,276	$5,115	$128,000
28-110_28-109	28-110	28-109	10.009	18.2	24	$180	$89,820	$7,186	$10,778	$4,491	$112,000
29-221_29-252	29-221	29-252	0.079	4.6	8	$125	$22,926	$1,834	$2,751	$1,146	$29,000
30-300_30-301	30-300	30-301	0.104	#DIV/0!	21	$170	$54,793	$4,383	$6,575	$2,740	$68,000
30-286_30-265	30-286	30-265	0.104	4.4	8	$125	$25,558	$2,045	$3,067	$1,278	$32,000
28-109_28-108	28-109	28-108	9.704	18.0	24	$180	$75,798	$6,064	$9,096	$3,790	$95,000
36-097_28-108	36-097	28-108	1.708	9.0	15	$140	$42,434	$3,395	$5,092	$2,122	$53,000
36-100_36-098	36-100	36-098	2.117	10.6	18	$155	$20,821	$1,666	$2,499	$1,041	$26,000
36-102_36-101	36-102	36-101	1.693	9.3	15	$140	$13,860	$1,109	$1,663	$693	$17,000
36-105_36-104	36-105	36-104	1.493	8.9	15	$140	$35,267	$2,821	$4,232	$1,763	$44,000
36-106_36-105	36-106	36-105	1.656	9.4	15	$140	$15,540	$1,243	$1,865	$777	$19,000
36-107_36-106	36-107	36-106	1.583	9.1	15	$140	$20,702	$1,656	$2,484	$1,035	$26,000
36-159_36-229	36-159	36-229	0.368	4.9	10	$130	$18,275	$1,462	$2,193	$914	$23,000
36-161_36-175	36-161	36-175	0.447	4.8	10	$130	$39,410	$3,153	$4,729	$1,970	$49,000
36-174_36-107	36-174	36-107	0.930	6.6	12	$135	$24,829	$1,986	$2,980	$1,241	$31,000
36-175_36-174	36-175	36-174	0.614	5.6	10	$130	$25,949	$2,076	$3,114	$1,297	$32,000
36-188_36-157	36-188	36-157	0.630	7.1	12	$135	$17,446	$1,396	$2,094	$872	$22,000
36-196_36-197	36-196	36-197	0.215	4.5	10	$130	$16,561	$1,325	$1,987	$828	$21,000
36-197_36-191	36-197	36-191	0.209	4.3	10	$130	$15,915	$1,273	$1,910	$796	$20,000
36-229_36-160	36-229	36-160	0.388	4.9	10	$130	$18,543	$1,483	$2,225	$927	$23,000
36-244_36-204	36-244	36-204	0.178	4.6	10	$130	$15,510	$1,241	$1,861	$776	$19,000
36-001_36-025	36-001	36-025	8.394	16.4	21	$170	$18,870	$1,510	$2,264	$944	$24,000
36-002_36-001	36-002	36-001	6.607	15.0	21	$170	$83,300	$6,664	$9,996	$4,165	$104,000
36-003_36-002	36-003	36-002	7.978	16.7	21	$170	$93,558	$7,485	$11,227	$4,678	$117,000
36-004_36-003	36-004	36-003	3.243	10.8	18	$155	$62,136	$4,971	$7,456	$3,107	$78,000
36-005_36-052	36-005	36-052	10.236	19.6	24	$180	$46,350	$3,708	$5,562	$2,318	$58,000
36-006_36-067	36-006	36-067	4.704	12.9	18	$155	$43,967	$3,517	$5,276	$2,198	$55,000
36-009_36-008	36-009	36-008	0.444	5.9	8	$125	$31,250	$2,500	$3,750	$1,563	$39,000

Cec Creek
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
36-010_36-009	36-010	36-009	0.425	5.8	8	$125	$31,159	$2,493	$3,739	$1,558	$39,000
36-017_36-016	36-017	36-016	0.108	4.5	8	$125	$19,781	$1,583	$2,374	$989	$25,000
36-025_36-026	36-025	36-026	16.869	27.7	36	$255	$59,925	$4,794	$7,191	$2,996	$75,000
36-052_36-004	36-052	36-004	9.413	18.5	24	$180	$44,231	$3,539	$5,308	$2,212	$55,000
36-067_36-005	36-067	36-005	18.455	35.2	42	$280	$51,346	$4,108	$6,162	$2,567	$64,000
36-246_36-001	36-246	36-001	0.557	5.5	8	$125	$17,173	$1,374	$2,061	$859	$21,000
37-001_37-369	37-001	37-369	13.351	24.0	30	$200	$62,600	$5,008	$7,512	$3,130	$78,000
37-127_37-001	37-127	37-001	10.897	25.4	36	$255	$110,201	$8,816	$13,224	$5,510	$138,000
29-297_29-336	29-297	29-336	0.111	5.2	8	$125	$44,038	$3,523	$5,285	$2,202	$55,000
37-004_37-003	37-004	37-003	0.520	9.2	10	$130	$8,126	$650	$975	$406	$10,000
37-177_37-176	37-177	37-176	4.609	16.1	18	$155	$50,143	$4,011	$6,017	$2,507	$63,000
38-001_37-223	38-001	37-223	0.894	9.9	12	$135	$36,896	$2,952	$4,427	$1,845	$46,000
38-044_38-098	38-044	38-098	0.798	8.4	10	$130	$25,220	$2,018	$3,026	$1,261	$32,000
38-046_38-045	38-046	38-045	0.678	7.5	8	$125	$46,988	$3,759	$5,639	$2,349	$59,000
38-070_38-069	38-070	38-069	0.053	#DIV/0!	18	$155	$59,664	$4,773	$7,160	$2,983	$75,000
38-319_38-067	38-319	38-067	0.685	#DIV/0!	42	$280	$79,800	$6,384	$9,576	$3,990	$100,000
38-321_38-058	38-321	38-058	1.475	8.6	10	$130	$15,561	$1,245	$1,867	$778	$19,000
37-128_37-127	37-128	37-127	10.829	25.3	36	$255	$47,940	$3,835	$5,753	$2,397	$60,000
37-129_37-128	37-129	37-128	9.601	22.4	30	$200	$37,660	$3,013	$4,519	$1,883	$47,000
37-130_37-129	37-130	37-129	10.730	25.2	36	$255	$78,795	$6,304	$9,455	$3,940	$98,000
37-131_37-347	37-131	37-347	7.987	20.9	30	$200	$36,214	$2,897	$4,346	$1,811	$45,000
37-132_37-131	37-132	37-131	7.846	20.8	30	$200	$53,200	$4,256	$6,384	$2,660	$67,000
37-133_37-132	37-133	37-132	9.045	23.7	30	$200	$54,000	$4,320	$6,480	$2,700	$68,000
37-294_37-296	37-294	37-296	0.209	6.6	12	$135	$15,617	$1,249	$1,874	$781	$20,000
37-347_37-130	37-347	37-130	11.576	29.6	36	$255	$30,291	$2,423	$3,635	$1,515	$38,000
37-349_37-355	37-349	37-355	0.511	6.4	15	$140	$45,958	$3,677	$5,515	$2,298	$57,000
37-350_37-349	37-350	37-349	1.170	8.5	15	$140	$1,495	$120	$179	$75	$2,000
37-355_37-348	37-355	37-348	0.586	6.7	15	$140	$36,289	$2,903	$4,355	$1,814	$45,000
37-134_37-133	37-134	37-133	7.550	22.1	24	$180	$39,956	$3,197	$4,795	$1,998	$50,000
37-135_37-134	37-135	37-134	4.769	15.7	18	$155	$19,786	$1,583	$2,374	$989	$25,000
37-136_37-135	37-136	37-135	7.320	21.9	24	$180	$31,837	$2,547	$3,820	$1,592	$40,000
37-137_37-136	37-137	37-136	7.281	21.8	24	$180	$33,399	$2,672	$4,008	$1,670	$42,000
37-138_37-137	37-138	37-137	5.448	17.2	21	$170	$23,419	$1,874	$2,810	$1,171	$29,000
37-227_37-177	37-227	37-177	4.280	14.1	18	$155	$12,059	$965	$1,447	$603	$15,000
37-238_37-227	37-238	37-227	2.041	10.7	15	$140	$39,007	$3,121	$4,681	$1,950	$49,000
37-310_37-133	37-310	37-133	0.577	7.1	18	$155	$58,668	$4,693	$7,040	$2,933	$73,000
37-338_37-336	37-338	37-336	0.105	4.1	15	$140	$10,952	$876	$1,314	$548	$14,000
37-228_37-237	37-228	37-237	2.537	12.4	15	$140	$34,805	$2,784	$4,177	$1,740	$44,000
37-231_37-232	37-231	37-232	1.956	10.8	15	$140	$14,787	$1,183	$1,774	$739	$18,000
37-232_37-228	37-232	37-228	2.469	12.8	18	$155	$40,533	$3,243	$4,864	$2,027	$51,000

Cedar Creek
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
37-237_37-238	37-237	37-238	2.568	12.4	15	$140	$39,808	$3,185	$4,777	$1,990	$50,000
37-247_37-231	37-247	37-231	2.202	11.0	15	$140	$30,807	$2,465	$3,697	$1,540	$39,000
37-248_37-247	37-248	37-247	2.045	10.4	15	$140	$50,984	$4,079	$6,118	$2,549	$64,000
37-249_37-248	37-249	37-248	0.916	7.4	12	$135	$50,039	$4,003	$6,005	$2,502	$63,000
38-281_38-282	38-281	38-282	1.577	8.9	12	$135	$24,731	$1,978	$2,968	$1,237	$31,000
38-282_38-283	38-282	38-283	1.758	9.7	15	$140	$40,247	$3,220	$4,830	$2,012	$50,000
38-283_38-284	38-283	38-284	1.560	8.6	12	$135	$39,215	$3,137	$4,706	$1,961	$49,000
38-284_37-249	38-284	37-249	0.755	6.8	12	$135	$21,487	$1,719	$2,578	$1,074	$27,000
38-082_38-081	38-082	38-081	0.549	7.3	10	$130	$19,581	$1,566	$2,350	$979	$24,000
45-042_45-066	45-042	45-066	0.285	#DIV/0!	30	$200	$64,340	$5,147	$7,721	$3,217	$80,000
Total											$10,195,000

Note: Parallel Pipe Diameters changed to reflect the required diameters for the Ultimate Flow Conditions

Big Creek
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
47-006_47-007	47-006	47-007	0.413	6.5	8	$125	$50,030	$4,002	$6,004	$2,502	$63,000
47-007_47-016	47-007	47-016	0.560	7.3	8	$125	$39,989	$3,199	$4,799	$1,999	$50,000
47-016_47-017	47-016	47-017	2.121	12.1	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
47-022_47-023	47-022	47-023	2.321	16.2	18	$155	$46,675	$3,734	$5,601	$2,334	$58,000
47-023_47-069	47-023	47-069	1.561	10.8	12	$135	$29,539	$2,363	$3,545	$1,477	$37,000
47-068_54-017	47-068	54-017	1.996	12.4	15	$140	$32,199	$2,576	$3,864	$1,610	$40,000
47-069_47-068	47-069	47-068	1.824	12.0	15	$140	$32,203	$2,576	$3,864	$1,610	$40,000
54-008_54-007	54-008	54-007	3.696	14.9	18	$155	$62,002	$4,960	$7,440	$3,100	$78,000
54-010_54-009	54-010	54-009	3.865	15.9	18	$155	$62,000	$4,960	$7,440	$3,100	$78,000
54-011_54-010	54-011	54-010	3.932	17.3	21	$170	$61,533	$4,923	$7,384	$3,077	$77,000
54-012_54-011	54-012	54-011	2.131	11.6	15	$140	$41,597	$3,328	$4,992	$2,080	$52,000
54-013_54-012	54-013	54-012	3.704	16.9	21	$170	$49,487	$3,959	$5,938	$2,474	$62,000
54-014_54-013	54-014	54-013	3.562	16.7	21	$170	$64,405	$5,152	$7,729	$3,220	$81,000
54-015_54-014	54-015	54-014	2.554	13.6	18	$155	$63,220	$5,058	$7,586	$3,161	$79,000
54-016_54-015	54-016	54-015	1.232	9.1	12	$135	$53,997	$4,320	$6,480	$2,700	$67,000
54-017_54-016	54-017	54-016	2.771	15.2	18	$155	$61,997	$4,960	$7,440	$3,100	$77,000
Total											$1,007,000

Note: Parallel Pipe Diameters changed to reflect the required diameters for the Ultimate Flow Conditions

Ma ook
Watershed
Required Parallel Pipes

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
10-218_10-079	10-218	10-079	6.084	16.6	18	$155	$1,590	$127	$191	$80	$2,000
10-219_10-218	10-219	10-218	6.002	16.5	18	$155	$26,488	$2,119	$3,179	$1,324	$33,000
10-220_10-219	10-220	10-219	5.767	16.3	18	$155	$23,250	$1,860	$2,790	$1,163	$29,000
10-221_10-080	10-221	10-080	0.989	8.4	10	$130	$1,352	$108	$162	$68	$2,000
11-039_11-133	11-039	11-133	2.958	13.7	15	$140	$41,630	$3,330	$4,996	$2,082	$52,000
11-075_11-039	11-075	11-039	5.544	18.2	21	$170	$63,786	$5,103	$7,654	$3,189	$80,000
14-027_14-026	14-027	14-026	1.793	11.3	12	$135	$25,529	$2,042	$3,063	$1,276	$32,000
14-045_14-027	14-045	14-027	1.448	10.5	12	$135	$13,500	$1,080	$1,620	$675	$17,000
14-022_14-011	14-022	14-011	2.554	12.9	15	$140	$52,850	$4,228	$6,342	$2,643	$66,000
14-023_14-022	14-023	14-022	2.400	12.6	15	$140	$56,000	$4,480	$6,720	$2,800	$70,000
14-024_14-023	14-024	14-023	2.445	12.7	15	$140	$55,958	$4,477	$6,715	$2,798	$70,000
14-025_14-024	14-025	14-024	2.226	11.8	12	$135	$53,879	$4,310	$6,465	$2,694	$67,000
08-127_08-126	08-127	08-126	0.285	5.3	8	$125	$15,913	$1,273	$1,910	$796	$20,000
08-065_08-016BS	08-065	08-016BS	0.970	11.7	15	$140	$6,147	$492	$738	$307	$8,000
08-066_08-065	08-066	08-065	1.427	10.0	12	$135	$14,850	$1,188	$1,782	$743	$19,000
08-067_08-066	08-067	08-066	0.464	5.5	8	$125	$30,625	$2,450	$3,675	$1,531	$38,000
08-167_08-067	08-167	08-067	1.072	8.4	10	$130	$7,827	$626	$939	$391	$10,000
Total											$615,000

Note: Parallel Pipe Diameters changed to reflect the required diameters for the Ultimate Flow Conditions

Middle Big Creek
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
56-100_56-099	56-100	56-099	0.370	6.6	15	$140	$40,627	$3,250	$4,875	$2,031	$51,000
56-116_56-115	56-116	56-115	0.744	7.5	15	$140	$48,324	$3,866	$5,799	$2,416	$60,000
56-117_56-116	56-117	56-116	0.743	7.8	15	$140	$26,286	$2,103	$3,154	$1,314	$33,000
56-118_56-117	56-118	56-117	0.719	7.7	15	$140	$43,506	$3,481	$5,221	$2,175	$54,000
56-119_56-118	56-119	56-118	0.339	6.4	15	$140	$20,828	$1,666	$2,499	$1,041	$26,000
60-018_60-001CO	60-018	60-001CO	4.427	20.6	36	$255	$8,084	$647	$970	$404	$10,000
60-019_60-018	60-019	60-018	1.044	8.9	18	$155	$56,637	$4,531	$6,796	$2,832	$71,000
60-022_60-021	60-022	60-021	0.362	5.6	15	$140	$10,370	$830	$1,244	$518	$13,000
60-031_60-022	60-031	60-022	0.484	6.9	15	$140	$41,171	$3,294	$4,941	$2,059	$51,000
60-066_60-019	60-066	60-019	1.120	10.0	18	$155	$15,064	$1,205	$1,808	$753	$19,000
60-074_60-066	60-074	60-066	1.233	12.8	21	$170	$9,928	$794	$1,191	$496	$12,000
57-042_61-327	57-042	61-327	1.176	9.7	21	$170	$51,850	$4,148	$6,222	$2,593	$65,000
61-114_61-115	61-114	61-115	2.109	11.2	21	$170	$67,660	$5,413	$8,119	$3,383	$85,000
61-115_61-116	61-115	61-116	2.132	11.2	21	$170	$50,108	$4,009	$6,013	$2,505	$63,000
61-116_61-117	61-116	61-117	2.499	12.3	21	$170	$64,631	$5,170	$7,756	$3,232	$81,000
61-117_61-118	61-117	61-118	2.411	11.7	21	$170	$63,978	$5,118	$7,677	$3,199	$80,000
61-118_61-119	61-118	61-119	2.602	12.5	21	$170	$67,091	$5,367	$8,051	$3,355	$84,000
61-323_61-114	61-323	61-114	2.841	15.3	24	$180	$39,125	$3,130	$4,695	$1,956	$49,000
61-324_61-323	61-324	61-323	2.022	12.5	21	$170	$54,919	$4,393	$6,590	$2,746	$69,000
61-326_61-325	61-326	61-325	2.469	14.5	24	$180	$45,837	$3,667	$5,500	$2,292	$57,000
61-906T_61-905T	61-906T	61-905T	2.568	10.0	10	$130	$63,222	$5,058	$7,587	$3,161	$79,000
61-122_61-003BS	61-122	61-003BS	2.876	17.5	18	$155	$10,191	$815	$1,223	$510	$13,000
Total											$1,125,000

Note: Parallel Pipe Diameters changed to reflect the required diameters for the Ultimate Flow Conditions

South Prairie Lee Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
26-167_26-166	26-167	26-166	0.611	4.5	8	$125	$1,795	$144	$215	$90	$2,000
26-168_26-167	26-168	26-167	0.958	7.2	8	$125	$9,860	$789	$1,183	$493	$12,000
26-169_26-168	26-169	26-168	1.300	9.3	10	$130	$15,305	$1,224	$1,837	$765	$19,000
26-170_26-169	26-170	26-169	1.351	9.8	10	$130	$21,718	$1,737	$2,606	$1,086	$27,000
26-173_26-170	26-173	26-170	1.100	8.7	10	$130	$33,157	$2,653	$3,979	$1,658	$41,000
26-174_26-173	26-174	26-173	0.967	8.1	10	$130	$22,781	$1,822	$2,734	$1,139	$28,000
26-179_26-178	26-179	26-178	0.192	4.1	8	$125	$37,835	$3,027	$4,540	$1,892	$47,000
26-180_26-179	26-180	26-179	0.521	6.8	8	$125	$48,188	$3,855	$5,783	$2,409	$60,000
26-181_26-180	26-181	26-180	0.342	5.5	8	$125	$18,086	$1,447	$2,170	$904	$23,000
26-192_26-174	26-192	26-174	0.512	5.9	8	$125	$17,325	$1,386	$2,079	$866	$22,000
26-041_26-040	26-041	26-040	8.267	18.1	21	$170	$50,114	$4,009	$6,014	$2,506	$63,000
26-044_26-041	26-044	26-041	6.761	15.4	18	$155	$54,002	$4,320	$6,480	$2,700	$68,000
26-068_26-002	26-068	26-002	4.888	14.8	21	$170	$6,496	$520	$779	$325	$8,000
26-069_26-068	26-069	26-068	4.957	15.4	21	$170	$68,000	$5,440	$8,160	$3,400	$85,000
26-070_26-069	26-070	26-069	3.604	9.6	15	$140	$30,100	$2,408	$3,612	$1,505	$38,000
26-071_26-070	26-071	26-070	4.914	15.3	21	$170	$47,600	$3,808	$5,712	$2,380	$60,000
26-076_26-071	26-076	26-071	4.914	15.8	21	$170	$49,368	$3,949	$5,924	$2,468	$62,000
26-083_26-044	26-083	26-044	8.454	23.1	24	$180	$26,775	$2,142	$3,213	$1,339	$33,000
26-084_26-083	26-084	26-083	4.888	14.8	15	$140	$7,088	$567	$851	$354	$9,000
26-085_26-084	26-085	26-084	8.186	22.8	24	$180	$65,515	$5,241	$7,862	$3,276	$82,000
33-231_33-232	33-231	33-232	6.031	15.0	15	$140	$35,060	$2,805	$4,207	$1,753	$44,000
33-232_33-233	33-232	33-233	6.975	17.0	18	$155	$31,033	$2,483	$3,724	$1,552	$39,000
33-233_33-234	33-233	33-234	7.670	18.7	21	$170	$64,865	$5,189	$7,784	$3,243	$81,000
33-234_26-085	33-234	26-085	8.567	19.5	21	$170	$46,570	$3,726	$5,588	$2,328	$58,000
26-077_26-076	26-077	26-076	4.741	15.6	21	$170	$10,880	$870	$1,306	$544	$14,000
26-078_26-077	26-078	26-077	1.768	9.5	8	$125	$47,271	$3,782	$5,673	$2,364	$59,000
26-079_26-078	26-079	26-078	1.699	9.5	8	$125	$43,750	$3,500	$5,250	$2,188	$55,000
26-080_26-079	26-080	26-079	1.448	8.5	8	$125	$32,135	$2,571	$3,856	$1,607	$40,000
26-086_26-077	26-086	26-077	2.882	#DIV/0!	8	$125	$24,625	$1,970	$2,955	$1,231	$31,000
26-087_26-086	26-087	26-086	2.008	11.0	21	$170	$33,490	$2,679	$4,019	$1,675	$42,000
26-088_26-087	26-088	26-087	2.028	11.9	21	$170	$18,290	$1,463	$2,195	$915	$23,000
26-089_26-088	26-089	26-088	1.871	11.0	21	$170	$50,497	$4,040	$6,060	$2,525	$63,000
26-094_26-089	26-094	26-089	0.605	6.6	18	$155	$40,925	$3,274	$4,911	$2,046	$51,000
26-095_26-094	26-095	26-094	0.447	5.9	18	$155	$17,053	$1,364	$2,046	$853	$21,000
32-108_32-109	32-108	32-109	1.707	11.7	12	$135	$62,224	$4,978	$7,467	$3,111	$78,000
32-117_32-118	32-117	32-118	0.918	8.8	10	$130	$17,334	$1,387	$2,080	$867	$22,000
32-118_32-119	32-118	32-119	0.733	7.8	8	$125	$19,036	$1,523	$2,284	$952	$24,000
32-119_32-259	32-119	32-259	0.740	7.8	8	$125	$14,673	$1,174	$1,761	$734	$18,000
32-130_32-127	32-130	32-127	0.684	7.6	8	$125	$37,516	$3,001	$4,502	$1,876	$47,000
32-440_32-441	32-440	32-441	2.143	12.8	15	$140	$36,208	$2,897	$4,345	$1,810	$45,000

South . .irie Lee
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
32-441_32-442	32-441	32-442	4.219	17.8	18	$155	$31,865	$2,549	$3,824	$1,593	$40,000
33-195_33-223	33-195	33-223	2.768	15.2	18	$155	$63,702	$5,096	$7,644	$3,185	$80,000
33-223_33-224	33-223	33-224	2.930	15.5	18	$155	$61,966	$4,957	$7,436	$3,098	$77,000
33-224_33-225	33-224	33-225	2.932	14.4	18	$155	$62,000	$4,960	$7,440	$3,100	$78,000
33-225_33-304	33-225	33-304	1.297	9.3	12	$135	$44,078	$3,526	$5,289	$2,204	$55,000
33-235_33-231	33-235	33-231	3.173	11.4	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
33-304_33-226	33-304	33-226	3.480	16.5	18	$155	$19,479	$1,558	$2,337	$974	$24,000
33-434_33-379	33-434	33-379	0.017	#DIV/0!	10	$130	$11,167	$893	$1,340	$558	$14,000
33-237_33-436	33-237	33-436	1.923	9.1	10	$130	$36,803	$2,944	$4,416	$1,840	$46,000
33-238_33-237	33-238	33-237	2.463	10.6	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
33-239_33-238	33-239	33-238	3.016	12.1	12	$135	$43,177	$3,454	$5,181	$2,159	$54,000
33-240_33-239	33-240	33-239	3.525	14.0	15	$140	$18,084	$1,447	$2,170	$904	$23,000
33-241_33-240	33-241	33-240	2.794	11.7	12	$135	$47,075	$3,766	$5,649	$2,354	$59,000
33-390_33-408	33-390	33-408	2.412	9.9	10	$130	$28,562	$2,285	$3,427	$1,428	$36,000
33-408_33-235	33-408	33-235	3.528	12.3	15	$140	$4,900	$392	$588	$245	$6,000
33-436_33-236	33-436	33-236	5.106	13.3	15	$140	$15,694	$1,256	$1,883	$785	$20,000
31-195_31-196	31-195	31-196	1.298	13.0	10	$130	$32,903	$2,632	$3,948	$1,645	$41,000
32-049_32-067	32-049	32-067	0.221	5.2	8	$125	$50,000	$4,000	$6,000	$2,500	$63,000
32-067_32-068	32-067	32-068	0.339	6.4	8	$125	$46,963	$3,757	$5,636	$2,348	$59,000
32-068_32-108	32-068	32-108	0.846	7.9	8	$125	$10,133	$811	$1,216	$507	$13,000
32-209_32-208	32-209	32-208	0.384	#DIV/0!	36	$255	$43,614	$3,489	$5,234	$2,181	$55,000
33-183_33-184	33-183	33-184	1.929	10.5	12	$135	$22,626	$1,810	$2,715	$1,131	$28,000
33-184_33-191	33-184	33-191	2.042	10.7	12	$135	$43,011	$3,441	$5,161	$2,151	$54,000
33-191_33-192	33-191	33-192	1.727	9.6	12	$135	$16,436	$1,315	$1,972	$822	$21,000
33-192_33-193	33-192	33-193	2.143	10.9	12	$135	$37,800	$3,024	$4,536	$1,890	$47,000
33-193_33-194	33-193	33-194	2.189	11.0	15	$140	$27,832	$2,227	$3,340	$1,392	$35,000
33-194_33-195	33-194	33-195	2.220	11.0	15	$140	$56,034	$4,483	$6,724	$2,802	$70,000
33-222_33-260	33-222	33-260	0.248	4.6	8	$125	$17,250	$1,380	$2,070	$863	$22,000
33-242_33-277	33-242	33-277	1.473	8.2	8	$125	$45,413	$3,633	$5,450	$2,271	$57,000
33-251_33-243	33-251	33-243	0.658	6.1	8	$125	$25,900	$2,072	$3,108	$1,295	$32,000
33-257_33-251	33-257	33-251	0.696	7.6	8	$125	$26,163	$2,093	$3,140	$1,308	$33,000
33-259_33-258	33-259	33-258	0.294	4.9	8	$125	$26,978	$2,158	$3,237	$1,349	$34,000
33-260_33-259	33-260	33-259	0.323	5.2	8	$125	$24,925	$1,994	$2,991	$1,246	$31,000
33-264_33-262	33-264	33-262	0.907	8.1	10	$130	$48,867	$3,909	$5,864	$2,443	$61,000
33-267_33-264	33-267	33-264	1.004	8.7	10	$130	$32,188	$2,575	$3,863	$1,609	$40,000
33-277_33-241	33-277	33-241	5.304	#DIV/0!	8	$125	$27,504	$2,200	$3,300	$1,375	$34,000
33-302_33-267	33-302	33-267	0.792	8.0	10	$130	$46,956	$3,756	$5,635	$2,348	$59,000
33-303_33-302	33-303	33-302	0.986	9.0	10	$130	$31,057	$2,485	$3,727	$1,553	$39,000
65-020_65-022	65-020	65-022	0.466	6.6	8	$125	$30,566	$2,445	$3,668	$1,528	$38,000
65-023_33-222	65-023	33-222	0.212	4.4	8	$125	$21,891	$1,751	$2,627	$1,095	$27,000

South irie Lee
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
32-451_32-248	32-451	32-248	1.078	12.1	12	$135	$16,292	$1,303	$1,955	$815	$20,000
32-452_32-451	32-452	32-451	0.670	10.2	10	$130	$31,831	$2,546	$3,820	$1,592	$40,000
32-453_32-452	32-453	32-452	0.952	11.6	12	$135	$12,980	$1,038	$1,558	$649	$16,000
32-455_32-453	32-455	32-453	0.605	9.8	10	$130	$17,973	$1,438	$2,157	$899	$22,000
40-130_40-127	40-130	40-127	0.967	11.6	12	$135	$28,836	$2,307	$3,460	$1,442	$36,000
40-170_40-160	40-170	40-160	0.139	4.3	8	$125	$49,696	$3,976	$5,964	$2,485	$62,000
40-191_40-110	40-191	40-110	0.617	6.8	10	$130	$41,295	$3,304	$4,955	$2,065	$52,000
40-196_40-195	40-196	40-195	0.218	4.1	8	$125	$25,473	$2,038	$3,057	$1,274	$32,000
40-200_40-196	40-200	40-196	0.370	5.4	8	$125	$45,916	$3,673	$5,510	$2,296	$57,000
40-201_40-200	40-201	40-200	0.289	4.8	8	$125	$23,756	$1,901	$2,851	$1,188	$30,000
40-204_40-201	40-204	40-201	0.387	5.7	10	$130	$6,176	$494	$741	$309	$8,000
32-457_32-456	32-457	32-456	1.244	9.9	12	$135	$53,915	$4,313	$6,470	$2,696	$67,000
40-005_40-047	40-005	40-047	0.353	6.2	8	$125	$43,838	$3,507	$5,261	$2,192	$55,000
40-358_32-457	40-358	32-457	0.975	9.0	12	$135	$46,587	$3,727	$5,590	$2,329	$58,000
68-003_68-005	68-003	68-005	0.560	5.6	10	$130	$49,334	$3,947	$5,920	$2,467	$62,000
68-004_68-003	68-004	68-003	1.799	9.1	12	$135	$31,903	$2,552	$3,828	$1,595	$40,000
68-005_33-183	68-005	33-183	2.694	11.3	15	$140	$22,163	$1,773	$2,660	$1,108	$28,000
68-007_68-004	68-007	68-004	1.621	8.4	12	$135	$39,518	$3,161	$4,742	$1,976	$49,000
68-008_68-007	68-008	68-007	1.549	8.2	10	$130	$15,270	$1,222	$1,832	$764	$19,000
68-009_68-008	68-009	68-008	1.725	9.2	12	$135	$34,385	$2,751	$4,126	$1,719	$43,000
68-010_68-009	68-010	68-009	1.764	9.5	12	$135	$39,017	$3,121	$4,682	$1,951	$49,000
68-011_68-010	68-011	68-010	1.464	8.5	12	$135	$9,956	$796	$1,195	$498	$12,000
68-012_68-011	68-012	68-011	1.535	9.0	12	$135	$21,975	$1,758	$2,637	$1,099	$27,000
68-101_68-012	68-101	68-012	1.492	8.9	12	$135	$54,097	$4,328	$6,492	$2,705	$68,000
68-075_68-076	68-075	68-076	2.112	11.2	12	$135	$13,916	$1,113	$1,670	$696	$17,000
68-076_33-303	68-076	33-303	2.049	10.7	12	$135	$17,847	$1,428	$2,142	$892	$22,000
68-077_68-075	68-077	68-075	1.509	9.6	10	$130	$34,060	$2,725	$4,087	$1,703	$43,000
68-081_69-022	68-081	69-022	0.161	4.2	8	$125	$20,250	$1,620	$2,430	$1,013	$25,000
68-124_68-083	68-124	68-083	0.240	5.3	8	$125	$52,600	$4,208	$6,312	$2,630	$66,000
69-001_68-077	69-001	68-077	0.552	6.7	8	$125	$33,500	$2,680	$4,020	$1,675	$42,000
69-002_69-001	69-002	69-001	0.408	6.0	8	$125	$43,100	$3,448	$5,172	$2,155	$54,000
69-003_69-002	69-003	69-002	0.379	5.9	8	$125	$53,225	$4,258	$6,387	$2,661	$67,000
69-003_69-004	69-004	69-003	0.282	5.2	8	$125	$12,338	$987	$1,481	$617	$15,000
69-005_69-004	69-005	69-004	0.138	4.0	8	$125	$16,964	$1,357	$2,036	$848	$21,000
40-081_40-080	40-081	40-080	0.387	6.4	10	$130	$50,057	$4,005	$6,007	$2,503	$63,000
40-210_40-372	40-210	40-372	0.291	5.3	8	$125	$4,000	$320	$480	$200	$5,000
40-087_40-086	40-087	40-086	0.200	#DIV/0!	30	$200	$53,474	$4,278	$6,417	$2,674	$67,000
68-127_68-101	68-127	68-101	1.652	10.2	12	$135	$39,971	$3,198	$4,796	$1,999	$50,000
68-128_68-127	68-128	68-127	0.916	6.6	8	$125	$21,893	$1,751	$2,627	$1,095	$27,000
68-129_68-128	68-129	68-128	1.521	9.6	10	$130	$49,075	$3,926	$5,889	$2,454	$61,000

South Prairie Lee
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
68-131_68-130	68-131	68-130	0.161	4.2	8	$125	$50,064	$4,005	$6,008	$2,503	$63,000
68-157_68-158	68-157	68-158	0.477	6.6	8	$125	$6,270	$502	$752	$314	$8,000
68-158_68-159	68-158	68-159	0.480	6.6	8	$125	$46,288	$3,703	$5,555	$2,314	$58,000
68-159_68-160	68-159	68-160	0.469	6.3	8	$125	$15,025	$1,202	$1,803	$751	$19,000
68-160_68-162	68-160	68-162	0.563	7.0	8	$125	$49,850	$3,988	$5,982	$2,493	$62,000
68-162_68-163	68-162	68-163	0.542	6.7	8	$125	$13,338	$1,067	$1,601	$667	$17,000
68-163_68-164	68-163	68-164	0.452	5.9	8	$125	$30,088	$2,407	$3,611	$1,504	$38,000
68-164_68-165	68-164	68-165	0.603	7.0	8	$125	$45,040	$3,603	$5,405	$2,252	$56,000
68-165_68-166	68-165	68-166	0.641	7.1	8	$125	$50,041	$4,003	$6,005	$2,502	$63,000
68-166_68-129	68-166	68-129	0.665	7.2	8	$125	$33,550	$2,684	$4,026	$1,678	$42,000
Total							$4,322,103				$5,408,000

Note: Parallel Pipe Diameters changed to reflect the required diameters for the Ultimate Flow Conditions

West Prairie Lee
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
17-001_24-232	17-001	24-232	0.473	6.4	8	$125	$52,688	$4,215	$6,323	$2,634	$66,000
17-020_17-019	17-020	17-019	0.565	7.0	8	$125	$24,000	$1,920	$2,880	$1,200	$30,000
18-110_18-109	18-110	18-109	3.139	15.9	21	$170	$67,526	$5,402	$8,103	$3,376	$84,000
24-001_25-009	24-001	25-009	2.196	10.5	15	$140	$31,529	$2,522	$3,784	$1,576	$39,000
24-010_24-001	24-010	24-001	1.768	9.5	12	$135	$26,870	$2,150	$3,224	$1,344	$34,000
24-011_24-010	24-011	24-010	3.718	17.0	21	$170	$68,425	$5,474	$8,211	$3,421	$86,000
24-012_24-011	24-012	24-011	2.025	10.4	15	$140	$35,910	$2,873	$4,309	$1,796	$45,000
24-018_24-012	24-018	24-012	1.577	9.1	12	$135	$52,164	$4,173	$6,260	$2,608	$65,000
24-019_24-018	24-019	24-018	2.308	11.5	15	$140	$57,918	$4,633	$6,950	$2,896	$72,000
25-005_25-370	25-005	25-370	1.898	9.1	12	$135	$7,488	$599	$899	$374	$9,000
25-006_25-184	25-006	25-184	3.246	13.6	18	$155	$30,861	$2,469	$3,703	$1,543	$39,000
25-007_25-006	25-007	25-006	1.704	8.9	12	$135	$20,883	$1,671	$2,506	$1,044	$26,000
25-008_25-007	25-008	25-007	1.597	8.7	12	$135	$25,676	$2,054	$3,081	$1,284	$32,000
25-009_25-008	25-009	25-008	1.756	9.1	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
25-184_25-005	25-184	25-005	4.411	18.1	21	$170	$18,717	$1,497	$2,246	$936	$23,000
25-185_25-284	25-185	25-284	0.910	6.6	10	$130	$30,862	$2,469	$3,703	$1,543	$39,000
25-186_25-185	25-186	25-185	4.215	15.6	18	$155	$28,994	$2,320	$3,479	$1,450	$36,000
25-275_25-340	25-275	25-340	4.803	18.7	24	$180	$63,463	$5,077	$7,616	$3,173	$79,000
25-276_25-275	25-276	25-275	3.712	14.3	18	$155	$59,791	$4,783	$7,175	$2,990	$75,000
25-278_25-276	25-278	25-276	7.875	22.5	30	$200	$61,846	$4,948	$7,422	$3,092	$77,000
25-279_25-278	25-279	25-278	3.407	13.8	18	$155	$52,681	$4,215	$6,322	$2,634	$66,000
25-281_25-279	25-281	25-279	4.792	16.4	21	$170	$16,842	$1,347	$2,021	$842	$21,000
25-282_25-281	25-282	25-281	3.173	13.0	18	$155	$16,835	$1,347	$2,020	$842	$21,000
25-283_25-282	25-283	25-282	5.398	15.9	18	$155	$54,323	$4,346	$6,519	$2,716	$68,000
25-284_25-283	25-284	25-283	5.381	15.8	18	$155	$61,360	$4,909	$7,363	$3,068	$77,000
25-340_18-110	25-340	18-110	5.033	19.0	24	$180	$56,164	$4,493	$6,740	$2,808	$70,000
18-029_18-030	18-029	18-030	0.153	4.2	8	$125	$33,448	$2,676	$4,014	$1,672	$42,000
18-030_18-041	18-030	18-041	0.286	5.3	8	$125	$22,908	$1,833	$2,749	$1,145	$29,000
18-042_18-043	18-042	18-043	0.622	6.7	8	$125	$21,561	$1,725	$2,587	$1,078	$27,000
18-044_18-045	18-044	18-045	1.439	10.4	12	$135	$13,757	$1,101	$1,651	$688	$17,000
18-045_18-080	18-045	18-080	1.357	9.8	12	$135	$44,667	$3,573	$5,360	$2,233	$56,000
18-059_25-188	18-059	25-188	0.068	4.3	8	$125	$14,068	$1,125	$1,688	$703	$18,000
18-060_18-069	18-060	18-069	3.684	14.8	18	$155	$12,412	$993	$1,489	$621	$16,000
18-066_18-060	18-066	18-060	3.286	14.2	18	$155	$27,540	$2,203	$3,305	$1,377	$34,000
18-067_18-066	18-067	18-066	3.243	14.1	18	$155	$30,242	$2,419	$3,629	$1,512	$38,000
18-069_25-187	18-069	25-187	3.718	14.9	18	$155	$48,761	$3,901	$5,851	$2,438	$61,000
18-076_18-067	18-076	18-067	2.722	12.3	15	$140	$42,351	$3,388	$5,082	$2,118	$53,000
18-077_18-076	18-077	18-076	1.267	7.6	10	$130	$13,607	$1,089	$1,633	$680	$17,000
18-078_18-077	18-078	18-077	2.016	11.8	15	$140	$49,686	$3,975	$5,962	$2,484	$62,000
18-079_18-078	18-079	18-078	1.950	11.7	15	$140	$51,115	$4,089	$6,134	$2,556	$64,000

West P ie Lee
Watershed
Required Parallel Pipes
2015 Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
18-080_18-079	18-080	18-079	1.751	10.8	15	$140	$53,124	$4,250	$6,375	$2,656	$66,000
25-187_25-186	25-187	25-186	3.772	15.0	18	$155	$26,984	$2,159	$3,238	$1,349	$34,000
18-109_25-271	18-109	25-271	4.258	17.8	21	$170	$41,176	$3,294	$4,941	$2,059	$51,000
25-217_25-329	25-217	25-329	16.713	#DIV/0!	30	$200	$12,970	$1,038	$1,556	$649	$16,000
25-267_25-JS01	25-267	25-JS01	4.170	17.7	24	$180	$70,578	$5,646	$8,469	$3,529	$88,000
25-268_25-267	25-268	25-267	3.551	16.7	21	$170	$61,321	$4,906	$7,358	$3,066	$77,000
25-269_25-268	25-269	25-268	3.668	16.9	21	$170	$68,066	$5,445	$8,168	$3,403	$85,000
25-270_25-269	25-270	25-269	3.744	17.0	21	$170	$42,599	$3,408	$5,112	$2,130	$53,000
25-271_25-270	25-271	25-270	5.711	22.7	30	$200	$60,000	$4,800	$7,200	$3,000	$75,000
24-020_24-019	24-020	24-019	1.897	10.2	15	$140	$55,825	$4,466	$6,699	$2,791	$70,000
24-022_24-216	24-022	24-216	0.763	6.6	10	$130	$12,186	$975	$1,462	$609	$15,000
24-023_24-022	24-023	24-022	1.487	9.1	12	$135	$66,466	$5,317	$7,976	$3,323	$83,000
24-024_24-023	24-024	24-023	0.933	7.3	10	$130	$19,003	$1,520	$2,280	$950	$24,000
24-069_24-071	24-069	24-071	0.317	5.2	8	$125	$33,834	$2,707	$4,060	$1,692	$42,000
24-071_24-072	24-071	24-072	0.334	5.3	8	$125	$33,624	$2,690	$4,035	$1,681	$42,000
24-072_24-073	24-072	24-073	0.673	7.8	10	$130	$12,786	$1,023	$1,534	$639	$16,000
24-073_24-074	24-073	24-074	0.605	7.2	10	$130	$35,984	$2,879	$4,318	$1,799	$45,000
24-074_24-075	24-074	24-075	0.890	8.7	12	$135	$47,021	$3,762	$5,642	$2,351	$59,000
24-075_24-029	24-075	24-029	0.865	8.3	10	$130	$22,191	$1,775	$2,663	$1,110	$28,000
24-215_24-020	24-215	24-020	3.122	15.9	18	$155	$53,353	$4,268	$6,402	$2,668	$67,000
24-216_24-021	24-216	24-021	1.649	9.6	12	$135	$48,850	$3,908	$5,862	$2,442	$61,000
24-235_24-062	24-235	24-062	0.622	#DIV/0!	42	$280	$9,797	$784	$1,176	$490	$12,000
24-253_24-252	24-253	24-252	0.261	4.6	8	$125	$23,436	$1,875	$2,812	$1,172	$29,000
24-254_24-253	24-254	24-253	0.240	4.5	8	$125	$20,666	$1,653	$2,480	$1,033	$26,000
24-128_24-326	24-128	24-326	0.619	8.0	8	$125	$11,796	$944	$1,416	$590	$15,000
24-326_24-127	24-326	24-127	0.781	8.8	10	$130	$39,417	$3,153	$4,730	$1,971	$49,000
31-005_31-006	31-005	31-006	0.263	6.3	8	$125	$16,511	$1,321	$1,981	$826	$21,000
31-087_32-458	31-087	32-458	2.913	9.2	10	$130	$16,081	$1,286	$1,930	$804	$20,000
31-091_31-090	31-091	31-090	1.852	11.0	10	$130	$17,584	$1,407	$2,110	$879	$22,000
31-114_31-396	31-114	31-396	4.185	14.0	15	$140	$35,393	$2,831	$4,247	$1,770	$44,000
31-137_31-088	31-137	31-088	2.324	12.5	12	$135	$54,297	$4,344	$6,516	$2,715	$68,000
31-166_31-137	31-166	31-137	1.276	8.6	8	$125	$51,266	$4,101	$6,152	$2,563	$64,000
31-066_31-081	31-066	31-081	0.192	5.6	8	$125	$20,531	$1,643	$2,464	$1,027	$26,000
31-081_31-082	31-081	31-082	0.144	4.6	8	$125	$34,333	$2,747	$4,120	$1,717	$43,000
31-112_31-113	31-112	31-113	0.381	7.2	8	$125	$19,924	$1,594	$2,391	$996	$25,000
31-214_31-213	31-214	31-213	3.005	#DIV/0!	60	$480	$47,582	$3,807	$5,710	$2,379	$59,000
31-379_31-117	31-379	31-117	2.237	16.0	15	$140	$42,322	$3,386	$5,079	$2,116	$53,000
31-205_31-167	31-205	31-167	1.092	7.9	8	$125	$9,375	$750	$1,125	$469	$12,000
31-278_31-279	31-278	31-279	0.653	#DIV/0!	42	$280	$15,448	$1,236	$1,854	$772	$19,000
Total											$3,585,000

Note: Parallel Pipe Diameters changed to reflect the required diameters for the Ultimate Flow Conditions

Appendix 9.7

Detailed Cost Estimate – Ultimate Recommended Capital Improvements

Mou_ Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
35-002_35-118	35-002	35-118	0.365	6.2	8	$125	$23,635	$1,891	$2,836	$1,182	$30,000
35-118_35-001	35-118	35-001	1.018	9.7	10	$130	$40,294	$3,223	$4,835	$2,015	$50,000
42-002_42-005	42-002	42-005	2.216	15.9	18	$155	$54,157	$4,333	$6,499	$2,708	$68,000
42-003_42-002	42-003	42-002	1.074	9.3	10	$130	$24,882	$1,991	$2,986	$1,244	$31,000
42-005_42-006	42-005	42-006	2.407	14.4	15	$140	$33,432	$2,675	$4,012	$1,672	$42,000
42-006_42-007	42-006	42-007	2.638	14.9	15	$140	$23,562	$1,885	$2,827	$1,178	$29,000
42-007_42-008	42-007	42-008	2.872	15.4	18	$155	$54,312	$4,345	$6,517	$2,716	$68,000
42-008_42-009	42-008	42-009	3.084	15.8	18	$155	$23,684	$1,895	$2,842	$1,184	$30,000
42-009_42-010	42-009	42-010	3.328	16.3	18	$155	$46,733	$3,739	$5,608	$2,337	$58,000
42-010_42-011	42-010	42-011	3.036	13.8	15	$140	$43,106	$3,448	$5,173	$2,155	$54,000
42-011_42-012BS	42-011	42-012BS	3.802	17.1	18	$155	$33,341	$2,667	$4,001	$1,667	$42,000
42-016_42-015	42-016	42-015	1.338	11.6	12	$135	$44,146	$3,532	$5,298	$2,207	$55,000
42-017_42-016	42-017	42-016	1.074	10.6	12	$135	$53,753	$4,300	$6,450	$2,688	$67,000
42-018_42-017	42-018	42-017	0.797	9.5	10	$130	$34,529	$2,762	$4,144	$1,726	$43,000
42-019_42-018	42-019	42-018	0.532	8.2	10	$130	$37,584	$3,007	$4,510	$1,879	$47,000
49-006_49-005	49-006	49-005	27.163	35.7	36	$255	$59,729	$4,778	$7,167	$2,986	$75,000
49-007_49-006	49-007	49-006	26.855	35.6	36	$255	$79,853	$6,388	$9,582	$3,993	$100,000
49-008_49-007	49-008	49-007	20.416	29.8	30	$200	$63,696	$5,096	$7,644	$3,185	$80,000
49-009_49-008	49-009	49-008	22.933	33.5	36	$255	$87,320	$6,986	$10,478	$4,366	$109,000
49-010_49-009	49-010	49-009	32.592	43.6	48	$305	$116,217	$9,297	$13,946	$5,811	$145,000
49-011_49-010	49-011	49-010	23.269	33.7	36	$255	$72,440	$5,795	$8,693	$3,622	$91,000
49-013_49-012	49-013	49-012	37.069	40.2	42	$280	$122,102	$9,768	$14,652	$6,105	$153,000
50-001_49-013	50-001	49-013	16.003	23.8	24	$180	$84,600	$6,768	$10,152	$4,230	$106,000
50-002_50-001	50-002	50-001	20.484	27.1	30	$200	$67,012	$5,361	$8,041	$3,351	$84,000
50-003_50-002	50-003	50-002	33.346	38.6	42	$280	$62,300	$4,984	$7,476	$3,115	$78,000
50-004_50-003	50-004	50-003	28.709	33.8	36	$255	$123,043	$9,843	$14,765	$6,152	$154,000
50-005_50-004	50-005	50-004	24.576	31.9	36	$255	$69,375	$5,550	$8,325	$3,469	$87,000
50-019_50-018	50-019	50-018	2.285	11.9	12	$135	$54,284	$4,343	$6,514	$2,714	$68,000
50-020_50-019	50-020	50-019	1.948	11.2	12	$135	$48,609	$3,889	$5,833	$2,430	$61,000
50-020A_50-020	50-020A	50-020	2.638	13.1	15	$140	$18,050	$1,444	$2,166	$903	$23,000
50-111_50-094	50-111	50-094	3.176	14.0	15	$140	$29,165	$2,333	$3,500	$1,458	$36,000
50-006_50-005	50-006	50-005	14.136	24.6	30	$200	$61,940	$4,955	$7,433	$3,097	$77,000
50-007_50-006	50-007	50-006	23.482	33.8	36	$255	$119,070	$9,526	$14,288	$5,953	$149,000
50-015_50-005	50-015	50-005	8.558	18.9	21	$170	$37,553	$3,004	$4,506	$1,878	$47,000
50-018_50-016	50-018	50-016	3.911	16.0	18	$155	$61,644	$4,931	$7,397	$3,082	$77,000
50-041_50-015	50-041	50-015	7.182	17.2	18	$155	$51,065	$4,085	$6,128	$2,553	$64,000
50-042_50-041	50-042	50-041	6.461	15.4	18	$155	$18,640	$1,491	$2,237	$932	$23,000
50-069_50-042	50-069	50-042	3.987	10.5	12	$135	$29,816	$2,385	$3,578	$1,491	$37,000
50-112_50-069	50-112	50-069	2.264	7.7	8	$125	$18,463	$1,477	$2,216	$923	$23,000

Mou Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
50-117_50-112	50-117	50-112	6.373	15.6	18	$155	$57,003	$4,560	$6,840	$2,850	$71,000
50-118_50-117	50-118	50-117	5.991	15.0	15	$140	$27,336	$2,187	$3,280	$1,367	$34,000
50-119_50-118	50-119	50-118	6.184	15.8	18	$155	$19,071	$1,526	$2,289	$954	$24,000
50-120_50-119	50-120	50-119	5.358	13.9	15	$140	$49,909	$3,993	$5,989	$2,495	$62,000
50-013_50-012	50-013	50-012	5.926	20.2	21	$170	$83,829	$6,706	$10,059	$4,191	$105,000
50-014_50-013	50-014	50-013	5.715	16.8	18	$155	$68,119	$5,450	$8,174	$3,406	$85,000
55-041_55-006	55-041	55-006	0.343	5.2	8	$125	$11,764	$941	$1,412	$588	$15,000
Total											$3,057,000

Litt. Cedar
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
00-004_00-005	00-004	00-005	11.589	21.9	24	$180	$70,524	$5,642	$8,463	$3,526	$88,000
00-005_00-006	00-005	00-006	22.419	26.3	30	$200	$100,174	$8,014	$12,021	$5,009	$125,000
00-006_00-007	00-006	00-007	18.762	23.5	24	$180	$66,389	$5,311	$7,967	$3,319	$83,000
00-007_00-008	00-007	00-008	30.414	32.7	36	$255	$58,683	$4,695	$7,042	$2,934	$73,000
00-008_00-009	00-008	00-009	29.323	31.0	36	$255	$42,713	$3,417	$5,126	$2,136	$53,000
00-009_00-010	00-009	00-010	33.812	36.0	36	$255	$28,101	$2,248	$3,372	$1,405	$35,000
00-010_00-011	00-010	00-011	14.846	20.7	21	$170	$10,979	$878	$1,317	$549	$14,000
00-011_00-012	00-011	00-012	20.711	24.9	30	$200	$14,204	$1,136	$1,704	$710	$18,000
00-012_00-013	00-012	00-013	20.875	25.0	30	$200	$54,682	$4,375	$6,562	$2,734	$68,000
00-013_00-014	00-013	00-014	10.130	17.1	18	$155	$51,486	$4,119	$6,178	$2,574	$64,000
00-015_00-016	00-015	00-016	18.185	22.7	24	$180	$51,140	$4,091	$6,137	$2,557	$64,000
00-016_00-017	00-016	00-017	17.892	22.6	24	$180	$72,254	$5,780	$8,670	$3,613	$90,000
00-018_00-019	00-018	00-019	28.633	30.7	36	$255	$62,580	$5,006	$7,510	$3,129	$78,000
00-019_00-020	00-019	00-020	28.967	30.8	36	$255	$58,803	$4,704	$7,056	$2,940	$74,000
00-022_00-023	00-022	00-023	9.266	16.4	18	$155	$48,066	$3,845	$5,768	$2,403	$60,000
00-023_00-024	00-023	00-024	19.365	23.3	24	$180	$52,267	$4,181	$6,272	$2,613	$65,000
00-024_00-025	00-024	00-025	19.528	23.3	24	$180	$89,955	$7,196	$10,795	$4,498	$112,000
00-025_00-026	00-025	00-026	19.582	23.4	24	$180	$44,894	$3,592	$5,387	$2,245	$56,000
00-026_00-027	00-026	00-027	19.124	23.2	24	$180	$39,982	$3,199	$4,798	$1,999	$50,000
00-027_00-028	00-027	00-028	14.846	24.0	24	$180	$50,263	$4,021	$6,032	$2,513	$63,000
00-028_00-030	00-028	00-030	19.535	27.7	30	$200	$75,150	$6,012	$9,018	$3,758	$94,000
00-030_00-031	00-030	00-031	18.561	27.2	30	$200	$91,548	$7,324	$10,986	$4,577	$114,000
00-034_00-035	00-034	00-035	16.693	26.1	30	$200	$100,694	$8,056	$12,083	$5,035	$126,000
00-035_00-036	00-035	00-036	16.328	25.9	30	$200	$71,642	$5,731	$8,597	$3,582	$90,000
00-036_00-037	00-036	00-037	17.287	26.5	30	$200	$28,032	$2,243	$3,364	$1,402	$35,000
00-037_00-038	00-037	00-038	15.624	29.0	30	$200	$97,698	$7,816	$11,724	$4,885	$122,000
00-038_00-039	00-038	00-039	14.157	28.0	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-039_00-040	00-039	00-040	16.289	29.5	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-040_00-041	00-040	00-041	14.334	28.1	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-041_00-042	00-041	00-042	16.464	29.6	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-042_00-043	00-042	00-043	17.614	30.4	36	$255	$127,500	$10,200	$15,300	$6,375	$159,000
00-043_00-044	00-043	00-044	17.700	30.4	36	$255	$127,500	$10,200	$15,300	$6,375	$159,000
00-044_00-045	00-044	00-045	41.136	173.6	42	$280	$162,400	$12,992	$19,488	$8,120	$203,000
00-045_00-046	00-045	00-046	29.507	42.0	42	$280	$70,000	$5,600	$8,400	$3,500	$88,000
16-009_16-008	16-009	16-008	0.993	7.6	8	$125	$47,745	$3,820	$5,729	$2,387	$60,000
16-021_16-011	16-021	16-011	1.895	12.2	15	$140	$6,644	$532	$797	$332	$8,000
16-022_16-021	16-022	16-021	1.273	10.0	10	$130	$13,425	$1,074	$1,611	$671	$17,000
16-023_16-022	16-023	16-022	1.423	11.0	12	$135	$26,164	$2,093	$3,140	$1,308	$33,000

Littl edar
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
00-001_00-002	00-001	00-002	6.480	18.3	21	$170	$85,066	$6,805	$10,208	$4,253	$106,000
22-038_00-001	22-038	00-001	14.216	28.0	30	$200	$99,284	$7,943	$11,914	$4,964	$124,000
22-043_22-042	22-043	22-042	11.484	24.0	24	$180	$89,154	$7,132	$10,698	$4,458	$111,000
23-046_23-045	23-046	23-045	0.846	8.5	10	$130	$52,046	$4,164	$6,245	$2,602	$65,000
23-047_23-046	23-047	23-046	1.060	9.8	10	$130	$52,035	$4,163	$6,244	$2,602	$65,000
23-118_23-117	23-118	23-117	11.626	21.2	24	$180	$22,145	$1,772	$2,657	$1,107	$28,000
23-125_23-124	23-125	23-124	1.829	10.6	12	$135	$14,772	$1,182	$1,773	$739	$18,000
23-126_23-125	23-126	23-125	1.694	10.3	12	$135	$47,937	$3,835	$5,752	$2,397	$60,000
23-127_23-126	23-127	23-126	0.803	7.1	8	$125	$15,668	$1,253	$1,880	$783	$20,000
23-128_23-127	23-128	23-127	0.648	6.5	8	$125	$17,086	$1,367	$2,050	$854	$21,000
23-129_23-128	23-129	23-128	0.679	6.8	8	$125	$38,494	$3,080	$4,619	$1,925	$48,000
23-015_23-014	23-015	23-014	7.122	13.9	15	$140	$53,931	$4,314	$6,472	$2,697	$67,000
23-017_23-016	23-017	23-016	8.694	15.4	18	$155	$20,643	$1,651	$2,477	$1,032	$26,000
Total											$3,900,000

Boggs Hollow
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
21-086_21-085	21-086	21-085	2.910	14.3	15	$140	$6,100	$488	$732	$305	$8,000
21-087_21-086	21-087	21-086	2.324	12.5	15	$140	$54,058	$4,325	$6,487	$2,703	$68,000
21-088_21-087	21-088	21-087	2.127	10.0	10	$130	$15,222	$1,218	$1,827	$761	$19,000
21-089_21-088	21-089	21-088	1.956	9.9	10	$130	$38,475	$3,078	$4,617	$1,924	$48,000
21-090_21-089	21-090	21-089	2.217	9.2	10	$130	$47,445	$3,796	$5,693	$2,372	$59,000
21-091_21-090	21-091	21-090	1.781	8.3	10	$130	$47,692	$3,815	$5,723	$2,385	$60,000
21-092_21-091	21-092	21-091	1.685	8.3	10	$130	$51,076	$4,086	$6,129	$2,554	$64,000
22-001_21-092	22-001	21-092	1.201	7.1	8	$125	$40,966	$3,277	$4,916	$2,048	$51,000
22-048_22-047	22-048	22-047	0.953	8.3	10	$130	$28,795	$2,304	$3,455	$1,440	$36,000
Total											$413,000

Ced Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
20-002_20-001	20-002	82	29.807	42.1	42	$280	$114,752	$9,180	$13,770	$5,738	$143,000
20-003_20-002	20-003	20-002	29.588	42.0	42	$280	$104,412	$8,353	$12,529	$5,221	$131,000
20-005_20-004	20-005	20-004	29.489	42.0	42	$280	$104,280	$8,342	$12,514	$5,214	$130,000
20-006_20-001BS	20-006	20-001BS	46.531	43.7	48	$305	$99,766	$7,981	$11,972	$4,988	$125,000
20-007_20-006	20-007	20-006	54.399	192.8	36	$255	$89,480	$7,158	$10,738	$4,474	$112,000
20-008_20-007	20-008	20-007	39.482	36.1	36	$255	$127,653	$10,212	$15,318	$6,383	$160,000
20-009_20-008	20-009	20-008	23.484	26.8	30	$200	$95,740	$7,659	$11,489	$4,787	$120,000
20-010_20-009	20-010	20-009	37.069	37.2	42	$280	$141,014	$11,281	$16,922	$7,051	$176,000
20-011_20-010	20-011	20-010	36.867	37.1	42	$280	$138,692	$11,095	$16,643	$6,935	$173,000
20-012_20-011	20-012	20-011	36.942	37.2	42	$280	$140,308	$11,225	$16,837	$7,015	$175,000
20-013_20-012	20-013	20-012	41.950	47.9	54	$380	$186,960	$14,957	$22,435	$9,348	$234,000
20-015_20-008	20-015	20-008	6.053	14.5	15	$140	$24,024	$1,922	$2,883	$1,201	$30,000
20-016_20-015	20-016	20-015	7.800	25.5	30	$200	$77,226	$6,178	$9,267	$3,861	$97,000
20-017_20-016	20-017	20-016	6.308	12.9	15	$140	$44,219	$3,538	$5,306	$2,211	$55,000
20-018_20-017	20-018	20-017	5.900	12.1	15	$140	$31,248	$2,500	$3,750	$1,562	$39,000
20-019_20-018	20-019	20-018	6.915	15.8	18	$155	$35,177	$2,814	$4,221	$1,759	$44,000
20-020_20-019	20-020	20-019	4.601	10.7	12	$135	$43,744	$3,500	$5,249	$2,187	$55,000
20-021_20-020	20-021	20-020	4.790	11.4	12	$135	$53,933	$4,315	$6,472	$2,697	$67,000
20-022_20-021	20-022	20-021	4.725	11.4	12	$135	$41,513	$3,321	$4,982	$2,076	$52,000
20-025_20-024	20-025	20-024	1.123	8.2	10	$130	$12,119	$969	$1,454	$606	$15,000
20-030_20-025	20-030	20-025	0.945	8.3	10	$130	$39,852	$3,188	$4,782	$1,993	$50,000
20-031_20-030	20-031	20-030	0.891	8.1	10	$130	$18,126	$1,450	$2,175	$906	$23,000
20-032_20-031	20-032	20-031	0.795	7.7	8	$125	$28,188	$2,255	$3,383	$1,409	$35,000
20-034_20-032	20-034	20-032	0.919	9.3	10	$130	$19,757	$1,581	$2,371	$988	$25,000
20-035_20-034	20-035	20-034	0.494	6.3	8	$125	$19,606	$1,569	$2,353	$980	$25,000
20-036_20-035	20-036	20-035	0.509	6.8	8	$125	$30,858	$2,469	$3,703	$1,543	$39,000
20-037_20-036	20-037	20-036	0.339	5.5	8	$125	$40,838	$3,267	$4,901	$2,042	$51,000
21-001_20-022	21-001	20-022	3.945	9.4	10	$130	$34,943	$2,795	$4,193	$1,747	$44,000
21-002_21-001	21-002	21-001	4.250	10.3	12	$135	$43,430	$3,474	$5,212	$2,171	$54,000
21-020_21-019	21-020	21-019	0.603	6.3	8	$125	$34,688	$2,775	$4,163	$1,734	$43,000
21-040_21-002	21-040	21-002	0.786	4.7	8	$125	$17,931	$1,435	$2,152	$897	$22,000
21-041_21-040	21-041	21-040	2.177	8.7	10	$130	$17,914	$1,433	$2,150	$896	$22,000
21-042_21-041	21-042	21-041	2.499	12.8	15	$140	$12,565	$1,005	$1,508	$628	$16,000
21-047_21-042	21-047	21-042	1.809	10.0	10	$130	$19,790	$1,583	$2,375	$989	$25,000
21-049_21-047	21-049	21-047	1.745	10.1	12	$135	$20,918	$1,673	$2,510	$1,046	$26,000
21-050_21-049	21-050	21-049	1.434	8.6	10	$130	$9,458	$757	$1,135	$473	$12,000
21-051_21-050	21-051	21-050	1.589	9.7	10	$130	$29,640	$2,371	$3,557	$1,482	$37,000
21-052_21-051	21-052	21-051	1.468	9.2	10	$130	$43,537	$3,483	$5,224	$2,177	$54,000
21-053_21-052	21-053	21-052	1.355	8.8	10	$130	$31,447	$2,516	$3,774	$1,572	$39,000

Ced: Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
21-054_21-053	21-054	21-053	1.289	8.8	10	$130	$43,983	$3,519	$5,278	$2,199	$55,000
21-058_21-054	21-058	21-054	0.780	6.7	8	$125	$22,925	$1,834	$2,751	$1,146	$29,000
21-060_21-058	21-060	21-058	0.481	6.1	8	$125	$41,663	$3,333	$5,000	$2,083	$52,000
21-061_21-060	21-061	21-060	0.356	5.3	8	$125	$17,375	$1,390	$2,085	$869	$22,000
21-062_21-061	21-062	21-061	0.331	5.3	8	$125	$27,900	$2,232	$3,348	$1,395	$35,000
21-063_21-062	21-063	21-062	0.274	4.9	8	$125	$44,375	$3,550	$5,325	$2,219	$55,000
27-001_27-015	27-001	27-015	36.880	37.1	42	$280	$59,430	$4,754	$7,132	$2,972	$74,000
27-002_27-001	27-002	27-001	32.415	31.1	36	$255	$127,566	$10,205	$15,308	$6,378	$159,000
27-003_27-002	27-003	27-002	35.526	34.7	36	$255	$109,660	$8,773	$13,159	$5,483	$137,000
27-004_27-003	27-004	27-003	35.401	34.7	36	$255	$109,665	$8,773	$13,160	$5,483	$137,000
27-005_27-004	27-005	27-004	34.457	36.2	42	$280	$129,027	$10,322	$15,483	$6,451	$161,000
27-015_20-013	27-015	20-013	33.702	35.9	36	$255	$12,559	$1,005	$1,507	$628	$16,000
27-016_27-015	27-016	27-015	3.433	13.4	15	$140	$53,200	$4,256	$6,384	$2,660	$67,000
27-017_27-016	27-017	27-016	2.886	10.7	12	$135	$9,165	$733	$1,100	$458	$11,000
27-018_27-017	27-018	27-017	1.846	7.5	8	$125	$21,558	$1,725	$2,587	$1,078	$27,000
27-019_27-018	27-019	27-018	1.816	7.6	8	$125	$5,971	$478	$717	$299	$7,000
27-020_27-019	27-020	27-019	1.040	5.6	8	$125	$22,874	$1,830	$2,745	$1,144	$29,000
27-022_27-021	27-022	27-021	2.217	9.8	10	$130	$38,624	$3,090	$4,635	$1,931	$48,000
27-023_27-022	27-023	27-022	0.925	5.6	8	$125	$15,125	$1,210	$1,815	$756	$19,000
27-025_27-024	27-025	27-024	1.000	6.1	8	$125	$22,016	$1,761	$2,642	$1,101	$28,000
27-033_27-032	27-033	27-032	0.588	7.5	8	$125	$27,245	$2,180	$3,269	$1,362	$34,000
27-034_27-033	27-034	27-033	0.387	6.1	8	$125	$11,374	$910	$1,365	$569	$14,000
27-036_27-035	27-036	27-035	0.161	4.6	8	$125	$17,485	$1,399	$2,098	$874	$22,000
27-006_27-005	27-006	27-005	34.488	36.2	42	$280	$139,882	$11,191	$16,786	$6,994	$175,000
27-007_27-006	27-007	27-006	31.240	30.6	36	$255	$127,653	$10,212	$15,318	$6,383	$160,000
27-008_27-007	27-008	27-007	29.512	31.0	36	$255	$127,842	$10,227	$15,341	$6,392	$160,000
27-009_27-008	27-009	27-008	34.180	36.1	36	$255	$129,665	$10,373	$15,560	$6,483	$162,000
27-010_27-007	27-010	27-007	4.295	10.8	12	$135	$46,609	$3,729	$5,593	$2,330	$58,000
27-013_27-055	27-013	27-055	1.311	9.7	10	$130	$22,372	$1,790	$2,685	$1,119	$28,000
27-043_28-285	27-043	28-285	0.297	4.2	8	$125	$20,898	$1,672	$2,508	$1,045	$26,000
27-055_27-012	27-055	27-012	1.402	8.7	10	$130	$40,866	$3,269	$4,904	$2,043	$51,000
28-013_27-010	28-013	27-010	2.455	11.8	12	$135	$40,635	$3,251	$4,876	$2,032	$51,000
28-014_28-013	28-014	28-013	2.404	11.7	12	$135	$24,300	$1,944	$2,916	$1,215	$30,000
28-015_28-014	28-015	28-014	1.411	9.6	10	$130	$12,350	$988	$1,482	$618	$15,000
28-016_28-015	28-016	28-015	1.857	9.7	10	$130	$31,200	$2,496	$3,744	$1,560	$39,000
28-017_28-016	28-017	28-016	0.811	5.6	8	$125	$21,750	$1,740	$2,610	$1,088	$27,000
28-018_28-017	28-018	28-017	1.128	6.8	8	$125	$34,850	$2,788	$4,182	$1,743	$44,000
28-021_28-020	28-021	28-020	1.608	9.2	10	$130	$30,472	$2,438	$3,657	$1,524	$38,000
28-022_28-021	28-022	28-021	1.558	9.0	10	$130	$14,430	$1,154	$1,732	$722	$18,000

Ceda... Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
28-023_28-022	28-023	28-022	1.249	8.3	10	$130	$22,866	$1,829	$2,744	$1,143	$29,000
28-024_28-023	28-024	28-023	1.193	8.2	10	$130	$15,470	$1,238	$1,856	$774	$19,000
28-025_28-024	28-025	28-024	1.139	8.0	10	$130	$25,740	$2,059	$3,089	$1,287	$32,000
28-026_28-293	28-026	28-293	1.034	7.8	8	$125	$51,126	$4,090	$6,135	$2,556	$64,000
28-036_28-030	28-036	28-030	0.158	5.2	8	$125	$27,670	$2,214	$3,320	$1,384	$35,000
28-264_28-265	28-264	28-265	0.419	5.9	8	$125	$27,249	$2,180	$3,270	$1,362	$34,000
28-276_27-009	28-276	27-009	38.458	40.7	42	$280	$56,000	$4,480	$6,720	$2,800	$70,000
28-280_27-044	28-280	27-044	0.554	6.1	8	$125	$10,788	$863	$1,295	$539	$13,000
28-285_27-014	28-285	27-014	0.659	6.2	8	$125	$48,750	$3,900	$5,850	$2,438	$61,000
28-293_28-025	28-293	28-025	1.086	7.9	8	$125	$11,000	$880	$1,320	$550	$14,000
28-046_28-045	28-046	28-045	4.450	13.0	15	$140	$57,400	$4,592	$6,888	$2,870	$72,000
28-047_28-046	28-047	28-046	3.837	11.6	12	$135	$7,962	$637	$955	$398	$10,000
28-048_28-047	28-048	28-047	3.361	10.6	12	$135	$46,575	$3,726	$5,589	$2,329	$58,000
28-049_28-048	28-049	28-048	3.104	10.4	12	$135	$51,648	$4,132	$6,198	$2,582	$65,000
28-050_28-049	28-050	28-049	3.217	10.9	12	$135	$46,062	$3,685	$5,527	$2,303	$58,000
28-051_28-050	28-051	28-050	3.328	11.6	12	$135	$54,108	$4,329	$6,493	$2,705	$68,000
28-052_28-051	28-052	28-051	3.675	12.5	15	$140	$55,055	$4,404	$6,607	$2,753	$69,000
28-053_28-052	28-053	28-052	2.312	9.2	10	$130	$44,616	$3,569	$5,354	$2,231	$56,000
28-055_28-054	28-055	28-054	2.230	11.4	12	$135	$21,777	$1,742	$2,613	$1,089	$27,000
28-068_28-067	28-068	28-067	1.488	9.1	10	$130	$13,468	$1,077	$1,616	$673	$17,000
28-076_28-068	28-076	28-068	1.402	10.3	12	$135	$17,431	$1,394	$2,092	$872	$22,000
28-083_28-082	28-083	28-082	0.251	4.6	8	$125	$17,500	$1,400	$2,100	$875	$22,000
28-100_28-099	28-100	28-099	3.212	13.5	15	$140	$28,812	$2,305	$3,457	$1,441	$36,000
28-101_28-100	28-101	28-100	0.724	6.9	8	$125	$40,050	$3,204	$4,806	$2,003	$50,000
28-185_28-098	28-185	28-098	0.653	6.3	8	$125	$48,125	$3,850	$5,775	$2,406	$60,000
29-082_29-081	29-082	29-081	0.695	7.9	8	$125	$28,750	$2,300	$3,450	$1,438	$36,000
29-083_29-082	29-083	29-082	0.625	7.6	8	$125	$27,418	$2,193	$3,290	$1,371	$34,000
29-039_29-040	29-039	29-040	0.012	8.3	10	$130	$47,918	$3,833	$5,750	$2,396	$60,000
27-041_27-042	27-041	27-042	2.920	9.4	10	$130	$35,326	$2,826	$4,239	$1,766	$44,000
27-042_28-275	27-042	28-275	5.943	16.4	18	$155	$30,564	$2,445	$3,668	$1,528	$38,000
27-061_27-041	27-061	27-041	5.434	15.9	18	$155	$60,100	$4,808	$7,212	$3,005	$75,000
27-062_27-061	27-062	27-061	2.714	9.8	10	$130	$42,951	$3,436	$5,154	$2,148	$54,000
27-063_27-062	27-063	27-062	1.238	7.2	8	$125	$36,879	$2,950	$4,425	$1,844	$46,000
27-065_27-064	27-065	27-064	1.117	7.0	8	$125	$34,176	$2,734	$4,101	$1,709	$43,000
28-042_28-276	28-042	28-276	20.250	25.3	30	$200	$43,760	$3,501	$5,251	$2,188	$55,000
28-275_28-276	28-275	28-276	6.288	17.4	18	$155	$49,617	$3,969	$5,954	$2,481	$62,000
35-123_35-122	35-123	35-122	1.046	8.3	10	$130	$32,449	$2,596	$3,894	$1,622	$41,000
35-125_35-124	35-125	35-124	0.871	7.8	8	$125	$36,409	$2,913	$4,369	$1,820	$46,000
35-148_35-128	35-148	35-128	1.807	10.5	12	$135	$32,612	$2,609	$3,913	$1,631	$41,000

Ced. Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
35-149_35-148	35-149	35-148	0.452	5.7	8	$125	$38,913	$3,113	$4,670	$1,946	$49,000
35-155_35-148	35-155	35-148	0.218	4.4	8	$125	$20,281	$1,623	$2,434	$1,014	$25,000
35-197_27-065	35-197	27-065	3.025	12.4	15	$140	$40,041	$3,203	$4,805	$2,002	$50,000
35-198_35-197	35-198	35-197	1.751	11.2	12	$135	$1,863	$149	$224	$93	$2,000
35-199_35-198	35-199	35-198	1.628	10.1	12	$135	$12,407	$993	$1,489	$620	$16,000
35-200_35-199	35-200	35-199	1.566	10.0	10	$130	$15,305	$1,224	$1,837	$765	$19,000
35-201_35-200	35-201	35-200	1.543	9.9	10	$130	$19,087	$1,527	$2,290	$954	$24,000
35-203_35-201	35-203	35-201	1.462	9.7	10	$130	$18,435	$1,475	$2,212	$922	$23,000
35-204_35-203	35-204	35-203	1.436	9.7	10	$130	$15,600	$1,248	$1,872	$780	$20,000
35-205_35-204	35-205	35-204	1.196	9.0	10	$130	$11,700	$936	$1,404	$585	$15,000
35-206_35-205	35-206	35-205	0.928	8.2	10	$130	$21,875	$1,750	$2,625	$1,094	$27,000
35-207_35-206	35-207	35-206	0.647	6.5	8	$125	$15,000	$1,200	$1,800	$750	$19,000
35-209_35-208	35-209	35-208	0.520	6.0	8	$125	$15,029	$1,202	$1,803	$751	$19,000
35-213_35-209	35-213	35-209	0.427	5.6	8	$125	$19,298	$1,544	$2,316	$965	$24,000
35-269_35-150	35-269	35-150	0.261	4.7	8	$125	$7,925	$634	$951	$396	$10,000
35-273_35-272	35-273	35-272	0.320	5.3	8	$125	$22,961	$1,837	$2,755	$1,148	$29,000
28-043_28-042	28-043	28-042	28.859	30.8	36	$255	$127,561	$10,205	$15,307	$6,378	$159,000
28-044_28-043	28-044	28-043	28.905	30.8	36	$255	$130,200	$10,416	$15,624	$6,510	$163,000
28-045_28-044	28-045	28-044	4.032	12.0	12	$135	$58,343	$4,667	$7,001	$2,917	$73,000
28-105_28-044	28-105	28-044	17.191	22.3	24	$180	$81,000	$6,480	$9,720	$4,050	$101,000
28-106_28-105	28-106	28-105	18.369	23.3	24	$180	$90,792	$7,263	$10,895	$4,540	$113,000
28-107_28-106	28-107	28-106	26.792	28.1	30	$200	$107,000	$8,560	$12,840	$5,350	$134,000
28-108_28-107	28-108	28-107	24.530	26.5	30	$200	$102,296	$8,184	$12,276	$5,115	$128,000
28-110_28-109	28-110	28-109	16.271	21.8	24	$180	$89,820	$7,186	$10,778	$4,491	$112,000
36-026_28-110	36-026	28-110	5.793	12.1	15	$140	$30,520	$2,442	$3,662	$1,526	$38,000
29-221_29-252	29-221	29-252	0.104	5.0	8	$125	$22,926	$1,834	$2,751	$1,146	$29,000
30-300_30-301	30-300	30-301	0.105	18.5	21	$170	$54,793	$4,383	$6,575	$2,740	$68,000
30-286_30-265	30-286	30-265	0.104	4.4	8	$125	$25,558	$2,045	$3,067	$1,278	$32,000
28-109_28-108	28-109	28-108	15.966	21.7	24	$180	$75,798	$6,064	$9,096	$3,790	$95,000
36-097_28-108	36-097	28-108	5.668	14.2	15	$140	$42,434	$3,395	$5,092	$2,122	$53,000
36-098_36-097	36-098	36-097	4.606	11.9	12	$135	$21,641	$1,731	$2,597	$1,082	$27,000
36-100_36-098	36-100	36-098	5.929	15.6	18	$155	$20,821	$1,666	$2,499	$1,041	$26,000
36-101_36-100	36-101	36-100	1.295	6.2	8	$125	$25,066	$2,005	$3,008	$1,253	$31,000
36-102_36-101	36-102	36-101	5.485	14.5	15	$140	$13,860	$1,109	$1,663	$693	$17,000
36-103_36-102	36-103	36-102	3.231	9.9	10	$130	$21,910	$1,753	$2,629	$1,096	$27,000
36-104_36-103	36-104	36-103	4.136	11.7	12	$135	$11,692	$935	$1,403	$585	$15,000
36-105_36-104	36-105	36-104	5.206	14.2	15	$140	$35,267	$2,821	$4,232	$1,763	$44,000
36-106_36-105	36-106	36-105	3.837	12.9	15	$140	$15,540	$1,243	$1,865	$777	$19,000
36-107_36-106	36-107	36-106	3.747	12.6	15	$140	$20,702	$1,656	$2,484	$1,035	$26,000

Cedar Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
36-110_36-109	36-110	36-109	0.808	6.9	8	$125	$41,044	$3,284	$4,925	$2,052	$51,000
36-111_36-110	36-111	36-110	1.533	9.9	10	$130	$32,920	$2,634	$3,950	$1,646	$41,000
36-113_36-112	36-113	36-112	0.518	6.2	8	$125	$37,750	$3,020	$4,530	$1,888	$47,000
36-158_36-159	36-158	36-159	0.938	6.0	8	$125	$19,153	$1,532	$2,298	$958	$24,000
36-159_36-229	36-159	36-229	1.846	8.9	10	$130	$18,275	$1,462	$2,193	$914	$23,000
36-160_36-161	36-160	36-161	1.809	7.9	8	$125	$42,175	$3,374	$5,061	$2,109	$53,000
36-161_36-175	36-161	36-175	2.329	8.9	10	$130	$39,410	$3,153	$4,729	$1,970	$49,000
36-174_36-107	36-174	36-107	2.972	10.2	12	$135	$24,829	$1,986	$2,980	$1,241	$31,000
36-175_36-174	36-175	36-174	2.517	9.4	10	$130	$25,949	$2,076	$3,114	$1,297	$32,000
36-188_36-157	36-188	36-157	1.920	10.8	12	$135	$17,446	$1,396	$2,094	$872	$22,000
36-189_36-188	36-189	36-188	0.540	4.8	8	$125	$11,985	$959	$1,438	$599	$15,000
36-190_36-189	36-190	36-189	1.029	6.9	8	$125	$28,111	$2,249	$3,373	$1,406	$35,000
36-196_36-197	36-196	36-197	1.219	8.6	10	$130	$16,561	$1,325	$1,987	$828	$21,000
36-197_36-191	36-197	36-191	1.298	8.6	10	$130	$15,915	$1,273	$1,910	$796	$20,000
36-229_36-160	36-229	36-160	1.967	8.9	10	$130	$18,543	$1,483	$2,225	$927	$23,000
36-244_36-204	36-244	36-204	0.990	8.7	10	$130	$15,510	$1,241	$1,861	$776	$19,000
36-245_36-244	36-245	36-244	0.775	7.7	8	$125	$18,030	$1,442	$2,164	$902	$23,000
36-310_36-245	36-310	36-245	0.455	6.3	8	$125	$32,033	$2,563	$3,844	$1,602	$40,000
36-311_36-310	36-311	36-310	0.279	5.2	8	$125	$15,725	$1,258	$1,887	$786	$20,000
36-312_36-311	36-312	36-311	0.249	5.0	8	$125	$26,125	$2,090	$3,135	$1,306	$33,000
36-001_36-025	36-001	36-025	14.544	20.2	21	$170	$18,870	$1,510	$2,264	$944	$24,000
36-002_36-001	36-002	36-001	12.740	19.2	21	$170	$83,300	$6,664	$9,996	$4,165	$104,000
36-003_36-002	36-003	36-002	14.108	20.7	21	$170	$93,558	$7,485	$11,227	$4,678	$117,000
36-004_36-003	36-004	36-003	9.370	16.0	18	$155	$62,136	$4,971	$7,456	$3,107	$78,000
36-005_36-052	36-005	36-052	16.289	23.3	24	$180	$46,350	$3,708	$5,562	$2,318	$58,000
36-006_36-067	36-006	36-067	10.715	17.5	18	$155	$43,967	$3,517	$5,276	$2,198	$55,000
36-009_36-008	36-009	36-008	0.542	6.3	8	$125	$31,250	$2,500	$3,750	$1,563	$39,000
36-010_36-009	36-010	36-009	0.515	6.2	8	$125	$31,159	$2,493	$3,739	$1,558	$39,000
36-017_36-016	36-017	36-016	0.357	7.0	8	$125	$19,781	$1,583	$2,374	$989	$25,000
36-025_36-026	36-025	36-026	23.040	31.1	36	$255	$59,925	$4,794	$7,191	$2,996	$75,000
36-052_36-004	36-052	36-004	15.537	22.3	24	$180	$44,231	$3,539	$5,308	$2,212	$55,000
36-067_36-005	36-067	36-005	24.504	39.1	42	$280	$51,346	$4,108	$6,162	$2,567	$64,000
36-246_36-001	36-246	36-001	0.907	6.6	8	$125	$17,173	$1,374	$2,061	$859	$21,000
37-001_37-369	37-001	37-369	19.353	27.6	30	$200	$62,600	$5,008	$7,512	$3,130	$78,000
37-127_37-001	37-127	37-001	18.728	31.1	36	$255	$110,201	$8,816	$13,224	$5,510	$138,000
37-369_36-006	37-369	36-006	6.190	13.1	15	$140	$28,269	$2,262	$3,392	$1,413	$35,000
29-297_29-336	29-297	29-336	0.130	5.5	8	$125	$44,038	$3,523	$5,285	$2,202	$55,000
37-004_37-003	37-004	37-003	0.542	9.4	10	$130	$8,126	$650	$975	$406	$10,000
37-177_37-176	37-177	37-176	5.655	17.4	18	$155	$50,143	$4,011	$6,017	$2,507	$63,000

Ceda reek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
37-210_37-283	37-210	37-283	0.132	4.8	8	$125	$37,000	$2,960	$4,440	$1,850	$46,000
38-001_37-223	38-001	37-223	1.032	10.5	12	$135	$36,896	$2,952	$4,427	$1,845	$46,000
38-044_38-098	38-044	38-098	0.817	8.4	10	$130	$25,220	$2,018	$3,026	$1,261	$32,000
38-046_38-045	38-046	38-045	0.695	7.6	8	$125	$46,988	$3,759	$5,639	$2,349	$59,000
38-070_38-069	38-070	38-069	0.085	17.1	18	$155	$59,664	$4,773	$7,160	$2,983	$75,000
38-077_38-076	38-077	38-076	0.364	5.6	8	$125	$21,513	$1,721	$2,582	$1,076	$27,000
38-319_38-067	38-319	38-067	0.760	38.9	42	$280	$79,800	$6,384	$9,576	$3,990	$100,000
38-321_38-058	38-321	38-058	1.475	8.6	10	$130	$15,561	$1,245	$1,867	$778	$19,000
37-128_37-127	37-128	37-127	18.604	31.0	36	$255	$47,940	$3,835	$5,753	$2,397	$60,000
37-129_37-128	37-129	37-128	17.321	28.0	30	$200	$37,660	$3,013	$4,519	$1,883	$47,000
37-130_37-129	37-130	37-129	18.394	30.9	36	$255	$78,795	$6,304	$9,455	$3,940	$98,000
37-131_37-347	37-131	37-347	13.676	25.6	30	$200	$36,214	$2,897	$4,346	$1,811	$45,000
37-132_37-131	37-132	37-131	13.473	25.5	30	$200	$53,200	$4,256	$6,384	$2,660	$67,000
37-133_37-132	37-133	37-132	14.611	28.3	30	$200	$54,000	$4,320	$6,480	$2,700	$68,000
37-294_37-296	37-294	37-296	0.764	10.7	12	$135	$15,617	$1,249	$1,874	$781	$20,000
37-296_37-297	37-296	37-297	0.303	5.1	8	$125	$14,856	$1,189	$1,783	$743	$19,000
37-301_37-302	37-301	37-302	0.478	4.5	8	$125	$15,071	$1,206	$1,809	$754	$19,000
37-302_37-350	37-302	37-350	1.637	8.1	10	$130	$17,892	$1,431	$2,147	$895	$22,000
37-347_37-130	37-347	37-130	19.186	35.7	36	$255	$30,291	$2,423	$3,635	$1,515	$38,000
37-348_37-347	37-348	37-347	2.722	11.0	12	$135	$2,426	$194	$291	$121	$3,000
37-349_37-355	37-349	37-355	2.858	12.1	15	$140	$45,958	$3,677	$5,515	$2,298	$57,000
37-350_37-349	37-350	37-349	3.469	12.7	15	$140	$1,495	$120	$179	$75	$2,000
37-355_37-348	37-355	37-348	2.985	12.3	15	$140	$36,289	$2,903	$4,355	$1,814	$45,000
37-134_37-133	37-134	37-133	9.178	23.8	24	$180	$39,956	$3,197	$4,795	$1,998	$50,000
37-135_37-134	37-135	37-134	5.999	17.1	18	$155	$19,786	$1,583	$2,374	$989	$25,000
37-136_37-135	37-136	37-135	8.483	23.1	24	$180	$31,837	$2,547	$3,820	$1,592	$40,000
37-137_37-136	37-137	37-136	8.378	23.0	24	$180	$33,399	$2,672	$4,008	$1,670	$42,000
37-138_37-137	37-138	37-137	6.477	18.3	21	$170	$23,419	$1,874	$2,810	$1,171	$29,000
37-227_37-177	37-227	37-177	5.603	15.6	18	$155	$12,059	$965	$1,447	$603	$15,000
37-238_37-227	37-238	37-227	3.436	13.0	15	$140	$39,007	$3,121	$4,681	$1,950	$49,000
37-310_37-133	37-310	37-133	6.002	17.1	18	$155	$58,668	$4,693	$7,040	$2,933	$73,000
37-312_37-311	37-312	37-311	2.149	10.4	12	$135	$60,013	$4,801	$7,202	$3,001	$75,000
37-313_37-312	37-313	37-312	2.234	11.1	12	$135	$47,435	$3,795	$5,692	$2,372	$59,000
37-314_37-313	37-314	37-313	0.883	7.2	8	$125	$24,351	$1,948	$2,922	$1,218	$30,000
37-318_37-314	37-318	37-314	0.395	5.4	8	$125	$23,651	$1,892	$2,838	$1,183	$30,000
37-328_37-358	37-328	37-358	0.412	5.5	8	$125	$15,493	$1,239	$1,859	$775	$19,000
37-329_37-328	37-329	37-328	0.529	6.6	8	$125	$17,248	$1,380	$2,070	$862	$22,000
37-337_37-310	37-337	37-310	3.829	10.4	12	$135	$38,030	$3,042	$4,564	$1,901	$48,000
37-338_37-336	37-338	37-336	1.883	12.2	15	$140	$10,952	$876	$1,314	$548	$14,000

Ced: Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
37-340_37-339	37-340	37-339	0.566	5.4	8	$125	$29,349	$2,348	$3,522	$1,467	$37,000
37-341_37-340	37-341	37-340	0.921	7.4	8	$125	$18,125	$1,450	$2,175	$906	$23,000
37-359_37-367	37-359	37-367	0.815	7.4	8	$125	$34,015	$2,721	$4,082	$1,701	$43,000
37-360_37-359	37-360	37-359	0.696	7.0	8	$125	$46,250	$3,700	$5,550	$2,313	$58,000
37-361_37-360	37-361	37-360	0.289	5.0	8	$125	$27,750	$2,220	$3,330	$1,388	$35,000
37-367_37-341	37-367	37-341	1.159	9.2	10	$130	$8,190	$655	$983	$410	$10,000
37-387_37-329	37-387	37-329	0.167	3.9	8	$125	$19,550	$1,564	$2,346	$978	$24,000
37-228_37-237	37-228	37-237	3.925	14.6	15	$140	$34,805	$2,784	$4,177	$1,740	$44,000
37-231_37-232	37-231	37-232	3.322	13.2	15	$140	$14,787	$1,183	$1,774	$739	$18,000
37-232_37-228	37-232	37-228	3.846	15.1	18	$155	$40,533	$3,243	$4,864	$2,027	$51,000
37-237_37-238	37-237	37-238	3.961	14.6	15	$140	$39,808	$3,185	$4,777	$1,990	$50,000
37-247_37-231	37-247	37-231	3.610	13.3	15	$140	$30,807	$2,465	$3,697	$1,540	$39,000
37-248_37-247	37-248	37-247	3.461	12.7	15	$140	$50,984	$4,079	$6,118	$2,549	$64,000
37-249_37-248	37-249	37-248	2.449	10.7	12	$135	$50,039	$4,003	$6,005	$2,502	$63,000
38-281_38-282	38-281	38-282	3.133	11.5	12	$135	$24,731	$1,978	$2,968	$1,237	$31,000
38-282_38-283	38-282	38-283	3.308	12.2	15	$140	$40,247	$3,220	$4,830	$2,012	$50,000
38-283_38-284	38-283	38-284	3.105	11.2	12	$135	$39,215	$3,137	$4,706	$1,961	$49,000
38-284_37-249	38-284	37-249	2.293	10.3	12	$135	$21,487	$1,719	$2,578	$1,074	$27,000
45-003_45-002	45-003	45-002	0.857	6.7	8	$125	$13,814	$1,105	$1,658	$691	$17,000
38-082_38-081	38-082	38-081	0.741	8.1	10	$130	$19,581	$1,566	$2,350	$979	$24,000
45-006_45-005	45-006	45-005	0.679	6.6	8	$125	$49,993	$3,999	$5,999	$2,500	$62,000
45-076_45-006	45-076	45-006	0.656	6.7	8	$125	$47,454	$3,796	$5,694	$2,373	$59,000
45-080_45-003	45-080	45-003	0.661	6.7	8	$125	$39,009	$3,121	$4,681	$1,950	$49,000
45-081_45-080	45-081	45-080	0.766	7.6	8	$125	$25,493	$2,039	$3,059	$1,275	$32,000
45-082_45-081	45-082	45-081	0.692	7.1	8	$125	$50,140	$4,011	$6,017	$2,507	$63,000
45-083_45-082	45-083	45-082	0.617	6.8	8	$125	$24,470	$1,958	$2,936	$1,224	$31,000
45-112_45-111	45-112	45-111	0.068	15.7	18	$155	$53,832	$4,307	$6,460	$2,692	$67,000
45-042_45-066	45-042	45-066	0.365	29.5	30	$200	$64,340	$5,147	$7,721	$3,217	$80,000
Total							$10,652,068				$13,321,000

Big eek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
46-025_46-024	46-025	46-024	5.386	15.4	18	$155	$79,405	$6,352	$9,529	$3,970	$99,000
46-026_46-025	46-026	46-025	5.341	17.1	18	$155	$11,391	$911	$1,367	$570	$14,000
46-027_46-026	46-027	46-026	4.543	16.9	18	$155	$33,567	$2,685	$4,028	$1,678	$42,000
46-028_46-027	46-028	46-027	3.163	13.4	15	$140	$17,158	$1,373	$2,059	$858	$21,000
46-029_46-028	46-029	46-028	2.196	11.7	12	$135	$50,537	$4,043	$6,064	$2,527	$63,000
46-030_46-029	46-030	46-029	1.188	9.3	10	$130	$24,752	$1,980	$2,970	$1,238	$31,000
47-006_47-007	47-006	47-007	0.255	5.5	8	$125	$50,030	$4,002	$6,004	$2,502	$63,000
47-007_47-016	47-007	47-016	0.385	6.4	8	$125	$39,989	$3,199	$4,799	$1,999	$50,000
47-016_47-017	47-016	47-017	1.595	10.8	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
47-022_47-023	47-022	47-023	2.485	16.6	18	$155	$46,675	$3,734	$5,601	$2,334	$58,000
47-023_47-069	47-023	47-069	1.861	11.5	12	$135	$29,539	$2,363	$3,545	$1,477	$37,000
47-068_54-017	47-068	54-017	2.568	13.7	15	$140	$32,199	$2,576	$3,864	$1,610	$40,000
47-069_47-068	47-069	47-068	2.261	13.0	15	$140	$32,203	$2,576	$3,864	$1,610	$40,000
54-008_54-007	54-008	54-007	5.338	17.0	18	$155	$62,002	$4,960	$7,440	$3,100	$78,000
54-010_54-009	54-010	54-009	5.302	17.9	18	$155	$62,000	$4,960	$7,440	$3,100	$78,000
54-011_54-010	54-011	54-010	5.301	19.4	21	$170	$61,533	$4,923	$7,384	$3,077	$77,000
54-012_54-011	54-012	54-011	3.432	13.9	15	$140	$41,597	$3,328	$4,992	$2,080	$52,000
54-013_54-012	54-013	54-012	4.937	18.9	21	$170	$49,487	$3,959	$5,938	$2,474	$62,000
54-014_54-013	54-014	54-013	4.677	18.5	21	$170	$64,405	$5,152	$7,729	$3,220	$81,000
54-015_54-014	54-015	54-014	3.534	15.4	18	$155	$63,220	$5,058	$7,586	$3,161	$79,000
54-016_54-015	54-016	54-015	2.076	11.1	12	$135	$53,997	$4,320	$6,480	$2,700	$67,000
54-017_54-016	54-017	54-016	3.480	16.5	18	$155	$61,997	$4,960	$7,440	$3,100	$77,000
54-029_54-028	54-029	54-028	4.919	17.4	18	$155	$39,942	$3,195	$4,793	$1,997	$50,000
54-030_54-029	54-030	54-029	4.297	15.7	18	$155	$56,504	$4,520	$6,780	$2,825	$71,000
54-031_54-030	54-031	54-030	4.072	16.3	18	$155	$63,927	$5,114	$7,671	$3,196	$80,000
54-032_54-031	54-032	54-031	4.267	16.5	18	$155	$63,355	$5,068	$7,603	$3,168	$79,000
46-021_53-015	46-021	53-015	6.217	19.0	21	$170	$42,010	$3,361	$5,041	$2,101	$53,000
46-022_46-021	46-022	46-021	6.277	16.3	18	$155	$30,572	$2,446	$3,669	$1,529	$38,000
46-024_46-022	46-024	46-022	5.946	15.2	18	$155	$51,116	$4,089	$6,134	$2,556	$64,000
53-003_54-032	53-003	54-032	4.253	16.5	18	$155	$63,229	$5,058	$7,587	$3,161	$79,000
53-003A_53-003	53-003A	53-003	4.225	16.5	18	$155	$49,377	$3,950	$5,925	$2,469	$62,000
53-004_53-003A	53-004	53-003A	4.241	16.5	18	$155	$49,247	$3,940	$5,910	$2,462	$62,000
53-005_53-004	53-005	53-004	4.232	16.5	18	$155	$61,138	$4,891	$7,337	$3,057	$76,000
53-006_53-005	53-006	53-005	4.216	16.5	18	$155	$48,050	$3,844	$5,766	$2,403	$60,000
53-007_53-006	53-007	53-006	4.283	16.6	18	$155	$23,362	$1,869	$2,803	$1,168	$29,000
53-008_53-007	53-008	53-007	4.168	16.4	18	$155	$59,698	$4,776	$7,164	$2,985	$75,000
53-009_53-008	53-009	53-008	4.069	16.3	18	$155	$45,148	$3,612	$5,418	$2,257	$56,000
53-010_53-009	53-010	53-009	6.169	19.0	21	$170	$47,185	$3,775	$5,662	$2,359	$59,000

Big Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
53-011_53-010	53-011	53-010	6.147	19.0	21	$170	$46,791	$3,743	$5,615	$2,340	$58,000
53-012_53-011	53-012	53-011	6.229	19.1	21	$170	$40,358	$3,229	$4,843	$2,018	$50,000
53-013_53-012	53-013	53-012	6.078	18.9	21	$170	$50,193	$4,015	$6,023	$2,510	$63,000
53-014_53-013	53-014	53-013	6.225	19.1	21	$170	$46,072	$3,686	$5,529	$2,304	$58,000
53-015_53-014	53-015	53-014	6.249	19.1	21	$170	$45,132	$3,611	$5,416	$2,257	$56,000
Total											$2,555,000

May ook
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
14-027_14-026	14-027	14-026	1.657	11.0	12	$135	$25,529	$2,042	$3,063	$1,276	$32,000
14-045_14-027	14-045	14-027	1.337	10.1	12	$135	$13,500	$1,080	$1,620	$675	$17,000
14-002_11-126	14-002	11-126	1.083	44.4	48	$305	$59,292	$4,743	$7,115	$2,965	$74,000
14-022_14-011	14-022	14-011	2.395	12.6	15	$140	$52,850	$4,228	$6,342	$2,643	$66,000
14-023_14-022	14-023	14-022	2.239	12.3	15	$140	$56,000	$4,480	$6,720	$2,800	$70,000
14-024_14-023	14-024	14-023	2.284	12.4	15	$140	$55,958	$4,477	$6,715	$2,798	$70,000
14-025_14-024	14-025	14-024	2.064	11.4	12	$135	$53,879	$4,310	$6,465	$2,694	$67,000
01-033_01-032	01-033	01-032	0.944	8.9	10	$130	$18,850	$1,508	$2,262	$943	$24,000
01-032_01-031	01-032	01-031	1.044	8.9	10	$130	$39,000	$3,120	$4,680	$1,950	$49,000
04-008_04-007	04-008	04-007	2.151	10.4	12	$135	$54,116	$4,329	$6,494	$2,706	$68,000
04-009_04-008	04-009	04-008	1.549	9.9	10	$130	$52,000	$4,160	$6,240	$2,600	$65,000
08-127_08-126	08-127	08-126	0.271	5.2	8	$125	$15,913	$1,273	$1,910	$796	$20,000
08-065_08-016BS	08-065	08-016BS	1.767	14.6	15	$140	$6,147	$492	$738	$307	$8,000
08-066_08-065	08-066	08-065	1.957	11.2	12	$135	$14,850	$1,188	$1,782	$743	$19,000
08-067_08-066	08-067	08-066	0.918	7.1	8	$125	$30,625	$2,450	$3,675	$1,531	$38,000
08-167_08-067	08-167	08-067	1.448	9.4	10	$130	$7,827	$626	$939	$391	$10,000
Total											$697,000

Middle Big Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
56-094_56-078	56-094	56-078	1.396	8.9	10	$130	$20,098	$1,608	$2,412	$1,005	$25,000
56-095_56-094	56-095	56-094	0.916	7.3	8	$125	$19,781	$1,583	$2,374	$989	$25,000
56-096_56-095	56-096	56-095	1.159	8.3	10	$130	$52,079	$4,166	$6,250	$2,604	$65,000
56-099_56-098	56-099	56-098	1.408	9.9	10	$130	$40,266	$3,221	$4,832	$2,013	$50,000
56-100_56-099	56-100	56-099	2.471	13.5	15	$140	$40,627	$3,250	$4,875	$2,031	$51,000
56-101_56-100	56-101	56-100	1.816	10.2	12	$135	$39,022	$3,122	$4,683	$1,951	$49,000
56-103_56-102	56-103	56-102	1.420	9.1	10	$130	$21,960	$1,757	$2,635	$1,098	$27,000
56-104_56-103	56-104	56-103	1.524	9.9	10	$130	$17,057	$1,365	$2,047	$853	$21,000
56-105_56-104	56-105	56-104	1.303	9.3	10	$130	$31,496	$2,520	$3,780	$1,575	$39,000
56-106_56-105	56-106	56-105	1.298	9.6	10	$130	$14,973	$1,198	$1,797	$749	$19,000
56-107_56-106	56-107	56-106	1.171	9.3	10	$130	$28,750	$2,300	$3,450	$1,437	$36,000
56-108_56-107	56-108	56-107	1.006	8.7	10	$130	$21,169	$1,694	$2,540	$1,058	$26,000
56-109_56-108	56-109	56-108	0.834	8.1	10	$130	$37,470	$2,998	$4,496	$1,873	$47,000
56-110_56-109	56-110	56-109	0.676	7.5	8	$125	$16,023	$1,282	$1,923	$801	$20,000
56-111_56-110	56-111	56-110	0.480	6.6	8	$125	$10,575	$846	$1,269	$529	$13,000
56-112_56-111	56-112	56-111	0.432	6.4	8	$125	$18,998	$1,520	$2,280	$950	$24,000
56-116_56-115	56-116	56-115	3.679	13.7	15	$140	$48,324	$3,866	$5,799	$2,416	$60,000
56-117_56-116	56-117	56-116	3.602	14.1	15	$140	$26,286	$2,103	$3,154	$1,314	$33,000
56-118_56-117	56-118	56-117	3.504	14.0	15	$140	$43,506	$3,481	$5,221	$2,175	$54,000
56-119_56-118	56-119	56-118	2.242	13.0	15	$140	$20,828	$1,666	$2,499	$1,041	$26,000
56-120_56-119	56-120	56-119	1.111	8.5	10	$130	$15,743	$1,259	$1,889	$787	$20,000
56-121_56-120	56-121	56-120	1.094	9.9	10	$130	$12,734	$1,019	$1,528	$637	$16,000
56-122_56-121	56-122	56-121	0.685	7.6	8	$125	$12,305	$984	$1,477	$615	$15,000
56-127_56-126	56-127	56-126	0.679	9.0	10	$130	$24,543	$1,963	$2,945	$1,227	$31,000
56-132_56-127	56-132	56-127	0.200	5.0	8	$125	$24,960	$1,997	$2,995	$1,248	$31,000
56-133_56-132	56-133	56-132	0.181	5.1	8	$125	$7,424	$594	$891	$371	$9,000
56-146_56-131	56-146	56-131	0.240	5.1	8	$125	$17,194	$1,376	$2,063	$860	$21,000
60-018_60-001CO	60-018	60-001CO	13.035	30.9	36	$255	$8,084	$647	$970	$404	$10,000
60-019_60-018	60-019	60-018	4.860	15.8	18	$155	$56,637	$4,531	$6,796	$2,832	$71,000
60-022_60-021	60-022	60-021	3.090	12.5	15	$140	$10,370	$830	$1,244	$518	$13,000
60-031_60-022	60-031	60-022	2.864	13.5	15	$140	$41,171	$3,294	$4,941	$2,059	$51,000
60-033_60-018	60-033	60-018	3.904	16.0	18	$155	$55,814	$4,465	$6,698	$2,791	$70,000
60-034_60-033	60-034	60-033	4.965	18.9	21	$170	$51,000	$4,080	$6,120	$2,550	$64,000
60-066_60-019	60-066	60-019	4.654	17.1	18	$155	$15,064	$1,205	$1,808	$753	$19,000
60-074_60-066	60-074	60-066	4.484	20.7	21	$170	$9,928	$794	$1,191	$496	$12,000
60-157_60-034	60-157	60-034	4.580	18.3	21	$170	$11,016	$881	$1,322	$551	$14,000
60-161_60-160	60-161	60-160	2.553	14.7	15	$140	$25,460	$2,037	$3,055	$1,273	$32,000
60-163_60-162	60-163	60-162	0.979	9.5	10	$130	$37,694	$3,015	$4,523	$1,885	$47,000

Middle Big Creek
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
60-165_60-164	60-165	60-164	1.290	10.0	12	$135	$17,280	$1,382	$2,074	$864	$22,000
57-042_61-327	57-042	61-327	7.015	18.9	21	$170	$51,850	$4,148	$6,222	$2,593	$65,000
61-114_61-115	61-114	61-115	7.817	18.2	21	$170	$67,660	$5,413	$8,119	$3,383	$85,000
61-115_61-116	61-115	61-116	7.818	18.2	21	$170	$50,108	$4,009	$6,013	$2,505	$63,000
61-116_61-117	61-116	61-117	8.163	19.2	21	$170	$64,631	$5,170	$7,756	$3,232	$81,000
61-117_61-118	61-117	61-118	8.053	18.4	21	$170	$63,978	$5,118	$7,677	$3,199	$80,000
61-118_61-119	61-118	61-119	8.224	19.2	21	$170	$67,091	$5,367	$8,051	$3,355	$84,000
61-323_61-114	61-323	61-114	8.570	23.2	24	$180	$39,125	$3,130	$4,695	$1,956	$49,000
61-324_61-323	61-324	61-323	7.775	20.7	21	$170	$54,919	$4,393	$6,590	$2,746	$69,000
61-325_61-324	61-325	61-324	5.322	14.3	15	$140	$8,812	$705	$1,057	$441	$11,000
61-326_61-325	61-326	61-325	8.265	22.9	24	$180	$45,837	$3,667	$5,500	$2,292	$57,000
61-327_61-326	61-327	61-326	6.221	16.3	18	$155	$8,153	$652	$978	$408	$10,000
61-122_61-003BS	61-122	61-003BS	2.539	16.7	18	$155	$10,191	$815	$1,223	$510	$13,000
64-009_64-008	64-009	64-008	1.164	12.5	15	$140	$32,631	$2,610	$3,916	$1,632	$41,000
Total											$1,986,000

South Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
26-167_26-166	26-167	26-166	0.676	4.6	8	$125	$1,795	$144	$215	$90	$2,000
26-168_26-167	26-168	26-167	1.012	7.3	8	$125	$9,860	$789	$1,183	$493	$12,000
26-169_26-168	26-169	26-168	1.355	9.4	10	$130	$15,305	$1,224	$1,837	$765	$19,000
26-170_26-169	26-170	26-169	1.408	9.9	10	$130	$21,718	$1,737	$2,606	$1,086	$27,000
26-173_26-170	26-173	26-170	1.165	8.9	10	$130	$33,157	$2,653	$3,979	$1,658	$41,000
26-174_26-173	26-174	26-173	1.034	8.3	10	$130	$22,781	$1,822	$2,734	$1,139	$28,000
26-179_26-178	26-179	26-178	0.244	4.4	8	$125	$37,835	$3,027	$4,540	$1,892	$47,000
26-180_26-179	26-180	26-179	0.571	7.1	8	$125	$48,188	$3,855	$5,783	$2,409	$60,000
26-181_26-180	26-181	26-180	0.390	5.8	8	$125	$18,086	$1,447	$2,170	$904	$23,000
26-182_26-181	26-182	26-181	0.159	4.0	8	$125	$16,625	$1,330	$1,995	$831	$21,000
26-192_26-174	26-192	26-174	0.577	6.1	8	$125	$17,325	$1,386	$2,079	$866	$22,000
26-166_26-001PS	26-166	26-001PS	0.675	4.6	8	$125	$1,615	$129	$194	$81	$2,000
26-041_26-040	26-041	26-040	8.504	18.3	21	$170	$50,114	$4,009	$6,014	$2,506	$63,000
26-044_26-041	26-044	26-041	6.964	15.6	18	$155	$54,002	$4,320	$6,480	$2,700	$68,000
26-068_26-002	26-068	26-002	9.655	19.2	21	$170	$6,496	$520	$779	$325	$8,000
26-069_26-068	26-069	26-068	9.712	19.8	21	$170	$68,000	$5,440	$8,160	$3,400	$85,000
26-070_26-069	26-070	26-069	8.346	13.2	15	$140	$30,100	$2,408	$3,612	$1,505	$38,000
26-071_26-070	26-071	26-070	9.644	19.7	21	$170	$47,600	$3,808	$5,712	$2,380	$60,000
26-076_26-071	26-076	26-071	9.582	20.4	21	$170	$49,368	$3,949	$5,924	$2,468	$62,000
26-083_26-044	26-083	26-044	8.542	23.2	24	$180	$26,775	$2,142	$3,213	$1,339	$33,000
26-084_26-083	26-084	26-083	4.968	14.9	15	$140	$7,088	$567	$851	$354	$9,000
26-085_26-084	26-085	26-084	8.259	22.9	24	$180	$65,515	$5,241	$7,862	$3,276	$82,000
33-231_33-232	33-231	33-232	5.873	14.9	15	$140	$35,060	$2,805	$4,207	$1,753	$44,000
33-232_33-233	33-232	33-233	6.825	16.8	18	$155	$31,033	$2,483	$3,724	$1,552	$39,000
33-233_33-234	33-233	33-234	7.527	18.6	21	$170	$64,865	$5,189	$7,784	$3,243	$81,000
33-234_26-085	33-234	26-085	8.634	19.6	21	$170	$46,570	$3,726	$5,588	$2,328	$58,000
33-398_33-234	33-398	33-234	0.433	5.7	8	$125	$18,750	$1,500	$2,250	$938	$23,000
26-077_26-076	26-077	26-076	9.460	20.3	21	$170	$10,880	$870	$1,306	$544	$14,000
26-078_26-077	26-078	26-077	0.466	5.8	8	$125	$47,271	$3,782	$5,673	$2,364	$59,000
26-079_26-078	26-079	26-078	0.443	5.8	8	$125	$43,750	$3,500	$5,250	$2,188	$55,000
26-080_26-079	26-080	26-079	0.240	4.3	8	$125	$32,135	$2,571	$3,856	$1,607	$40,000
26-086_26-077	26-086	26-077	8.801	97.4	8	$125	$24,625	$1,970	$2,955	$1,231	$31,000
26-087_26-086	26-087	26-086	7.974	18.4	21	$170	$33,490	$2,679	$4,019	$1,675	$42,000
26-088_26-087	26-088	26-087	8.041	19.9	21	$170	$18,290	$1,463	$2,195	$915	$23,000
26-089_26-088	26-089	26-088	7.930	19.0	21	$170	$50,497	$4,040	$6,060	$2,525	$63,000
26-094_26-089	26-094	26-089	7.193	16.7	18	$155	$40,925	$3,274	$4,911	$2,046	$51,000
26-095_26-094	26-095	26-094	7.089	16.7	18	$155	$17,053	$1,364	$2,046	$853	$21,000
26-096_26-095	26-096	26-095	5.304	10.2	12	$135	$15,660	$1,253	$1,879	$783	$20,000

South P rie Lee
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
26-101_26-096	26-101	26-096	5.440	10.6	12	$135	$18,506	$1,480	$2,221	$925	$23,000
26-102_26-101	26-102	26-101	6.885	16.1	18	$155	$29,140	$2,331	$3,497	$1,457	$36,000
26-103_26-102	26-103	26-102	6.662	16.7	18	$155	$51,708	$4,137	$6,205	$2,585	$65,000
26-104_26-103	26-104	26-103	5.754	12.4	15	$140	$25,298	$2,024	$3,036	$1,265	$32,000
26-105_26-104	26-105	26-104	6.500	16.5	18	$155	$48,365	$3,869	$5,804	$2,418	$60,000
26-106_26-105	26-106	26-105	6.262	15.5	18	$155	$25,343	$2,027	$3,041	$1,267	$32,000
32-108_32-109	32-108	32-109	1.621	11.5	12	$135	$62,224	$4,978	$7,467	$3,111	$78,000
32-117_32-118	32-117	32-118	0.829	8.5	10	$130	$17,334	$1,387	$2,080	$867	$22,000
32-118_32-119	32-118	32-119	0.645	7.4	8	$125	$19,036	$1,523	$2,284	$952	$24,000
32-119_32-259	32-119	32-259	0.650	7.4	8	$125	$14,673	$1,174	$1,761	$734	$18,000
32-130_32-127	32-130	32-127	0.695	7.6	8	$125	$37,516	$3,001	$4,502	$1,876	$47,000
32-261_32-260	32-261	32-260	0.209	5.1	8	$125	$15,675	$1,254	$1,881	$784	$20,000
32-440_32-441	32-440	32-441	1.922	12.3	15	$140	$36,208	$2,897	$4,345	$1,810	$45,000
32-441_32-442	32-441	32-442	3.973	17.4	18	$155	$31,865	$2,549	$3,824	$1,593	$40,000
33-195_33-223	33-195	33-223	3.272	16.2	18	$155	$63,702	$5,096	$7,644	$3,185	$80,000
33-223_33-224	33-223	33-224	3.416	16.4	18	$155	$61,966	$4,957	$7,436	$3,098	$77,000
33-224_33-225	33-224	33-225	3.416	15.2	18	$155	$62,000	$4,960	$7,440	$3,100	$78,000
33-225_33-304	33-225	33-304	1.772	10.4	12	$135	$44,078	$3,526	$5,289	$2,204	$55,000
33-227_33-228	33-227	33-228	0.941	7.6	8	$125	$50,000	$4,000	$6,000	$2,500	$63,000
33-230_33-370	33-230	33-370	1.194	8.4	10	$130	$38,026	$3,042	$4,563	$1,901	$48,000
33-235_33-231	33-235	33-231	3.011	11.2	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
33-304_33-226	33-304	33-226	3.941	17.3	18	$155	$19,479	$1,558	$2,337	$974	$24,000
33-434_33-379	33-434	33-379	0.017	9.4	10	$130	$11,167	$893	$1,340	$558	$14,000
33-237_33-436	33-237	33-436	1.775	8.8	10	$130	$36,803	$2,944	$4,416	$1,840	$46,000
33-238_33-237	33-238	33-237	2.318	10.3	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
33-239_33-238	33-239	33-238	2.872	11.9	12	$135	$43,177	$3,454	$5,181	$2,159	$54,000
33-240_33-239	33-240	33-239	3.381	13.8	15	$140	$18,084	$1,447	$2,170	$904	$23,000
33-241_33-240	33-241	33-240	2.650	11.5	12	$135	$47,075	$3,766	$5,649	$2,354	$59,000
33-390_33-408	33-390	33-408	2.256	9.6	10	$130	$28,562	$2,285	$3,427	$1,428	$36,000
33-408_33-235	33-408	33-235	3.367	12.1	15	$140	$4,900	$392	$588	$245	$6,000
33-436_33-236	33-436	33-236	4.951	13.1	15	$140	$15,694	$1,256	$1,883	$785	$20,000
31-195_31-196	31-195	31-196	0.498	9.1	10	$130	$32,903	$2,632	$3,948	$1,645	$41,000
32-049_32-067	32-049	32-067	0.206	5.0	8	$125	$50,000	$4,000	$6,000	$2,500	$63,000
32-067_32-068	32-067	32-068	0.322	6.3	8	$125	$46,963	$3,757	$5,636	$2,348	$59,000
32-068_32-108	32-068	32-108	0.777	7.7	8	$125	$10,133	$811	$1,216	$507	$13,000
32-209_32-208	32-209	32-208	0.402	30.6	36	$255	$43,614	$3,489	$5,234	$2,181	$55,000
32-247_32-246	32-247	32-246	1.267	11.3	12	$135	$54,336	$4,347	$6,520	$2,717	$68,000
33-183_33-184	33-183	33-184	2.514	11.6	12	$135	$22,626	$1,810	$2,715	$1,131	$28,000

South Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
33-184_33-191	33-184	33-191	2.627	11.8	12	$135	$43,011	$3,441	$5,161	$2,151	$54,000
33-191_33-192	33-191	33-192	2.313	10.7	12	$135	$16,436	$1,315	$1,972	$822	$21,000
33-192_33-193	33-192	33-193	2.729	11.9	12	$135	$37,800	$3,024	$4,536	$1,890	$47,000
33-193_33-194	33-193	33-194	2.773	12.0	15	$140	$27,832	$2,227	$3,340	$1,392	$35,000
33-194_33-195	33-194	33-195	2.800	12.1	15	$140	$56,034	$4,483	$6,724	$2,802	$70,000
33-222_33-260	33-222	33-260	0.275	4.8	8	$125	$17,250	$1,380	$2,070	$863	$22,000
33-242_33-277	33-242	33-277	1.357	8.0	8	$125	$45,413	$3,633	$5,450	$2,271	$57,000
33-251_33-243	33-251	33-243	0.641	6.1	8	$125	$25,900	$2,072	$3,108	$1,295	$32,000
33-257_33-251	33-257	33-251	0.718	7.7	8	$125	$26,163	$2,093	$3,140	$1,308	$33,000
33-259_33-258	33-259	33-258	0.319	5.1	8	$125	$26,978	$2,158	$3,237	$1,349	$34,000
33-260_33-259	33-260	33-259	0.350	5.4	8	$125	$24,925	$1,994	$2,991	$1,246	$31,000
33-264_33-262	33-264	33-262	0.931	8.2	10	$130	$48,867	$3,909	$5,864	$2,443	$61,000
33-267_33-264	33-267	33-264	1.027	8.8	10	$130	$32,188	$2,575	$3,863	$1,609	$40,000
33-277_33-241	33-277	33-241	5.163	79.7	8	$125	$27,504	$2,200	$3,300	$1,375	$34,000
33-302_33-267	33-302	33-267	0.823	8.1	10	$130	$46,956	$3,756	$5,635	$2,348	$59,000
33-303_33-302	33-303	33-302	1.020	9.2	10	$130	$31,057	$2,485	$3,727	$1,553	$39,000
65-020_65-022	65-020	65-022	0.497	6.7	8	$125	$30,566	$2,445	$3,668	$1,528	$38,000
65-023_33-222	65-023	33-222	0.241	4.6	8	$125	$21,891	$1,751	$2,627	$1,095	$27,000
32-451_32-248	32-451	32-248	0.978	11.7	12	$135	$16,292	$1,303	$1,955	$815	$20,000
32-452_32-451	32-452	32-451	0.569	9.6	10	$130	$31,831	$2,546	$3,820	$1,592	$40,000
32-453_32-452	32-453	32-452	0.851	11.1	12	$135	$12,980	$1,038	$1,558	$649	$16,000
32-455_32-453	32-455	32-453	0.504	9.1	10	$130	$17,973	$1,438	$2,157	$899	$22,000
40-130_40-127	40-130	40-127	0.918	11.4	12	$135	$28,836	$2,307	$3,460	$1,442	$36,000
40-170_40-160	40-170	40-160	0.136	4.3	8	$125	$49,696	$3,976	$5,964	$2,485	$62,000
40-069_40-361	40-069	40-361	0.347	4.9	8	$125	$12,719	$1,018	$1,526	$636	$16,000
40-072_40-071	40-072	40-071	0.309	4.7	8	$125	$49,963	$3,997	$5,996	$2,498	$62,000
40-074_40-072	40-074	40-072	0.265	4.4	8	$125	$38,331	$3,067	$4,600	$1,917	$48,000
40-080_40-079	40-080	40-079	0.323	5.0	8	$125	$47,081	$3,767	$5,650	$2,354	$59,000
40-191_40-110	40-191	40-110	1.242	8.9	10	$130	$41,295	$3,304	$4,955	$2,065	$52,000
40-195_40-191	40-195	40-191	0.724	6.2	8	$125	$28,854	$2,308	$3,462	$1,443	$36,000
40-196_40-195	40-196	40-195	0.851	6.9	8	$125	$25,473	$2,038	$3,057	$1,274	$32,000
40-200_40-196	40-200	40-196	1.009	7.8	8	$125	$45,916	$3,673	$5,510	$2,296	$57,000
40-201_40-200	40-201	40-200	0.930	7.5	8	$125	$23,756	$1,901	$2,851	$1,188	$30,000
40-204_40-201	40-204	40-201	1.032	8.3	10	$130	$6,176	$494	$741	$309	$8,000
32-457_32-456	32-457	32-456	1.885	11.5	12	$135	$53,915	$4,313	$6,470	$2,696	$67,000
40-005_40-047	40-005	40-047	0.320	5.9	8	$125	$43,838	$3,507	$5,261	$2,192	$55,000
40-358_32-457	40-358	32-457	1.615	10.9	12	$135	$46,587	$3,727	$5,590	$2,329	$58,000
40-359_40-358	40-359	40-358	1.190	10.2	12	$135	$50,799	$4,064	$6,096	$2,540	$63,000

South Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
40-360_40-359	40-360	40-359	0.873	9.1	10	$130	$29,272	$2,342	$3,513	$1,464	$37,000
68-003_68-005	68-003	68-005	1.581	8.3	10	$130	$49,334	$3,947	$5,920	$2,467	$62,000
68-004_68-003	68-004	68-003	2.828	10.8	12	$135	$31,903	$2,552	$3,828	$1,595	$40,000
68-005_33-183	68-005	33-183	3.280	12.2	15	$140	$22,163	$1,773	$2,660	$1,108	$28,000
68-007_68-004	68-007	68-004	2.654	10.1	12	$135	$39,518	$3,161	$4,742	$1,976	$49,000
68-008_68-007	68-008	68-007	2.584	9.9	10	$130	$15,270	$1,222	$1,832	$764	$19,000
68-009_68-008	68-009	68-008	2.773	11.0	12	$135	$34,385	$2,751	$4,126	$1,719	$43,000
68-010_68-009	68-010	68-009	2.814	11.3	12	$135	$39,017	$3,121	$4,682	$1,951	$49,000
68-011_68-010	68-011	68-010	2.534	10.5	12	$135	$9,956	$796	$1,195	$498	$12,000
68-012_68-011	68-012	68-011	2.607	11.0	12	$135	$21,975	$1,758	$2,637	$1,099	$27,000
68-101_68-012	68-101	68-012	2.568	10.9	12	$135	$54,097	$4,328	$6,492	$2,705	$68,000
68-075_68-076	68-075	68-076	2.141	11.2	12	$135	$13,916	$1,113	$1,670	$696	$17,000
68-076_33-303	68-076	33-303	2.078	10.8	12	$135	$17,847	$1,428	$2,142	$892	$22,000
68-077_68-075	68-077	68-075	1.546	9.6	10	$130	$34,060	$2,725	$4,087	$1,703	$43,000
68-081_69-022	68-081	69-022	0.192	4.5	8	$125	$20,250	$1,620	$2,430	$1,013	$25,000
68-082_68-081	68-082	68-081	0.149	4.1	8	$125	$22,500	$1,800	$2,700	$1,125	$28,000
68-124_68-083	68-124	68-083	0.271	5.6	8	$125	$52,600	$4,208	$6,312	$2,630	$66,000
69-001_68-077	69-001	68-077	0.599	7.0	8	$125	$33,500	$2,680	$4,020	$1,675	$42,000
69-002_69-001	69-002	69-001	0.450	6.3	8	$125	$43,100	$3,448	$5,172	$2,155	$54,000
69-003_69-002	69-003	69-002	0.419	6.1	8	$125	$53,225	$4,258	$6,387	$2,661	$67,000
69-003_69-004	69-004	69-003	0.317	5.5	8	$125	$12,338	$987	$1,481	$617	$15,000
69-005_69-004	69-005	69-004	0.169	4.3	8	$125	$16,964	$1,357	$2,036	$848	$21,000
69-006_69-005	69-006	69-005	0.144	4.1	8	$125	$16,913	$1,353	$2,030	$846	$21,000
40-081_40-080	40-081	40-080	0.721	8.0	10	$130	$50,057	$4,005	$6,007	$2,503	$63,000
40-210_40-372	40-210	40-372	0.658	7.2	8	$125	$4,000	$320	$480	$200	$5,000
40-082_40-081	40-082	40-081	0.190	4.2	8	$125	$40,363	$3,229	$4,844	$2,018	$50,000
40-087_40-086	40-087	40-086	0.374	29.8	30	$200	$53,474	$4,278	$6,417	$2,674	$67,000
68-127_68-101	68-127	68-101	1.939	10.8	12	$135	$39,971	$3,198	$4,796	$1,999	$50,000
68-128_68-127	68-128	68-127	1.049	6.9	8	$125	$21,893	$1,751	$2,627	$1,095	$27,000
68-129_68-128	68-129	68-128	1.492	9.5	10	$130	$49,075	$3,926	$5,889	$2,454	$61,000
68-131_68-130	68-131	68-130	0.166	4.3	8	$125	$50,064	$4,005	$6,008	$2,503	$63,000
68-157_68-158	68-157	68-158	0.484	6.6	8	$125	$6,270	$502	$752	$314	$8,000
68-158_68-159	68-158	68-159	0.487	6.7	8	$125	$46,288	$3,703	$5,555	$2,314	$58,000
68-159_68-160	68-159	68-160	0.477	6.4	8	$125	$15,025	$1,202	$1,803	$751	$19,000
68-160_68-162	68-160	68-162	0.572	7.1	8	$125	$49,850	$3,988	$5,982	$2,493	$62,000
68-162_68-163	68-162	68-163	0.551	6.7	8	$125	$13,338	$1,067	$1,601	$667	$17,000
68-163_68-164	68-163	68-164	0.463	6.0	8	$125	$30,088	$2,407	$3,611	$1,504	$38,000
68-164_68-165	68-164	68-165	0.613	7.0	8	$125	$45,040	$3,603	$5,405	$2,252	$56,000

South Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
68-165_68-166	68-165	68-166	0.651	7.2	8	$125	$50,041	$4,003	$6,005	$2,502	$63,000
68-166_68-129	68-166	68-129	0.676	7.3	8	$125	$33,550	$2,684	$4,026	$1,678	$42,000
Total											$6,341,000

West F rie Lee
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
17-001_24-232	17-001	24-232	0.422	6.1	8	$125	$52,688	$4,215	$6,323	$2,634	$66,000
17-004_17-003	17-004	17-003	0.207	5.0	8	$125	$45,788	$3,663	$5,495	$2,289	$57,000
17-020_17-019	17-020	17-019	0.500	6.7	8	$125	$24,000	$1,920	$2,880	$1,200	$30,000
18-110_18-109	18-110	18-109	5.437	19.5	21	$170	$67,526	$5,402	$8,103	$3,376	$84,000
24-001_25-009	24-001	25-009	3.501	12.5	15	$140	$31,529	$2,522	$3,784	$1,576	$39,000
24-010_24-001	24-010	24-001	2.963	11.5	12	$135	$26,870	$2,150	$3,224	$1,344	$34,000
24-011_24-010	24-011	24-010	4.905	18.8	21	$170	$68,425	$5,474	$8,211	$3,421	$86,000
24-012_24-011	24-012	24-011	3.207	12.4	15	$140	$35,910	$2,873	$4,309	$1,796	$45,000
24-018_24-012	24-018	24-012	2.714	11.1	12	$135	$52,164	$4,173	$6,260	$2,608	$65,000
24-019_24-018	24-019	24-018	3.438	13.4	15	$140	$57,918	$4,633	$6,950	$2,896	$72,000
25-005_25-370	25-005	25-370	3.388	11.4	12	$135	$7,488	$599	$899	$374	$9,000
25-006_25-184	25-006	25-184	4.623	15.5	18	$155	$30,861	$2,469	$3,703	$1,543	$39,000
25-007_25-006	25-007	25-006	3.076	11.1	12	$135	$20,883	$1,671	$2,506	$1,044	$26,000
25-008_25-007	25-008	25-007	2.937	10.9	12	$135	$25,676	$2,054	$3,081	$1,284	$32,000
25-009_25-008	25-009	25-008	3.088	11.3	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
25-184_25-005	25-184	25-005	5.895	20.1	21	$170	$18,717	$1,497	$2,246	$936	$23,000
25-185_25-284	25-185	25-284	1.889	8.6	10	$130	$30,862	$2,469	$3,703	$1,543	$39,000
25-186_25-185	25-186	25-185	5.189	16.9	18	$155	$28,994	$2,320	$3,479	$1,450	$36,000
25-275_25-340	25-275	25-340	7.048	21.5	24	$180	$63,463	$5,077	$7,616	$3,173	$79,000
25-276_25-275	25-276	25-275	5.949	17.0	18	$155	$59,791	$4,783	$7,175	$2,990	$75,000
25-278_25-276	25-278	25-276	10.014	24.6	30	$200	$61,846	$4,948	$7,422	$3,092	$77,000
25-279_25-278	25-279	25-278	5.538	16.6	18	$155	$52,681	$4,215	$6,322	$2,634	$66,000
25-281_25-279	25-281	25-279	6.868	18.7	21	$170	$16,842	$1,347	$2,021	$842	$21,000
25-282_25-281	25-282	25-281	5.242	15.7	18	$155	$16,835	$1,347	$2,020	$842	$21,000
25-283_25-282	25-283	25-282	7.459	17.9	18	$155	$54,323	$4,346	$6,519	$2,716	$68,000
25-284_25-283	25-284	25-283	7.436	17.9	18	$155	$61,360	$4,909	$7,363	$3,068	$77,000
25-340_18-110	25-340	18-110	7.323	21.9	24	$180	$56,164	$4,493	$6,740	$2,808	$70,000
18-029_18-030	18-029	18-030	0.350	5.7	8	$125	$33,448	$2,676	$4,014	$1,672	$42,000
18-030_18-041	18-030	18-041	0.518	6.6	8	$125	$22,908	$1,833	$2,749	$1,145	$29,000
18-042_18-043	18-042	18-043	0.972	7.9	8	$125	$21,561	$1,725	$2,587	$1,078	$27,000
18-043_18-044	18-043	18-044	0.446	4.9	8	$125	$19,750	$1,580	$2,370	$988	$25,000
18-044_18-045	18-044	18-045	1.877	11.5	12	$135	$13,757	$1,101	$1,651	$688	$17,000
18-045_18-080	18-045	18-080	1.861	11.0	12	$135	$44,667	$3,573	$5,360	$2,233	$56,000
18-059_25-188	18-059	25-188	0.190	6.3	8	$125	$14,068	$1,125	$1,688	$703	$18,000
18-060_18-069	18-060	18-069	4.567	16.1	18	$155	$12,412	$993	$1,489	$621	$16,000
18-066_18-060	18-066	18-060	4.060	15.4	18	$155	$27,540	$2,203	$3,305	$1,377	$34,000
18-067_18-066	18-067	18-066	3.998	15.3	18	$155	$30,242	$2,419	$3,629	$1,512	$38,000
18-069_25-187	18-069	25-187	4.612	16.1	18	$155	$48,761	$3,901	$5,851	$2,438	$61,000
18-076_18-067	18-076	18-067	3.404	13.3	15	$140	$42,351	$3,388	$5,082	$2,118	$53,000

West Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
18-077_18-076	18-077	18-076	1.953	8.9	10	$130	$13,607	$1,089	$1,633	$680	$17,000
18-078_18-077	18-078	18-077	2.692	13.2	15	$140	$49,686	$3,975	$5,962	$2,484	$62,000
18-079_18-078	18-079	18-078	2.602	13.0	15	$140	$51,115	$4,089	$6,134	$2,556	$64,000
18-080_18-079	18-080	18-079	2.383	12.1	15	$140	$53,124	$4,250	$6,375	$2,656	$66,000
25-187_25-186	25-187	25-186	4.677	16.2	18	$155	$26,984	$2,159	$3,238	$1,349	$34,000
18-109_25-271	18-109	25-271	6.563	21.0	21	$170	$41,176	$3,294	$4,941	$2,059	$51,000
25-217_25-329	25-217	25-329	17.621	126.3	30	$200	$12,970	$1,038	$1,556	$649	$16,000
25-267_25-JS01	25-267	25-JS01	6.958	21.4	24	$180	$70,578	$5,646	$8,469	$3,529	$88,000
25-268_25-267	25-268	25-267	6.280	20.6	21	$170	$61,321	$4,906	$7,358	$3,066	$77,000
25-269_25-268	25-269	25-268	6.314	20.7	21	$170	$68,066	$5,445	$8,168	$3,403	$85,000
25-270_25-269	25-270	25-269	6.303	20.7	21	$170	$42,599	$3,408	$5,112	$2,130	$53,000
25-271_25-270	25-271	25-270	8.185	26.0	30	$200	$60,000	$4,800	$7,200	$3,000	$75,000
25-330_25-329	25-330	25-329	0.788	7.5	8	$125	$23,200	$1,856	$2,784	$1,160	$29,000
25-331_25-330	25-331	25-330	0.532	6.2	8	$125	$26,145	$2,092	$3,137	$1,307	$33,000
25-332_25-331	25-332	25-331	0.371	5.4	8	$125	$16,106	$1,289	$1,933	$805	$20,000
25-333_25-332	25-333	25-332	0.421	6.1	8	$125	$36,166	$2,893	$4,340	$1,808	$45,000
25-334_25-333	25-334	25-333	0.477	7.3	8	$125	$17,684	$1,415	$2,122	$884	$22,000
25-JS01_25-PS01	25-JS01	25PS01	13.295	31.1	36	$255	$24,228	$1,938	$2,907	$1,211	$30,000
24-020_24-019	24-020	24-019	3.022	12.1	15	$140	$55,825	$4,466	$6,699	$2,791	$70,000
24-021_24-215	24-021	24-215	1.427	7.9	8	$125	$8,254	$660	$990	$413	$10,000
24-022_24-216	24-022	24-216	1.813	9.1	10	$130	$12,186	$975	$1,462	$609	$15,000
24-023_24-022	24-023	24-022	2.531	11.1	12	$135	$66,466	$5,317	$7,976	$3,323	$83,000
24-024_24-023	24-024	24-023	1.909	9.6	10	$130	$19,003	$1,520	$2,280	$950	$24,000
24-068_24-069	24-068	24-069	0.537	6.1	8	$125	$35,128	$2,810	$4,215	$1,756	$44,000
24-069_24-071	24-069	24-071	0.698	7.0	8	$125	$33,834	$2,707	$4,060	$1,692	$42,000
24-071_24-072	24-071	24-072	0.719	7.1	8	$125	$33,624	$2,690	$4,035	$1,681	$42,000
24-072_24-073	24-072	24-073	1.064	9.3	10	$130	$12,786	$1,023	$1,534	$639	$16,000
24-073_24-074	24-073	24-074	1.000	8.7	10	$130	$35,984	$2,879	$4,318	$1,799	$45,000
24-074_24-075	24-074	24-075	1.326	10.1	12	$135	$47,021	$3,762	$5,642	$2,351	$59,000
24-075_24-029	24-075	24-029	1.306	9.6	10	$130	$22,191	$1,775	$2,663	$1,110	$28,000
24-215_24-020	24-215	24-020	4.216	17.8	18	$155	$53,353	$4,268	$6,402	$2,668	$67,000
24-216_24-021	24-216	24-021	2.714	11.6	12	$135	$48,850	$3,908	$5,862	$2,442	$61,000
24-235_24-062	24-235	24-062	0.879	41.0	42	$280	$9,797	$784	$1,176	$490	$12,000
24-249_24-248	24-249	24-248	0.525	6.8	8	$125	$50,078	$4,006	$6,009	$2,504	$63,000
24-253_24-252	24-253	24-252	0.789	7.0	8	$125	$23,436	$1,875	$2,812	$1,172	$29,000
24-254_24-253	24-254	24-253	0.764	6.9	8	$125	$20,666	$1,653	$2,480	$1,033	$26,000
24-266_24-265	24-266	24-265	0.289	4.7	8	$125	$43,838	$3,507	$5,261	$2,192	$55,000
24-274_24-266	24-274	24-266	0.345	5.2	8	$125	$26,600	$2,128	$3,192	$1,330	$33,000
24-128_24-326	24-128	24-326	0.537	7.6	8	$125	$11,796	$944	$1,416	$590	$15,000

West P. _ rie Lee
Watershed
Required Parallel Pipes
Ultimate Flows

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
24-326_24-127	24-326	24-127	0.689	8.3	10	$130	$39,417	$3,153	$4,730	$1,971	$49,000
31-005_31-006	31-005	31-006	0.345	7.0	8	$125	$16,511	$1,321	$1,981	$826	$21,000
31-087_32-458	31-087	32-458	2.684	8.9	10	$130	$16,081	$1,286	$1,930	$804	$20,000
31-091_31-090	31-091	31-090	1.077	9.0	10	$130	$17,584	$1,407	$2,110	$879	$22,000
31-114_31-396	31-114	31-396	3.407	13.0	15	$140	$35,393	$2,831	$4,247	$1,770	$44,000
31-137_31-088	31-137	31-088	1.824	11.4	12	$135	$54,297	$4,344	$6,516	$2,715	$68,000
31-166_31-137	31-166	31-137	0.772	7.1	8	$125	$51,266	$4,101	$6,152	$2,563	$64,000
31-066_31-081	31-066	31-081	0.240	6.1	8	$125	$20,531	$1,643	$2,464	$1,027	$26,000
31-081_31-082	31-081	31-082	0.187	5.1	8	$125	$34,333	$2,747	$4,120	$1,717	$43,000
31-112_31-113	31-112	31-113	0.422	7.5	8	$125	$19,924	$1,594	$2,391	$996	$25,000
31-214_31-213	31-214	31-213	2.205	57.9	60	$480	$47,582	$3,807	$5,710	$2,379	$59,000
31-379_31-117	31-379	31-117	1.348	13.2	15	$140	$42,322	$3,386	$5,079	$2,116	$53,000
31-205_31-167	31-205	31-167	0.569	6.2	8	$125	$9,375	$750	$1,125	$469	$12,000
31-278_31-279	31-278	31-279	0.648	36.6	42	$280	$15,448	$1,236	$1,854	$772	$19,000
Total											$4,051,000

Appendix 9.8

Detailed Cost Estimate – Ultimate (Without PRI) Recommended Capital Improvements

West Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
24-326_24-127	24-326	24-127	0.689	8.3	10	$130	$39,417	$3,153	$4,730	$1,971	$49,000
31-005_31-006	31-005	31-006	0.345	7.0	8	$125	$16,511	$1,321	$1,981	$826	$21,000
31-087_32-458	31-087	32-458	2.684	8.9	10	$130	$16,081	$1,286	$1,930	$804	$20,000
31-091_31-090	31-091	31-090	1.077	9.0	10	$130	$17,584	$1,407	$2,110	$879	$22,000
31-114_31-396	31-114	31-396	3.407	13.0	15	$140	$35,393	$2,831	$4,247	$1,770	$44,000
31-137_31-088	31-137	31-088	1.824	11.4	12	$135	$54,297	$4,344	$6,516	$2,715	$68,000
31-166_31-137	31-166	31-137	0.772	7.1	8	$125	$51,266	$4,101	$6,152	$2,563	$64,000
31-066_31-081	31-066	31-081	0.240	6.1	8	$125	$20,531	$1,643	$2,464	$1,027	$26,000
31-081_31-082	31-081	31-082	0.187	5.1	8	$125	$34,333	$2,747	$4,120	$1,717	$43,000
31-112_31-113	31-112	31-113	0.422	7.5	8	$125	$19,924	$1,594	$2,391	$996	$25,000
31-214_31-213	31-214	31-213	2.205	57.9	60	$480	$47,582	$3,807	$5,710	$2,379	$59,000
31-379_31-117	31-379	31-117	1.348	13.2	15	$140	$42,322	$3,386	$5,079	$2,116	$53,000
31-205_31-167	31-205	31-167	0.569	6.2	8	$125	$9,375	$750	$1,125	$469	$12,000
31-278_31-279	31-278	31-279	0.648	36.6	42	$280	$15,448	$1,236	$1,854	$772	$19,000
Total											$4,051,000

Mouse Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
35-002_35-118	35-002	35-118	0.365	6.2	8	$125	$23,635	$1,891	$2,836	$1,182	$30,000
35-118_35-001	35-118	35-001	1.018	9.7	10	$130	$40,294	$3,223	$4,835	$2,015	$50,000
42-002_42-005	42-002	42-005	2.216	15.9	18	$155	$54,157	$4,333	$6,499	$2,708	$68,000
42-003_42-002	42-003	42-002	1.074	9.3	10	$130	$24,882	$1,991	$2,986	$1,244	$31,000
42-005_42-006	42-005	42-006	2.407	14.4	15	$140	$33,432	$2,675	$4,012	$1,672	$42,000
42-006_42-007	42-006	42-007	2.638	14.9	15	$140	$23,562	$1,885	$2,827	$1,178	$29,000
42-007_42-008	42-007	42-008	2.872	15.4	18	$155	$54,312	$4,345	$6,517	$2,716	$68,000
42-008_42-009	42-008	42-009	3.084	15.8	18	$155	$23,684	$1,895	$2,842	$1,184	$30,000
42-009_42-010	42-009	42-010	3.328	16.3	18	$155	$46,733	$3,739	$5,608	$2,337	$58,000
42-010_42-011	42-010	42-011	3.036	13.8	15	$140	$43,106	$3,448	$5,173	$2,155	$54,000
42-011_42-012BS	42-011	42-012BS	3.802	17.1	18	$155	$33,341	$2,667	$4,001	$1,667	$42,000
42-016_42-015	42-016	42-015	1.338	11.6	12	$135	$44,146	$3,532	$5,298	$2,207	$55,000
42-017_42-016	42-017	42-016	1.074	10.6	12	$135	$53,753	$4,300	$6,450	$2,688	$67,000
42-018_42-017	42-018	42-017	0.797	9.5	10	$130	$34,529	$2,762	$4,144	$1,726	$43,000
42-019_42-018	42-019	42-018	0.532	8.2	10	$130	$37,584	$3,007	$4,510	$1,879	$47,000
49-006_49-005	49-006	49-005	17.391	30.2	36	$255	$59,729	$4,778	$7,167	$2,986	$75,000
49-007_49-006	49-007	49-006	17.191	30.1	36	$255	$79,853	$6,388	$9,582	$3,993	$100,000
49-008_49-007	49-008	49-007	10.906	23.5	24	$180	$57,326	$4,586	$6,879	$2,866	$72,000
49-009_49-008	49-009	49-008	13.563	27.5	36	$255	$87,320	$6,986	$10,478	$4,366	$109,000
49-010_49-009	49-010	49-009	23.253	38.4	48	$305	$116,217	$9,297	$13,946	$5,811	$145,000
49-011_49-010	49-011	49-010	13.961	27.8	36	$255	$72,440	$5,795	$8,693	$3,622	$91,000
49-013_49-012	49-013	49-012	27.853	36.1	42	$280	$122,102	$9,768	$14,652	$6,105	$153,000
50-001_49-013	50-001	49-013	6.819	17.3	18	$155	$72,850	$5,828	$8,742	$3,643	$91,000
50-002_50-001	50-002	50-001	11.402	21.7	24	$180	$60,311	$4,825	$7,237	$3,016	$75,000
50-003_50-002	50-003	50-002	24.405	34.3	42	$280	$62,300	$4,984	$7,476	$3,115	$78,000
50-004_50-003	50-004	50-003	19.908	29.5	36	$255	$123,043	$9,843	$14,765	$6,152	$154,000
50-005_50-004	50-005	50-004	15.932	27.1	36	$255	$69,375	$5,550	$8,325	$3,469	$87,000
50-111_50-094	50-111	50-094	1.476	10.5	12	$135	$28,123	$2,250	$3,375	$1,406	$35,000
50-006_50-005	50-006	50-005	4.410	15.9	18	$155	$48,004	$3,840	$5,760	$2,400	$60,000
50-007_50-006	50-007	50-006	13.746	27.7	36	$255	$119,070	$9,526	$14,288	$5,953	$149,000
50-015_50-005	50-015	50-005	8.558	18.9	21	$170	$37,553	$3,004	$4,506	$1,878	$47,000
50-041_50-015	50-041	50-015	7.182	17.2	18	$155	$51,065	$4,085	$6,128	$2,553	$64,000
50-042_50-041	50-042	50-041	6.461	15.4	18	$155	$18,640	$1,491	$2,237	$932	$23,000
50-069_50-042	50-069	50-042	3.987	10.5	12	$135	$29,816	$2,385	$3,578	$1,491	$37,000
50-112_50-069	50-112	50-069	2.264	7.7	8	$125	$18,463	$1,477	$2,216	$923	$23,000
50-117_50-112	50-117	50-112	6.373	15.6	18	$155	$57,003	$4,560	$6,840	$2,850	$71,000
50-118_50-117	50-118	50-117	5.991	15.0	15	$140	$27,336	$2,187	$3,280	$1,367	$34,000
50-119_50-118	50-119	50-118	6.184	15.8	18	$155	$19,071	$1,526	$2,289	$954	$24,000
50-120_50-119	50-120	50-119	5.358	13.9	15	$140	$49,909	$3,993	$5,989	$2,495	$62,000

Mouse Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
50-013_50-012	50-013	50-012	5.920	20.2	21	$170	$83,829	$6,706	$10,059	$4,191	$105,000
50-014_50-013	50-014	50-013	5.811	16.9	18	$155	$68,119	$5,450	$8,174	$3,406	$85,000
55-041_55-006	55-041	55-006	0.343	5.2	8	$125	$11,764	$941	$1,412	$588	$15,000
Total											$2,778,000

Little Cedar
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
00-004_00-005	00-004	00-005	11.589	21.9	24	$180	$70,524	$5,642	$8,463	$3,526	$88,000
00-005_00-006	00-005	00-006	22.419	26.3	30	$200	$100,174	$8,014	$12,021	$5,009	$125,000
00-006_00-007	00-006	00-007	18.762	23.5	24	$180	$66,389	$5,311	$7,967	$3,319	$83,000
00-007_00-008	00-007	00-008	30.414	32.7	36	$255	$58,683	$4,695	$7,042	$2,934	$73,000
00-008_00-009	00-008	00-009	29.323	31.0	36	$255	$42,713	$3,417	$5,126	$2,136	$53,000
00-009_00-010	00-009	00-010	33.812	36.0	36	$255	$28,101	$2,248	$3,372	$1,405	$35,000
00-010_00-011	00-010	00-011	14.846	20.7	21	$170	$10,979	$878	$1,317	$549	$14,000
00-011_00-012	00-011	00-012	20.711	24.9	30	$200	$14,204	$1,136	$1,704	$710	$18,000
00-012_00-013	00-012	00-013	20.875	25.0	30	$200	$54,682	$4,375	$6,562	$2,734	$68,000
00-013_00-014	00-013	00-014	10.130	17.1	18	$155	$51,486	$4,119	$6,178	$2,574	$64,000
00-015_00-016	00-015	00-016	18.185	22.7	24	$180	$51,140	$4,091	$6,137	$2,557	$64,000
00-016_00-017	00-016	00-017	17.892	22.6	24	$180	$72,254	$5,780	$8,670	$3,613	$90,000
00-018_00-019	00-018	00-019	28.633	30.7	36	$255	$62,580	$5,006	$7,510	$3,129	$78,000
00-019_00-020	00-019	00-020	28.967	30.8	36	$255	$58,803	$4,704	$7,056	$2,940	$74,000
00-022_00-023	00-022	00-023	9.266	16.4	18	$155	$48,066	$3,845	$5,768	$2,403	$60,000
00-023_00-024	00-023	00-024	19.365	23.3	24	$180	$52,267	$4,181	$6,272	$2,613	$65,000
00-024_00-025	00-024	00-025	19.528	23.3	24	$180	$89,955	$7,196	$10,795	$4,498	$112,000
00-025_00-026	00-025	00-026	19.582	23.4	24	$180	$44,894	$3,592	$5,387	$2,245	$56,000
00-026_00-027	00-026	00-027	19.124	23.2	24	$180	$39,982	$3,199	$4,798	$1,999	$50,000
00-027_00-028	00-027	00-028	14.846	24.0	24	$180	$50,263	$4,021	$6,032	$2,513	$63,000
00-028_00-030	00-028	00-030	19.535	27.7	30	$200	$75,150	$6,012	$9,018	$3,758	$94,000
00-030_00-031	00-030	00-031	18.561	27.2	30	$200	$91,548	$7,324	$10,986	$4,577	$114,000
00-034_00-035	00-034	00-035	16.693	26.1	30	$200	$100,694	$8,056	$12,083	$5,035	$126,000
00-035_00-036	00-035	00-036	16.328	25.9	30	$200	$71,642	$5,731	$8,597	$3,582	$90,000
00-036_00-037	00-036	00-037	17.287	26.5	30	$200	$28,032	$2,243	$3,364	$1,402	$35,000
00-037_00-038	00-037	00-038	15.624	29.0	30	$200	$97,698	$7,816	$11,724	$4,885	$122,000
00-038_00-039	00-038	00-039	14.157	28.0	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-039_00-040	00-039	00-040	16.289	29.5	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-040_00-041	00-040	00-041	14.334	28.1	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-041_00-042	00-041	00-042	16.464	29.6	30	$200	$100,000	$8,000	$12,000	$5,000	$125,000
00-042_00-043	00-042	00-043	17.614	30.4	36	$255	$127,500	$10,200	$15,300	$6,375	$159,000
00-043_00-044	00-043	00-044	17.700	30.4	36	$255	$127,500	$10,200	$15,300	$6,375	$159,000
00-044_00-045	00-044	00-045	41.136	173.6	42	$280	$162,400	$12,992	$19,488	$8,120	$203,000
00-045_00-046	00-045	00-046	29.507	42.0	42	$280	$70,000	$5,600	$8,400	$3,500	$88,000
16-009_16-008	16-009	16-008	0.993	7.6	8	$125	$47,745	$3,820	$5,729	$2,387	$60,000
16-021_16-011	16-021	16-011	1.895	12.2	15	$140	$6,644	$532	$797	$332	$8,000
16-022_16-021	16-022	16-021	1.273	10.0	10	$130	$13,425	$1,074	$1,611	$671	$17,000
16-023_16-022	16-023	16-022	1.423	11.0	12	$135	$26,164	$2,093	$3,140	$1,308	$33,000

Little Cedar
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
00-001_00-002	00-001	00-002	6.480	18.3	21	$170	$85,066	$6,805	$10,208	$4,253	$106,000
22-038_00-001	22-038	00-001	14.216	28.0	30	$200	$99,284	$7,943	$11,914	$4,964	$124,000
22-043_22-042	22-043	22-042	11.484	24.0	24	$180	$89,154	$7,132	$10,698	$4,458	$111,000
23-046_23-045	23-046	23-045	0.846	8.5	10	$130	$52,046	$4,164	$6,245	$2,602	$65,000
23-047_23-046	23-047	23-046	1.060	9.8	10	$130	$52,035	$4,163	$6,244	$2,602	$65,000
23-118_23-117	23-118	23-117	11.626	21.2	24	$180	$22,145	$1,772	$2,657	$1,107	$28,000
23-125_23-124	23-125	23-124	1.829	10.6	12	$135	$14,772	$1,182	$1,773	$739	$18,000
23-126_23-125	23-126	23-125	1.694	10.3	12	$135	$47,937	$3,835	$5,752	$2,397	$60,000
23-127_23-126	23-127	23-126	0.803	7.1	8	$125	$15,668	$1,253	$1,880	$783	$20,000
23-128_23-127	23-128	23-127	0.648	6.5	8	$125	$17,086	$1,367	$2,050	$854	$21,000
23-129_23-128	23-129	23-128	0.679	6.8	8	$125	$38,494	$3,080	$4,619	$1,925	$48,000
23-015_23-014	23-015	23-014	7.122	13.9	15	$140	$53,931	$4,314	$6,472	$2,697	$67,000
23-017_23-016	23-017	23-016	8.694	15.4	18	$155	$20,643	$1,651	$2,477	$1,032	$26,000
Total											$3,900,000

Boggs Hollow
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
21-086_21-085	21-086	21-085	2.910	14.3	15	$140	$6,100	$488	$732	$305	$8,000
21-087_21-086	21-087	21-086	2.324	12.5	15	$140	$54,058	$4,325	$6,487	$2,703	$68,000
21-088_21-087	21-088	21-087	2.127	10.0	10	$130	$15,222	$1,218	$1,827	$761	$19,000
21-089_21-088	21-089	21-088	1.956	9.9	10	$130	$38,475	$3,078	$4,617	$1,924	$48,000
21-090_21-089	21-090	21-089	2.217	9.2	10	$130	$47,445	$3,796	$5,693	$2,372	$59,000
21-091_21-090	21-091	21-090	1.781	8.3	10	$130	$47,692	$3,815	$5,723	$2,385	$60,000
21-092_21-091	21-092	21-091	1.685	8.3	10	$130	$51,076	$4,086	$6,129	$2,554	$64,000
22-001_21-092	22-001	21-092	1.201	7.1	8	$125	$40,966	$3,277	$4,916	$2,048	$51,000
22-048_22-047	22-048	22-047	0.953	8.3	10	$130	$28,795	$2,304	$3,455	$1,440	$36,000
Total											$413,000

Cedar Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
20-002_20-001	20-002	82	20.691	36.7	42	$280	$114,752	$9,180	$13,770	$5,738	$143,000
20-003_20-002	20-003	20-002	20.479	36.6	42	$280	$104,412	$8,353	$12,529	$5,221	$131,000
20-005_20-004	20-005	20-004	20.380	36.5	42	$280	$104,280	$8,342	$12,514	$5,214	$130,000
20-006_20-001BS	20-006	20-001BS	37.423	40.3	48	$305	$99,766	$7,981	$11,972	$4,988	$125,000
20-007_20-006	20-007	20-006	45.283	180.0	36	$255	$89,480	$7,158	$10,738	$4,474	$112,000
20-008_20-007	20-008	20-007	30.375	32.7	36	$255	$127,653	$10,212	$15,318	$6,383	$160,000
20-009_20-008	20-009	20-008	14.366	22.2	24	$180	$86,166	$6,893	$10,340	$4,308	$108,000
20-010_20-009	20-010	20-009	27.958	33.5	42	$280	$141,014	$11,281	$16,922	$7,051	$176,000
20-011_20-010	20-011	20-010	27.750	33.4	42	$280	$138,692	$11,095	$16,643	$6,935	$173,000
20-012_20-011	20-012	20-011	27.832	33.4	42	$280	$140,308	$11,225	$16,837	$7,015	$175,000
20-013_20-012	20-013	20-012	32.832	43.7	54	$380	$186,960	$14,957	$22,435	$9,348	$234,000
20-015_20-008	20-015	20-008	6.053	14.5	15	$140	$24,024	$1,922	$2,883	$1,201	$30,000
20-016_20-015	20-016	20-015	7.800	25.5	30	$200	$77,226	$6,178	$9,267	$3,861	$97,000
20-017_20-016	20-017	20-016	6.308	12.9	15	$140	$44,219	$3,538	$5,306	$2,211	$55,000
20-018_20-017	20-018	20-017	5.900	12.1	15	$140	$31,248	$2,500	$3,750	$1,562	$39,000
20-019_20-018	20-019	20-018	6.915	15.8	18	$155	$35,177	$2,814	$4,221	$1,759	$44,000
20-020_20-019	20-020	20-019	4.601	10.7	12	$135	$43,744	$3,500	$5,249	$2,187	$55,000
20-021_20-020	20-021	20-020	4.790	11.4	12	$135	$53,933	$4,315	$6,472	$2,697	$67,000
20-022_20-021	20-022	20-021	4.725	11.4	12	$135	$41,513	$3,321	$4,982	$2,076	$52,000
20-025_20-024	20-025	20-024	1.123	8.2	10	$130	$12,119	$969	$1,454	$606	$15,000
20-030_20-025	20-030	20-025	0.945	8.3	10	$130	$39,852	$3,188	$4,782	$1,993	$50,000
20-031_20-030	20-031	20-030	0.891	8.1	10	$130	$18,126	$1,450	$2,175	$906	$23,000
20-032_20-031	20-032	20-031	0.795	7.7	8	$125	$28,188	$2,255	$3,383	$1,409	$35,000
20-034_20-032	20-034	20-032	0.919	9.3	10	$130	$19,757	$1,581	$2,371	$988	$25,000
20-035_20-034	20-035	20-034	0.494	6.3	8	$125	$19,606	$1,569	$2,353	$980	$25,000
20-036_20-035	20-036	20-035	0.509	6.8	8	$125	$30,858	$2,469	$3,703	$1,543	$39,000
20-037_20-036	20-037	20-036	0.339	5.5	8	$125	$40,838	$3,267	$4,901	$2,042	$51,000
21-001_20-022	21-001	20-022	3.945	9.4	10	$130	$34,943	$2,795	$4,193	$1,747	$44,000
21-002_21-001	21-002	21-001	4.250	10.3	12	$135	$43,430	$3,474	$5,212	$2,171	$54,000
21-020_21-019	21-020	21-019	0.603	6.3	8	$125	$34,688	$2,775	$4,163	$1,734	$43,000
21-040_21-002	21-040	21-002	0.786	4.7	8	$125	$17,931	$1,435	$2,152	$897	$22,000
21-041_21-040	21-041	21-040	2.177	8.7	10	$130	$17,914	$1,433	$2,150	$896	$22,000
21-042_21-041	21-042	21-041	2.499	12.8	15	$140	$12,565	$1,005	$1,508	$628	$16,000
21-047_21-042	21-047	21-042	1.809	10.0	10	$130	$19,790	$1,583	$2,375	$989	$25,000
21-049_21-047	21-049	21-047	1.745	10.1	12	$135	$20,918	$1,673	$2,510	$1,046	$26,000
21-050_21-049	21-050	21-049	1.434	8.6	10	$130	$9,458	$757	$1,135	$473	$12,000
21-051_21-050	21-051	21-050	1.589	9.7	10	$130	$29,640	$2,371	$3,557	$1,482	$37,000
21-052_21-051	21-052	21-051	1.468	9.2	10	$130	$43,537	$3,483	$5,224	$2,177	$54,000
21-053_21-052	21-053	21-052	1.355	8.8	10	$130	$31,447	$2,516	$3,774	$1,572	$39,000
21-054_21-053	21-054	21-053	1.289	8.8	10	$130	$43,983	$3,519	$5,278	$2,199	$55,000

Cedar Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
21-058_21-054	21-058	21-054	0.780	6.7	8	$125	$22,925	$1,834	$2,751	$1,146	$29,000
21-060_21-058	21-060	21-058	0.481	6.1	8	$125	$41,663	$3,333	$5,000	$2,083	$52,000
21-061_21-060	21-061	21-060	0.356	5.3	8	$125	$17,375	$1,390	$2,085	$869	$22,000
21-062_21-061	21-062	21-061	0.331	5.3	8	$125	$27,900	$2,232	$3,348	$1,395	$35,000
21-063_21-062	21-063	21-062	0.274	4.9	8	$125	$44,375	$3,550	$5,325	$2,219	$55,000
27-001_27-015	27-001	27-015	27.767	33.4	42	$280	$59,430	$4,754	$7,132	$2,972	$74,000
27-002_27-001	27-002	27-001	23.297	27.5	36	$255	$127,566	$10,205	$15,308	$6,378	$159,000
27-003_27-002	27-003	27-002	26.417	31.1	36	$255	$109,660	$8,773	$13,159	$5,483	$137,000
27-004_27-003	27-004	27-003	26.287	31.0	36	$255	$109,665	$8,773	$13,160	$5,483	$137,000
27-005_27-004	27-005	27-004	25.337	32.3	42	$280	$129,027	$10,322	$15,483	$6,451	$161,000
27-015_20-013	27-015	20-013	24.646	31.9	36	$255	$12,559	$1,005	$1,507	$628	$16,000
27-016_27-015	27-016	27-015	3.433	13.4	15	$140	$53,200	$4,256	$6,384	$2,660	$67,000
27-017_27-016	27-017	27-016	2.886	10.7	12	$135	$9,165	$733	$1,100	$458	$11,000
27-018_27-017	27-018	27-017	1.846	7.5	8	$125	$21,558	$1,725	$2,587	$1,078	$27,000
27-019_27-018	27-019	27-018	1.816	7.6	8	$125	$5,971	$478	$717	$299	$7,000
27-020_27-019	27-020	27-019	1.040	5.6	8	$125	$22,874	$1,830	$2,745	$1,144	$29,000
27-022_27-021	27-022	27-021	2.217	9.8	10	$130	$38,624	$3,090	$4,635	$1,931	$48,000
27-023_27-022	27-023	27-022	0.925	5.6	8	$125	$15,125	$1,210	$1,815	$756	$19,000
27-025_27-024	27-025	27-024	1.000	6.1	8	$125	$22,016	$1,761	$2,642	$1,101	$28,000
27-033_27-032	27-033	27-032	0.588	7.5	8	$125	$27,245	$2,180	$3,269	$1,362	$34,000
27-034_27-033	27-034	27-033	0.387	6.1	8	$125	$11,374	$910	$1,365	$569	$14,000
27-036_27-035	27-036	27-035	0.161	4.6	8	$125	$17,485	$1,399	$2,098	$874	$22,000
27-006_27-005	27-006	27-005	25.381	32.3	42	$280	$139,882	$11,191	$16,786	$6,994	$175,000
27-007_27-006	27-007	27-006	22.130	26.9	36	$255	$127,653	$10,212	$15,318	$6,383	$160,000
27-008_27-007	27-008	27-007	20.393	27.0	36	$255	$127,842	$10,227	$15,341	$6,392	$160,000
27-009_27-008	27-009	27-008	25.062	32.1	36	$255	$129,665	$10,373	$15,560	$6,483	$162,000
27-010_27-007	27-010	27-007	4.295	10.8	12	$135	$46,609	$3,729	$5,593	$2,330	$58,000
27-013_27-055	27-013	27-055	1.311	9.7	10	$130	$22,372	$1,790	$2,685	$1,119	$28,000
27-043_28-285	27-043	28-285	0.297	4.2	8	$125	$20,898	$1,672	$2,508	$1,045	$26,000
27-055_27-012	27-055	27-012	1.402	8.7	10	$130	$40,866	$3,269	$4,904	$2,043	$51,000
28-013_27-010	28-013	27-010	2.455	11.8	12	$135	$40,635	$3,251	$4,876	$2,032	$51,000
28-014_28-013	28-014	28-013	2.404	11.7	12	$135	$24,300	$1,944	$2,916	$1,215	$30,000
28-015_28-014	28-015	28-014	1.411	9.6	10	$130	$12,350	$988	$1,482	$618	$15,000
28-016_28-015	28-016	28-015	1.857	9.7	10	$130	$31,200	$2,496	$3,744	$1,560	$39,000
28-017_28-016	28-017	28-016	0.811	5.6	8	$125	$21,750	$1,740	$2,610	$1,088	$27,000
28-018_28-017	28-018	28-017	1.128	6.8	8	$125	$34,850	$2,788	$4,182	$1,743	$44,000
28-021_28-020	28-021	28-020	1.608	9.2	10	$130	$30,472	$2,438	$3,657	$1,524	$38,000
28-022_28-021	28-022	28-021	1.558	9.0	10	$130	$14,430	$1,154	$1,732	$722	$18,000
28-023_28-022	28-023	28-022	1.249	8.3	10	$130	$22,866	$1,829	$2,744	$1,143	$29,000
28-024_28-023	28-024	28-023	1.193	8.2	10	$130	$15,470	$1,238	$1,856	$774	$19,000

Cedar Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
28-025_28-024	28-025	28-024	1.139	8.0	10	$130	$25,740	$2,059	$3,089	$1,287	$32,000
28-026_28-293	28-026	28-293	1.034	7.8	8	$125	$51,126	$4,090	$6,135	$2,556	$64,000
28-036_28-030	28-036	28-030	0.158	5.2	8	$125	$27,670	$2,214	$3,320	$1,384	$35,000
28-264_28-265	28-264	28-265	0.419	5.9	8	$125	$27,249	$2,180	$3,270	$1,362	$34,000
28-276_27-009	28-276	27-009	29.340	36.8	42	$280	$56,000	$4,480	$6,720	$2,800	$70,000
28-280_27-044	28-280	27-044	0.554	6.1	8	$125	$10,788	$863	$1,295	$539	$13,000
28-285_27-014	28-285	27-014	0.659	6.2	8	$125	$48,750	$3,900	$5,850	$2,438	$61,000
28-293_28-025	28-293	28-025	1.086	7.9	8	$125	$11,000	$880	$1,320	$550	$14,000
28-046_28-045	28-046	28-045	4.450	13.0	15	$140	$57,400	$4,592	$6,888	$2,870	$72,000
28-047_28-046	28-047	28-046	3.837	11.6	12	$135	$7,962	$637	$955	$398	$10,000
28-048_28-047	28-048	28-047	3.361	10.6	12	$135	$46,575	$3,726	$5,589	$2,329	$58,000
28-049_28-048	28-049	28-048	3.104	10.4	12	$135	$51,648	$4,132	$6,198	$2,582	$65,000
28-050_28-049	28-050	28-049	3.217	10.9	12	$135	$46,062	$3,685	$5,527	$2,303	$58,000
28-051_28-050	28-051	28-050	3.328	11.6	12	$135	$54,108	$4,329	$6,493	$2,705	$68,000
28-052_28-051	28-052	28-051	3.675	12.5	15	$140	$55,055	$4,404	$6,607	$2,753	$69,000
28-053_28-052	28-053	28-052	2.312	9.2	10	$130	$44,616	$3,569	$5,354	$2,231	$56,000
28-055_28-054	28-055	28-054	2.230	11.4	12	$135	$21,777	$1,742	$2,613	$1,089	$27,000
28-068_28-067	28-068	28-067	1.488	9.1	10	$130	$13,468	$1,077	$1,616	$673	$17,000
28-076_28-068	28-076	28-068	1.402	10.3	12	$135	$17,431	$1,394	$2,092	$872	$22,000
28-083_28-082	28-083	28-082	0.251	4.6	8	$125	$17,500	$1,400	$2,100	$875	$22,000
28-100_28-099	28-100	28-099	3.212	13.5	15	$140	$28,812	$2,305	$3,457	$1,441	$36,000
28-101_28-100	28-101	28-100	0.724	6.9	8	$125	$40,050	$3,204	$4,806	$2,003	$50,000
28-185_28-098	28-185	28-098	0.653	6.3	8	$125	$48,125	$3,850	$5,775	$2,406	$60,000
29-082_29-081	29-082	29-081	0.695	7.9	8	$125	$28,750	$2,300	$3,450	$1,438	$36,000
29-083_29-082	29-083	29-082	0.625	7.6	8	$125	$27,418	$2,193	$3,290	$1,371	$34,000
29-039_29-040	29-039	29-040	0.012	8.3	10	$130	$47,918	$3,833	$5,750	$2,396	$60,000
27-041_27-042	27-041	27-042	2.920	9.4	10	$130	$35,326	$2,826	$4,239	$1,766	$44,000
27-042_28-275	27-042	28-275	5.943	16.4	18	$155	$30,564	$2,445	$3,668	$1,528	$38,000
27-061_27-041	27-061	27-041	5.434	15.9	18	$155	$60,100	$4,808	$7,212	$3,005	$75,000
27-062_27-061	27-062	27-061	2.714	9.8	10	$130	$42,951	$3,436	$5,154	$2,148	$54,000
27-063_27-062	27-063	27-062	1.238	7.2	8	$125	$36,879	$2,950	$4,425	$1,844	$46,000
27-065_27-064	27-065	27-064	1.117	7.0	8	$125	$34,176	$2,734	$4,101	$1,709	$43,000
28-042_28-276	28-042	28-276	11.137	20.2	21	$170	$37,196	$2,976	$4,464	$1,860	$46,000
28-275_28-276	28-275	28-276	6.288	17.4	18	$155	$49,617	$3,969	$5,954	$2,481	$62,000
35-123_35-122	35-123	35-122	1.046	8.3	10	$130	$32,449	$2,596	$3,894	$1,622	$41,000
35-125_35-124	35-125	35-124	0.871	7.8	8	$125	$36,409	$2,913	$4,369	$1,820	$46,000
35-148_35-128	35-148	35-128	1.807	10.5	12	$135	$32,612	$2,609	$3,913	$1,631	$41,000
35-149_35-148	35-149	35-148	0.452	5.7	8	$125	$38,913	$3,113	$4,670	$1,946	$49,000
35-155_35-148	35-155	35-148	0.218	4.4	8	$125	$20,281	$1,623	$2,434	$1,014	$25,000
35-197_27-065	35-197	27-065	3.025	12.4	15	$140	$40,041	$3,203	$4,805	$2,002	$50,000

Cedar Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
35-198_35-197	35-198	35-197	1.751	11.2	12	$135	$1,863	$149	$224	$93	$2,000
35-199_35-198	35-199	35-198	1.628	10.1	12	$135	$12,407	$993	$1,489	$620	$16,000
35-200_35-199	35-200	35-199	1.566	10.0	10	$130	$15,305	$1,224	$1,837	$765	$19,000
35-201_35-200	35-201	35-200	1.543	9.9	10	$130	$19,087	$1,527	$2,290	$954	$24,000
35-203_35-201	35-203	35-201	1.462	9.7	10	$130	$18,435	$1,475	$2,212	$922	$23,000
35-204_35-203	35-204	35-203	1.436	9.7	10	$130	$15,600	$1,248	$1,872	$780	$20,000
35-205_35-204	35-205	35-204	1.196	9.0	10	$130	$11,700	$936	$1,404	$585	$15,000
35-206_35-205	35-206	35-205	0.928	8.2	10	$130	$21,875	$1,750	$2,625	$1,094	$27,000
35-207_35-206	35-207	35-206	0.647	6.5	8	$125	$15,000	$1,200	$1,800	$750	$19,000
35-209_35-208	35-209	35-208	0.520	6.0	8	$125	$15,029	$1,202	$1,803	$751	$19,000
35-213_35-209	35-213	35-209	0.427	5.6	8	$125	$19,298	$1,544	$2,316	$965	$24,000
35-269_35-150	35-269	35-150	0.261	4.7	8	$125	$7,925	$634	$951	$396	$10,000
35-273_35-272	35-273	35-272	0.320	5.3	8	$125	$22,961	$1,837	$2,755	$1,148	$29,000
28-043_28-042	28-043	28-042	19.746	26.7	36	$255	$127,561	$10,205	$15,307	$6,378	$159,000
28-044_28-043	28-044	28-043	19.798	26.7	36	$255	$130,200	$10,416	$15,624	$6,510	$163,000
28-045_28-044	28-045	28-044	4.032	12.0	12	$135	$58,343	$4,667	$7,001	$2,917	$73,000
28-105_28-044	28-105	28-044	8.081	16.8	18	$155	$69,750	$5,580	$8,370	$3,488	$87,000
28-106_28-105	28-106	28-105	9.260	18.0	21	$170	$85,748	$6,860	$10,290	$4,287	$107,000
28-107_28-106	28-107	28-106	17.683	24.1	30	$200	$107,000	$8,560	$12,840	$5,350	$134,000
28-108_28-107	28-108	28-107	15.339	22.2	24	$180	$92,066	$7,365	$11,048	$4,603	$115,000
28-110_28-109	28-110	28-109	8.968	17.4	18	$155	$77,345	$6,188	$9,281	$3,867	$97,000
29-221_29-252	29-221	29-252	0.104	5.0	8	$125	$22,926	$1,834	$2,751	$1,146	$29,000
30-300_30-301	30-300	30-301	0.105	18.5	21	$170	$54,793	$4,383	$6,575	$2,740	$68,000
30-286_30-265	30-286	30-265	0.104	4.4	8	$125	$25,558	$2,045	$3,067	$1,278	$32,000
28-109_28-108	28-109	28-108	8.671	17.2	18	$155	$65,271	$5,222	$7,832	$3,264	$82,000
36-097_28-108	36-097	28-108	4.544	13.1	15	$140	$42,434	$3,395	$5,092	$2,122	$53,000
36-098_36-097	36-098	36-097	3.481	10.7	12	$135	$21,641	$1,731	$2,597	$1,082	$27,000
36-100_36-098	36-100	36-098	4.601	14.2	15	$140	$18,806	$1,504	$2,257	$940	$24,000
36-102_36-101	36-102	36-101	4.157	13.1	15	$140	$13,860	$1,109	$1,663	$693	$17,000
36-103_36-102	36-103	36-102	1.871	8.0	10	$130	$21,910	$1,753	$2,629	$1,096	$27,000
36-104_36-103	36-104	36-103	2.791	10.1	12	$135	$11,692	$935	$1,403	$585	$15,000
36-105_36-104	36-105	36-104	3.877	12.7	15	$140	$35,267	$2,821	$4,232	$1,763	$44,000
36-106_36-105	36-106	36-105	1.888	9.9	10	$130	$14,430	$1,154	$1,732	$722	$18,000
36-107_36-106	36-107	36-106	3.747	12.6	15	$140	$20,702	$1,656	$2,484	$1,035	$26,000
36-158_36-159	36-158	36-159	0.938	6.0	8	$125	$19,153	$1,532	$2,298	$958	$24,000
36-159_36-229	36-159	36-229	1.846	8.9	10	$130	$18,275	$1,462	$2,193	$914	$23,000
36-160_36-161	36-160	36-161	1.809	7.9	8	$125	$42,175	$3,374	$5,061	$2,109	$53,000
36-161_36-175	36-161	36-175	2.329	8.9	10	$130	$39,410	$3,153	$4,729	$1,970	$49,000
36-174_36-107	36-174	36-107	2.972	10.2	12	$135	$24,829	$1,986	$2,980	$1,241	$31,000
36-175_36-174	36-175	36-174	2.517	9.4	10	$130	$25,949	$2,076	$3,114	$1,297	$32,000

Cedar Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
36-188_36-157	36-188	36-157	1.920	10.8	12	$135	$17,446	$1,396	$2,094	$872	$22,000
36-189_36-188	36-189	36-188	0.540	4.8	8	$125	$11,985	$959	$1,438	$599	$15,000
36-190_36-189	36-190	36-189	1.029	6.9	8	$125	$28,111	$2,249	$3,373	$1,406	$35,000
36-196_36-197	36-196	36-197	1.219	8.6	10	$130	$16,561	$1,325	$1,987	$828	$21,000
36-197_36-191	36-197	36-191	1.298	8.6	10	$130	$15,915	$1,273	$1,910	$796	$20,000
36-229_36-160	36-229	36-160	1.967	8.9	10	$130	$18,543	$1,483	$2,225	$927	$23,000
36-244_36-204	36-244	36-204	0.990	8.7	10	$130	$15,510	$1,241	$1,861	$776	$19,000
36-245_36-244	36-245	36-244	0.775	7.7	8	$125	$18,030	$1,442	$2,164	$902	$23,000
36-310_36-245	36-310	36-245	0.455	6.3	8	$125	$32,033	$2,563	$3,844	$1,602	$40,000
36-311_36-310	36-311	36-310	0.279	5.2	8	$125	$15,725	$1,258	$1,887	$786	$20,000
36-312_36-311	36-312	36-311	0.249	5.0	8	$125	$26,125	$2,090	$3,135	$1,306	$33,000
36-001_36-025	36-001	36-025	6.902	15.3	18	$155	$17,205	$1,376	$2,065	$860	$22,000
36-002_36-001	36-002	36-001	4.634	13.2	15	$140	$68,600	$5,488	$8,232	$3,430	$86,000
36-003_36-002	36-003	36-002	6.005	15.0	18	$155	$85,303	$6,824	$10,236	$4,265	$107,000
36-004_36-003	36-004	36-003	1.270	7.6	8	$125	$50,110	$4,009	$6,013	$2,506	$63,000
36-005_36-052	36-005	36-052	8.015	17.9	18	$155	$39,913	$3,193	$4,790	$1,996	$50,000
36-006_36-067	36-006	36-067	2.364	9.9	10	$130	$36,876	$2,950	$4,425	$1,844	$46,000
36-009_36-008	36-009	36-008	0.542	6.3	8	$125	$31,250	$2,500	$3,750	$1,563	$39,000
36-010_36-009	36-010	36-009	0.515	6.2	8	$125	$31,159	$2,493	$3,739	$1,558	$39,000
36-017_36-016	36-017	36-016	0.357	7.0	8	$125	$19,781	$1,583	$2,374	$989	$25,000
36-025_36-026	36-025	36-026	15.444	26.8	36	$255	$59,925	$4,794	$7,191	$2,996	$75,000
36-052_36-004	36-052	36-004	7.408	16.9	18	$155	$38,088	$3,047	$4,571	$1,904	$48,000
36-067_36-005	36-067	36-005	16.217	33.5	42	$280	$51,346	$4,108	$6,162	$2,567	$64,000
36-246_36-001	36-246	36-001	0.907	6.6	8	$125	$17,173	$1,374	$2,061	$859	$21,000
37-001_37-369	37-001	37-369	11.026	22.4	24	$180	$56,340	$4,507	$6,761	$2,817	$70,000
37-127_37-001	37-127	37-001	10.404	24.9	36	$255	$110,201	$8,816	$13,224	$5,510	$138,000
29-297_29-336	29-297	29-336	0.130	5.5	8	$125	$44,038	$3,523	$5,285	$2,202	$55,000
37-004_37-003	37-004	37-003	0.542	9.4	10	$130	$8,126	$650	$975	$406	$10,000
37-177_37-176	37-177	37-176	4.444	15.9	18	$155	$50,143	$4,011	$6,017	$2,507	$63,000
37-210_37-283	37-210	37-283	0.132	4.8	8	$125	$37,000	$2,960	$4,440	$1,850	$46,000
38-001_37-223	38-001	37-223	1.032	10.5	12	$135	$36,896	$2,952	$4,427	$1,845	$46,000
38-044_38-098	38-044	38-098	0.817	8.4	10	$130	$25,220	$2,018	$3,026	$1,261	$32,000
38-046_38-045	38-046	38-045	0.695	7.6	8	$125	$46,988	$3,759	$5,639	$2,349	$59,000
38-070_38-069	38-070	38-069	0.085	17.1	18	$155	$59,664	$4,773	$7,160	$2,983	$75,000
38-077_38-076	38-077	38-076	0.364	5.6	8	$125	$21,513	$1,721	$2,582	$1,076	$27,000
38-319_38-067	38-319	38-067	0.760	38.9	42	$280	$79,800	$6,384	$9,576	$3,990	$100,000
38-321_38-058	38-321	38-058	1.475	8.6	10	$130	$15,561	$1,245	$1,867	$778	$19,000
37-128_37-127	37-128	37-127	10.286	24.8	36	$255	$47,940	$3,835	$5,753	$2,397	$60,000
37-129_37-128	37-129	37-128	8.993	21.9	24	$180	$33,894	$2,712	$4,067	$1,695	$42,000
37-130_37-129	37-130	37-129	10.071	24.6	36	$255	$78,795	$6,304	$9,455	$3,940	$98,000

Cedar Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
37-131_37-347	37-131	37-347	7.462	20.4	21	$170	$30,782	$2,463	$3,694	$1,539	$38,000
37-132_37-131	37-132	37-131	7.249	20.2	21	$170	$45,220	$3,618	$5,426	$2,261	$57,000
37-133_37-132	37-133	37-132	9.226	23.8	24	$180	$48,600	$3,888	$5,832	$2,430	$61,000
37-294_37-296	37-294	37-296	0.133	5.5	8	$125	$14,460	$1,157	$1,735	$723	$18,000
37-347_37-130	37-347	37-130	10.868	28.9	36	$255	$30,291	$2,423	$3,635	$1,515	$38,000
37-348_37-347	37-348	37-347	2.722	11.0	12	$135	$2,426	$194	$291	$121	$3,000
37-350_37-349	37-350	37-349	0.622	6.7	8	$125	$1,335	$107	$160	$67	$2,000
37-134_37-133	37-134	37-133	8.078	22.7	24	$180	$39,956	$3,197	$4,795	$1,998	$50,000
37-135_37-134	37-135	37-134	4.803	15.7	18	$155	$19,786	$1,583	$2,374	$989	$25,000
37-136_37-135	37-136	37-135	7.284	21.8	24	$180	$31,837	$2,547	$3,820	$1,592	$40,000
37-137_37-136	37-137	37-136	7.175	21.7	24	$180	$33,399	$2,672	$4,008	$1,670	$42,000
37-138_37-137	37-138	37-137	5.270	17.0	18	$155	$21,353	$1,708	$2,562	$1,068	$27,000
37-227_37-177	37-227	37-177	3.012	12.4	15	$140	$10,892	$871	$1,307	$545	$14,000
37-238_37-227	37-238	37-227	2.862	12.2	15	$140	$39,007	$3,121	$4,681	$1,950	$49,000
37-310_37-133	37-310	37-133	0.625	7.3	8	$125	$47,313	$3,785	$5,678	$2,366	$59,000
37-338_37-336	37-338	37-336	0.127	4.4	8	$125	$9,779	$782	$1,173	$489	$12,000
37-228_37-237	37-228	37-237	3.351	13.7	15	$140	$34,805	$2,784	$4,177	$1,740	$44,000
37-231_37-232	37-231	37-232	2.683	12.2	15	$140	$14,787	$1,183	$1,774	$739	$18,000
37-232_37-228	37-232	37-228	3.240	14.1	15	$140	$36,610	$2,929	$4,393	$1,831	$46,000
37-237_37-238	37-237	37-238	3.395	13.8	15	$140	$39,808	$3,185	$4,777	$1,990	$50,000
37-247_37-231	37-247	37-231	3.197	12.7	15	$140	$30,807	$2,465	$3,697	$1,540	$39,000
37-248_37-247	37-248	37-247	3.039	12.1	15	$140	$50,984	$4,079	$6,118	$2,549	$64,000
37-249_37-248	37-249	37-248	2.196	10.3	12	$135	$50,039	$4,003	$6,005	$2,502	$63,000
38-281_38-282	38-281	38-282	2.895	11.2	12	$135	$24,731	$1,978	$2,968	$1,237	$31,000
38-282_38-283	38-282	38-283	3.067	11.9	12	$135	$38,810	$3,105	$4,657	$1,940	$49,000
38-283_38-284	38-283	38-284	2.859	10.8	12	$135	$39,215	$3,137	$4,706	$1,961	$49,000
38-284_37-249	38-284	37-249	2.044	9.8	10	$130	$20,691	$1,655	$2,483	$1,035	$26,000
45-003_45-002	45-003	45-002	0.478	5.4	8	$125	$13,814	$1,105	$1,658	$691	$17,000
38-082_38-081	38-082	38-081	0.741	8.1	10	$130	$19,581	$1,566	$2,350	$979	$24,000
45-006_45-005	45-006	45-005	0.679	6.6	8	$125	$49,993	$3,999	$5,999	$2,500	$62,000
45-076_45-006	45-076	45-006	0.656	6.7	8	$125	$47,454	$3,796	$5,694	$2,373	$59,000
45-080_45-003	45-080	45-003	0.132	3.7	8	$125	$39,009	$3,121	$4,681	$1,950	$49,000
45-081_45-080	45-081	45-080	0.251	5.0	8	$125	$25,493	$2,039	$3,059	$1,275	$32,000
45-082_45-081	45-082	45-081	0.189	4.4	8	$125	$50,140	$4,011	$6,017	$2,507	$63,000
45-083_45-082	45-083	45-082	0.128	3.8	8	$125	$24,470	$1,958	$2,936	$1,224	$31,000
45-042_45-066	45-042	45-066	0.365	29.5	30	$200	$64,340	$5,147	$7,721	$3,217	$80,000
Total											$12,117,000

Big Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
47-006_47-007	47-006	47-007	0.255	5.5	8	$125	$50,030	$4,002	$6,004	$2,502	$63,000
47-007_47-016	47-007	47-016	0.385	6.4	8	$125	$39,989	$3,199	$4,799	$1,999	$50,000
47-016_47-017	47-016	47-017	1.595	10.8	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
47-022_47-023	47-022	47-023	2.485	16.6	18	$155	$46,675	$3,734	$5,601	$2,334	$58,000
47-023_47-069	47-023	47-069	1.861	11.5	12	$135	$29,539	$2,363	$3,545	$1,477	$37,000
47-068_54-017	47-068	54-017	2.568	13.7	15	$140	$32,199	$2,576	$3,864	$1,610	$40,000
47-069_47-068	47-069	47-068	2.261	13.0	15	$140	$32,203	$2,576	$3,864	$1,610	$40,000
54-008_54-007	54-008	54-007	5.338	17.0	18	$155	$62,002	$4,960	$7,440	$3,100	$78,000
54-010_54-009	54-010	54-009	5.302	17.9	18	$155	$62,000	$4,960	$7,440	$3,100	$78,000
54-011_54-010	54-011	54-010	5.301	19.4	21	$170	$61,533	$4,923	$7,384	$3,077	$77,000
54-012_54-011	54-012	54-011	3.432	13.9	15	$140	$41,597	$3,328	$4,992	$2,080	$52,000
54-013_54-012	54-013	54-012	4.937	18.9	21	$170	$49,487	$3,959	$5,938	$2,474	$62,000
54-014_54-013	54-014	54-013	4.677	18.5	21	$170	$64,405	$5,152	$7,729	$3,220	$81,000
54-015_54-014	54-015	54-014	3.534	15.4	18	$155	$63,220	$5,058	$7,586	$3,161	$79,000
54-016_54-015	54-016	54-015	2.076	11.1	12	$135	$53,997	$4,320	$6,480	$2,700	$67,000
54-017_54-016	54-017	54-016	3.480	16.5	18	$155	$61,997	$4,960	$7,440	$3,100	$77,000
53-010_53-009	53-010	53-009	0.733	8.5	10	$130	$36,083	$2,887	$4,330	$1,804	$45,000
53-011_53-010	53-011	53-010	0.659	8.2	10	$130	$35,781	$2,862	$4,294	$1,789	$45,000
53-012_53-011	53-012	53-011	0.687	8.3	10	$130	$30,862	$2,469	$3,703	$1,543	$39,000
53-014_53-013	53-014	53-013	0.579	7.8	8	$125	$33,876	$2,710	$4,065	$1,694	$42,000
53-015_53-014	53-015	53-014	0.549	7.7	8	$125	$33,185	$2,655	$3,982	$1,659	$41,000
Total											$1,219,000

Maybrook
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
14-027_14-026	14-027	14-026	1.657	11.0	12	$135	$25,529	$2,042	$3,063	$1,276	$32,000
14-045_14-027	14-045	14-027	1.337	10.1	12	$135	$13,500	$1,080	$1,620	$675	$17,000
14-002_11-126	14-002	11-126	1.083	44.4	48	$305	$59,292	$4,743	$7,115	$2,965	$74,000
14-022_14-011	14-022	14-011	2.395	12.6	15	$140	$52,850	$4,228	$6,342	$2,643	$66,000
14-023_14-022	14-023	14-022	2.239	12.3	15	$140	$56,000	$4,480	$6,720	$2,800	$70,000
14-024_14-023	14-024	14-023	2.284	12.4	15	$140	$55,958	$4,477	$6,715	$2,798	$70,000
14-025_14-024	14-025	14-024	2.064	11.4	12	$135	$53,879	$4,310	$6,465	$2,694	$67,000
01-033_01-032	01-033	01-032	0.944	8.9	10	$130	$18,850	$1,508	$2,262	$943	$24,000
01-032_01-031	01-032	01-031	1.044	8.9	10	$130	$39,000	$3,120	$4,680	$1,950	$49,000
04-008_04-007	04-008	04-007	2.151	10.4	12	$135	$54,116	$4,329	$6,494	$2,706	$68,000
04-009_04-008	04-009	04-008	1.549	9.9	10	$130	$52,000	$4,160	$6,240	$2,600	$65,000
08-127_08-126	08-127	08-126	0.271	5.2	8	$125	$15,913	$1,273	$1,910	$796	$20,000
08-065_08-016BS	08-065	08-016BS	1.767	14.6	15	$140	$6,147	$492	$738	$307	$8,000
08-066_08-065	08-066	08-065	1.957	11.2	12	$135	$14,850	$1,188	$1,782	$743	$19,000
08-067_08-066	08-067	08-066	0.918	7.1	8	$125	$30,625	$2,450	$3,675	$1,531	$38,000
08-167_08-067	08-167	08-067	1.448	9.4	10	$130	$7,827	$626	$939	$391	$10,000
Total											$697,000

Middle Big Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
56-094_56-078	56-094	56-078	1.396	8.9	10	$130	$20,098	$1,608	$2,412	$1,005	$25,000
56-095_56-094	56-095	56-094	0.916	7.3	8	$125	$19,781	$1,583	$2,374	$989	$25,000
56-096_56-095	56-096	56-095	1.159	8.3	10	$130	$52,079	$4,166	$6,250	$2,604	$65,000
56-099_56-098	56-099	56-098	1.408	9.9	10	$130	$40,266	$3,221	$4,832	$2,013	$50,000
56-100_56-099	56-100	56-099	2.471	13.5	15	$140	$40,627	$3,250	$4,875	$2,031	$51,000
56-101_56-100	56-101	56-100	1.816	10.2	12	$135	$39,022	$3,122	$4,683	$1,951	$49,000
56-103_56-102	56-103	56-102	1.420	9.1	10	$130	$21,960	$1,757	$2,635	$1,098	$27,000
56-104_56-103	56-104	56-103	1.524	9.9	10	$130	$17,057	$1,365	$2,047	$853	$21,000
56-105_56-104	56-105	56-104	1.303	9.3	10	$130	$31,496	$2,520	$3,780	$1,575	$39,000
56-106_56-105	56-106	56-105	1.298	9.6	10	$130	$14,973	$1,198	$1,797	$749	$19,000
56-107_56-106	56-107	56-106	1.171	9.3	10	$130	$28,750	$2,300	$3,450	$1,437	$36,000
56-108_56-107	56-108	56-107	1.006	8.7	10	$130	$21,169	$1,694	$2,540	$1,058	$26,000
56-109_56-108	56-109	56-108	0.834	8.1	10	$130	$37,470	$2,998	$4,496	$1,873	$47,000
56-110_56-109	56-110	56-109	0.676	7.5	8	$125	$16,023	$1,282	$1,923	$801	$20,000
56-111_56-110	56-111	56-110	0.480	6.6	8	$125	$10,575	$846	$1,269	$529	$13,000
56-112_56-111	56-112	56-111	0.432	6.4	8	$125	$18,998	$1,520	$2,280	$950	$24,000
56-116_56-115	56-116	56-115	3.679	13.7	15	$140	$48,324	$3,866	$5,799	$2,416	$60,000
56-117_56-116	56-117	56-116	3.602	14.1	15	$140	$26,286	$2,103	$3,154	$1,314	$33,000
56-118_56-117	56-118	56-117	3.504	14.0	15	$140	$43,506	$3,481	$5,221	$2,175	$54,000
56-119_56-118	56-119	56-118	2.242	13.0	15	$140	$20,828	$1,666	$2,499	$1,041	$26,000
56-120_56-119	56-120	56-119	1.111	8.5	10	$130	$15,743	$1,259	$1,889	$787	$20,000
56-121_56-120	56-121	56-120	1.094	9.9	10	$130	$12,734	$1,019	$1,528	$637	$16,000
56-122_56-121	56-122	56-121	0.685	7.6	8	$125	$12,305	$984	$1,477	$615	$15,000
56-127_56-126	56-127	56-126	0.679	9.0	10	$130	$24,543	$1,963	$2,945	$1,227	$31,000
56-132_56-127	56-132	56-127	0.200	5.0	8	$125	$24,960	$1,997	$2,995	$1,248	$31,000
56-133_56-132	56-133	56-132	0.181	5.1	8	$125	$7,424	$594	$891	$371	$9,000
56-146_56-131	56-146	56-131	0.240	5.1	8	$125	$17,194	$1,376	$2,063	$860	$21,000
60-018_60-001CO	60-018	60-001CO	13.035	30.9	36	$255	$8,084	$647	$970	$404	$10,000
60-019_60-018	60-019	60-018	4.860	15.8	18	$155	$56,637	$4,531	$6,796	$2,832	$71,000
60-022_60-021	60-022	60-021	3.090	12.5	15	$140	$10,370	$830	$1,244	$518	$13,000
60-031_60-022	60-031	60-022	2.864	13.5	15	$140	$41,171	$3,294	$4,941	$2,059	$51,000
60-033_60-018	60-033	60-018	3.904	16.0	18	$155	$55,814	$4,465	$6,698	$2,791	$70,000
60-034_60-033	60-034	60-033	4.965	18.9	21	$170	$51,000	$4,080	$6,120	$2,550	$64,000
60-066_60-019	60-066	60-019	4.654	17.1	18	$155	$15,064	$1,205	$1,808	$753	$19,000
60-074_60-066	60-074	60-066	4.484	20.7	21	$170	$9,928	$794	$1,191	$496	$12,000
60-157_60-034	60-157	60-034	4.580	18.3	21	$170	$11,016	$881	$1,322	$551	$14,000
60-161_60-160	60-161	60-160	2.553	14.7	15	$140	$25,460	$2,037	$3,055	$1,273	$32,000
60-163_60-162	60-163	60-162	0.979	9.5	10	$130	$37,694	$3,015	$4,523	$1,885	$47,000
60-165_60-164	60-165	60-164	1.290	10.0	12	$135	$17,280	$1,382	$2,074	$864	$22,000

Middle Big Creek
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
57-042_61-327	57-042	61-327	7.015	18.9	21	$170	$51,850	$4,148	$6,222	$2,593	$65,000
61-114_61-115	61-114	61-115	7.817	18.2	21	$170	$67,660	$5,413	$8,119	$3,383	$85,000
61-115_61-116	61-115	61-116	7.818	18.2	21	$170	$50,108	$4,009	$6,013	$2,505	$63,000
61-116_61-117	61-116	61-117	8.163	19.2	21	$170	$64,631	$5,170	$7,756	$3,232	$81,000
61-117_61-118	61-117	61-118	8.053	18.4	21	$170	$63,978	$5,118	$7,677	$3,199	$80,000
61-118_61-119	61-118	61-119	8.224	19.2	21	$170	$67,091	$5,367	$8,051	$3,355	$84,000
61-323_61-114	61-323	61-114	8.570	23.2	24	$180	$39,125	$3,130	$4,695	$1,956	$49,000
61-324_61-323	61-324	61-323	7.775	20.7	21	$170	$54,919	$4,393	$6,590	$2,746	$69,000
61-325_61-324	61-325	61-324	5.322	14.3	15	$140	$8,812	$705	$1,057	$441	$11,000
61-326_61-325	61-326	61-325	8.265	22.9	24	$180	$45,837	$3,667	$5,500	$2,292	$57,000
61-327_61-326	61-327	61-326	6.221	16.3	18	$155	$8,153	$652	$978	$408	$10,000
61-122_61-003BS	61-122	61-003BS	2.539	16.7	18	$155	$10,191	$815	$1,223	$510	$13,000
64-009_64-008	64-009	64-008	1.164	12.5	15	$140	$32,631	$2,610	$3,916	$1,632	$41,000
Total											$1,986,000

South Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
26-167_26-166	26-167	26-166	0.676	4.6	8	$125	$1,795	$144	$215	$90	$2,000
26-168_26-167	26-168	26-167	1.012	7.3	8	$125	$9,860	$789	$1,183	$493	$12,000
26-169_26-168	26-169	26-168	1.355	9.4	10	$130	$15,305	$1,224	$1,837	$765	$19,000
26-170_26-169	26-170	26-169	1.408	9.9	10	$130	$21,718	$1,737	$2,606	$1,086	$27,000
26-173_26-170	26-173	26-170	1.165	8.9	10	$130	$33,157	$2,653	$3,979	$1,658	$41,000
26-174_26-173	26-174	26-173	1.034	8.3	10	$130	$22,781	$1,822	$2,734	$1,139	$28,000
26-179_26-178	26-179	26-178	0.244	4.4	8	$125	$37,835	$3,027	$4,540	$1,892	$47,000
26-180_26-179	26-180	26-179	0.571	7.1	8	$125	$48,188	$3,855	$5,783	$2,409	$60,000
26-181_26-180	26-181	26-180	0.390	5.8	8	$125	$18,086	$1,447	$2,170	$904	$23,000
26-182_26-181	26-182	26-181	0.159	4.0	8	$125	$16,625	$1,330	$1,995	$831	$21,000
26-192_26-174	26-192	26-174	0.577	6.1	8	$125	$17,325	$1,386	$2,079	$866	$22,000
26-166_26-001PS	26-166	26-001PS	0.675	4.6	8	$125	$1,615	$129	$194	$81	$2,000
26-041_26-040	26-041	26-040	8.504	18.3	21	$170	$50,114	$4,009	$6,014	$2,506	$63,000
26-044_26-041	26-044	26-041	6.964	15.6	18	$155	$54,002	$4,320	$6,480	$2,700	$68,000
26-068_26-002	26-068	26-002	9.655	19.2	21	$170	$6,496	$520	$779	$325	$8,000
26-069_26-068	26-069	26-068	9.712	19.8	21	$170	$68,000	$5,440	$8,160	$3,400	$85,000
26-070_26-069	26-070	26-069	8.346	13.2	15	$140	$30,100	$2,408	$3,612	$1,505	$38,000
26-071_26-070	26-071	26-070	9.644	19.7	21	$170	$47,600	$3,808	$5,712	$2,380	$60,000
26-076_26-071	26-076	26-071	9.582	20.4	21	$170	$49,368	$3,949	$5,924	$2,468	$62,000
26-083_26-044	26-083	26-044	8.542	23.2	24	$180	$26,775	$2,142	$3,213	$1,339	$33,000
26-084_26-083	26-084	26-083	4.968	14.9	15	$140	$7,088	$567	$851	$354	$9,000
26-085_26-084	26-085	26-084	8.259	22.9	24	$180	$65,515	$5,241	$7,862	$3,276	$82,000
33-231_33-232	33-231	33-232	5.873	14.9	15	$140	$35,060	$2,805	$4,207	$1,753	$44,000
33-232_33-233	33-232	33-233	6.825	16.8	18	$155	$31,033	$2,483	$3,724	$1,552	$39,000
33-233_33-234	33-233	33-234	7.527	18.6	21	$170	$64,865	$5,189	$7,784	$3,243	$81,000
33-234_26-085	33-234	26-085	8.634	19.6	21	$170	$46,570	$3,726	$5,588	$2,328	$58,000
33-398_33-234	33-398	33-234	0.433	5.7	8	$125	$18,750	$1,500	$2,250	$938	$23,000
26-077_26-076	26-077	26-076	9.460	20.3	21	$170	$10,880	$870	$1,306	$544	$14,000
26-078_26-077	26-078	26-077	0.466	5.8	8	$125	$47,271	$3,782	$5,673	$2,364	$59,000
26-079_26-078	26-079	26-078	0.443	5.8	8	$125	$43,750	$3,500	$5,250	$2,188	$55,000
26-080_26-079	26-080	26-079	0.240	4.3	8	$125	$32,135	$2,571	$3,856	$1,607	$40,000
26-086_26-077	26-086	26-077	8.801	97.4	8	$125	$24,625	$1,970	$2,955	$1,231	$31,000
26-087_26-086	26-087	26-086	7.974	18.4	21	$170	$33,490	$2,679	$4,019	$1,675	$42,000
26-088_26-087	26-088	26-087	8.041	19.9	21	$170	$18,290	$1,463	$2,195	$915	$23,000
26-089_26-088	26-089	26-088	7.930	19.0	21	$170	$50,497	$4,040	$6,060	$2,525	$63,000
26-094_26-089	26-094	26-089	7.193	16.7	18	$155	$40,925	$3,274	$4,911	$2,046	$51,000
26-095_26-094	26-095	26-094	7.089	16.7	18	$155	$17,053	$1,364	$2,046	$853	$21,000
26-096_26-095	26-096	26-095	5.304	10.2	12	$135	$15,660	$1,253	$1,879	$783	$20,000
26-101_26-096	26-101	26-096	5.440	10.6	12	$135	$18,506	$1,480	$2,221	$925	$23,000

South Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
26-102_26-101	26-102	26-101	6.885	16.1	18	$155	$29,140	$2,331	$3,497	$1,457	$36,000
26-103_26-102	26-103	26-102	6.662	16.7	18	$155	$51,708	$4,137	$6,205	$2,585	$65,000
26-104_26-103	26-104	26-103	5.754	12.4	15	$140	$25,298	$2,024	$3,036	$1,265	$32,000
26-105_26-104	26-105	26-104	6.500	16.5	18	$155	$48,365	$3,869	$5,804	$2,418	$60,000
26-106_26-105	26-106	26-105	6.262	15.5	18	$155	$25,343	$2,027	$3,041	$1,267	$32,000
32-108_32-109	32-108	32-109	1.621	11.5	12	$135	$62,224	$4,978	$7,467	$3,111	$78,000
32-117_32-118	32-117	32-118	0.829	8.5	10	$130	$17,334	$1,387	$2,080	$867	$22,000
32-118_32-119	32-118	32-119	0.645	7.4	8	$125	$19,036	$1,523	$2,284	$952	$24,000
32-119_32-259	32-119	32-259	0.650	7.4	8	$125	$14,673	$1,174	$1,761	$734	$18,000
32-130_32-127	32-130	32-127	0.695	7.6	8	$125	$37,516	$3,001	$4,502	$1,876	$47,000
32-261_32-260	32-261	32-260	0.209	5.1	8	$125	$15,675	$1,254	$1,881	$784	$20,000
32-440_32-441	32-440	32-441	1.922	12.3	15	$140	$36,208	$2,897	$4,345	$1,810	$45,000
32-441_32-442	32-441	32-442	3.973	17.4	18	$155	$31,865	$2,549	$3,824	$1,593	$40,000
33-195_33-223	33-195	33-223	3.272	16.2	18	$155	$63,702	$5,096	$7,644	$3,185	$80,000
33-223_33-224	33-223	33-224	3.416	16.4	18	$155	$61,966	$4,957	$7,436	$3,098	$77,000
33-224_33-225	33-224	33-225	3.416	15.2	18	$155	$62,000	$4,960	$7,440	$3,100	$78,000
33-225_33-304	33-225	33-304	1.772	10.4	12	$135	$44,078	$3,526	$5,289	$2,204	$55,000
33-227_33-228	33-227	33-228	0.941	7.6	8	$125	$50,000	$4,000	$6,000	$2,500	$63,000
33-230_33-370	33-230	33-370	1.194	8.4	10	$130	$38,026	$3,042	$4,563	$1,901	$48,000
33-235_33-231	33-235	33-231	3.011	11.2	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
33-304_33-226	33-304	33-226	3.941	17.3	18	$155	$19,479	$1,558	$2,337	$974	$24,000
33-434_33-379	33-434	33-379	0.017	9.4	10	$130	$11,167	$893	$1,340	$558	$14,000
33-237_33-436	33-237	33-436	1.775	8.8	10	$130	$36,803	$2,944	$4,416	$1,840	$46,000
33-238_33-237	33-238	33-237	2.318	10.3	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
33-239_33-238	33-239	33-238	2.872	11.9	12	$135	$43,177	$3,454	$5,181	$2,159	$54,000
33-240_33-239	33-240	33-239	3.381	13.8	15	$140	$18,084	$1,447	$2,170	$904	$23,000
33-241_33-240	33-241	33-240	2.650	11.5	12	$135	$47,075	$3,766	$5,649	$2,354	$59,000
33-390_33-408	33-390	33-408	2.256	9.6	10	$130	$28,562	$2,285	$3,427	$1,428	$36,000
33-408_33-235	33-408	33-235	3.367	12.1	15	$140	$4,900	$392	$588	$245	$6,000
33-436_33-236	33-436	33-236	4.951	13.1	15	$140	$15,694	$1,256	$1,883	$785	$20,000
31-195_31-196	31-195	31-196	0.498	9.1	10	$130	$32,903	$2,632	$3,948	$1,645	$41,000
32-049_32-067	32-049	32-067	0.206	5.0	8	$125	$50,000	$4,000	$6,000	$2,500	$63,000
32-067_32-068	32-067	32-068	0.322	6.3	8	$125	$46,963	$3,757	$5,636	$2,348	$59,000
32-068_32-108	32-068	32-108	0.777	7.7	8	$125	$10,133	$811	$1,216	$507	$13,000
32-209_32-208	32-209	32-208	0.402	30.6	36	$255	$43,614	$3,489	$5,234	$2,181	$55,000
32-247_32-246	32-247	32-246	1.267	11.3	12	$135	$54,336	$4,347	$6,520	$2,717	$68,000
33-183_33-184	33-183	33-184	2.514	11.6	12	$135	$22,626	$1,810	$2,715	$1,131	$28,000
33-184_33-191	33-184	33-191	2.627	11.8	12	$135	$43,011	$3,441	$5,161	$2,151	$54,000
33-191_33-192	33-191	33-192	2.313	10.7	12	$135	$16,436	$1,315	$1,972	$822	$21,000

South Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
33-192_33-193	33-192	33-193	2.729	11.9	12	$135	$37,800	$3,024	$4,536	$1,890	$47,000
33-193_33-194	33-193	33-194	2.773	12.0	15	$140	$27,832	$2,227	$3,340	$1,392	$35,000
33-194_33-195	33-194	33-195	2.800	12.1	15	$140	$56,034	$4,483	$6,724	$2,802	$70,000
33-222_33-260	33-222	33-260	0.275	4.8	8	$125	$17,250	$1,380	$2,070	$863	$22,000
33-242_33-277	33-242	33-277	1.357	8.0	8	$125	$45,413	$3,633	$5,450	$2,271	$57,000
33-251_33-243	33-251	33-243	0.641	6.1	8	$125	$25,900	$2,072	$3,108	$1,295	$32,000
33-257_33-251	33-257	33-251	0.718	7.7	8	$125	$26,163	$2,093	$3,140	$1,308	$33,000
33-259_33-258	33-259	33-258	0.319	5.1	8	$125	$26,978	$2,158	$3,237	$1,349	$34,000
33-260_33-259	33-260	33-259	0.350	5.4	8	$125	$24,925	$1,994	$2,991	$1,246	$31,000
33-264_33-262	33-264	33-262	0.931	8.2	10	$130	$48,867	$3,909	$5,864	$2,443	$61,000
33-267_33-264	33-267	33-264	1.027	8.8	10	$130	$32,188	$2,575	$3,863	$1,609	$40,000
33-277_33-241	33-277	33-241	5.163	79.7	8	$125	$27,504	$2,200	$3,300	$1,375	$34,000
33-302_33-267	33-302	33-267	0.823	8.1	10	$130	$46,956	$3,756	$5,635	$2,348	$59,000
33-303_33-302	33-303	33-302	1.020	9.2	10	$130	$31,057	$2,485	$3,727	$1,553	$39,000
65-020_65-022	65-020	65-022	0.497	6.7	8	$125	$30,566	$2,445	$3,668	$1,528	$38,000
65-023_33-222	65-023	33-222	0.241	4.6	8	$125	$21,891	$1,751	$2,627	$1,095	$27,000
32-451_32-248	32-451	32-248	0.978	11.7	12	$135	$16,292	$1,303	$1,955	$815	$20,000
32-452_32-451	32-452	32-451	0.569	9.6	10	$130	$31,831	$2,546	$3,820	$1,592	$40,000
32-453_32-452	32-453	32-452	0.851	11.1	12	$135	$12,980	$1,038	$1,558	$649	$16,000
32-455_32-453	32-455	32-453	0.504	9.1	10	$130	$17,973	$1,438	$2,157	$899	$22,000
40-130_40-127	40-130	40-127	0.918	11.4	12	$135	$28,836	$2,307	$3,460	$1,442	$36,000
40-170_40-160	40-170	40-160	0.136	4.3	8	$125	$49,696	$3,976	$5,964	$2,485	$62,000
40-069_40-361	40-069	40-361	0.347	4.9	8	$125	$12,719	$1,018	$1,526	$636	$16,000
40-072_40-071	40-072	40-071	0.309	4.7	8	$125	$49,963	$3,997	$5,996	$2,498	$62,000
40-074_40-072	40-074	40-072	0.265	4.4	8	$125	$38,331	$3,067	$4,600	$1,917	$48,000
40-080_40-079	40-080	40-079	0.323	5.0	8	$125	$47,081	$3,767	$5,650	$2,354	$59,000
40-191_40-110	40-191	40-110	1.242	8.9	10	$130	$41,295	$3,304	$4,955	$2,065	$52,000
40-195_40-191	40-195	40-191	0.724	6.2	8	$125	$28,854	$2,308	$3,462	$1,443	$36,000
40-196_40-195	40-196	40-195	0.851	6.9	8	$125	$25,473	$2,038	$3,057	$1,274	$32,000
40-200_40-196	40-200	40-196	1.009	7.8	8	$125	$45,916	$3,673	$5,510	$2,296	$57,000
40-201_40-200	40-201	40-200	0.930	7.5	8	$125	$23,756	$1,901	$2,851	$1,188	$30,000
40-204_40-201	40-204	40-201	1.032	8.3	10	$130	$6,176	$494	$741	$309	$8,000
32-457_32-456	32-457	32-456	1.885	11.5	12	$135	$53,915	$4,313	$6,470	$2,696	$67,000
40-005_40-047	40-005	40-047	0.320	5.9	8	$125	$43,838	$3,507	$5,261	$2,192	$55,000
40-358_32-457	40-358	32-457	1.615	10.9	12	$135	$46,587	$3,727	$5,590	$2,329	$58,000
40-359_40-358	40-359	40-358	1.190	10.2	12	$135	$50,799	$4,064	$6,096	$2,540	$63,000
40-360_40-359	40-360	40-359	0.873	9.1	10	$130	$29,272	$2,342	$3,513	$1,464	$37,000
68-003_68-005	68-003	68-005	1.581	8.3	10	$130	$49,334	$3,947	$5,920	$2,467	$62,000
68-004_68-003	68-004	68-003	2.828	10.8	12	$135	$31,903	$2,552	$3,828	$1,595	$40,000

South Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
68-005_33-183	68-005	33-183	3.280	12.2	15	$140	$22,163	$1,773	$2,660	$1,108	$28,000
68-007_68-004	68-007	68-004	2.654	10.1	12	$135	$39,518	$3,161	$4,742	$1,976	$49,000
68-008_68-007	68-008	68-007	2.584	9.9	10	$130	$15,270	$1,222	$1,832	$764	$19,000
68-009_68-008	68-009	68-008	2.773	11.0	12	$135	$34,385	$2,751	$4,126	$1,719	$43,000
68-010_68-009	68-010	68-009	2.814	11.3	12	$135	$39,017	$3,121	$4,682	$1,951	$49,000
68-011_68-010	68-011	68-010	2.534	10.5	12	$135	$9,956	$796	$1,195	$498	$12,000
68-012_68-011	68-012	68-011	2.607	11.0	12	$135	$21,975	$1,758	$2,637	$1,099	$27,000
68-101_68-012	68-101	68-012	2.568	10.9	12	$135	$54,097	$4,328	$6,492	$2,705	$68,000
68-075_68-076	68-075	68-076	2.141	11.2	12	$135	$13,916	$1,113	$1,670	$696	$17,000
68-076_33-303	68-076	33-303	2.078	10.8	12	$135	$17,847	$1,428	$2,142	$892	$22,000
68-077_68-075	68-077	68-075	1.546	9.6	10	$130	$34,060	$2,725	$4,087	$1,703	$43,000
68-081_69-022	68-081	69-022	0.192	4.5	8	$125	$20,250	$1,620	$2,430	$1,013	$25,000
68-082_68-081	68-082	68-081	0.149	4.1	8	$125	$22,500	$1,800	$2,700	$1,125	$28,000
68-124_68-083	68-124	68-083	0.271	5.6	8	$125	$52,600	$4,208	$6,312	$2,630	$66,000
69-001_68-077	69-001	68-077	0.599	7.0	8	$125	$33,500	$2,680	$4,020	$1,675	$42,000
69-002_69-001	69-002	69-001	0.450	6.3	8	$125	$43,100	$3,448	$5,172	$2,155	$54,000
69-003_69-002	69-003	69-002	0.419	6.1	8	$125	$53,225	$4,258	$6,387	$2,661	$67,000
69-003_69-004	69-004	69-003	0.317	5.5	8	$125	$12,338	$987	$1,481	$617	$15,000
69-005_69-004	69-005	69-004	0.169	4.3	8	$125	$16,964	$1,357	$2,036	$848	$21,000
69-006_69-005	69-006	69-005	0.144	4.1	8	$125	$16,913	$1,353	$2,030	$846	$21,000
40-081_40-080	40-081	40-080	0.721	8.0	10	$130	$50,057	$4,005	$6,007	$2,503	$63,000
40-210_40-372	40-210	40-372	0.658	7.2	8	$125	$4,000	$320	$480	$200	$5,000
40-082_40-081	40-082	40-081	0.190	4.2	8	$125	$40,363	$3,229	$4,844	$2,018	$50,000
40-087_40-086	40-087	40-086	0.374	29.8	30	$200	$53,474	$4,278	$6,417	$2,674	$67,000
68-127_68-101	68-127	68-101	1.939	10.8	12	$135	$39,971	$3,198	$4,796	$1,999	$50,000
68-128_68-127	68-128	68-127	1.049	6.9	8	$125	$21,893	$1,751	$2,627	$1,095	$27,000
68-129_68-128	68-129	68-128	1.492	9.5	10	$130	$49,075	$3,926	$5,889	$2,454	$61,000
68-131_68-130	68-131	68-130	0.166	4.3	8	$125	$50,064	$4,005	$6,008	$2,503	$63,000
68-157_68-158	68-157	68-158	0.484	6.6	8	$125	$6,270	$502	$752	$314	$8,000
68-158_68-159	68-158	68-159	0.487	6.7	8	$125	$46,288	$3,703	$5,555	$2,314	$58,000
68-159_68-160	68-159	68-160	0.477	6.4	8	$125	$15,025	$1,202	$1,803	$751	$19,000
68-160_68-162	68-160	68-162	0.572	7.1	8	$125	$49,850	$3,988	$5,982	$2,493	$62,000
68-162_68-163	68-162	68-163	0.551	6.7	8	$125	$13,338	$1,067	$1,601	$667	$17,000
68-163_68-164	68-163	68-164	0.463	6.0	8	$125	$30,088	$2,407	$3,611	$1,504	$38,000
68-164_68-165	68-164	68-165	0.613	7.0	8	$125	$45,040	$3,603	$5,405	$2,252	$56,000
68-165_68-166	68-165	68-166	0.651	7.2	8	$125	$50,041	$4,003	$6,005	$2,502	$63,000
68-166_68-129	68-166	68-129	0.676	7.3	8	$125	$33,550	$2,684	$4,026	$1,678	$42,000
Total											$6,341,000

West Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
17-001_24-232	17-001	24-232	0.422	6.1	8	$125	$52,688	$4,215	$6,323	$2,634	$66,000
17-004_17-003	17-004	17-003	0.207	5.0	8	$125	$45,788	$3,663	$5,495	$2,289	$57,000
17-020_17-019	17-020	17-019	0.500	6.7	8	$125	$24,000	$1,920	$2,880	$1,200	$30,000
18-110_18-109	18-110	18-109	5.437	19.5	21	$170	$67,526	$5,402	$8,103	$3,376	$84,000
24-001_25-009	24-001	25-009	3.501	12.5	15	$140	$31,529	$2,522	$3,784	$1,576	$39,000
24-010_24-001	24-010	24-001	2.963	11.5	12	$135	$26,870	$2,150	$3,224	$1,344	$34,000
24-011_24-010	24-011	24-010	4.905	18.8	21	$170	$68,425	$5,474	$8,211	$3,421	$86,000
24-012_24-011	24-012	24-011	3.207	12.4	15	$140	$35,910	$2,873	$4,309	$1,796	$45,000
24-018_24-012	24-018	24-012	2.714	11.1	12	$135	$52,164	$4,173	$6,260	$2,608	$65,000
24-019_24-018	24-019	24-018	3.438	13.4	15	$140	$57,918	$4,633	$6,950	$2,896	$72,000
25-005_25-370	25-005	25-370	3.388	11.4	12	$135	$7,488	$599	$899	$374	$9,000
25-006_25-184	25-006	25-184	4.623	15.5	18	$155	$30,861	$2,469	$3,703	$1,543	$39,000
25-007_25-006	25-007	25-006	3.076	11.1	12	$135	$20,883	$1,671	$2,506	$1,044	$26,000
25-008_25-007	25-008	25-007	2.937	10.9	12	$135	$25,676	$2,054	$3,081	$1,284	$32,000
25-009_25-008	25-009	25-008	3.088	11.3	12	$135	$54,000	$4,320	$6,480	$2,700	$68,000
25-184_25-005	25-184	25-005	5.895	20.1	21	$170	$18,717	$1,497	$2,246	$936	$23,000
25-185_25-284	25-185	25-284	1.889	8.6	10	$130	$30,862	$2,469	$3,703	$1,543	$39,000
25-186_25-185	25-186	25-185	5.189	16.9	18	$155	$28,994	$2,320	$3,479	$1,450	$36,000
25-275_25-340	25-275	25-340	7.048	21.5	24	$180	$63,463	$5,077	$7,616	$3,173	$79,000
25-276_25-275	25-276	25-275	5.949	17.0	18	$155	$59,791	$4,783	$7,175	$2,990	$75,000
25-278_25-276	25-278	25-276	10.014	24.6	30	$200	$61,846	$4,948	$7,422	$3,092	$77,000
25-279_25-278	25-279	25-278	5.538	16.6	18	$155	$52,681	$4,215	$6,322	$2,634	$66,000
25-281_25-279	25-281	25-279	6.868	18.7	21	$170	$16,842	$1,347	$2,021	$842	$21,000
25-282_25-281	25-282	25-281	5.242	15.7	18	$155	$16,835	$1,347	$2,020	$842	$21,000
25-283_25-282	25-283	25-282	7.459	17.9	18	$155	$54,323	$4,346	$6,519	$2,716	$68,000
25-284_25-283	25-284	25-283	7.436	17.9	18	$155	$61,360	$4,909	$7,363	$3,068	$77,000
25-340_18-110	25-340	18-110	7.323	21.9	24	$180	$56,164	$4,493	$6,740	$2,808	$70,000
18-029_18-030	18-029	18-030	0.350	5.7	8	$125	$33,448	$2,676	$4,014	$1,672	$42,000
18-030_18-041	18-030	18-041	0.518	6.6	8	$125	$22,908	$1,833	$2,749	$1,145	$29,000
18-042_18-043	18-042	18-043	0.972	7.9	8	$125	$21,561	$1,725	$2,587	$1,078	$27,000
18-043_18-044	18-043	18-044	0.446	4.9	8	$125	$19,750	$1,580	$2,370	$988	$25,000
18-044_18-045	18-044	18-045	1.877	11.5	12	$135	$13,757	$1,101	$1,651	$688	$17,000
18-045_18-080	18-045	18-080	1.861	11.0	12	$135	$44,667	$3,573	$5,360	$2,233	$56,000
18-059_25-188	18-059	25-188	0.190	6.3	8	$125	$14,068	$1,125	$1,688	$703	$18,000
18-060_18-069	18-060	18-069	4.567	16.1	18	$155	$12,412	$993	$1,489	$621	$16,000
18-066_18-060	18-066	18-060	4.060	15.4	18	$155	$27,540	$2,203	$3,305	$1,377	$34,000
18-067_18-066	18-067	18-066	3.998	15.3	18	$155	$30,242	$2,419	$3,629	$1,512	$38,000
18-069_25-187	18-069	25-187	4.612	16.1	18	$155	$48,761	$3,901	$5,851	$2,438	$61,000
18-076_18-067	18-076	18-067	3.404	13.3	15	$140	$42,351	$3,388	$5,082	$2,118	$53,000

West Prairie Lee
Watershed
Required Parallel Pipes
Ultimate Flows Without PRI

ID	From Manhole	To Manhole	Additional Capacity Required (cfs)	Parallel Pipe Diameter (in)	Parallel Pipe Diameter (in)	Unit Cost ($/LF)	Pipe Cost	Admin/Inspection (8%)	Design (12%)	Land Acquisition (5%)	Total Cost
18-077_18-076	18-077	18-076	1.953	8.9	10	$130	$13,607	$1,089	$1,633	$680	$17,000
18-078_18-077	18-078	18-077	2.692	13.2	15	$140	$49,686	$3,975	$5,962	$2,484	$62,000
18-079_18-078	18-079	18-078	2.602	13.0	15	$140	$51,115	$4,089	$6,134	$2,556	$64,000
18-080_18-079	18-080	18-079	2.383	12.1	15	$140	$53,124	$4,250	$6,375	$2,656	$66,000
25-187_25-186	25-187	25-186	4.677	16.2	18	$155	$26,984	$2,159	$3,238	$1,349	$34,000
18-109_25-271	18-109	25-271	6.563	21.0	21	$170	$41,176	$3,294	$4,941	$2,059	$51,000
25-217_25-329	25-217	25-329	17.621	126.3	30	$200	$12,970	$1,038	$1,556	$649	$16,000
25-267_25-JS01	25-267	25-JS01	6.958	21.4	24	$180	$70,578	$5,646	$8,469	$3,529	$88,000
25-268_25-267	25-268	25-267	6.280	20.6	21	$170	$61,321	$4,906	$7,358	$3,066	$77,000
25-269_25-268	25-269	25-268	6.314	20.7	21	$170	$68,066	$5,445	$8,168	$3,403	$85,000
25-270_25-269	25-270	25-269	6.303	20.7	21	$170	$42,599	$3,408	$5,112	$2,130	$53,000
25-271_25-270	25-271	25-270	8.185	26.0	30	$200	$60,000	$4,800	$7,200	$3,000	$75,000
25-330_25-329	25-330	25-329	0.788	7.5	8	$125	$23,200	$1,856	$2,784	$1,160	$29,000
25-331_25-330	25-331	25-330	0.532	6.2	8	$125	$26,145	$2,092	$3,137	$1,307	$33,000
25-332_25-331	25-332	25-331	0.371	5.4	8	$125	$16,106	$1,289	$1,933	$805	$20,000
25-333_25-332	25-333	25-332	0.421	6.1	8	$125	$36,166	$2,893	$4,340	$1,808	$45,000
25-334_25-333	25-334	25-333	0.477	7.3	8	$125	$17,684	$1,415	$2,122	$884	$22,000
25-JS01_25-PS01	25-JS01	25PS01	13.295	31.1	36	$255	$24,228	$1,938	$2,907	$1,211	$30,000
24-020_24-019	24-020	24-019	3.022	12.1	15	$140	$55,825	$4,466	$6,699	$2,791	$70,000
24-021_24-215	24-021	24-215	1.427	7.9	8	$125	$8,254	$660	$990	$413	$10,000
24-022_24-216	24-022	24-216	1.813	9.1	10	$130	$12,186	$975	$1,462	$609	$15,000
24-023_24-022	24-023	24-022	2.531	11.1	12	$135	$66,466	$5,317	$7,976	$3,323	$83,000
24-024_24-023	24-024	24-023	1.909	9.6	10	$130	$19,003	$1,520	$2,280	$950	$24,000
24-068_24-069	24-068	24-069	0.537	6.1	8	$125	$35,128	$2,810	$4,215	$1,756	$44,000
24-069_24-071	24-069	24-071	0.698	7.0	8	$125	$33,834	$2,707	$4,060	$1,692	$42,000
24-071_24-072	24-071	24-072	0.719	7.1	8	$125	$33,624	$2,690	$4,035	$1,681	$42,000
24-072_24-073	24-072	24-073	1.064	9.3	10	$130	$12,786	$1,023	$1,534	$639	$16,000
24-073_24-074	24-073	24-074	1.000	8.7	10	$130	$35,984	$2,879	$4,318	$1,799	$45,000
24-074_24-075	24-074	24-075	1.326	10.1	12	$135	$47,021	$3,762	$5,642	$2,351	$59,000
24-075_24-029	24-075	24-029	1.306	9.6	10	$130	$22,191	$1,775	$2,663	$1,110	$28,000
24-215_24-020	24-215	24-020	4.216	17.8	18	$155	$53,353	$4,268	$6,402	$2,668	$67,000
24-216_24-021	24-216	24-021	2.714	11.6	12	$135	$48,850	$3,908	$5,862	$2,442	$61,000
24-235_24-062	24-235	24-062	0.879	41.0	42	$280	$9,797	$784	$1,176	$490	$12,000
24-249_24-248	24-249	24-248	0.525	6.8	8	$125	$50,078	$4,006	$6,009	$2,504	$63,000
24-253_24-252	24-253	24-252	0.789	7.0	8	$125	$23,436	$1,875	$2,812	$1,172	$29,000
24-254_24-253	24-254	24-253	0.764	6.9	8	$125	$20,666	$1,653	$2,480	$1,033	$26,000
24-266_24-265	24-266	24-265	0.289	4.7	8	$125	$43,838	$3,507	$5,261	$2,192	$55,000
24-274_24-266	24-274	24-266	0.345	5.2	8	$125	$26,600	$2,128	$3,192	$1,330	$33,000
24-128_24-326	24-128	24-326	0.537	7.6	8	$125	$11,796	$944	$1,416	$590	$15,000

Appendix 9.9

CMOM Audit

Infrastructure Security

Although outside the scope of a CMOM program, municipal wastewater utilities should also consider security vulnerabilities. To reduce the threat of both intentional and natural disasters, the utility should take steps to implement appropriate countermeasures and develop or update emergency response plans.

About the CMOM Program Self Assessment Checklist

Introduction

A sanitary sewer collection system is a vital element of any community's infrastructure and a critical component of the wastewater treatment process. The nation's sanitary sewer infrastructure has been built over the last 100 years or more using a variety of materials, design standards, installation techniques, and maintenance practices. As this valuable infrastructure ages, the importance of preventive and predictive maintenance increases.

What is CMOM?

CMOM stands for "capacity, management, operations, and maintenance." It is a flexible, dynamic framework for municipalities to identify and incorporate widely-accepted wastewater industry practices to:

- Better manage, operate, and maintain collection systems
- Investigate capacity constrained areas of the collection system
- Respond to sanitary sewer overflow (SSO) events

The CMOM approach helps municipal wastewater utility operators provide a high level of service to customers and reduce regulatory noncompliance. CMOM can help utilities optimize use of human and material resources by shifting maintenance activities from "reactive" to "predictive"--often leading to cost savings through avoided overtime, emergency construction costs, increased insurance premiums, and the possibility of lawsuits. CMOM information and documentation can also help improve communications with the public, other municipal works and regional planning organizations, and regulators.

In CMOM planning, the utility selects performance goal targets, and designs CMOM activities to meet the goals. The CMOM planning framework covers operation and maintenance (O&M) planning, capacity assessment and assurance, capital improvement planning, and financial management planning. Information collection and management practices are used to track how well each CMOM activity is meeting the performance goals, and whether overall system efficiency is improving. On an ongoing basis, activities are reviewed and adjusted to better meet the performance goals. As the CMOM program progresses, performance goals can change. For instance, an initial goal may be to develop a geographic information system (GIS) of the system. Once the GIS is complete, a new goal might be to use the GIS to track emergency calls and use the information to improve maintenance planning.

An important component of a successful CMOM program is to periodically collect information on current systems and activities and develop a "snapshot-in-time" analysis. From this analysis, the utility establishes its performance goals and plans its CMOM program activities.

Additional information describing CMOM can be found at: www.epa.gov/npdes/sso or www.epa.gov/region1/water/wpeb/pdfs/self-audit_review2-3.pdf.

About this Checklist (Continued)

What is the purpose of the CMOM program checklist?

This document is a screening-level tool that can help utilities evaluate CMOM programs and identify general areas of strength and weakness. Completing this CMOM assessment will allow the utility to flag CMOM program areas that need improvement and establish priorities for additional, more detailed assessments. In addition, the checklist will allow the utility to compare annual performance (e.g., percent of employees meeting training standards).

This document is not intended to be all-inclusive. It addresses the types of practices EPA believes should be considered by most utilities when implementing a CMOM program. However, the ways in which utilities use the information gathered through the checklist will depend on the complexity and site-specific issues facing individual collection systems. When reviewing the questions, utilities should use their judgment to determine if the question is reasonable for their collection system size and design.

How do I use this checklist?

The questions on the checklist will request answers in three different formats:

- Check yes, no, or not applicable (NA),
- Fill in the blank, and
- Check all that apply.

At the end of each section, additional space is provided to allow for comments on or explanations of the answers recorded (information that will be useful to the utility in follow-on planning). Each utility should make an effort to answer all the questions that are applicable to its system. If a particular question takes a significant amount of time to answer, this could be an indication of an area of weakness. Utilities should plan to invest approximately one day to complete the checklist.

This document is designed to help utilities perform an initial evaluation of CMOM activities. **It is not intended to serve as an absolute indicator of a successful CMOM program, nor will all of the questions apply to every utility.** By working through these questions, utilities will be able to identify strengths and areas for improvements in their CMOM programs. If a utility has a significant number of "no" answers or very few items selected in the checklist, this could indicate an area of weakness. The utility manager then can make a more detailed evaluation, including identifying specific actions needed to address areas for improvement.

General Information

CHECKLIST COMPLETED BY:

Name _____ Date _____

Daytime Telephone Number _____

UTILITY CONTACT INFORMATION

Utility Name _____

LOCATION

Street Address _____

Street Address (continued) _____

City _____ State _____ Zip _____

STAFF

Name _____

Title _____

Email _____

Phone ( ) - Fax ( ) -

PERMITTED TREATMENT & COLLECTION FACILIITES

NPDES or STATE PERMIT #	PERMITTEE/CO-PERMITTEE/JURISDICTIONS	PERMIT COVERAGE: WWTP Effluent	Collection System	Wet-Weather Facility
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐

Collection System Description

SYSTEM INVENTORY

	# of Treatment facilities	NUMBER
Treatment Facilities	WWTP design capacity	MGD
	Average daily flow	MGD
	Average dry weather fow	MGD
Access & Maintenance	Manholes	NUMBER
	Number of air vacuum relief valves	NUMBER

Conveyance & Pumping	Gravity Sewers	Force Mains	Pump Stations
Pipes and pumps Length/quantity	MILES	MILES	NUMBER
Age of system 0 - 25 years old	% PERCENT	% PERCENT	% NUMBER
26 - 50 years old	% PERCENT	% PERCENT	% NUMBER
51 - 75 years old	% PERCENT	% PERCENT	% NUMBER
>76 years old	% PERCENT	% PERCENT	% NUMBER

Number of inverted siphons _____

SERVICE AREA CHARACTERISTICS

Service area ACRES

Service population PEOPLE

Annual precipitation INCHES

Number of Service Connections

Residential	+	Commercial	+	Industrial	=	TOTAL
NUMBER		NUMBER		NUMBER		NUMBER

Collection system service lateral responsibility *(check one)*

- ☐ At main line connection only
- ☐ From main line to property line or easement/cleanout
- ☐ Beyond property line/clean out
- ☐ Other: _____

Combined Sewer Systems

What percent of sewer system is served by combined sewers (i.e., sanitary sewage and storm water in the same pipe)? % PERCENT

Collection System Description

	Gravity Sewers	Force Mains
PIPE DIAMETER		
8 inches or less	% PERCENT	% PERCENT
9 - 18 inches	% PERCENT	% PERCENT
19 - 36 inches	% PERCENT	% PERCENT
>36 inches	% PERCENT	% PERCENT
PIPE MATERIALS		
Prestressed concrete cylinder pipe (PCCP)	% PERCENT	% PERCENT
High density polyethylene (HDPE)	% PERCENT	% PERCENT
Reinforced concrete pipe (RCP)	% PERCENT	% PERCENT
Polyvinyl chloride (PVC)	% PERCENT	N/A PERCENT
Vitrified clay pipe (VCP)	% PERCENT	N/A PERCENT
Ductile iron	% PERCENT	% PERCENT
Non-reinforced concrete pipe	% PERCENT	% PERCENT
Asbestos cement pipe	% PERCENT	% PERCENT
Cast iron	% PERCENT	% PERCENT
Brick	% PERCENT	% PERCENT
Fiberglass	% PERCENT	% PERCENT
Other (*Explain*)	% PERCENT	% PERCENT

Engineering Design (ED)

ED-01	Is there a document which includes design criteria and standard construction details?	YES	NO
ED-02	Is there a document that describes the procedures that the utility follows in construction design review?	YES	NO
ED-03	Are WWTP and O&M staff involved in the design review process?	YES	NO
ED-04	Is there a procedure for testing and inspecting new or rehabilitated system elements both during and after the construction is completed?	YES	NO
ED-05	Are construction sites supervised by qualified personnel (such as professional engineers or certified engineering technicians) to ascertain that the construction is taking place in accordance with the agreed upon plans and specifications?	YES	NO
ED-06	Are new manholes tested for inflow and infiltration?	YES	NO
ED-07	Are new gravity sewers checked using closed circuit TV inspection?	YES	NO
ED-08	Does the utility have documentation on private service lateral design and inspection standards?	YES	NO
ED-09	Does the utility attempt to standardize equipment and sewer system components?	YES	NO

Satellite Communities and Sewer Use Ordinance (SUO)

SUO-01	Does the utility receive flow from satellite communities? IF NO, GO TO PAGE 6	YES	
SUO-02	What is the total area from satellite communities that contribute flow to the collection system? *(Acres or square miles)*	_____	
SUO-03	Does the utility require satellite communities to enter into an agreement? IF NO, GO TO QUESTION SUO-06.	YES	NO
SUO-04	Does the agreement include the requirements listed in the sewer use ordinance (SUO)?	YES	NO
SUO-05	Do the agreements have a date of termination and allow for renewal under different terms?	YES	NO
SUO-06	Does the utility maintain the legal authority to control the maximum flow introduced into the collection system from satellite communities?	YES	NO
SUO-07	Are standards, inspections, and approval for new connections clearly documented in a SUO?	YES	NO
SUO-08	Does the SUO require satellite communities to adopt the same industrial and commercial regulator discharge limits as the utility?	YES	NO
SUO-09	Does the SUO require satellite communities to adopt the same inspection and sampling schedules as required by the pretreatment ordinance?	YES	NO
SUO-10	Does the SUO require that satellite communities or the utility to issue control permits for significant industrial users?	YES	NO
SUO-11	Does the SUO contain provisions for addressing overstrength wastewater from satellite communities?	YES	NO

SUO-12 Does the SUO contain procedures for the following? *(Check all that apply)*

- ☐ Inspection standards
- ☐ Pretreatment requirements
- ☐ Building/sewer permit issues

SUO-13 Does the SUO contain general prohibitions of the following materials? *(Check all that apply)*

- ☐ Fire and explosions hazards
- ☐ Corrosive materials
- ☐ Obstructive materials
- ☐ Oils or petroleum
- ☐ Material which may cause interference at the wastewater treatment plant

SUO-14 Does the SUO contain procedures and enforcement actions for the following? *(Check all that apply)*

- ☐ Fats, oils, and grease (FOG)
- ☐ Storm water connections to sanitary lines (downspouts)
- ☐ Infiltration and inflow
- ☐ Defects in service laterals located on private property
- ☐ Building structures over the sewer lines
- ☐ Sump pumps, air conditioner connections

Organizational Structure (OC)

OC-01 Is an organizational chart available that shows the overall personnel structure for the utility, including operation and maintenance staff? YES NO

OC- 02 Are up-to-date job descriptions available that delineate responsibilities and authority for each position? YES NO

OC-03 Are the following items discussed in the job descriptions? *(Check all that apply)*

- ☐ Nature of work to be performed
- ☐ Examples of the types of work
- ☐ Minimum requirements for the position
- ☐ List of licenses required for the position
- ☐ Necessary special qualifications or certifications
- ☐ Performance measures or promotion potential

OC-04 What percent of staff positions are currently vacant? _____ %

OC-05 On average how long do positions remain vacant? *(months)* _____

OC-06 What percent of utility work is contracted out? _____ %

Internal Communications (IC)

IC-01 Which of the following methods are used to communicate with utility staff? *(Check all that apply)*

☐ Regular meetings ☐ Bulletin boards ☐ E-mail ☐ Other (walkie talkie/pager)

IC-02 How often are staff meetings held? *(e.g., Daily, Weekly, Monthly, etc.)* _____

IC-03 Are incentives offered to employees for performance improvements? YES NO

IC-04 Does the utility have an "Employee of the Month/Quarter/Year" program? YES NO

IC-05 How often are performance reviews conducted? *(e.g. Semi-annually, Annually, etc.)* _____

IC-06 Does the utility regularly communicate/coordinate with other municipal departments? YES NO

Budgeting (BUD)

BUD-01	What is the average annual fee for residential users?	$ _____
BUD-02	How often are user charges evaluated and adjusted? *(e.g. annually, biannually, etc.)*	_____
BUD-03	Are utility-generated funds used for non-utility programs?	YES NO
BUD-04	Are costs for collection system operation and maintenance (O&M) separated from other utility services such as water, storm water, and treatment plants? IF NO, GO TO QUESTION BUD-07.	YES NO
BUD-05	What is your average annual (O&M) budget?	$ _____
BUD-06	What percentage of the utility's overall budget is allocated to maintenance of the collection system?	_____ %
BUD-07	Does the utility have a Capital Improvement Plan (CIP) that provides for system repairs/replacements on a prioritized basis?	YES NO
BUD-08	What is your average annual CIP budget?	$ _____
BUD-09	What percentage of the maintenance budget is allotted to the following maintenance?	
	Predictive maintenance (tracking design, life span, and scheduled parts replacements)	_____ %
	Preventive maintenance (identifying and fixing system weaknesses which, if left unaddressed, could lead to overflows)	_____ %
	Corrective maintenance (fixing system components that are functioning but not at 100% capacity/efficiency; for example partially blocked lines)	_____ %
	Emergency maintenance (reactive maintenance, overflows, equipment breakdowns)	_____ %
BUD-10	Does the utility have a budgeted program for the replacement of under-capacity pipes?	YES NO
BUD-11	Does the utility have a budgeted program for the replacement of over-capacity pipes?	YES NO

Training (TR)

TR-01	Does the utility have a formal job knowledge, skills, and abilities (KSA) training program?	YES	NO
TR-02	Does the training program address the fundamental mission, goals, and policies of the utility?	YES	NO
TR-03	Does the utility have mandatory training requirements identified for key employees?	YES	NO

TR-04 What percentage of employees met or exceeded their annual training goals during the past year? _____ %

TR-05 Does the utility provide training in the following areas? *(Check all that apply)*

- ☐ Safety
- ☐ Traffic control
- ☐ Public relations
- ☐ Routine line maintenance
- ☐ Record keeping
- ☐ SSO/Emergency response
- ☐ Confined space entry
- ☐ Electrical and instrumentation
- ☐ Pump station operations and maintenance
- ☐ Other
- ☐ Pipe repair
- ☐ CCTV and trench/shoring
- ☐ Bursting CIPP

TR-06	Are operator and maintenance certification programs used? IF NO, GO TO QUESTION TR-08	YES	NO
TR-07	Are operator and maintenance certification programs required?	YES	NO
TR-08	Is on-the-job training progress and performance measured?	YES	NO

TR-09 Which of the following methods are used to assess the effectiveness of the training? *(Check all that apply)*

☐ None ☐ Periodic testing ☐ Drills ☐ Demonstrations

TR-10 What percentage of the training offered by the utility is in the form of the following?

Manufacturer training _____ % In-house classroom training _____ %

On-the-job training _____ % Industry-wide training _____ %

Safety (SAF)

SAF-01	Does the utility have a written safety policy?	YES	NO
SAF-02	How often are safety procedures reviewed and revised? *(e.g. Semiannually, Annually, etc.)*	YES	NO
SAF-03	Does the utility have a safety committee?	YES	NO
SAF-04	Are regular safety meetings held with the utility employees?	YES	NO
SAF-05	Does the utility have a safety training program?	YES	NO
SAF-06	Are records of employee safety training kept up to date?	YES	NO

SAF-07 Does the utility have written procedures for the following? *(Check all that apply)*

- ☐ Lockout/tagout
- ☐ Material safety date sheets (MSDS)
- ☐ Chemical handling
- ☐ Confined spaces permit program
- ☐ Trenching and excavations safety
- ☐ Biological hazards in wastewater
- ☐ Traffic control and work site safety
- ☐ Electrical and mechanical systems
- ☐ Pneumatic and hydraulic systems safety

SAF-08 What is your agency's lost-time injury rate? _____ % or _____ hours

SAF-09 Are the following equipment items available and in adequate supply? *(Check all that apply)*

- ☐ Rubber/disposable gloves
- ☐ Confined space ventilation equipment
- ☐ Hard hats, safety glasses, rubber boots
- ☐ Antibacterial soap and first aid kit
- ☐ Tripods or non-entry rescue equipment
- ☐ Fire extinguishers
- ☐ Equipment to enter manholes
- ☐ Portable crane/hoist
- ☐ Atmospheric testing equipment and gas detectors
- ☐ Oxygen sensors
- ☐ H_2S Monitors
- ☐ Full body harness
- ☐ Protective clothing
- ☐ Traffic/public access control equipment
- ☐ 5-minute escape breathing devices
- ☐ Life preservers for lagoons
- ☐ Safety buoy at activated sludge plants
- ☐ Fiberglass or wooden ladders for electrical work
- ☐ Respirators and/or self contained breathing apparatus
- ☐ Methane gas or optical vector (OVA) analyzer
- ☐ Lower explosion limit (LEL) metering

SAF-10 Are safety monitors clearly identified? YES NO

Customer Service (CS)

CS-01 Does the utility have a customer service and public relations program? IF NO GO TO QUESTION CS-03 YES NO

CS-02 Does the customer service program include giving formal presentations on the wastewater field to the following? *(Check all that apply)*

- ☐ Schools and universities
- ☐ Local officials
- ☐ Media
- ☐ Building Inspector(s)
- ☐ Community gatherings
- ☐ Businesses
- ☐ Citizens
- ☐ Public utility officials

CS-03 Are employees of the utility specifically trained in customer service? YES NO

CS-04 Are there sample correspondence, Q/A's, or "scripts" to help guide staff through written or oral responses to customers? YES NO

CS-05 What methods are used to notify the public of major construction or maintenance work? *(Check all that apply)*

- ☐ Door hangers
- ☐ Newspaper
- ☐ Fliers
- ☐ Signs
- ☐ Other
- ☐ None
- ☐ Public radio or T.V. announcements

CS-06 Is a homeowner notified prior to construction that his/her property may be affected? YES NO

CS-07 Do you provide information to residents on cleanup and safety procedures following basement backups and overflows from manholes when they occur? YES NO

CS-08 Does the utility have a customer service evaluation program to obtain feedback from the community? YES NO

CS-09 Do customer service records include the following information? *(Check all that apply)*

- ☐ Personnel who received the complaint or request
- ☐ Name, address, and telephone number of customer
- ☐ Nature of the complaint or request
- ☐ Location of the problem
- ☐ To whom the follow-up action was assigned
- ☐ Date the follow up action was assigned
- ☐ Date of the complaint or request
- ☐ Cause of the problem
- ☐ Date the complaint or request was resolved
- ☐ Feedback to customer
- ☐ Total days to end the problem

CS-10 Does the utility have a goal for how quickly customer complaints (or ermergency calls) are resolved? IF NO, GO TO THE NEXT PAGE. YES NO

CS-11 What percentage of customer complaints (or emergency calls) are resolved within the timeline goals? _____ %

Equipment and Collection System Maintenance (ESM)

ESM-01 Is a maintenance card or record kept for each piece of mechanical equipment within the collection system? IF NO, GO TO QUESTION ESM-03. YES NO

ESM-02 Do equipment maintenance records include the following information? *(Check all that apply)*

- ☐ Maintenance recommendations
- ☐ Maintenance schedule
- ☐ Instructions on conducting the specific maintenance activity
- ☐ A record of maintenance on the equipment to date
- ☐ Other observations on the equipment

ESM-03 Are dated tags used to show out-of-service equipment? YES NO

ESM-04 Is there an established system for prioritizing equipment maintenance needs? YES NO

ESM-05 What percent of repair funds are spent on emergency repairs? _____%

ESM-06 Are corrective repair work orders backlogged more than six months? YES NO

ESM-07 Do collection system personnel coordinate with state, county, and local personnel on repairs, before the street is paved? YES NO

Equipment Parts Inventory (EPI)

EPI-01	Have critical spare parts been identified?	YES	NO
EPI-02	Are adequate supplies on hand to allow for two point repairs in any part of the system?	YES	NO
EPI-03	Is there a parts standardization policy in place?	YES	NO
EPI-04	Does the utility have a central location for storing spare parts?	YES	NO
EPI-05	Does the utility maintain a stock of spare parts on its maintenance vehicles?	YES	NO
EPI-06	Does the utility have a system in place to track and maintain an accurate inventory of spare parts?	YES	NO
EPI-07	For those parts which are not kept in inventory, does the utility have a readily available source or supplier?	YES	NO

Management Information System (MIS)

MIS-01 Does the utility have a management information system (MIS) in place for tracking maintenance activities? *(Either electronic or good paper files)* IF NO, GO TO PAGE 15. YES NO

MIS-02 Are the MIS records maintained for a period of at least three years? YES NO

MIS-03 Is the MIS able to distinguish activities taken in response to an overflow event? YES NO

MIS-04 Are there written instructions for managing and tracking the following information? *(Check all that apply)*

- ☐ Complaint work orders
- ☐ Scheduled inspections
- ☐ Compliance/overflow tracking
- ☐ Scheduled work orders
- ☐ Sewer system inventory
- ☐ Equipment/tools tracking
- ☐ Customer service
- ☐ Safety incidents
- ☐ Parts inventory
- ☐ Scheduled preventive maintenance
- ☐ Scheduled monitoring/ sampling

MIS-05 Do the written instructions for tracking procedures include the following information? *(Check all that apply)*

- ☐ Accessing data and information
- ☐ Updating the MIS
- ☐ Instructions for using the tracking system
- ☐ Developing and printing reports

MIS-06 How often is the management information system updated? *(Check one)*

- ☐ Immediately
- ☐ Within one week of the "incident"
- ☐ Monthly
- ☐ As time permits

System Mapping (MAP)

MAP-01 Are "as built" plans (record drawings) or maps available for use by field crews in the office and in the field? YES NO

MAP-02 Is there a procedure for field crews to record changes or inaccuracies in the maps and update the mapping system? YES NO

MAP-03 Do the maps show the date the map was drafted and the date of the last revision? YES NO

MAP-04 Do the sewer line maps include the following? *(Check all that apply)*

- ☐ Scale
- ☐ North arrow
- ☐ Date the map was drafted
- ☐ Date of last revision
- ☐ Service area boundaries
- ☐ Property lines
- ☐ Other landmarks (Roads, water bodies, etc.)
- ☐ Manhole and other access points
- ☐ Location of building laterals
- ☐ Street names
- ☐ SSOs occurrences/CSOs outfalls
- ☐ Flow monitors
- ☐ Force mains
- ☐ Pump stations
- ☐ Lined sewers
- ☐ Main, trunk, and interceptor sewers
- ☐ Easement lines and dimensions
- ☐ Pipe material
- ☐ Pipe diameter
- ☐ Installation date
- ☐ Slope
- ☐ Manhole rim elevation
- ☐ Manhole coordinates
- ☐ Manhole invert elevation
- ☐ Distance between manholes

MAP-05 Are the following sewer attributes recorded? *(Check all that apply)*

- ☐ Size
- ☐ Shape
- ☐ Invert elevation
- ☐ Material
- ☐ Separate/combined sewer
- ☐ Installation Date

MAP-06 Are the following manhole attributes recorded? *(Check all that apply)*

- ☐ Shape
- ☐ Type (e.g., precast, cast in place, etc.)
- ☐ Depth
- ☐ Material
- ☐ Age

MAP-07 Is there a systematic numbering and identification method/system established to identify sewer system manhole, sewer lines, and other items (pump stations, etc.)? YES NO

Internal TV Inspection (TVI)

TVI-01 Does the utility have a standardized pipeline condition assessment program? YES NO

TVI-02 Is internal TV inspection used to perform condition assessment? IF NO, GO TO PAGE 17. YES NO

TVI-03 Are there written operation procedures and guidelines for the internal TV inspection program? YES NO

TVI-04 Do the internal TV record logs include the following? *(Check all that apply)*

- ☐ Pipe size, type, length, and joint spacing
- ☐ Distance recorded by internal TV
- ☐ Results of the internal TV inspection (including a structural rating)
- ☐ Internal TV operator name
- ☐ Cleanliness of the line
- ☐ Location and identification of line being televised by manholes

TVI-05 Is a rating system used to determine the severity of the defects found during the inspection process? YES NO

TVI-06 Is there documentation explaining the codes used for internal TV results reporting? YES NO

TVI-07 Approximately what percent of the total defects determined by TV inspection during the past 5 years were the following?

Failed coatings or linings	%	Line deflection	%
House connection leaks	%	Joint separation	%
Illegal connections	%	Crushed pipes	%
Pipe corrosion (H_2S)	%	Collapsed pipes	%
Fats, oil, and grease	%	Offset joints	%
Broken pipes	%	Root intrusions	%
Debris	%	Minor cracks	%
Other	%		

TVI-08 Are main line and lateral repairs checked by internal TV inspection after the repair(s) have been made? YES NO

Sewer Cleaning (CLN)

CLN-01	What is the system cleaning frequency? (the entire system is cleaned every "X" years)	_____
CLN-02	What is the utility's plan for system cleaning (% or frequency in years)?	_____
CLN-03	What percent of the sewer lines are cleaned, even high/repeat cleaning trouble spots, during the past year?	_____ %
CLN-04	Is there a program to identify sewer line segments, with chronic problems, that should be cleaned on a more frequent schedule?	YES NO
CLN-05	Does the utility have a root control program?	YES NO
CLN-06	Does the utility have a fats, oils, and grease (FOG) program?	YES NO
CLN-07	What is the average number of stoppages experienced per mile of sewer pipe per year?	_____ %
CLN-08	Has the number of stoppages increased, decreased, or stayed the same over the past 5 years? ☐ Increased ☐ Decreased ☐ Stayed the same	
CLN-09	Are stoppages plotted on maps and correlated with other data such as pipe size and material or location?	YES NO
CLN-10	Do the sewer cleaning records include the following information? *(Check all that apply)* ☐ Date and time ☐ Method of cleaning ☐ Identity of cleaning crew ☐ Cause of stoppage ☐ Location of stoppage or routine cleaning activity ☐ Further actions necessary/initiated	
CLN-11	If sewer cleaning is done by a contractor are videos taken of before and after cleaning?	YES NO

Manhole Inspection and Assessment (MAN)

MAN-01 Does the utility have a routine manhole inspection and assessment program? IF NO, GO TO QUESTION MAN-06. YES NO

MAN-02 Are the results and observations from the routine manhole inspections recorded? YES NO

MAN-03 Does the utility have a goal for the number of manholes inspected annually? YES NO

MAN-04 How many manholes were inspected during the past year? _____

MAN-05 Do the records for manhole/pipe inspection include the following? *(Check all that apply)*

- ☐ Conditions of the frame and cover
- ☐ Evidence of surcharge
- ☐ Offsets or misalignments
- ☐ Atmospheric hazards measurements (especially hydrogen sulfide)
- ☐ Details on the root cause of cracks or breaks in the manhole or pipe including blockages
- ☐ Recording conditions of (corbel, walls, bench, trough, and pipe seals)
- ☐ Presence of corrosion
- ☐ If repair is necessary
- ☐ Manhole identifying number/location
- ☐ Wastewater flow characteristics (flowing freely or backed up)
- ☐ Accumulations of grease, debris, or grit
- ☐ Presence of infiltration, location, and estimated quantity
- ☐ Inflow from manhole covers

MAN-06 Does the utility have a grouting program? YES NO

Pump Stations (PS)

PS-01	Are Standard Operation Procedures (SOPs) and Standard Maintenance Procedures (SMPs) used for each pump station?	YES	NO
PS-02	Are there enough trained personnel to properly maintain all pump stations?	YES	NO
PS-03	Is there an emergency operating procedure for each pump station?	YES	NO
PS-04	Is there an alarm system to notify personnel of pump station failures and overflow?	YES	NO
PS-05	Percent of pump stations with back up power sources	_____ %	
PS-06	Does the utility use the following methods when loss of power ocurs? *(Check all that apply)* ☐ On-site electrical generators ☐ Portable electric generators ☐ Alternate power source ☐ Other ☐ Vacuum trucks to bypass pump station		
PS-07	Is there a procedure for manipulating pump operations (manually or automatically) during wet weather to increase in-line storage of wet weather flows?	YES	NO
PS-08	Are wet well operating levels set to limit pump start/stops?	YES	NO
PS-09	Are the lead, lag, and backup pumps rotated regularly?	YES	NO
PS-10	Are operation logs maintained for all pump stations?	YES	NO
PS-11	Are the original manuals that contain the manufacturers recommended maintenance schedules for all pump station equipment easily available?	YES	NO
PS-12	On average, how often were pump stations inspected during the past year?	YES	NO
PS-13	Are records maintained for each inspection?	YES	NO
PS-14	Average annual labor hours spent on pump station inspection	_____	
PS-15	Percent of pump stations with pump capacity redundancy	_____ %	
PS-16	Percent of pump stations with dry weather capacity limitations	_____ %	
PS-17	Percent of pump stations with wet weather capacity limitations	_____ %	
PS-18	Percent of pump stations calibrated annually	_____ %	
PS-19	Percent of pump stations with permanent flow meters	_____ %	

Capacity Assessment (CA)

CA-01	Does the utility have a flow monitoring program?	YES	NO
CA-02	Does the utility have a comprehensive capacity assessment and planning program?	YES	NO
CA-03	Are flows measured prior to allowing new connections?	YES	NO
CA-04	Do you have a tool (hydraulic model, spreadsheet, etc.) for assessing whether adequate capacity exists in the sewer system? IF NO, GO TO QUESTION CA-06.	YES	NO
CA-05	Does your capacity assessment tool produce results consistent with conditions observed in the system?	YES	NO

CA-06 What is the ratio of peak wet weather flow to average dry weather flow at the wastewater treatment plant? _____

CA-07 How many permanent flow meters are currently in the system? *(Include meters at pump stations and wastewater treatment plants)* _____

CA-08 How frequently are the flow meters checked? *(e.g. Daily, Weekly, Monthly, etc.)* _____

CA-09 Do the flow meter checks include the following? *(Check all that apply)*

- ☐ Independent water level
- ☐ Velocity reading
- ☐ Downloading data
- ☐ Checking the desiccant
- ☐ Cleaning away debris
- ☐ Battery condition

CA-10	Are records maintained for each inspection? IF NO, GO TO QUESTION CA-12.	YES	NO

CA-11 Do the flow monitoring records include the following? *(Check all that apply)*

- ☐ Descriptive location of flow meter
- ☐ Frequency of flow meter inspection
- ☐ Type of flow meter
- ☐ Frequency of flow meter calibration

CA-12	Does the utility maintain any rain gauges or have access to local rainfall data?	YES	NO
CA-13	Does the utility have any wet weather capacity problems?	YES	NO
CA-14	Are low points or flood-plain areas monitored during rain events?	YES	NO
CA-15	Does the utility have any dry weather capacity problems?	YES	NO
CA-16	Is flow monitoring used for billing purposes, capacity analysis, and/or inflow and infiltration investigations?	YES	NO

Tracking SSOs (TRK)

TRK-01 How many SSO events have been reported in the past 5 years? _____

TRK-02 What percent of the SSOs were less than 1,000 gallons in the past 5 years ? _____ %

TRK-03 Does the utility document and report all SSOs regardless of size? YES NO

TRK-04 Does the utility document basement backups? YES NO

TRK-05 Are there areas that experience frequent basement or street flooding? YES NO

TRK-06 Approximately what percent of SSOs discharges were from each of the following in the last 5 years?

Manholes _____ % Main and trunk sewers _____ % Structural bypasses _____ %

Pump stations _____ % Lateral and branch sewers _____ %

TRK-07 Approximately what percent of SSOs discharges were caused by the following in the last 5 years?

Debris buildup _____ % Root intrusion _____ % Excessive infiltration and inflow _____ %

Collapsed pipe _____ % Capacity limitations _____ % Fats, oil, and grease _____ %

Vandalism _____ %

TRK-07A What percentage of SSOs were released to:

Soil _____ % Basements _____ % Paved area _____ %

Surface water (rivers/lakes/streams) _____ % Coastal, ocean, beaches _____ %

TRK-07B For surface water releases, what percent are to areas that could affect:

Contact recreation (beaches, swimming, areas) _____ % Drinking water sources _____ %

Shellfish growing areas _____ %

TRK-08 How many chronic SSO locations are in the collection system? _____

TRK-09 Are pipes with chronic SSOs being monitored for sufficient capacity and/or structural condition? YES NO

TRK-10 Prior to collapse, are structurally deteriorating pipelines being monitored for renewal or replacement? YES NO

Overflow Emergency Response Plan (OERP)

OERP-01	Does the utility have a documented OERP available for utility staff to use? IF NO, GO TO QUESTION OERP-04.	YES	NO
OERP-02	How often is the OERP reviewed and updated? *(Annually, Biannually, etc.)* _____		
OERP-03	Are specific responsibilities detailed in the OERP for personnel who respond to emergencies?	YES	NO
OERP-04	Are staff continuously trained and drilled to respond to emergency situations?	YES	NO
OERP-05	Do work crews have immediate access to tools and equipment during emergencies?	YES	NO
OERP-06	Does the utility have standard procedures for notifying state agencies, local health departments, the NPDES authority, the public, and drinking water authorities of significant overflow events?	YES	NO
OERP-07	Does the procedure include a current list of the names, titles, phone numbers, and responsibilities of all personnel involved?	YES	NO
OERP-08	Does the utility have a public notification plan?	YES	NO
OERP-09	Does the utility have procedures to limit public access to and contact with areas affected with SSOs? *(Procedure can be delegated to another authority)*	YES	NO
OERP-10	Does the utility use containment techniques to protect the storm drainage systems?	YES	NO

OERP-11 Do the overflow records include the following information? *(Check all that apply)*

- ☐ Date and time
- ☐ Location
- ☐ Any remediation efforts
- ☐ Cause s)
- ☐ How it was stopped
- ☐ Estimated flow/volume discharged
- ☐ Names of affected receiving water(s)
- ☐ Duration of overflow

OERP-12	Does the utility have signage to keep public from effected area?	YES	NO

Smoke and Dye Testing (SDT)

SDT-01	Does the utility have a smoke testing program to identify sources of inflow and infiltration?	YES	NO
SDT-01A	Does the utility have a smoke testing program to identify sources of inflow and infiltration in illegal connectors?	YES	NO
SDT-01B	Does the utility have a smoke testing program to identify sources of inflow and infiltration in house laterals (private service laterals)?	YES	NO
SDT-02	Are there written procedures for the frequency and schedule of smoke testing?	YES	NO
SDT-03	Is there a documented procedure for isolating line segments?	YES	NO
SDT-04	Is there a documented procedure for notifying local residents that smoke testing will be conducted in their area?	YES	NO
SDT-05	What is the guideline for the maximum amount of the line to be tested at one time? *(Feet or Miles)*	_____	
SDT-06	Are there guidelines for the weather conditions under which smoke testing should be conducted?	YES	NO
SDT-07	Does the utility have a goal for the percent of the system smoke tested each year?	YES	NO
SDT-08	What percent of the system has been smoke tested over the past year?	_____ %	
SDT-09	Do the written records contain location, address, and description of the smoking element that produced a positive result?	YES	NO
SDT-10	Does the utility have a dye testing program?	YES	NO
SDT-11	Are there written procedures for dye testing?	YES	NO
SDT-12	Does the utility have a goal for the percent of the system dye tested each year?	YES	NO
SDT-13	What percent of the main collection system has been dye tested over the past year?	_____ %	
SDT-14	Does the utility share smoke and dye testing equipment with another utility?	YES	NO

Hydrogen Sulfide Monitoring and Control (HSMC)

HSMC-01 How would you rate the systems vulnerability for hydrogen sulfide corrosion? *(Check only one)*

☐ Not a problem ☐ Only in a few isolated areas ☐ A major problem

HSCM-02 Does the utility have a corrosion control program? YES NO

HSCM-03 Does the utility take hydrogen sulfide corrosion into consideration when designing new or replacement sewers? YES NO

HSCM-04 Does the utility have written procedures for the application of chemical dosages? YES NO

HSCM-05 Are the chemical dosages, dates, and locations documented? YES NO

HSCM-06 Does the utility document where odor is a continual problem in the system? YES NO

HSCM-07 Does the utility have a program in place for renewing or replacing severely corroded sewer lines to prevent collapse? YES NO

HSCM-08 Are the following methods used for hydrogen sulfide control? *(Check all that apply)*

☐ Aeration ☐ Chlorine ☐ Potassium permanganate
☐ Iron salts ☐ Sodium hydroxide ☐ Biofiltration
☐ Enzymes ☐ Hydrogen peroxide ☐ Other
☐ Activated charcoal canisters

HSCM-09 Does the system contain air relief valves at the high points of the force main system? YES NO

HSCM-10 How often are the valves maintained and inspected? *(Weekly, Monthly, etc.)* _____

HSMC-11 Does the utility enforce pretreatment requirements? YES NO

Appendix 9.10

Computer Model Summary

Computer Model Summary

A.1 Introduction

To perform a capacity analysis of the existing collection system, a computer model of existing sanitary sewers 8 inches and larger within the city limits was prepared. The information required for the preparation of the model included manhole locations, rim elevations, sewer sizes, pipe lengths and invert elevations. The City of Lee's Summit made this information available on an internet "ftp" site in database format. The original database was downloaded as a single geodatabase file. The geodatabase was broken into separate shape files for manholes, pipes, wet wells, pump stations, streets, and basins (watersheds) to be imported into the H2OMap Sewer modeling software.

The software used for the computer model was MWHSoft's H2OMap Sewer. This software was chosen by the city to be used by the city's engineering staff for future planning efforts. Therefore the model was developed with the same software so the city would have a prepared model at the completion of the project.

A.2 Model Set-up

Following downloading and separating the geodatabase the individual files were imported into the H2OMap Sewer software. The attributes of the original database was mapped to the software recognized attributes as indicated in Tables A-1 through A-3 for the indicated system componets.

Table A-1 Manholes and Cleanouts

H2OMap Field Identifier	Database Field Identifier
ID Mapping	FACILITYID
RIM_ELEV	RIMELEVATION

The provided database has a "SUBTYPE" field that has data input differing from what the modeling software recognizes. A new field was created "TYPEH20" to map to TYPE.

For the manholes under the lakes a field had to be created to "seal" these manholes for the modeling software. A sealed manhole does not allow flow to enter or escape from the modeled system.

Table A-2 Gravity and Pressure Pipe

H2OMap Field Identifier	Database Field Identifier
ID Mapping	FACILITYID
MATERIAL	MATERIAL
FROM_INV	ELEVATIONUPSTREAM

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TO_INV	ELEVATIONDOWNSTREAM
LENGTH	RECORDEDLENGTH
DIAMETER	DIAMETER
FROM	UPSTREAMFE
TO	DOWNSTREAM
CAL_LENGTH	SHAPE_LENGTH

The provided database has a "SUBTYPE" field that has data input differing from what the modeling software recognizes. A new field was created "TYPEH20" to map to TYPE.

Table A-3 Wet Wells

H2OMap Field Identifier	Database Field Identifier
ID Mapping	FACILITYID
WWELLHYD->TYPE	WETWELLTYP
WWELLHYD->BTM_ELEV	WETWELLBOT
WWELLHYD->MIN_LEVEL	WETWELLMIN
WWELLHYD->MAX_LEVEL	WETWELLMAX
WWELLHYD->INIT_LEVEL	WETWELLINI
WWELLHYD->DIAMETER	WETWELLDIA

Pump Stations

Pump station information was provided by city staff and the pump features were created within the modeling software.

The modeling software error checking capabilities and engineering judgement were used to clean up the inventory data. Assumptions used for data cleanup were as follows:

- All manholes were modeled as 4' diameter.
- Orphaned links and nodes were eliminated from the system.
- Links with undefined nodes were redrawn to define node information for the link.
- Similarly links with identical end nodes and with invalid number of items were redrawn capturing the correct manholes.
- Rim elevations for manholes indicating rim elevations lower than pipe invert elevation were arbitrarily raised to an elevation of 1000 feet. Some instances required the rim elevation to be raised to 1100 feet.

- Invert elevations were set to the elevation of the adjacent link upstream or downstream when possible. Straight line interpolation was used when no other information was available.

A detailed inventory of sanitary sewer system assets is provided in Section 4.

A.4 Model Loading

Once the database was cleaned up to the point the model would perform a complete run projected wet weather flows were loaded into each manhole. The projected flows were provided by Archer Engineers. To identify how much flow would be loaded into each manhole a map was developed detailing 158 sub-basins. A spreadsheet was created along with the map with the projected peak wet weather flows to be produced from each individual basin. Please see section 3.5 for details on the development of the projected flows.

Once the incremental flow by sub basin was established the data was further refined by calculating an estimated base flow for average daily conditions. The base flow and peak flow were related in a "peaking" curve that was loaded into the model. This curve was used to similate the relationship that as the area of drainage increases the amount of flow per acre decreases. Once the amount of flow to be loaded into each basin was calculated GIS functions in ArcGIS were used to count the number of manholes in each sub basin and insert a field into the database indicating which basin each manhole was in. Combining the information a load per manhole was established for each sub basin and the manholes could be loaded with a lookup function in Microsoft Office Excel. From there a comma delimited text file was generated that could be loaded into the model providing the load for each manhole.

A.5 Model Runs

Projected flows for each of 3 conditions were established: 2015 growth projections, ultimate growth projections assuming all PRI property would eventually develop, and ultimate growth projections assuming all PRI property would not develop. The previously described procedure was carried out for each growth condition. The loads for each growth condition were loaded into separate scenerios within the model and the curve from each condition was assigned to peak the corresponding scenerio. Each scenario was run within the model. At the completion of each scenario run the cumulative output from the model was compared back to the original flow projection spreadsheet to verify the output of the model. With additional manipulation of the base flows within the model the output agreed with the spreadsheet to within 5%-7.5%.

As these model runs were completed the output indicating which gravity mains were overloaded was used as the basis for the improvements recommended in section 5.1.

In addition to the model run for each of the growth conditions a model run was performed using the 1998 monitered flows from the GBA report. The monitored flows were only input into the model for the basins indicating a higher k-value than 0.006. The "k"-value is an assigned value based on the leakyness of the system.

The information from this run was compared against the amount of overloaded pipe from the ultimate growth projection with PRI scenario. This comparison provided a cost

effective analysis of the recommended collection system improvement detailed in section 7.1.

A.6 Model Maintenance and Updating.

The model developed is based on the City's GIS inventory data, flow and rainfall monitoring performed by others, the standard design flow curve for the City, and population estimates. The model is a representation of the sewer system and is a valuable tool to evaluate system capacity and to determine the effectiveness of planned improvements. In order to keep the model in good working order, it is important that regular model maintenance and updates be performed on a regular basis. Model maintenance recommended is as follows:

- Continue to resolve differences between the City GIS system and the model. It is recommended that the City's GIS department conduct checks identify differences and make recommendations for updates to the model inventory.
- Incorporate completed system improvement projects into the model on an annual basis.
- Incorporate new flow and rainfall data into the model loading parameters. It is recommended that the model be recalibrated on at least a 5 year cycle.
- Convert the existing model into a fully dynamic model by upgrading the existing software