Comprehensive Wastewater Plan

March 2023

Western Lake Superior Sanitary District
2626 Courtland Street • Duluth, MN 55806
(218) 722 - 3336 • wlssd.com

WLSSD Board of Directors

WLSSD is governed by a nine-member citizen board. The makeup of the board is defined in Minnesota statutes within WLSSD's enabling legislation. Four members are appointed by the City of Duluth, three by the City of Cloquet, one is elected by Carlton County cities and townships in the WLSSD service area and one is elected by St. Louis County cities and townships in the service area. Board members are selected by the communities they serve and provide direction and oversight to the programs and employees of WLSSD.

- Laura Ness, Chair
- Julene Boe, Vice Chair
- Paul Thomsen, Treasurer
- Rob Schilling, Secretary
- Jack Ezell
- Marcia Podratz
- David Manderfeld
- Jim Aird
- Loren Lilly

WLSSD Executive Director

- Marianne Bohren

Wastewater Comprehensive Adoption Date

- February 27, 2023
- Amended April 28, 2025

Engineer Certification

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: ______________________________

Name: Nathan D. Hartman

Date: 3/1/2023 **License #:** 50391

RESOLUTION 25-07
AMENDING WLSSD COMPREHENSIVE WASTEWATER SERVICES MASTER PLAN TO EXPAND THE URBAN SERVICES BOUNDARY

WHEREAS, the Western Lake Superior Sanitary District (WLSSD) adopted an amended Comprehensive Wastewater Services Plan in March of 2023.

WHEREAS, the Comprehensive Wastewater Services Plan describes the Urban Services Boundary in Figure 4.2 and Table 4-1.

WHEREAS, the City of Hermantown has requested an expansion of the Urban Services Boundary near the Highway 2 Corridor to provide wastewater services to facilitate residential, light industrial and commercial development.

WHEREAS, the revised expanded Urban Services Boundary is shown as a red line in attached **Exhibit A.**

WHEREAS, expansion of the Urban Services Boundary as proposed is consistent with the WLSSD Comprehensive Wastewater Services Plan.

NOW, THEREFORE, BE IT RESOLVED, the Board finds that expansion of the WLSSD Urban Services Boundary as proposed is in the District's best interest and meets the requirements set forth in Chapter 458D of Minnesota Statutes.

BE IT FURTHER RESOLVED, that for the reasons set forth herein, and for other good and sufficient reasons, the WLSSD Urban Services Boundary is expanded to include the area identified in **Exhibit A**, and the Comprehensive Wastewater Services Plan is hereby amended to provide for the expanded Urban Services Boundary.

WESTERN LAKE SUPERIOR SANITARY DISTRICT

By ______________________
Julene Boe
Its Chair

By ______________________
Robert Schilling
Its Vice Chair

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Executive Summary

The Western Lake Superior Sanitary District (WLSSD) serves a population of approximately 140,000 people including eight cities, nine townships, and four industrial customers. On average, WLSSD conveys and treats approximately 36 million gallons per day (MGD) of wastewater, which discharges into the St. Louis River estuary.

The WLSSD Wastewater Comprehensive Plan is the overarching planning document that presents key issues and opportunities and serves as the guide to future water quality planning, capital budgeting and facility management for the District. This document serves as an update to the District's 2016 Wastewater Comprehensive Plan.

The content of the Wastewater Comprehensive Plan centers on the main mission of the WLSSD to develop and provide a plan that is environmentally sensitive to key water quality and wastewater collection and treatment needs that is consistent with community plans and state and federal regulations. This document also functions as the WLSSD Facility Plan submittal to the Minnesota Pollution Control Agency (MPCA) pursuant to Minn. R. 7077.0272.

This Comprehensive Plan provides an evaluation of the District's wastewater treatment facilities, a revised assessment of the treatment plant capacity and highlights opportunities for the optimization of the current treatment facilities and processes. The Plan provides an updated condition assessment the District's network of interceptor sewers and pump stations along with a revised capacity evaluation of the collection system looking at current flows and year 2050 flows based upon projected population and employment growth in the area. This plan also outlines the future roadmap of energy improvements to meet the District's energy and treatment goals while focusing on transforming WLSSD from a net energy user to an energy independent utility.

A significant challenge to wastewater treatment facilities currently are anticipating and preparing for new water quality regulations to address emerging contaminants of concern. This Plan summarizes and discusses those pollutants and specific regulatory and scientific focus areas that are a priority for WLSSD. The Comprehensive Plan works to integrate water quality enhancement and compliance goals into planning efforts and District capital improvement projects.

By including all District facilities and processes in this Comprehensive Plan, the result is a thorough and well-coordinated resource that will serve as a guidance document for future WLSSD projects, initiatives, and investment decisions. A great deal of data and information has been collected and analyzed in developing a useful and beneficial Comprehensive Plan. This document includes the following main topic areas:

- Introduction and Background
- Demographics and Land Use
- Environmental Characteristics
- Wastewater Service Areas
- Wastewater Treatment Process and Facility Analysis
- Collection System Process and Facility Analysis
- Regulatory Compliance and Scientific Focuses
- Plan Recommendations and Capital Improvement Program
- Plan Administration

Comprehensive Plan Goals

The goals of this Comprehensive Plan offer broad guidelines for providing the highest standard of public facilities and services to support the current and future population and employment growth within the District area while protecting and preserving water quality. The list below identifies the goals of this Comprehensive Plan for meeting the mission of WLSSD and state and federal regulations.

1. Maintain full compliance with the National Pollutant Discharge Elimination System (NPDES) Permit issued to WLSSD (MN0048786).

2. Provide cost effective and environmentally sound wastewater collection and treatment facilities, in accordance with Minnesota State Statute 458D.05, which provides for the preservation and best and most economic use of the water and other natural resources within the District.

3. Collaborate with appropriate agencies and local governmental units in their planning efforts to ensure coordination and compatibility of local plans with the WLSSD Wastewater Comprehensive Plan.

4. Keep District customers and the community at-large informed of the progress and investment made in maintaining and improving the District's regional wastewater collection and treatment system and local water quality management initiatives.

5. Ensure operational efficiencies through implementation of best management practices related to cost effective preventative maintenance and utilizing a comprehensive asset management program to manage and track operating and life cycle costs of District assets

6. Continue to work toward energy self-sufficiency by establishing and implementing an effective and fiscally responsible energy management and conservation program that supports modern technological capabilities and customer satisfaction, provides a safe and comfortable work environment, while maintaining effective operations and compliance with all permit requirements.

7. Build and maintain the resiliency of District infrastructure by developing long-term strategies that strengthen the District's ability to prepare for, respond to, recover from, and adapt to a range of climate related threats (environmental, economic, social) which may create system vulnerabilities that could lead to a disruption of critical wastewater treatment services to residents and businesses.

8. Actively engage and promote fair and equitable involvement with District residents and stakeholders in planning for WLSSD wastewater collection and treatment regardless of race, color, national origin or income.

9. Develop and implement financial policies and practices consistent with the District's enabling legislation and other applicable state and federal requirements while maintaining a sustainable capital improvement program to meet the long-term needs of the WLSSD and its customers.

10. Maintain Minnesota Safety and Health Achievement Recognition Program (MNSHARP) certification at District facilities to ensure employee, contractor, and public safety at all WLSSD facilities and continue to exceed State and Federal safety regulations and recommendations.

Section 1: Introduction and Background

1.1 Location and Planning Area

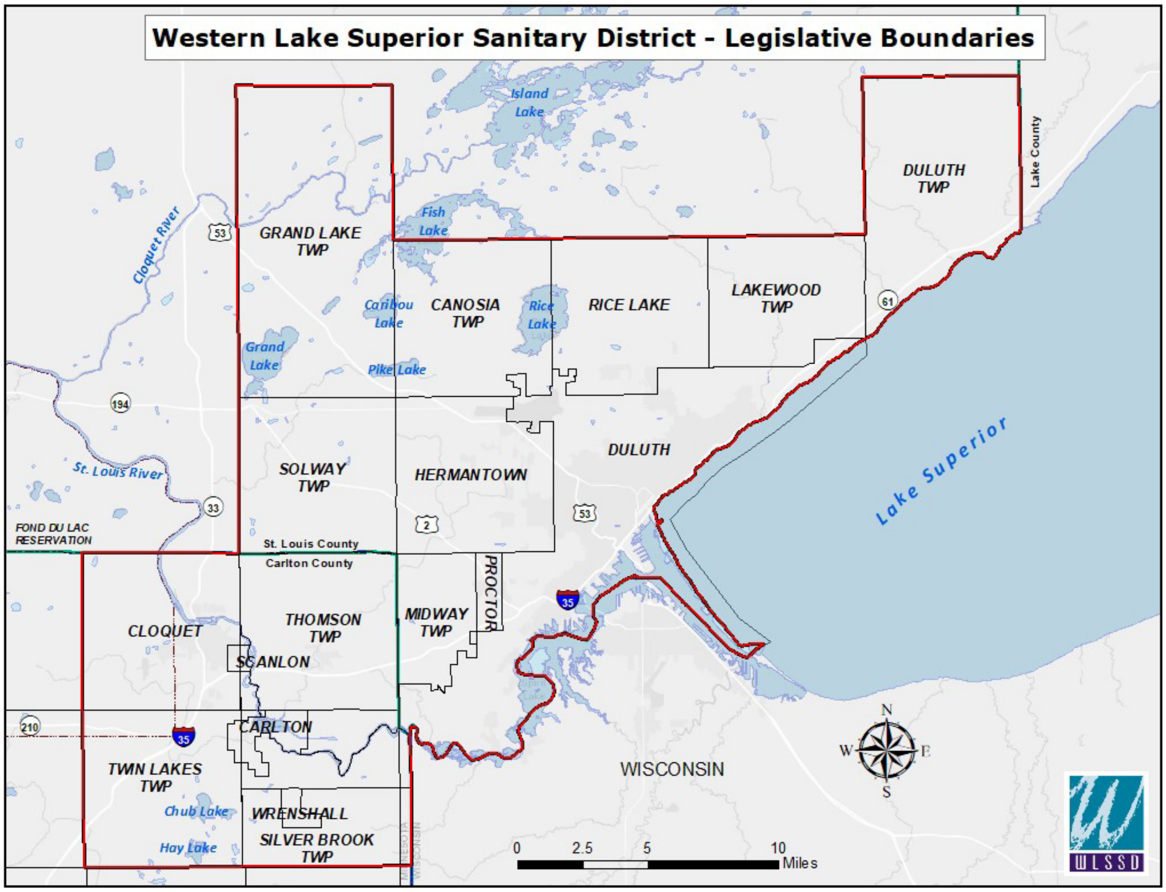
The Western Lake Superior Sanitary District ("WLSSD" or "the District") is located in northeastern Minnesota at the western tip of Lake Superior (**Figure 1-1**). The District covers an area of approximately 530 square miles in northeastern Carlton County and southeastern St. Louis County.

Figure 1-1, WLSSD Location Map

Within the WLSSD legislative boundaries are eight cities and nine townships including the cities of Duluth, Cloquet, Hermantown, Rice Lake, Proctor, Scanlon, Carlton and Wrenshall along with the townships of Silver Brook, Thomson, Twin Lakes, Canosia, Duluth, Grand Lake, Lakewood, Midway, and Solway. Four industries are direct customers to WLSSD including Sappi, USG and Specialty Minerals in the City of Cloquet and the ST Paper 1, LLC mill in the City of Duluth.

The District also serves the Village of Oliver in Wisconsin and the Knife River Larsmont Sanitary District (KRLSD) along the north shore of Lake Superior, neither of which is within the WLSSD legislative boundaries. A portion of the Fond du Lac Reservation is also included within the Carlton County potion of the District. In addition, WLSSD accepts hauled liquid waste from throughout northeast Minnesota including household septic tank waste.

Figure 1-2, WLSSD Legislative Boundaries



1.2 WLSSD Authority

The Western Lake Superior Sanitary District was created in 1971 by the Minnesota Legislature as a special purpose subdivision of the State to address problems with water pollution, and collection and disposal of sewage. Minnesota Statutes, Chapter 458D, outlines the framework by which the District is governed, the powers and duties of its Board and officers, taxing authority, cost sharing and planning responsibilities. The statute charged the District with the responsibility of improving and protecting the waters of the St. Louis River basin area.

In 1974, additional legislation was passed which gave the District the added responsibility of solid waste management. The District's enabling legislation as well as subsequent state legislative action such as SCORE (Select Committee on Resources and the Environment) gave the WLSSD broad powers for planning for wastewater treatment and solid waste, acquisition of existing facilities, construction of new facilities, and the authority to operate facilities and set rates for such services. Within this framework, the District has initiated programs for the abatement of pollutant discharges. Such measures included construction of an advanced regional wastewater treatment plant and wastewater conveyance facilities, supported by ongoing water quality monitoring and facility planning programs.

1.3 WLSSD Mission and Vision Statements

WLSSD Mission Statement

The mission of Western Lake Superior Sanitary District (WLSSD) is to plan and provide for the effective and economical collection and treatment of wastewater and to ensure responsible solid waste management through effective planning and oversight, education and customer services in order to:

- protect public health and safety;
- preserve and ensure the best use of waters, land, and natural resources;
- prevent, control and abate water and solid waste pollution, thereby protecting the St. Louis River basin and Lake Superior.

These services will be performed in a manner that exceeds state and federal environmental regulations and with a focus on pollution prevention, waste and toxicity reduction, beneficial reuse and recycling.

WLSSD Vision Statement

WLSSD will be a leader in effective waste management, continuously evolving to reflect the changing needs of its constituents and stakeholders from local to international levels. This will be achieved through effective long-range planning.

WLSSD's services will be delivered in a cost-effective manner, providing value to its users and ensuring the long-term financial viability of District operations. WLSSD will consistently meet or exceed all permit standards. WLSSD will be proactive in seeking and implementing innovative environmental protection strategies that allow the organization to continue as an international leader, especially by pioneering preventive approaches and technologies. Facilities and equipment will be maintained to a standard of excellence. Resources to determine effective treatment and disposal options will be available to all within the District.

WLSSD will be a place where all employees are proud to come to work and express the pride both inside and outside the organization. District employees will work together to achieve the WLSSD vision by focusing on continuous improvement.

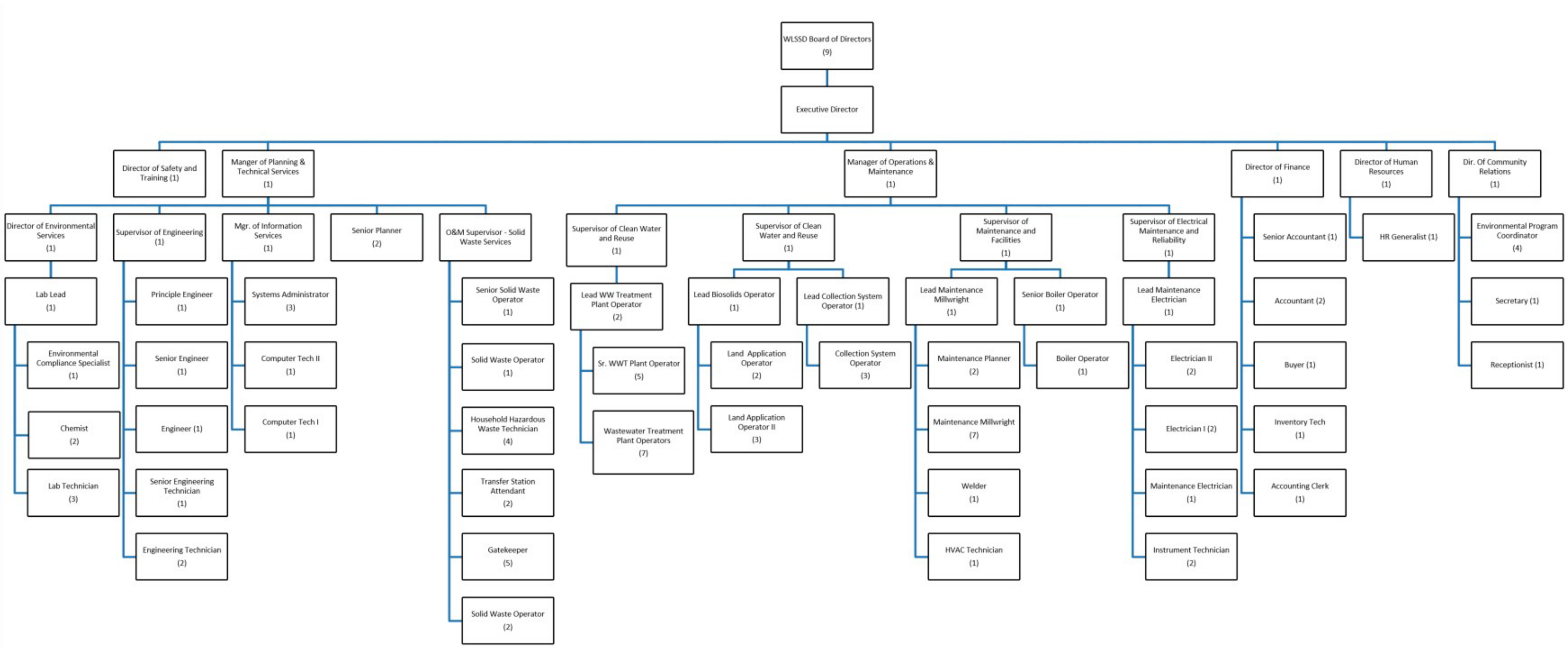
1.4 Organizational Structure

Organizationally, WLSSD is made up of five main areas – Planning and Technical Services, Operations and Maintenance, Finance, Community Relations, and Human Resources. The Managers and/or Directors of each area make up the District's Executive Team that reports to the Executive Director. The various departments within each area function as work teams and are responsible for participating in many of the decisions about day-to-day operations and setting annual team goals.

WLSSD has a staff of approximately 100 full-time and part-time personnel in a broad range of professions in order to efficiently and reliably provide award-winning wastewater services 24 hours a day, 7 days a week.

- **Operations and Skilled Trades**: Wastewater operators, maintenance technicians, welders, electricians, HVAC, instrumentation technicians, solid waste operators and HHW technicians
- **Business Administration**: Finance and purchasing, human resources, safety, community relations, environmental programming, and administrative services
- **Technical Services**: Engineers and engineering technicians, environmental services, laboratory, planning, and information technology.

Figure 1-3, WLSSD Organizational Chart



1.5 Budget and Finance

WLSSD wastewater services are funded through fees paid by users of the sewer system. Approximately half of the wastewater treated by WLSSD comes from directly connected industrial customers and the remaining half comes from residents and businesses connected through sewer systems in their communities. Residents and businesses are not typically connected directly into the WLSSD system and do not directly pay WLSSD for services. District residents pay sewer fees through their communities, who subsequently pay WLSSD for the wastewater treatment services used by the community as a whole.

The WLSSD operating and maintenance (O & M) budget (direct wastewater departments and allocated shared service departments) for 2023 is $20,377,276. The District has a wastewater capital budget of $18,839,000 for 2023.

The WLSSD capital budget includes interceptor replacement and rehabilitation, pump station replacement and rehabilitation, general replacement-wastewater treatment plant, and process and energy improvements. Wastewater capital investments are paid for through current revenues and low-interest loans made possible through the U.S. EPA Clean Water State Revolving Fund administered by Minnesota's Public Facilities Authority. The entire 10-year Capital Improvement Program (CIP) is included in **Figure 8-1** in Section 8 of the Plan.

WLSSD aims to finance projects by means that are equitable to all District customers by:

- Developing and implementing financial policies and practices consistent with the District's enabling legislation and other applicable state and federal requirements;
- Developing capital improvement plans based upon strategic priorities and ensuring each project undergoes rigorous technical and financial review to ensure it meets the long-term needs of the District and its users;
- Pursuing all available grants, loans and other alternative funding sources to fund wastewater system improvement projects consistent with the implementation of Plan recommendations;
- Supporting efforts by local member communities to secure outside funding assistance of local collection system projects to those consistent with WLSSD facility plans and capital improvement projects;
- Utilizing the resources and assistance of the State and Federal governments for support of the water quality initiatives.

1.6 Basis for Comprehensive Plan and Planning History

The planning authority and sewage treatment responsibilities of WLSSD are a key element to achievement of water quality goals and pollution control. Minnesota State Statue 458D requires that the District Board:

> *"Prepare and by resolution adopt a comprehensive plan for the collection, treatment and disposal of sewage in all or a designated part of the District through a system of interceptors and treatment works. [. . .].*
>
> *The Plan shall take into account the preservation and best and most economic use of water and other natural resources in the area; the preservation, use and potential for use of lands adjoining waters to the state to be used for the disposal of sewage; and the impact such a disposal system will have on present and future land use in the area affected thereby."*

The WLSSD Board of Directors adopted its first comprehensive plan/program statement on October 4, 1972. Since its adoption, the plan has served to guide WLSSD efforts to correct water quality problems that existed in the middle 1970s. Revisions were made reflecting the changing character and duties of the District. In 1976, the Comprehensive Plan was updated to reflect the experience and knowledge the District gained over its first five years of existence. There have been significant changes over the past 40+ years within the WLSSD area in terms of land use patterns, population growth, environmental issues and priorities. New environmental guidelines are also continually changing on both state and federal levels. The wastewater planning history for WLSSD is summarized as follows:

- October 4, 1972 – adoption of first Comprehensive Plan
- 1974 – "Revision to the Comprehensive Plan and Program"
- 1976 – "Comprehensive Water Quality Management Plan"
- 1995 – "Comprehensive Water Quality Management Plan"
- 2003 – "Wastewater Services Master Plan"
- 2010 – "Comprehensive Wastewater Service Plan"
- 2016 – "Comprehensive Wastewater Services Plan"
- 2023 – "Wastewater Comprehensive Plan"

Similar to previous plans, this Wastewater Comprehensive Plan serves as a guide to future water quality planning, capital budgeting and facility management for the District. Integral parts of the Plan include goals and policies covering a wide variety of statutory responsibilities and coordination efforts with local, state, and federal governments. Much like previous plans, this plan recognizes the significant changes facing the District as it relates to population growth, land use patterns and environmental guidelines.

1.7 Planning Objectives

The objective of the revision of the District's Comprehensive Plan is to develop guidelines, which accurately reflect the current and future issues and needs of WLSSD and the communities served. Further, the intent of the Comprehensive Plan is to focus all basic information and planning data into a single resource document, which describes existing conditions of the wastewater conveyance system and treatment facilities and processes, identifies future infrastructure needs, specifies planning goals/objectives, and recommends policies and actions that support the wastewater management needs of the WLSSD region.

Appropriate use of water resources and enforcement of water quality protection can be ensured through strong policies and responsible program implementation. Implementation of such a program requires the cooperation of the two counties, eight cities and nine townships, and tribal interests that comprise the WLSSD area as well as the wide variety of commercial and industrial interests, state and local regulatory agencies and community and environmental groups.

The general approach of the planning process is to evaluate current and expected future conditions and prepare effective goals and policies for water quality management, asset management and a Capital Improvement Program (CIP) for the WLSSD now and for the future. This comprehensive planning process has involved extensive data collection, analysis, and discussions related to important issues facing the District today and in the near future. The Comprehensive Plan addresses the following key areas:

- Demographics and Land Use
- Physical & Environmental Characteristics
- WLSSD Service Areas
- Process and Facility Analyses (Treatment Plant and Collection System)
- Regulatory and Environmental
- Plan Recommendations
- Capital Improvement Plan

Section 2: Demographics and Land Use

Section 2.1: Historic and Current Population

The demographic data used in this report was primarily collected utilizing resources available from the U.S. Census Bureau and the Minnesota State Demographic Center. In addition, a review of local comprehensive plans was completed to identify demographic trends and projections. An historical analysis of the WLSSD area finds that long-range trends showed a peak in Duluth and immediate surrounding area population in the 1960s. It was during this period that Duluth reached its highest population of 106,884 with more than 45-percent of the total St. Louis County population. However, since that time Duluth has experienced a gradual decline and leveling off in total population.

The 2020 census figures for the City of Duluth show a population of 86,697, or 43-percent of the St. Louis County total population and 62-percent of the total WLSSD area population. Census data for the WLSSD area show a 1.9% increase in total District population between 2010 and 2020. Overall, the Carlton County portion of WLSSD increased over 3.6% between 2010 and 2020 while the St. Louis County portion of WLSSD increased by 1.6%. **Table 2-1** shows the percentage of population change between 2010 and 2020 for all District communities.

Historic data and economic fluctuations found population movement to more concentrated neighborhoods in Duluth urban areas. However, over the last 15-20 years a change in population is noted from these areas to nearby second tier suburban tracts including Hermantown, Thomson Township, Duluth Township and rural locations. Isolated development and population shifts are also noted around area lakes (e.g., Pike Lake, Caribou Lake, Grand Lake, Chub Lake) and along the North Shore of Lake Superior. An overall "shift" in population to suburban and nearby rural areas is indicative of demographic trends experienced throughout northeastern Minnesota. A population density map for the District area is shown in **Figure 2-1**.

As discussed in detail in Section 4 of this plan, approximately 82-percent of the total population within WLSSD is connected to municipal sanitary sewer service. Of the Carlton County portion of WLSSD 63-percent is connected to municipal sanitary sewer service while 85-percent of the St. Louis County portion is connected.

Table 2-1, WLSSD Area Population Trends 1980 - 2020

Area	1980	1990	2000	2010	2020	% Change '10-'20
St. Louis County Total	222,229	198,213	200,528	200,226	200,231	0.0%
St. Louis County (WLSSD)	116,944	109,841	113,033	115,242	117,049	1.6%
Duluth	92,811	85,493	86,918	86,265	86,697	0.5%
Hermantown	6,759	6,761	7,448	9,414	10,221	8.6%
Proctor	3,180	2,974	2,852	3,057	3,120	2.1%
Rice Lake	3,861	3,883	4,139	4,095	4,112	0.4%
Grand Lake Twp.	2,166	2,355	2,621	2,779	2,720	-2.1%
Lakewood Twp.	1,680	1,799	2,013	2,190	2,276	3.9%
Canosia Twp.	1,562	1,743	1,998	2,158	2,206	2.2%
Solway Twp.	1,665	1,722	1,842	1,944	1,957	0.7%
Duluth Twp.	1,604	1,561	1,723	1,941	2,309	19.0%
Midway Twp.	1,656	1,500	1,479	1,399	1,431	2.3%
Carlton County Total	29,936	29,259	31,671	35,386	36,207	2.3%
Carlton County (WLSSD)	19,647	19,292	20,192	22,294	23,103	3.6%
Cloquet	11,142	10,885	11,201	12,124	12,568	3.7%
Carlton**	1,014	1,055	963	1,021	948	-0.7%
Scanlon	1,050	878	838	991	987	-0.4%
Wrenshall	333	296	308	399	428	7.2%
Thomson Twp.	3,962	3,970	4,361	5,003	5,465	9.2%
Twin Lakes Twp.	1,595	1,673	1,912	2,108	2,093	-0.7%
Silver Brook Twp.	551	535	609	648	614	-5.2%
TOTAL WLSSD AREA	**136,591**	**129,133**	**133,225**	**137,536**	**140,152**	**1.9%**

Source: Minnesota State Demographic Center
** City of Carlton and City of Thomson merged in 2015; 1980, 1990, 2000, and 2010 data includes former City of Thomson

Section 2.2: Population and Employment Projections

Based on data developed by the Minnesota Demographic Center, between 2020 and 2050 the population of St. Louis County is projected to decline by 12-percent while Carlton County is projected to decline by 8-percent. The Minnesota Demographic Center no longer produces population projections for individual cities and townships and instead uses extrapolations of overall county projections to individual cities and townships. Between now and 2050, it is anticipated that more than two-thirds of Minnesota's 87 counties will decline in population, with the Arrowhead Region of Northeast Minnesota experiencing the greatest decline with a loss of nearly 50,000 residents.

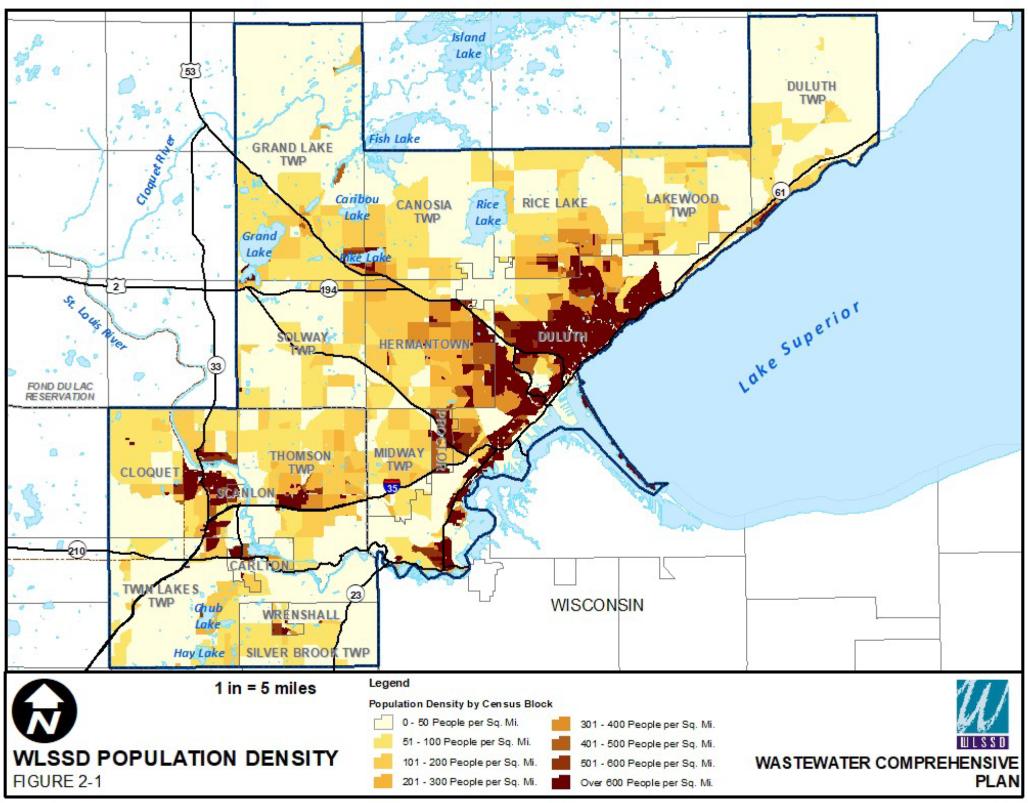
There are pockets of Greater Minnesota that will see some increase in population, particularly in areas with high-infrastructure and in some areas known for outdoor recreation such along the north shore of Lake Superior. Given the more urbanized nature of the WLSSD area in comparison to greater St. Louis and Carlton counties and with the City of Duluth and surrounding cities being a regional population, economic, healthcare and tourism center, the same level of decline as discussed above is not anticipated within the WLSSD area.

Referencing data in recent local plans and trends from U.S. Census data and the Minnesota Demographic Center, a projected population growth of 1.8% per decade until the year 2050 is being assumed for the purposes of this planning process. These growth projections are discussed in further in Sections 5 and 6 as they relate to impacts on the District's wastewater treatment plant capacity and the capacity of the District's collection system and pump stations. In addition to population growth, WLSSD must consider industrial and commercial growth resulting in expansion to the wastewater system. WLSSD is assuming a total employment growth of 1.6% per decade until 2050 for this planning process.

Table 2-2, WLSSD Area Population Density (2010-2020)

Area	Total Area (Sq. Mi.)	2010 Pop.	2010 Pop. Density	2020 Pop.	2020 Pop. Density	'10 –'20 Change (people/sq. mi.)
St. Louis County (WLSSD)	398.4	115,242	289.3	117,049	293.8	4.5
Duluth	87.4	86,265	987.0	86,697	992.0	5.0
Hermantown	34.4	9,414	273.7	10,221	297.1	23.4
Proctor	3.0	3,057	1019.0	3,120	1040.0	21.0
Rice Lake	33.2	4,095	123.3	4,112	123.9	0.6
Grand Lake Twp.	71.4	2,779	38.9	2,720	38.1	-0.8
Lakewood Twp.	27.8	2,190	78.8	2,276	81.9	3.1
Canosia Twp.	35.7	2,158	60.4	2,206	61.8	1.4
Solway Twp.	35.7	1,944	54.5	1,957	54.8	0.3
Duluth Twp.	51.8	1,941	37.5	2,309	44.6	7.1
Midway Twp.	18.0	1,399	77.7	1,431	79.5	1.8
Carlton County (WLSSD)	147.1	22,294	149.0	23,103	157.1	8.1
Cloquet	36.0	12,124	336.8	12,568	349.1	12.3
Carlton**	4.0	1,021	255.3	948	237.0	-18.3
Scanlon	0.9	991	1,101.1	987	1,096.7	-4.4
Wrenshall	1.5	399	266.0	428	285.3	19.3
Thomson Twp.	39.9	5,003	125.4	5,465	137.0	11.6
Twin Lakes Twp.	44.8	2,108	47.1	2,093	46.7	-0.4
Silver Brook Twp.	20.0	648	32.4	614	30.7	-1.7
TOTAL WLSSD AREA	**545.5**	**137,536**	**252.1**	**140,152**	**256.9**	**4.8**

Source: Minnesota State Demographic Center
** City of Carlton and City of Thomson merged in 2015; 2010 data includes former City of Thomson



WLSSD POPULATION DENSITY
FIGURE 2-1

Section 2.3: Environmental Justice

The U.S. Environmental Protection Agency (EPA) defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies". WLSSD serves 17 communities each with their own unique considerations. As a publicly owned treatment works (POTW) that provides critical wastewater conveyance and treatment services for the region, the District strives to ensure that all residents are fairly and equitably served to preserve our natural resources and protect public health.

WLSSD works to be inclusive and equitable in all matters related to wastewater planning, operation, and service to our communities in several different ways. WLSSD is governed by a nine-member citizen Board of Directors that is made up of residents from throughout the District. Diverse Board representation ensures that varied constituencies throughout the District have a voice, including both urban and rural parts of the District, business owners and industry, citizen advisory groups, residents, and more.

To further provide for inclusivity, the WLSSD Community Relations Director and Environmental Programs Team focuses on interfacing with community members and providing education and outreach so residents can be involved and aware of District programs and initiatives. WLSSD provides for transparency in decision making by conducting public Board meetings, holding public comment periods on important projects, and by periodically having open house visits where the public can come and see the facility that serves the community 24 hours a day, 7 days a week. WLSSD has a continued commitment to everyone in the District because it is understood that the best way to protect public health and natural resources is to serve everyone equally and fairly.

Section 2.4: Community Comprehensive Planning

The land use planning authority in relationship to WLSSD is clearly set forth in Minnesota State Statutes, Chapter 458D, Subsection 458D.05. Under this authority, the District requires that "each local governmental unit…..shall adopt a similar comprehensive plan and program for the collection, treatment, and disposal of sewage for which the local government unit is responsible …"

All member communities have maintained and adopted comprehensive plans since the mid-1970s, including the identification of future wastewater management needs. Some plans have been updated more often than others. WLSSD staff has worked to ensure that the needs of local cities and townships are accurately represented in this Comprehensive Plan. Future modifications or revisions of local plans which affect the WLSSD Comprehensive Plan require review and approval by the WLSSD Board of Directors. Since beginning operations in the 1970s, local sewer extension requests have systematically been reviewed and approved by District staff to determine consistency of planned land uses and utility expansions with local land use plans.

2.4.1 : St. Louis County Communities

City of Proctor

The City of Proctor has had a stable population over the past 50 years, with a peak population of 3,180 in 1980. The population of Proctor is concentrated in the central part of the community, while the northern and southern portions remain relatively rural. Economic development efforts within Proctor are focused in the downtown area and along the Interstate 35 corridor. In 2023, the City will undertake a major construction project on 2nd Street to replace water, sanitary, and storm sewers to serve the downtown area.

The City of Proctor completed the Kirkus Street construction approximately 10 years ago, which created a direct east-west connection in the southern half of Proctor and opened up a largely undeveloped section of the City for potential future residential development. While no major development has occurred yet, the City plans to build a public works storage facility and garage on Kirkus Street as this part of the City continues to develop.

The area around the intersection of Interstate 35 and Boundary Avenue has developed into a highway commercial node with the additions of fast food restaurants, gas station/convenience stores, and a hotel. Additional commercial development is possible in this area. In 2013, the City of Proctor annexed a 67.5-acre portion of neighboring Midway Township along Interstate 35, which has been identified by the City as a potential area for expansion of water and wastewater utilities to facilitate additional commercial development.

The City of Proctor last updated its comprehensive plan in May 2016.

Midway Township

Midway Township is a primarily rural community immediately adjacent to the cities of Hermantown, Proctor and Duluth. Population within the Township has gradually declined since the 1970s.

The majority of the Township is rural residential in nature with some agricultural uses. Midway Park is a portion of the Township immediately adjacent to the City of Proctor with more urban densities and is served by public sewer and water. Midway Township has an agreement with the City of Proctor for the maintenance of the Midway Park sewer utility along with billing for residents connected to the sewer in this area. Part of this agreement stipulates that water services from Proctor will not be extended beyond the areas they currently serve. As a result, significant additional wastewater flows are unlikely in the future. Additionally, the Township intends to limit utility services within the Midway Park area to the currently served area.

Sanitary sewer service is provided to a number of parcels in the Midway Road/Becks Road area. The Township received a grant from WLSSD to complete a sewer study in 2013. The study recommended the extension of sanitary sewer to multiple areas within the Interstate 35 and Midway/Becks Road vicinity. No projects have taken place as of this Comprehensive Plan update. The extension of utilities in these areas will address existing issues with on-site treatment systems and will not be used as a tool to increase the density of development. An Orderly Annexation Agreement was reached between Midway Township and the City of Duluth in 2014 to annex 2,500 acres of mainly Duluth owned land south of the Interstate 35 corridor.

Midway Township updated its comprehensive plan in 2016.

Solway Township

Solway Township is located in the southern portion of St. Louis County, adjacent to Hermantown, Proctor and west of the City of Duluth. The Township has experienced small population growth over the past 30 years. Large portions of the Township are forest covered and nearly one-third of the Township is wetland. The soils in Solway Township have issues with permeability and/or high water tables, which present severe limitations to build dwellings with basements in lower areas.

Solway Township has no immediate plans for adding sewer service to any portion of the Township in the next 5-10 years. The dominant land use in the Township is large-lot rural residential. The highest levels of residential development can be found in the eastern part of the township and along Morris Thomas Road, paralleling the southern border. In addition, the northeast corner of Solway Township contains several more densely populated residential subdivisions.

Solway Township does not have a large amount of commercial or industrial development. Commercially zoned land accounts for about 120 acres of Solway Township and lies mainly between U.S. Highway 2 and Old Highway 2. Highway 194 is an option for commercial development with good road access.

The Solway Township Comprehensive Plan was most recently revised March 2001. In 2019, St. Louis County updated its comprehensive plan which includes future development plans for Solway Township.

City of Hermantown

The City of Hermantown updated its 1976 Comprehensive Plan in August 2001, amended the plan in 2014-15, and will be undertaking a full Plan update beginning in 2022. Land use projections did not change significantly as a result of the 2014-15 plan update and no major changes to land use or the WLSSD Urban Services Boundary are proposed within the 2022 update.

Much of the Hermantown sanitary collection system was installed in the early 2000s and consists of mainly PVC piping, making Hermantown's collection system one of the newer systems within WLSSD. Property east of the Ugstad Road is a high-density area (1/2 to 1-acre lots) while west of the Ugstad Road is lower density. Hermantown's current population growth averages approximately 35 new homes per year, but potential exists for rapid short-term growth along the Maple Grove Road corridor and the Morris-Thomas Road corridor. Most of the larger sewer extensions have been intended to serve existing development; however, new development is occurring within the interiors of main roadways where new sewer extensions have been constructed. There is potential for secondary retail development remaining behind existing principal retailers along the Highway 53 corridor.

In 2022, Hermantown requested a small Urban Services Boundary change to capture area south of Highway 2. This is in proximity to the Adolph Neighborhood Small Area Plan update from 2014-15. While there is longer term potential for development of this area it is unlikely to see large-scale development in the next 5-10 years.

Canosia Township
Canosia Township is located within St. Louis County immediately adjacent to the cities of Duluth and Hermantown. Since 1980, Canosia Township has seen population growth of 41.2%, which is one of the fastest growing areas within the WLSSD area. The northern portions of Canosia Township are characterized by low-density rural residential or undeveloped land. The areas around Pike Lake and Caribou Lake have more dense residential development. Since the majority of lakeshore on these lakes is currently developed, most new development on these lakes would likely be additions to existing homes or the redevelopment of seasonal cabins or traditional mobile homes into year-round homes. There is currently additional second-tier lake development in some areas around Pike Lake and Caribou Lake that includes multi-unit homes, a golf course, and an event center. In 2000, Canosia and Grand Lake townships completed building a wastewater collection system and created the Pike Lake Area Wastewater Collection System (PLAWCS) to sewer areas with identified water quality and health concerns. There is additional potential for development in this area, but future development will be limited by capacity in the WLSSD Pike Lake Forcemain.

The Four Corners area at the intersection of Highway 53 and Midway Road is the primary commercial district within the Township and serves both local and through traffic. An area identified within the Township as an area of future growth and development is the North Airport Development area along Stebner Road. Water and sewer service would be needed in this area if any future development were to occur, and future development will be restricted based on sewer capacity availability. In addition, Canosia Township supports continuing to look at wastewater treatment concepts to address issues with on-site treatment systems on Caribou Lake.

Canosia Township updated its comprehensive plan in 2019.

Grand Lake Township
Grand Lake Township updated its comprehensive plan in 2000, and in 2019, St. Louis County updated its comprehensive plan to include Grand Lake Township. The Township plan projects the growth of approximately 700 people in the next 20 years adding about 265 new households. This growth will be sporadic and dependent on changing economic conditions, but on average, 13 new households are projected per year. This could resultin additional environmental pressures on surrounding Pike, Caribou and Grand lakes as the expected growth will likely focus on shoreland areas. The only area in Grand Lake that is presently sewered is the western half of Pike Lake.

City of Rice Lake
The City of Rice Lake is located in southern St. Louis County directly north of the City of Duluth. Once primarily a rural area, the City is now a transition area between the urban area around Duluth and rural St. Louis County. The southern portions of the City generally has the highest density of development, with densities continuing to decrease to the north. Since 1980, the City of Rice Lake has seen a gradual increase in population, nearly 6.5% during this time.

Besides vacant land, single-family homes are the most dominant land use feature in the City of Rice Lake. Residential land south of Martin Road is zoned urban residential and contains smaller average sized lots with a higher density throughout. North of Martin Road is considered rural residential and contains larger lot sizes extending to 160 acres. Since there is an abundance of vacant land throughout the City, the opportunity for future development of residential land use is promising. Recent expansion has occurred in the urban residential zone along Charles Road while several new roads have been constructed throughout the rural residential zones.

Most of the homes in Rice Lake have subsurface sewage treatment systems (SSTS). The majority of properties located in the southeast portion of the City are served by a centralized sewer system. Over the past several years, the City has completed the construction of additional sewer utilities along West Calvary Road and has connected individual single family homes formerly with on-site treatment systems to the wastewater collection system.

Commercial uses occupy approximately two-percent of City land. The majority of commercial sites are in the western half of the City along Rice Lake Road with several newer small businesses filling in lots. Existing commercial sites are also located along main traffic corridors in the City including Howard Gnesen, Arnold, and East Calvary roads. The City most recently has been working on extending sanitary sewer and water along Rice Lake Road north of Martin Road. The goal is to extend as far north as the Tischer Road. The City also plans to build a new fire hall in the western portion of the City on Howard Gnesen Road.

The City of Rice Lake last amended its Comprehensive Plan in September of 2020.

City of Duluth

The City of Duluth last completed the update of its comprehensive plan in 2018. There are currently 26 square miles of developable land in the City of Duluth. City of Duluth planning staff have indicated that a majority of future development within the City will be in-fill and/or redevelopment of existing areas.

One major development currently in progress in Duluth is in the Spirit Valley neighborhood of West Duluth, the "River West Development," which will be a mixed-use subdivision consisting of single-family and multi-family dwellings, as well as commercial businesses to serve area residents. Another recent development impacting sewer flows is the Essentia Health expansion in downtown Duluth. There is potential for additional industrial re-development sites t the location of the former U.S. Steel Mill in Gary New Duluth. Further commercial and light industrial uses are anticipated to infill around the Duluth International Airport and within the existing Airport Industrial Park.

While commercial development has been expanding in the City in recent years, the majority of growth impacting sewer flows will likely be residential in nature. The City intends to focus on residential infill, as well as improving and further developing existing neighborhoods. One example is the Lincoln Park Neighborhood, which has seen substantial growth with the additions of several apartment complexes and commercial businesses. Additional residential development areas have been identified along Arlington Road, between Highway 53 and Central Entrance as well as an area referred to as the Sugarloaf Development north of the Bayview Forest off Vinland Street for single- family residential development. Finally, the Lester Park Golf Course will be closed and 37 acres sold for the development of housing units with a focus on affordable housing.

There are approximately 15,400 acres within the City of Duluth (36%) that are undeveloped, including both public and private ownership. According to the City of Duluth Comprehensive Plan, the preference for future development is infill, redevelopment, and neighborhood extensions.

Duluth Township

Duluth Township completed a comprehensive plan update in August 2002. New housing has occurred throughout the Township. All new housing promotes the rural character of the Township and sustainable development practices. Residential developments include a broader mix of homes and some multi-unit, larger parcel developments. Commercial and industrial developments within the Township have experienced some growth, but only in a limited and well-managed way. New commercial services exist that serve the basic needs of residents and are located in commercial districts along Scenic Highway 61.

The 2002 comprehensive plan discourages development that changes the density as currently zoned and encourages the preservation or protection of areas unsuitable for development due to environmental, economic, or community constraints. Along the north shore corridor of Duluth Township there is existing sewer service through the Duluth North Shore Sanitary District (DNSSD), which is connected to the WLSSD collection system. The DNSSD was formed in 2004 to meet the needs of the existing community and to eliminate potential water quality concerns from SSTS. The 2002 plan recommends that the current development density and mix of housing lot sizes, housing types, and amenities are maintained. The plan also seeks to limit development in the north shore corridor that puts at risk the capacity of the community wastewater infrastructure.

Lakewood Township

Lakewood Township adopted a revised comprehensive land use plan in August 2008. There are relatively large areas of undeveloped private properties in the Township. How these numerous, relatively undeveloped properties are developed will be an emerging issue for the Township. The dominant land use in Lakewood Township is single-family residences located primarily along roads. Approximately 1,000 acres of the Township are in a density class greater than 4.8 acres. Sixty acres are in developments less than one acre. There is currently one area zoned for commercial use. There are two areas in the Township where residential development occurs in higher densities than the majority of the Township. These areas are located in the southeast and southwest corners of the Township. These areas continue to experience increasing development pressure.

A very small portion of Lakewood Township is served by municipal sanitary sewer in the Duluth North Shore Sanitary District (DNSSD).

2.4.2 : Carlton County Communities

City of Cloquet

The City of Cloquet depicts a stable, freestanding community not specifically tied to the growth patterns of the City of Duluth. Development is confined to existing City limits and service areas. Rural density patterns are found in the balance of Cloquet. Over the past fifteen years, the City of Cloquet has extended utilities north along Highway 33 to serve the 120-acre business park (with 80 developable acres). Presently, the business park has two tenants and is not showing signs of any substantial growth in the next 5-10 years. The City has also indicated that a significant area surrounding the business park could be developed into residential uses over the next 20 years. In April of 2018, the City completed a utility extension study with funds received from the WLSSD Wastewater Services Planning Grant. The study looked at five primary areas for extension of public utilities and are summarized in the final report. The City has included a map of "Phased Public Sewer and Water Extension and Staged Urban Growth" within their 2007-2027 comprehensive plan.

City of Carlton

Effective in January 2015, the cities of Carlton and Thomson consolidated to create a larger City of Carlton. The City of Carlton comprehensive plan was updated at that time. The cities of Carlton and Thomson had not experienced significant growth in the last several years, with the City of Carlton experiencing a population decrease over the past 20 years.

The City of Carlton has a mix of existing housing including single-family homes, apartments and assisted living. The City still has some limited developable land within the core of the community. Currently water and sanitary service cover all but the rural portion of the City. A new water line will be installed down Highway 210 to accommodate the new Justice Center that is being built. Commercial development within Carlton is primarily located in the downtown area with some light industrial activities on the outskirts of the City.

The City of Carlton has identified a number of areas as focal points for housing development areas. These include a four block area on the west side of First Street, a section of land south of Dalles Avenue, the South Terrace Neighborhood, an area east of Thomson Road, and a housing development off of Sunrise Drive. Another potential site identified for apartments or townhomes exists along Third Street, north of Cedar Avenue. The landscape in Carlton limits development in some locations with the presence of wetlands and rock. In 2008, the City of Carlton constructed a new water tower.

Silver Brook and Twin Lakes Townships

Since 2010, the townships of Twin Lakes and Silver Brook have seen a small decrease in population of 0.4% and 1.7% respectively. It is anticipated that Twin Lakes Township will see potential growth in the future, as it continues to plan for sewering additional areas north of Highway 210 and a larger development south and east of the Olsonville area along I-35 and Hwy 61. A new Justice Center in Carlton with corresponding sewer and water line also opens up significantly more potential for development in Twin Lakes Township, though nothing beyond the Justice Center has been proposed as of 2022.

In 2006, the Black Bear Casino expanded its footprint with the construction of a new larger casino and additional hotel and banquet hall space among other things. There have been past discussions about a possible future annexation of Twin Lakes Township by the City of Carlton. As of 2022, the City of Carlton Utilities Staff is taking over sewer maintenance for the Township. Twin Lakes and Silver Brook townships both fall under the Carlton County comprehensive plan, which was last updated in 2001.

Fond du Lac Reservation

The Fond du Lac Reservation Land Use and Management Plan was adopted in January of 1998 and was most recently updated in 2019. The next 20-year period calls for some growth in commercial and residential development. Increased residential development is anticipated in areas that had previously been designated as "future sewered areas."

Primarily there are three distinctive "neighborhoods" – Brookston, Cloquet and Sawyer – with no single central focal point. The area roughly a half-mile to the west, south and east of the intersection of Big Lake and University roads is the institutional core of the Fond du Lac Reservation. It contains the tribal center, Ojibwe School, clinic and other tribal offices and service buildings. Future commercial development will most likely occur in this part of the Reservation. This area depicts the most westerly expansion of sanitary sewer from the City of Cloquet system.

The Big Lake Area Sanitary District (BLASD) was officially formed in January 2007 in accordance with Minn. Stat. §§ 115.18 to 115.37 and covered portions of Perch Lake Township, Sawyer Township and the Fond du Lac Indian Reservation. Past studies had looked into all the available wastewater treatment options for the estimated 350 residential properties located around and adjacent to Big Lake and the area between the lake and the City of Cloquet had concluded that the best available option would be connection to and treatment of the wastewater by WLSSD. While there had been historical momentum for connecting the Big Lake Area Sanitary District to WLSSD, the BLASD Board of Directors has since dissolved and the plans to connect this community to the WLSSD collection system have been abandoned at this time.

City of Scanlon

The City of Scanlon has seen some new commercial development along the southeast portion of the city with another 35 potential acres zoned for commercial development. Residential growth in Scanlon has been, and is projected to remain, small over the next five years. Currently the City of Scanlon has approximately 100 acres of undeveloped residential land available. The City of Scanlon last updated its comprehensive plan in 2013.

Scanlon utlizes a systematic short-range planning process to continue to provide adequate infrastructure and maintenance for city structures, parks, trails, water, sanitary, and storm sewer systems, roads, and other public facilities to sustain future growth.

In 2015, the residents of the City of Scanlon initiated a petition requesting that the State of Minnesota explore the benefits of a merger between the cities of Cloquet and Scanlon. The Scanlon City Council voted to move forward with the preliminary merger study in 2015, but as of 2022, the City of Scanlon is still independent from the City of Cloquet.

Thomson Township (Esko)
Thomson Township has seen significant growth over the past 20-years with expected growth to continue at its present pace. Most recently, the Township has developed land along Interstate 35 between Esko and Scanlon as an industrial/business park with sanitary sewer infrastructure. The Township has also platted land adjacent to Interstate 35 just east of County Highway 1. This area is designated for highway commercial uses and is referred to as the Town Center development area. Thomson Township last updated its comprehensive plan in 2020.

City of Wrenshall
The City of Wrenshall has remained relatively stable over the past 10 years. The potential for growth within the City limits is great but expected to happen at a much more gradual pace than some other areas within the District. The City of Wrenshall built a new water tower in 1997-98. The City also received a Wastewater Services Planning Grant from WLSSD to assist with smoke testing the entire City collection system. Several areas were identified as needing repairs and have been either fixed or in the planning stages of getting fixed. The City of Wrenshall completed their most recent comprehensive plan revision in 2017.

Section 2.5: WLSSD Area Land Use Patterns

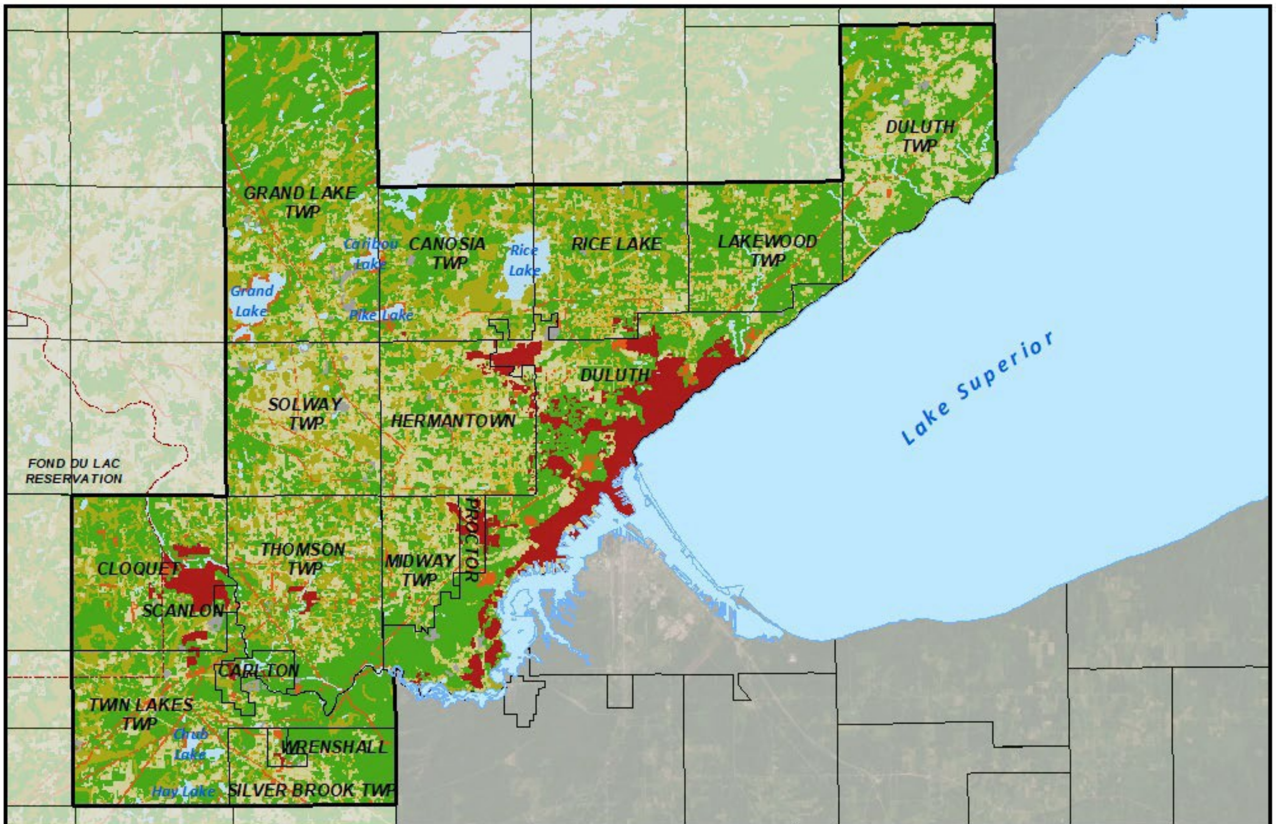
The land-use and demographic features of the eight cities and nine townships within the WLSSD illustrate a primary concentrated urban area in Duluth and parts of Hermantown and a smaller center to the west along Interstate 35 in Cloquet. Scattered urban density development has also occurred adjacent to inland lakes such as Pike Lake, Grand Lake, Caribou Lake and Chub Lake and along the shore of Lake Superior in Duluth and Lakewood townships. The urban development pattern of the WLSSD is a result of early settlement, historical growth, and current economic conditions within the region. Besides being influenced directly by the Lake Superior basin and associated environmental issues, the WLSSD area is also characterized by the wide variety of rural and urban development patterns found within its jurisdictional boundaries. Waterways, transportation corridors, natural green belts, and commercial ventures influence community growth patterns and shape land use and demographic features. The environmental features of the WLSSD region play an important role in the Comprehensive Plan. Existing and future service areas are greatly influenced by the natural character and environmental sensitivity of the District.

Growth in the WLSSD area can be described as linear. The City of Duluth, as the major metropolitan area, stretches northeast-southwest along the north shore of Lake Superior and has urban land uses and local infrastructure needs. Development activity has historically spread to outlying suburban areas and along transportation corridors extending to the north, south, and west of the city. The land use and demographic picture for the WLSSD area indicates a shift in population distribution and development to outlying suburban areas of Duluth and rural areas of adjoining communities (City of Rice Lake, Canosia Township, Grand Lake Township, and surrounding townships to the north). Considerable development has taken place in the City of Hermantown, with higher density growth in its eastern half. Also of note is significant growth in the second tier of townships surrounding the city of Duluth where lake frontage and rural character within commuting distance attract residential development. Concentrated pockets of residential development are found around Pike Lake, Caribou Lake, Chub Lake, and the Grand Lake areas.

More concentrated areas of residential and commercial development is also found along the north shore of Lake Superior. As a result of a new sanitary sewer along the north shore between Duluth and Knife River a North Shore Land Use Plan was created to address growth in an area from Lester River to Two Harbors. The Duluth/North Shore Sanitary District and Lake County commissioned the North Shore Land Use Plan to address the land use issues and local development priorities in light of the potential for new development opportunities along the North Shore.

A large percentage of the high-growth areas are rural in nature and served by individual sewage treatment systems. Emerging issues are also found in the surrounding communities experiencing growth around suburban lakes and other unsewered areas that are attracting rapid growth.

Figure 2-2 below depicts the various land use and land cover classifications within the District area.



WLSSD LAND COVER
FIGURE 2-2

Current land use trends show residential development extending from Duluth west to outlying suburban areas, bordering communities and adjoining townships. Key development areas include Hermantown, Rice Lake and portions of Twin Lakes, Canosia and Grand Lake townships.

The shift in residential development from central Duluth to outlying suburban and rural areas shows a land use pattern typical of large metropolitan communities. Residential, commercial, and industrial development interests follow major corridor routes with open, available land areas found in outlying suburban locations. Rural low-density development typically occurs in areas removed from urban services.

Commercial and industrial land uses in the WLSSD area are mainly confined to urban areas and transportation corridors related to Duluth and Cloquet. Commercial strip development is located in association to these transportation areas and is not specifically restricted to corporate limit boundaries. A linear development pattern is found to a great degree along Highway 53 west of Duluth, as well as along the north-south Interstate 35 corridor, Highway 61 along the north shore and Highway 33 north through the City of Cloquet.

Section 3: Environmental Characteristics

The natural environment within the District area represent constraints to development and limitations to conventional individual sewage treatment systems. The natural environment not only helps shape the land use patterns, but also dictate the level of management activity necessary to meet the goals and policies of this plan. Recognizing and understanding natural resources and environmental constraints are a key step in providing an adequate level of protection to the sensitive environments of the District.

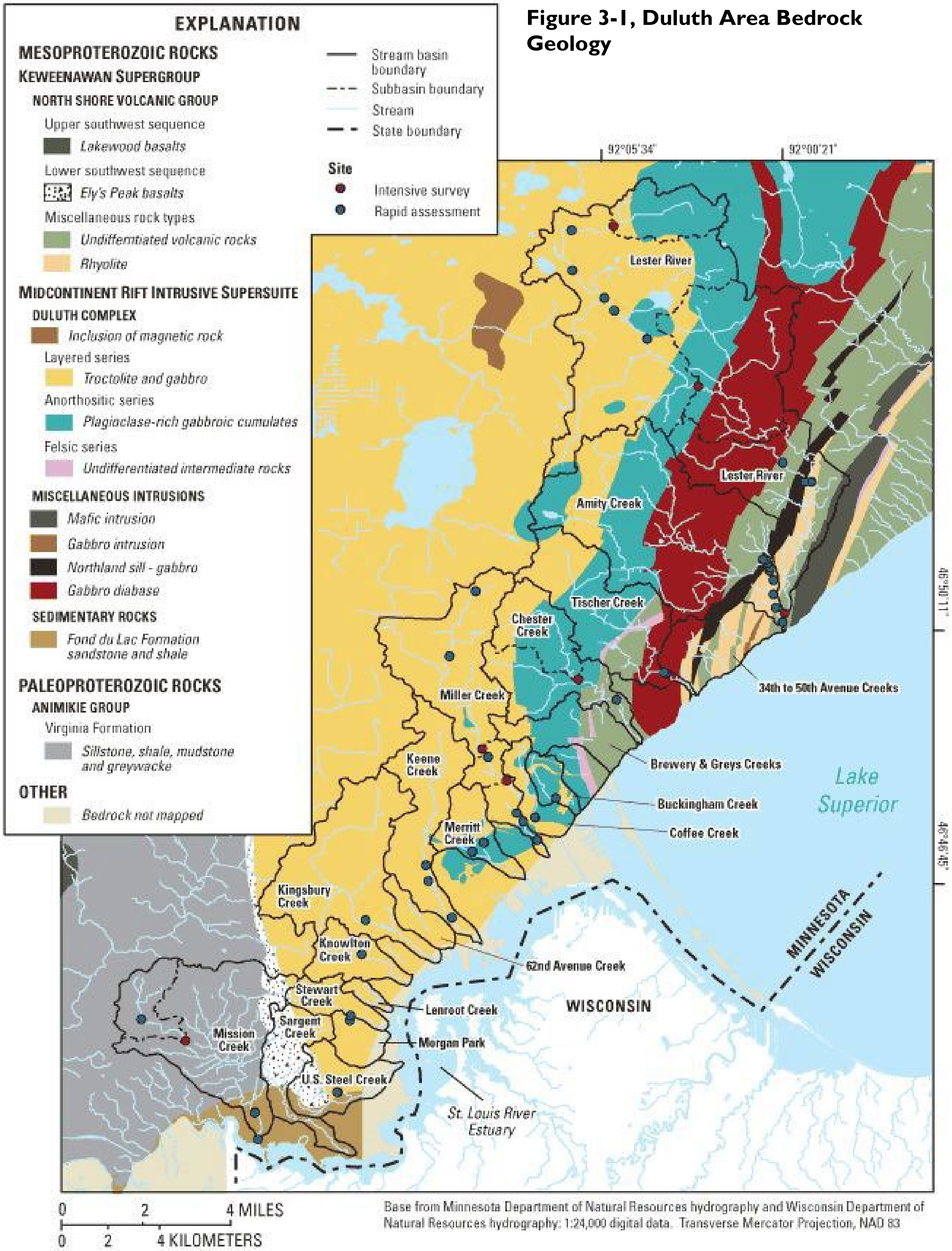
Section 3.1: Bedrock Geology

The environmental characteristics of the WLSSD area is defined largely by Lake Superior, inland forests, and open agricultural land. Geologic landforms and variable soil characteristics dominate natural and constructed environments along the Lake Superior shoreline and bluff areas. Farther inland, hardwood and coniferous forest areas provide vegetative wildlife habitat. Wetlands and lakes are also identified throughout the region with associated soil, vegetative and wildlife features. Farm areas with associated crops and livestock further make up the environmental character of the region.

Bedrock geology is one of many natural features that affect future development patterns, water quality and the suitability of available wastewater management alternatives within the WLSSD area. The geologic history of the District area is recorded in five rock formations: The Duluth Gabbro Complex, North Shore Volcanic Group and Nopeming Formation in St. Louis County and the Thomson Formation and the Fond du Lac Formation in Carlton County. The dominant geology of the WLSSD area is the Duluth Complex, which is the second largest Gabbro complex in the world.

According to the Carlton County Water Plan 2014 amendment, surficial and near-surficial bedrock in certain areas of the county cause other water resource problems. These areas of shallow bedrock can cause groundwater to move quickly along the joints and fractures rather than slowly by inter-granular flow. Three of the bedrock aquifers present in Carlton County, the Proterozoic, Metasedimentary, Keweenawan Volcanics, and Precambrian Undifferentiated, have this characteristic. Shallow bedrock occurs in a band in Carlton County from the northeast to the southwest central townships, and in the southeast corner. Bedrock wells in these areas are susceptible to contamination from the land surface.

Figure 3-1, Duluth Area Bedrock Geology



Miller, J. D., Green, J. C., Severson, M. J., Chandler, V. W., and Peterson, D. M., 2002, Geologic map of the Duluth Complex and related rocks, northeastern Minnesota: Minnesota Geological Survey Miscellaneous Map Series M–119, scale 1:200,000.

Section 3.2: Soils

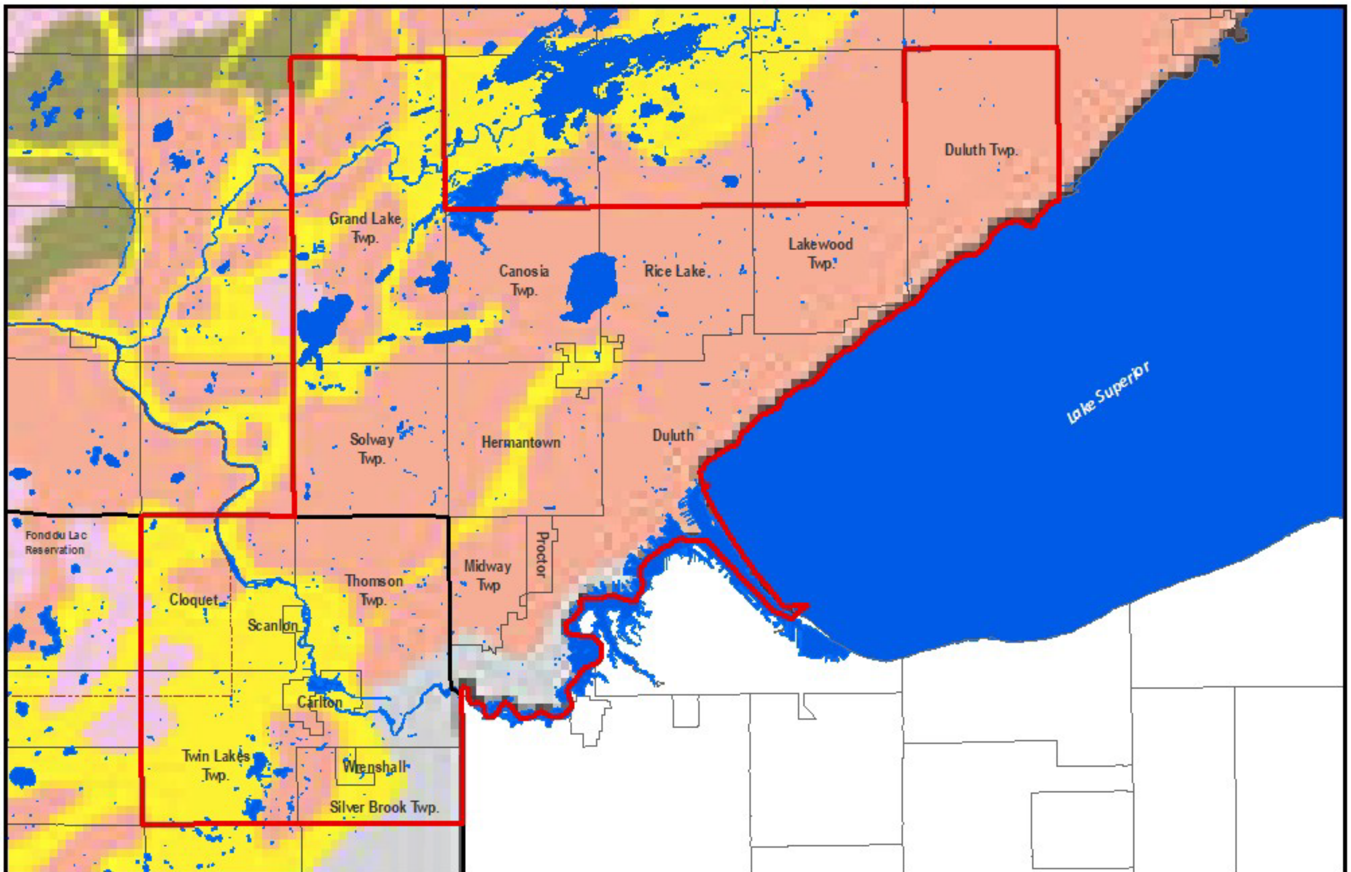
The present landscape in the WLSSD service area is primarily a result of the Pleistocene glaciation, which produced a variety of erosional and depositional landforms. Glacial deposits are evident in the form of moraines, eskers, outwash deposits and glacial lake sediments. All these features are relatively young, geologically, with none older than 25,000 years, and some as young as 12,000 years.

The major soils within the St. Louis River watershed are very deep, nearly level to sloping, on loamy glacial till moraines and nearly level silty glacial lake plains and nearly level muck and peat in bogs. They are well and moderately well drained on summits and sideslopes, somewhat poorly and poorly drained on flat areas and very poorly drained in depressions and bogs. Natural fertility is moderately high-to-high. The potential for surface erosion on steeper areas is high. Minor soils are located on sandy glacial outwash plains.

The major soils within the Cloquet River watershed are very deep, nearly level to sloping, on sandy glacial outwash plains. They are somewhat excessively to moderately well drained on summits and side slopes, somewhat poorly drained on flat areas and poorly or very poorly drained in depressions. The potential for surface erosion on steeper areas is moderately high. Minor soils area on dense-loamy glacial till moraines and drumlins on the borders of the outwash plains. Other minor soils are muck and peat in bogs.

The major soils within the Lake Superior (south) and (north) watersheds above 1,000 feet elevation, are very deep to shallow over bedrock, nearly level to extremely steep, on gravelly-loamy glacial till moraines. They are well to moderately well drained on summits and side slopes, somewhat poorly and poorly drained on flat areas and poorly or very poorly drained in depressions. The potential for surface erosion on steeper areas is high. Below 1,000 feet elevation, the major soils area very deep to shallow over bedrock, nearly level to steep, on clayey glacial till moraines. They are well to moderately well drained on summits and sides slopes, somewhat poorly and poorly drained on flat areas and poorly or very poorly drained in depressions. The potential for surface erosion and soil slumping on steeper areas is high. Minor soils are on sandy glacial outwash terraces adjacent to major streams. Other minor soils are mucks and peat in bogs.

Figure 3-2 on the following page depicts the dominant soil types within the WLSSD area.



WLSSD AREA DOMINANT SOILS
FIGURE 3-2

Section 3.3: Topography

Given its geologic history, topography is one of the major natural resources related constraints that exist within the District. Steep slopes not only add considerable difficulties and cost for development, but also represent areas of high risk from erosion. Topography varies considerably from the shores of Lake Superior inland along the areas adjacent to the St. Louis River.

The general relief within the District varies considerably. Slopes rise sharply from Lake Superior and the St. Louis River, transitioning into a more gently rolling topography. Relief within the St. Louis River watershed varies from 50 feet to 550 feet. Topographic descriptions as they relate to the soil landscape units are included in the soil portion of this section of the report.

Section 3.4: Wetlands

The majority of wetland resources within the District occur in the northwest and southwestern areas. The areas surrounding Grand Lake, Pike Lake and Wild Rice Lake Reservoir in St. Louis County, and the Twin Lakes area of Carlton County in particular, have vast wetland resources. Wetlands not only represent a physical constraint to development but they also require protection from pollutant discharges, whether from surface sources or groundwater influences. Residents need to be aware of the limitations represented by wetlands. Additionally, it should be recognized wetland protection responsibilities are covered by a matrix of wetland regulations.

The Minnesota DNR, through its Protected Waters and Wetlands Program has designated over 50 wetlands within the District as protected. Generally, any activity adjacent to the wetlands, which is below the ordinary high water level of the wetland, is subject to a protected waters permit. DNR protected waters maps are on file at the local DNR offices.

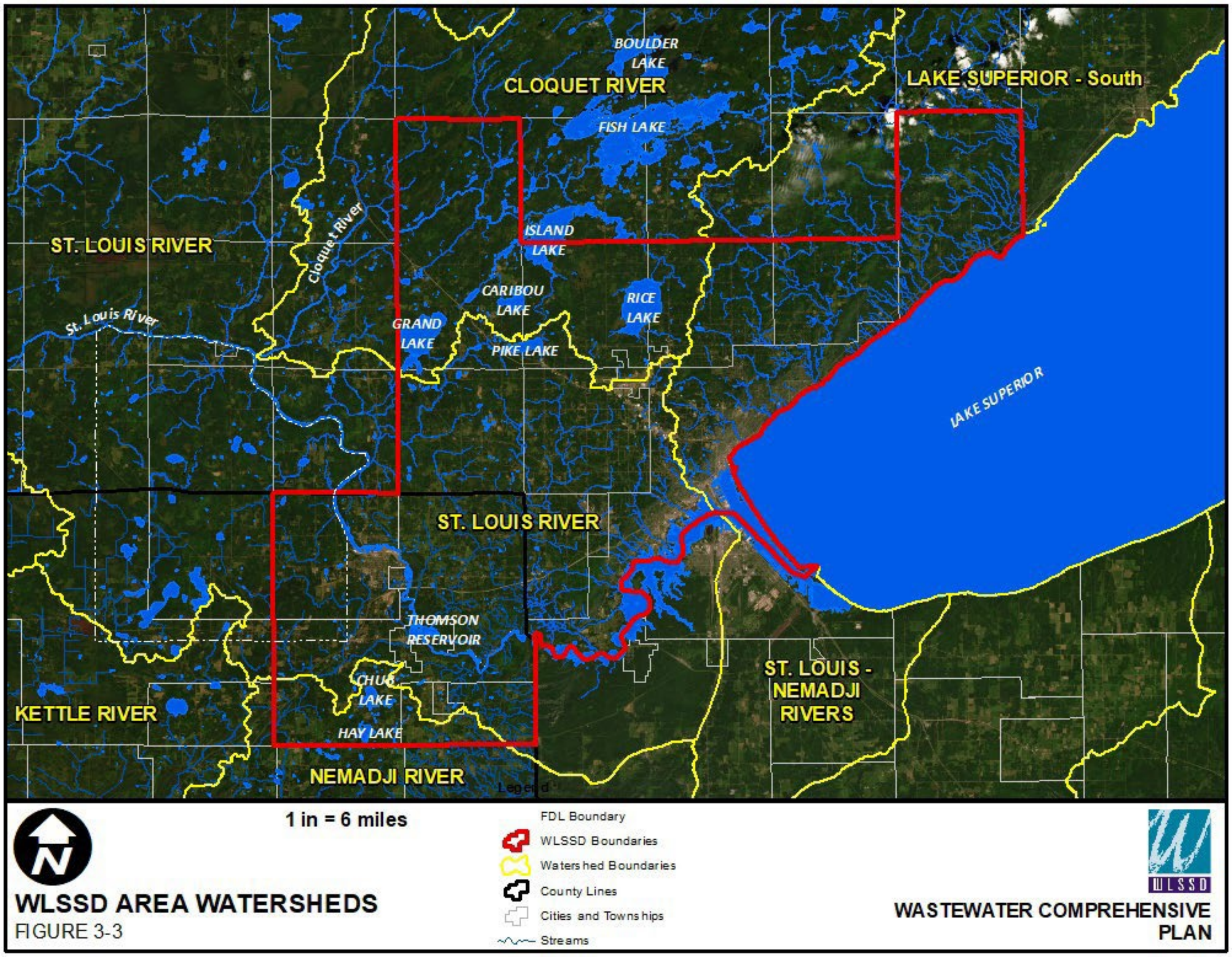
Section 3.5: Water Resources

Area-wide water resources can be divided in two general categories; surface water resources and groundwater resources. Lake Superior, the St. Louis River and St. Louis Bay are the major surface water resources. Many smaller tributary rivers, lakes and streams comprise the minor surface water resources within WLSSD boundaries.

The WLSSD area has significant water resources in the form of lakes, rivers and streams. Protection of these resources represents a major constraint to development. The need for the extension of public facilities or implementation of effective SSTS technology is based on the need to protect these resources. The County Water Management Plans (Carlton County, 2014 and St. Louis County, 2015) are the means by which water quality conditions are addressed in a comprehensive manner. The District is part of the county solutions, however counties have been given the statutory authority to develop and implement plans to protect and enhance surface and groundwater resources.

3.5.1 : Surface Waters

Major influences within the WLSSD boundaries are watersheds associated with the St. Louis River and Lake Superior basin. These watersheds consist of the Upper St. Louis River Watershed, Lower St. Louis River Watershed, Cloquet River Watershed, Nemadji River Watershed, and the Lake Superior Watershed (**Figure 3-3**). Local tributaries and associated drainage patterns within these watersheds are important factors influencing water quality and future utility services for future suburban and rural development.



In addition to Lake Superior, the surface waters within District boundaries consist of lakes, bogs, rivers and streams. The largest lakes/reservoirs include Wild Rice (reservoir), Grand, Caribou, Pike and part of Fish (reservoir) in St. Louis County; and Thomson Reservoir, Chub and Hay Lakes in Carlton County. There are numerous rivers and streams in the District, with the major river being the St. Louis River, which drain into Lake Superior and are protected watercourses under the Minnesota Department of Natural Resources (MN DNR) protected waters designation.

The most dramatic recovery in the quality of surface water has occurred in that portion of the St. Louis River downstream from Cloquet since startup of the WLSSD regional wastewater treatment facility in 1978. In general, the quality of surface waters is good. However, there remain some isolated areas of poorer water quality in the more densely developed and unsewered areas of the District. In addition, several reaches of the St. Louis River are currently considered impaired by some toxic substances including mercury and several organic chemicals. This situation is the result of past practices of many historical riverfront businesses and industries and other historical local and atmospheric sources of contamination.

3.5.2 : Groundwater

Groundwater wells throughout the District draw from water in unconsolidated glacial deposits or bedrock. The regional groundwater flow is to the east-southeast toward Lake Superior. Locally, movement is toward rivers, such as the St. Louis River and its tributaries. In the Nemadji Basin on the other hand, flow is from the basin divide with the St. Louis to the Nemadji River and its tributaries.

In general, the quality of the groundwater within the WLSSD is good. The waters from the aquifers contain calcium, magnesium and bicarbonate ions; however, saline water containing sodium chloride and sulfates is found in some bedrock aquifers. The highly variable quality of the water from bedrock wells, particularly in the volcanic rocks, is due to the presence of different minerals, as well as the length of time the water is in the rock.

3.5.3 : Suburban Lakes and Streams

"Suburban lakes" in both counties are subject to continuing threats of water quality degradation from shoreland development. Many of the lakes in St. Louis and Carlton counties are highly populated with seasonal or year-round homes.

Lakes receive both point and nonpoint sources of pollution. Lakes are also deposition areas for pollutants from the atmosphere. Known atmospheric problems including acid rain (attributed to sulfur compounds from burning fossil fuels) and nitrate, dioxins, mercury, and other contaminants, have been detected in lakes and rivers in the District. The MPCA does administer a number of programs dealing with surface water quality assessment and assistance, including the Citizen Lake Monitoring Program, Clean Lakes Program, Clean Water Partnership, Lake Assessment Program, Routine Water Quality Monitoring, and Toxic Substance Control Program. Shoreland protection measures (e.g., Shoreland Zoning and Best Management Practices) have been implemented for most lakes and streams in St. Louis and Carlton counties.

Lake associations have been formed for several of lakes within the area. These citizen groups strive to maintain and improve water quality of the lakes, educate both members and nonmembers about water quality issues, and obtain funding to address water quality and education issues within their watershed.

Within the District, issues relate more to dealing with existing problems than preventing future problems. Many of the prime suburban lakes have already developed to the state where there is little, if any, prime developable land remaining. In most cases development occurred prior to the enactment of shoreline setback and structure spacing criteria. Improperly located and spaced structures leads to improperly located wastewater disposal systems. Since poor soils and/or high groundwater tables typify shoreline areas, the danger of contamination is magnified.

3.5.4 : The St. Louis River

The St. Louis River is the largest tributary to Lake Superior and drains 3,634 square miles of watershed and encompasses 1,020 square miles. The St. Louis River crosses state boundaries, including both the state of Minnesota and Wisconsin. The St. Louis River is a vital resource to the regional economy and encompasses the Duluth-Superior port and is an active walleye fishery and a resource for recreation, commerce and quality of life.

As the St. Louis River approaches Duluth and Superior, it becomes a 12,000-acre freshwater estuary, which is the largest in North America. The upper estuary has wilderness-like areas, while the lower estuary is characterized by urban development. The lower estuary includes St. Louis Bay, Superior Bay, Allouez Bay and the lower Nemadji River.

Over the past 100 years a legacy of historical actions such as unregulated municipal and industrial waste disposal and unchecked land use practices, including dredging and filling of aquatic habitat and damaging logging and manufacturing processes, contributed to a complex set of issues facing the estuary. Industrial uses of the St. Louis River prior to the creation of modern pollution laws resulted in sediments in the river contaminated with mercury, dioxins, polychlorinated biphenyls, polycyclic aromatic hydrocarbons and other toxins.

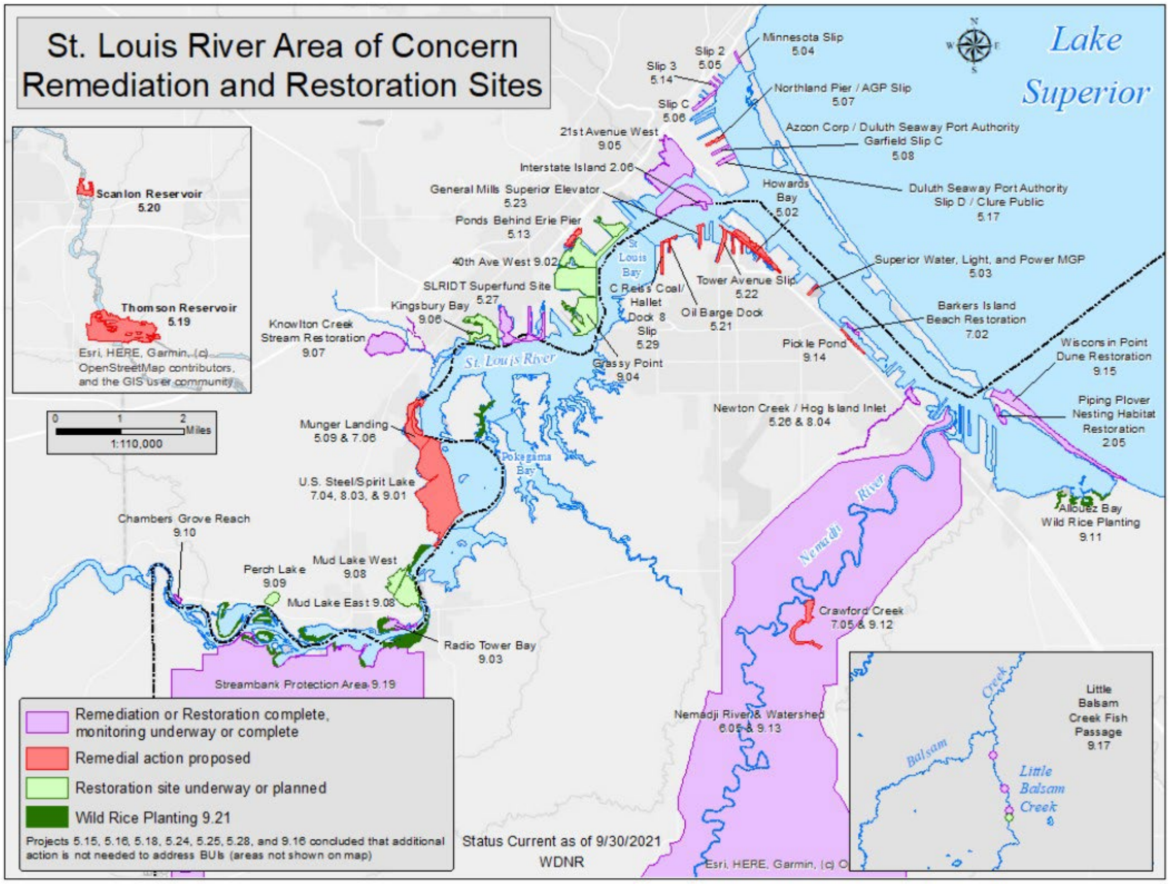
In 1987, the St. Louis River was designated as one of 43 international Areas of Concern (AOC) on the Great Lakes due to significant environmental degradation that occurred at those locations before environmental regulations were adopted. The St. Louis River Area of Concern (SLRAOC) is one of the 31 AOCs within the United States and is the second largest U.S. based AOC.

The Clean Water Act (CWA), passed in 1972, and other environmental regulations have been implemented to protect the environment from these types of large-scale problems. The scope of the AOC program does not include “modern” issues that are now addressed by many existing natural resources program authorities managed by a variety of state and federal agencies. Some examples of modern issues are: contaminants of emerging concern, water-related climate change impacts, non-compliance of point source permits, and impairments identified and regulated under the CWA.

The historical pollution problems were initially addressed by the 1992 Stage I and the 1995 Stage II St. Louis River System Remedial Action Plans (RAP), which focused primarily on the 39 miles of the St. Louis River below Cloquet, Minnesota. The St. Louis River Remedial Action Plan describes the removal targets for nine total beneficial use impairments (BUIs), the actions needed to reach those targets, and the anticipated schedule to complete those actions. Once all nine BUIs are removed, the St. Louis River Area of Concern (SLRAOC) can be delisted. Local state, tribal and federal agencies are working with citizens, non-profit organizations, universities, and businesses to move the SLRAOC from an “Area of Concern” to an “Area of Recovery”.

Figure 3-4 on the following page shows the remediation and restoration sites within the SLRAOC.

Figure 3-4, St. Louis River Area Remediation and Restoration Sites



3.5.5: Lake Superior (Great Lakes Restoration Initiative)

Lake Superior is a vast fresh water resource that has not experienced the same levels of development, urbanization and pollution as the other Great Lakes. Recognizing the critical importance of this resource, the United State and Canada are working to continue to restore and protect the Lake Superior Basin. The Great Lakes Water Quality Agreement (GLWQA) is a commitment between the governments of the United States and Canada to restore and protect the Great Lakes. The GLWQA provides a framework for identifying binational priorities and implementing actions that improve water quality. The U.S. EPA coordinates the U.S. activities under the GLWQA.

In 2010, the Environmental Protection Agency (EPA) and the Great Lake states worked to develop and implement the Great Lake Restoration Initiative (GLRI) to further efforts to protect and restore the largest system of fresh surface water in the world. The goal of the GLRI is to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem by directing activities to address five focus areas including:

- Toxic substances and Areas of Concern (AOC);
- Invasive species;
- Nearshore health and nonpoint source pollution;
- Habitat and wildlife protection and restoration;
- Accountability, monitoring, evaluation, communication, and partnerships.

The GLRI guidance consists of water quality criteria for 29 pollutants to protect aquatic life, wildlife, and human health, and detailed methodologies to develop criteria for additional pollutants; implementation procedures to develop more consistent, enforceable water quality-based effluent limits in discharge permits, as well as total maximum daily loads of pollutants that can be allowed to reach the Lakes and their tributaries from all sources; and anti-degradation policies and procedures.

The Guidance for the Great Lakes System will help establish consistent, enforceable, long-term protection from all types of pollutants, but will place short-term emphasis on the types of long-lasting pollutants that accumulate in the food web and pose a threat to the Great Lakes System. The Guidance includes minimum water quality criteria, anti-degradation policies, and implementation procedures that provide a coordinated ecosystem approach for addressing existing and possible pollutant problems and improves consistency in water quality standards and permitting procedures in the Great Lakes System. In addition, the Guidance provisions help establish consistent goals or minimum requirements for Remedial Action Plans (RAPs) and Lakewide Management Plans (LaMPs) that are critical to the success of international multi-media efforts to protect and restore the Great Lakes ecosystem.

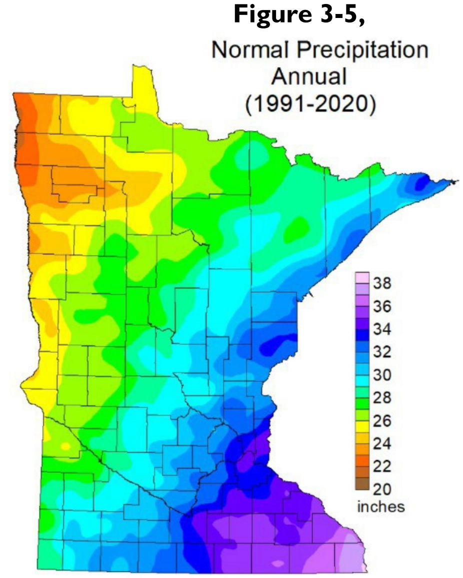
Section 3.6: Climate

The climate of the WLSSD area is classified as a mid-latitude continental climate with warm to hot summers and cold winters, slightly moderated by the influence of Lake Superior. Temperatures can range from highs near 90-100 degrees Fahrenheit in the summer months to lows of minus 30-40 degrees Fahrenheit during the winter months. The average high temperature annually is approximately 50.0 degrees Fahrenheit.

Average annual precipitation in the District area ranges from 29 to 31 inches. Because the District area is so large (530 square miles), there can be rain events in one portion of the District that are significant while other portions of the District receive little or no precipitation. This variation can cause difficulty in determining how the collection system will respond one rain event to the next and the variability complicates using hydraulic modeling tools to predict system performance. The most damaging precipitation event in the history of the area occurred on June 19-20, 2012 when over 7-inches of rain fell over a 24-hour period on top of already saturated ground. The flooding resulting from this historic rain resulted in catastrophic damage to portions of the WLSSD collection system.

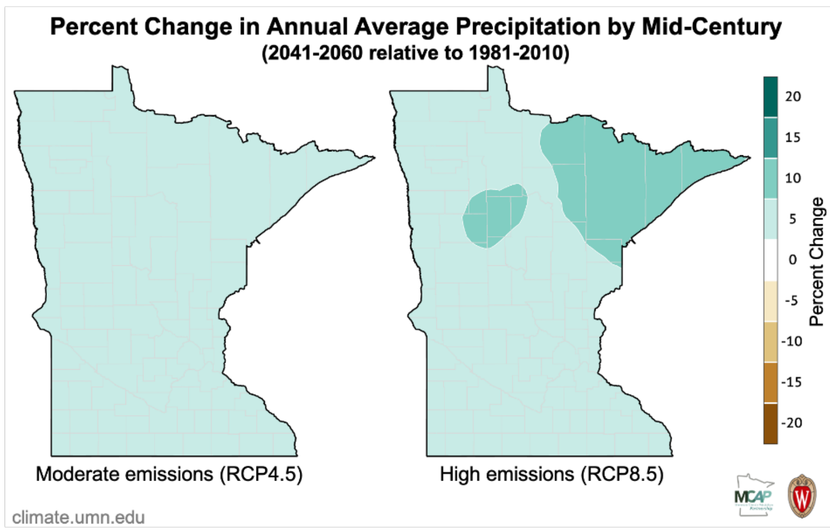
The WLSSD area typically averages approximately 90.2 inches of snowfall per year. Snowmelt each spring can result in inflow and infiltration issues, especially through manholes in located in ditches or other low-lying areas. **Figure 3-5** depicts the annual precipitation for the State of Minnesota.

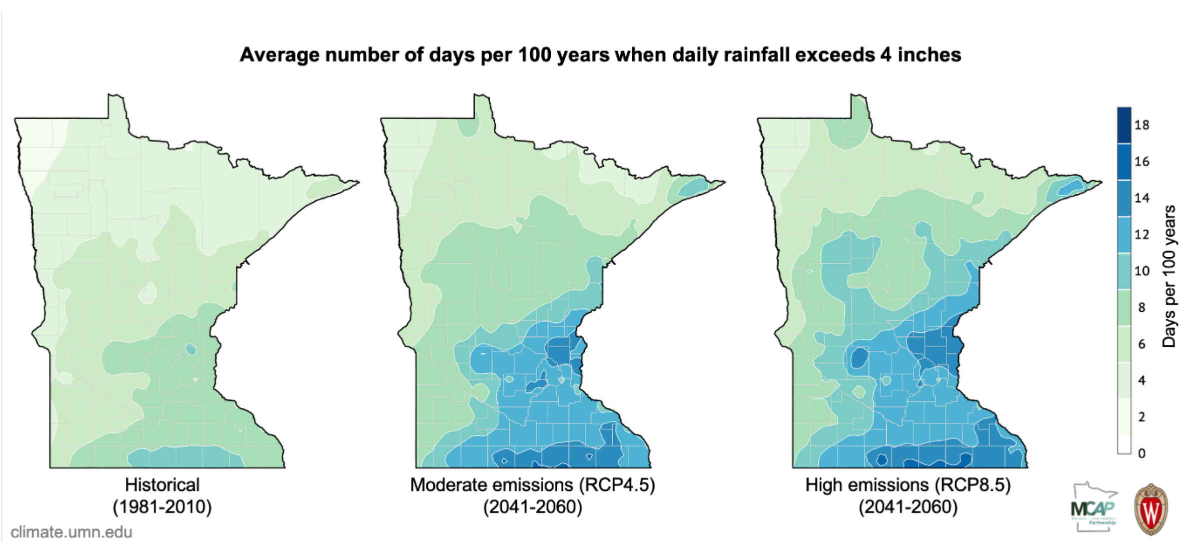
Figure 3-5,



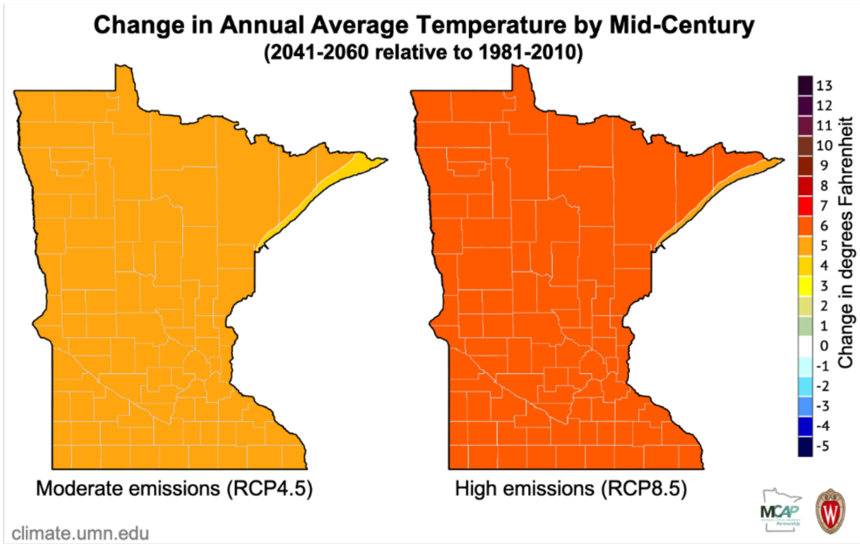
Climate projections from the University of Minnesota Climate Adaptation Partnership suggest that Minnesota will experience rising temperatures, fewer days below freezing, and increased precipitation as time goes on . These are important considerations to make when planning for the future because increased temperatures and precipitation could have an impact on WLSSD infrastructure and operations. Most notably, these changes have the potential to strain existing capacity for wastewater treatment and conveyance.

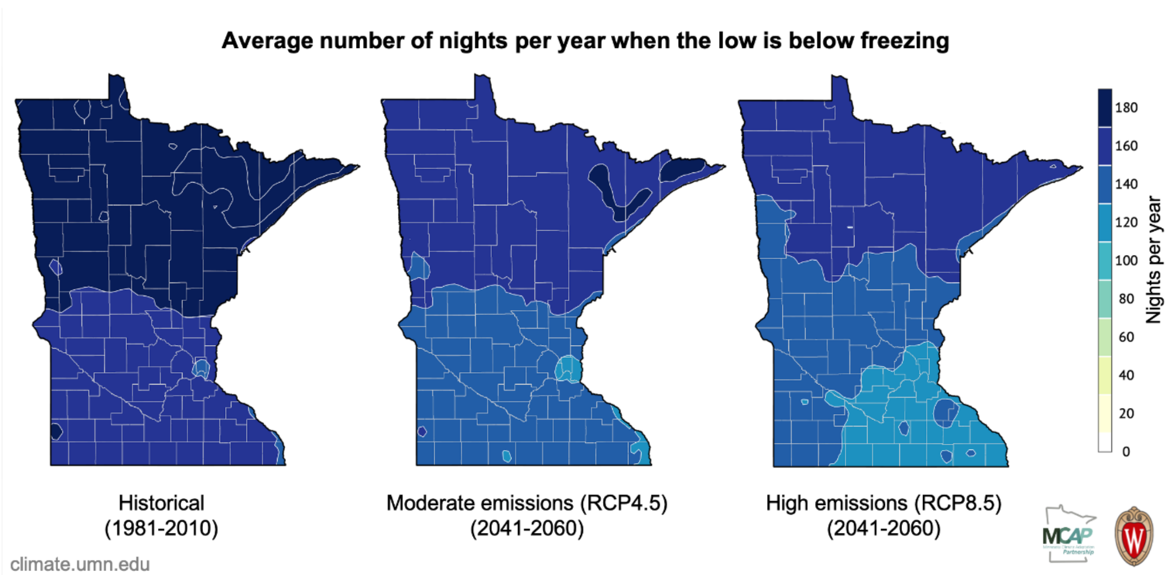
More frequent large rain events have the potential to overwhelm the conveyance system and lead to sanitary sewer overflows (SSOs). Large rain events also may reach or exceed wastewater capacity at the main treatment plant. Additionally, large rain events can stress wastewater conveyance and treatment infrastructure, leading to more frequent, costly repairs. The projections below show that there will be an increase in annual average precipitation and an increase in average number of days per 100 years that exceed 4-inches of rain, respectively.





Fewer days of below freezing temperatures may also influence inflow and infiltration (I & I) in the District. WLSSD currently maintains a community I & I program that monitors individual community progress towards reducing the amount of clear water getting into their respective sanitary sewer systems. With more precipitation and more days of melting snow, I & I may become a bigger issue for communities and for the finite capacity of WLSSD infrastructure. Additionally, freeze-thaw cycles could potentially stress infrastructure more and require better, longer lasting materials to ensure reliability. The projections below predict that temperatures will rise in Northern Minnesota in the coming decades, which could potentially have an impact on WLSSD infrastructure and services.





Changes in climate have the potential to affect WLSSD wastewater operations in the future and present both expected and unexpected challenges. WLSSD will continue to rely on the most up to date science to plan and make decisions for the future to ensure the demands of District communities are met and public and environmental health continue to be protected.

Section 4: WLSSD Service Areas

The WLSSD service area covers approximately 530 square miles encompassing two counties, eight cities and nine townships. Much of this area, however, is not served directly by a public sewer utility system. From a geographic perspective, only 12-percent (62.78 square miles) of the total WLSSD service area is actually served by public sewers. Another approximately 5-percent (29.00 square miles) of the WLSSD area has been identified in local plans as areas where future sanitary sewer service is possible within the next 10-20 years.

Within the WLSSD area, the District owns and operates 17 pump stations. The dry-weather volumes handled by the pumping stations range from 0.50 to 24 million gallons per day (MGD). Approximately 76 miles of sewer interceptors are operated by WLSSD including 43 miles of gravity interceptors and 33 miles of forcemain. The District also owns and operates four wastewater storage basins ranging from 200,000 gallons to 1,000,000 gallons in capacity.

Table 4-1 below summarizes the total sewered and future sewered areas within WLSSD. Each service area is discussed in further detail later in this section.

Table 4-1, WLSSD Service Areas

Status	Within WLSSD Boundaries (sq. mi.)	Percent of WLSSD Area	Outside WLSSD Boundaries (sq. mi.)
Existing Sewered Areas	62.78	11.8%	1.63
Future Sewer (less than 10 years)	15.08	2.8%	0.00
Future Sewer (greater than 10 years)	13.68	2.5%	0.75
Areas of Concern	2.42	0.4%	4.22
Unsewered/No Current Plans	436.04	80.7%	N/A

Section 4.1: Existing Sewered Areas

Sewered areas are defined as the areas that are currently served by publicly owned sanitary sewers. The WLSSD collection system consists of a network of pumping stations, metering stations, interceptors and force mains involved in the transmission of municipal and industrial wastewater to the wastewater treatment plant (WWTP) located in Duluth. The municipal customers within the WLSSD area own, operate and maintain their own collection systems prior to entry into the WLSSD interceptor collection system.

Figure 4-1 on the following page shows the existing WLSSD system of interceptors and pump stations.

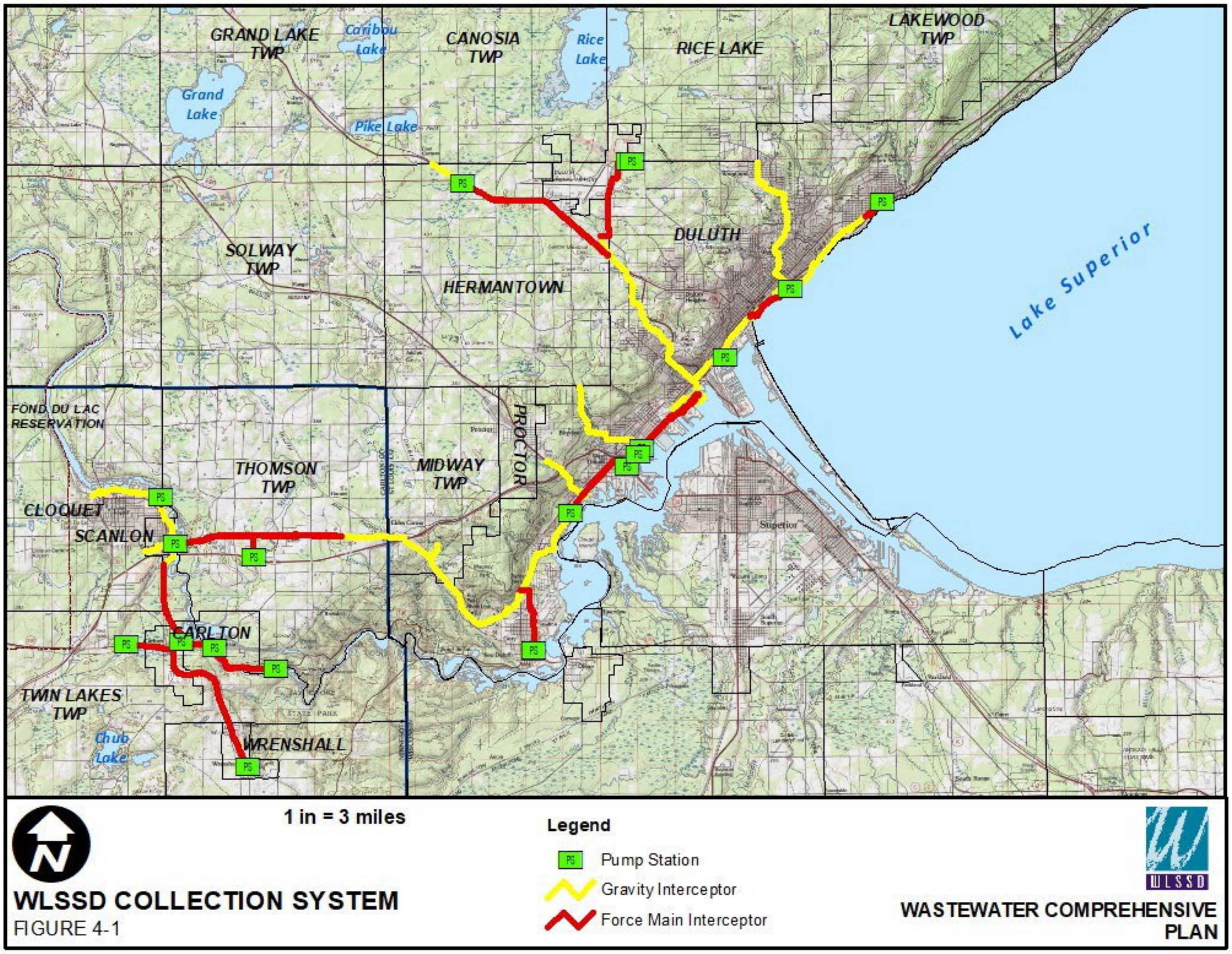


Table 4-2 on the following page illustrates the total population within WLSSD and distribution between sewered and unsewered communities. Unsewered areas are dependent upon some form of SSTS for wastewater management. The current population data reflects 2020 Census block data. The estimated sewered and unsewered population estimates were obtained by reviewing community plans and data from community leaders.

Approximately 19-percent of the population residing within the WLSSD area is not served by a public sewer system. This percentage is below the estimated 30-percent of Minnesota's population that is not served by a public sewer system as stated by the Minnesota Pollution Control Agency.

Table 4-2, WLSSD Estimated Sewered and Unsewered Populations

Community	2020 Population	Estimated Sewered Population	Estimated Unsewered Population
CARLTON COUNTY			
City of Carlton	948	887	61
City of Cloquet	12,568	9,933	2,635
City of Scanlon	987	987	0
Silver Brook Township	614	0	614
Thomson Township	5,465	2,220	3,245
Twin Lakes Township	2,093	142	1,951
City of Wrenshall	428	397	31
Carlton County WLSSD Subtotal:	***23,103***	***14,566***	***8,537***
Percent of WLSSD - Carlton County:		***63.0%***	***37.0%***
ST. LOUIS COUNTY			
Canosia Township	2,206	718	1,488
Duluth Township	2,309	467	1,842
City of Duluth	86,697	85,953	744
Grand Lake Township	2,720	254	2,466
City of Hermantown	10,221	7,963	2,258
Lakewood Township	2,276	68	2,208
Midway Township	1,431	200	1,231
City of Proctor	3,120	2,936	184
City of Rice Lake	4,112	740	3,372
Solway Township	1,957	0	1,957
St. Louis County WLSSD Subtotal:	***117,049***	***99,299***	***17,750***
Percent of WLSSD - St. Louis County:		***84.8%***	***15.2%***
OUTSIDE WLSSD LEGISLATIVE BOUNDARIES			
Oliver	370	195	175
KRLSD	230	210	20
TOTAL WLSSD SERVICE AREA	***140,752***	***114,270***	***26,482***
Percent of WLSSD Total		***81.2%***	***18.8%***

*Estimates calculated by using 2020 Census block data, local plans, and discussion with community leaders.

Section 4.2: Future Service Areas - Urban Services Boundary

During the Comprehensive Planning process, District communities identified through their local comprehensive plans, areas where additional urban growth is likely to occur during the next 10-20 years. Urban growth would be characterized by higher density development served by public utilities such as sewer. Communities also identified those areas that are expected to retain more of their rural characteristics.

After consulting with each community within the District, the Urban Services Boundary (USB) originally developed during the 2003 update of the Wastewater Quality Master Plan, has been revised to reflect community plans. The purpose of the USB is to show the approximate location which public utilities, such as sanitary sewer, are appropriate for extension. Areas outside this boundary should be protected from urban sprawl or unorganized growth. Establishment of the USB insures controlled expansion of local sewer systems consistent with local Comprehensive Plans as well as the goals and policies of the WLSSD Comprehensive Plan and Capital Improvement Program.

The location of the USB will be evaluated again at the end of the planning period or at other times deemed necessary by the District Board. Requests to expand the USB would be evaluated on a case-by-case basis and at a minimum would need to be consistent with local comprehensive plans. Areas within the District boundaries will have priority in receiving technical assistance from the District in the evaluation of current problems and potential solutions. For areas outside of WLSSD boundaries, District staff may be available to provide support such as technical assistance or educational resources as time and funding allows.

Figure 4-2 shows the map depicting the WLSSD Urban Services Boundary. These areas are defined as follows:

- **Urban Services Boundary (USB) –** Within this area are the approximate locations which public utilities such as sanitary sewer are appropriate for expansion. Areas outside the USB should be protected from urban sprawl and/or unorganized growth. This is represented by the red outline in the map.

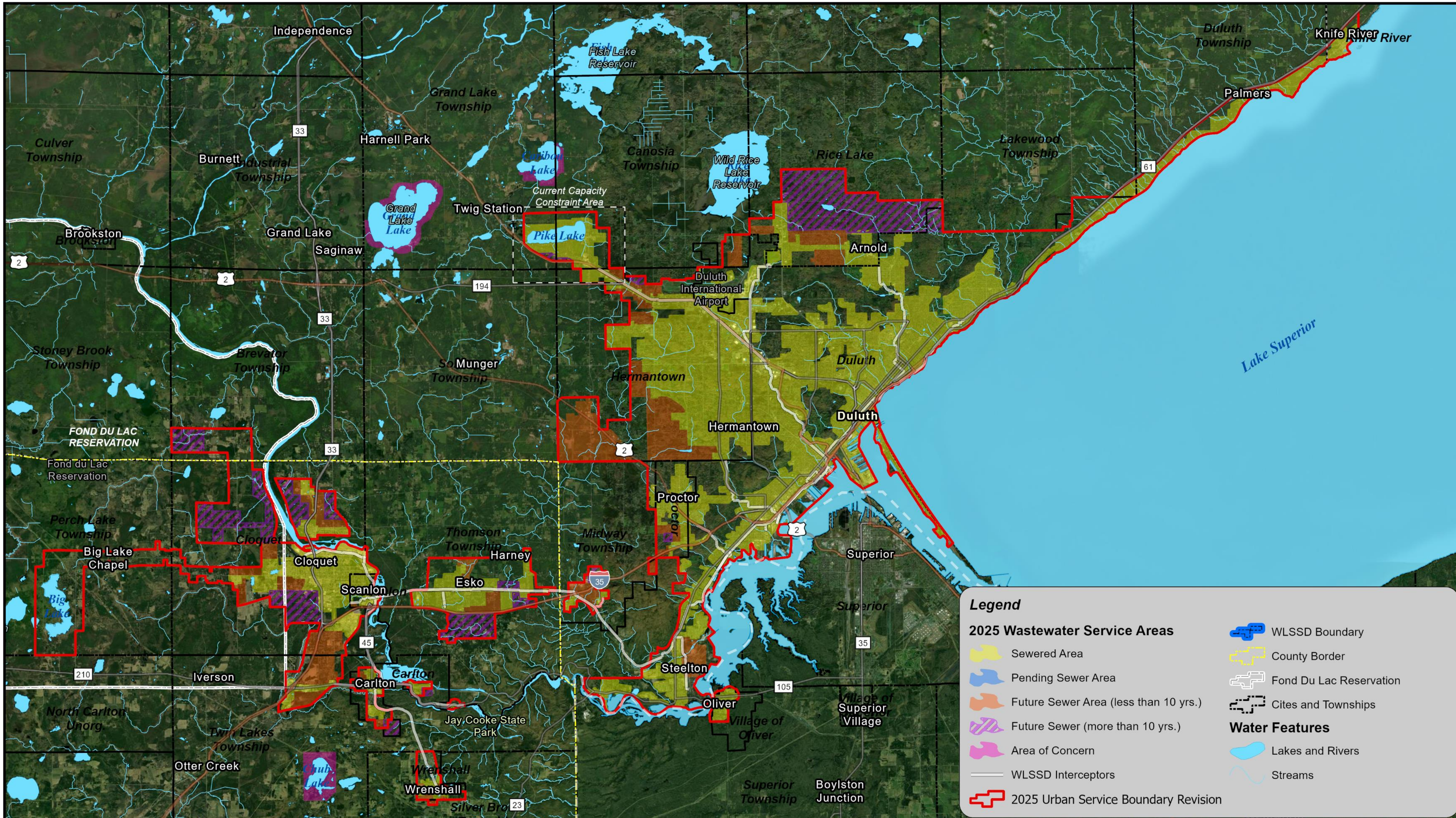
- **Sewered Area** – Areas currently served by publicly owned sanitary sewers. Wastewater is conveyed through the District's interceptor system and treated at the WLSSD regional wastewater treatment facility located in Duluth. This is represented by the yellow shaded areas in the map.

- **Pending Sewer Area** – These areas show locations where extending wastewater service is in the planning stages at the time of this Plan revision. This is represented by the light blue shaded areas on the map.

- **Future Sewer Areas** – These areas depict locations where communities have identified in their community plans as areas where sewer could likely be extended in either the short or long-term. This is represented by the orange shaded areas on the map.

- **Areas of Concern** – Areas within or just beyond the 530 square mile statutory boundaries of the WLSSD, which due to existing development densities and/or known wastewater management problems may require further investigation during the planning period. These areas are typically located around lakes and rivers that have small lots containing seasonal and/or year round homes and limited options for expanding, replacing or improving either their homes or subsurface sewage treatment systems (SSTS). Additionally, these areas would include areas zoned to accommodate large industrial or commercial uses. This is represented by the purple shaded areas on the map.

- **WLSSD Boundary: -** The WLSSD Boundary represents the legally defined area that encompasses the District. This is represented by the thick blue line in the map.



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0 2.5 5 10 Miles

WLSSD Urban Services Boundary 2025 Revision

WESTERN LAKE SUPERIOR SANITARY DISTRICT

DULUTH, MINNESOTA

Section 4.3: Subsurface Sewage Treatment Systems (SSTS)

Subsurface Sewage Treatment Systems are commonly known as septic systems. They are soil-based treatment systems used by homes and businesses which are not connected to municipal sewer. SSTS were formerly called Individual Sewage Treatment Systems (ISTS). While the terminology has changed to reflect changes in the septic system industry, a septic system is still a combination of tanks or other treatment devices providing initial treatment of sewage which ultimately discharging the sewage into the soil for final treatment. As with large wastewater facilities, SSTS need to be properly designed, installed, regulated and maintained.

SSTS treat sewage through a combination of biological, physical and chemical processes. They are designed to account for the daily wastewater flow, the type of distribution system (gravity or pressure), soil conditions of the site, and need the development of a biological layer (a biomat) for proper wastewater treatment. When properly designed, constructed and maintained they provide a high degree of sewage treatment and are a proven method of controlling the negative environmental effects of untreated sewage.

One decentralized community/cluster system presently exists within the boundaries of the WLSSD. This system is located on Grand Lake in Grand Lake Township and consists on 10-12 residential dwellings contributing wastewater to a community wetland treatment system. Another decentralized collection system that is currently in use is the Birch Point Subordinate Service District in Grand Lake Township. The system utilizes a septic tank effluent pump (STEP) point of use system. The STEP tanks send only effluent to the BioMicrobics FAST® system, which treats the effluent. There are multiple disposal fields at the treatment site, each of which is utilized on a randomized basis. The cost of the construction and operation of the system has been paid by the residents who are connected to the system. Eighty-one percent of the system was funded by grant funds.

4.3.1 : Responsible Units

State of Minnesota

Minnesota Rules, Chapter 7080-7083 (Subsurface Sewage Treatment System Standards or SSTS) administered by the Minnesota Pollution Control Agency (MPCA) provide technical standards and guidance for the siting, design and construction of on-site systems. Minnesota Statutes, Chapter 103F requires counties and municipalities to adopt and enforce these standards within designated floodplain, shoreland and wild and scenic river areas. Outside the designated areas, Chapter 7080-7083 rules act only as a guidance document to counties and municipalities.

The 1995 legislation, known as the ISTS Act, has been codified as Minn. Stat. §§ 115.55 and 115.56. The Act has been amended in recent years, with major changes in 1996 and again in 2008. The purpose of this legislative activity was to address the serious problems associated with failing ISTS. The law has brought increased attention and regulation to a problem of which many citizens and community leaders were previously unaware.

Counties, Municipalities, and Towns

The St. Louis County Planning and Community Development Department - Onsite Wastewater Division administers the Subsurface Sewage Treatment System Ordinance 61, along with incorporating by reference the minimum standards established by Minnesota statutes and administrative rules of the Minnesota Pollution Control Agency (MPCA).

In St. Louis County, municipalities and townships with individual zoning authority make use of County staff for approval of new SSTS systems and rehabilitations. For example, in the City of Hermantown this arrangement works well because the City does not relinquish its zoning authority, however St. Louis County staff expertise is utilized relating to SSTS. The County also conducts SSTS approvals, inspections and enforcement in the remaining rural townships within the WLSSD service area.

The Carlton County Zoning and Environmental Services Department administers the Subsurface Sewage Treatment System Ordinance (Ordinance #30) in all areas of the County. Carlton County permits and inspects all new installations, replacements and repairs of systems.

Western Lake Superior Sanitary District

The enabling statute of the WLSSD, Chapter 458D is quite specific to the purposes of the District as a regional government unit. Section 458D.01 established a sanitary board to be "*assigned the responsibility of carrying on a continuous long range program of planning with respect thereto and given the authority to take over, acquire, construct, better administer, operate and maintain any and all interceptors and treatment works needed for the collection, treatment and disposal of sewage and solid waste in such area, as well as local sanitary sewer facilities over which the Board agrees to assume responsibility at the request of any local government unit.*"

The statute does not mention subsurface sewage treatment system authority as an intended purpose for the District. In the absence of specific authority, it is potentially problematic to assume such where none explicitly exists and there could be administrative risks to the District with such assumption. However, there is an indirect role for the District in SSTS authority from a planning perspective. Section 458D.05 states that the Board shall prepare and adopt a comprehensive plan for "*the collection, treatment and disposal of sewage in all or a designated part of the District through a system of interceptors and treatment works...etc.*"

The collection of sewage is generally accepted as a role for local government. Sewage collection system need is often driven by the following:

- Comprehensive land use planning which dictates development densities requiring such service;
- Existing development with failing SSTS which can sometimes be more cost effectively replaced with a collection system; and
- Environmental conditions which do not allow for effective installation, operation or design life of SSTS.

The transport of sewage through an interceptor and its treatment may either be a local or regional responsibility. In this case, the WLSSD has the authority for transport and treatment through Chapter 458D. The issue of land use and comprehensive planning as discussed elsewhere in the plan provides an indirect role for the District in SSTS authority. This occurs when a local government requests the transport of sewage anticipated from an existing or future collection system versus continuing with the construction or maintenance of subsurface sewage treatment systems.

4.3.2 : Constraints

Significant portions of Carlton County contain soils that have severe limitations for SSTS. Specifically, Thomson Township contains soil types, which are well-drained, but have slow water percolation rates. Therefore, sewage treatment systems may become hydraulically overloaded and fail to function properly.

The north shore area of Lake Superior has variable conditions for soil thickness with ledge rock often outcropping. Experience has found that a site-specific soils survey is required at the time of an SSTS suitability determination. However, this is often too late for the landowner to discover that the site may have an SSTS limitation. It is apparent that soils characteristics are a limiting factor for the location of subsurface sewage treatment systems in a significant portion of the WLSSD area.

4.3.3 : Inspection and Monitoring Needs

Long-term protection of the environment requires that inspection and monitoring of SSTS continue by the responsible local government unit particularly in those areas most susceptible to contamination (e.g., shoreland zones). Inspection should continue to be the primary responsibility of local government (county and city). Monitoring needs refer to field and administrative actions, which can be implemented to address how well the SSTS program is administered by local government.

4.3.4 : Managed On-Site Treatment Systems

The WLSSD Wastewater Comprehensive Plan contemplates that in certain areas management of wastewater generated from a home or business would continue to utilize on-site systems. In these areas, systems continue to be managed by the user, with County oversight (St. Louis or Carlton), under rules established by the Legislature and the Minnesota Pollution Control Agency (MPCA). Costs of construction, maintenance, and operation are typically the responsibility of the property owner.

In certain communities, poor soil conditions, high population densities, small lot sizes or persistent failures of on-site systems have made continued management by the home or business owner a less than desirable alternative. Often the only solutions recommended in these areas have been to connect to a centralized sewer system for ultimate treatment either at WLSSD or at a decentralized treatment site. An option available that stands between publicly owned collection systems and individually owned on-site systems are managed on-site systems.

A system of managed on-site treatment systems could entail different levels of control, but in each case it would mean that the property owner would give up some or all control of the on-site treatment system in exchange for management by a third party. The third party could be the local unit of government (i.e., township, city, county or an entity similar to the Pike Lake Area Wastewater Collection System (PLAWCS) or the Duluth North Shore Sanitary District (DNSSD). In exchange for the third party having control of the on-site system, the property owner would receive services on their system, and payment for such services would be collected in a way that all property owners could benefit equitably from being part of the managed on-site systemarea.

On-site system management could come in various levels of control beyond the direct control of the property owner. The following decentralized wastewater management models, from the least comprehensive to the most comprehensive, are shown below as described by the Environmental Protection Agency (EPA).

- ***Homeowner Awareness Model***
  This model is well suited to areas of low environmental sensitivity where sites are suitable for conventional onsite systems. In this case, systems are sited and constructed on prescribed criteria and the homeowner is provided with maintenance reminders. This system is relatively easy to implement, however there is often times no compliance mechanism in place.

- ***Maintenance Contract Model***
  This model is best suited for areas with low to moderate environmental sensitivity where sites are marginally suitable for conventional onsite systems due to small lots, shallow soils or low-permeability soils. They are often times found in small cluster systems. Under the Maintenance Contract Model there is a lower risk of treatment system malfunctions, however, like the Homeowner Awareness Model there is some degree of difficulty tracking and enforcing compliance due to the reliance on the owner or contractor to report a lapse in services.

- ***Operating Permit Model***
  A typical application of this model is found in areas of moderate environmental sensitivity where sites are marginally suitable for conventional onsite systems due to small lots, shallow solids or low permeability soils. This system uses regular compliance monitoring reports and non-compliant systems are identified and corrective actions are required.

- ***Responsible Management Entity (RME) Operation***
  This model is best suited for areas of moderate to high environmental sensitivity where reliable and sustainable system management is required. This application is frequently found in cluster systems. Operations and maintenance responsibility is transferred from the system owner to a professional management entity that holds the operating permit. Typically, there is one permit for each group of systems. The RME must have the approval of the property owner for repairs which could result in a conflict if performance problems are identified by the RME and not corrected by the property owner.

- ***Responsible Management Entity (RME) Ownership Model***
  This management model is typically found in areas of greatest environmental sensitivity, where reliable management is required. This includes sole source aquifers, wellhead or source water protection zones, critical aquatic habitats, and outstanding value resource waters. This is the preferred management model for cluster systems serving multiple properties under different ownership. The model provides the greatest protection of environmental resources and homeowner investment and also removes the potential conflicts between the user and the RME as discussed in the previous model. This system offers a high level of oversight if system problems occur.

Section 5: WASTEWATER TREATMENT PROCESS & FACILITY ANALYSIS

Section 5.1: Treatment Plant Capacity

The WLSSD wastewater treatment plant is a tertiary treatment facility that currently treats approximately 36 MGD of wastewater on average from 17 municipal customers throughout a 530-square mile region along with wastewater from several industrial users that include two large pulp and paper mills. The industrial and municipal customers within the WLSSD service area create a diverse and sometimes highly variable wastewater flow, temperature and composition.

One of the unique characteristics of the WLSSD facility is the dominance of loading from industries relative to municipal sources. On average, 50-60 percent of current influent wastewater flows are from the Sappi paper mill located in Cloquet and the ST Paper 1, LLC mill located in Duluth (Duluth Mill). The Sappi facility is the largest wastewater contributor in the WLSSD service area. All Sappi and Duluth Mill flows are conveyed by the Knowlton Creek forcemain. **Table 5-1** below shows the design capacities for the treatment plant.

Table 5-1, Wastewater Treatment Plant Design Capacities

Measure	Capacity
Flow (MGD)	48.4 MGD
Peak Flow (MGD)	100.0 MGD
Total Suspended Solids (TSS)	112,000 LBS/DAY
Biochemical Oxygen Demand (BOD)	121,000 LBS/DAY

Section 5.2: Treatment Plant Baseline Flows and Loads

Historical 2015-2019 total plant influent (TPI) annual average, maximum month and maximum daily flows are shown in **Table 5-2** on the following page. Data is excluded for 2020 and 2021 because it is not representative of normal operations due to COVID-19 pandemic effects, abnormally dry weather, and a temporary shutdown of the Duluth Mill.

Table 5-2, Historical Treatment Plant Flow and Loadings 2015-2019

Parameter	2015	2016	2017	2018	2019
Total Plant Influent Flow					
Annual Average	36.7	37.1	38.5	35.9	37.8
Maximum Month	45.9	49.4	45.9	43.5	46.1
Maximum Week	55.7	66.1	57.2	57.3	56.1
Maximum Day	81.9	112.8	97.3	101.4	71.2
BOD Load (lb/d)					
Annual Average	84,213	71,397	61,432	59,668	57,732
Maximum Month	101,251	95,288	75,351	72,424	71,797
Maximum Week	110,994	100,860	92,052	77,578	86,758
Maximum Day	148,674	142,754	197,556	103,739	120,041
TSS Load (lb/d)					
Annual Average	68,344	55,791	58,395	54,150	58,252
Maximum Month	84,641	70,121	73,102	66,520	92,115
Maximum Week	102,661	89,083	121,782	75,909	147,146
Maximum Day	137,905	180,049	261,683	124,174	198,427
Phosphorous Load (lb/d)					
Annual Average	755	813	792	714	819
Maximum Month	996	1,097	1,246	919	989
Maximum Week	996	2,482	3,707	1,162	1,544
Maximum Day	1,063	2,482	3,707	1,290	1,567

Section 5.3: Treatment Plant Projected Flows and Loads

Future wastewater flows and loadings will be largely defined by those from the two pulp and paper mills: Sappi and the Duluth Mills. WLSSD expects Sappi to operate consistent with its recent operation so future flows and loadings will be consistent in magnitude and variability with what has been observed recently.

Historical TPI data includes historical Duluth Mill flows and loadings that are different than those anticipated in the future. Year 2042 annual average flows and loadings are summarized in **Table 5-3** on the following page and were projected using the following assumptions:

- 40% of the TPI flow and 20% of the TPI loading is attributed to domestic users
- Domestic flows and loadings will increase linearly 1.8% per decade
- Sappi and Duluth Mill flows and loadings will remain constant
- Future peaking factors will be consistent with historical peaking factors

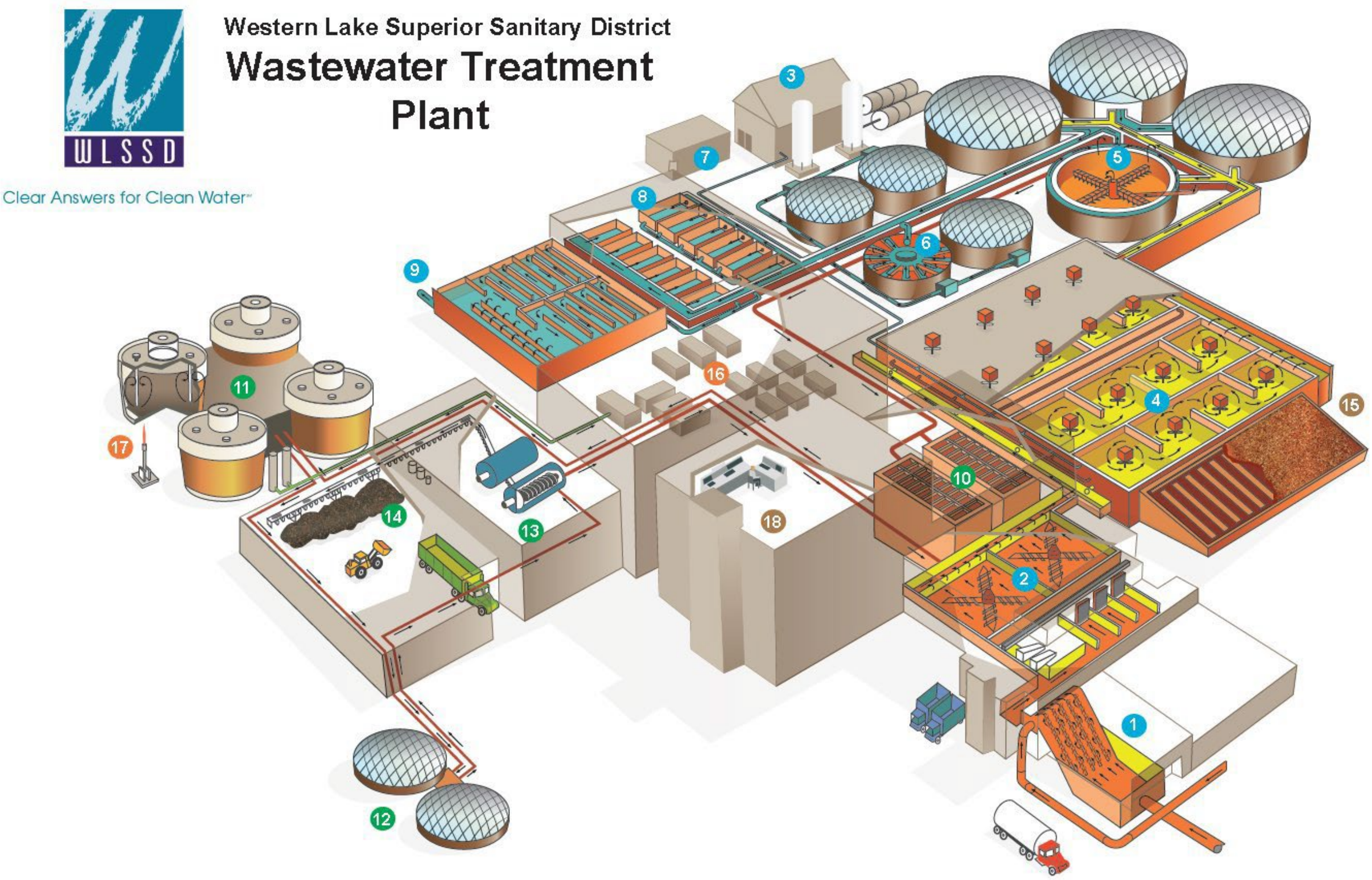
Table 5-3, Projected Treatment Plant Flow and Loadings 2022-2042

Parameter	2022	2032	2042
Total Plant Influent Flow			
Annual Average	35.0	35.3	35.5
Maximum Month	46.5	46.8	47.2
Maximum Week	62.3	62.7	63.2
Maximum Day	106.2	107.0	107.7
BOD Load (lb/d)			
Annual Average	59,432	59,646	59,860
Maximum Month	89,964	90,288	90,612
Maximum Week	98,621	98,976	99,331
Maximum Day	175,866	176,165	176,767
TSS Load (lb/d)			
Annual Average	57,474	57,681	57,888
Maximum Month	89,753	90,076	90,400
Maximum Week	143,373	143,889	144,405
Maximum Day	254,972	255,890	256,808
Phosphorous Load (lb/d)			
Annual Average	779	781	784
Maximum Month	1,246	1,251	1,255
Maximum Week	3,707	3,720	3,734
Maximum Day	3,707	3,720	3,734

Section 5.4: WLSSD Existing Facilities

The wastewater treatment train consists of preliminary screening and grit removal, secondary treatment with a high purity oxygen activated sludge process, secondary clarification, disinfection with chlorination and dechlorination, and tertiary mixed media filtration. The solids produced by the liquid train are thickened, anaerobically digested at thermophilic and mesophilic temperatures, dewatered, and land applied as Class B biosolids material. **Figure 5-1** below shows a schematic of the WLSSD treatment plant.

Figure 5-1, WLSSD Existing Facilities Schematic



1. In-plant pumping
2. Bar screens and grit removal
3. Oxygen generation
4. Activated sludge secondary treatment
5. Secondary settling tanks
6. Flocculation tanks
7. Disinfection
8. Mixed-media filtration
9. Effluent discharge
10. Dissolved air flotation thickeners (DAFT)
11. Digesters
12. Digested sludge storage
13. Biosolids dewatering centrifuges
14. Biosolids storage
15. Biofilter
16. Methane gas boilers
17. Gas flare
18. Process control

5.4.1 Conveyance

- **In-plant Pumping:** Wastewater from east of the plant is lifted into the plant by five, 40-foot long screw pumps, lifting the wastewater 20 feet so that it can flow by gravity through the rest of the treatment process. Each 72-inch diameter screw is driven by a 100-horsepower motor and can pump 18.75 million gallons per day (MGD). An additional 20 (MGD) centrifugal pump can be added when wastewater flows are high.

  Each of the five screw pumps were replaced beginning in 2016 with three flight screws instead of two flight and firm capacity was increased from 60 to 75 MGD, with a capacity of 95 MGD when including the high flow pump. The wastewater from the western portion of the collection system, including flows from paper mills in Duluth and Cloquet, arrives at the total plant influent channel through the Knowlton Creek Forcemain.

- **Bar Screens and Grit Removal:** Wastewater flows through large mechanically cleaned bar screens into grit tanks. The three 1/4-inch bar screens remove sticks, rags, and other debris that could damage process equipment, and each bar screen can process 80 MGD of wastewater, giving a firm capacity of 160 MGD with one bar screen out of service. The wastewater slows down in one of two 50' x 50' x 7.5' grit tanks, allowing sand and grit to settle out. Once wastewater is processed by the grit tanks, the grit screenings are transported by a flat belt conveyor and are sent to a landfill.

  In 2016, the District completed a major headworks rehabilitation project that improved screening and grit removal improvements. This project replaced the influent bar screens and reduced the bar spacing from ¾ inch to ¼ inch, installed new channel gate valves and stop logs, new scum collection equipment, grit collection, pumping and washing equipment. Additional concrete repairs were completed on the grit tanks and walkways to replace deteriorated concrete. In case of a system emergency involving the Knowlton Creek Pump Station, a redundant influent valve was added to the grit tanks. Odor curtains were added in the grit tank room to minimize odor in working areas.

5.4.2 Secondary Treatment

- **Oxygen Generation:** In 2019, WLSSD replaced the original 1970s cryogenic oxygen generation equipment with two vacuum swing adsorption (VSA) systems that now serve as the primary source of high purity oxygen gas to meet the biological needs of the treatment process. The original liquid oxygen tanks were moved to the new oxygen generation facility and the vaporizers were replaced. Each system is capable of producing 40 tons of pure oxygen per day for a total of 80 tons of pure oxygen daily. Liquid oxygen is stored in tanks for use as a backup or supplemental source of oxygen if needed. The systems move air through pressure vessels containing adsorbent media. The media act as a molecular sieve, retaining nitrogen molecules and other impurities at a low, positive pressure while the gaseous oxygen continues into the treatment system. Every 20-30 seconds, a vacuum blower briefly drops the pressure in the vessel, venting the impurities to the atmosphere. If demand for oxygen drops, the system can be "dialed down" to meet the lower need by operating a single VSA system, or by adding idle time within each cycle. Because of this project and other energy improvement projects, compared to 2021 the overall electrical usage at the wastewater treatment plant has decreased by approximately 23-percent since 2015 and 37-percent since 2011.

- **Activated Sludge Secondary Treatment:** Wastewater, return-activated sludge, and pure oxygen are mixed in concrete oxygenation tanks that were constructed in the late 1970s and have been in continuous operation since. Each of the four oxygenation tanks contain four connected cells, or stages, that are 56 feet square and are 18-feet deep.. As wastewater flows from cell to cell, surface aeration mixers dissolve the high-purity oxygen into the wastewater. The oxygen creates an ideal environment for bacteria, which feed on organic matter in the wastewater. This biological process yields large populations of microorganisms, which breaks down pollutants into simpler non-polluting materials. This same process occurs in natural waterways, only at a slower pace.

In 2022, a comprehensive assessment was completed for oxygenation reactor #4, which reviewed the condition of the structural roof slab, the visible exterior concrete, and the interior concrete. The condition of the 16 mixers were investigated and potential energy savings for upgrading the mixer impellers was analyzed. The assessment assumed the condition of reactor #4 to be representative of the condition of the remaining three reactors. This assessment is included as Appendix M of this Plan.

The reactors are constructed with a topping slab over a structural beam/slab system with variable thickness that directs surface water to existing drains. The assessment revealed significant deterioration to the topping slab including freeze-thaw damage and cracking. The condition of the structure slab beneath the topping slab is not currently known as it is not visible. Between the topping slab and structural slab is a rubber membrane which has failed in a number of locations allowing water to leak into the interior central tunnel. Most of the tank exterior walls are below ground, however areas of visible exterior wall showed some failed expansion joints, some spalling and actively leaking cracks.

The interior inspection revealed concrete degradation with areas of aggregate visible below the waterline indicating ¾ to 1-inch of missing material. Above the waterline, the walls and underside of the slab were clean. Reinforcing bars were visible on the underside of the slab and concrete beams, indicating a loss of the 2-inches of concrete cover. The columns had surface aggregate visible for the full height.

Structural rehabilitation and mixer rehabilitation and optimization for each of the four reactor trains are currently planned in the 10-year Capital Improvement Program for 2025, 2027, 2029 and 2031.

- **Secondary Settling Tanks:** Solids in wastewater settle to the bottom or float to the top in four settling tanks, or clarifiers. Each tank is 160’ in diameter and 14’ deep, and has a capacity of 2.1 million gallons. Large sweeping arms remove settled and floating solids from the tanks. The bacteria-rich settled solids, called sludge, are returned to the aeration basins as return-activated sludge to be mixed with incoming wastewater and oxygen. A smaller portion of the sludge is removed in order to make room for new microorganism growth and continued treatment. These solids are used to produce fertilizer (see biosolids production). The secondary clarifiers underwent a rehabilitation in 2000-2003, which included replacement of all mechanical and electrical components as well as exterior concrete repairs and subsequent recoating of the steel mechanisms in 2004 and 2005. In 2018, condition assessments were completed for clarifiers #2 and #4, which are included in Appendicies Q and R of the Plan.

  In 2019, a major rehabilitation to secondary clarifier #3 was completed which consisted of concrete repairs to deteriorated exterior and interior wall surfaces and corbels (launder supports), replacement of concrete launders and effluent box with stainless steel, new replacement FRP weirs and scum baffles, new dome vents, and extension of the center flocculation well baffle height and depth for improved settling at high-flow rates. This project also included the installation of a new cathodic protection system for the clarifier system and a new stair and ramp system to the top of the dome with modifications to the fan to allow for safe in-place maintenance of the exhaust fans.

Planned repairs of the remaining three secondary clarifiers are incorporate into the WLSSD 10-year Capital Improvement Program in 2024, 2026 and 2028.

- **Flocculation Tanks:** Four tanks, each 120' in diameter and 13.7' deep with a 1,162,500-million-gallon capacity and a detention time of 2.6 hours, are used to remove small amounts of suspended solids. The tanks were originally designed to be used for phosphorus removal, but because of low phosphorus levels in the plant's wastewater the tanks were converted to this new use.

  In 2006-2007, WLSSD completed a rehabilitation project of the flocculation tanks that included the complete replacement of internal components including the sludge collector mechanism and radial launders and weirs in addition to associated pipe and electrical demolition and modifications. The replacement internal components was necessary to address condition issues including corrosion and structural fatigue. A 2018 assessment of flocculation tank #2 is included in Appendix P of the Plan. Additional assessment and rehabilitation of the flocculation tanks is anticipated in the future but is not currently included in the WLSSD 10-year Capital Improvement Program.

5.4.3 Tertiary Treatment

- **Disinfection:** Sodium hypochlorite (commonly called bleach), a strong oxidizer, is added to wastewater to kill pathogens. Sodium hypochlorite is added after it leaves the settling tanks and can also be added at the beginning of the chlorine contact tanks. There are four 15,000 gallon storage tanks for sodium hypochlorite to ensure there is enough disinfectant at the facility at all times. Disinfection occurs from April 1 – October 31 when people are likely to be using the river for recreation. Sodium bisulfite is used to remove residual chlorine from the wastewater if needed. There are two chlorine contact tanks and normally both are in operation, but one can be taken down for emergencies or maintenance.

- **Mixed-Media Filters:** Twelve mixed-media filters trap solid particles remaining in the wastewater. Each filter consists of layers of anthracite coal, silica sand, and gravel totaling approximately 3.8-feet in thickness. The filters are automatically backwashed to remove accumulated solids. Backwash water is pumped to the beginning of the plant for treatment. The filters are similar to those used at many drinking water filtration plants. Once passing through the filters, the effluent flows to the chlorine contact tanks.

  Mixed media filter #1 was taken out of service in early 2020 due to an issue discovered with the underdrain system. The filter media was removed in order to inspect the underdrain system and it was discovered the drain tile within this filter was damaged. The WLSSD 10-year Capital Improvement Program includes funding to rehabilitate mixed media filter #1 in 2023 and restore it to original operating condition and to replace the media in mixed media filter #3.

  Additional study is underway on alternative filtration options, including cloth media filtration, to promote further reduction of mercury as an alternative to the current mixed media filtration. The District's 10-year CIP includes funds for additional pilot testing of cloth media filtration technology in 2023. The District's notification letter to the MPCA of this pilot is included as Appendix V of this Plan.

- **Final Effluent Discharge:** The de-chlorination contact tanks provide space for dechlorination chemical to consume any excess chlorine from the effluent before being discharged, and also provide an opportunity to re-oxygenate the water after it has been treated. The treated effluent is then discharged to the St. Louis River Bay. Regular effluent sampling by WLSSD assures that all state and federal water quality standards are achieved.

5.4.4 Biosolids Production

- **Dissolved Air Flotation Thickeners (DAFT):** The first step in the biosolids production process involves separating the solid materials from the wastewater. This occurs in four 55,000 gallon dissolved air flotation thickener (DAFT) tanks. Water in the sludge is reduced by blending polymer and fine air bubbles that attach to waste activated sludge (WAS) and chemical sludge, which causes the solids to float to the surface. The process increases solid content from 1.5-percent to approximately 5-percent. The concentrated blanket of sludge is skimmed from the surface and deposited into the thickened sludge well for storage. The water removed from the sludge is returned to the beginning of the treatment plant for further treatment.

  The DAFTs have been in service for over 40 years and many components are reaching end of service life. A condition assessment of existing equipment was performed in 2021 and various thickening technologies were evaluated. This 2021 assessment is included in Appendix O of this Plan. The selected alternative is to replace the existing DAFTs with new rotary drum thickeners which use less energy and have lower operations and maintenance costs. The replacement of the DAFTs is included in the WLSSD 10-year Capital Improvement Program in 2023 and is anticipated to be completed in 2024. The design report for this project is included as Appendix N of this Plan. This project will also include the replacement of one waste activated sludge (WAS) pump and select piping and construction of a new polymer makeup system and polymer feed system improvements.

- **Digesters:** Temperature-phased anaerobic digestion (TPAD) takes place in four one-million gallon anaerobic digester tanks. This system was initially put on-line in July 2001. Thickened sludge flows through digester #1, which operates in the thermophilic range at a temperature of approximately 130 degrees Fahrenheit for about 10-12 days. Digester #2 operates in series with Digester #1 in the thermophilic range. After the second digester, the sludge is split between two mesophilic digesters and held at approximately 100 degrees Fahrenheit for 10-12 days – digesters #3 and #4 always operate in the mesophilic range. Each digester tank contains four mechanical draft tube mixers and 10 HP pumps to provide effective mixing, allowing bacteria to break down large complex molecules in the sludge to simpler molecules. Volatile organic matter in the digested sludge is reduced at least 38-percent, and at times up to 55-percent, and pathogenic organisms are virtually eliminated by the high temperatures used in the process.

  Digester #1 was cleaned and rehabilitated in 2010. Digester #2 was cleaned and rehabilitated in 2011 and was converted to thermophilic at that time, and digester #4 was rehabilitated in 2014. The rehabilitation of digester #3 is currently in the WLSSD 10-year Capital Improvement Program and planned for 2023. This project will include installation of knife gate valves on circulating sludge piping, replacing internal piping with glass lined piping, replacing external plug valves, re-coating cooling tower piping, miscellaneous concrete repairs, repair of HDPE liner and repairing coating on the draft tube mixers if necessary.

- **Digested Sludge Storage:** Two 450,000-gallon tanks temporarily store anaerobically digested sludge prior to dewatering in centrifuges. The tanks serve to blend the sludge and provide a steady feed to the centrifuges. Each tank contains a mixing system consisting of a chopper pump, three 10-inch lines with high-energy discharge nozzles, and one 18-inch suction line. One vertical variable speed, non-clog, end suction, centrifugal pump is provided to maintain a steady flow of blended sludge in circulation at all times.

- **Biosolids Dewatering Centrifuges:** The digested sludge is fed to one of two centrifuges that rotate between 2,500 and 3,000 RPM. At the same time, neat liquid polymer is fed to the centrifuges to mix with digested sludge to allow it to thicken properly. Polymer is stored in a 16,000 gallon storage tank in Building 8. The high-speed rotation created by the centrifuges separates water from solids, raising the solids concentration tenfold, from about 3-percent to approximately 30-percent. The dewatered biosolids can then be handled for storage in Building 11 on the tip floor, where it will eventually be hauled by truck to land application sites as part of the WLSSD Biosolids Land Application Program. This process is critical for recapturing nutrients from the wastewater stream and producing the District's Field Green® biosolids fertilizer product. The water removed from the biosolids by the centrifuge is returned to the head of the plant for further treatment.

  The District's 10-year Capital Improvement Program includes future funding to assess the existing dewatering process for system optimization, including the polymer feed systems, and potential replacement of a centrifuge in 2024. This project could also incorporate the inclusion of improvements to the existing sludge piping and storage system.

- **Biosolids Storage:** Biosolids are conveyed to a short-term storage area in Building 11 with sufficient space to store 15 days of production. Drivers utilize a pull-through loading bay constructed in 2020 to load trucks with biosolids using a front-end loader. The new pull through bay eliminates the need for drivers to back-up out of the loading bay and is much safer for drivers and anyone in the nearby vicinity. Long-term storage for up to 30 additional days of production is available at an enclosed off-site storage facility in Carlton, MN. When ready for land application, trucks will stage at the application site and use a spreader to distribute the biosolids at the site. Prior to land application, trucks loaded with biosolids must use the tip-scale located behind Building 8 to track the amount of biosolids hauled. The location of the scale is currently undesirable from a safety standpoint due to its location in the center of a high traffic area, and there is discussion of relocating that equipment in the near future.

5.4.5 Odor Control

- **Biofilter:** Odorous air is collected from the influent pump room, screen and grit room, and thickener room, and is then transported via ducting to the biofilter. A fine mist of city water is added to humidify the air before three 50 HP biofilter fans with a capacity of 16,700 cfm each deliver the air to the biofilter air distribution laterals. These blowers have been in service for over 20 years and have proven to be maintenance intensive and difficult to service due to space constraints. Downtime with any of the three blowers results in diminished airflows being routed to the biofilter, posing the risk of increased odors and toxic gases to be present at the treatment plant. An assessment of the odorous air collection system was completed in 2021 and included in Appendix O of the Plan.

  The 10-year Capital Improvement Program includes funding for odorous air improvements in 2023, which will include replacement of the three blowers and relocating them to a newly constructed building. New electrical distribution equipment for this project will also be added in Building 2 and the electrical room ventilation will be pressurized to eliminate the corrosion of electrical equipment and controls.

The biofilter is made up of three cells approximately 4,000 square feet in size that are composed of woodchips which form a four foot bed above a series of perforated pipes. The woodchips are replaced every 3 to 5 years as needed, since plants and other vegetation can grow on the biofilter as the wood chips break down over time. Beneficial microorganisms living in the woodchip media break down the odorous compounds, naturally deodorizing the air as it passes through the biofilter and back into the atmosphere.

The 10-year Capital Improvement Program includes funds to rehabilitate biofilter cell #1 in 2023. In 2022, the District completed an evaluation on the feasibility of using engineered media in the biofilter to replace woodchips at some point in the future, which is included as Appendix K of the Plan.

5.4.6 Energy Production

- **Biogas:** The methane-rich biogas that accumulates in the top of the digesters is collected, conditioned, and piped to a series of biogas and natural gas boilers to heat the plant and provide necessary heat to the treatment processes. After being collected from the digesters, the digester gas flows to the biogas clean system where most of the hydrogen sulfide (H_2S), moisture, and heat are removed using a biological process to make a higher quality gas. Currently the biogas is utilized in three Hurst boilers located in Building 10. The boilers are designed to run off process methane, but can also be used with natural gas if no methane is available.

  WLSSD is committed to continuing to work toward energy self-sufficiency. One of the main methods identified for moving toward energy independence is to beneficially use the biogas energy produced by the anaerobic digestion process. With proper conditioning the biogas can be used to produce heat and electricity, referred to as combined heat and power (CHP).

  Previous projects that have been completed as the District works towards energy self-sufficiency are: the installation of biogas conditioning equipment to remove sulfur from biogas, replacement of the steam boilers with smaller modular hot water boilers to better utilize biogas for process and facility heating, and the switchgear project updating the District's electrical distribution system as well as preparing it for the future installation of biogas engine generators.

  In 2021, the District began work on the CHP project with Phase 1, which addresses containment for spills around the biogas towers, drainage for low pH solutions coming from the biogas towers, elimination of corrosive mist from the biogas, and site preparation for Phase II of the project.

  Phase II of the project began in 2022 and includes the installation of siloxane removal equipment, additional H_2S polishing, replacement of the Building 10 electrical substation, and the commissioning of three 850kW biogas engine generators. The engine generators will allow the District to maximize the electrical generation at current biogas generation rates and have room for increased future biogas from high strength waste feed stocks. Installing three engines allows for not only substantial electrical generation but also system reliability and redundancy. It is anticipated that the engines will be started up sometime in 2024.

- **Biogas Flare:** Currently if excess biogas is generated beyond the needs of process and plant heating, the biogas is burned off with a flare. In the future, biogas will be used in three 850kW engine generators, capable of producing about 35-percent of the electricity needed to run the plant. Heat from the generators will also be recovered and reused in the process.

5.4.7 Process Control

- **Process Control:** The wastewater treatment plant and WLSSD's network of interceptor sewers are monitored and controlled through a SCADA (supervisory control and data acquisition) system. The SCADA system includes thousands of sensors and other monitoring devices throughout the plant and in WLSSD's wastewater collection system. Wastewater operators monitor data the computers gather and can change plant or pump operations utilizing the computer system. The District upgraded its SCADA software system in 2022 and the 10-year Capital Improvement Program has additional funds allocated for future improvements to Process Control hardware including video displays.

5.4.8 Facility Support Systems

- **Electrical Distribution:** The main electrical distribution point at the wastewater treatment facility is the 13.8kV main switchgear located in Building 2. Two independent electric utility feeds (#224 and #225), from separate substations, supply power to the switchgear. If utility power is lost to one of the main feeders, that breaker opens and the tie circuit breaker closes to restore power to the plant. In 2019, new main plant switchgear was installed, replacing the existing 40-year-old switchgear. Prior to replacement the existing switchgear and circuit breakers were at the end of their useful life which posed safety issues and an increased the risk of major power outages. The upgraded switchgear is automated and allows the facility to run more reliably between different power sources during normal operations or emergencies.

  The facility also includes a 2MW Ziegler Cat diesel standby generator and 4-bay 13.8kV paralleling switchgear located in separate enclosures next to Building 10. In the event of a power outage on both electric services, the backup generator can supply backup power to a few 480V unit substations but not the entire facility. If both electric services are lost, the circuit breakers in the main 13.8kV switchgear are opened and the generator circuit breakers in the 13.8kV switchgear are closed providing backup generator power to a few 480V unit substations. When an electric service is available the 13.8kV paralleling switchgear will parallel the generator with the utility, transfer the load to the electric utility, open the generator circuit breakers, and shut down the generator in a "bump less" transfer. The 13.8kV paralleling switchgear can also test the generator under load by paralleling with the electric utility, disconnecting from the utility, re-paralleling with the electric utility, and shutting down the generator in a "bump less" transfer.

  As discussed above, the District is in the process of installing CHP engine generators that will produce and supply power to the District electric grid. It is anticipated the engine generators will be commissioned some time in 2024.

- **HVAC System:** The heating, ventilation, and air conditioning system (HVAC) is important for providing a comfortable indoor climate for employees as well as providing for safe and effective plant operations. Office spaces are heated and cooled throughout the year using the HVAC system. Operational spaces have air exchange requirements in order to insure a safe working environment for employees, with the rate of air exchange per hour dependent upon the use of the space, how large the space is, and how many people may occupy it. The HVAC distribution system also supports plant process heating and cooling needs, and is integral to the odor collection and control systems.

The District's Administration Building (Building 9) has the original HVAC system (two constant volume multi-zone air-handling units; two water-cooled refrigerant condensing units) that were installed when the treatment plant was built in 1978. These multi-zone units were designed for each zone to mix heated and cooled air to satisfy the zone temperature demand. Prior to 1980, this was the standard practice for providing temperature control to multiple zones. This type of system does not meet current energy codes because it heats and cools air at the same time to meet the zone demand. To save energy, the system is currently run with one of the coils shut down to either heat or cool the space. The tradeoff for energy saving is inaccurate temperature control and occupant discomfort.

In 2023, the District intends to renovate the Building 9 HVAC system with new equipment and controls to increase occupancy satisfaction and reduce maintenance costs and utility costs. The District is in the process of upgrading HVAC control systems throughout the facility to the Niagara Building Automation System (BAS).

- **Compressed Air System:** The compressed air system is used to provide moderate volumes of compressed air at approximately 100 PSI for use throughout the plant including the operation of pneumatic valves and instrumentation The compressed air system is composed of two Atlas Copco air compressors with a capacity of 8,000 SCFM, which have integral air dryers that feed two air receiver tanks, where it then flows to a larger air dryer and then to the plant for distribution. The existing air compressors were commissioned together and have split operating time over the past 20 years. The current system utilizes city water for cooling and is vulnerable to unexpected shutdowns of the city water supply. An unexpected loss of compressed air results in the loss of pneumatic valves, which control oxygen production, the biogas flare valve and many other valves. Compressed air is used also in the lab, HVAC system, actuating valves (for the flare, reactor deck, O2 plant, and other processes), grit tank scum ejectors, hoists, screw pumps, and bubblers.

  In 2022, the District upgraded its compressed air system so it is all "instrument quality," meaning it is more reliable in cold temperatures and can be used for more processes. The upgrade project consisted of the installation of a new air cooled 150 HP air compressor and heat regenerative desiccant dryer. The new compressor will operate in conjunction with the existing Atlas Copco air compressors. New air piping modifications were completed to combine the new and old compressors together. A flow control valve was installed that works in concert with existing air receivers to maintain system pressure, providing a stable air supply to the system.

- **Low Pressure Air System:** The District's low pressure air system is used to provide high volumes of low pressure air for several processes throughout the facility. In 2011 a Neuros high-speed turbo (HST) blower replaced one of the Hoffman blowers that was initially commissioned in the early 1990s. A second Neuros blower was added in 2018 for redundancy and resiliency of the low-pressure air system. The blowers run at 18,000-19,000 RPMs using an air bearing to provide air for the thickened sludge wells, the reactor influent channel, the secondary effluent channel for carbon dioxide stripping, for aerating chlorine contact tanks and the sodium bisulfite contact tank for further carbon dioxide stripping, for post-aeration, and to mix the dechlorination chemical.

- **Plant Water System:** Treated wastewater effluent at WLSSD is used for various internal processes such as multimedia filter surface washing, scum eduction, and at numerous hose connections where non-potable water may be used for cleaning and other purposes. If plant water is not available for these processes, city water would need to be used at much greater expense to the District.
  The original District plant water system included a total of 11 pumps that were put into service in 1978. Over the years the plant processes changed and only three 60 HP plant water pumps remained in service. In 2018, a complete inventory was done on the plant water system and services and also the City of Duluth water services. The assessment identified the condition of the existing systems to determine what portions of the existing systems needed to be replaced, improved or removed. An assessment was also completed of City of Duluth water services throughout the plant to determine if processes that utilize City water could be potentially converted to plant water to reduce the use of City water. District Engineering and Operations staff audits the City water bill and metered use each month to identify potential water use and cost reduction opportunities. The complete Plant Water Systems Assessment is included as Appendix T of the Plan.

  As part of a 2021 plant water pumping improvements project the three 60 HP pumps were replaced with three new 40 HP pumps with VFDs, a magnetic flowmeter was added to the system, and the obsolete concrete pads were demolished to allow filtration equipment installation. In 2022, the next phase of the plant water improvement project included the installation of one filter assembly, one backwash tank, one backwash waste pump and associated piping and valves. Two additional filters will be installed in the future once this new filter is proven from an operations and maintenance standpoint with extended run times. The backwash tank and associated equipment are common to all three filters.

- **Enterprise Asset Management (EAM) Program:** WLSSD is committed to managing its facilities to provide an acceptable level of service, achieve regulatory compliance, and ensure the lowest possible lifecycle costs for District assets. The Enterprise Asset Management Program (EAM) is a tool that WLSSD uses to meet these commitments. WLSSD tracks over 4,000 assets within over 100 asset types. Specific information regarding each asset is tracked to enable data analysis for optimized decision-making. Data that is for the assets includes things like physical attributes of the asset, O & M data, date of installation, asset hierarchy location, etc. The WLSSD EAM Program focuses on the attainment of goals within five main areas including;

  1. **Financial Performance** – Asset management activities will optimize operational and capital expenditures relative to meeting defined service levels, minimizing operational risk, and satisfying regulatory requirements.
  2. **Operating and Maintaining Asset Performance** – Asset management will enable improved identification, acquisition, utilization, and disposition of assets.
  3. **Service Level Performance** – Asset management will include service level requirements for WLSSD's assets to improve the District's capacity to use those assets in meeting or exceeding stakeholder expectations.
  4. **Organization and People Performance** – Asset management will have a strong organizational commitment resulting in streamlined work practices that are consistently implemented.
  5. **Continuous Improvement** – Asset management will include a continuous improvement process to ensure long-term value.

  WLSSD is continually improving how staff incorporates asset management into existing work processes and practices. The WLSSD EAM Handbook is included as Appendix U of this Plan.

Section 5.5: Energy Improvements

As part of WLSSD's mission to protect public health and natural resources through effective wastewater treatment, the District has developed an Energy Management Master Plan (EMMP) to guide decision-making related to District initiatives. The District has developed an energy policy to guide decision-making. The objectives of this policy are to improve energy efficiency, reduce annual operating costs, decrease capital investment, reduce environmental emissions, and conserve natural resources. The District will continue to work toward achieving these goals through the implementation of an effective energy management and conservation program that complies with all permit requirements, through collaborating with governmental agencies, utility companies, and other relevant stakeholders, and by actively seeking out and establishing funding sources dedicated to implementing energy reduction improvements.

The District first produced an EMMP in 2013. That comprehensive planning effort was documented in a report titled *Becoming the District of the Future: Energy Master Plan and Roadmap* (Donohue, October 2013). Consistent with the District's energy policy, that plan outlined and recommended strategies to reduce energy consumption, increase the production and use of renewable energy, and reduce energy spending.

In 2015, WLSSD established an energy baseline for the wastewater treatment plant and established purchased-energy reduction goals, referred to as SWIFt (Sustainable Wastewater Infrastructure of the Future) goals of 35 to 50-percent for electricity and 30-percent for all forms of purchased energy. As of 2021, WLSSD has realized a 24-percent reduction in purchased electricity (kWh) and a 21-percent reduction in total energy purchased (MMBTU) since the baseline year of 2015 shown **in figures 5-2 and 5-3**.

These reductions are the result of the District implementing several of the EMMP strategies including replacing the cryogenic oxygen production system with a more energy-efficient vacuum swing adsorption (VSA) system, adding biogas conditioning so the biogas is suitable for fueling boilers and/or internal combustion engines, and replacing the antiquated campus-wide heating plant with higher-efficiency natural gas boilers and biogas boilers.

The District is currently in the process of implementing a combined heat and power (CHP) project that includes the installation of three engine-driven electrical generators that can be fueled with conditioned biogas and/or natural gas which are anticipated to be commissioned by 2024.

Figure 5-2, Total Energy Purchased at WWTP (MMBTU) 2015-2021

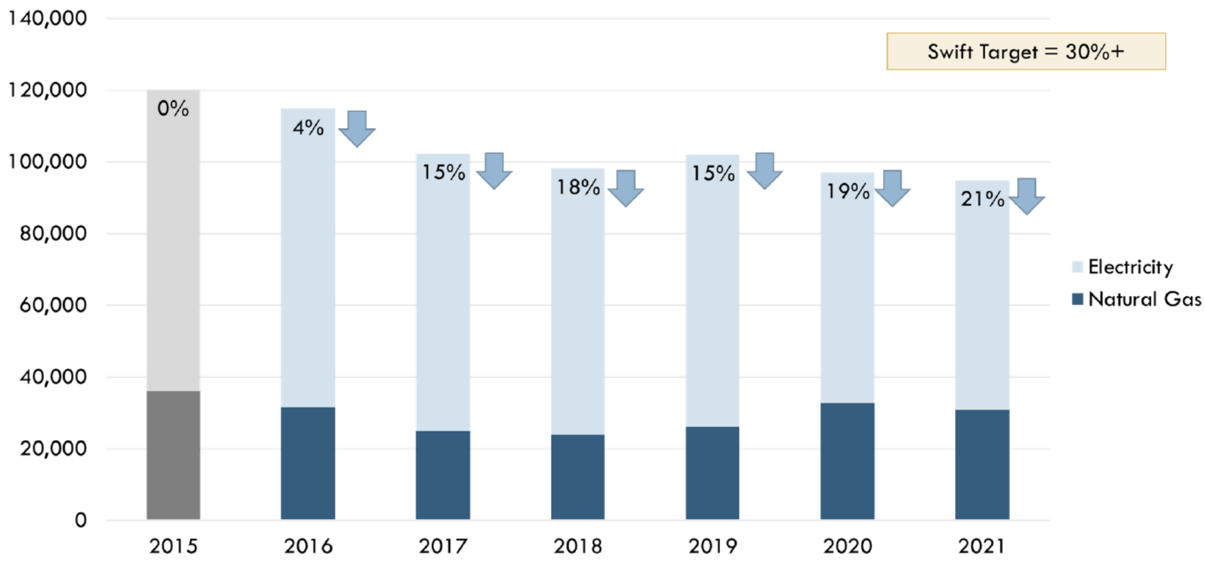
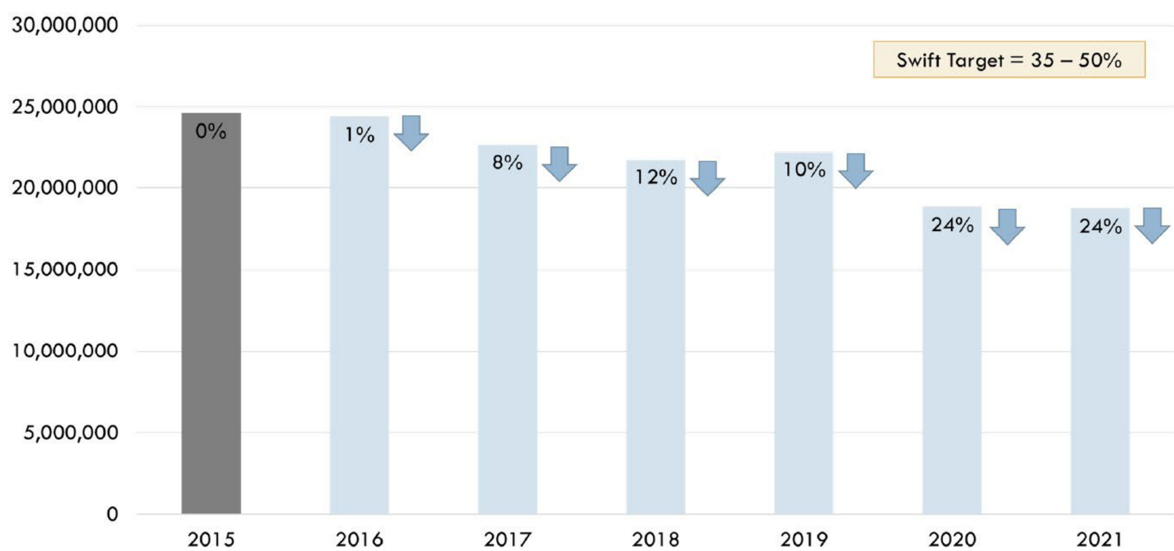


Figure 5-3, Total Electricity Purchased at WWTP (kWh) 2015-2021



The objectives of the 2022 EMMP update were to document present-day and forecast future energy use, production, consumption, and spending throughout the District and update the previously-developed strategies to reduce energy consumption and spending. This update accomplishes those objectives by identifying and evaluating "energy-positive" alternatives intended to reduce energy consumption and spending. These energy-positive alternatives are categorized as either equipment replacements, process efficiency enhancements, or energy recovery and production. These categories are described in additional detail in the following pages. The complete 2022 update of the EMMP is included in Appendix L of the Plan.

Section 5.5.1: Equipment Replacement Alternatives

These include asset replacements that enhance energy efficiency and will reduce energy consumption by replacing aging equipment or technologies that are nearing, at, or beyond their reliable service lives with more efficient equipment or technologies.

1. **Replace Dewatering Centrifuge**: This alternative would replace one of the two existing centrifuges with a new, right-sized, more efficient dewatering centrifuge. Replacing one of the existing units would avoid expensive ancillary work: adding conveyor length, piping, valving, plumbing, and electrical.

2. **Replacing DAFT with RDTs**: The District is currently in the process of replacing the dissolved air flotation thickeners (DAFTs) with rotary drum thickeners (RDTs). The capital cost to replace the DAFTs with RDTs is roughly $2.8M less than the capital cost to replace them with DAFTs. The original evaluation of competing thickening alternatives was performed by Donohue as part of the predesign phase of the thickener replacement capital project.

3. **Replace Effluent Filters with 50 MGD Cloth Media Filters:** This alternative would replace the existing, aging sand media effluent filters with cloth media disk filters possessing 50 MGD of firm forward flow capacity. The disk filters dramatically increase the forward flow capacity for a given filter area and reduce the quantity of backwash water, from 10-percent of the forward flow for sand filters to 2-percent for cloth media filters. Reducing the quantity of backwash will reduce the energy required to pump it. Cloth media disk filters might also simplify controls, reduce building humidity, reduce filter flies, enhance TSS removal, and enhance effluent mercury (Hg) removal. The capital cost to upgrade the existing sand filters and ancillary components could cost in the vicinity of $10M or more.

4. **Replace Effluent Filters with 75 MGD Cloth Media Filters:** This alternative would replace the existing, aging sand media effluent filters with cloth media disk filters possessing 75 MGD of firm forward flow capacity. The advantages of cloth media disk filters are stated in the previous section.

5. **Upgrade Building 9 HVAC With VAV System:** This alternative was identified and developed as part of the original Energy Management Master Plan project (2013). That economic evaluation was updated using present-day costs. Building 9 has thermal comfort issues due to the type of HVAC system, controls, and thermostat locations. The existing system consists of a multi-zone, constant volume, variable temperature HVAC system and does a poor job of maintaining a consistent thermal environment throughout the building.

   Variable air volume (VAV) systems provide a variable amount of air at constant temperature to provide heating, ventilation, and air conditioning to the spaces. Air is typically supplied at 55°F for cooling purposes, and the supply air volume modulates to maintain set point temperatures. VAV systems consist of a control box for each zone with a modulating damper and reheat coil. The control box receives a signal from the thermostat indicating the required airflow for cooling, down to a minimum airflow percentage. Once the control box hits the minimum airflow, it indicates that no more cooling is required and the reheat coil will energize to provide necessary heating. VAV systems are ideal for laboratory spaces due to high flexibility and quick response time to varying conditions and loads.

6. **Reduce Outside Air at Select Process Buildings:** This alternative was identified and developed as part of the original Energy Management Master Plan project (2013). That economic evaluation was updated using present-day costs. Most of the process buildings on campus use 100-percent outdoor air for ventilation. Outdoor air must be raised from the ambient conditions to the leaving air temperature. Depending on code approval, several buildings could reduce the amount of ventilation air required

during unoccupied periods. Reducing the ventilation air during unoccupied periods will reduce the demand on the hot water coil.

This strategy appears feasible at Buildings 6, 10, 11, and 19. Estimated energy benefits are 2,667 MMBTU for Building 6; 1,227 MMBTU for Building 10; 1,429 MMBTU for Building 11; and 4,342 MMBTU for Building 19. Building 19 offers the most benefit.

Section 5.5.2: Process Efficiency Enhancements

These improvements include process modifications that enhance energy efficiency. They will reduce energy consumption by either modifying the way a unit process is operated or replacing unit process equipment or technologies with more efficient equipment or technologies despite significant remaining service life.

1. **Revise Digester Mixer Strategy to Lower Energy by 25-Percent:** The District anaerobically digests biosolids in four 1.05-Mgal digesters. Each digester is mixed by four, 15-hp, variable-speed, continuously-on, draft tubes. The mixers are operated at full speed. The mixing energy per unit volume (57 hp/Mgal) is relatively high compared to other successful anaerobic systems. This alternative would employ a strategy that reduces energy consumption by 25-percent. An example strategy would be to use three active mixers and rotate the three active mixers in 15-min intervals. This alternative is a change to the current operating strategy without a capital cost.

2. **Revise Digester Mixer Strategy to Lower Energy by 50-Percent:** This alternative would employ a strategy similar to the alternative above but reduce energy consumption by 50%. This alternative is a change to the current operating strategy without a capital cost.

3. **Revise Liquid Storage Mixing Strategy to Lower Energy by 25-percent:** Digested biosolids are stored in two liquid storage tanks before being pumped to dewatering. The tank contents are kept homogenous by a pumped mixing system. The mixing system uses three 40-hp pumps: two firm, one standby. This alternative would employ a strategy that reduces energy consumption by 25-percent. This alternative is a change to the current operating strategy without a capital cost.

4. **Revise Liquid Storage Mixing Strategy to Lower Energy by 50-percent:** This alternative would employ a strategy that reduces energy consumption by 50-percent. This alternative is a change to the current operating strategy without a capital cost.

5. **Replace Digester Mixing System With Linear Motion Mixers:** This alternative would replace the four draft tube mixers in each anaerobic digester with smaller-HP draft tube mixers. This change out could be made in the near-term before the existing mixers reach the end of their reliable service lives or in the far-term when the aging draft tubes need to be replaced. Linear motion mixing of digesters with solids concentrations similar to those in the District's digesters are a well-established and proven mixing technology. The Milwaukee Metropolitan Sewerage District performed a full-scale, side-by-side evaluation of linear motion mixing and pumped jet-nozzle mixing. That evaluation found linear motion mixing provided similar volatile solids reductions and biogas production using less energy.

6. **Enhance High-Purity Oxygen (HPO) Mixing and Controls:** This alternative includes adding VFDs to reactor cell #4 mixers and dissolved oxygen (DO) control. The evaluation of this alternative predicted an energy savings of 1,500 kWh/d and a total capital cost of $360,000.

Section 5.5.3: Energy Recovery and Production

These projects will reduce purchased energy consumption and/or spending by leveraging renewable energy sources and will recover and/or produce useable energy from latent energy within wastewater, latent energy from hauled liquid waste or solid waste streams, sunlight, or wind.

1. **Raw Wastewater Heat Recovery and Heat Pump:** This alternative would use the warm wastewater and a heat pump to heat the entire WWTP. The specific technology assumed (by SharcEnergy) with this alternative grinds and filters the raw wastewater to protect the heat exchanger from plugging and fouling. This alternative is perhaps more illustrative than practical. The electrical load required to off-set all natural gas purchases would be 2 MW.

2. **Raw Wastewater Heat Recovery:** This alternative would use the warm wastewater to heat the entire WWTP. The specific technology assumed (by SharcEnergy) with this alternative grinds and filters the raw wastewater to protect the heat exchanger from plugging and fouling. This alternative does save energy, but the pay back exceeds 20 years.

3. **Thermophilic Sludge Heat Recovery:** This alternative would use the warm sludge exiting the thermophilic digestion stage to pre-heat the raw sludge entering the thermophilic digester. This heat recovery alternative would use a sludge-to-sludge heat exchanger. This alternative would only reduce purchased natural gas during the cold-weather months when there is not excess heat from the biogas system: estimated to be 5,988 MMBTU between October – April. The payback exceeds 20 years.

4. **Thermophilic Sludge Heat Recovery and Heat Pump:** This alternative would use the warm sludge exiting the thermophilic digestion stage and a heat pump to pre-heat the raw sludge entering the thermophilic digester. This alternative would reduce purchased natural gas year-round (10,888 MMBTU) but consume significantly more electricity. The additional electrical cost exceeds the avoided natural gas cost.

5. **Solar Arrays on Buildings 6, 8, 10, and 11:** This alternative would add a solar array on the roof of Buildings 6, 8, 10 and 11 at the WWTP. The economic analysis done on this alterative as part of the EMMP does not include any grants, subsidies, or tax incentives.

6. **Install Hydroturbine:** This alternative would add a low head hydroturbine at the WWTP. The most amenable location appears to be downstream of effluent filtration, particularly if cloth media disk filters replace the existing sand filters. Assuming cloth media disk filtration, 9-feet of available head, 35-mgd average forward flow, and a turbine that is 65% efficient, then the turbine could produce on average 235,000 kWh of electricity. A more reliable capital cost opinion will require close coordination with a suitable turbine manufacturer. The ideal time to investigate this alternative is during the preliminary design phase of a cloth media disk filter project.

7. **Receive and Digest Hauled-in, High-Strength Waste:** This alternative would add hauled-in, high-strength waste receiving and the ability to feed a consistent rate to the anaerobic digestion system. A previous study by Avant in 2015 determined that the WLSSD service area has 235 restaurant equivalents capable of producing 9,453 pounds of grease (FOG) annually. This alternative would add the capability to accept FOG or industrial slurry waste. The receiving system would control and limit access to only authorized haulers using a card reader, keypad, fob or similar credentials. It would also provide flow metering and volume tracking for automated and accurate billing.

The FOG/slurry waste receiving system would include debris removal in the form of a rock trap, screen, and/or a grinder. Storage would be provided in the form of two 15,000 gallon above-grade fiberglass tanks. The tanks, tank mixing system, and pumps (feeding the digestion complex) would be housed in a heated building. Each tank would be heated using hot water from the campus-wide hot water system. The economic analysis assumes tipping fees will cover the cost associated with the additional biosolids.

8. **Receive and Digest Source-Separated Solid Organic Waste:** This alternative would add a system to receive and process solid organic waste, diverting that organic material from local landfills. The source of this waste could take the form of source-separated, postconsumer food scraps and pre-consumer packaged food waste. A previous study by Avant in 2015 determined that the WLSSD service area has the potential to provide 14,800 wet tones of residential organic waste.

   This alternative would add a building housing waste receiving, a de-packaging system, debris storage, debris loadout, and an organics pumping system that would send the high-strength organic slurry to the digestion system or FOG/slurry storage system. Biosolids will increase significantly, roughly 33-percent. The economic analysis assumes tipping fees will cover the cost associated with the additional biosolids, debris handling and disposal, and staff time to maintain and operate the complex solids waste receiving/processing system.

9. **Receive and Digest Hauled-in Biosolids:** This alternative would add a system to receive and digest liquid biosolids from neighboring wastewater treatment facilities (e.g., Superior, Wisconsin). The solids loading to digestion would increase 10-percent, indicated that the digestion complex has ample capacity to accept and digest these solids.

Figure 5-4 on the following page shows the full list of alternatives evaluated during the 2022 EMMP update.

		Capital Cost Opinion	Years to Payback	Heat Savings	Electricity Savings	Annual Savings		
						Year 1	5-Yr Ave	10-Yr Ave
ID	Alternative	$	Years	MMBTU	kWh	$	$	$
C-T17	Source-Separated Solid Waste Digestion	$5,072,000	10	5,150	3,650,000	$449,686	$479,751	$521,490
C-T16	Hauled-In Liquid Waste Digestion	$3,970,000	13	2,900	2,055,000	$253,183	$270,109	$293,610
A-T3A	Replace Filter System - 50 mgd	$23,573,000	#N/A	0	1,100,000	$124,984	$134,044	$146,623
A-T3B	**Replace Filter System - 75 mgd**	**$34,401,000**	**#N/A**	**0**	**1,100,000**	**$124,984**	**$134,044**	**$146,623**
B-T6E	Digester Mixing - Replace IDT with LM	$3,969,000	23	0	1,051,200	$119,439	$128,098	$140,119
C-T18	Hauled-In Biosolids Digestion	$2,000,000	14	1,396	990,000	$121,964	$130,118	$141,440
B-T6B	Digester Mixing - 1/2 of 240 hp	$0	0	0	788,400	$89,579	$96,073	$105,089
B-T8	HPO Mixing and Control	$360,000	6	0	547,500	$62,208	$66,718	$72,979
A-T2	Thickening Equipment	($2,800,000)	0	0	546,000	$5,235	$9,732	$15,976
A-T1	Dewatering Equipment	$1,791,000	12	0	497,284	$131,502	$135,598	$141,285
B-T6A	Digester Mixing - 3/4 of 240 hp	$0	0	0	394,200	$44,790	$48,037	$52,545
C-T14B	Solar - WWTP - Bldg 8, 10, 11, and 6	$450,000	12	0	289,000	$32,837	$35,217	$38,522
B-T6D	Liquid Sludge Storage Mixing - 50% of FT	$0	0	0	263,000	$29,883	$32,049	$35,056
C-T15	Low-Head Hydropower	$555,000	16	0	235,000	$26,701	$28,637	$31,324
B-T6C	Liquid Sludge Storage Mixing - 75% of FT	$0	0	0	131,400	$14,930	$16,012	$17,515
C-T14A	Solar - WWTP - Bldg 10	$150,000	12	0	90,672	$10,302	$11,049	$12,086
C-P5	Solar - Pumping Station	$45,000	17	0	16,585	$2,057	$2,206	$2,413
A-T5	Process HVAC [Reduce OA]	$375,000	7	8,255	0	$56,050	$56,050	$56,050
A-T4	**Administration HVAC**	**$2,277,353**	**#N/A**	**416**	**0**	**$2,825**	**$2,825**	**$2,825**
C-P4B2	Knowlton PS RWW HR Direct Heat	$848,000	#N/A	1,083	-10,261	$9,341	$9,249	$9,121
C-P4C2	Scanlon PS RWW HR Low Direct Heat	$848,000	#N/A	1,083	-10,261	$9,341	$9,249	$9,121
C-P4A2	Cloquet PS RWW HR Direct Heat	$848,000	#N/A	1,474	-14,115	$12,695	$12,568	$12,392
C-T13A	Thermo Digester HR - Sludge-to-Sludge	$1,914,038	#N/A	5,988	-49,472	$35,036	$34,628	$34,062
C-P4B1	Knowlton PS RWW HR w/ Heat Pump	$1,266,000	#N/A	1,083	-68,392	$2,131	$1,516	$663
C-P4C1	Scanlon PS RWW HR w/ Heat Pump	$1,266,000	#N/A	1,083	-68,392	$2,131	$1,516	$663
C-P4A1	Cloquet PS RWW HR w/ Heat Pump	$1,266,000	#N/A	1,474	-93,312	$2,872	$2,034	$869
C-T9B	Wastewater HR - W/ Direct Heat	$7,500,000	#N/A	50,232	-736,110	$257,423	$251,359	$242,941
C-T13B	Thermo Digester HR - Heat Pump	$2,022,713	#N/A	10,888	-936,035	-$32,428	-$40,137	-$50,842
C-T9A	Wastewater HR - W/ Heat Pump	$10,500,000	#N/A	50,232	-3,680,548	-$77,130	-$107,445	-$149,535

Note
Table sorted by Electricity Savings: Largest to Smalles

Legend

#NA	Payback exceeds 30 years.
(light blue)	District implementing. Capital cost relative to status quo replacement.
(light green)	Near-term maintenance project. Payback not relevant.
(grey)	Alternatives use warm wastewater to heat pump station at NFPA-required ventilation. Savings relative to direct-fired alternative.
(pink)	District proceeding with steps to impliment these energy-positive alternatives.
X-X	District taking steps to implement these maintenance projects in a manner that will reduce energy consumption.

Section 5.6: Operational Resiliency

WLSSD maintains operational resiliency by planning for the future and using the best industry standard equipment and processes available. Effective and efficient wastewater treatment is critical to the functioning of modern communities. Wastewater that is not immediately conveyed to a treatment facility can pose significant public health concerns, and once at the treatment facility untreated wastewater must be cleaned to protect the receiving waters where the community works, recreates, and gets drinking water. WLSSD ensures that operations are reliable at all times so that wastewater treatment is not disrupted, and in turn, so communities are not disrupted.

There are many different things that could potentially disrupt WLSSD services. These include environmental factors such as natural disaster events that damage infrastructure, or increased precipitation due to changes in climate that prompts a need for increased capacity for wastewater treatment. Social factors such as changes in regional population can influence capacity considerations for the District and must be planned for long-term. Economic factors such as the availability of funding for major upgrades can also affect District services. Since the District faces an array of different challenges both expected and unexpected, it is vital that WLSSD continue to plan ahead and implement the best and most reliable technology to ensure services are maintained no matter the circumstances.

Section 6: COLLECTION SYSTEM PROCESS & FACILITY ANALYSIS

Section 6.1: Existing Facilities

The WLSSD collection system is comprised of a network of 17 pumping stations ranging in size from 0.3 MGD in capacity to 48 MGD and over 76-miles of interceptor sewers up to 54-inches in diameter, with approximately 43-miles of gravity interceptor and 33-miles of forcemain. The collection system includes approximately 940 manhole structures, 70 air release valves and 4 wastewater storage basins ranging in size from 200,000 gallons to 1,000,000 gallons in storage capacity.

Section 6.2: Conveyance System Capacity

A collection system model was initially developed as part of the 2003 Comprehensive Wastewater Services Master Plan as a tool to evaluate capacity of the WLSSD collection system. The collection system model consists of two model components; wastewater flow generation (hydrologic) model which is used to simulate wastewater and inflow and infiltration flows entering the collection system, and a hydraulic model which simulates the results of the generated flow within the collection system. The development of the collection system model in 2002 used CAPE (Capacity Assurance Planning Environment) for the hydrologic model and SewerCat for the hydraulic model. The collection system model updates include extensive calibration updates based on additional years of flow and rain data and incorporation of recent collection system improvements.

The collection system model was updated and calibrated in 2009 and 2014 using additional years of flow and rain data and incorporation of recent collection system improvements. The model components consisted of CAPE for the hydrologic model component and MIKE URBAN for the hydraulic model component for future WLSSD modeling. The Danish Hydraulic Institute (DHI) released its final update of the MIKE URBAN model in 2019. A new model platform was recommended to maintain and use data into the future.

In 2022, the collection system model data was converted to utilize the EPA's SWMM5 and PC SWMM software. This model is widely used and contains both the hydrologic and hydraulic portions of the model. This update converted the MIKE URBAN in to PCSWMM and incorporated recent updates to the collection system. The update utilized approximately 8 years of data to calibrate and update the accuracy of the model based on over 90 sets of data.

Wastewater flow is comprised of base sanitary flow and inflow and infiltration (I & I). Base sanitary flow represents flow intentionally discharged to the sewer system. It consists of domestic flow from residential properties, flow from commercial establishments, and flow from industries. Inflow and infiltration is "clearwater" that is not intended to enter the sewer system and reaches the system through defects in pipes and manholes and clearwater connections to the sewer system, such as connected foundation footing drains. Inflow and infiltration is heavily influenced by precipitation, therefore, an analysis of a sewer system must be made for conditions that reflect the influence of precipitation.

It has been generally accepted, through discussions with the Minnesota Pollution Control Agency (MPCA) that the design level for basic components of the WLSSD collection system is that which will convey a design flow from a 25-year, one-hour rainfall event. Deriving a design flow event from a 25-year one-hour rainfall event is problematic because a rainfall event does not take into account antecedent conditions; however, an analysis was done which generally related the 25-year, one-hour rainfall event to be approximately equivalent to the 10-year flow event. Based on this correlation, the 10-year flow event was used for evaluation of capacity and flow conditions throughout the collection system. **Table 6-1** summarizes the parameters discussed in this plan and how they are applied to capacity analysis.

The collection system model was calibrated using most recent available monitored wastewater flow and rain data from 2014 to 2021. The calibration for most locations in the collection system represents a very large database of information that provides a high level of confidence in the calibrated model. Each hydraulic model update expands on the data used for calibration of the previous collection system models.

The model is used to evaluate the collection system and storage facilities for various projects ranging from planning, design and construction. It is used to project surcharge and overflow conditions at locations within the system. It is also used to evaluate potential impacts from future flows from proposed development.

Table 6-1, Summary of WLSSD Capacity and Design Parameters

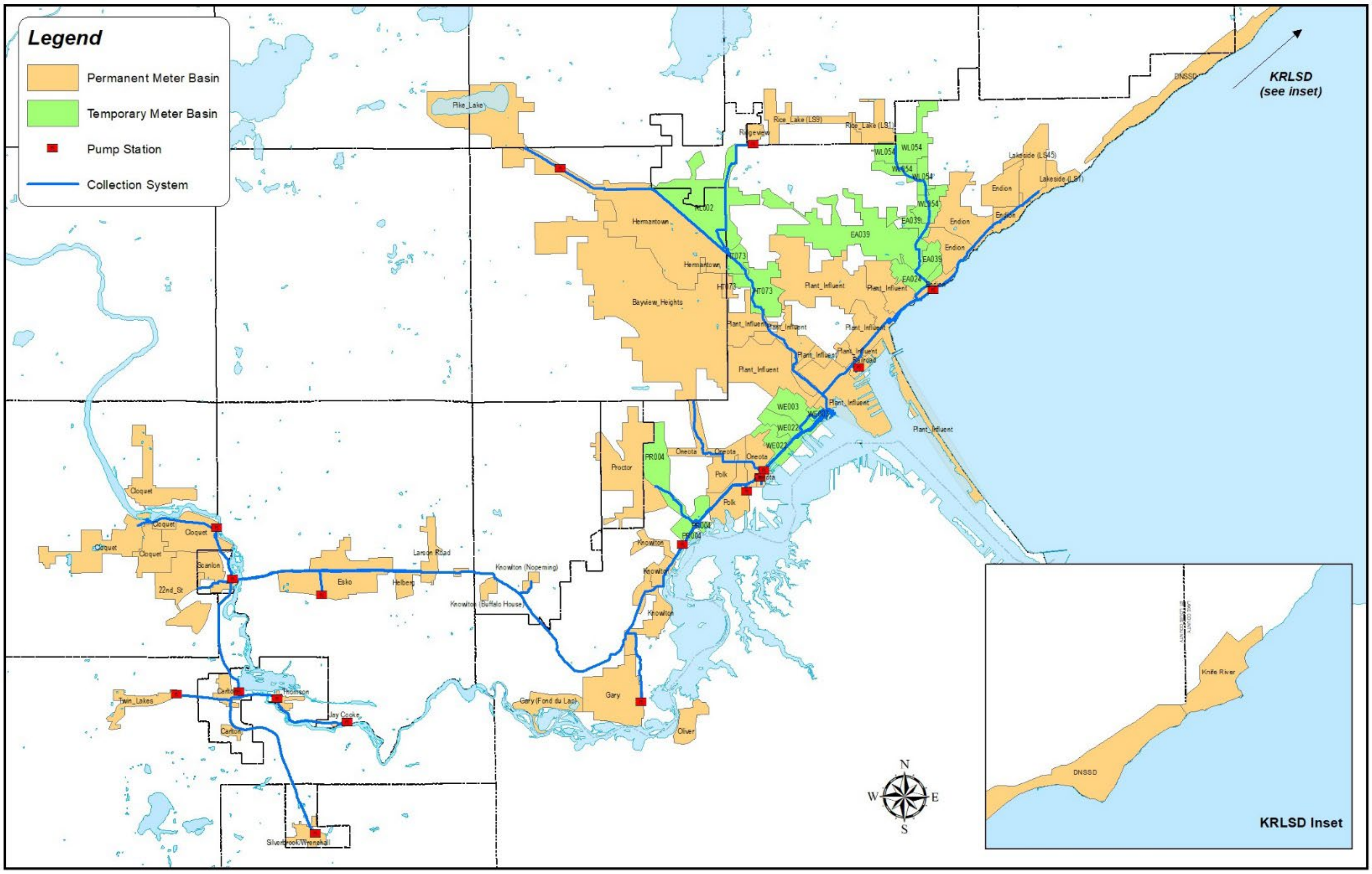
Parameter	Definition	Use	Comments
Level of Service – Peak Flow (LOS)	The peak allowable flow that a municipality may discharge to the WLSSD sewage collection system.	The primary design basis for sizing interceptor sewers and pump stations.	Level of Service and Municipal Peak Flow Standards were adopted by the WLSSD Board of Directors in 2003. The 2003 Comprehensive Wastewater Services Master Plan defines and presents the rationale for the Level of Service – Peak Flow philosophy.
Capacity Allocation – Peak Flow (CAPF)	The peak allowable flow that an industrial user may discharge to the WLSSD sewage collection system.	Used in conjunction with Level of Service Peak Flow as the primary basis for sizing interceptor sewers and pump stations.	Every 5 years a capacity allocation agreement is executed with each user. A peak flow rate is established within the Capacity Allocation Agreement.
Design Rainfall Event	A rainfall event selected for design purposes. Typically generated based on historical rainfall data.	The primary parameter used to generate design flow events. Used historically as the primary means for benchmarking sewer system performance during rainfall events.	
Design Flow Event	Developed by simulating a design rainfall event through a calibrated flow generation and hydraulic model. The recurrence interval for the design flow event is based modeling runs that are generated from historical rainfall events followed by a statistical analysis.	The flow generation and hydraulic model is essentially used predict sewer flows for given storm events. The result is a design flow event For this reason; the design flow event becomes the key parameter for most engineering design exercises related to interceptor pump station, and storage tank sizing.	Appendix B of 2003 WLSSD's Wastewater Services Master Plan provides a summary of the flow generation and hydraulic model output that was developed for the purpose of generating design flow events. Because a calibrated flow generation and hydraulic model is unique to each sanitary sewer system, the resulting design flow events and recurrence intervals are unique to the specified sanitary sewer system being evaluated.

Parameter	Definition	Use	Comments
25-year 1-hour Rainfall Event	An isolated storm event with a duration of 1-hour and recurrence interval of 25 years.	The reference rainfall event for purposes of I/I reduction. Municipal and Industrial users are required to restrict flows below their peak flow limitations (LOS or CAPF) during this reference event.	Bulletin 71 – Rainfall Frequency Atlas of the Midwest by Floyd A. Huff and James R. Angel – 1992 defines the magnitude of the 25-year 1-hour Event. When the reference rainfall event is simulated through WLSSD's calibrated flow generation and hydraulic model, a design flow event with a recurrence interval of 10-years results. For this reason, the 25-year 1-hour Storm Event and the 10-year Design Flow Event are used interchangeably by WLSSD.
10-year Design Flow Event	A design flow event with a 10-year recurrence interval.	Used interchangeably by WLSSD with the 25-year 1-hour Rainfall as the reference event for purposes of I/I reduction and system design.	

The system was evaluated under both existing and future conditions. Existing conditions were based on actual, recent flow conditions. Future conditions were based on flows adjusted for population and employment projected to the year 2050. The future condition scenario does not include any assumptions for continued reductions resulting from the ongoing municipal customers inflow and infiltration reduction programs (footing drain disconnections, lateral linings, etc.). These programs are expected to continue to reduce inflow and infiltration to the sewer system, however is not included in the model update as a variable. This is a conservative approach in that there may be fewer capacity constraints under future conditions than those identified because actual, future peak flows may be less than those used in this evaluation.

A comprehensive description of the collection system model and details of the hydraulic capacity evaluation for current and future conditions are presented in Appendix A. The results are summarized in the following discussion. **Figure 6-1** below shows the WLSSD collection system basins used in the hydraulic model. Areas highlighted orange are monitored by permanent flow metering systems. Areas highlighted in green are monitored with temporary flow metering units.

Figure 6-1, WLSSD Collection System Model Basins



6.2.1 : Capacity Measures

The parameters used to assess the capacity of pipes in the WLSSD conveyance system include the following:

Average Velocity
Average velocity is a measure of how fast wastewater is moving through the sewer system. Extremely high velocities can damage the pipe. Velocities that are too low can result in deposition of sediment in the sewers, which reduces the sewer capacity. Acceptable velocities under dry weather flow conditions are in the range of 2 – 10 feet per second (fps).

Percent of Full Pipe Capacity
This is a measure of the peak flow in the sewer relative to the amount of flow the sewer can convey when it is full. A value of 100-percent indicates the pipe is flowing full. A value greater than 100-percent indicates the pipe is being surcharged. Surcharging is a condition when the water level rises above the crown of the pipe in the adjacent manholes providing a larger driving head to push more flow through the pipe. Gravity sewers are generally designed to flow without surcharging. However, some degree of surcharging can usually be tolerated for short durations that may occur during wet weather flow events.

Surcharge Height
Surcharge height is a measure of how high water rises in a manhole above the crown of the adjacent pipe. A surcharge height of 1 – 2 feet is generally acceptable for short durations under wet weather conditions. Higher surcharge values may be tolerated depending on site-specific conditions.

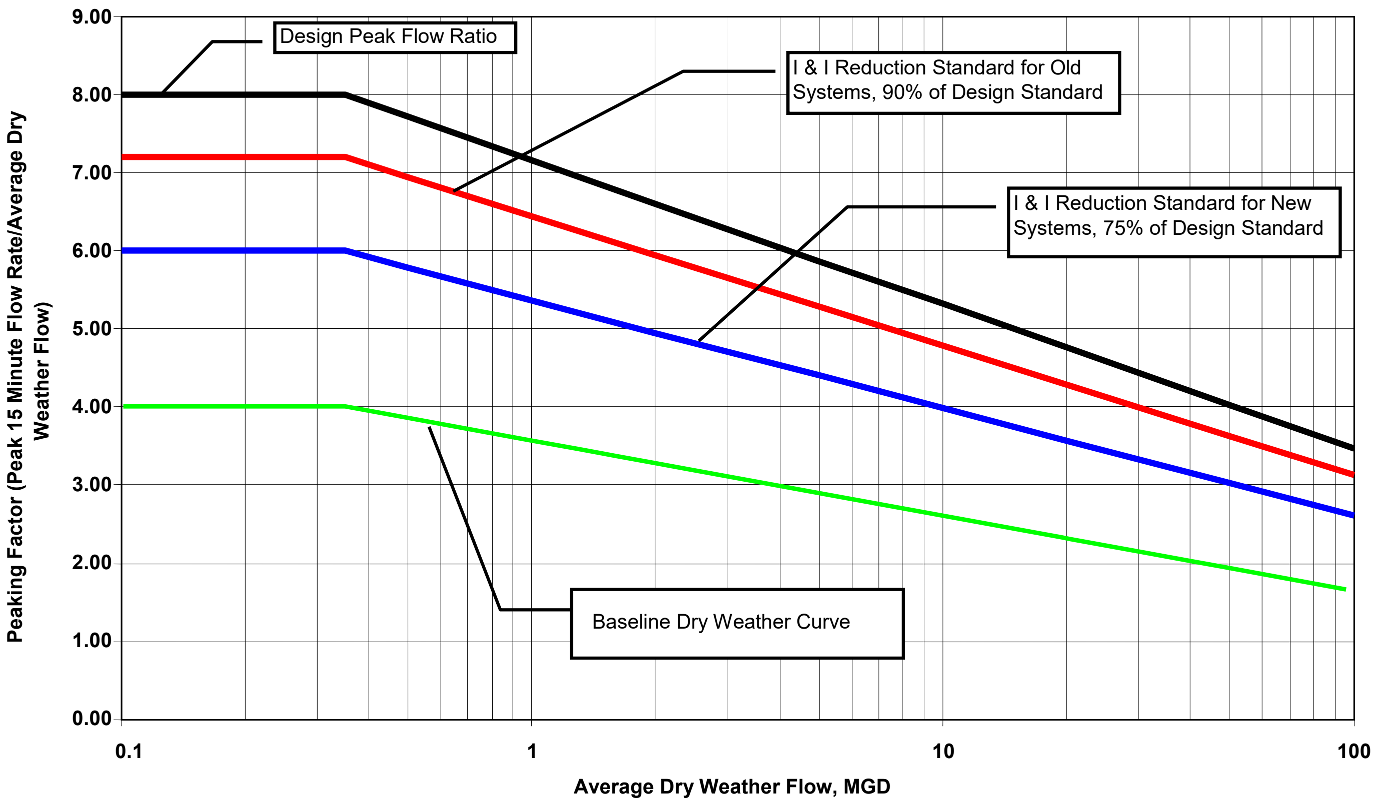
Level of Service
The amount of capacity to be provided to a municipality by the WLSSD is defined as the Level of Service (LOS). The assessment completed as part of the 2003 Comprehensive Wastewater Services Master Plan established an appropriate LOS for the WLSSD to provide to its municipal users based on the wet weather peaking factor curves shown in **Figure 6-2**. The assessment concluded that the proposed wet weather peaking factor curve is a reasonable standard for sizing conveyance system components for wet weather flow and that it is generally more cost effective to reduce peak flows by inflow and infiltration removal in collection systems with peaking factors above 8 to 10 than to provide additional conveyance and treatment capacity. A comprehensive view of the collection system capacity based on this accepted LOS shows that the capacity of the pumped side and gravity side of the collection system are in balance with the hydraulic capacity of the wastewater treatment plant. The LOS concept was implemented when the 2003 Wastewater Comprehensive Plan was adopted by the WLSSD Board of Directors. The LOS concept has since been incorporated into the capacity allocation system, inflow and infiltration ordinance and is used as a design parameter when evaluating capacity needs for infrastructure improvements.

The District's Capacity Allocation Ordinance was updated in 2017. This Ordinance recognizes the finite capacity of the treatment plant and allocates flow and loads to each municipal and industrial customer. Historical flows are evaluated and new allocations are proposed for base flow, peak flow, BOD and TSS. The allocations are based on the average daily flow under normal flow conditions, and the permitted peak flow which is the highest one-hour wastewater flow rate allowed within a calendar day. This value is determined by averaging five years of average dry weather flow (typically January) for each customer and applying the wet weather municipal peak flow standards as shown in **Figure 6-2**. For industrial customers, the permitted peak flow accounts for the remaining hydraulic capacity of the WLSSD system.

The allowable peaking factor for each municipal user defined by the municipal peak flow standard is also used to evaluate the progress of each community on I & I reduction efforts and compliance with the WLSSD Inflow and Infiltration Ordinance, which became effective on January 1, 2009 and was revised most recently in 2017.

When evaluating a design for rehabilitation or new installation of collection system components, the design wet weather peaking factor curve is referenced which is two times the dry weather peaking factor curve.

Figure 6-2, WLSSD Municipal Peak Flow Standards



Capacity Ratio

The municipal peak flow standard defines the allowable peak flow from a municipal customer, based on the municipal dry weather flow and peaking factors. The large industrial component of the WLSSD wastewater flow tends to skew this type of evaluation in comparison to systems with mostly municipal wastewater.

The industrial peak flow allocation is based on agreements between the WLSSD and the individual industries. The remaining capacity is available to municipal customers. Determination of the municipal peak flow standard is determined by subtracting out the system capacity allocated to industrial flow and the average industrial flow. The resulting parameter, referred to as the capacity ratio (CR), is defined as follows:

$$\text{Capacity Ratio} = \frac{\text{Facility Capacity Available for Municipal Flow}}{\text{Average Municipal Flow}}$$

$$\text{Capacity Ratio} = \frac{\text{Total Facility Capacity – Industrial Peak Flow Allocation}}{\text{Total Average Flow – Average Industrial Flow Allocation}}$$

The facility capacity for municipal flow is defined as the total facility capacity minus the peak flow allocation for industrial flow. For pipes, the total capacity is based on either the full pipe gravity flow capacity, or the surcharge capacity in those areas where surcharging can be accommodated. The average municipal flow is the total average flow minus the average industrial flow allocation.

The capacity ratio should be greater than the peaking factor defined by the design peak flow ratio for the municipal peak flow standard, as this represents the physical measurement of the capacity available to the municipal customer.

Firm capacity of a pump station is generally defined as the station capacity available with the largest pump unit out of service. Standards for the WLSSD collection system are keyed to the capacity ratio provided for each sewershed. Detailed discussion of the development and calculation of the capacity ratio can be found in the 2003 Wastewater Comprehensive Master Plan.

Consistent with the approach followed for previous wastewater comprehensive plans, the failure of a pump station to meet the target capacity ratio based on firm capacity will not trigger a capital improvement to increase the firm capacity as long as the target capacity ratio is being met based on total capacity. However, when major pump station renovations are undertaken to address aging or obsolete equipment, the firm capacity of the pump station would be increased to meet the target capacity ratio based on firm capacity.

Table 6-2 on the following page summarizes the peak flow values by flow metering basin. The values are based on model predicted flows for a 10-year flow event generated by each customer without regard to available sewer or pump station capacities. When the existing conditions 10-year event peak flow exceeds the allowable peak flow, it is anticipated the municipality will have a municipal peak flow standard violation in the event of a 10-year flow event.

Table 6-2, Average Dry Weather Flow, Allowable Peak Flow and Modeled Peak Flow by Flow Metering Location (2022 model results)

Metering Location	Average Dry Weather Flow (ADWF) (MGD); Municipal portion only	Level of Service Allowable Peak Flow (MGD)	Existing Conditions: 10-year Flow Event Peak Flow (MGD)	Future Conditions: 10-year Flow Event Peak Flow (MGD)	Comments
Bayview Heights	0.215	1.58	2.9	3.1	Flows increasing
Carlton	0.098	0.76	1.0	1.0	
Cloquet 22nd St.	0.127	0.75	1.0	1.0	
Cloquet Metering Station	0.696	8.43	6.7	7.0	ADWF decreased but large increased noted for 10-year flow and future flow
Duluth North Shore Sanitary District	0.038	0.23	0.7	0.7	Wet weather storage available; ADWF are reduced
Endion	1.045	8.66	36.7	36.9	Storage tank; flows increasing
Esko	0.113	0.80	1.5	1.5	Growth community – flows increasing
Gary/Fond du Lac	0.259	2.01	3.9	4.0	Wet weather storage available; slight increase in flows
Helberg Rd. (Thomson Twp.)	0.006	0.04	0.2	0.2	
Hermantown	0.318	3.73	2.6	2.8	Growth community. While flows have increased, wet weather flows have decreased.
Jay Cooke	0.001	0.01	0.03	0.03	75% decrease in LOS with removal of service to Oldenburg Point
Knife River/Larsmont	0.013	0.09	0.3	0.3	Wet weather storage available
Lakeside/Dodge (City of Duluth)	0.320	2.32	9.2	9.3	Wet weather storage available. ADWF have decreased; wet weather flows have increased
Knowlton Creek	0.490	N/A	7.7	7.7	
MPCA Landfill/ Ridgeview RD	0.02	0.18	0.3	0.3	Can turn off landfill leachate flow; large reduction in flow after landfill capped in 2010 resulting in decrease of LOS by 50%; Rice Lake community flows are increasing
Larson Road (Thomson Twp.)	0.006	0.07	0.1	0.1	
Oliver, WI	0.017	0.10	0.2	0.2	
Oneota	0.389	4.24	11.9	12.0	
Pike Lake	0.072	0.42	0.6	0.8	Growth community; Wet weather storage available
Polk Street	0.375	2.66	11.1	11.2	Wet weather storage available
Proctor	0.269	1.92	3.9	4.1	Growth community – Flows are increasing
Railroad Street	0.042	N/A	0.3	0.3	
Rice Lake	0.029	0.21	0.3	0.3	Growth community
Scanlon Metering Station	0.121	1.63	1.0	1.0	
Thomson	0.006	0.05	0.2	0.2	Flows are decreasing
Twin Lakes	0.066	0.29	0.7	0.6	Variable flows due to casino operation and COVID; flows decreasing
Wrenshall	0.020	0.15	0.3	0.3	Flows increasing, station magmeter replaced in 2016

***Level of Service is based on the Average Dry Weather Flow for the previous 5-years of data:** In 2014, the LOS calculation was revised to use the ADWF average over the previous 5 years. This allows for LOS changes to be moderated and more consistent for municipalities. The COVID 19 pandemic altered wastewater use and flows. The years surrounding COVID 19 quarantine and business closure periods were not used to evaluate the average dry weather flow.

The evaluation of the WLSSD conveyance system shows that the municipal level of service is exceeded at several locations under extreme wet weather flows for both current and future conditions. Municipalities with additional I & I opportunities to reduce flows include Duluth, Carlton, Duluth North Shore Sanitary District, Esko, Jay Cooke, Knife River/Larsmont Sanitary District, Proctor, Oliver, Pike Lake, Rice Lake, Thomson and Wrenshall.

Growth communities identified have increased their dry weather flow and therefore their level of service since 2016. These communities include Esko, Hermantown, Proctor, Pike Lake, Rice Lake, Scanlon and some areas of Duluth. It will be particularly important to continue monitoring flows from these areas to ensure capacity is available and that I & I reduction plans are sufficient.

6.2.2 : Capacity Evaluation – Current Conditions

A hydraulic capacity evaluation was performed as part of the planning process to assess system capacity of the gravity portion of the WLSSD interceptor system and pump stations and identify hydraulic restrictions in the collection system based on the 10-year flow event. The full report can be found in Appendix A.

Figures 6-3 and 6-4 depict the results of the evaluation. These figures show the percent of full capacity for each modeled pipe segment. It is a measure of peak flow in the sewer relative to the amount of flow the sewer can convey when it is full, based on full pipe capacity using Manning's Equation.

Figure 6-3, WLSSD Existing Flow Conditions – Pipe Capacity – East

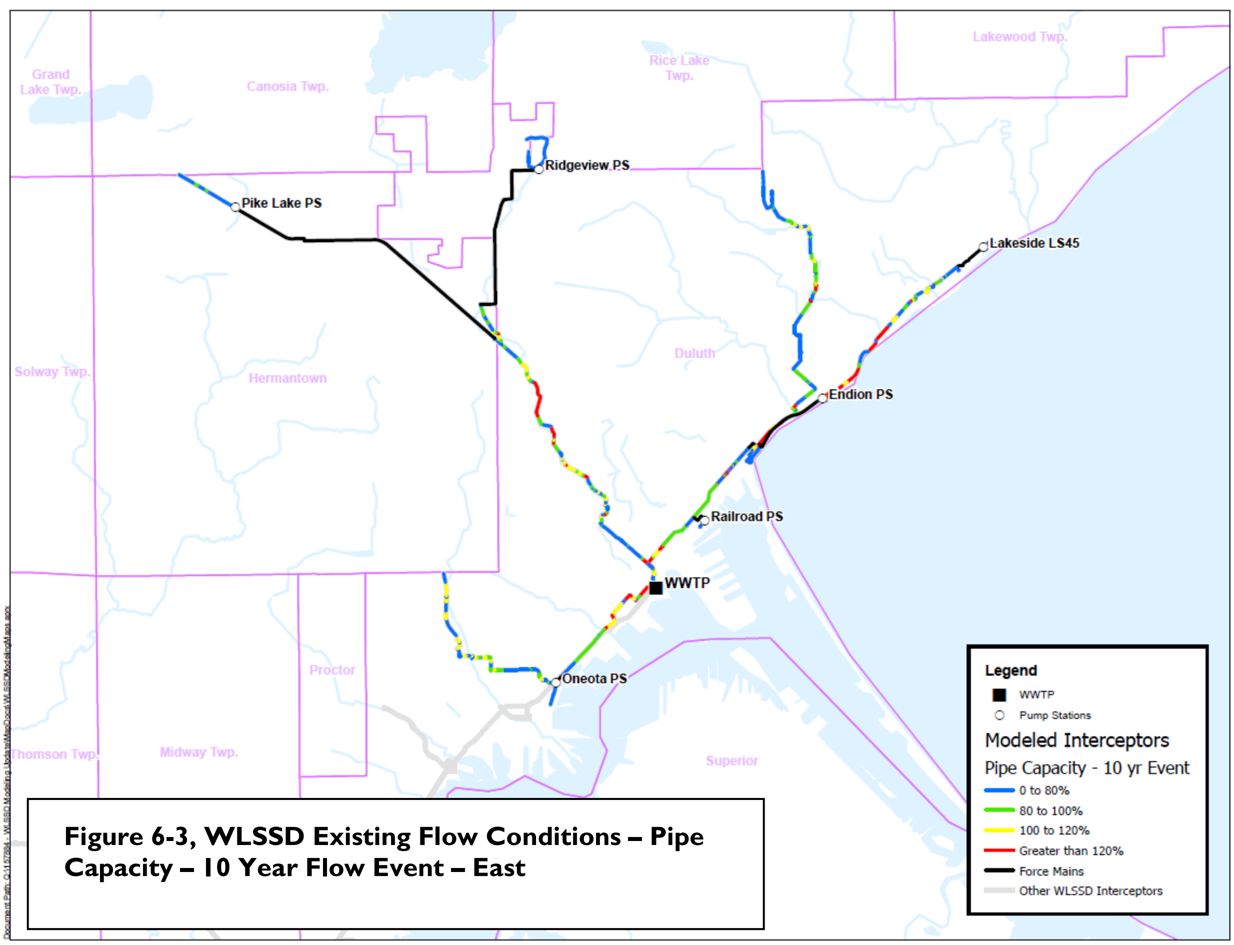


Figure 6-3, WLSSD Existing Flow Conditions – Pipe Capacity – 10 Year Flow Event – East

Figure 6-4, WLSSD Existing Flow Conditions – Pipe Capacity – West

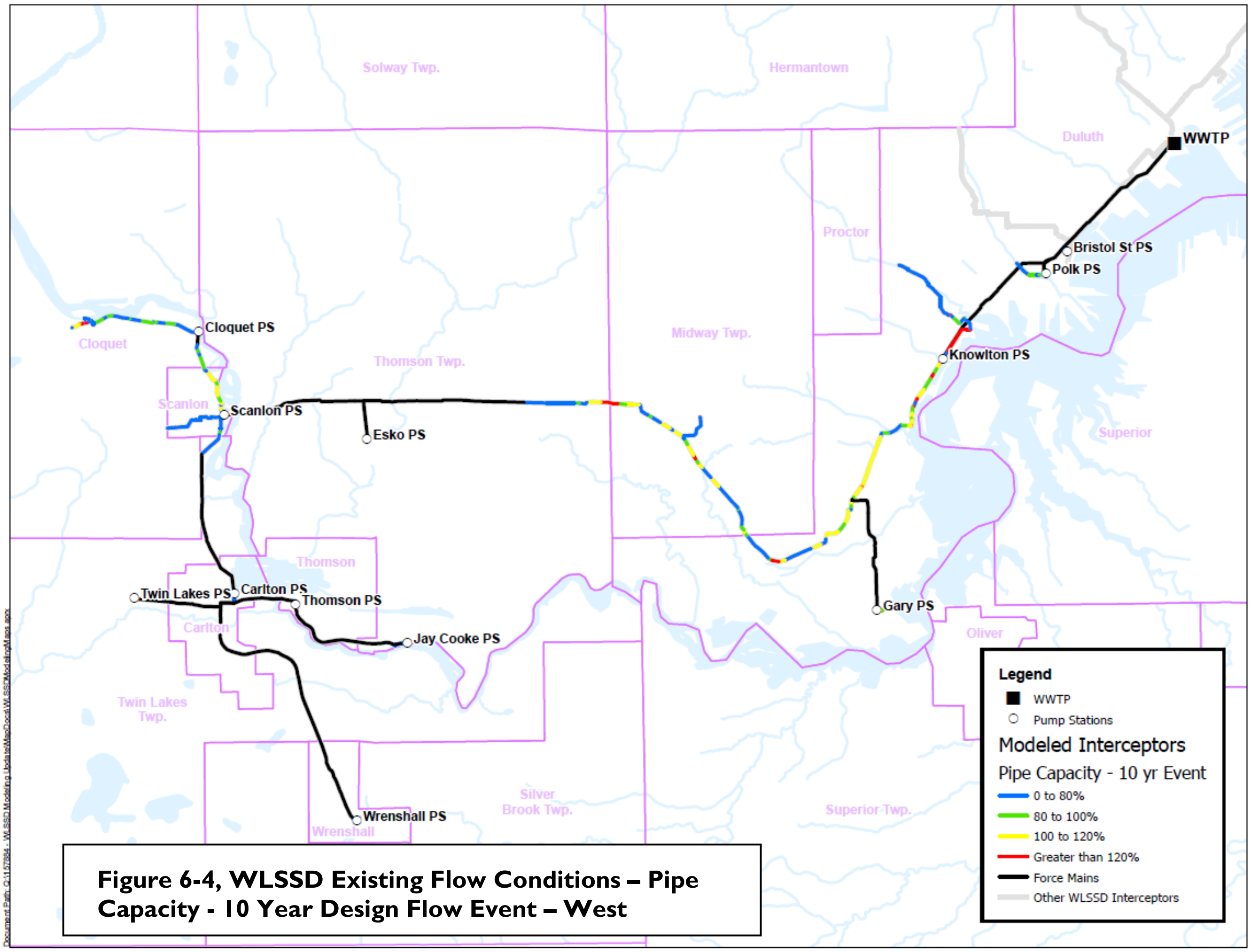


Figure 6-4, WLSSD Existing Flow Conditions – Pipe Capacity - 10 Year Design Flow Event – West

In addition to the pipe capacity, surcharge height was also determined and summarized in **Figures 6-5 and 6-6.**

Figure 6-5, WLSSD Existing Flow Conditions – Pipe Surcharging – East

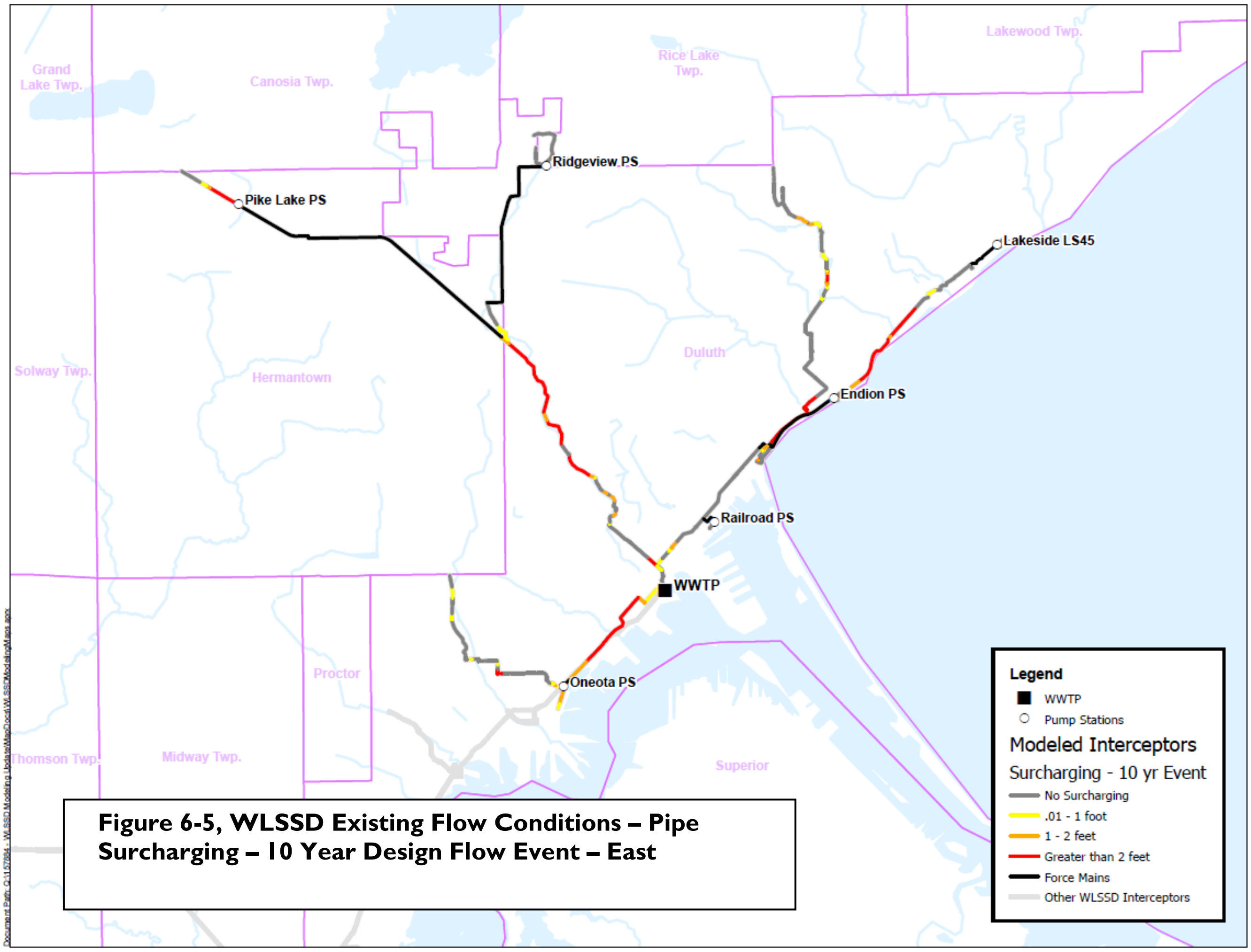


Figure 6-5, WLSSD Existing Flow Conditions – Pipe Surcharging – 10 Year Design Flow Event – East

Figure 6-6, WLSSD Existing Flow Conditions – Pipe Surcharging – West

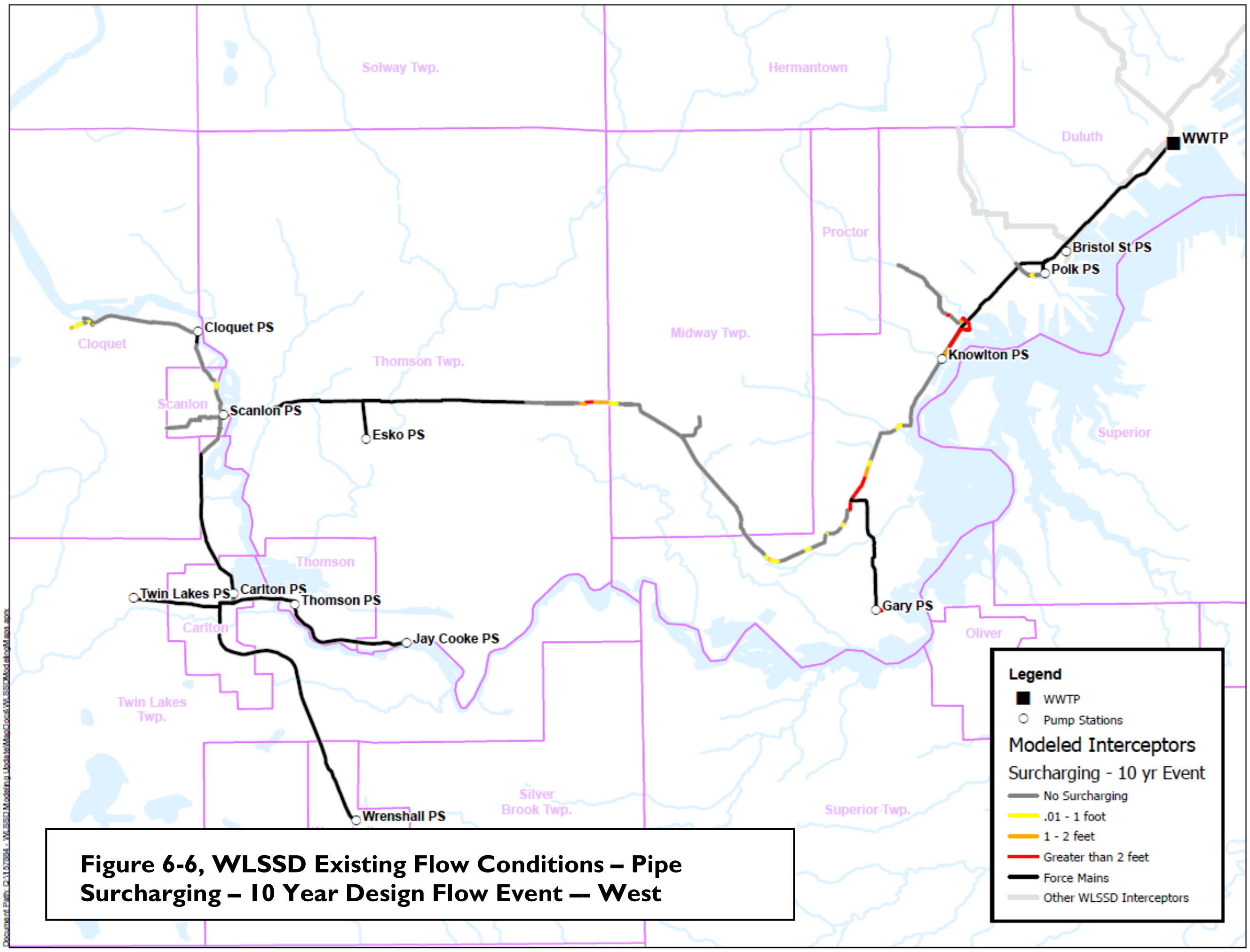


Figure 6-6, WLSSD Existing Flow Conditions – Pipe Surcharging – 10 Year Design Flow Event –- West

The above figures summarize the capacity and surcharging of the system relative to the design flow event. These figures indicate that at some locations peak flows in pipes are greater than 100-percent of pipe capacity and surcharging can be expected to occur in portions of the interceptor system under peak wet weather conditions.

It is important to note, that a pipe indicated to be over 100-percent of full pipe capacity does not necessarily indicate a problematic situation or overflow conditions. This information must be used in combination with observed conditions, model assumptions, surcharge tolerance and other factors to provide a full assessment. Individual locations highlighted in these figures can be further evaluated using the hydraulic model in order to determine surcharge tolerance and potential overflow locations.

While velocities in most pipes are within a reasonable range, some pipe velocities exceed 10 feet per second (fps). These are pipes with sleep slopes. High velocities at these locations are unavoidable because of the steep terrain in which the pipes were built. These pipe sections are regularly inspected and monitored for evidence of erosion of the pipe material.

The 10-year design flow events show greater than 120-percent of pipe capacity is used in areas of the Scanlon, Proctor, West, Hermantown, East, Woodland, Bayview Heights, Cloquet and Lakeside interceptors. Areas of pipe surcharging greater than two-feet occur on the Proctor, West, Hermantown, East, Pike Lake, Bayview Heights, Woodland and Lakeside interceptors. These surcharges and pipe capacity are generally tolerated, however must be continued to be measured and monitored. The District's temporary flow-metering program assists in collecting data to improve and validate the modeling results.

Capacity ratios were computed for each interceptor segment. Capacity ratios shown in **Figures 6-7 and 6-8** are based on either the full pipe capacity or the capacity that can be achieved with surcharging, where surcharge can be accommodated. In general, the system has the capacity to meet the municipal peak flow standard for existing flow conditions. The interceptor segments that do not meet the target values for current conditions are pipe segments located on the Hermantown Interceptor and the downstream portion of the West Interceptor. Capacity ratios in both interceptors have improved since the 2014 model run. The Pike Lake Interceptor upstream of the pump station also does not meet target capacity values.

The Hermantown Interceptor had 2,650 feet of pipe replaced and upsized in 2021. Additionally, the City of Hermantown rerouted approximately 250,000 gallons per day of flow from the Hermantown Interceptor into the Bayview Heights and West interceptors in late 2021. These changes have allowed the reconstruction timeframe for subsequent phases of the Hermantown Interceptor to be postponed. Routine updates to the hydraulic model will be completed in order to monitor growth and determine the appropriate capital schedule. Portions of the interceptor will be rehabilitated or replaced as warranted by condition assessments and flow conditions. The rerouting of flow will make monitoring the West Interceptor even more critical as flows increase in this pipe.

The West Interceptor area of concern is primarily the lower section, just upstream of the wastewater treatment plant. The model shows that the volume of flow causes surcharging as the pipe floods from the treatment plant back up the West Interceptor causing potential overflows at manholes with lower rim elevations. The City of Duluth lift stations 16 and 17 connect to the West Interceptor upstream of this area and sources of inflow and infiltration in the tributaries continue to be addressed by the City of Duluth by using cured in place pipe (CIPP) lining. It is expected continued reduction of I & I in this area will be seen in future flow metering data. A level sensor has been located in manhole WE029 to notify WLSSD operations when surcharge levels are rising in this area.

Figure 6-7, WLSSD Existing Flow Conditions – Pipe and Pump Capacity Ratios – East

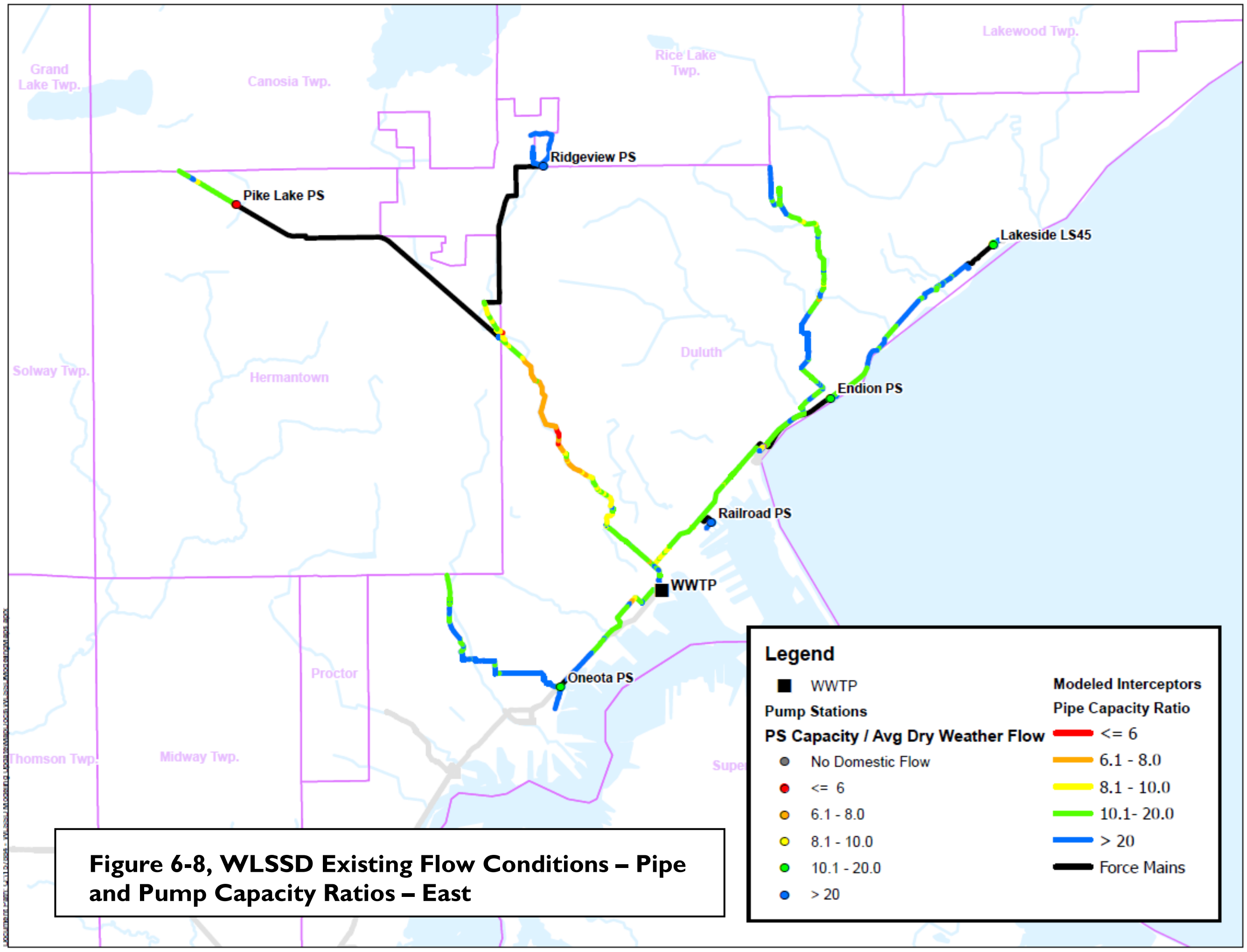


Figure 6-8, WLSSD Existing Flow Conditions – Pipe and Pump Capacity Ratios – East

Figure 6-8, WLSSD Existing Flow Conditions – Pipe and Pump Capacity Ratios - West

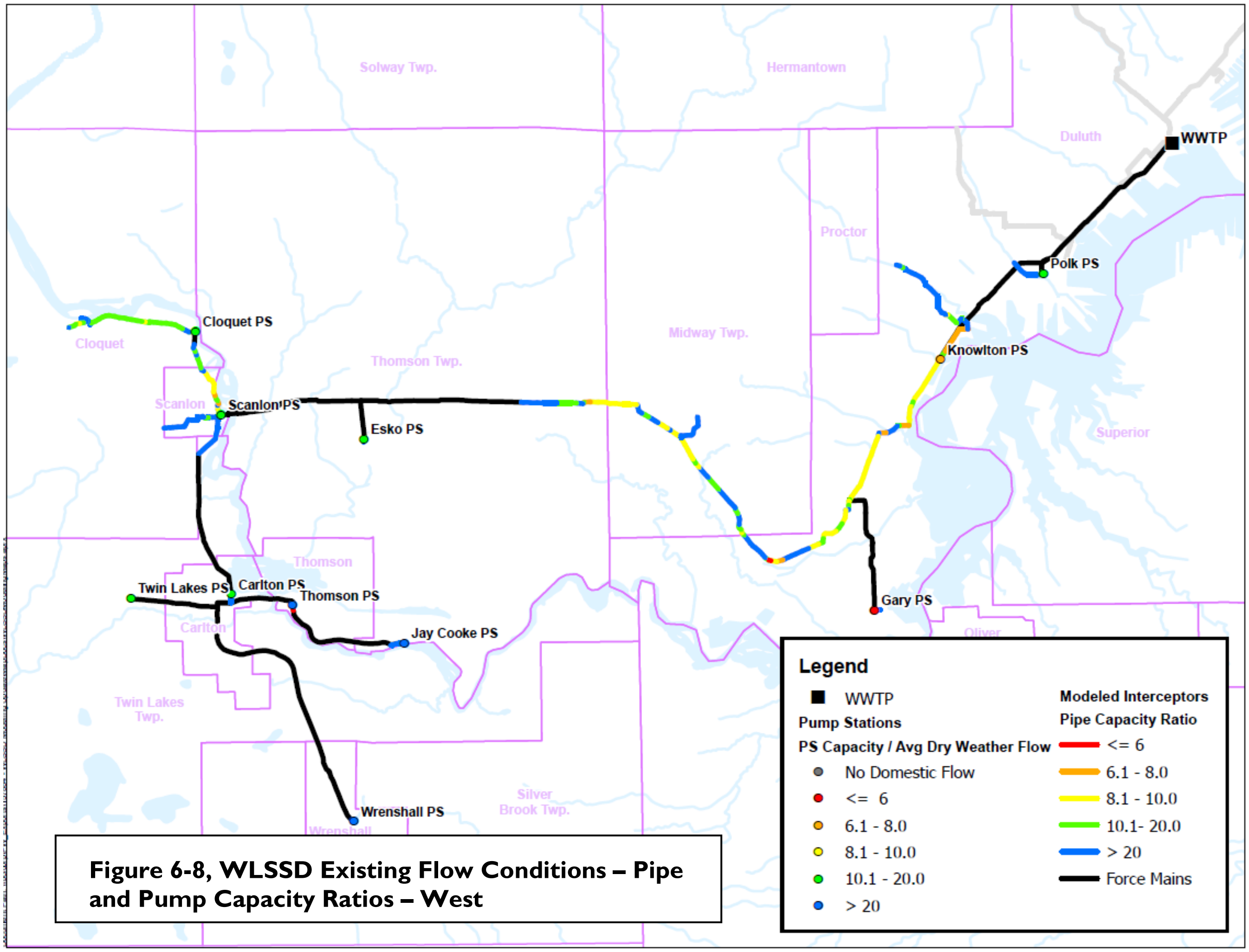


Figure 6-8, WLSSD Existing Flow Conditions – Pipe and Pump Capacity Ratios – West

The West Interceptor has a very shallow slope and therefore average velocity in the pipe is very low. Pipe sags have been identified in the area of the predicted overflows on the West Interceptor which increase the need for maintenance in this area. While sediment buildup increases the risk of overflow, it is not the reason for the hydraulic overload condition identified as the flow backs up from the WLSSD plant. WLSSD has established a routine pipe cleaning schedule in order to ensure continued pipe capacity is maximized in this area.

Additionally, upstream pipe rehabilitation will assist in reducing inflow and infiltration to this area. If these pipes are replaced in the future to accommodate future growth, they should be sized to meet the target capacity ratio. Consideration to storage capacity for wet weather flow should also be evaluated.

6.2.3 Capacity Evaluation – Future Conditions

The quantity of wastewater generated in the WLSSD service area is expected to increase as a result of both growth within existing sewered areas and the development of new sewered areas that will become part of the WLSSD service area in the future. The existing and future WLSSD service areas are shown in **Figure 6-9**. Possible future areas of sewer service are highlighted in purple. The results of the capacity evaluation for future conditions are similar to those for current conditions and can be viewed in the following **Figures 6-10 through 6-15**. All WLSSD interceptors show some areas where the pipe capacity and surcharge levels exceed recommended design conditions. As explained previously, some of the areas are better tolerated than others. Future flows are taken into consideration when rehabilitating or reconstructing these interceptors. The full report can be found in Appendix A.

Since the last hydraulic model and comprehensive master plan update, the following possible future service areas have been removed from the future condition evaluation:

- Grand Lake
- Caribou Lake
- Chub Lake

Figure 6-9, WLSSD Existing Model Basins with Future Service Areas

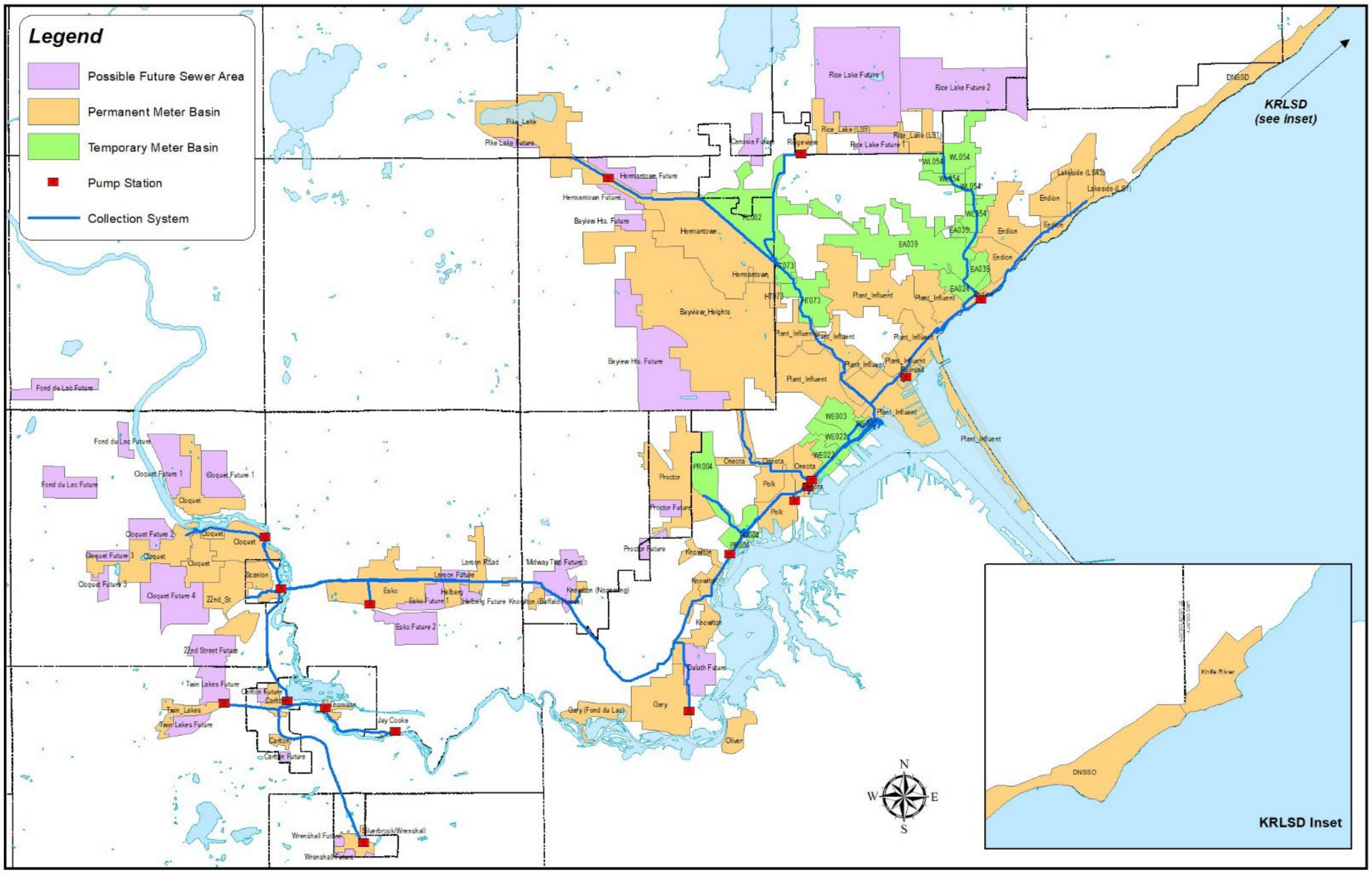


Figure 6-10, WLSSD Future Flow Conditions – Pipe Capacity – East

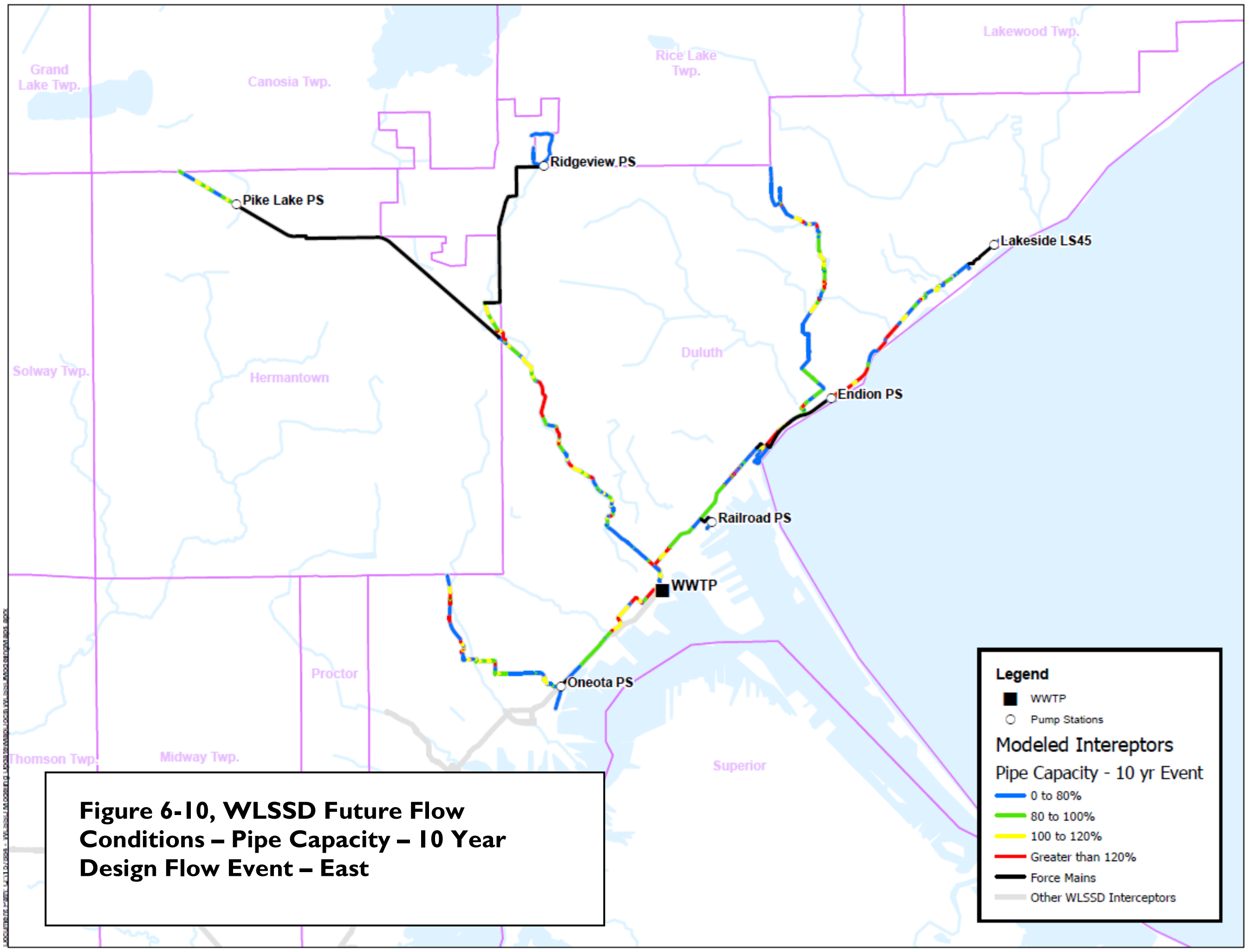


Figure 6-10, WLSSD Future Flow Conditions – Pipe Capacity – 10 Year Design Flow Event – East

Figure 6-11, WLSSD Future Flow Conditions – Pipe Capacity – West

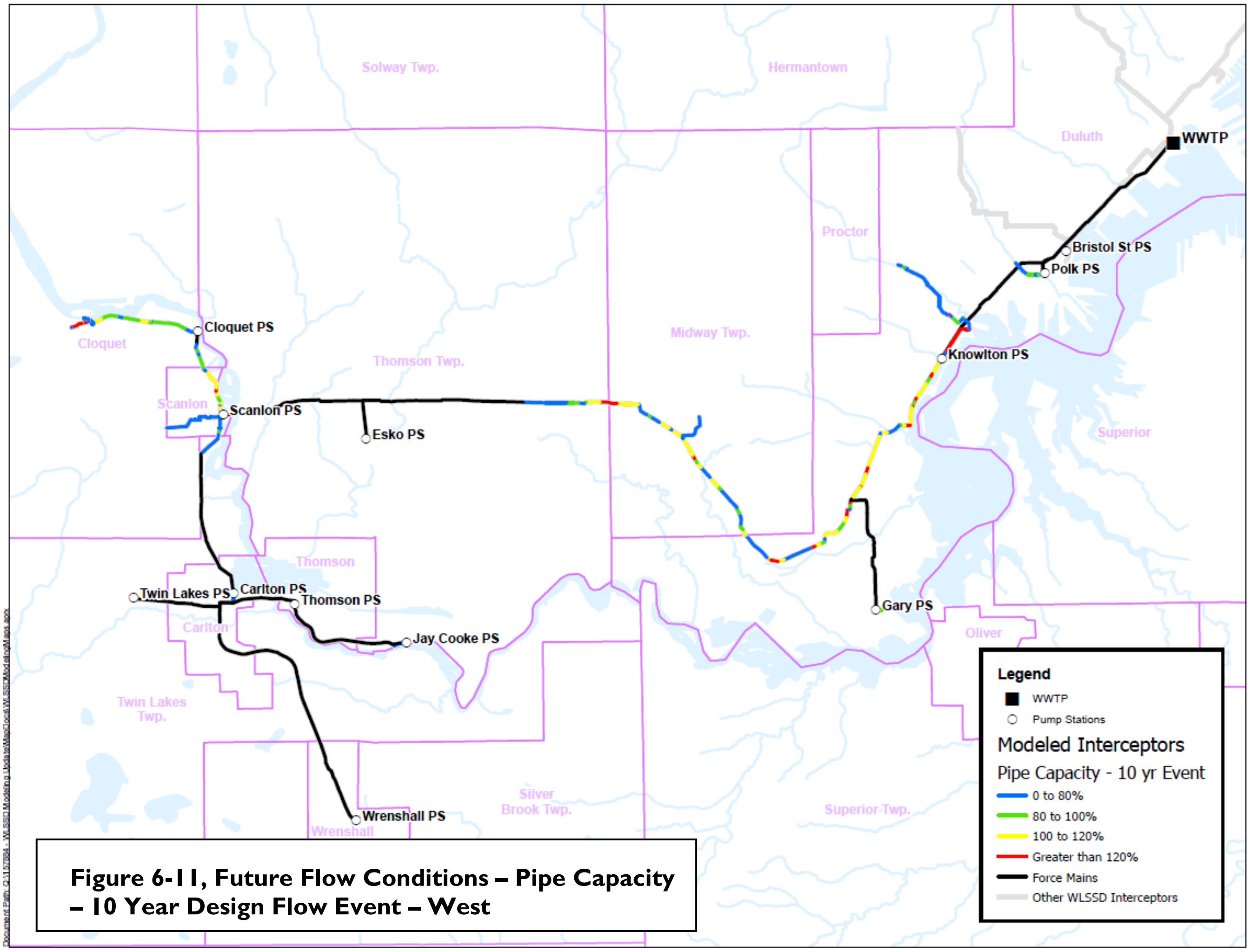


Figure 6-11, Future Flow Conditions – Pipe Capacity – 10 Year Design Flow Event – West

Figure 6-12, WLSSD Future Flow Conditions – Pipe Surcharging – East

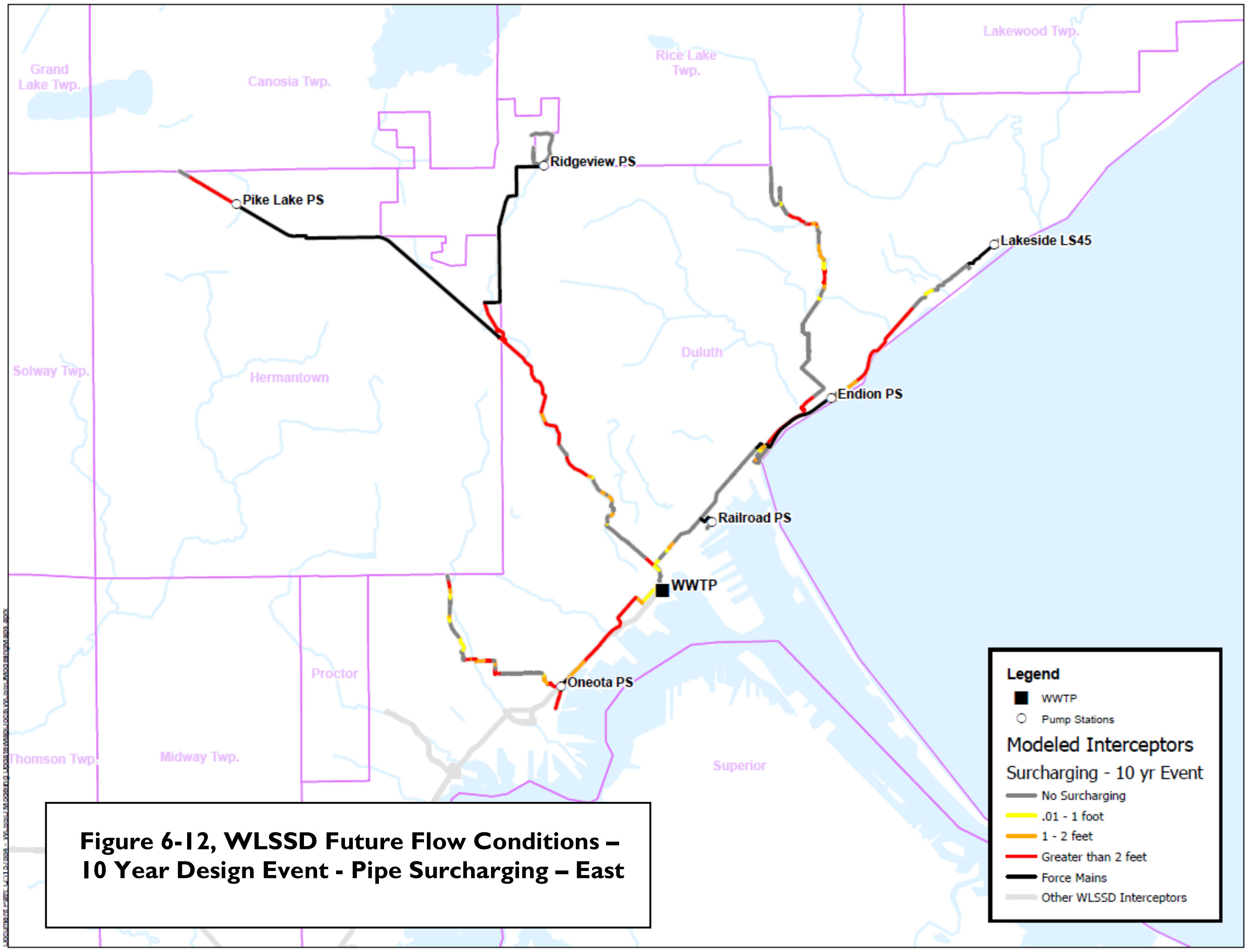


Figure 6-13, WLSSD Future Flow Conditions – Pipe Surcharging – West

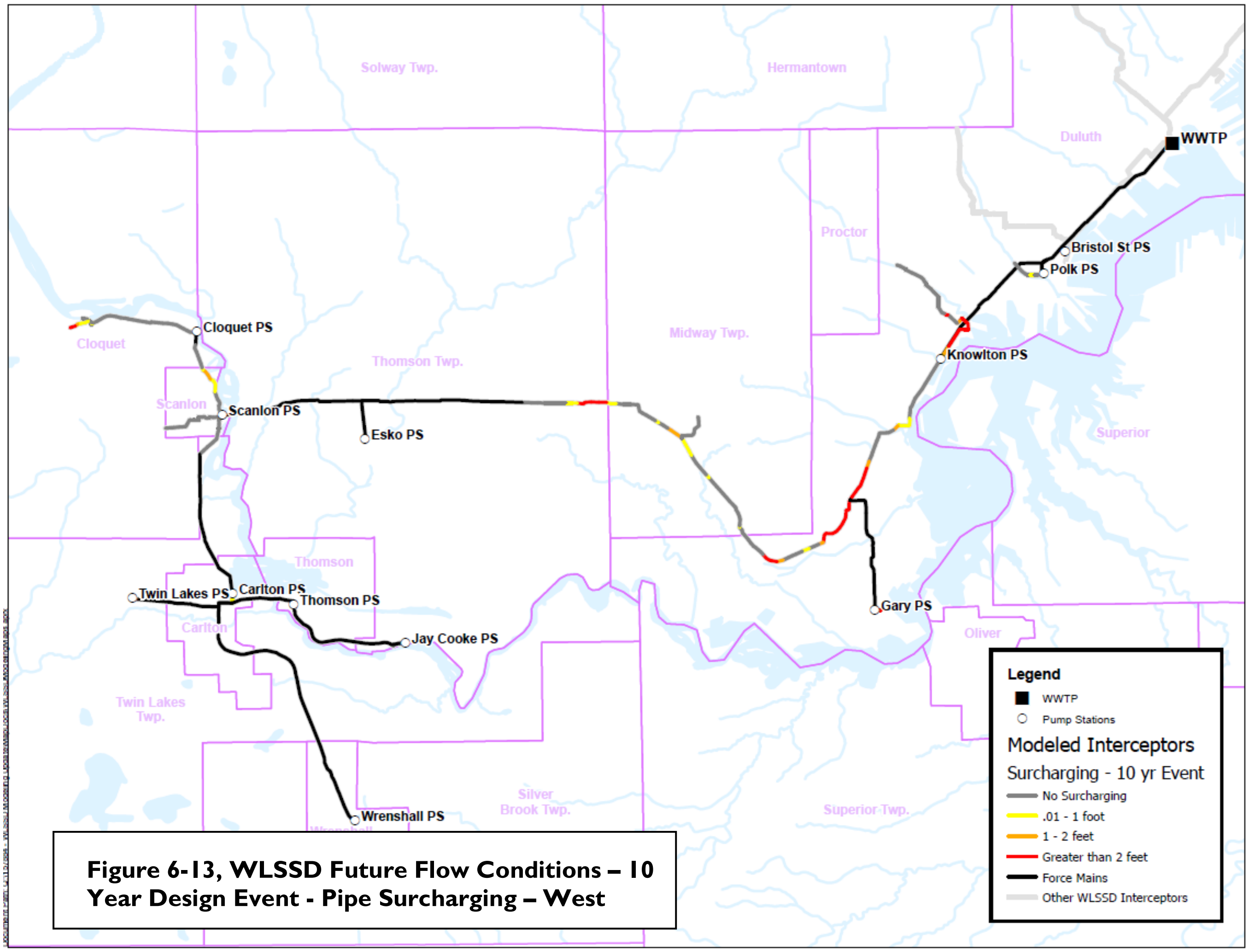


Figure 6-13, WLSSD Future Flow Conditions – 10 Year Design Event - Pipe Surcharging – West

Figure 6-14, WLSSD Future Flow Conditions – Pipe and Pump Capacity Ratios – East

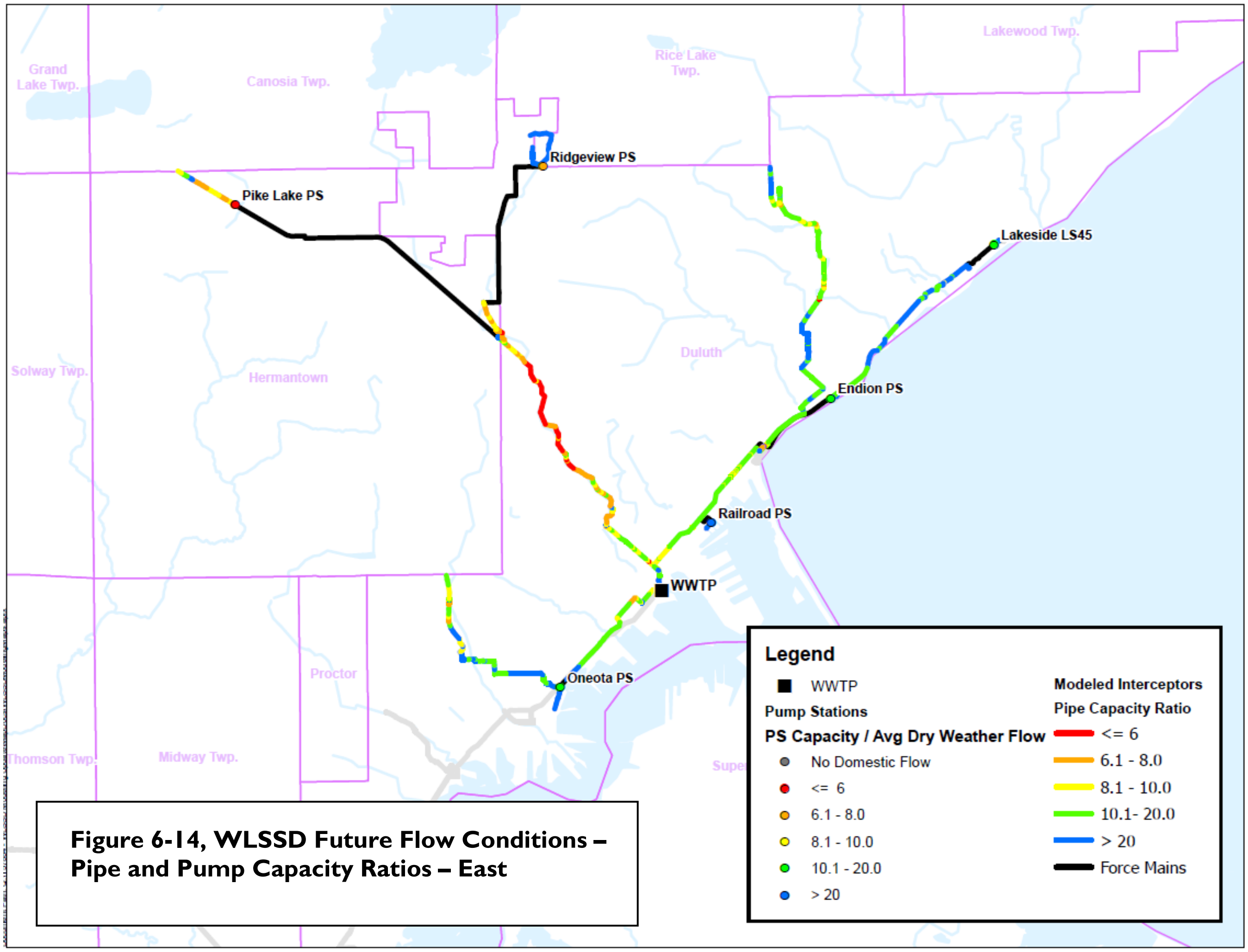


Figure 6-15, WLSSD Future Flow Conditions – Pipe and Pump Capacity Ratios – West

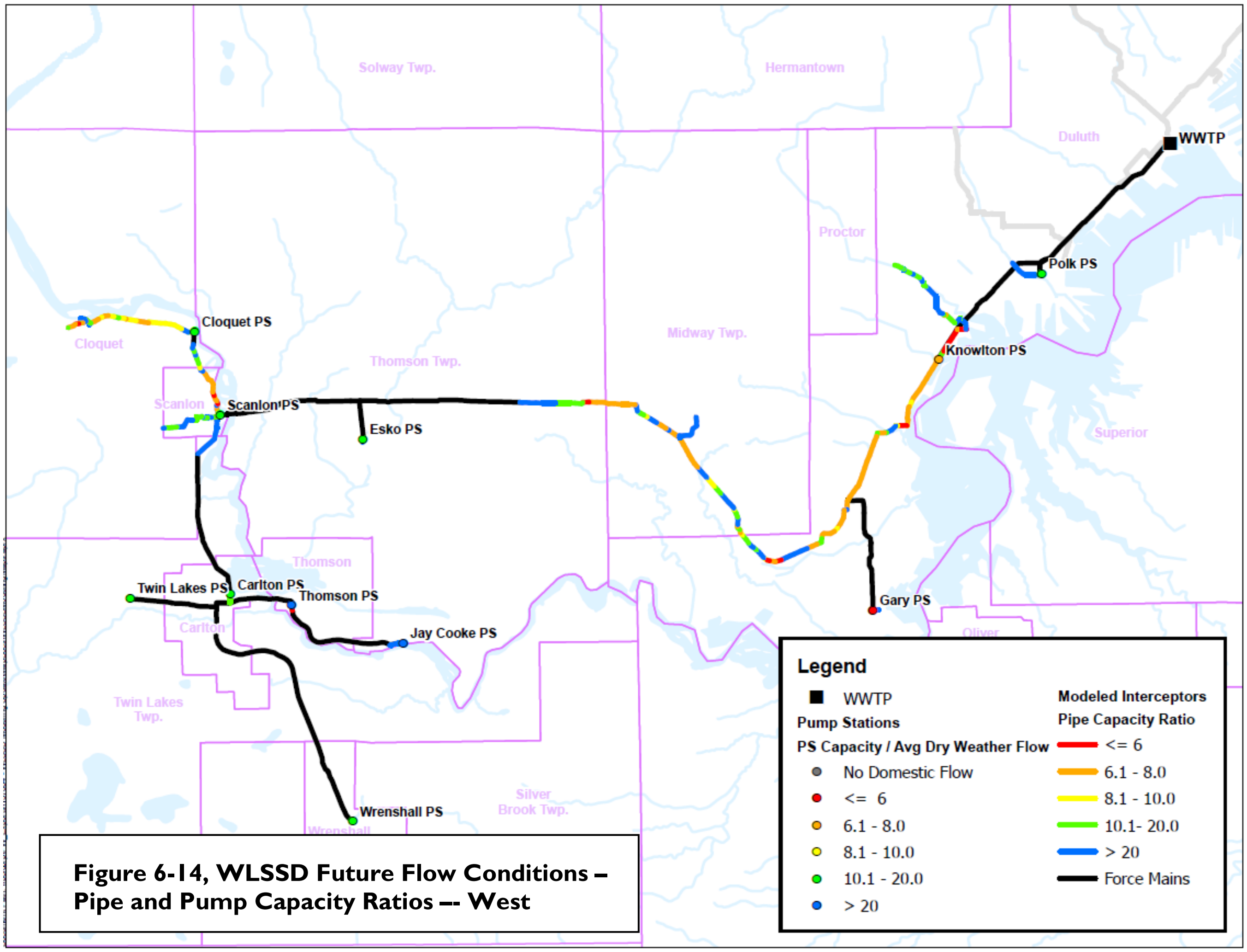


Figure 6-14, WLSSD Future Flow Conditions – Pipe and Pump Capacity Ratios –- West

6.2.4 : Capacity Evaluation – Pump Stations

Peak flows at each pump station and their respective capacities are summarized in **Table 6-3**. Capacities are exceeded for the design flow event at several of the pump stations. Storage basins are located at the Gary, Endion, Dodge Street (City of Duluth LS45), Polk Street and Pike Lake pump stations to store peak flows. Those are the pump stations that have a capacity ratio less than the target capacity ratio. There is a footnote under each table noting that and some text at the bottom of page 84 as well.

Table 6-3, Pump Station Capacity and Model Predicted Results for Existing & Future Conditions (10-year Flow Event)

Pump Station	Total Station Capacity (MGD)	Existing Conditions: 10-year Flow Event	Future Conditions: 10-year Flow Event
Knowlton Creek	48.9	43.4	45.6
Scanlon	45.9	35	36.8
Cloquet	36.0	31.4	32.5
Bristol Street	11.0	5.0	5.0
Polk Street*	6.4	**11.1**	**11.2**
Gary*	1.5	**4.1**	**4.2**
Esko	1.74	1.5	1.6
Carlton	2.9	2.0	2.3
Carlton – New Station	4.0	2.1	2.4
Twin Lakes	1.2	0.66	0.86
Thomson	0.4	0.17	0.17
Jay Cooke	0.34	0.03	0.03
Wrenshall	0.56	0.34	0.39
Endion*	16	**27.9**	**27.9**
Dodge St. (City of Duluth)*	3.7	**9.2**	**9.3**
Railroad Street	1.7	0.34	0.34
Oneota Street**	10.8	**12.7**	**13.1**
Pike Lake*	0.34	**0.48**	**0.70**
Ridgeview Road	0.75	0.27	0.69

*Storage capacity available at these locations

**Total capacity of Oneota St. PS may cause flooding in downstream gravity sewer

The Oneota Street Pump Station does not meet the model predicted 10-year flow capacity for existing conditions. Use of the total station capacity could result in overflows in the downstream West interceptor for existing and future conditions. Use of only the firm capacity (8.3 MGD) of the station could result in flooding of the upstream West Interceptor manholes. Flows into this area of the system must continue to be monitored closely.

Table 6-4 lists the WLSSD stations, their firm and total capacities, and a comparison of the firm capacity ratio and the target capacity ratio as defined for the WLSSD system. Firm capacity of a pump station is generally defined as the station capacity available with the largest pump unit out of service. It is noted that the firm capacity ratio for several of the stations falls short of the target capacity – these are shown in **bold** font.

Table 6-4, Pump Station Capacities and Capacity Ratios – Existing Conditions (2022)

Station	Total Capacity (MGD)	Firm Capacity (MGD)	Total Capacity Ratio	Firm Capacity Ratio[3]	Target Capacity Ratio
Knowlton Creek	48.9	40.3	7.6	**4.8**	6.4
Scanlon	45.9	31.7	17.8	**5.3**	7.0
Cloquet	36.0	27.1	14.8	**2.0**	7.2
Bristol Street (LSPI[1])	11.0	8.8	NA[2]	NA[2]	NA[2]
Polk Street	6.4	6.4	17.1	17.1	7.8
Gary	1.5	1.3	**5.4**	**4.7**	8.0
Esko	1.74	1.74	14.2	10.6	8.0
Carlton	2.9	2.3	15.1	12.0	8.0
Carlton – New Station	4.0	4.0	20.5	20.5	8.0
Twin Lakes	1.2	1.1	18.1	16.6	8.0
Thomson	0.40	0.26	52.5	34.1	8.0
Jay Cooke	0.34	0.29	283	242	8.0
Wrenshall	0.56	0.475	19.7	12.8	8.0
Endion	16.0	10.0	11.3	7.1	6.7
Railroad Street (PS-8[1])	1.7	1.2	40.7	28.7	8.0
Oneota Street (PS-12[1])	10.8[4]	8.3	17.9	13.7	7.5
Pike Lake	0.34	0.34	**4.7**	**4.7**	8.0
Ridgeview Road	0.75	0.69	37.5	34.5	8.0

1. Historical pump station name
2. Station only receives industrial flow
3. Firm Capacity Ratios shown in **bold** font are less than the target Capacity Ratio
4. Total capacity of Oneota St. PS may cause overflow in downstream gravity sewer

Knowlton Creek, Scanlon and Cloquet Pump Stations - As a way of addressing the deficiency in installed capacity of the three largest pump stations, WLSSD keeps a spare pump unit for the Knowlton Creek and Scanlon pump stations in stock and ready for immediate replacement in the event of a failure. Planned major retrofits of these stations should include a detailed analysis of the condition of the pumps prior to any upgrades or other changes in station capacity.

Oneota Street Pump Station - The Oneota Street Pump Station was designed to provide the required peak flow using firm capacity – two of the three installed pumps. While reductions of I & I by the City of Duluth upstream of this station have occurred, increased flow to the interceptor from area communities has increased the risk of hydraulic problems in the West Interceptor. Monitoring of this station after high flow events should continue in order to determine upstream and downstream effects in the system. When the Oneota Street Pump Station capacity is exceeded, the upstream West Interceptor surcharges and risks overflow.

To prevent overflows downstream of the Oneota Street Pump Station, a level measurement system was placed in downstream manhole WE029 in order to monitor surcharge levels. The system notifies WLSSD staff when certain internal depths are reached. This allows District staff to adjust operations and call out liquid hauler trucks if needed prior to an overflow. This location has not had an overflow event after the station was inhibited from starting all three pumps.

Gary Pump Station - The Gary Pump Station does not meet its target capacity ratio even when the station total capacity is considered. This station was replaced in 2010 and has a firm capacity of 1.3 MGD and total capacity of 1.5 MGD. In addition, peak flows to this pump station are attenuated by the adjacent storage basin; thus, it is not necessary for the pump station to meet the target capacity ratio.

Polk Street Pump Station - The Polk Street Pump Station was rebuilt in 2011 with over 1,000,000 gallons of storage capacity added to accommodate wet weather events.

Pike Lake Pump Station - The Pike Lake Pump Station is also below the target capacity ratio using both firm and total capacity. A 179,000 gallon storage tank was installed in 2011 to remedy the capacity concerns. In 2017-2018, WLSSD updated the hydraulic model to determine the impact of additional flow to this area of the system. It was ultimately determined that 40,000 gallons per day of additional flow could be accommodated using 100-percent of the storage capacity available and still accommodate the 25-year design flow event.

In 2021, WLSSD limited PLAWCS to an additional capacity of 30,000 gallons per day for proposed development projects. As of the date of this Plan, the vast majority of that capacity has been allocated to various projects by the PLAWCS Board, leaving approximately 2,000 gallons per day of remaining additional capacity. Approximately 10,000 gallons per day of capacity remains for additional Hermantown connections, for MNDOT ongoing dewatering activities and the future construction of a maintenance facility at the intersection of HWY 53/194. Any additional flow to this basin must be accompanied by a plan for additional storage or hydraulic improvements. Additional capacity could come from continued I & I reductions, the installation of a community storage basin (PLAWCS and/or WLSSD), transfer of flow or installation of a larger forcemain. The Pike Lake Area Wastewater Collection System (PLAWCS) is being closely monitored to accommodate the planned growth in this basin.

Endion and Dodge Street (LS45) Pump Stations – Storage tank facilities were built to accommodate the excess flow at these stations as described in Section 6.2.6.

Increases in future flow will result in some WLSSD interceptors and pump stations having capacity ratios that do not meet the target level of service as shown in **Table 6-5**. Growth in the system needs to be monitored and upgrades of facilities made to meet the target level of service when flows dictate. Facilities with capacity ratios less than the target values are not recommended for upgrade immediately if they are not causing capacity problems. However, when these facilities are upgraded either to accommodate future growth or to address condition concerns, they should be upgraded to meet the target capacity ratios based on future flow conditions and firm capacities.

A detailed capacity verification was not performed for this Comprehensive Plan at any of the pump stations. Pumps are generally performing as designed, evidenced by the analyses performed for the recent collection system modeling work. Significant capacity deficiencies are noted at a few of the stations, most of which have onsite storage capacity available to attenuate flows. The Pike Lake Pump Station will need to be upgraded or storage provided to manage future flows if growth continues. The use of storage tanks at Pike Lake, Endion, Dodge Street (LS45) and Gary must be monitored to ensure they meet capacity requirements of future flows. Continued I & I reduction is needed upstream of the Pike Lake and Oneota Street pump stations to ensure continued capacity.

Table 6-5, Pump Station Capacities and Capacity Ratios – Future Conditions

Station	Total Capacity (MGD)	Firm Capacity (MGD)	Total Capacity Ratio	Firm Capacity Ratio[3]	Target Capacity Ratio
Knowlton Creek	48.9	40.3	7.1	**4.5**	6.4
Scanlon	45.9	31.7	13.0	**3.9**	7.0
Cloquet	36.0	27.1	10.9	**1.5**	7.2
Bristol Street (LSPI[1])	11.0	8.8	NA[2]	NA[2]	NA[2]
Polk Street	6.4	6.4	16.4	16.4	7.8
Gary	1.5	1.3	**5.2**	**4.5**	8.0
Esko	1.74	1.74	10.8	8.1	8.0
Carlton	2.9	2.3	11.2	8.9	8.0
Carlton – New Station	4.0	4.0	15.3	15.3	8.0
Twin Lakes	1.2	1.1	10.4	9.5	8.0
Thomson	0.40	0.26	56.2	36.5	8.0
Jay Cooke	0.34	0.29	283	242	8.0
Wrenshall	0.56	0.475	12.7	8.3	8.0
Endion	16.0	10.0	10.9	6.8	6.7
Railroad Street (PS-8[1])	1.7	1.2	39.9	28.2	8.0
Oneota Street (PS-12[1])	10.8[4]	8.3	15.0	11.6	7.5
Ridgeview Road	0.75	0.69	**6.4**	**5.9**	8.0
Pike Lake[5]	0.34	0.34	**3.2**	**3.2**	8.0

1. Historical pump station name
2. Station only receives industrial flow
3. Firm Capacity Ratios shown in **bold** font are less than the target Capacity Ratio
4. Total capacity of Oneota St. PS may cause flooding in downstream gravity sewer.
5. The Pike Lake PS has storage available to attenuate the current planned and peak flows.

6.2.5 : System Overflows

The occurrence of peak wet weather wastewater flows that exceed the capacities of the pipes and pump stations may result in overflows through either dedicated bypass pipes or manholes.

The main areas in the WLSSD interceptor system that historically experienced persistent overflows and were recognized locations in the Consent Decree have all been addressed. The Consent Decree was terminated in June 2015. WLSSD continues to utilize the hydraulic model to determine areas of concern for hydraulic issues.

Table 6-6 describes model predicted overflow volumes at locations where overflows are expected for the 10-year flow event under existing flow conditions for the 2009, 2014 and 2022 model results. Much of the improvement noted is a result of the work done by both WLSSD and the City of Duluth to address the points identified in the Consent Decree. This work included miles of interceptor rehabilitation, primarily cured in place pipe lining, and construction of numerous storage basins to contain wet weather flows. Work on I & I reduction continues.

The model updates included the storage tank capacities and updated flow data from 2014 to 2021. The amounts of predicted overflows have increased along the Lakeside and Hermantown interceptors. Interceptors with areas at risk for potential overflows include the following:

- Lakeside Interceptor (Manholes LS030 - LS035)
- West Interceptor (Manholes WE023 – WE029 and WE040 – WE046)
- Hermantown Interceptor (Manholes HT003 – HT005 and HT063 – HT042 and HT095-HT075)
- Proctor Interceptor (Manholes PR021 – PR007)
- East Interceptor (Manholes EA042-EA034)

Table 6-7 directly compares the model predicted overflow volumes at locations where overflows are expected for the 10-year flow even using 2009, 2014 and 2022 model results under future flow conditions. Future conditions adjust for population and employment growth to the year 2050. These areas include:

- Lakeside Interceptor (Manholes LS030 - LS035)
- West Interceptor (Manholes WE023 – WE029 and WE040 – WE046)
- Hermantown Interceptor (Manholes HT003 – HT005 and HT063 – HT042 and HT095-HT075)
- Proctor Interceptor (Manholes PR021 – PR007)
- East Interceptor (Manholes EA042-EA034)
- Bayview Heights Interceptor (Manholes BV058-BV043)
- Scanlon Interceptor (Manholes D052-D041)

While it is expected further reduction of inflow and infiltration will occur as a result of ongoing City of Duluth efforts, the data was not adjusted to account for this.

Table 6-8 summarizes the hydraulic model overflow predictions for the 10-year flow event under existing and future flow conditions.

Table 6-6, Model Predicted Overflow Points and Volumes from 2009 to 2022 for Existing Conditions 10-year Flow Event

Location	2009 Predicted Overflow (MG)	2015 Predicted Overflow	2022 Predicted Overflow
Lakeside	LS001, LS016 – LS039 **3.5 MGD**	LS030-LS035 **0.02 MGD**	LS030-LS035 **0.18 MGD**
Hermantown and Rice Lake	HT004, HT026-HT032, HT055-HT060 **1.56 MGD** Hermantown HT090-102 **0.03 MGD**	HT003-HT006, HT058-HT063 **0.04 MGD** RL001 – RL014; HT091-HT096 **0.01 MGD**	HT003-HT005 HT042-HT063 HT075 – HT095 **0.07 MGD**
West	WE017 – WE029 **0.28 MGD**	WE023 – WE029 **0.03 MGD**	WE023-WE029 WE040-WE046 **0.01 MGD**
Proctor	PR005-PR015, PR041-PR051 **0.32 MGD**	**0 MGD**	PR007 – PR021 **0.03 MGD**
Scanlon Div. D	**0.08 MGD**	**0 MGD**	**0 MGD**
Cloquet	F000SC, F000_CQ **0.02 MGD**	**0 MGD**	**0 MGD**
Woodland	WL011-WL012, WL056-WL061, WL069-WL080, WL089-WL099 **0.14 MGD**	**0 MGD**	**0 MGD**
Pike Lake	**0 MGD**	PL008 **0.003 MGD** (assumes weir plate removed)	**0 MGD** (assumes weir plate removed and 5% of storage basin (0.17 MG) is used)
Polk Street	PO008-PO014 **0.6 MGD**	**0 MGD** – 20% basin (1MG) used	**0 MGD** – 30% basin (1MG) used
Endion	**8.84 MGD**	**0 MGD** – 95% Phase 1 basin (1MG) and 50% Phase 2 (3MG) basin used	**0 MGD** – 40% Phase 1 basin (1MG) and 35% Phase 2 (3MG) basin used
Fitger's Overflow	**3.25 MGD**	**0 MGD** – 10% Canal Park Basin (8.3 MG) used	**0 MGD** – 15% Canal Park Basin (8.3 MG) used
East Interceptor	EA018, EA036-EA045 **0.76 MGD**	**0 MGD** – 10% Canal Park Basin (8.3 MG) used	EA034 – EA042 **0.06 MGD** **0 MGD** – 15% Canal Park Basin (8.3 MG) used
Lakeside 45 (Dodge St.)	**0 MGD** at Station **3.5 MGD** in Downstream Manholes	**0 MGD** – 70% of basin (2.2 MG) used	**0 MGD** – 15% of basin (2.2 MG) used

Table 6-7, Model Predicted Overflow Points and Volumes from 2009 to 2022 for Future Conditions (10-year Flow Event)

Location	2009 Predicted Overflow (MG)	2015 Predicted Overflow	2022 Predicted Overflow
Lakeside	LS001, LS016 – LS039 **3.54 MGD**	LS030-LS035 **0.03 MGD**	LS030 – LS035 **0.23 MGD**
Hermantown and Rice Lake	HT004, HT026-HT032, HT055-HT060, HT090-102 **2.13 MGD**	HT003 – HT006, HT058 – HT063, HT091 – HT096 **0.11 MGD** RL001 – RL014 **0.10 MGD**	HT003-HT005 HT042-HT063 HT075 – HT095 **0.19 MGD**
West	WE017 – WE029 **0.32 MGD**	WE023 – WE029 **0.04 MGD**	WE023-WE029 WE040-WE046 **0.01 MGD**
Proctor	PR005-PR015, PR041-PR051 **0.32 MGD**	**0 MGD**	PR007 – PR021 **0.03 MGD**
Bayview Heights	BV103-104 **0.11 MGD**	**0 MGD**	BV043 – BV058 **0 MGD**
Scanlon Div. D	D018-D137 **0.42 MGD**	**0 MGD**	D041 – D052 **0.01 MGD**
Pike Lake	**0 MGD**	PL008 – PL017 **2.17 MGD** 95% basin used	**0 MGD** 95% basin (0.17 MG) used
Cloquet	F000SC, F000_CQ **0.05 MGD**	**0 MGD**	**0 MGD**
Esko	E006T2 **0.003 MGD**	**0 MGD**	**0 MGD**
Woodland	WL011-WL012, WL056-WL061, WL069-WL080, WL089-WL099 **0.15 MGD**	**0 MGD**	**0 MGD**
Polk Street	PO008-PO014 **0.62 MGD**	**0 MGD** – 20% basin used	**0 MGD** – 30% basin (1MG) used
Endion	**9.90 MGD**	**0 MGD** – 95% Phase 1 and 50% Phase 2 basin used	**0 MGD** – 40% Phase 1 basin (1MG) and 35% Phase 2 (3MG) basin used
Fitger's Overflow	**3.54 MGD**	**0 MGD** – 55% Canal Park Basin used	**0 MGD** – 15% Canal Park Basin (8.3 MG) used
East Interceptor	EA018, EA036-EA045 **0.88 MGD** EA008 **0.01 MGD**	**0 MGD** – 55% Canal Park Basin used	**0.09 MGD** – 15% Canal Park Basin (8.3 MG) used EA034-EA042
Gary PS Storage Basin	**0 MGD**	**0 MGD** – 10% basin used	**0 MGD** – 15% basin (1.6 MG) used
Lakeside 45 (Dodge)	**0 MGD** at Station **3.67 MGD** in downstream manholes	**0 MGD** – 70% of basin used	**0 MGD** – 15% of basin (2.2 MG) used

Table 6-8, Summary of Model Predicted Overflow Points and Volumes for the 10-year Flow Event under Existing and Future Conditions (2022)

Area	Manhole Range	Current Condition Overflow Volume: 10-year Flow Event (MG)	Future Condition Overflow Volume: 10-year Flow Event (MG)
Lakeside Interceptor	LS030-LS035	0.22	0.23
Hermantown Interceptor	HT003-HT005; HT042-HT063 HT075 – HT095	0.09	0.19
East Interceptor	EA034 – EA042	0.06	0.09
Proctor Interceptor	PR007 – PR021	0.02	0.03
West Interceptor	WE023 – WE029 WE040 – WE046	0	0.01
Scanlon Interceptor	D052-D041	0	0.01

6.2.6 : Overflow Mitigation

One or more of the following actions can mitigate overflows from the WLSSD collection system:

- Increase system conveyance and treatment capacity
- Provide storage to attenuate peak flows
- Reduce peak flows tributary to the system

Mitigation of the expected overflows can be addressed by providing storage, reducing peak wet weather flows, or a combination of both actions. A balance between the amount of capacity provided by storage and the peak flows discharged to the system must be achieved to optimize performance of the system.

Several facilities were constructed by the City of Duluth and the WLSSD during the Consent Decree to mitigate peak flows and reduce overflows.

Table 6-9 summarizes the model predicted use of storage facilities under existing and future flow conditions and recognizes the overflow points eliminated.

Table 6-9, Model Predicted Use of Storage Facilities & Summary of Eliminated Overflow Points for the 10-year Flow Event under Existing and Future Conditions (2022)

Area	Storage Tank Use / Eliminated overflow locations
Polk Street Overflow & Manholes	**25%** of basin capacity (1.0 MG) for existing and future flows
LS45 - Dodge Street Overflow (City of Duluth Asset)	**20%** of basin capacity used for existing flow. **25%** of basin capacity future flows
Endion Overflow	**40%** of Phase 1 (1 MG used) and **35%** of Phase 2 (3 MG) used for existing and future conditions
Fitger's Overflow and East Interceptor Manholes	**15%** of Canal Park storage basin (8.3 MG) capacity used for existing conditions and future conditions
Gary Pump Station Storage Basin	**15%** of basin capacity (1.6 MG) used for existing and future flows
Pike Lake Interceptor	**< 5%** for existing conditions. **85%** of the basin is used for future flows. PL008 – PL017 have significant surcharge. PL008 and PL009 have been secured to keep flow in the pipe and preventoverflows
Rice Lake	Overflow eliminated from RL001 – RL014
Hermantown	Overflow eliminated from HT091-HT096
Esko Manhole	Overflow eliminated from E006
Cloquet, Division F Manholes	Overflow eliminated from F000_SC, F000_CQ
Woodland Manholes	Overflow eliminated from WL011 – WL012, WL056 – WL061, WL069 - WL073 WL089 - WL099

Available storage is described below and shown on the drawing in Appendix B (East and Lakeside Interceptors Storage Facilities Schematic).

- **East Interceptor / Fitger's Area**
  Historical overflows have occurred during wet weather events at manholes located at 3rd Avenue East and Superior and 5th Avenue East and Superior, next to the Fitger's Brewery Complex. An 8.3 million gallon storage tank (LS-6) was constructed at Canal Park by the City of Duluth to accommodate the overflow from Fitger's and manhole EA018.

- **Lakeside Interceptor/Endion Pump Station Area**
  A one million gallon storage tank (LS-50) was constructed at the Endion Pump Station in 2007. A three million gallon storage tank (LS-51) was constructed in 2011 and is located just upstream of the Endion Pump Station.

- **Polk Street Pump Stations**
  A one million gallon storage tank at the Polk Street Pump Station was completed in 2011. The pump station was rebuilt and sized with a firm capacity of 6.4 MGD.

- **Dodge Street Pump Station**
  A 1.9 million gallon storage tank (LS-45) was constructed in 2005 and is owned and operated by the City of Duluth. The City of Duluth increased pumping capacity in order to drain the storage basin faster

following use in order to optimize use during successive wet weather events. The pumps are controlled by the level in the upstream interceptor and in the downstream storage basins to prevent overflows.

- **Gary Pump Station**
  A 1.63 million gallon wastewater storage facility is available to attenuate peak flows from the Gary New-Duluth area.

- **Pike Lake Pump Station**
  A 179,000 gallon wastewater storage facility is used to attenuate peak flows from the Pike Lake Pump Station. Modifications were made to PL008 and PL009 manholes to prevent overflows from station surcharges due to high flows. These manholes were secured and bolted down in 2022.

- **Duluth North Shore Sanitary District (DNSSSD) Pump Station**
  A 300,000 gallon wastewater storage facility is used to attenuate peak flows from the Duluth North Shore Sanitary District Facility. The pump station stores flow based on the wet well level and flow at the Endion Pump Station.

- **Knife River/Larsmont Sanitary District (KRLSD) Pump Station**
  A 100,000 gallon wastewater storage facility is used to attenuate peak flows from the Knife River/Larsmont Sanitary District Pump Station. The pump station stores flow based on the wet well level and flow at the Endion Pump Station.

Section 6.3: Asset Management

6.3.1 : Pump Station Condition Assessment

A summary of the WLSSD pump stations, age, locations and classifications is shown in **Table 6-10**. Additional information such as capacity and power sources for each station can be found in Appendix C.

Table 6-10, WLSSD Pump Stations

Station	Address	Classification[1]	Year Constructed
Knowlton Creek	8500 Bayhill Dr., Duluth MN 55807	Major	1975; 2006 rehab.
Scanlon	3209 Hwy 61, Scanlon MN 55720	Major	1975; 2009 rehab.
Cloquet	2201 Ave. B, Cloquet MN 55720	Major	1976; 2019 rehab
Bristol Street	4920 Recycle Way, Duluth MN 55807	Major	1986; 2004 and 2022 rehab
Endion	505 S 18th Ave. E., Duluth MN 55812	Major	1988
Oneota Street	4826 Oneota St., Duluth MN 55807	Major	2008
Polk Street	110 Central Ave. S, Duluth MN 55807	Submersible	2011
Pike Lake	5489 Miller Trunk Hwy, Hermantown MN	Submersible	2001 (2011 storage added)
Gary	499 95th Ave. W, Gary MN 56545	Submersible	1975, 2010 rehab
Esko	52 West Riverside Rd., Esko MN 55733	Submersible	2016 2016
Ridgeview Road	4537 Ridgeview Rd., Duluth, MN 55803	Submersible	2008
Twin Lakes	1465 Komoko Rd., Twin Lakes Twp. MN 55718	Submersible	1993
Wrenshall	150 Pioneer Dr., Wrenshall MN 55797	Submersible	1995; 2017 rehab
Thomson	110 Vermillion St., Thomson MN 55718	Prefabricated	1975
Jay Cooke	709 Hwy 210, Carlton MN 55718	Prefabricated	1975
Carlton	305 N 6th St., Carlton MN 55718	Prefabricated	1975; rebuild scheduled- 2023
Railroad Street	1116 Railroad St., Duluth MN 55802	Minor	2005

[1] **Major** – total pumping capacity from 10.8 to 49 MGD; constructed during or after original WLSSD development in 1976; cast concrete wet well/dry well configurations and brick block or panel faced structures
Prefabricated – total pumping capacity ranges from 0.34 to 2.9 MGD; constructed during or after original collection system in 1976; pre-cast concrete wet well, fabricated steel dry well and precast concrete super-structure
Minor – total pumping capacity less than 10 MGD; original stations constructed prior to formation of sanitary district have been rehabilitated; cast concrete wet well/dry well configuration
Submersible – total pumping capacity ranges from 0.34 to 6.4 MGD; Constructed over last 10-25 years; precast wet wells and meter vaults.

In 2021 and 2022, Lake Superior Consulting (LSC) performed condition assessments of the Bristol Street, Cloquet, Scanlon and Knowlton Creek pump stations. Included in this analysis were recommendations for the HVAC systems in each station. The HVAC systems were evaluated for the safety of personnel and corrosive conditions that could affect building integrity in the future. The full reports can be found in Appendix H and are summarized below:

- **<u>Bristol Street Pump Station</u>** – WLSSD's second largest industrial customer, Verso, stopped making paper in July 2020 and the paper mill was sold in 2021. A full station inspection, including the inside of the wet well was completed and a pump station rehabilitation project was recommended. In 2022, structural repairs, concrete rehabilitation, and a new wet well coating system were completed. The roof and doors were replaced. HVAC improvements recommended increasing air exchanges in below grade dry well. Because of the changes in code requirements, upgrades are likely to include the need for heated make-up air. Once the new Duluth mill is in operation, testing will be completed to determine if the existing exhaust fans in both the wet and dry sides can be run continually without risk of freezing equipment in the winter. Air balancing is also recommended to determine current performance of all the supply and exhaust fans.

- **Cloquet Pump Station** - In 2017, a structural assessment was completed by Lake Superior Consulting to assess cracking of masonry walls, breakout of concrete masonry units from the walls, exposed steel member corrosion, coating failures and cracking of cast in place concrete. Structural improvements were recommended and updates were completed in 2019. The wet well exhaust fan was replaced in order to maintain adequate ventilation in the wet well.

- **Scanlon Pump Station** - After realizing the significance of concrete and steel degradation found at the Cloquet Pump Station, an inspection was completed by WLSSD in 2020. The building structure and wet well integrity was compromised by corrosion and visible degradation of the structure was noted. It was recommended destructive testing be done on the building steel columns and beams and a plan developed for maintenance of the concrete, brick surfaces and roof systems.

  In 2021, Lake Superior Consulting was hired to complete a structural assessment of the masonry and structural steel at the station. The exterior envelope, roof, interior steel and concrete were inspected. A general review was completed for the below grade portions of the structure and pipe supports. In addition, LSC conducted visual inspections of the adjacent maintenance wing building and storage building located on the Scanlon Pump Station site. LSC subcontracted a general contractor to remove select portions of the concrete block to expose portions of embedded structural steel framing and lintels in order to determine the extent of corrosion, delamination and section loss in the structural steel framing.

  A number of structural deficiencies were found. It is recommended portions of the masonry building be reconstructed due to the deterioration of concrete and steel. Recommended improvements include reconstructing and rehabilitating portions of the masonry building and installing of a new coating system on the ceiling, walls and structural steel. Wet well coating is warranted to prevent additional corrosion of the concrete surfaces. The coating systems will minimize infiltration of moisture into the masonry walls and steel framing/rebar. Other maintenance and roof repairs are also advised. It is recommended the wet well ventilation system be reviewed and updated to lower the humidity levels and prevent additional corrosion. Budgetary costs are estimated at $1,625,100. HVAC updates are not included in this cost estimate.

  A preliminary HVAC analysis was completed in 2021 by LSC. It was recommended to continuously run an additional dry well exhaust fan in order to increase the total number of continuous air exchanges for the below grade space. This will likely require an additional heat source be incorporated in the station. The wet well meets NFPA 820 requirements. It was recommended additional testing be completed on the wet well side to determine if upsizing the exhaust fan will result in the need for heated make up air. A supply fan may be required if any upgrades to the system are completed.

- **Knowlton Creek Pump Station** - After realizing the significance of concrete and steel degradation found at the Cloquet Pump Station, an inspection of the Knowlton Creek Pump Station was completed by WLSSD in 2020. Visible degradation of the structure was noted. The grating in the wet well was significantly deteriorated and in need of replacement. It was recommended destructive testing be done on the building steel columns and beams and a plan developed for maintenance of the concrete, brick surfaces and roof systems.

In 2021, Lake Superior Consulting completed a condition assessment of the Knowlton Creek Pump Station. The exterior and roof, interior steel and concrete were inspected. A number of structural deficiencies were found. Recommended improvements include reconstructing and rehabilitating portions of the masonry building and installing of a new coating system on the ceiling, walls and structural steel. Wet well coating is needed to prevent additional corrosion of the concrete surfaces. The coating systems will minimize infiltration of moisture into the masonry walls and steel framing/rebar. Other maintenance and roof repairs are also advised. It is recommended the wet well ventilation system be reviewed and updated to lower the humidity levels and prevent additional corrosion. Budgetary costs are estimated at $782,550. HVAC updates are not included in this cost estimate.

A preliminary HVAC analysis was completed in 2022 by LSC. It was recommended to continuously run an additional dry well exhaust fan in order to increase the total number of continuous air exchanges for the below grade space. This will likely require an additional heat source be incorporated in the station. The wet well meets NFPA 820 requirements. It was recommended additional analysis be completed on the wet well side to determine if upsizing the exhaust fan will result in the need for heated make up air. A supply fan may be required if any upgrades to the system are completed. It was recommended to continuously run an additional dry well exhaust fan in order to increase the total number of continuous air exchanges for the below grade space. This will likely require an additional heat source be incorporated in the station.

- **Endion Pump Station** - An initial condition assessment of the Endion Pump Station was also completed in 2020. Recommendations include further plans for maintenance of the building envelope including concrete, doors and louvers.

- **Miscellaneous Pump Stations** - The condition of each of the WLSSD pump stations were evaluated and discussed with collection operations, maintenance and electrical personnel to determine capital needs. These workshops resulted in Appendix D and E attached to this report. Appendix D details notable improvements completed since 2015 to debris handling, pumping, mechanical, electrical, technology, odor and safety at each of the pump stations. In addition to this list, numerous additional preventative maintenance activities are ongoing at each of the pump stations. Appendix E lists recommendations for improvements to be performed or evaluated at each of the WLSSD Pump Stations.

- **Prefabricated Pump Stations** - In 2006, a condition assessment and capital improvement planning for the prefabricated pump stations by Brown and Caldwell resulted in a number of recommendations. All have been implemented except for replacement of the Jay Cooke Pump Station. This delay is possible due to the decreased flow resulting from the removal of pipe after the June 2012 flood, as well as additional safety measures to address confined space entries and fall protection at the station. The Thomson pump station should be further evaluated to determine its remaining life expectancy.

6.3.2 : Pump Stations - Improvements

Significant pump station improvements completed since the 2016 Comprehensive Plan include:

- **Wrenshall and Silverbrook Pump Stations**
  In 2016, the Wrenshall Pump Station was upgraded and the Silverbook Pump Station was eliminated. The upgrade consisted of new pumps, controls and flow measurement.

- **Esko Pump Station**
  In 2017, the Esko Pump Station was replaced with a new submersible station with approximately two-hours of storage capacity in the wet well.

- **Cloquet Pump Station Structural Rehabilitation and Wet Well HVAC**
  The Cloquet Pump Station upper wet well structure was rebuilt in 2019 after discovering numerous structural deficiencies. Three structural exterior walls were replaced; the interior wet well upper walls and supports were repaired; lintels were replaced, columns and beams were reinforced; all wet well walls, floors and ceiling were coated with a corrosion protective coating; additional roof bracing was installed and wet well grating was replaced. The wet well HVAC was improved by adding a continuous exhaust fan and VFD. Humidity control in the station wet well is greatly improved. The deficiencies discovered led to a destructive inspection of the Knowlton and Scanlon pump stations by LSC in 2021 (Appendix H).

- **Scanlon and Knowlton Creek Pump Station Wet Well Grating and Lifting Beam Improvements**
  The grating in the wet wells at the Scanlon and Knowlton Creek pump stations was replaced and the supporting structures were reinforced. Lifting beams were installed at both stations to aid in maintenance activities. Safety fall protection was installed.

- **Bristol Street Pump Station Rehabilitation**
  Once the closed Verso Paper Mill was purchased and a reopening announced, WLSSD completed a rehabilitation project as recommended in the 2021 inspection. The project included a full structural rehabilitation of the wet well including a full coating system. Portions of the dry well were improved and a new roof was installed in 2022. The degradation of the concrete inside the wet well was significant and additional rebar reinforcement was required to maintain the structural integrity.

- **Gary and Pike Lake Pump Stations**
  The Pike Lake Pump Station pumps were replaced and new pumps and VFD's were installed at the Gary Pump Station in 2019.

- **Odor Control at Scanlon and Knowlton Creek Pump Stations**
  The primary and secondary biofilters at Scanlon and Knowlton Creek pump stations were rehabilitated and BacTee air dispersion systems, new HDPE lining and new media were installed between 2015 and 2022.

- **Scanlon Hauled Waste Receiving Station**
  A new hauled waste receiving station was installed at the Scanlon Pump Station in 2019 to provide a site for septic and leachate haulers to discharge.

- **Pike Lake and Ridgeview Road Pump Station Generators**
  New generators were installed at the Pike Lake and Ridgeview Road pump stations in 2022.

6.3.3 : Pump Stations - Key Recommendations

The most significant recommendations resulting from the updated Pump Station Condition Assessment are listed below and can be found in Appendices E and H:

- Complete evaluation of HVAC at Scanlon, Knowlton and Bristol pump stations and upgrade systems to meet safety requirements and to protect from corrosion.
- Reconstruct and rehabilitate portions of the masonry building and install a new coating system on the ceiling, walls and structural steel at Knowlton Creek and Scanlon Pump Stations.
- Evaluate Knowlton Creek and Scanlon pump station wet well structures for possible coating system repair and structural updates.
- Maintain the Endion Pump Station building envelope including concrete, doors and louvers.
- Evaluate electrical infrastructure at Cloquet, Knowlton, Scanlon and Bristol Street pump stations and develop schedule for motor rebuilds, VFD backup and possible station replacement.
- Evaluate risk of equipment failure at pump stations.
- Replace entry doors on the Railroad Street and Endion Pump Stations.
- Paint existing generators at Polk, Bristol Street, and Twin Lakes.
- Investigate operational status of suction and discharge valves.
- Evaluate cathodic protection at the Thomson pump station to ensure continued protection. Evaluate the station for long-term capital improvements.
- The Jay Cooke pump station was construction in 1975 to serve the Jay Cooke State Park. In 2013, the sewer service that served the Oldenburg Point area of the Park was abandoned and replaced with an on-site septic system. Evaluate flows for possible removal of pump station and forcemain with replacement of an onsite treatment system.

Additional recommendations for maintenance, operational improvement and smaller capital improvement projects are discussed and outlined in Appendix E.

6.3.4 : Gravity Interceptor - Condition Assessment

A summary of the WLSSD interceptors, age, locations and materials can be found in the Asset Management Program in Appendix F.

The Interceptor Asset Management Program developed by Camp, Dresser and McKee in 2008 and described in detail in previous comprehensive master plans continues to be utilized to assess the condition of the gravity interceptors and to develop capital improvement and maintenance plans. In 2019, WLSSD purchased closed circuit television inspection system (CCTV) and GraniteNet software to self-perform inspections of the gravity system using staff certified by the Pipeline Assessment and Certification Program (PACP). The Pipeline Assessment and Certification Program (PACP) coding standardizes the CCTV inspections and thus allows for a rating to be assigned to each defect. Both structural defects and operation/maintenance issues can be observed and graded based on severity. The quantity and percent of pipe affected by each PACP-rated defect can be tabulated using the software.

Maintenance and capital improvement needs are prioritized in WLSSD's computerized asset management system using a matrix of condition and criticality scores. The tools allow for the development of alternatives and prioritization of rehabilitation or replacement projects for the collection system. The asset management system assists WLSSD to effectively and efficiently prioritize maintenance, rehabilitation or replacement work in the collection system. The IAMP Decision Tools were updated in 2021 to incorporation new PACP standards (Version 7) and GraniteNet software updates. Base files were also updated associated with the hydraulic model update and geodatabase files (ArcGIS updates).

The approach summarized above, enables WLSSD to perform a comprehensive interceptor assessment and evaluation, from which it can develop a 10-year CIP that is based on a detailed review and analysis of each interceptor's condition and criticality.

In summary, the following components are used in the Interceptor Asset Management Program to develop the Capital Improvement Program (CIP):

1. **Criticality** – Each pipe segment is issued a value for criticality based on the severity or consequence of failure. Categories of assessment include public safety, financial impact, human and environmental exposure, proximity to sensitive waters and impact to service. An overall criticality score is assigned to each pipe segment based on present parameters and scoring.

2. **Condition** – The physical condition of each pipe is inspected using CCTV and each segment is coded using the PACP coding method. Each defect is scored based on the severity and each pipe is assigned a condition score based on the most severe defect present.

3. **Condition/Criticality Matrix** – A matrix of condition and criticality scores is developed which highlights pipes that may require additional capital improvements or maintenance actions.

4. **Other data** – Other data such as odor reports, access issues, Level of Service adequacy and surcharging are reviewed.

5. **Project Development** – Projects are developed using the condition, criticality scores, matrix rating and other data. Once summarized, the pipes are assigned a recommended type of repair, based on the defects. Then they are evaluated on an interceptor-by-interceptor basis. Capital projects are developed based on condition, criticality, type of project and proximity to other defected pipes.

6. **Prioritize Projects** – Projects are prioritized based on defects, condition, criticality, and other data.

7. **Project Costs** – Project costs are developed for each capital project, based on estimates developed using actual construction cost information.

8. **Develop a CIP** – The data is used to develop the 10-year CIP.

6.3.5 : Gravity Interceptor Improvements

Significant interceptor improvements completed since the 2016 Comprehensive Plan are summarized in **Table 6-11** and include:

- Replacement of 2,550 feet of Hermantown Interceptor HT104-97
- Cured in place pipe (CIPP) lining of HT084 and HT044
- CIPP lining of EA019
- CIPP lining of Cloquet (F047, F043, 2019) (232 feet at Cloquet Pump Station 2022)
- CIPP lining as part of USACO LS034, LS028
- CIPP lining LS001 to LS015
- CIPP lining of Rice Lake Interceptor RL001-RL015
- Replacement of broken fiberglass reinforced pipe on Scanlon Interceptor
- CIPP lining of FRP pipe on Scanlon Interceptor
- Steelton Hill manhole abandonment on Scanlon Interceptor
- Manhole rehabilitation of WL070, WL069 and WL067 and LS001 to LS014
- Repair of WL014 by CIPP lining
- CIPP Lining of Woodland Interceptor WL088-WL086; WL083, WL079-WL076; WL074-WL066, WL060, WL058-WL054 WLE048, WL042, WL014
- CIPP lining of West Interceptor condition issues – WE039, WE011

Table 6-11, WLSSD Interceptor Improvement Details (2016-2022)

Interceptor	Pipe ID	Pipe Size (inches)	Length (feet)	Rehab type	Year
Cloquet	F022d to Cloquet PS	27-54	232	CIPP (Manholes FRP panels and liners)	2022
Cloquet	F047; F043 F051	18-27	996	CIPP liner (F056 grouted)	2019
East	EA020 to EA017	36-48	1,230	CIPP	2016
Hermantown	HT104-HT097	18	2,549	Replaced and upsized to 24" PVC	2021
Hermantown	HT084 HT044	18 15	430 235	CIPP lined	2020
Hermantown	HT089, HT088a	18	137	Replaced and upsized to 24" PVC	2020
Lakeside	LS015 to LS001	30	4,451	CIPP; manholes rehabbed with Monoform	2020
Lakeside	LS035-LS034	36	861	CIPP - USACOE	2017
Rice Lake	RL015-RL001	15	3,823	CIPP lined	2019
Scanlon	D147-D137	42	5,432	CIPP lined	2018
Scanlon	D068-D054	36-42	5,615	CIPP lined; replacement; MH replacement and liners	2018
West	WE039 WE011	36 36	211 119	CIPP lined	2019
Woodland	WL014	21	163	CIPP lined	2017
Woodland	WL088-WL086; WL083, WL079-WL076; WL074-WL066, WL060, WL058-WL054 WLE048, WL042	18-30	3,848	CIPP lined	2019
Total	**20,175 Linear Feet Replaced or Rehabilitated**				

6.3.6 : Gravity Interceptor – Key Recommendations

The Interceptor Asset Management Plan (IAMP), dated October 2022 contains the 2023-2032 Capital Improvement Program. This document contains information on program development, cost estimate assumptions, asset management programs and supporting documentation. Each year, the plans are updated and adjusted based on changes in condition, criticality, budgets and schedules. It is the intent that the summary document is updated in its entirety with every Comprehensive Plan update, approximately every 5 years.

The IAMP and current ten-year Capital Improvement Program (CIP) are located in Appendices F and G. Planning-level costs for the CIP indicate a ten-year cost of $65,742,000 with annual expenditures averaging $6,574,000.

Key recommendations for management of the WLSSD interceptors include the following:

- Continue routine inspections of gravity interceptors and manholes.
- Maintain the Interceptor Asset Management Program and associated manuals, on an ongoing basis, in order to develop the annual budget for capital projects and operation and maintenance.
- Complete gravity interceptor rehabilitation and replacement projects in accordance with the asset management program (IAMP) and as outlined in the Capital Improvement Plan (CIP).
- Implement interceptor maintenance program to televise and clean pipes as outlined in the CIP and IMP in Appendix G.
- Maintain WLSSD's collection system GIS and Drawing Management Systems.

6.3.7 : Forcemain – Condition Assessment

WLSSD owns and maintains approximately 33 miles of forcemain pipe ranging in size from 6 to 54 inches. While gravity pipe can be televised using closed circuit televising (CCTV), inspection of forcemains is difficult due to their design, use and available technologies. Non-destructive testing methods have been used at WLSSD air release valves to measure the thickness and condition of the pipe along the Endion, Scanlon and Knowlton Creek forcemains. These locations provide access points to the pipe at high points in the forcemain, which are more susceptible to corrosion and condition concerns.

The majority of WLSSD's forcemains are considered small diameter and range from 6 to 24 inches. WLSSD maintains clamps to repair small holes in all sizes of its forcemains. The pump stations upstream of the small forcemains can divert flow to haulers or storage while the forcemains are repaired. Small forcemains are typically repaired within 12 hours. Large forcemains range from 30 to 54 inch on the Knowlton Creek and Scanlon Interceptors. The large forcemains require many more resources and specialized equipment to repair. Because of the critical nature of these lines, they are evaluated further to determine corrosion, etc.

An Emergency Response and Repair Guidance document was developed for any event where a pipe is compromised and repair is needed in the collection system. This document contains forcemain asset background, break history, notification procedures, emergency response guidance, repair guidance and resources available in the event of an emergency.

Large pressure variations within the forcemains can occur during typical operations, and rare events such as a full power outage. A transient analysis computer model estimates pressures in the existing forcemain under extreme conditions in order to determine areas susceptible to damage. This analysis allows for further prioritization and planning for our forcemain capital programming.

In 2019, the Scanlon, Knowlton Creek and Carlton forcemains were evaluated using transient analysis. These forcemains represent approximately 1/3 of the system. The Scanlon and Knowlton Creek forcemains are critical to operation and contain approximately half the flow to the plant. The Carlton Forcemain is a start-stop pump station and serves many small communities in the western portion of the District's system. Different operational scenarios have been evaluated to determine areas of increased pressure and water hammer that could be detrimental to the forcemain. The project identified areas of increased corrosion potential due to air pockets or turbulence within the pipe.

In addition, the District's Interceptor Asset Management Program (IAMP) contains an appendix dedicated to Forcemains. A number of inspections have been completed throughout the forcemain system since the development of the IAMP and are summarized below and in Appendix I:

- **Scanlon and Endion FM Inspection, 2013**
  Inspections of the Scanlon and Endion forcemains were performed in 2013 by AMI Consulting Engineers (AMI). Seven test locations were evaluated and excessive cracking, pitting or corrosion were not observed.

- **Scanlon River Crossing Inspection, 2014**
  A scour protection inspection of the dual forcemain crossing the St. Louis River in Scanlon was performed in 2014 by AMI. Scour protection along the length of the crossing appears to be present. There was no significant difference in elevation noted from the as built drawings along the centerline of the pipe.

- **Scanlon River Crossing Connection Repair, 2015**
  In 2015, S.O.S. Industrial Services installed two 30 inch clamps filled with epoxy in order to secure two tapped connections in the river crossing valves. These connections were originally installed to pressure test the pipe during installation.

- **Knowlton Creek FM Inspection, 2016**
  In 2016, non-destructive testing was completed along the Knowlton Creek Forcemain by AMI. No surface discontinuities were noted from magnetic particle tests. The pipe at the excavations was found to be in very good condition with only 0-1.2 mils of thickness loss observed. C001, C009 and C010 air release assemblies were noted to have damaged saddles.

- **Knowlton Creek FM Inspection, 2019**
  Additional non-destructive testing was completed at C001 to C004, C007 and C009 to C012 by AMI in 2019. Corrosion was noted on the pipe and saddles, particularly at the crown of pipe, within 6 inches of sidewall penetrations and within 6 inches of saddle straps. C001 had pack rust suspected of deforming saddle bolts. C002 had heavily corroded bolts on the valve and heavy corrosion on valve base. C007 was noted to be welded directly onto pipe. C009, C011 and C012 had spalling and cracks in grout noted.

- **Knowlton Creek FM Inspection, 2020**
  In 2020, Precision Engineering Solutions was hired to provide additional assessment of the Knowlton Creek Forcemain from C001 to C012. This assessment was to determine the minimum thickness and document corrosion rates to determine remaining service life of pipe. Existing data and information was

used to establish a monitoring program to continue pipe inspection and thickness testing program. Corrective actions and costs were evaluated and recommendations were made to reduce corrosion. Six mitigation options were presented.

- **Transient Analysis Model - Knowlton Creel, Scanlon and Carlton FM, 2019-2020**
  HR Green measured actual working conditions at Knowlton Creek, Scanlon and Carlton pump stations to calibrate transient analysis model (KY Pipe). Areas of increased pressure, water hammer and corrosion potential were identified. HR Green evaluated additional air release valve locations, orifice sizes, check valve modifications, start up\shut down control of pumps or surge relief valve adjustments. Recommendations were developed for each station based on the results and evaluation of existing equipment.

- **Syrinix Transient Pressure monitoring, 2020/2021**
  Two Syrinix PIPEMINDER-C transient monitors were purchased to continually measure transient pressures in WLSSD forcemains. It was determined normal operating conditions line up well with what the KYPIPE transient model showed. The following observations were noted:
  - Multiple main power outage events were captured at the Scanlon Pump Station, which showed very high-pressure transients in the system. This resulted in the local utility replacing power feeds to the station.
  - The Syrinix data and model results were used to confirm limited air transfer into and out of Air Release Valve (ARV) C007. The valve was not providing significant air transfer or pressure abatement within the forcemain and was eliminated from the system in 2022.
  - The Carlton forcemain was evaluated under vented and unvented air release valve vault conditions. It was determined under vented conditions, the system pressure actually increases, which was not in line with the model. The new pump station was designed with a surge tank to reduce the transients in this line and protect against the increased pressures.

6.3.8 : Forcemain Improvements

Significant forcemain improvements completed since the 2016 Comprehensive Plan include the following:

- In 2019 and 2020, the ballast rock used to support the pipe was removed in all Knowlton Creek and Scanlon air release valve vaults. Previous inspections noted water accumulation against the pipe in this area, which was increasing corrosion. Removal of this ballast also allows additional thickness measurements at the rock interface and toward the pipe invert.

- In 2020, access was improved by adding gravel pads and improving drainage at air release valves E009 (Maki Road) and E008 (Bruce Circle). Corrosion was observed in both vaults on the knife gate valves, which were installed in 2012. In 2022, the knife gate valves inside the structures were protected by coating the valve bodies and installing Trenton primer, wax tape and poly-ply topcoat.

- In 2022, three air release valve vaults were removed on the Knowlton Creek Forcemain (C007, C002 and C001). ARV C007 was analyzed using the transient model, field observation and a syrinix unit and it was determined the valve is not necessary for operation of the system. This valve was removed and not replaced. C002 and C001 contained corroded valves and pipe within the vault. These were replaced with new vault structures and valve assemblies. A cathodic protection system was installed to maintain the integrity at the air release vaults.

The pipe corrosion was most significant in the location of the former ballast rock located at the pipe invert. In addition, the pipe was also corroded at the doghouse connection where water was infiltrating. The forcemain pipe was in excellent condition at each of the 18 pipe penetrations for the flow diversion system, as well as the areas where the pipe was replaced.

- In 2022, Thomson Township discovered a plugged sewer main, which was located below the WLSSD Scanlon Forcemain in a busy intersection. The forcemain was exposed and inspected. Areas of corrosion were noted upon inspection. The exposed forcemain was sand blasted and coated with epoxy. As an additional precaution, a sleeve was installed over the corroded area.

- Wrenshall – In 2022, 500 feet of 6 inch Wrenshall Forcemain and two associated air release valve vaults and assemblies were replaced as part of a MN DNR project along the adjacent trail.

6.3.9 : Forcemains – Key Recommendations

Key recommendations for management of the WLSSD forcemains include the following:

- Complete the Knowlton Creek air release valve (ARV) improvement plan:
    - Inspect remaining ARVs using information obtained in the 2022 project
    - Replace saddles and base section of valve stems at C003, C004, C009 and C010
    - Install cathodic protection (sacrificial anodes) at vaults
    - Seal vaults from water infiltration
    - Replace air release vaults C012, C011, C008
    - Consider adding a vault and additional air release valve downstream of the Knowlton Creek Pump Station to reduce pressure transients

- Address the Scanlon River Crossing dual forcemain:
    - Complete a bathymetric survey of the St. Louis River bottom
    - Monitor erosion of the St. Louis River bank for additional erosion
    - Evaluate options to repair valves in place
    - Evaluate valve replacement with hot tap and flow diversion

- Update the Interceptor Asset Management Plan and Emergency Response and Repair Guidance Document annually.

- Monitor forcemain breaks on Wrenshall and Thomson and determine long term capital plan for replacement

- Improve access to forcemain easement areas:
    - Improve end of driveway to C009 by adding additional gravel
    - Access improvements to C004 for access during spring or wet conditions by improving gravel base

6.3.10 : Manhole Improvements and Recommendations

The asset management program routinely inspects manholes for their condition. Manhole data will be used to prioritize rehabilitation activities. Manhole inspections and improvements completed since the 2016 Comprehensive Plan include:

- Lakeside Interceptor manholes LS001 to LS014 were rehabilitated using the HK Monoform system in 2021.
- Three Woodland Interceptor manholes were rehabilitated using the HK Monoform system in 2019.

Manhole recommendations include:

- Further develop WLSSD's manhole rehabilitation program. Currently $100,000 in improvements every other year is anticipated.
- Maintain budget for emergency repairs and long-term rehab of manholes.
- Incorporate manhole improvements as part of rehabilitation projects.

6.3.11 : Metering/Sampling Station Improvements and Recommendations

Metering and sampling station improvements completed and recommended include:

- The Village of Oliver Metering Station was improved in 2021. A new flow meter, forcemain isolation valve and new piping were installed and will be maintained by WLSSD.
- The Proctor Metering Station was impacted by a vehicular accident in 2022 and was severely damaged. Replacement should be completed by the end of 2022.
- The Cloquet flow metering structure is being rehabilitated as part of the Cloquet rehabilitation project and should be completed by 2023.
- A project to add a sampling building is underway to provide for independent sampling of industrial flow at the Cloquet Pump Station (2023 completion expected).
- The Cloquet pump station flow meter is scheduled for replacement in 2023.
- An independent sampling station should be considered to serve the USG plant.

Section 6.4: Capital Improvement Program

Capital improvement recommendations for pump stations, gravity interceptors, forcemains, manholes and metering/sampling stations are summarized in **Tables 6-12 through 6-14** on the following pages. These tables detail the costs and implementation timelines for the 10-year capital planning period. These tables are used to develop and maintain the District's annual 10-year Capital Improvement Plan.

Table 6-12, 10-year Capital Improvement Plan for Pump Stations, Metering and Sampling Facilities (2022 Dollars)

Project	Estimated Capital Cost	Implementation Year
Knowlton Creek Pump Station		
Biofilter Drain Replacement	$ 50,000	2023
Design Upgrades (Mechanical/Electrical Review)	$ 500,000	2024
* HVAC Evaluation and Upgrades	$ 200,000	2024
* Structural Rehab	$ 785,000	2026
* Wet Well Coating System	$ 2,000,000	2026
Scanlon Pump Station		
Facilities Plan/Detailed Inspection	$ 500,000	2026
Design Upgrades (Mechanicall/Electrical Review)	$ 500,000	2024
* HVAC Evaluation and Upgrades	$ 200,000	2024
* Structural Rehab	$ 1,625,100	2025
* Wet Well Coating System	$ 2,000,000	2025
Cloquet Pump Station		
Flow Meter Replacement	$ 100,000	2023
Bristol Street Pump Station		
* HVAC Evaluation and Upgrades	$ 200,000	2024
Jay Cooke Pump Station		
* Evaluation of Options	$ 50,000	2024
* Replace Pump Station or Install Onsite System	$ 1,245,000	2026
Pike Lake Pump Station		
* Pike Lake Capacity Evaluation	$ 60,000	2024
Carlton Pump Station		
Replace Pump Station	$ 6,600,000	2023
Endion Pump Station		
* Building Envelope Maintenance	$ 70,000	2025
Miscellaneous Pump Stations		
* Risk Analysis – spare parts, VFDs	$ 200,000	2024
* USG Sampling Station	$ 100,000	2024
Total Estimated Costs	**$ 16,985,100**	

*Project not currently funded in 10-year CIP

- **Knowlton Creek and Scanlon Pump Stations**
  Major rehabilitation is needed at the Scanlon and Knowlton Creek pump stations. An evaluation of the mechanical and electrical systems must be done in order to determine a cost benefit analysis of reconstruction and rehabilitation. The amounts included in the Capital Improvement Plan are for rehabilitation of the structural envelope and coatings at the station. It is possible this analysis could result in reconstruction rather than individual rehabilitation projects.

- **Jay Cooke Pump Station**
  The Jay Cooke Pump Station was scheduled for replacement in 2021 with a submersible pumping station. It is recommended an evaluation take place to determine a long-term capital plan for the pump station and forcemain. Development of a plan to either replace the station or construct other sanitary sewage treatment options to serve the Jay Cooke State Park is warranted.

- **Pike Lake Pump Station**
  As mentioned previously, the Pike Lake Pump Station is limited by the capacity of the forcemain. It is recommended an evaluation take place to determine a long-term capital plan for the pump station and forcemain.

- **Carlton Pump Station**
  A new pump station is under construction and should be in operation toward the end of 2023.

- **Endion Pump Station**
  The Endion Pump Station requires updates to the exterior masonry and building envelope.

- **Miscellaneous**
  A risk analysis to assess available parts and components and impacts to operations is planned for all the pump stations.

- **Metering and Sampling Station Improvements**
  The sampling station building used for the USG facility should be rehabilitated or replaced.

Table 6-13, 10-year Capital Improvement Plan for Gravity Interceptors (2022 Dollars)

Project	Estimated Capital Cost	Implementation
Bayview Heights Interceptor		
*Pipe Crossing Inspection	$ 100,000	2025
Cloquet Interceptor		
*CIPP Lining, Point Repairs	$ 751,000	2030
East Interceptor		
CIPP line Fitger's	$ 1,900,000	2026
***Hermantown Interceptor**		
Design Pipe Replacement	$ 3,100,000	2025
*Replace Pipes, Phase 1: HT096-HT070	$ 5,400,000	2027
*Replace Pipes, Phase 2: HT069-HT040	$ 7,900,000	2029
*Replace Pipes, Phase 3: HT038-HT021	$ 3,500,000	2031
*Replace Pipes, Phase 4: HT020-HT00C	$ 3,900,000	2032
Jay Cooke Interceptor		
*Point Repairs H027, H024	$ 100,000	2029
Lakeside Interceptor		
LS015 to Endion PS	$ 3,715,000	2024
***Nopeming Interceptor**		
Point Repairs K008, K004; replace K002	$ 230,000	2030
Proctor Interceptor		
Replace PR016-PR013; Replace PR020-PR005	$ 870,000 $ 2,790,000	2025 2028
***Railroad Street Interceptor**		
Replace RR003 - R001	$ 500,000	2025
Scanlon Interceptor		
Design Pipe Rehabilitation – All Phases	$ 2,154,000	2024
Phase 5: CIPP D047-D031	$ 4,550,000	2028
Phase 6: CIPP D030-D018	$ 4,420,000	2027
Phase 7: CIPP D017-D001	$ 5,446,000	2026
Silver Brook Interceptor		
*Point Repair H003; Replace H004 Complete with City of Carlton road replacement)	$ 700,000	2025/2026
West Interceptor		
*WE036-WE007	$ 3,640,000	2030
Woodland Interceptor		
CIPP line WL086-WL015	$1,120,000	2024
CIPP line WL036-WL023	$ 890,000	2025
Total Estimated Costs	**$ 57,676,000**	

*Project not currently funded in 10-year CIP

- **Bayview Heights Interceptor**
  The Bayview Heights Interceptor crosses Keene Creek on a steel bridge that houses the gravity sewer and City of Duluth water main. The structure has corroded and an inspection is warranted. This project is scheduled for 2025 and will cost approximately $100,000.

- **Cloquet Interceptor**
  The Cloquet Interceptor contains cracks and infiltration requiring repair in multiple pipeline sections. Cured in place pipe (CIPP) lining and point repairs will be done to correct the pipe defects. This project is scheduled for 2030 and will cost approximately $751,000.

- **East Interceptor**
  The East Interceptor requires routine cleaning to remove roots and debris. CIPP lining and point repairs will be done to correct the pipe defects. This project is scheduled for 2026 and will cost approximately $1.9 million.

- **Hermantown Interceptor**
  The Hermantown Interceptor has hydraulic capacity and condition concerns throughout the entire length. It serves a growing area of the District and requires upsizing in order to meet level of service into the future. A preliminary design is scheduled for 2025. The project will consist of four phases and would look at replacing the entire interceptor. The entire cost of the project will be approximately $24.0 million.

- **Jay Cooke Interceptor**
  The Jay Cooke Interceptor contains infiltration requiring repairs. Evaluation of the long-term feasibility to retaining service to the Jay Cooke State Park should be done prior to repairing the pipe. If repairs proceed, this will cost approximately $100,000.

- **Lakeside Interceptor**
  The Lakeside Interceptor contains root intrusions and infiltration requiring repair. The Minnesota Department of Transportation is rebuilding a portion of London Road (HWY 61) in 2025. A CIPP lining project will be done to correct the pipe defects prior to road reconstruction project. This project is scheduled for 2024 and will cost approximately $3.72 million.

- **Nopeming Interceptor**
  The Nopeming Interceptor contains a deformed, broken pipe and infiltration requiring repair. Pipe replacement and point repairs will be done to correct the pipe defects. This project is tentatively scheduled for 2030 and will cost approximately $230,000.

- **Proctor Interceptor**
  The Proctor Interceptor has hydraulic capacity issues requiring replacement of pipe segments PR015 to PR006 with larger diameter pipe to meet capacity needs and level of service. This project is scheduled for 2025-2028 and will cost approximately $3.7 million.

- **Railroad Street Interceptor**
  The Railroad Street Interceptor contains a section of deformed and sagged pipe requiring repairs. Replacement of the pipe will be scheduled when plans for the use of the former Georgia Pacific plant are anticipated. This project is tentatively scheduled for 2025 and will cost approximately $500,000.

- **Scanlon Interceptor**
  The Scanlon Interceptor has weld failures at many of its pipe joints, which result in lining failure and reduced pipe wall thickness due to corrosion. CIPP lining will be done to correct the pipe defects. Three more phases of rehabilitation exist with Phases 5-7 planned between 2026 and 2028. The remaining cost will be approximately $16.6 million.

- **Silver Brook Interceptor**
  The Silver Brook Interceptor contains an offset joint and infiltration runner requiring repair. Pipe replacement is scheduled to be completed in 2025 in coordination with the City of Carlton 6th Street reconstruction and will cost approximately $700,000.

- **West Interceptor**
  The West Interceptor contains a number of pipe defects and infiltration requiring repair. CIPP repairs are scheduled for 2030 at a cost of $3.6 million.

- **Woodland Interceptor**
  The Woodland Interceptor contains pipe defects and infiltration requiring repair. CIPP lining and possibly upsizing will be done to correct the pipe defects. This project is scheduled for 2024-2025 and will cost approximately $2,010,000.

Table 6-14, 10-year Capital Improvement Plan for Forcemains (2022 Dollars)

Project	Estimated Capital Cost	Implementation
Jay Cooke Interceptor		
* Evaluate Removal of Forcemain and installation of onsite treatment	$ 50,000	2024
Scanlon Forcemain		
River Crossing Valve Evaluation/Replacement	$ 500,000	2024
Knowlton Creek		
Replace C003, C004, C009 and C010	$5,000,000	2026
Replace C008, C011, C012	$3,000,000	2025
Total Estimated Costs	**$ 8,550,000**	

*Project not currently funded in 10-year CIP

- **Jay Cooke Forcemain**
  The Jay Cooke forcemain will be evaluated with the pump station and gravity lines to determine whether the station warrants replacement or if other sanitary sewage treatment options exist to serve the Jay Cooke State Park.

- **Scanlon Forcemain**
  The Scanlon Forcemain located across the St. Louis River is original pipe from the late 1970's. Continued evaluation of options for replacement are needed and funding is planned for 2024 to continue the inspection and assessment activities in order to determine a timeline for replacement or rehabilitation.

- **Knowlton Creek Forcemain**
  The Knowlton Creek forcemain air release valve vaults and associated piping and assemblies are planned to be replaced between 2025-2026.

- **Manhole Improvements**
  The asset management program routinely inspects manholes for their condition. Manhole data will be used to prioritize rehabilitation activities. A budget of $100,000 every other year is planned to address manhole rehabilitation.

Section 6.5: Plan to Maintain System Capacity

The capacity analysis performed by Brown and Caldwell as part of updating the hydraulic model for existing and future conditions was discussed in Section 6.2 and in Appendix A. The results indicated that the system generally has adequate capacity to meet the municipal peak flow standard. The primary exceptions are the Pike Lake, Hermantown and West interceptors. The Hermantown Interceptor is planned for a major replacement (refer to Appendix J). The Pike Lake and Oneota Street pump stations will continue to be monitored to ensure capacity is available for future flow conditions.

As future flow increases, capacity of WLSSD interceptors and pump stations will continue to need to be monitored and upgrades of facilities made in order to meet the target level of service when flows dictate. Several tools are in place to insure system capacity is available when it is needed.

The following is a list of WLSSD tools and a brief discussion regarding how each contributes to the plan to maintain system capacity:

- **Updated Planning and Capacity Allocation System** – The Wastewater Comprehensive Plan will be reviewed and updated on an approximate five-year interval coincident with Capacity Allocation Permit renewals. This will insure that current community and industrial growth projections are known and incorporated into the WLSSD capital improvement program.

- **Capital Improvement Program** – Condition is the primary driver for improvements of a wastewater collection system with aging infrastructure, however, current and future capacity needs are evaluated as part of design of each capital improvement project. The hydraulic model assists in determining the improvement needs and the downstream impact of interceptor improvements. In portions of the system such as the Pike Lake where capacity is a near term driver for improvement, a more detailed capacity evaluation will be performed to develop capital improvement priorities in this area.

- **Capacity, Management, Operations and Maintenance (CMOM) Program** – The CMOM program is incorporates procedures for internal communication regarding keeping the hydraulic model up to date, and a cycle of continuous communication regarding new information from temporary flow metering activities, sewer extension activities, and capital improvement activities. An update to the CMOM program is planned in 2025.

- **Inflow and Infiltration Ordinance** – An inflow and infiltration (I&I) ordinance was first adopted in October 2008 and revised in 2017. This ordinance supports the plan to maintain system capacity by insuring that communities within the WLSSD are continuing to reduce inflow and infiltration. I&I entering the system reduces system capacity, which could be used for future growth.

Section 6.6: Energy Improvements – Pump Stations

As discussed previously in Section 5 of the Comprehensive Plan, the objectives of the District's 2022 Energy Management Master Plan (EMMP) update were to document present-day and forecast future energy use, production, consumption, and spending throughout the District and update the previously-developed strategies to reduce energy consumption and spending. This update accomplishes those objectives by identifying and evaluating "energy-positive" alternatives intended to reduce energy consumption and spending. These energy-positive alternatives are categorized as either equipment replacements, process efficiency enhancements, or energy recovery and production. The complete 2022 update of the EMMP is included in Appendix L of the Plan. A number of the alternatives identified in the EMMP focusing on energy improvements at WLSSD pump stations and are discussed below.

Section 6.6.1: Equipment Replacement Alternatives

These include asset replacements that enhance energy efficiency and will reduce energy consumption by replacing aging equipment or technologies that are nearing, at, or beyond their reliable service lives with more efficient equipment or technologies.

1. **Major Pumping Stations:** Collectively, the District's three major pump stations (Cloquet, Scanlon, and Knowlton Creek) consume a roughly 27-percent of the total electricity used by the District. The existing raw wastewater pumps are original (circa 1977). This alternative would replace the existing pumps with more efficient pumps. The evaluation with the EMMP did not include detailed hydraulic analyses to produce calibrated system curves. The manufacturers pump curves, the original systems curves, and historical performance data provided the basis for the evaluation of alternative pumps.

   The fundamental energy findings were consistent at all three stations: the original pumps and pump selections yield excellent electrical efficiency and replacement pumps will offer little to no energy benefit. In fact, present-day pump offerings at the required flow-pressure regime may be less efficient than the existing pumps. At the Scanlon and Knowlton Creek pump stations, the pump manufacturer was unable to match the current efficiencies. At the Cloquet Pump Station, the same manufacturer could provide a pump with the same, but not better, efficiency. The evaluation determined there is no significant energy benefit to changing the pumps at any of the three major pump stations.

Section 6.6.2: Energy Recovery and Production

These projects will reduce purchased energy consumption and/or spending by leveraging renewable energy sources and will recover and/or produce useable energy from latent energy within wastewater, latent energy from hauled liquid waste or solid waste streams, sunlight, or wind.

1. **Raw Wastewater Heat Recovery and Heat Pump at Pump Stations:** This alternative would use the warm wastewater and a heat pump to heat the three major pump stations at the required ventilation rates. The specific technology assumed (by SharcEnergy) with this alternative grinds and filters the raw wastewater to protect the heat exchanger from plugging and fouling. The wastewater at the three major pumping stations is warm (100°F), making this a feasible alternative at each of those locations.

   All three stations would be similar. Raw wastewater pumps supplying the heat recovery system would be installed at the lowest level. The heat pump and Sharc macerator, filter, and heat exchanger would be installed at the middle level (mezzanine). The capital cost to install a direct-fired, gas-fueled HVAC strategy without heat recovery is $530,000. The capital cost to install a Sharc Energy heat recovery system with a heat pump is $1.27 million. This alternative will save energy, but not enough to pay back the additional capital in less than 20 years. A decision to implement this type of system will need to be justified by non-economic considerations. The stated annual energy and cost savings are relative to a direct-fired HVAC strategy.

2. **Raw Wastewater Heat Recovery Pump Stations:** This alternative would use the warm wastewater to heat the three major pumping stations at the required ventilation rates (Cloquet, Scanlon, and Knowlton). The specific technology assumed (by SharcEnergy) with this alternative grinds and filters the raw wastewater to protect the heat exchanger from plugging and fouling. The wastewater at the three major pumping stations is warm (100°F), making this a feasible alternative at each of those locations. The conceptual layout for this alternative is like what is described above but without the heat pump. All three stations would be similar. Raw wastewater pumps supplying the heat recovery system would be installed at the lowest level. The Sharc macerator, filter, and heat exchanger would be installed at the middle level (mezzanine). The capital cost to install a direct-fired, gas-fueled HVAC strategy without heat recovery is $530,000. The capital cost to install a Sharc Energy heat recovery system is $850,000. This alternative will save energy, but not enough to pay back the additional capital in less than 20 years. A decision to implement this type of system will need to be justified by non-economic considerations. The stated annual energy and cost savings are relative to a direct-fired HVAC strategy.

3. **Solar Array at Major Pump Stations:** This alternative would add a relatively small solar array at two of the major pumping stations: Knowlton Creek and Scanlon. The economic analysis done on this alterative as part of the EMMP does not include any grants, subsidies, or tax incentives.

Section 7: Regulatory Compliance & Scientific Focuses

Section 7.1: NPDES Permit

The WLSSD wastewater treatment facility current National Pollutant Discharge Elimination System (NPDES) Permit (MN0049786) was issued on June 21, 2016 and expired on May 31, 2021. WLSSD applied for reissuance of the NPDES Permit in October 2020 and as of the date of this Plan continues to operate under the expired permit until permit reissuance is completed by the Minnesota Pollution Control Agency (MPCA).

The WLSSD treatment plant is a Class A Facility with a continuous discharge (SD-001) to the St. Louis River Bay (a Class 2B, 3, 4A, 4B, 5, 6 water) which is also designated as an Outstanding International Water Resource (OIRW), and Duluth/Superior Harbor (Class 2B, 3, 4A, 4B, 5, 6 water). The St. Louis River Bay then outlets to Lake Superior (a Class 1B, 2A, 3, 4A, 4B, 5, 6 water) which is an Outstanding Resource Value Water (ORVW) (Restricted) discharge category

A pre-public notice draft of the NPDES Permit reissuance began on October 4, 2022 for review by WLSSD and area Tribal partners, which concluded on November 1, 2022. It is anticipated that the draft Permit will be issued by the MPCA for the required 60-day public notice period beginning on December 2, 2022.

The WLSSD NPDES Permit contains two variances from water quality standards for mercury and for year-round disinfection, both of which are discussed in further detail in this section. These variances will remain in effect once the permit is reissued.

Section 7.2: Mercury

The United States Environmental Protection Agency (EPA) Great Lakes Water Quality Initiative (GLI) led to *The Final Water Quality Guidance for the Great Lakes System*, which was finalized on March 23, 1995 (60 Federal Register, 15366-15425). The Clean Water Act (CWA) required the Great Lakes States to adopt the Guidance provisions into their water quality standards and NPDES permit programs. The Guidance specified numeric criteria for selected pollutants to protect aquatic life, wildlife, and human health from bioaccumulative chemicals of concern (BCC), including mercury. The basis of the wildlife-based criteria is summarized in the *Great Lakes Water Quality Initiative Criteria Documents for Protection of Wildlife* (EPA/820/B-95/008).

The Minnesota Pollution Control Agency (MPCA) adopted water quality standards based on GLI in Minn. R. Ch. 7052, along with the wildlife-based criteria in 1998. As shown in Minn. R. 7052.0100, chronic standards values were derived to protect aquatic life, human health, and fish-eating wildlife. Most stringent chronic standard was then adopted as the applicable standard. The EPA wildlife-based criteria for mercury - 1.3 ng/L (1300 pg/L) - was more stringent than the values calculated to protect human consumers of fish (1.53 ng/L) and aquatic life (3,400 ng/L) and is therefore applied as the applicable chronic standard.

The basis for the MPCA wildlife-based chronic standards were the EPA GLI criteria documents. The EPA calculated chronic criterion for mammalian wildlife using mink and otter. The geometric mean for the mink and otter was 2.4 ng/L. The document then calculated a mercury chronic criterion for avian wildlife, based on the belted kingfisher, herring gull, and bald eagle. The geometric mean for the three avian species 1.3 ng/L. Because the avian wildlife value was more restrictive, it was selected as the final criterion. The calculation of wildlife-based chronic criteria or standards involved determining values for body weight, water ingestion rate, food ingestion rate, and bioaccumulation factor, as well as a combined uncertainty factor of six. A list of documents, including the criteria document and the more detailed technical support document are at:

- https://www.epa.gov/gliclearinghouse/great-lakes-initiative-technical-support-documents.

WLSSD continues to be a pioneer and leader in mercury source identification and reduction as evidenced by regulatory agencies referencing its Blueprint for Mercury Elimination; e.g.,

- https://archive.epa.gov/greatlakes/p2/web/pdf/blueprint.pdf
- https://www.pca.state.mn.us/sites/default/files/wq-wwtp7-14.doc

In October 2020, WLSSD applied to the MPCA for reissuance of NPDES permit number MN0049786 that expired on May 31, 2021. The application included a request for a variance from the mercury limits of 1.8 ng/L as a monthly average, and 3.2 ng/L as a monthly maximum in treatment plant final effluent.

WLSSD informed the MPCA per NPDES permit section 5.4.54 that there was a very high probability that final mercury limits effective on the permit expiration date would not be attained. WLSSD proactively submitted to the MPCA a Mercury Compliance and Minimization Plan in June 2021 following the expiration of the permit. The plan details mercury reduction efforts over the previous five years from 2016 through 2020, and the plans for the following five years from 2021 through 2025. WLSSD will continue implementing reduction efforts while awaiting the reissuance of the District's NPDES permit. The efforts include the following past and future key components;

- 2019 – "Proof of Concept" for mercury removal using Clearas® Advanced Biological Nutrient Removal (ABNR) small scale, batch test pilot system.

- 2020 – "Proof of Concept" for mercury removal using Clearas® ABNR small-scale flow through pilot system.

- 2021 – Professional engineering study to determine feasibility of Clearas® ABNR full scale system application at WLSSD.

- 2022 – Following 2021 feasibility study detailing that full-scale operation of the Clearas® ABNR system at WLSSD was not economically feasible, nor capable of net reduction in mercury release to the environment, WLSSD pursued filtration studies including a system similar to the filtration used in the Clearas® ABNR pilot studies of 2019 and 2020. Bench scale studies indicate upgrade of treatment plant filtration may further reduce mercury concentration for final effluent.

- 2023 – Hydrotech Discfilter pilot testing will investigate performance and provide operational data to demonstrate that the Discfilter process is a viable solution for tertiary treatment to meet the WLSSD mercury limits along with total suspended solids (TSS) and total phosphorous (TP). The District's notification letter to the MPCA of this pilot testing is included as Appendix V of this Plan.

- 2023 through 2025 – Depending on outcome of the May 2023 filtration study, other filtration or reduction technologies may be pursued.

Treatment plant upgrades, capital improvement plans, communication of compliance status to stakeholders including Industrial Users enrolled in WLSSD's Industrial Pretreatment Program, regulatory initiatives including the 2018 publishing of WLSSD's Ordinance Regulating Dental Amalgam and the 2019 publishing of WLSSD's Ordinance for Transported Liquid Waste, and community outreach programs to reduce mercury in waste streams also continue.

Section 7.3: Effluent Disinfection

The effluent limit for fecal coliform bacteria is a State of Minnesota imposed discharge restriction (Minn R. 7053-0215, subp. 1). There are two drinking water intakes within 25 miles of the WLSSD treated effluent discharge, which include the City of Duluth, MN, and the City of Superior, WI drinking water intakes. Monitoring data collected at the drinking water intakes, as per NPDES/SDS Permit requirements applicable to WLSSD, have shown that there have been no exceedences of the fecal coliform threshold at any of the drinking water intakes when disinfection is not occurring from November through March.

The MPCA included both a fecal coliform and E. coli effluent-monitoring limit in NPDES/SDS permit requirements applicable to WLSSD as an additional measure of disinfection efficacy. This was done because *Klebsiella* sp. Bacteria, known to be present in pulp and paper mills, can interfere with fecal coliform testing method, and lead to falsely high fecal coliform results. Approximately half of WLSSD's plant influent flow is comprised of pulp and paper mill wastewater.

WLSSD's effluent complies with both (fecal coliform and E. coli added) numeric limits for bacteria for the recreational months of April through October. Fecal coliform is monitored during the months of November through March, but no numeric limit is applied. Drinking water intakes are also monitored during non-chlorination months, and intervention limits that would require activation of the chlorination process exist.

WLSSD applied for reissue of variance for effluent disinfection during the months of November through March. The request was based on Minn. Rule 7050.0190, subpart 4., A. (3)., detailing the use of sodium hypochlorite, "bleach", (source of pollution) during winter months would cause more environmental damage to correct than to leave in place.

WLSSD has completed a Disinfection Compliance Plan and determined that WLSSD unique effluent matrix leaves sodium hypochlorite as the applicable system to maintain the highly reliable, controllable and responsive disinfection system. Fecal coliform analyses confirm that WLSSD's effluent has no effect on drinking water intakes within 25 miles of effluent outfall during winter months. Therefore, current variance submittal included request for a longer term than the previous five-year variance term, and a reduction in drinking water intake sampling frequency.

Section 7.4: Salty Discharges (Including Sulfate)

Wastewater from some process streams contains high concentrations of chlorides, sulfates, salinity and dissolved minerals (Total Dissolved Solids, "TDS"). For simplicity, they are often referred to as "salty discharges". Sources associated with high salt concentrations include: municipal or industrial water softening processes using concentrating treatment technologies (e.g. reverse osmosis, ion exchange, membrane filtration, etc.); food processing using density-based (saline) sorting; and beverage, ethanol, biofuels, meat jerky or cheese production, and animal rendering industries.

In 2009, the MPCA began adding monitoring for "salty" parameters to NPDES permits as new or reissued permits became due. WLSSD's NPDES permit was last reissued in 2016 and included "monitor only" requirements for Chloride, Sulfate and TDS. WLSSD applied for permit reissuance in October 2020, and the monitor only data will be used by MPCA to evaluate need for continued monitoring of "salty discharges" in WLSSD's next NPDES permit issuance.

Minnesota adopted (1973), and United States Environmental Protection Agency (EPA) approved (1977), a sulfate standard to protect "waters used for the production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels" based on past subjective studies showing wild rice was found primarily in low sulfate waters. Once a Water Quality Standard (WQS) is approved by EPA it remains in effect unless EPA approves a change (40 C.F.R. §131.21(e). The sulfate standard of 10 mg/L was codified as Minn. R. 7050.0224, subp.2. Minnesota is the only state that has adopted a water quality standard for sulfate relating to waters containing wild rice.

In 2010 the MPCA used the sulfate WQS to set a discharge limitation in a NPDES permit, and questions and challenges arose regarding the science behind the WQS and how to define "waters used for the production of wild rice".

The Minnesota Legislature enacted legislation appropriating money and requiring MPCA to "adopt and implement a wild rice research plan using the money appropriated to contract with appropriate scientific experts" (Minn. Laws 2011, 1st Spec. Sess., Chapter 2, Article 4, Section 32 at (d) ("Wild Rice Legislation"). In 2011, the Minnesota Legislature directed the MPCA to identify waters where the wild rice sulfate standard would apply. After consultation with stakeholders, the MPCA contracted with the University of Minnesota to research how sulfate affects wild rice. The MPCA published study results in 2014, which revealed sulfate is not directly toxic to wild rice, but can be converted to sulfide, which is toxic. Iron and Organic Carbon sediment levels specific to individual wild rice areas also influence toxicity. The study also concluded no single level of sulfate can be protective of wild rice in all water bodies.

In 2017, the MPCA proposed an amendment of the rule pertaining to WQS protecting wild rice from sulfate including; repealing the 10 mg/L sulfate standard and replacing the 10 mg/L sulfate standard with an equation-based sulfate standard, and a list of class 4D waters to be protected by the wild rice sulfate standard. In January 2018 the proposed amendments were disapproved by an Administrative Law Judge. The Chief Administrative Law Judge concurred with the disapproval in April 2018 and the MPCA withdrew its proposed amendments to rules governing water quality standards to protect wild rice from the impacts of sulfate.

In 2021, the EPA disapproved part of the MPCA's draft impaired waters list for 2020. The EPA overturned the MPCA decision to not list any waters that fail to meet sulfate standard to protect wild rice. The EPA added 32 bodies of water that are capable of producing wild rice to Minnesota's 2020 Impaired Waters List due to sulfate levels above 10 mg/L, including AUID 69-1291-04 located in the Saint Louis River Estuary (SLRE) upstream of WLSSD's effluent discharge.

In December 2021, WLSSD and MPCA first discussed NPDES permit reissuance based on the WLSSD application submitted in October 2020. The discussion included questions related to effluent "monitor only" sulfate concentration values reported to MPCA once per month since 2016. WLSSD subsequently contracted with Barr Engineering in 2022 to conduct a plume simulation using the Delft3D computer model to determine if WLSSD's effluent sulfate concentrations discharged downstream of AUID-69-1291-04 could impact the sulfate impaired section of the SLRE upstream of WLSSD discharge. Because the SLRE experiences a seiche effect approximately three times per day when the influence of Lake Superior can reverse SLRE flow direction the question posed was whether or not seiche effects can transport WLSSD effluent sulfate concentrations upstream to the sulfate impaired section of the SLRE.

The simulation used a continuous tracer plume of 200 mg/L which was "injected" at the downstream section of Grassy Point and then modeled over a two-month period, taking into account the seiche effects from Lake Superior and low flow rates in the St. Louis River. The tracer concentrations stabilized throughout the modeled area after approximately two weeks. The tracer concentration at the wild rice area stabilized at levels well below 2.0 mg/L. This shows that very little of the tracer makes it from the downstream injection point to the wild rice area. Since the WLSSD effluent discharge is an additional two miles downstream of the modeled area it was concluded that it is very unlikely that sulfate from the discharge would reach the wild rice growing within the Grassy Point area. The model simulation used reasonable worst-case scenarios (high seiche and low river flow) and showed that seiche induced currents are not sufficient to cause tracer migration upstream or levels of concern. Based on modeling results it is reasonable to conclude that sulfate from WLSSD will not migrate upstream to Grassy Point and will not have a negative impact on wild rice within Grassy Point.

In February 2022, the EPA informed the MPCA that effluent limitations governing sulfate are to be included in NPDES permits and the EPA urged the MPCA to work with State lawmakers to resolve matters related to sulfate WQS. It is the MPCA's recommendation that WLSSD continue monitoring sulfate in its effluent once per month and an effluent limit for sulfate is not necessary.

Section 7.5: Per and Polyfluoroalkyl Substances (PFAS)

Per and Polyfluoroalkyl Substances (PFAS) are a large family of more than 5,000 chemicals used since the 1940s. PFAS have very strong carbon and fluorine bonds and don't easily break down and accumulate over time in the environment. They are commonly referred to as "forever chemicals". Wastewater treatment plants are not the source of PFAS, they are receivers of PFAS. Wastewater coming into treatment plants may contain PFAS compounds that originate from other sources, including households, businesses and industries. Wastewater treatment plants are not designed to remove contaminants like PFAS. Removing the pollutant at the source before it is disposed in wastewater is of primary importance for pollution prevention. Technologies are being introduced and researched that help reduce PFAS pollution at the source.

The Minnesota Pollution Control Agency (MPCA) released the *Minnesota PFAS Blueprint* in February 2021 that identifies a plan to first prevent PFAS pollution, then manage pollution when prevention is not feasible, and lastly, clean up PFAS pollution at contaminated sites. In 2020-2021, all of WLSSD's industrial permittees were surveyed and indicated no known use of PFAS at their facilities.

Through a Memorandum of Understanding (MOU) between the MPCA and WLSSD signed in October 2022, the District will begin voluntarily sampling for PFAS in the influent waste stream beginning in 2023. The aim of this strategy is to help identify and reduce sources of PFAS in the communities that WLSSD serves. WLSSD will implement pollution prevention strategies as needed as the sampling data becomes available.

The Minnesota State Legislature is taking steps to address PFAS by passing a bill in 2021 to ban food packaging containing PFAS by 2024, proposing a ban on manufacturing, distributing and selling certain products that contain PFAS, providing funding to further identify sources of PFAS, and providing funding for research to assess PFAS in biosolids, its movement through soil, and impact on plants.

Section 7.6: Inflow and Infiltration (I & I)

Inflow means water other than wastewater that enters a sewer system from sources such as roof leaders, foundation drains, yard drains, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, storm water runoff and other drainage structures. *Infiltration* means water other than wastewater that enters the sewer system from the ground through defective pipe, pipe joints, and manholes. *Inflow* and *Infiltration* (I & I) is a part of every collection system and must be taken into account in the determination of an appropriate design flow of a wastewater treatment plant.

During substantial rainfall events, isolated periods of extensive snow/ice melt, or during combinations of rainfall and melting the WLSSD wastewater treatment plant can experience influent flows that exceed its design wet-weather flow capacity (48 million gallons per day) by as much as three-fold. WLSSD has an enforceable Inflow and Infiltration Ordinance that was adopted in 2009.

The WLSSD Inflow and Infiltration Ordinance continues to serve as an effective tool in mitigatigating I & I problems that can challenge the WLSSD conveyance system and the treatment plant's wet-weather flow capacity. The Ordinance has proven it effectiveness as evidenced by the complete termination in 2015 (one-year early) of the Consent Decree negotiated with the EPA and MPCA, which listed WLSSD as a co-defendant with the City of Duluth.

The Inflow and Infiltration Ordinance was further revised in 2017 requiring all municipalities within the District to develop and implement annual inspection and correction programs to address private side sources of I & I (foundation drains and service laterals).

Section 7.7: Underground Storage Tanks

WLSSD has multiple underground storage tanks (USTs) and a 1,000 gallon above ground fuel storage tank (AST) that must comply with MPCA requirements listed in regulations specific for ASTs and UST's; see:

- https://www.pca.state.mn.us/waste/underground-storage-tank-systems
- https://www.pca.state.mn.us/waste/aboveground-storage-tank-systems

Design and operating rules for regulated USTs include tank and piping corrosion protection, overfill prevention, secondary containment, cathodic protection system testing, release detection, operation and maintenance testing, inspections, and other requirements.

WLSSD has Spill Prevention, Control and Countermeasure (SPCC) Plans in place that cover both the wastewater treatment facility and the collection system pump stations. Certification is required every five years to officially assess compliance with several of State requirements. WLSSD utilizes external resources that have the proper certifications to assure that official compliance assessments are performed. The SPCC for the treatment plant was last updated and certified in October 2021 while the plan for the pump stations was last updated and certified in December 2021.

Section 7.8: Co-Digestion

WLSSD is moving forward with plans to anaerobically co-digest feed stocks with high caloric content with its (currently) anaerobically digested sludge. The Biosolids produced from anaerobic co-digestion must continue to meet all regulatory compliance aspects specified in the NPDES/SDS permit, which must be at least as (but can be more) restrictive than those specified by the U.S. EPA; see:

- https://www.epa.gov/biosolids/plain-english-guide-epa-part-503-biosolids-rule

WLSSD is also permitted to land apply Biolsolids in the State of Wisconsin. Therefore, the Biosolids produced from anaerobic co-digestion must continue to meet all regulatory compliance aspects specified in the WI DNR permit.

Section 7.9: Air Quality

In synchrony with the above-mentioned future co-digestion plans, in April 2022 the WLSSD Board of Directors approved plans to generate heat and electricity from the biogas generated by the co-digestion process. In 2021, WLSSD was awarded $6.75 million in funds toward the "Combined Heat and Power (CHP) Energy Project."

This project includes the installation of three 850-kilowatt engine generators and equipment to generate electricity with biogas, produced in the wastewater treatment process, and to capture and reuse heat from the process. Final completion of the CHP project is scheduled for early 2024.

WLSSD's Air Individual Permit Part 70 reissuance occurred in March 2020. Previous permit amendments made in 2014 were rolled into the permit reissuance, which authorized the installation of the three engine generators. The reissued permit includes requirements for various one-time notifications/updates on new emission units, both prior to their installation and in regards to their first use of fuel(s). Once the new emission units are performance-tested and operational, routine reporting on fuel use and emission output will prevai

Section 8: Plan Recommendations & Capital Improvement Program

1. **10-Year Capital Improvement Program:** The District is committed to the development, maintenance and implementation of a long-range plan for strategic investment in capital assets through the adoption of the recommendations within the 10-year Capital Improvement Program (CIP). The complete recommended 10-year CIP included in **Table 8-1** at the end of this section. The 10-year CIP ensures the integrity and long-term reliability of wastewater infrastructure and maintaining the capacity and effectiveness of the treatment works and conveyance facilities for current and future needs.

2. **Project Funding:** District staff will identify and seek alternative and creative sources of funding to complement the District's Capital Improvement Program to improve WLSSD assets while responsibly managing costs for District customers including funding through the MN Public Facilities Authority (PFA) Clean Water Revolving Loan Fund (CWRF), Waster Infrastructure Fund (WIF), Green Project Reserve (GPR) funds and through State bonding projects.

3. **Energy Sustainability:** Improve energy efficiency by continuously establishing and implementing an effective energy management and conservation program that supports modern technological capabilities and customer satisfaction, provides a safe and comfortable work environment, while complying with all permit requirements and maintaining effective operations. The recommended activities undertaken to accomplish this are specified in the 2022 WLSSD Energy Management Master Plan (EMMP) revision.

   Key measures of this recommendation includes the following at all District facilities:
   - Reduction of overall electricity usage;
   - Reduction of total energy usage;
   - Increase the percentage of renewable energy used;
   - Maintain or decrease total District energy costs

4. **Asset Management:** Incorporate enterprise asset management systems in decision-making and budgeting to proactively plan for asset maintenance and replacement while minimizing long-term investment in each asset, achieving desired performance levels, maintaining regulatory compliance, and improving District operations at the lowest possible costs.

5. **Facility Buildings and Structures Condition Assessment:** Complete overall structural condition assessments for District buildings and structures including concrete structures (tanks, channels, tunnels, etc.), building structures (roofs, pre-cast panels, bricks, etc.), large diameter piping (RAS, TPI, tank drainage, backwash, flocculent effluent, plant outfall, etc.), and security infrastructure (fencing, gates, doors, etc.) and implement recommendations for improvements into the Capital Improvement Program.

6. **Mercury Reduction:** Explore economically feasible technologies for effluent filtration to meet total mercury goals consistently. Based on success and viability of bench scale testing a larger scale pilot test(s) will be conducted using increased flows and real world variability. Given demonstration of larger pilot test proof of concept, the District would pursue a larger-scale feasibility study of the viable technology.

7. **Conveyance System Capacity Management - CMOM Program:** WLSSD will fulfill components of the CMOM to ensure capacity of the conveyance system for current and future flows by:

- Updating the Wastewater Comprehensive Plan every five years
- Maintaining the Interceptor Asset Management Program (IAMP) on an ongoing basis
- Assessing the condition of WLSSD pump stations as warranted
- Utilizing and updating the hydraulic model and modeling tools to determine priority projects and on-going modeling for inflow and infiltration sources and capacity management
- Maintaining the online Operations and Maintenance (O & M) Manual
- Working collaboratively with municipalities implementing I & I and FOG reduction programs
- Maintaining a seasonal flow metering program
- Maintaining accurate GIS information and maintain the District Collection System Map Book
- Further developing mobile program to document and query manhole inspections and conditions

7. **Per and Polyfluoroalkyl Substances (PFAS):** WLSSD will develop and implement an ongoing targeted pollution prevention program focusing on identification and reduction of sources of per and polyfluoroalkyl substances (PFAS) in the wastewater influent in anticipation of continued state and federal regulations as covered in Section 7.5.

8. **Wastewater Planning in Unsewered Areas:** District staff will work in an advisory capacity with all parties including residents, community officials, consultants and regulatory agencies to develop and implement the best available wastewater treatment solutions in unsewered areas.

9. **Urban Services Boundary Revision:** Adopt and administer the urban services boundary (USB) as proposed in Section 4 to meet the future needs of the WLSSD. The USB defines existing service areas and establishes future service areas that are consistent with local community plans and the District's Capital Improvement Program and will remain in effect until the Board takes action to cancel or amend the recommendation.

10. **Local Comprehensive Planning Review and Approval:** Continue policy whereby all member communities are required to adopt and maintain a local comprehensive plan. All revisions or updates of local community plans, specifically concerning wastewater utilities, will require review and approval by the District Board. The WLSSD enabling legislation recognizes the necessity of coordinated planning efforts to insure successful operations of the regional system and effective management of water quality in the lower St. Louis River Basin.

11. **Geographic Information Systems (GIS):** Develop a coordinated regional GIS related to wastewater infrastructure and water quality management, including maintaining a comprehensive database for all WLSSD infrastructure and programs to support District long-range planning and capital budgeting. Specific GIS initiatives include continued development of asset management tools, system capacity planning, capacity availability fee (CAF) and sewer extension tracking and administration, documentation of easements, and biosolids program site permitting and land application fieldwork.

12. **Conveyance System Management Standards:** Develop and publish conveyance system management standards that include policies and procedures for accepting, processing and inspecting direct/service connections to the WLSSD system when necessary, facility ownership/metering and design and construction standards for WLSSD constructed facilities and an annual review of asset ownership and identification of possible asset transfers.

13. **Capacity Availability Fee (CAF):** Complete review of the WLSSD Capacity Availability Fee (CAF) program by assessing the current fee structure and formula and revising the CAF Procedures Manual for publishing and distribution to District communities. The CAF addresses the cost of system capacity constructed to meet the needs of future growth within the WLSSD service area and reflects the cost of

system capacity available for expanded connections and uses. The CAF Procedures Manual was last updated in 2015 and the unit fee was last adjusted in 2008.

14. **Vulnerability Assessment:** Perform an assessment of WLSSD facilities to determine potential vulnerabilities in security procedures, software, internal system controls, transmission of data, or the lack of back-up or redundancy for critical parts of the wastewater collection and treatment system.

15. **Odor Management:** Annually review existing operational and response best management practices (BMPs) annually to ensure the District's Odor Management Plan is being implemented effectively in regards to the wastewater conveyance and treatment systems. Annual BMP reviews allow opportunities to identify or implement emerging technologies or methodologies to reduce odors emanating from the wastewater conveyance and treatment process.

16. **Community Education and Outreach:** Prioritize wastewater community education and outreach efforts serving District residents who are in areas disproportionally burdened by cumulative environmental pollution and other hazards that can lead to negative public health effects.

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	TOTAL
Safety Essential Projects											
Safety - Clarifier Rooftop Access Improvements	$0	$1,000,000	$0	$0	$0	$0	$0	$0	$0	$0	$1,000,000
Subtotal	**$0**	**$1,000,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$1,000,000**
Required General Replacement											
General, Compliance											
Comprehensive Plan Update (EMP, Comprehensive Plan, Hydraulic Model)	$0	$0	$0	$0	$175,000	$175,000	$0	$0	$0	$0	$350,000
Subtotal	**$0**	**$0**	**$0**	**$0**	**$175,000**	**$175,000**	**$0**	**$0**	**$0**	**$0**	**$350,000**
Interceptor Replacement / Rehabilitation											
Hermantown Interceptor Replacement	$0	$0	$0	$0	$0	$0	$210,000	$2,100,000	$0	$0	$2,310,000
Scanlon Interceptor Rehabilitation (Phases 5 - 7)	$0	$500,000	$0	$5,000,000	$0	$5,500,000	$6,000,000	$0	$0	$0	$17,000,000
Lakeside Interceptor Rehabilitation	$210,000	$3,635,000	$0	$0	$0	$0	$0	$0	$0	$0	$3,845,000
West Interceptor Rehabilitation	$0	$0	$0	$0	$0	$0	$0	$0	$598,000	$4,168,000	$4,766,000
Miscellaneous Gravity Interceptor Improvements (East, Woodland, Proctor)	$0	$0	$0	$267,000	$1,859,000	$146,000	$1,013,000	$953,000	$937,000	$0	$5,175,000
Miscellaneous Forcemain Improvements (Knowlton, Scanlon)	$0	$500,000	$5,500,000	$0	$0	$0	$0	$0	$0	$0	$6,000,000
Manhole Improvements	$0	$100,000	$0	$100,000	$0	$100,000	$0	$100,000	$0	$100,000	$500,000
Subtotal	**$210,000**	**$4,735,000**	**$5,500,000**	**$5,367,000**	**$1,859,000**	**$5,746,000**	**$7,223,000**	**$3,153,000**	**$1,535,000**	**$4,268,000**	**$39,596,000**
Pump Station Replacement / Rehabilitation											
Cloquet Pump Station Meter Replacement	$100,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$100,000
Knowlton Creek Pump Station Biofilter Drainline Replacement	$50,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000
Knowlton Creek Pump Station Elec./Mech. Rehabilitation	$0	$0	$500,000	$0	$0	$0	$0	$0	$0	$0	$500,000
Scanlon Pump Station Elec./Mech. Rehabilitation	$0	$0	$0	$500,000	$0	$0	$0	$0	$0	$0	$500,000
Subtotal	**$150,000**	**$0**	**$500,000**	**$500,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$1,150,000**
General Replacement-Wastewater Treatment Plant											
Process Improvements - Oxygen Dissolution Tank Rehabilitation	$0	$200,000	$1,000,000	$6,500,000	$0	$6,500,000	$0	$6,500,000	$6,500,000	$0	$27,200,000
Process Improvements - Secondary Clarifier Tank Rehabilitation	$0	$0	$6,700,000	$0	$6,200,000	$0	$6,200,000	$0	$0	$0	$19,100,000
Process Improvements - Biofilter Rehabilitation (Cells 1, 2, 3)	$0	$1,100,000	$0	$0	$1,100,000	$1,100,000	$0	$0	$0	$0	$3,300,000
Process Improvements - Mixed Media Filter Rehabilitation (Filters 1 & 3)	$385,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$385,000
Process Improvements - Effluent Filtration Improvements	$100,000	$0	$100,000	$250,000	$0	$0	$0	$0	$0	$0	$450,000
Process Improvements - Thickener and Odorous Air Improvements	$12,300,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12,300,000
Process Improvements - Plant Piping and Isolation Valve Replacements	$100,000	$0	$0	$100,000	$0	$0	$0	$100,000	$0	$0	$300,000
Process Improvements - Plant Air System Upgrades	$0	$0	$0	$0	$300,000	$0	$0	$0	$0	$0	$300,000
Process Improvements - Dewatering System Improvements	$150,000	$3,000,000	$0	$0	$0	$0	$0	$0	$0	$0	$3,150,000
Process Improvements - Digester Rehabilitation	$520,000	$0	$0	$950,000	$0	$0	$0	$950,000	$0	$0	$2,420,000
Facility and Site Improvements - Roof Rehab. (B9 storage, B11, B10, B8, B2, Biosolids)	$90,000	$545,640	$0	$0	$389,640	$0	$0	$0	$416,100	$691,000	$2,132,380
Facility and Site Improvements - Effluent Sample Building Replacement	$327,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$327,000
Facility and Site Improvements - Perimeter Security (B9 Lower Physical/Access Control)	$150,000	$500,000	$100,000	$0	$0	$0	$0	$0	$0	$0	$750,000
Facility and Site Improvements - Precast Panel Improvements	$0	$100,000	$0	$100,000	$0	$0	$0	$0	$0	$0	$200,000
Facility and Site Improvements - Office Space/Occupancy Improvements	$125,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$125,000
IT Improvements - PA System Upgrades (Phases 2 & 3)	$0	$600,000	$0	$0	$0	$0	$0	$0	$0	$0	$600,000
IT Improvements - WiFi Implementation (Plant/Conveyance)	$35,000	$35,000	$35,000	$35,000	$0	$0	$0	$0	$0	$0	$140,000
IT Improvements - eOPs upgrade	$0	$0	$115,000	$0	$0	$0	$126,500	$0	$0	$0	$241,500
IT Improvements - Virtual Server Upgrade (Simplivity)	$275,000	$0	$275,000	$0	$275,000	$0	$275,000	$0	$275,000	$0	$1,375,000
IT Improvements - Enterprise Resource Planning (ERP) Replacement	$2,000,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,000,000
IT Improvements - Cimplicity Upgrade	$0	$0	$0	$99,000	$0	$0	$0	$99,000	$0	$0	$198,000
IT Improvements - Store and Forward Devices (Conveyance)	$0	$65,000	$0	$0	$0	$0	$0	$0	$0	$0	$65,000
IT Improvements - Firewall Improvements	$250,000	$0	$100,000	$100,000	$0	$0	$150,000	$0	$100,000	$100,000	$800,000
IT Improvements - Process Control Video Wall Upgrade	$75,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$75,000
IT Improvements - MPLS Replacement	$0	$0	$125,000	$0	$0	$0	$0	$0	$0	$0	$125,000
Mobile Equipment Replacements (Trailer 067, Spreader 001)	$190,000	$200,000	$0	$200,000	$0	$225,000	$0	$225,000	$0	$225,000	$1,265,000
District Fleet Vehicle Replacements	$150,000	$0	$150,000	$0	$0	$0	$150,000	$0	$150,000	$0	$600,000
Subtotal	**$17,222,000**	**$6,345,640**	**$8,700,000**	**$8,334,000**	**$8,264,640**	**$7,825,000**	**$6,901,500**	**$7,874,000**	**$7,441,100**	**$1,016,000**	**$79,923,880**
Process / Energy Improvements											
HVAC Control Upgrades/Replacements	$0	$0	$50,000	$0	$50,000	$0	$0	$50,000	$0	$50,000	$200,000
Building Air Conditioning Improvements (B9, B8)	$547,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$547,000
Building Substation Replacements (B4, B6, B9)	$0	$750,000	$750,000	$0	$500,000	$0	$0	$0	$0	$0	$2,000,000
Digester Sludge Heat Exchanger Improvements/Replacement	$0	$0	$0	$0	$0	$2,000,000	$0	$0	$0	$0	$2,000,000
High Strength Waste Addition - Design and Construction	$0	$0	$0	$500,000	$5,500,000	$0	$0	$0	$0	$0	$6,000,000
Lighting Control Energy Improvements	$60,000	$75,000	$75,000	$0	$0	$0	$0	$0	$0	$0	$210,000
Subtotal	**$607,000**	**$825,000**	**$875,000**	**$500,000**	**$6,050,000**	**$2,000,000**	**$0**	**$50,000**	**$0**	**$50,000**	**$10,957,000**
Total	**$18,189,000**	**$12,905,640**	**$15,575,000**	**$14,701,000**	**$16,348,640**	**$15,746,000**	**$14,124,500**	**$11,077,000**	**$8,976,100**	**$5,334,000**	**$132,976,880**
Discretionary Projects	$650,000	$650,000	$650,000	$650,000	$650,000	$650,000	$650,000	$650,000	$650,000	$650,000	$6,500,000
Total Wastewater Capital Budget	**$18,839,000**	**$13,555,640**	**$16,225,000**	**$15,351,000**	**$16,998,640**	**$16,396,000**	**$14,774,500**	**$11,727,000**	**$9,626,100**	**$5,984,000**	**$139,476,880**
PFA Loan Funding	$15,839,000	$10,455,640	$9,675,000	$12,051,000	$10,498,640	$12,896,000	$8,074,500	$8,027,000	$5,826,100	$2,084,000	$95,426,880
Grant or Cash Funding Required	$0	$0	$3,350,000	$0	$3,100,000	$0	$3,100,000	$0	$0	$0	$9,550,000
Use of Wastewater Operations Fund	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
PAGO Total	$3,000,000	$3,100,000	$3,200,000	$3,300,000	$3,400,000	$3,500,000	$3,600,000	$3,700,000	$3,800,000	$3,900,000	$34,500,000
Debt Service Coverage (Target 120%)	275%	258%	246%	230%	213%	191%	175%	161%	146%	130%	

Section 9: Plan Administration

Section 9.1: Regulatory Controls

The land use planning authority in relationship to the WLSSD is clearly set forth in Minnesota State Statutes, Chapter 458D, Subsection 458D.05. Under this authority, the District requires that local plans be submitted for review and approval in relation to the collection, treatment, and disposal of sewage for which the local government unit is responsible. Local planning efforts are to be in compliance with the WLSSD Board's goals and policies and in relation to the District's planning efforts.

Section 9.2: Amendment Procedures

The WLSSD Comprehensive Plan intends to extend through the year 2028. For the Plan to remain dynamic, a process must be available to implement new information, ideas, methods, standards and management practices. Amendment proposals can be requested any time by any person or persons either residing or having business within the District.

- **Request for Amendment**: A written request for plan amendment is submitted to WLSSD staff. The request shall outline the need for the amendment as well as additional materials that the WLSSD will need to consider before making its decision.
- **Staff Review**: A decision is made as to the validity of the request. Three options exist; 1) reject the amendment, 2) accept the amendment as a minor issue, with minor issues collectively added to the plan at a later date, 3) accept the amendment as a major issue, with major issues requiring an immediate amendment. In acting on an amendment request, staff shall recommend to WLSSD Board of Directors whether or not a public hearing is warranted.
- **Board Consideration**: The amendment and the need for a public hearing shall be considered at a regular or special meeting of the WLSSD Board. Staff recommendations should also be considered before decisions on appropriate action(s) are made.
- **Public Hearing**: This step allows the public input based on the public sentiment. The WLSSD Board of Directors and staff shall determine when the public hearing should occur in the process.
- **Board Adoption**: Final action on an amendment is adoption by the WLSSD Board. However, prior to the adoption, an additional public hearing should be held.

Section 9.3: Plan Review

An annual report should be made by WLSSD Planning and Technical Services staff to the Board of Directors summarizing development changes, capital improvements and other water management-related issues that have occurred over the past year.

The plan will remain in effect through 2028 or until revised. The Plan should then be reviewed for consistency with current water resources management methods and local comprehensive plans. At this time, all annual reports and past amendments can be added to the document. Depending on the significance of changes, a new printing of the plan may be appropriate.

Western Lake Superior Sanitary District
2626 Courtland Street
Duluth, MN 55806
(218) 722-3336
www.wlssd.com