Chapter 4: Water Resources

Chapter 4 contains information regarding the Sanitary Sewer, Surface Water Management and Water Supply Plan.

Sanitary Sewer

1. INTRODUCTION

Purpose
The Sanitary Sewer Plan describes the existing sanitary sewer system, projects future wastewater flows, and proposes improvements to satisfy future conditions. The City is responsible for local wastewater collection, while the Metropolitan Council provides regional collection and treatment. Accordingly, the City uses this Plan to evaluate its local collection facilities, and the Metropolitan Council uses it to evaluate its regional collection and treatment facilities.

Community Forecasts
As shown in the table below, the Circle Pines population will not exceed 5,280, households will not exceed 2,180, and employment will not exceed 800 by the year 2040. Circle Pines is a fully developed community and will not require significant changes to the sanitary sewer system in the next 20 years.

Table 1. Community Forecasts

	2020	2030	2040
Sewered Population	5,030	5,120	5,280
Sewered Households	2,040	2,090	2,180
Sewered Employment	750	750	800
Unsewered Household	1	1	1

Because the City is not expecting significant increase in the projected population, households, or employment, the projected increase in wastewater flow is not significant enough to require changes to the existing sanitary sewer system. Any new development is anticipated to occur as redevelopment of areas that are already served by the sanitary sewer system.

2. EXISTING SANITARY SEWER SYSTEM

Summary

The City of Circle Pines sanitary sewer system includes 18 miles of gravity sewer, 501 manholes, 3 lift stations, and 0.6 miles of forcemain. The system has been divided into four districts, and further into sixteen sub-districts, for the purposes of capacity analysis. The existing sanitary sewer system and the sanitary sewer districts are shown in **Figures 4-1** and **4-2**.

The system collects and conveys the City's wastewater to Metropolitan Council Environmental Services (MCES) Meter M205. From there, the wastewater flows through the MCES regional system to the MCES Metropolitan Wastewater Treatment Plant (WWTP) located southeast of St. Paul on the Mississippi River. The Metropolitan WWTP has a capacity of 251 MGD, provides advanced secondary treatment with chlorination/dechlorination, and discharges treated effluent to the Mississippi River. It also generates energy from the residual biosolids for in-plant use.

Gravity Sewer

The City's gravity sewers consist of 8-inch to 15-inch diameter polyvinyl chloride (PVC) pipe, vitrified clay pipe (VCP), and cured-in-place pipe (CIPP). A summary of the trunk gravity sewers (greater than 8-inch diameter) is provided below.

Table 2. Trunk Sewers

District	Sub-District	Trunk Location	Diameter	Capacity (gpm)
North	1	Stardust Blvd	12"	750
	5	East Rd	15"	1,120
Central	7	Lake Dr	10"	520
	8	Tamarack Park	10"	570
	9	Golden Lake Rd	15"	1,120
	12	Woodland Rd	10"	520
South	13	Flowerfield Rd	12"	750

Lift Stations

The City's sanitary sewer system includes three (3) lift stations, as summarized below.

Table 3. Lift Stations

No.	Name	Year Constructed	Firm Pumping Capacity (gpm)
1	E Golden Lake LS	2016	110
2	Hillcrest LS	1983	175
3	Indian Hills LS	1987	220

M207
M211
M206
M205
1
2
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6
7
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15
16
LS
Circle Pines
Lexington
Golden Lake
Rice Creek
North Star Park
Inner Park
Carl Eck Park
West Oak Park
Tamarack Park
Golden Lake Beach Park
Lake Dr
Hodgson Rd
Woodland Rd
Jackson Ave
Dunlap Ave
Lexington Ave N
Lexington Ave NE
Cord St NE
Fraizer St NE
Ghia St NE
Hupp St NE
Isetta St NE
Jewell St NE
102nd Ave NE
101st Ln NE
97th Ln NE
88th Ln NE
87th Ave NE
85th Ave NE
Sandhill Dr

Gravity Main
- 8"
- 10"
- 12"
- 15"
- Lift Station
- Forcemain
- MCES Meter
- MCES Interceptor
- Sanitary Sewer Districts
- City Boundary
- Parcel

City of Circle Pines

Figure 4-1. Existing Sanitary Sewer System

Comprehensive Sanitary Sewer Plan
City of Circle Pines, MN

N

0 800 Feet
1 inch = 800 feet

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M207
M211
M206
M205
1
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13
14
15
16
LS
Circle Pines
Lexington
North Star Park
Inner Park
Carl Eck Park
West Oak Park
Tamarack Park
Golden Lake
Golden Lake Beach Park
Rice Creek
Baldwin L
Lake Dr
Woodland Rd
Hodgson Rd
Sandhill Dr
Dunlap Ave
Jackson Ave
Lexington Ave NE
Cord St NE
Fraizer St NE
Ghia St NE
Hupp St NE
Isetta St NE
Jewell St NE
101st Ln NE
102nd Ave NE
97th Ln NE
88th Ln NE
87th Ave NE
85th Ave NE
Ave NE
Ln NE
Sanitary Sewer Districts
North
Northeast
Central
South
Gravity Main
8"
10"
12"
15"
Lift Station
Forcemain
MCES Meter
MCES Interceptor
City Boundary
Parcel

City of Circle Pines

Figure 4-2. Sanitary Sewer Districts

Comprehensive Sanitary Sewer Plan
City of Circle Pines, MN

N
0 800 Feet
1 inch = 800 feet

wsb

Historical Wastewater Flows

The total per capita wastewater flow was calculated from MCES flow meter data from 2014-2018 and from populations interpolated based on the Metropolitan Council 2015 System Statement Forecasts for the City. The average total per capita wastewater flow from 2014-2018 was 65 gallons per capita per day.

Table 5. Historical Wastewater Flows

Year	Annual Flow (MG)	Average Daily Flow (MGD)	Total Per Capita Flow (gpcd)
2014	132	0.361	72
2015	119	0.327	65
2016	128	0.349	69
2017	109	0.298	59
2018	113	0.309	62

MG = million gallons; MGD = million gallons per day; gpcd = gallons per capita per day

Individual Sewage Treatment Systems

There is one individual sewage treatment system (ISTS) within the City of Circle Pines which serves a private residence and has no known issues. The location of this system is shown in **Figure 4-3**. The City Code requiring filling of existing ISTS and connection to the public collection system is excerpted below.

> *610.10 Existing Septic Tanks to be Filled.*
> *Upon applying for a permit to connect to the municipal sanitary sewer system, the applicant shall agree when applicable to pump out the contents of any cesspool or septic tank then located on this property and to refill same with noncombustible and non-deteriorating fill to the lot level. The owner or his/her agent shall have such septic tank and/or cesspool pumped and filled within one year from the time that said sewer connection is completed.*
>
> *620.02 Use of Public Sewers Required.*
> *Subd. 3 Construction of Sewage Disposal Facilities. Except as herein and under this Section of any municipality, it is unlawful to construct or maintain any privy, privy vault, septic tank, cesspool or other facilities intended or used for the disposal of sewage, or the disposal of any other type waste which pollute any waters of the state within the District.*

Intercommunity Flows

The service areas for the intercommunity sanitary sewer connections between the City of Circle Pines and neighboring communities are as follows:

Table 4. Intercommunity Flows

City	INTO Circle Pines	FROM Circle Pines
Lino Lakes	6 services	57 services
Blaine	70 services	-
Total	**76 services**	**57 services**

Community Treatment Systems

There are no public or private community treatment system within the City of Circle Pines. All properties within the City are served by the public collection system or by individual sewage treatment systems.

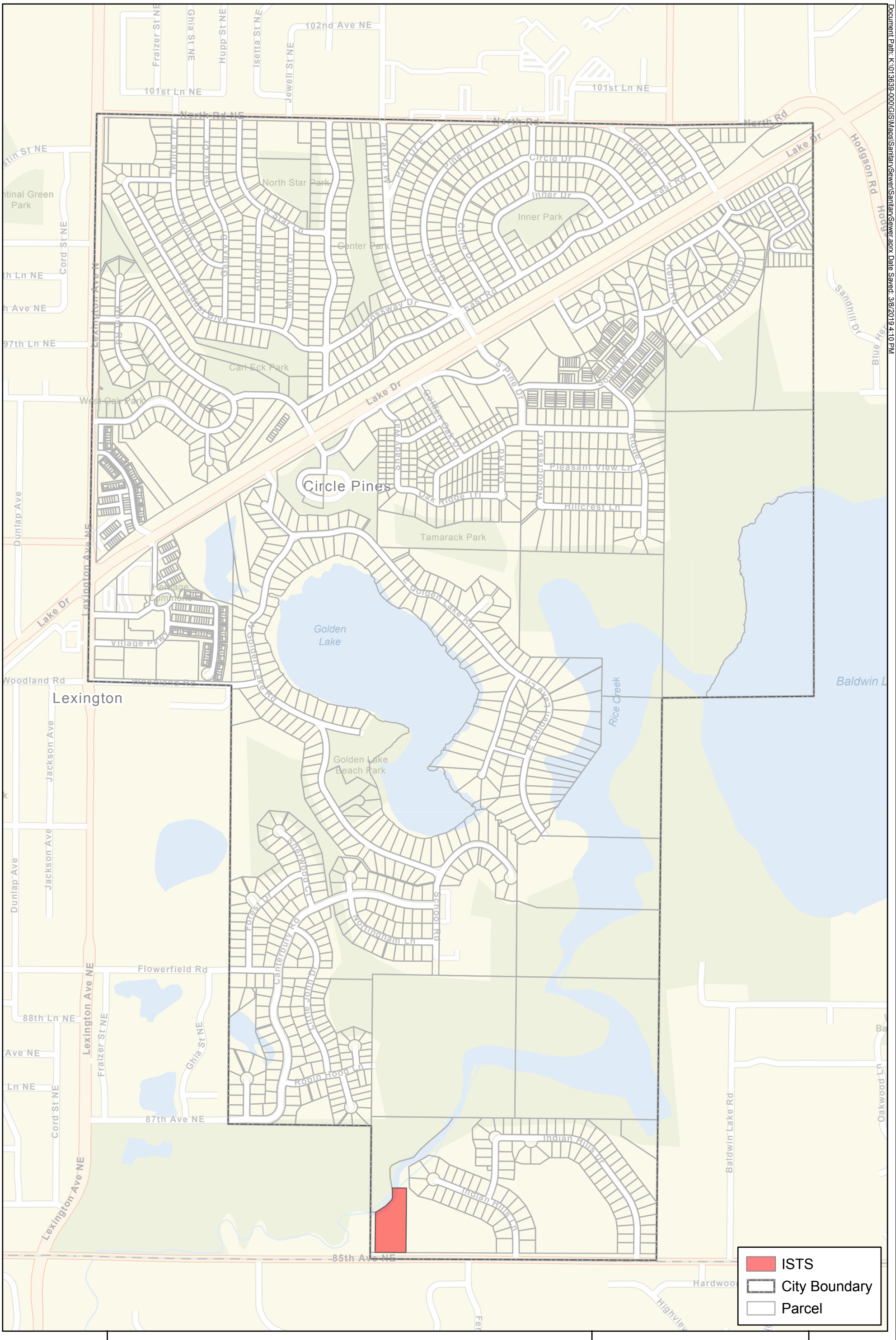

Figure 4-3. Individual Sewage Treatment Systems

Comprehensive Sanitary Sewer Plan
City of Circle Pines, MN

N

0 800 Feet

1 inch = 800 feet

3. FORECASTS AND CAPACITY ANALYSIS

Forecasts
The community forecasts for the City of Circle Pines are provided above in **Table 1**. The entire City is sewered and served by MCES Meter M205 and Interceptor 4-NS-523, with the exception of one ISTS. All projected growth will be served by the same MCES facilities.

Methodology
The City's existing land use designations were used to estimate existing wastewater flows. These flows were then calibrated to equal the average community-wide metered flow from 2014-2018. Future flows were estimated based on areas within the City that are expected to develop or redevelop and the wastewater flow assumptions in **Table 6**. Standard MCES peak hourly flow factors for sanitary sewer design were applied to calculate future peak hourly flows.

Table 6. Assumed Wastewater Flow by Land Use Type

Land Use	Average Daily Flow
Single Family Residential	180 gpd/unit
Medium Density Residential	1,440 gpd/acre
Multifamily Residential	3,600 gpd/acre
Mixed Use (50% Multifamily, 50% Commercial)	2,200 gpd/acre
Commercial, Industrial	800 gpd/acre
Institutional	600 gpd/acre
Parks, Open Space, ROW, Water	None

Trunk Sewer Capacity
The projected peak hourly flow and residual capacities in the City's trunk gravity sewers are listed below. The peak hourly flows listed include the flow from upstream sub-districts and lift stations. All trunk gravity sewers are projected to have adequate capacity through the year 2040.

Table 7. Trunk Sewers

Trunk Location	Diameter	Capacity (gpm)	2040 Peak Hourly Flow (gpm)	Residual Capacity (gpm)
Stardust Blvd	12"	750	107	643
East Rd	15"	1,120	80	1,040
Lake Dr	10"	520	139	381
Tamarack Park	10"	570	233	337
Golden Lake Rd	15"	1,120	256	864
Woodland Rd	10"	520	178	342
Flowerfield Rd	12"	750	315	435

Lift Station Capacity

The projected peak hourly flow and residual capacities in the City's lift stations are listed below. All lift stations are projected to have adequate capacity through the year 2040.

Table 8. Lift Stations

No.	Name	Firm Pumping Capacity (gpm)	2040 Peak Hourly Flow (gpm)	Residual Capacity (gpm)
1	E Golden Lake LS	110	29	81
2	Hillcrest LS	175	50	125
3	Indian Hills LS	220	39	181

Proposed Improvements

The proposed sanitary sewer system improvements are shown in **Figure 4-4**. Because the City is fully built out, few significant sanitary sewer system improvements are needed to serve forecasted growth and redevelopment.

The Land Use Plan identifies an opportunity for development of two parcels on the southern boundary of the City along County Road J. These parcels are partially isolated from the existing system by wetlands, and there are a few options for extending sanitary sewer service to this area. They can be served by (1) a gravity extension from Indian Hills Lane in Sanitary Sewer District 14 with insulation or fill, (2) a new lift station discharging to Sanitary Sewer District 14, or (3) a gravity extension from the City of Shoreview sanitary sewer system in Fernwood Street. Prior to development of this site, it is recommended that a feasibility study be completed to determine the most practical and cost-effective solution for extending service to that location.

M207
M211
M206
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Cty Rd J Sanitary Sewer Extension
Circle Pines
Lexington
North Star Park
Inner Park
Carl Eck Park
West Oak Park
Tamarack Park
Golden Lake
Golden Lake Beach Park
Rice Creek
Baldwin L
Hodgson Rd
Lake Dr
Woodland Rd
102nd Ave NE
101st Ln NE
North Rd NE
97th Ln NE
88th Ln NE
87th Ave NE
85th Ave NE
Jackson Ave
Dunlap Ave
Lexington Ave N
Lexington Ave NE
Cord St NE
Fraizer St NE
Ghia St NE
Hupp St NE
Isetta St NE
Jewell St NE
Sandhill Dr
LS

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City of Circle Pines

Figure 4-4. Proposed Sanitary Sewer System

Comprehensive Sanitary Sewer Plan
City of Circle Pines, MN

N
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4. INFLOW AND INFILTRATION

Introduction

Inflow and Infiltration (I/I) refers to water entering the sanitary sewer system from unintended sources. The water is typically clear, that is, not requiring treatment at the same level as wastewater. Inflow is runoff from rain events that drains directly into the sanitary sewer from such sources as storm sewer cross connections, foundation drains, sump pumps, and open manholes. Infiltration refers to groundwater that enters the sewer system through open pipe joints, leaking manhole walls, and cracked or broken pipe.

Inflow generally appears as a dramatic spike in the sewer flow during and immediately after a rain or snow melt event. The duration is generally short and the peak flow high. Oftentimes, inflow will result in short-term system backups that can flood basements and occasionally rise out of manholes.

Infiltration is also highlighted during rain and snow melt events, however, the rise in flow is delayed and flow rates can remain elevated for quite some time. The delay in rising flow rates is due to the time required for rainwater to filter through the ground to the sanitary sewer. This filtering both reduces the peaks and prolongs the duration of the high flows.

If left unchecked, I/I create additional cost for communities for a number of reasons. First, treating water that is already clean creates unnecessary chemical and electrical costs. Second, the dilution of the wastewater reduces the efficiency of the treatment process, making it more difficult to meet pollutant elimination regulations. Third, treatment plants and sanitary sewers must be made larger to handle the peak flows that can surge to the treatment plant after runoff events. It is more cost effective to eliminate sources of I/I than it is to expand infrastructure to collect and treat it.

MCES establishes annual I/I goals for each community discharging wastewater to its regional collection system based on average flows, adjustments for community growth, and I/I mitigation peaking factors.

I/I Reduction Strategy

Removing I/I from the sanitary sewer system requires a continuing program of replacement, inspections, maintenance, and repairs. The sanitary sewer system is no different than other infrastructure types. As with streets, every year the condition of the sewer system degrades. Cracks form, joints leak, and infiltration increases. If the existing system is left alone, it will only continue to deteriorate and become worse.

The I/I Reduction Program will consist of televising each main line every ten years, on a rotating schedule, to determine the repairs needed to eliminate the I/I from the area. Typical inspections will be manhole inspections. Typical repairs will include pressure grouting of pipe and manholes, slip lining of pipe, structural lining of manholes, and installation of chimney seals on manhole adjusting rings.

Of particular importance is the last item, installation of chimney seals. Because of the freeze thaw cycles in Minnesota, the adjusting rings (the area between the cast iron frame and the precast manhole wall) are especially susceptible to cracks and I/I. Typically, the joints between the rings, frame and manhole wall are made of mortar which does not have a great deal of flexibility. During freeze/thaw cycles, the castings move up and down with the roadway, cracking the mortar joints and opening an I/I pathway. "Chimney seals" are one type of flexible rubber gasket that can be installed around the inside or outside of the manhole. They flex with the ground during freeze/thaw cycles and remain watertight. There are several types of these flexible products available to address the variable conditions and uses in a collection system.

Reducing I/I also includes eliminating clearwater sources from private properties. The City Code prohibiting the discharge of clearwater to the sanitary sewer system is excerpted below. The City will pursue an ordinance requiring the disconnection of existing foundation drains, sump pumps, and roof leaders from the sanitary sewer system within six months of the adoption of this plan.

> *620.03 Public Sewers; Unpolluted Waters Prohibited.*
> *Subd. 1 Prohibited Discharges. No person shall discharge or cause to be discharged, directly or indirectly, to any sanitary sewer any of the following: storm water, surface water, groundwater, roof runoff, subsurface drainage, cooling water, or unpolluted industrial process waters.*

Existing I/I Analysis

The existing sanitary sewer system is made up of approximately 18 miles of gravity sewer, 501 manholes, 3 lift stations, and 0.6 miles of forcemain. There are also approximately 1.9 miles of MCES trunk sewer within the City. Approximately 40% of the housing in the City was constructed before 1970. The only I/I evaluation of the pre-1970 era housing has been the televising of the lateral connection to the main.

The amount of clearwater flow generated within the City was estimated by calculating the average annual and peak month I/I rates, equal to the average wastewater flow minus the base wastewater flow, using data from 2014-2018. The average flow, both annual and monthly, was calculated from MCES meter data. The peak month flow was determined for each year from 2014-2018, and then those peak month flows were averaged to give the value listed in **Table 9**. The base flow was approximated as the minimum daily flow within each year.

The City's metered flow is calculated using data from four meters: M205 – (M206 + M207 + M211). Because the City's meter formula is based on data from three other meters in other communities (Lexington, Blaine, and Lino Lakes), its data is susceptible to errors and irregularities from all of these metersheds and the intermediary regional collection system. Therefore, the data presented below should be considered qualitative in nature, rather than an exact quantification of I/I within Circle Pines.

Table 9. Estimated I/I Rate

Average Flow	0.33 MGD
Peak Month Flow	0.40 MGD
Base Flow	0.18 MGD
Average Annual I/I Rate	0.15 MGD (45%)
Peak Month I/I Rate	0.22 MGD (55%)

MGD = million gallons per day

It is also important to note that the City began a Street Reconstruction Program in 2008 that incorporated the replacement of all utilities, including sanitary sewer mains. The projects occur every other year and will continue until 2020. As shown in **Table 10**, significant investment has been made in the sanitary sewer system from 2014-2018, when this flow data was collected. Therefore, the full impact of these improvements has not yet been metered and is not reflected in the I/I rates listed in **Table 9**. In other words, it is expected that actual current I/I rates are lower than those above given the improvements made in recent years.

I/I Work Completed

The City completes regular street and utility improvement projects, typically every other year. These projects include pipe replacement, manhole replacement, casting adjustments, chimney seals, lining, and televising. The sanitary sewer costs for the projects completed in the last ten years are listed in **Table 10**. The City invests approximately $300,000 dollars each year in sanitary sewer improvements, which will lead to a long-term reduction of I/I.

Table 10. I/I Reduction Work

Year	Project	Cost
2008	West Golden Lake Rd Improvements	$389,371
2010	2010 Street Reconstruction	$332,103
2012	2012 Street Reconstruction	$341,572
2014	2014 Street Reconstruction	$687,403
2015	2015 Mill and Overlay Improvements	$59,780
2016	2016 Street and Utility Improvements	$521,394
2018	2018 Street and Utility Improvements	$837,862
2018	2018 Partial Street Reconstruction	$15,969

With the televising completed during the street and utility improvement projects, the City is able to view the condition of the private service lateral connections to the public sewer mains and identify any issues. The City will explore additional activities for I/I reduction from private sources, such as sump pump inspections, smoke testing, and service lateral televising.

I/I Cost Effectiveness

It is important to consider the cost effectiveness of the annual program described above. I/I reduction programs have varied effectiveness in reducing I/I rates. Some very successful programs have significantly reduced the amount of I/I in the sewer systems. However, it is also common for there to be very little actual reduction in I/I flow. That is not to say that these programs were not successful, just that all of the potential I/I sources could not be immediately identified and rehabilitated. The I/I defects that are rehabilitated will reduce treatment costs, but additional previously-unidentified sources may become active, suggesting that the removal was not completely effective.

Infiltration, as opposed to inflow, is very difficult to remove because the groundwater can enter any crack in manholes, sewer pipes, joints, and service lines. When one crack is repaired, the water may enter through another one further upstream. Each repair makes it more difficult for water to enter, but it is impossible to completely eliminate all infiltration.

On the other hand, if nothing is done in terms of maintenance and repair, pipes and manholes will continue to deteriorate, increasing the amount of groundwater entering the system. So, while the volume of I/I may or may not decrease with annual maintenance, I/I certainly will not increase as quickly as it would if nothing had been done.

Therefore, while a definitive answer to the question of how much I/I will be removed from the sewer system cannot be answered, the cost effectiveness of both the annual maintenance and sump pump removal programs are inherent. The annual maintenance program is needed as much for future I/I prevention as it is for current I/I reduction. No programs for I/I reduction will ever eliminate all of the clearwater from the sanitary sewer system.

5. CAPITAL IMPROVEMENTS

The City is fully built out, so the sanitary sewer capital improvements primarily consist of maintaining the existing infrastructure. As mentioned previously, the City will televise all sanitary sewer pipes once every ten (10) years on a rotating schedule. At a televising cost of $1.30 per linear foot, with a 10% contingency and 25% indirect costs, this equates to an annual investment of approximately $18,000.

Table 11. Sanitary Sewer Capital Improvements

Year	Project	Estimated Cost
2019	SCADA System Upgrades	$12,000
	Sewer Service Truck	$58,000
	I/I Reduction	$10,000
2020	Sewer Jetter Truck	$300,000
2023	I/I Reduction	$10,000
TBD	Cty Rd J Sanitary Sewer Extension	TBD*

**Pending feasibility study.*

6. SUMMARY AND RECOMMENDATIONS

In summary:

1. The City of Circle Pines has an existing sanitary sewer system made up of approximately 18 miles of gravity sewer, 501 manholes, 3 lift stations, and 0.6 miles of forcemain. There are also approximately 1.9 miles of MCES trunk sewer within the City.

2. The City has made significant investments to replace and rehabilitate the sanitary sewer system in the last ten years, which is expected to result in a reduction of I/I.

3. The City will continue I/I reduction efforts with an annual program to identify and reduce I/I sources. It is recommended that the annual I/I Reduction Program include televising, inspection, and repair of approximately 10% of the sanitary sewer system each year.

4. The City will continue to maintain the existing sanitary sewer system via the improvements listed in **Table 11**. Because the City is fully built out, no major improvements to the sanitary sewer system are required.