Future Wastewater Infrastructure Needs and Capital Costs

Fiscal Year 2016 Biennial Survey of Wastewater Collection and Treatment

Minnesota Pollution Control Agency

January 2016

Legislative charge

Minnesota Statutes §115.03, Subd. 9. Future costs of wastewater treatment; report.

The commissioner shall, by January 15, 1998, and each even-numbered year thereafter, provide the chairs of the house and senate committees with primary jurisdiction over the agency's budget with the following information: (1) an updated list of all wastewater treatment upgrade and construction projects the agency has identified to meet existing and proposed water quality standards and regulations; (2) an estimate of the total costs associated with the projects listed in clause (1), and the projects' priority ranking under Minnesota Rules, chapter 7077. The costs of projects necessary to meet existing standards must be identified separately from the costs of projects necessary to meet proposed standards; (3) the commissioner's best estimate, developed in consultation with the commissioner of employment and economic development and affected permittees, of the increase in sewer service rates to the residents in the municipalities required to construct the projects listed in clause (1) resulting from the cost of these projects; and (4) a list of existing and proposed state water quality standards which are more stringent than is necessary to comply with federal law, either because the standard has no applicable federal water quality criteria, or because the standard is more stringent than the applicable federal water quality criteria.

HIST: 1945 c 395 s 3; 1969 c 9 s 21; 1969 c 931 s 6; 1973 c 374 s 7-9; 1973 c 412 s 12; 1976 c 76 s 1; 1979 c 147 s 1; 1984 c 597 s 41; 1985 c 248 s 70; 1Sp1985 c 13 s 229; 1986 c 444; 1987 c 186 s 15; 1989 c 335 art 1 s 127; art 4 s 33; 1992 c 601 s 2; 1993 c 87 s 1; 1993 c 186 s 8; 1996 c 437 s 9,10; 1996 c 462 s 38; 1997 c 216 s 93; 2000 c 370 s 1; 1Sp2001 c 2 s 120; 2003 c 128 art 1 s 120,121; 1Sp2003 c 4 s 1

Minnesota Pollution Control Agency

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The staff team that compiled this legislative report gratefully acknowledges the time and effort that local elected officials, municipal engineers, staff contacts and consulting engineers dedicated to completing the 2015 Wastewater Infrastructure Needs Survey (WINS)

Cover photo courtesy Pine River Area Sanitary District

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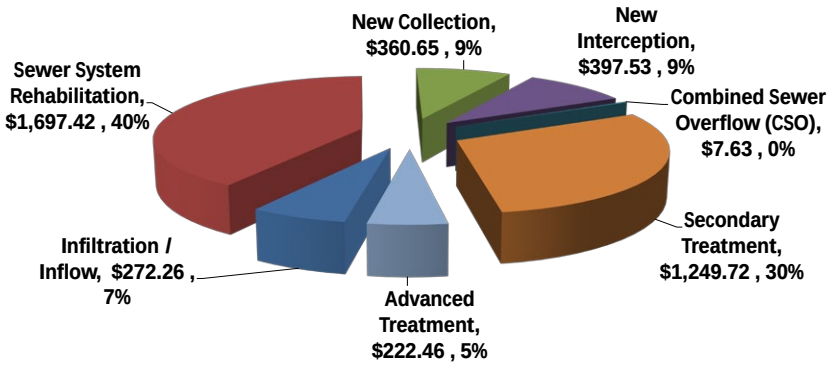
Executive summary

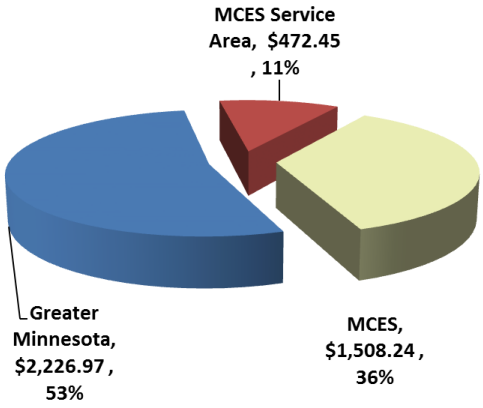
Statewide future infrastructure needs

Responding to the Minnesota Pollution Control Agency (MPCA) 2015 Wastewater Infrastructure Needs Survey (WINS) of future wastewater treatment and collection system needs, Minnesota's communities identified **over 1,350 wastewater infrastructure projects** at a cost of over **$4.20 billion dollars.** These Projects are necessary to rehabilitate, expand, and improve wastewater collection sewer systems and treatment facilities and to extend sewer systems to newly developed or existing unsewered areas. The distribution of costs by type of project is as follows (costs are in millions of dollars):



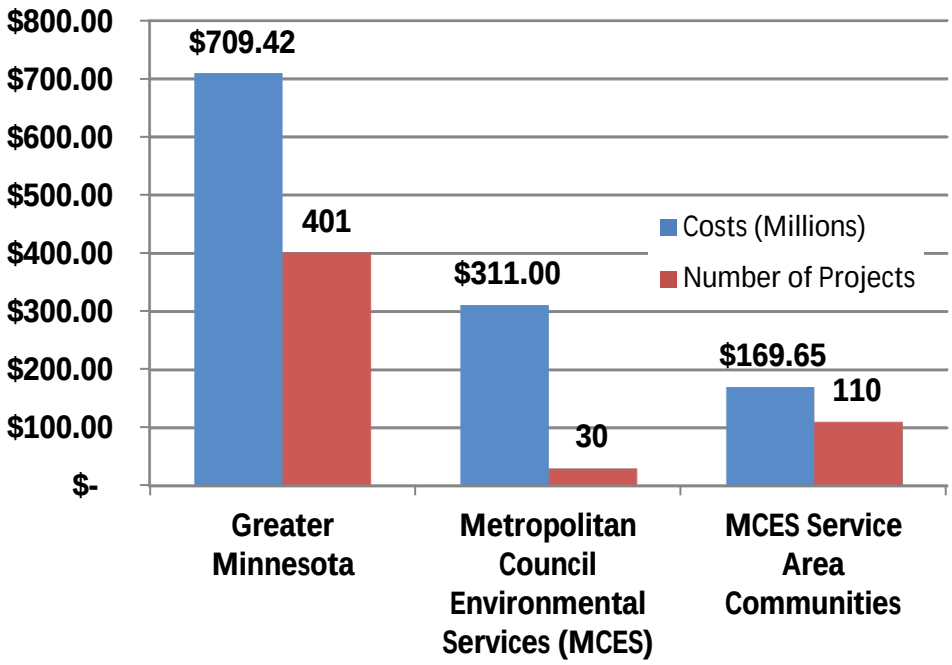
Greater Minnesota, Metropolitan Council Environmental Services, and MCES Service Area Communities needs

The distribution of need for Greater Minnesota as compared to the Metropolitan Council Environmental Services (MCES) and the approximately 112 communities served by MCES is as follows: (costs are in millions of dollars):



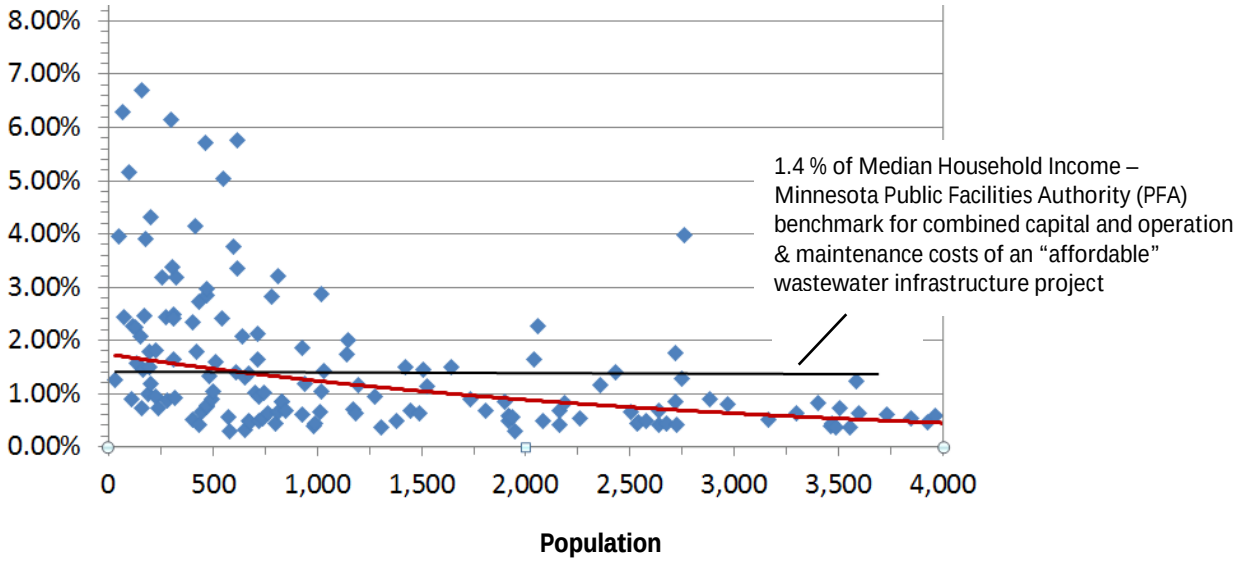
Completed wastewater infrastructure projects 2014-2015

During the two year period from January 1, 2014, through December 31, 2015, a total of 541 wastewater infrastructure projects were completed throughout Minnesota at a total cost of $1,190.07 million. The distribution of costs and projects between Greater Minnesota, MCES, and MCES Service Area Communities are as indicated below (costs are in millions of dollars). Note that costs are overall project totals for projects completed during the time period indicated. Multi-year projects may have been initiated and costs incurred prior to January 1, 2014.):



Project affordability: effects of economies of scale

Communities with low populations frequently struggle with the affordability of wastewater infrastructure – they lack the economies of scale that help keep costs down in more populous cities. The Minnesota Public Facilities Authority (PFA) uses 1.4% of median household income as a wastewater costs affordability index for Minnesota communities. On the following linear regression the y axis is annual capital and operational costs as a percent of a community's Median Household Income. As indicated a community characteristically needs a population of approximately 750 to achieve an affordability index of 1.4%.



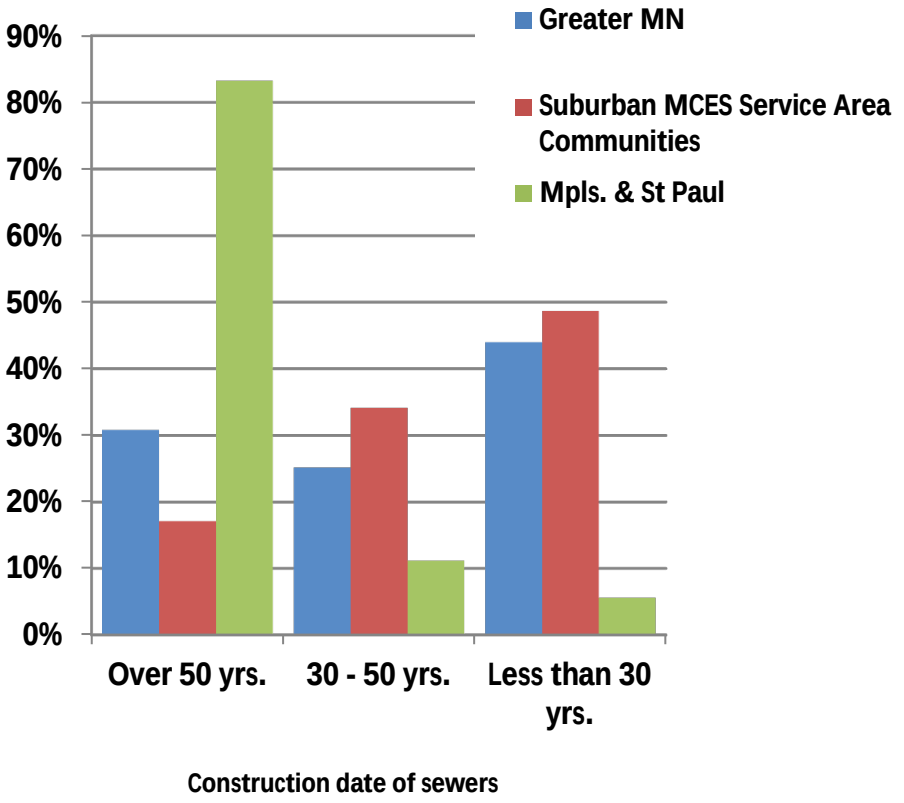
Age of collection sewers

Sewers installed over 50 years ago are frequently beyond their useful life in part because they were typically constructed of vitrified clay tiles that are not as durable and do not perform at current standards. The age and condition of Minnesota's collection sewer systems varies between communities but is primarily a contrast between: a) Minneapolis and St. Paul, b) Suburban MCES Service Area Communities, and, 3) Greater Minnesota.

As indicated below, Minneapolis and St. Paul have a high percentage (83%) of sewers constructed over 50 years ago. Accordingly both cities are engaged in long term capital improvement projects to rehabilitate their collection sewer systems. While recognizing the economies of scale of the communities involved, rehabilitating and replacing these aged sewers continues to be a significant capital investment for the central cities.

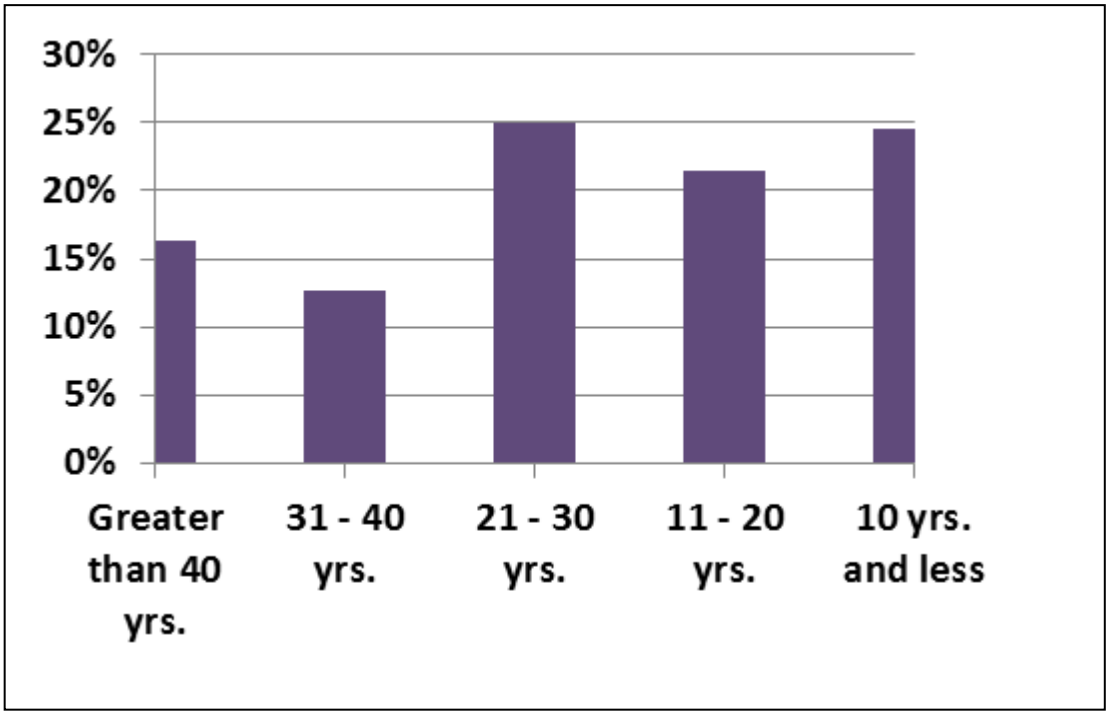
On average, suburban MCES Service Area Communities have a comparatively small percentage (17%) of sewers constructed over 50 years ago. However this average conceals substantial percentages of 50 years plus sewers in older communities located in the metro area, including: Richfield, St Louis Park, Excelsior, Falcon Heights, and Roseville. For information on specific communities, please see Appendix 6: Age of Infrastructure of Individual Communities.

In Greater Minnesota the age of collection sewer systems suggests that aged infrastructure is significant and extensive and represents an important challenge, particularly because many of the oldest sewers are located in the smallest communities. As indicated below, 31% of Greater Minnesota sewers were installed over 50 years ago and 25% of sewers in Greater Minnesota are 30 – 50 years old.



Age of treatment facilities

Major structural components of wastewater treatment facilities have an expected useful life of 40 years – dependent in part on operation and the diligence of maintenance. As these structures deteriorate, effectiveness declines leading to additional operating and maintenance, and a greater potential for permit violations and unintended discharges. As indicated below, at this point in time 16% of Greater Minnesota's treatment facilities are over 40 years old. In 10 years, without reconstruction projects, the percentage would reach approximately 30%. This scenario would likely result in continuing significant increased infrastructure demands and costs.



Age of treatment facilities in Greater Minnesota (472 facilities surveyed)

In the Twin Cities local communities collect sewage from households, businesses, etc. and then route it to the appropriate MCES interceptors. MCES operates an extensive interceptor system conveying wastewater to its several treatment facilities for treatment and discharge. The overall scale and revenue base of the MCES system facilitates the MCES practice of managing improvements and rehabilitation through long term capital investment planning.

Introduction

The purpose and scope of this report

In keeping with Minn. Stat. § 115.03 subd.9 the Minnesota Pollution Control Agency (MPCA) has prepared this report on:

- Future infrastructure needs and capital costs of rehabilitating, improving and expanding publicly owned wastewater treatment and collection systems.
- Cost increases to residential users resulting from currently planned wastewater infrastructure projects.
- The affordability of wastewater infrastructure needs and residential costs.

Minnesota's publicly owned wastewater treatment systems are operated according to National Pollution Discharge Elimination System (NPDES) and State Disposal System (SDS) permits issued by the MPCA. The ownership and operation of publicly owned wastewater treatment and collection systems is the work of approximately 680 Minnesota cities and sanitary districts. Of the latter, Metropolitan Council Environmental Services (MCES) and Western Lake Superior Sanitary District are the most prominent in the extent of services provided.

This report does *not* address:

- Privately owned NPDES or SDS permitted wastewater treatment facilities (e.g., industrial and commercial dischargers that do not discharge to publicly owned wastewater treatment facilities).
- Privately owned Subsurface Sewage Treatment Systems (SSTS) which account for approximately 25% of the domestic wastewater discharged by Minnesota residences.
- Stormwater Collection Systems, Management and Treatment Practices. Based primarily on population, approximately 200 of Minnesota's municipalities are responsible for stormwater management according to the conditions of NPDES stormwater permits. Stormwater in communities not subject to stormwater permits is managed according to nonpoint source best management practices.
- Publicly owned wastewater treatment facilities with flows less than 10,000 gallons per day (approximately 30 households) and land based disposal. These facilities are not issued NPDES or SDS permits.
- Unsewered communities, which are typically very small rural communities without sewer collection and wastewater treatment systems.
- Under – sewered communities; defined by the MPCA as communities with inadequate or deteriorated sewer systems and substandard or non-existent wastewater treatment with direct discharges. Again these are typically very small rural communities. (For a discussion of the wastewater needs of unsewered and under-sewered Minnesota communities see: *Small Community Wastewater Needs in Minnesota* issued by the MPCA June, 2008 and available at: https://www.pca.state.mn.us/sites/default/files/wq-wwtp1-06.pdf

Basics of wastewater and wastewater treatment

Wastewater or sewage is generated and discharged by households, businesses and industries. A typical household generates approximately 160 - 250 gallons of wastewater per day. The majority of wastewater generated in Minnesota (approximately 75 %) is discharged to sanitary sewer collection systems and flows to municipally operated wastewater treatment facilities where it is treated and released. The remainder is discharged by households and businesses to SSTS and to privately operated, primarily industrial treatment facilities.

Wastewater is typically about 99% water and 1% organic matter, solids, nutrients, potentially disease-causing organisms and other pollutants. These materials are suspended and dissolved in the wastewater. Sewage treatment is a multi-stage process to reduce or eliminate pollutants and nutrients before the treated wastewater is discharged to a river, lake, stream or wetland, land applied or reused. The wastewater treatment process screens out debris and separates suspended solids and greases from the wastewater. One or more biological treatment processes are then used to remove dissolved organic matter from wastewater. Together this series of processes is defined as *secondary treatment*. Depending upon the need to address specific pollutants or to ameliorate particular conditions in receiving waters advanced treatment may also be required. *Advance treatment* typically focuses on a specific pollutant or nutrient such as phosphorous. Wastewater treatment processes range from the relatively simple (stabilization ponds) to very complex (activated sludge treatment facilities), but all require careful operation and management to ensure the protection of the water body that receives the discharge. In wastewater treatment plants, trained operators measure and monitor the incoming sewage, the treatment process and the final effluent which is discharged to the lakes and streams of Minnesota. These operators are licensed and certified by the MPCA.

Minnesota's waters are affected by pollutants from three primary sources: Point source pollution which includes discharges from wastewater treatment facilities; nonpoint pollution which includes stormwater and runoff from other land use activities such as agriculture and forestry, and; atmospheric deposition. Each receiving body of water has limits to the amount of pollutants it can receive without degradation. These limits are carefully identified and defined as the Total Maximum Daily Load (TMDL) of the receiving waters. Accordingly, each sewage treatment plant has a permit stipulating the allowable levels of pollutants in the treated discharge. The majority of Minnesota's wastewater treatment facilities operate according to United States Environmental Protection Agency (EPA), NPDES permits. These permits are issued by the MPCA according to a delegation agreement with the EPA. Treatment facilities that discharge to land using, for example, spray irrigation, receive SDS permits instead of NPDES permits.

SSTS systems do not receive NPDES or SDS discharge permits. Instead water quality and public health goals and standards are maintained through a program for registering and licensing those who install, inspect, and maintain SSTS systems and by local government permits and inspections of design, installation and operation. SSTS installation and maintenance contractors are registered and licensed by the MPCA and participate in ongoing training and education programs provided by the MPCA and the University of Minnesota Extension.

State water quality standards

Minnesota Stat. § 115.03, subd. 9(4) requires the listing of "…existing and proposed state water quality standards which are more stringent than is necessary to comply with federal law, either because the standard has no applicable federal water quality criteria, or because the standard is more stringent than the applicable federal water quality criteria." While the federal Clean Water Act (CWA) establishes the requirements to develop and implement standards and the procedures for doing so, the details of water quality protection are left up to the states. This recognizes the "place-based" nature of water quality protection – water bodies in different areas have different characteristics, support different uses and react differently to pollutants; therefore, different standards are needed to protect those diverse water bodies. Given this, there are effectively no separate state of Minnesota water quality standards proposed or in existence that exceed federal standards; Minnesota's standards are developed to protect the uses of Minnesota's waters in conformance with the federal CWA requirements.

In general, Minnesota's water quality standards are developed following one of two pathways. Often, the EPA develops national numeric water quality criteria, and the MPCA adopts water quality standards based on these national criteria by tailoring them to local conditions (such as using only data from freshwater species). Where federal criteria do not exist, states may still need to adopt numeric standards to meet the federal requirement of protecting designated uses.

For example, in Minnesota where wild rice is an important component of the aquatic life community of many waters and is a resource of cultural significance, the state has adopted a standard to protect wild rice from impacts due to excess sulfate. Such a numeric standard does not exist at the federal level, but it fulfills the federal requirement of protecting existing and designated uses. Similarly, Minnesota has adopted nutrient standards to protect lakes from nutrient enrichment, which affects recreational suitability and aquatic life. Minnesota's standards are based on Minnesota-specific conditions and considerations, since lakes in Minnesota are different than lakes in Iowa or South Dakota.

In adopting these standards, MPCA has not gone beyond federal regulations. Federal regulations require states to protect designated uses such as swimming and fishing; federal regulations also establish procedures for developing standards to achieve the required protections. The MPCA follows these procedures.

Types of infrastructure costs: capital costs, operation, and maintenance costs

While this report focuses on future capital costs, publicly owned and operated wastewater treatment and collection systems are subject to both capital costs and operation and maintenance costs. Capital costs are for constructing wastewater infrastructure, rehabilitations, improvements, and expansions. Operation and maintenance costs include personnel costs and the costs of chemicals, supplies, laboratory analysis, power, equipment repair, and replacement, etc.

Capital cost increases result from one or some combination of the following factors:

- Infrastructure rehabilitation and replacement
- Community growth and corresponding infrastructure expansion
- Development of systems to address wastewater collection and treatment in unsewered and under-sewered communities
- Treatment facility upgrades to meet new and/or more restrictive wastewater discharge standards (i.e., NPDES and SDS permit conditions and requirements or implementation of TMDLs)

Operation and maintenance cost increases are attributable to:

- Changes in operation and maintenance procedures resulting from capital changes
- Expansion of treatment facility systems and processes
- Collection system expansions
- Inflation
- Changes in operation and maintenance to achieve new and/or more restrictive discharge standards

Capital projects are identified in the report as follows:

- Sewer System Projects – Projects involving the rehabilitation, construction and/or expansion of existing sewer collection and interceptor sewer systems and projects to correct infiltration and inflow and/or combined sewer overflows. Infiltration and Inflow is stormwater and ground water that enters sanitary sewers through leaks or through the direct connection of, for example, roof downspouts. Combined Sewer Overflows (CSOs) are discharge points in a sewer system that are utilized to release untreated sewage to rivers, lakes and streams when wastewater flow in combination with stormwater runoff exceeds the capacity of wastewater treatment facilities. Sewer collection systems constructed prior to the 1950s typically combined the collection of sanitary wastes and stormwater. During storms when stormwater runoff is high, these combined systems generate flows that exceed the capacity of treatment facilities. The primary solution to this problem is to construct separate sanitary and storm sewer systems.
- Wastewater Treatment Projects – The construction, improvement, expansion of treatment facilities/works/plants for the secondary and advanced treatment of wastewater to meet water quality standards.

Data sources

The data in this report have been acquired from sources including:

The 2015 Wastewater Infrastructure Needs Survey (WINS)
The 2015 WINS survey was mailed to communities and sanitary districts in late April 2015 with completed surveys being received and data entered through mid-August. Communities are required to complete the WINS survey biennially as a part of their NPDES and SDS permit conditions. This information is acquired so that the State can identify future wastewater infrastructure needs over the next 20 years. The needs of specific communities as reported in the 2015 WINS survey are provided in Appendices 1 and 2.

The State Fiscal Year 2016 Project Priority List September 2016
The Clean Water Project Priority List (PPL) consists of project proposals submitted to the MPCA by communities and sanitary districts seeking financial assistance for sewer and wastewater treatment construction projects and for stormwater projects. Proposals include information describing and supporting the needs that will be addressed by the project. The MPCA prepares the PPL annually by ranking project proposals according to environmental criteria defined by Minn. R. ch. 7077. The PPL is then used by the Public Facilities Authority (PFA) to award grants and low-interest loans. The State Fiscal Year (SFY) 2016 PPL is included as Appendix 3 of this Report. For information regarding PFA grants and loans the website is: http://mn.gov/deed/government/public-facilities/funds-programs/

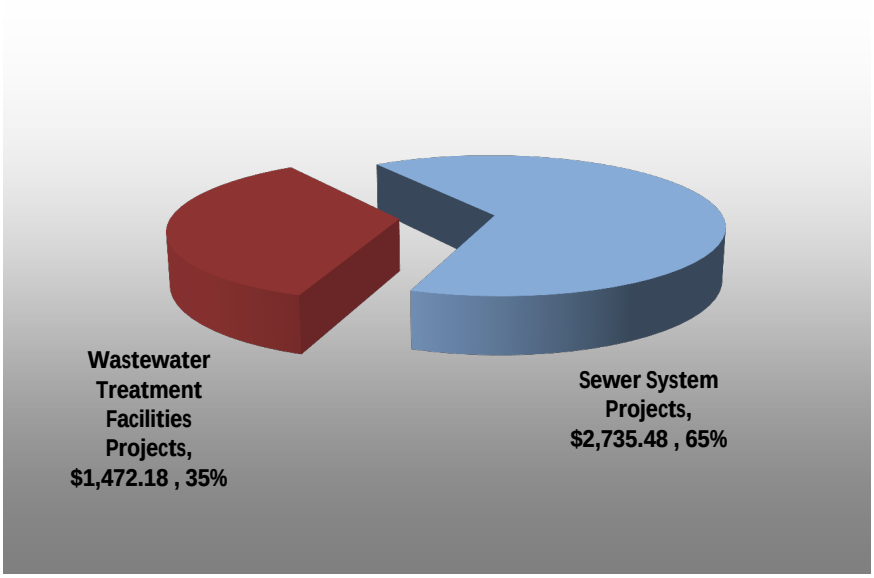
Wastewater infrastructure needs addressed by 2016 PPL project proposals for wastewater projects are a subset of, and represent approximately 22% of the total number of wastewater project proposals and 30% of the overall costs identified by the 2015 WINS Survey.

Wastewater infrastructure needs and capital costs

This section provides summary information on future wastewater infrastructure needs and corresponding capital costs facing Minnesota communities and sanitary districts. The summary data is based on over 1,350 wastewater infrastructure projects identified as future needs in the 2015 WINS survey and/or listed on the current SFY 2016 PPL. Summaries are provided statewide according to types of need (e.g., treatment facilities projects, sewer rehabilitation, etc.), the contrasting needs of Greater Minnesota and the Twin Cities Metropolitan Area, Minnesota's Economic Development Regions, and the proposer's projected time frame (i.e., current 0-5 years, 5-10 years, 10-20 years). The following charts and tables provide a basic overview of the projected $4,207.66 million[1] in in wastewater infrastructure needs. The specific needs of individual communities as reported in the 2015 WINS survey are summarized by Economic Development Regions and counties in Appendix 1; and according to needs, projects, costs, and affordability in Appendix 2.

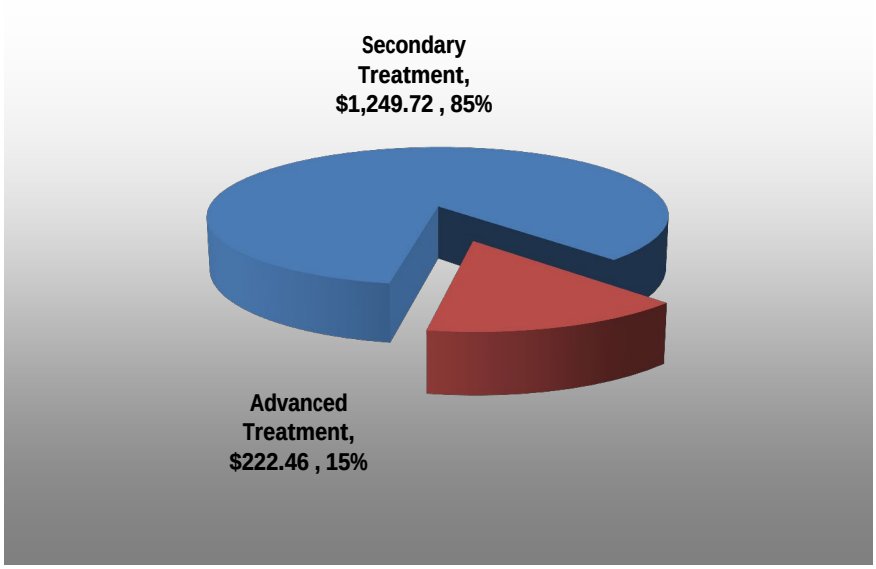
[1] The reported $4,207.66 million of overall need of the 2016 Report compares to reported needs of previous years (in millions) as follows: 2014 - $3,986.77; 2012 - $3,658; 2010 - $4,340; 2008 - $4,526.57; 2006 - $3,483.59 and 2004 - $2,539.28. The general congruence of needs from 2010 through 2016 suggest that the substantial increases in identified needs over the period 2004 to 2008 should not be understood as representing an actual "on the ground" approximately 80% increase in infrastructure need over a four year period. Rather they are primarily the result of an increase in the number of communities responding to the WINS survey and improvements in the quality of responses with participating communities and sanitary districts providing more thorough and complete responses.

Chart 1: Statewide wastewater infrastructure needs by project type
Total need = $4,207.66 (millions)



The $1,472.18 million dollars in wastewater treatment project costs for the rehabilitation, improvement and expansion of wastewater treatment facilities and processes are distributed between secondary and advanced treatment[2] as indicated in Chart 2 (below):

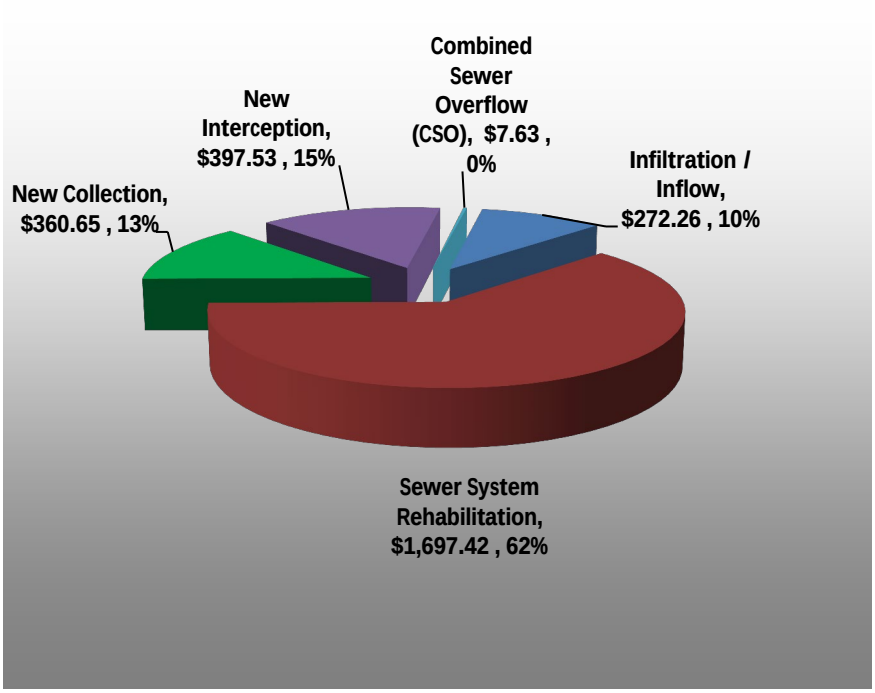
Chart 2: Statewide distribution of wastewater treatment facility needs according to secondary and advanced treatment (millions)



Of the $2,735.48 million dollars of sewer system projects to rehabilitate, improve and expand sewer collection and interceptor systems, costs are distributed as indicated in Chart 3:

[2] For descriptions of secondary and advanced treatment please see pages 9-10.

Chart 3: Statewide distribution of sewer system needs by type of sewer project (millions)



Greater Minnesota needs and MCES service area needs

This section provides summary information on future wastewater infrastructure needs and capital costs facing Greater Minnesota, as compared to the Metropolitan Twin Cities. Metropolitan area wastewater infrastructure needs and capital costs are those of MCES and the corresponding sanitary sewer system needs of Twin Cities communities (i.e. MCES Service Area Communities) receiving wastewater treatment and interceptor services from MCES*.

Chart 4: Distribution of $4,207.66 million statewide need between Greater Minnesota and the MCES and MCES Service Area Communities (millions)

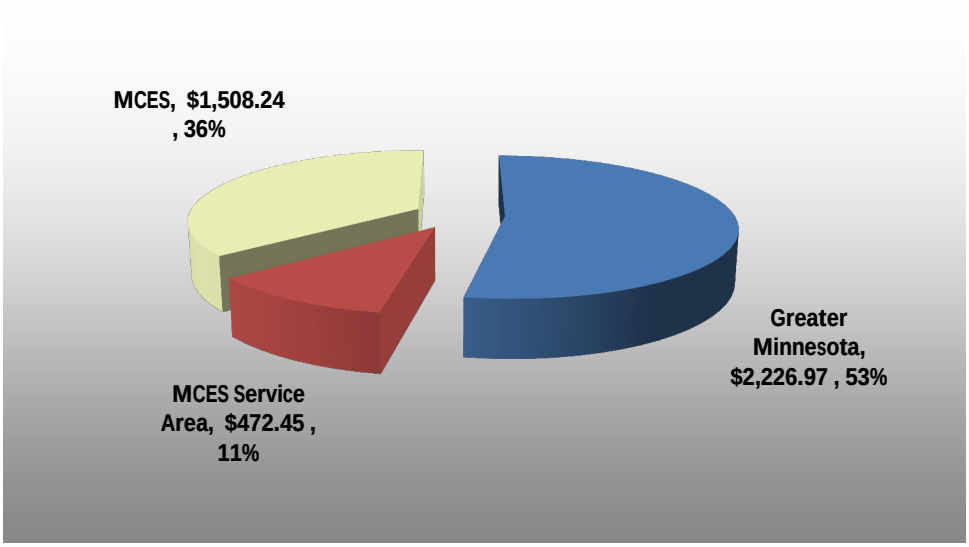
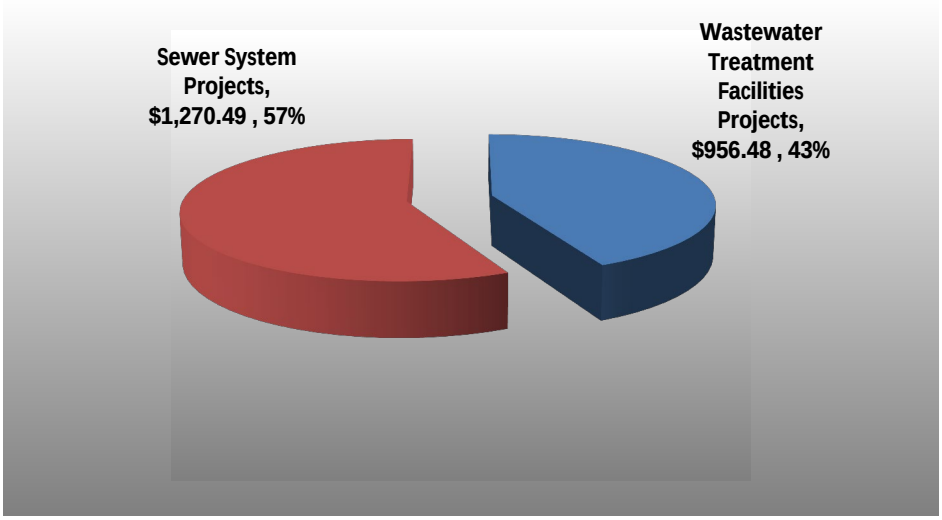


Chart 5: Greater Minnesota wastewater infrastructure needs by project type -- total Greater Minnesota need = $2,226.97 (millions)



*The MCES service area encompasses approximately 112 communities serving a total population of: 2,608,072, 51% of the State's total population (2010 US Census) See Appendix 4 for a list of MCES Service Area Communities.

Chart 6: Greater Minnesota wastewater infrastructure needs by treatment facilities and sewer system type -- total Greater Minnesota need = $2,226.97 (millions)

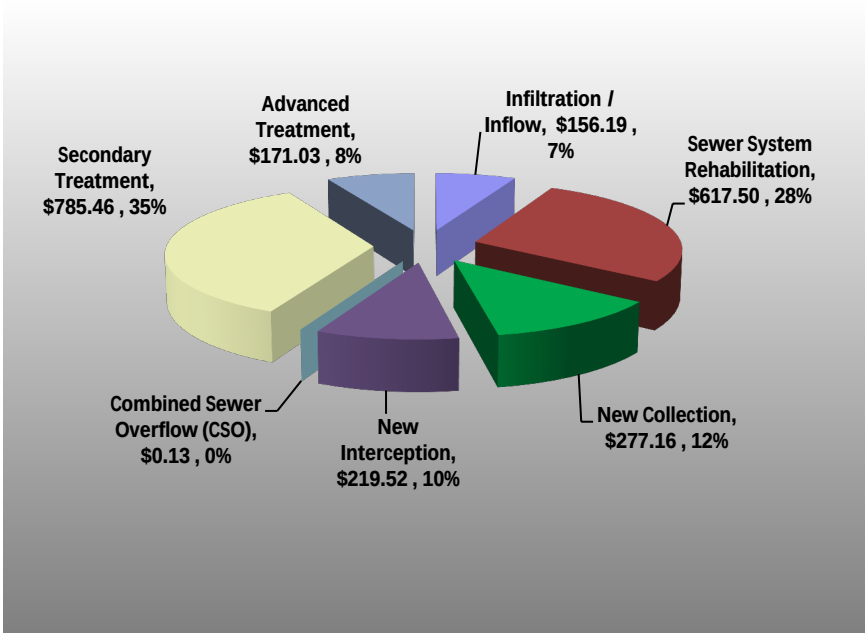
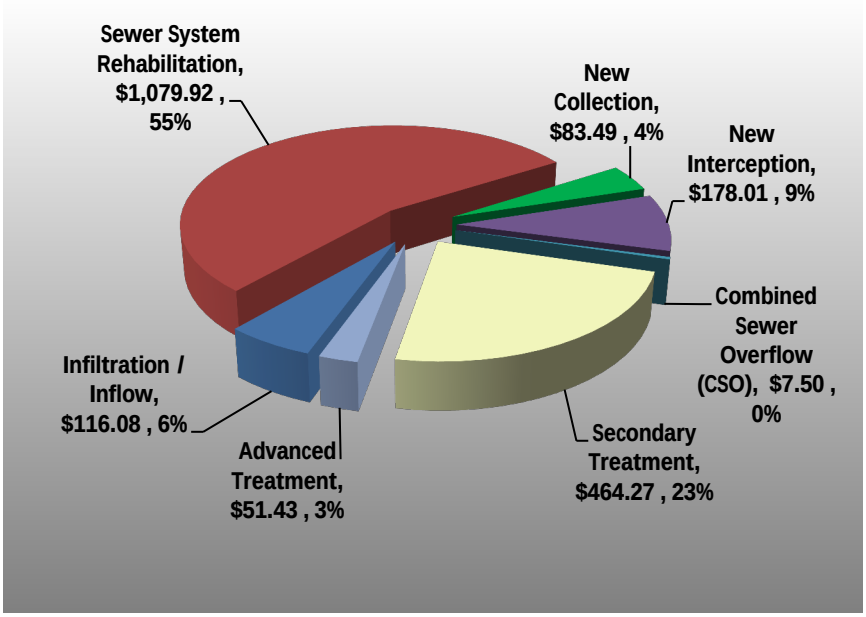


Chart 7: MCES and MCES Service Area Communities wastewater infrastructure needs by treatment facilities and sewer system type – total need = $1,980.69 (millions) *

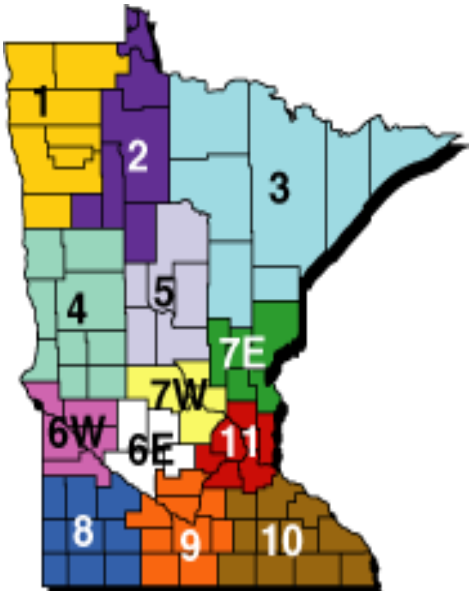


* The comparatively low percentages for "New Collection" may be influenced by a widespread local community policy of requiring residential developers to incorporate wastewater collection construction into development projects. Consequently such capital costs are not reported to the WINS survey which only identifies *public* needs. Also note that approximately 94% of the $343.05 of New Interceptor needs is attributable to MCES.

Needs by economic development region

Table 1: Projected wastewater infrastructure needs by Minnesota's Economic Development Regions [UPDATED]

Economic Development Regions (EDR)	Projected Wastewater Infrastructure Needs ($ million)
1	48.38
2	60.13
3	379.13
4	192.49
5	88.84
6E	134.27
6W	52.98
7E*	101.68
7W*	348.69
8	246.00
9	134.45
10	294.46
11**	2,126.16
Statewide Total:	4,207.66



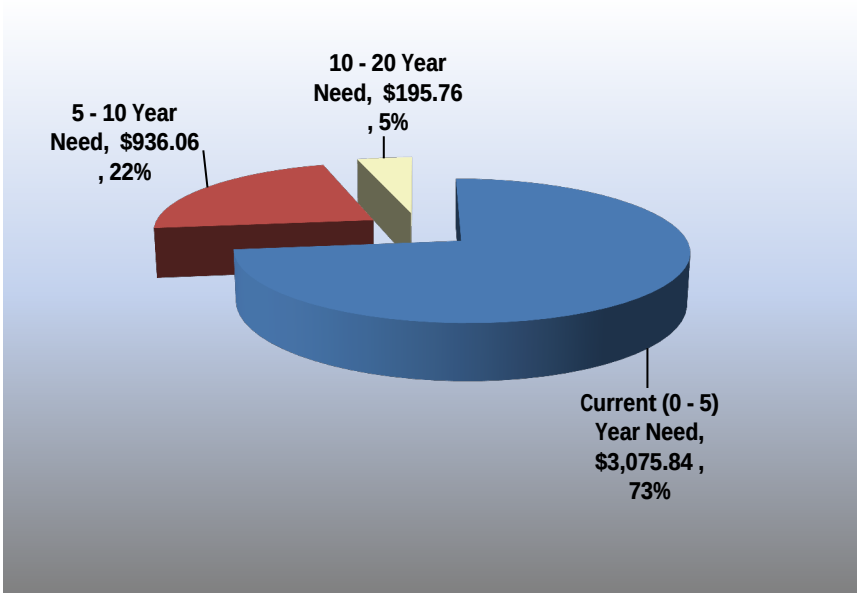
EDR # 1	Lake of the Woods
Kittson	Mahnomen
Marshall	EDR # 3
Norman	Aitkin
Pennington	Carlton
Polk	Cook
Red Lake	Itasca
Roseau	Koochiching
EDR # 2	Lake
Beltrami	St. Louis
Clearwater	EDR # 4
Hubbard	Becker

* EDRs 7E & 7W include three Twin Cities Metro Counties: Chisago, Sherburne, and Wright
** Twin Cities Metropolitan Area (*includes Metropolitan Council Environmental Services (MCES), MCES Service Area Communities and also a number of projects in exurban communities being integrated into the MCES Service Area.*

Statewide needs by timeframe

Chart 8 below, illustrates wastewater infrastructure needs according to time frames. As indicated, the majority of costs are identified as current needs. Infrastructure costs of 5-10 years and 10-20 years may be underrepresented, in part because such costs are unanticipated. In addition, many communities, particularly smaller communities, lack the planning and fiscal resources to engage in strategic and comprehensive capital improvement planning. (See "Appendix 5: Survey Responses and Methodological Considerations" for further discussion of this point.)

Chart 8: Wastewater infrastructure needs by time frame (millions)



Completed wastewater infrastructure projects 2014 - 2015

During the two year period from January 1, 2014, through December 31, 2015, a total of 541 wastewater infrastructure projects were completed throughout Minnesota for a total cost of $1,190.07 million. The distribution of costs and projects between Greater Minnesota, MCES and MCES service area communities are as indicated on the chart below. Note that costs are overall project totals for projects activities during the time period indicated. Multi-year projects may have been initiated and costs incurred prior to January 1, 2014.

Chart 9: Distribution of $1,190.07 (millions) of completed projects between Greater Minnesota, MCES and MCES Service Area Communities

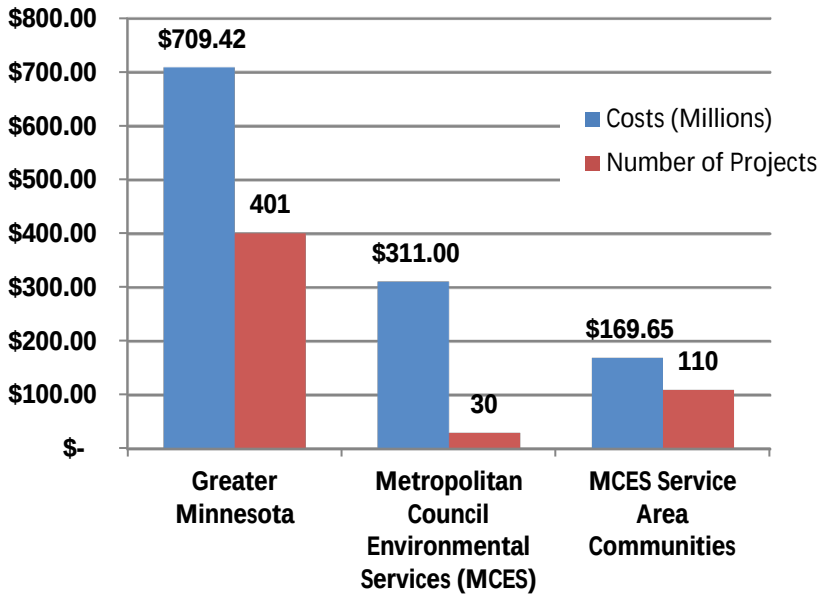


Chart 10 indicates that from Jan. 1, 2014 to Dec. 31, 2015 Greater Minnesota improvements focused on sewer system rehabilitation (along with I/I correction) and on rehabilitation and improvement of secondary treatment.

Chart 10: Distribution of $709.42 (millions) of completed projects in Greater Minnesota

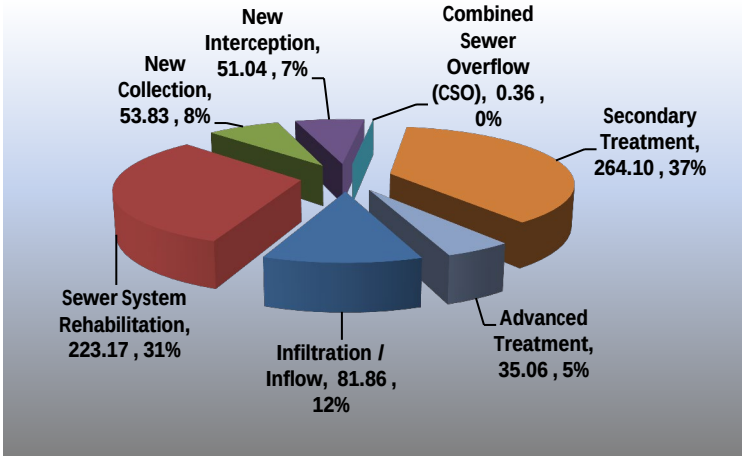


Chart 11 indicates improvements by MCES Service Area Communities from Jan. 1, 2014 through Dec. 31, 2015 focused primarily on I/I correction and sewer rehabilitation.

Chart 11: Distribution of $169.65 of completed projects in the MCES Service Area (in millions)

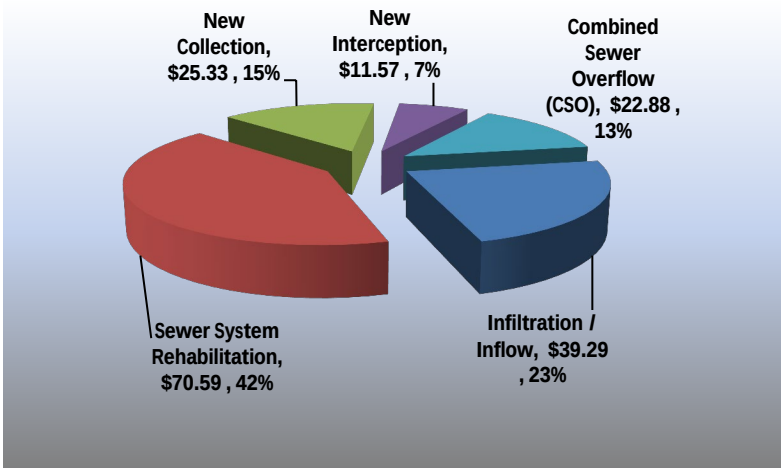
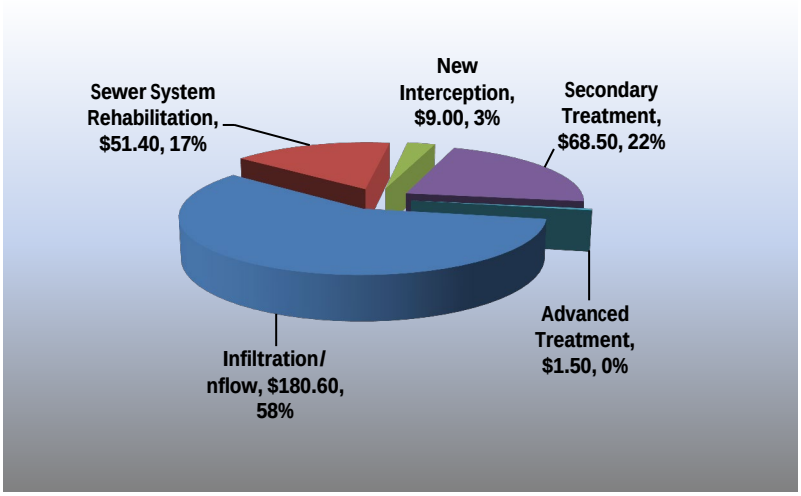


Chart 12 indicates construction activities by MCES from January 1, 2014, through December 31, 2015, focused on I/I.

Chart 12: Distribution of $311.00 of completed MCES improvement projects (in millions)



Wastewater infrastructure needs, household costs, and affordability

This section provides summary information on household costs and a comparative measure of affordability of wastewater infrastructure projects. In determining the effects of infrastructure costs on households, the following assumptions have been made:

- Current (0 – 5 yr.) projects are assigned an estimated market rate loan of 2.69% over 20 years.
- Residential connections are assumed to be responsible for providing 90% of the debt service payments for individual communities and projects. This general assumption may not apply to specific communities where, for example, a treatment facility's expansion is being funded by industrial development, in which case the residential share of a project could be considerably less than 90%.

- With sewer system collection or interceptor costs, affordability figures assume that such costs are spread across the entire community at 90% for residential connections, whereas such costs may in fact be localized and limited within communities and paid according to special assessments.

Chart 13 below is a regression analysis illustrating the relationship between population and household costs. Costs are for current (0 – 5 yrs.) infrastructure projects identified in 2015 WINS as necessary to meet existing identified sewer and wastewater treatment capital needs along with annual operation and maintenance costs. These combined household costs are presented as a percentage of annual median household income (2010 U.S. Census). The graph indicates the pronounced effect of economies of scale on household costs and affordability. The Minnesota PFA uses 1.4% of median household income as a wastewater costs affordability index for Minnesota communities. As indicated, a community characteristically needs a population of approximately 750 to achieve an affordability index of 1.4%.

Chart 13: Current wastewater infrastructure projects: household capital and operational cost as a percentage (%) of median household income for communities according to population

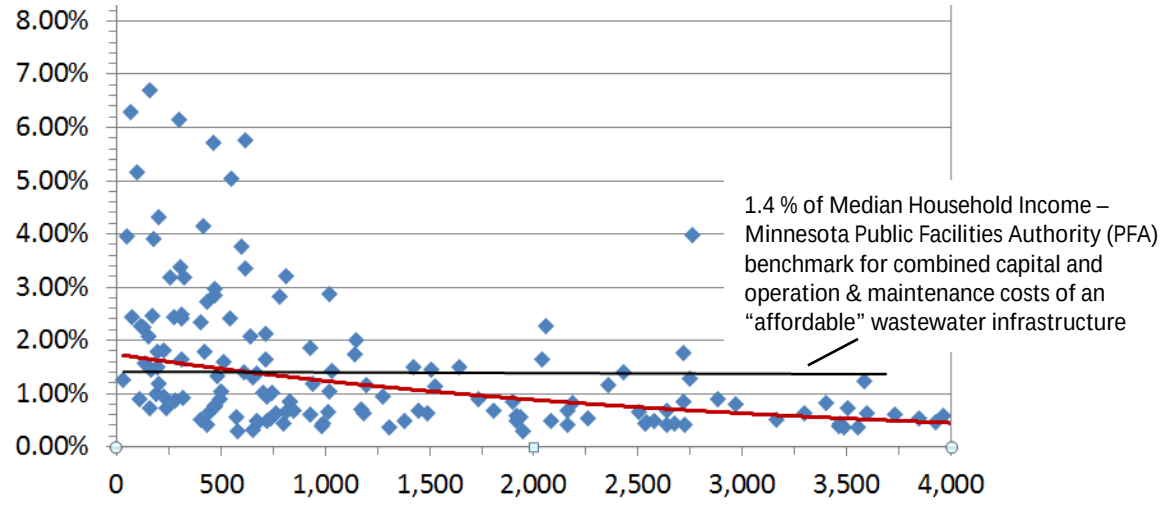
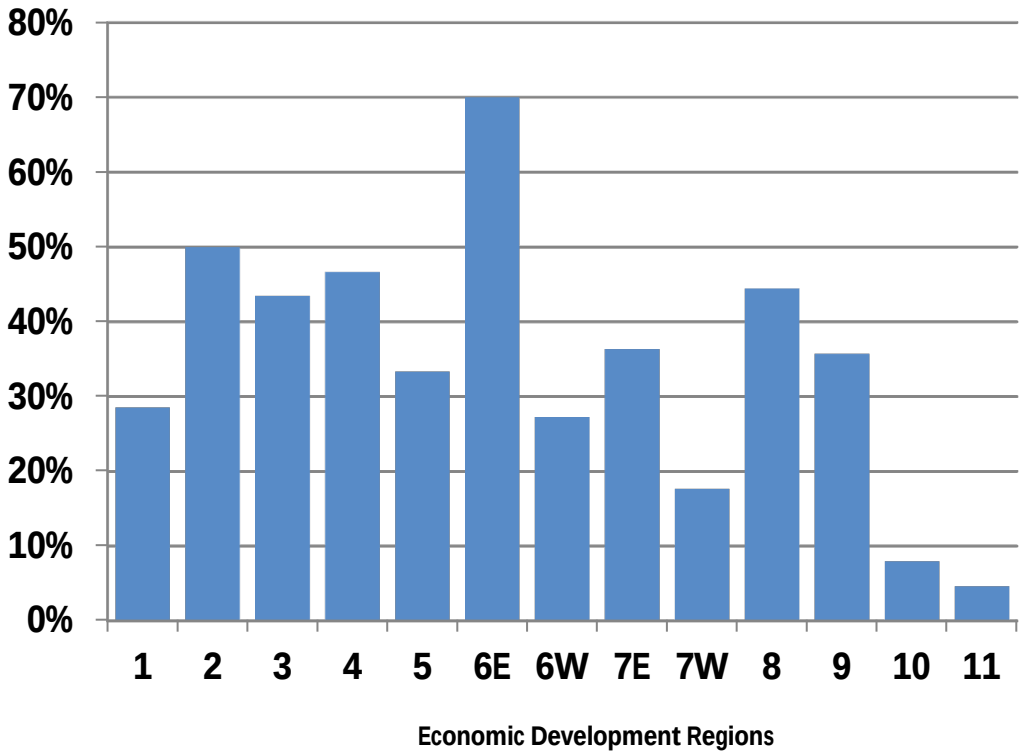


Chart 14 below indicates within each Economic Development Region (EDR) the percentage of communities responding to the WINS survey where the cost of paying for current (0 – 5 yrs.) wastewater infrastructure needs along with operating and maintenance costs exceed 1.4 percent of median household income. (A table listing counties by EDR is provided on page 17)

Chart 14: Percentage of communities with wastewater infrastructure needs exceeding 1.4% of median household income



Age and condition of existing wastewater Infrastructure

A report by the American Society of Civil Engineers (ASCE) issued February, 2007 describes the nation's aging and deteriorated wastewater infrastructure in which overloaded and inadequate systems "discharge billions of gallons of untreated sewage into U.S. surface waters each year." [3] The report notes that many collection systems have reached the end of their useful lives and blocked or broken pipes result in the release of raw sewage. The report goes on to cite estimates that a national investment of $390 billion will be required over the next 20 years to replace existing systems and build new ones to meet increasing demands. How does Minnesota compare to the rest of the nation when it comes to the age and condition of our existing wastewater infrastructure?

Combined sewer overflows (CSO): In many areas of the U.S., particularly in major metropolitan areas at and east of the Mississippi River, sewer collection systems constructed prior to the 1950s combined the collection of sanitary wastes and stormwater. During storms when stormwater runoff is high, these combined systems generate flows that greatly exceed the capacity of treatment facilities. Consequently,

[3] Available at the ASCE website: *http://www.infrastructurereportcard.org/fact-sheet/wastewater*

overflow "relief" discharge points – CSOs – are necessary from which untreated sewage is released to rivers, lakes and streams.

Nationwide CSO discharges of untreated sewage – estimated by EPA (2004) to reach 850 billion gallons per year – continue to be an enormous water quality and public health problem. In many metropolitan areas and states, eliminating CSO discharges comprises a major share of infrastructure needs and costs. In contrast Minnesota has acted effectively to address this problem. Thanks to a concerted funding effort during the 1980s and construction during the 1980s and 1990s, CSO elimination is now a relatively minor problem. Minnesota has only one remaining CSO permit which has not reported a discharge in many years.

Aged collection sewers and treatment facilities: The age and condition of Minnesota's collection sewer systems and treatment facilities varies between communities but is primarily a contrast between Greater Minnesota and the Twin Cities MCES service area. In Greater Minnesota the age of collection sewer systems and wastewater treatment facilities suggests that aged infrastructure is significant and extensive and represents an important challenge.

The expected useful life of sewer piping manufactured and installed is approximately 40-80 years. Factors including soils, geological conditions, flows, loadings, maintenance and the deterioration of materials will determine the actual life of particular installations. The ongoing condition and serviceability of sewers will vary on a case-by-case basis but performance can be enhanced and extended through effective programs of inspection, maintenance, repair, relining and rehabilitation. Chart 15 "Greater Minnesota Age of Collection Sewer Systems" presents the age of collection sewers in Greater Minnesota. As indicated, 44% of sewers in Greater Minnesota are less than 30 years old, 25% are 30 – 50 years old, and 31% of Greater Minnesota sewers were installed over 50 years ago.

Sewers installed over fifty years ago are frequently beyond their useful life in part because many such systems were constructed of vitrified clay tiles that are not as durable and do not perform at current standards. Accordingly substantial infiltration, inflow, outflow, obstruction and other performance problems tend to be pervasive. Based on current levels of investment in major sewer rehabilitation and replacement – as documented in WINS surveys received – it appears that there may be a significant gap in Greater Minnesota between the deterioration and the replacement of aged collection sewers.

Available at the ASCE website: http://www.infrastructurereportcard.org/wastewater/

Chart 15: Greater Minnesota - Age of Collection Sewer Systems (9,965 miles of sewers surveyed) [Updated]

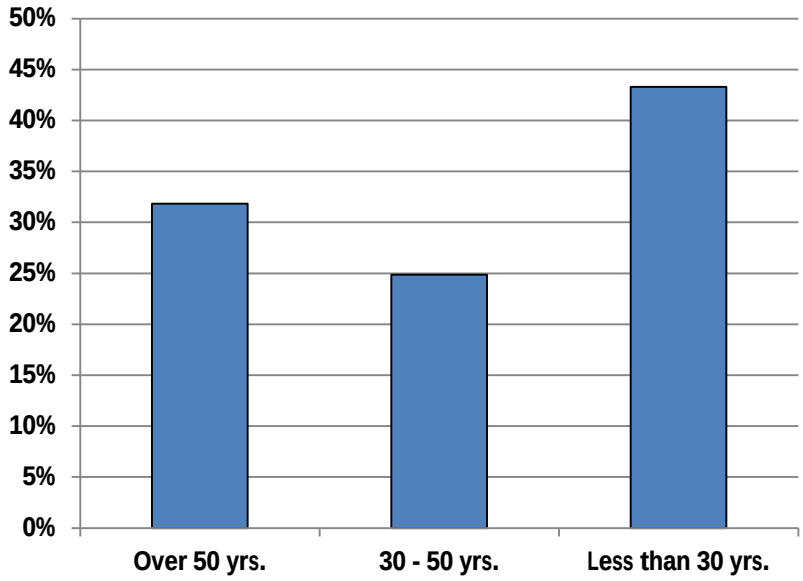
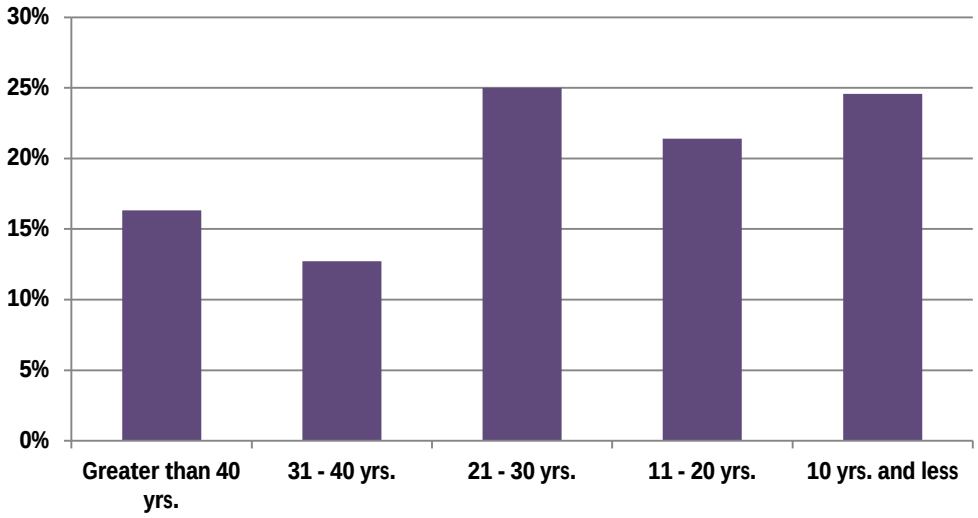


Chart 16 "Greater Minnesota Age of Wastewater Treatment Facilities" indicates the age of treatment facilities in Greater Minnesota.

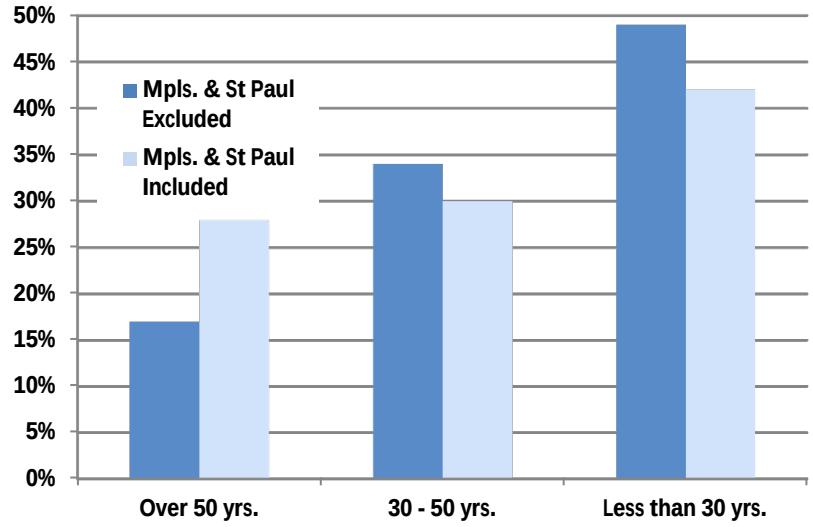
Chart 16: Greater Minnesota - Age of Wastewater Treatment Facilities (472 facilities surveyed)



Major structural components of wastewater treatment facilities have an expected useful life of 40 years – dependent in part on operation and maintenance. As these structures deteriorate beyond their useful life effectiveness declines leading to a greater potential for: permit violations, spills and related unintended discharges and additional operational and maintenance expenses. While at this point in time 16% of Greater Minnesota's treatment facilities are over 40 years old, in 10 years without reconstruction projects the percentage would reach approximately 28%. This scenario would likely result in significantly increased infrastructure demands and costs.

In the Twin Cities, local communities collect sewage from households, businesses, etc. and then route it to the appropriate MCES interceptors. MCES operates an extensive interceptor system conveying wastewater to its treatment facilities for treatment and discharge. Given the overall scale and the extensive revenue base of MCES, the MCES system is managed for scheduled rehabilitation and improvements according to extensive long term capital improvement planning. Consequently within the Twin Cities Metropolitan Area, local community collection sewers comprise the primary consideration relative to aged and deteriorated wastewater infrastructure. The age of collection sewers in the Twin Cities Metropolitan Area, excluding and including Minneapolis and St. Paul (MSP), is indicated by Chart 17 "MCES Communities (excluding and including MSP) Age of Collection Sewer Systems"

Chart 17: MCES communities (excluding and including MSP) – Age of Collection Sewer Systems
MCES Communities (excluding MSP) – 8,239 miles of sewers
MSP – 1,578 miles of sewers



The *dark blue bars* in Chart 17 indicate the age of Twin Cities Metropolitan Area community collection sewer systems with Minneapolis and St. Paul *excluded*. The *light blue bars* indicate the comparative data when Minneapolis and St. Paul are *included*. The reason for presenting MCES service area data with and without the Twin Cities is as follows: a) Minneapolis and St. Paul have Capital Improvement Plans in place to rehabilitate collection sewers that were not a part of the circa 1980s and 1990s CSO program and, b) While not minimizing the very substantial investments and the costs being incurred by Minneapolis and St. Paul, these communities have the economies of scale and the established financial resources to complete these projects and are making and planning to continue to make substantial progress in rehabilitating and replacing older sewers. Accordingly, in the Twin Cities Metropolitan Area outside of the cities of Minneapolis and St. Paul, 17% of collection sewers (1,410 miles) were installed 50 or more years ago. Thus on average suburban MCES Service Area Communities have a comparatively small percentage of sewers constructed over 50 years ago. However this average conceals substantial percentages of 50 years plus sewers in older communities located in the metro area, including: Richfield, St Louis Park, Excelsior, Falcon Heights, and Roseville.

The age of the collection sewer systems and wastewater treatment facilities of specific communities as reported in the 2015 WINS survey are provided in Appendix 6.

Estimating future costs

A number of factors influence the variability between reported estimates of future costs and the actual costs of infrastructure improvements encountered during construction. There are also conditions affecting the availability and timeliness of cost estimates.

The timeframe from when a need is identified and costs are estimated to the completion of construction consists of several phases:

- Recognition of need
- Facilities planning
- Plans and specifications
- Bidding and construction

The WINS survey uses three timeframes for cost estimates:

- Current needs (immediate needs up to 5 years)
- 5 – 10 year needs
- 10 – 20 year needs

The longer the timeframe from the initial estimate of future costs to the actual date of construction, the greater the likelihood of variability between the initial estimate and the actual construction costs. Correspondingly, as an anticipated project moves from initial planning to facility planning to the development of construction plans and specifications, cost estimates will become more detailed, refined and precise. There are, however, exceptions to this overall process.

Conditions affecting the availability and timeliness of cost information include:

Cost estimates from active projects
Communities that have already identified a wastewater need and are actively planning and developing a project will characteristically have readily available needs and cost information. Such information is likely to be both reasonably accurate and up-to-date. Accordingly, projects currently on the PPL are more likely to have readily available and well-developed cost information than communities not yet actively engaged in assessing and addressing needs.

Community capabilities, resources, and expertise
Correspondingly, the accuracy of future cost estimates are also affected by the availability of resources and expertise to:

- Effectively monitor, survey, and track the condition of existing infrastructure and ascertain the need for rehabilitation and replacement.
- Engage in strategic planning to address growth and expanding capacity needs.
- Estimate project costs, including architectural and engineering specifications, construction costs planning and project administration.

Given these factors, the capability of a community or sanitary district to estimate the future costs of wastewater treatment has to do with the availability of resources and expertise. The availability of resources and expertise is, in turn, dependent upon the number of connections and the economies of scale within a community or sanitary district. In general, as the population of a service area exceeds 1,000 residents, it becomes increasingly feasible for communities and sanitary districts to engage in capital improvement planning for wastewater infrastructure. A comprehensive approach implemented

by a number of communities – known as *Asset Management Planning* – involves carefully maintaining while closely monitoring system components to gain the efficiencies of maximum useful life and systematic, scheduled replacement. Smaller communities that are not faced with an immediate need tend to lack the resources required to exercise the technical and administrative capabilities necessary to survey and plan for infrastructure improvements. For additional comments on estimating future costs please see Appendix 5: Survey Responses and Methodological Considerations.

Average monthly residential sewer charges

Responding to the 2015 WINS Survey, 660 communities identified what they charged for sewer service for an average or typical residential connection at an assumed volume of 60,000 gallons annually / approximately 164 gallons per day. The following table provides various statistical parameters for average monthly residential sewer charges in Greater Minnesota and in the MCES Service Area. Greater Minnesota charges are reported by a series of population ranges. The sewer charges of individual communities as reported in response to WINS are listed alphabetically by community and also from highest to lowest charge in *Appendix 7 Average Monthly Residential Sewer Charges*.

Greater Minnesota					
Community Pop.	**Average**	**Median**	**High**	**Low**	**Range**
Under 500	$ 30.67	$ 30.00	$ 102.05	$ 1.67	$ 100.38
500 to 999	$ 35.79	$ 35.00	$ 185.00	$ 8.17	$ 176.83
1,000 to 2,499	$ 37.56	$ 34.95	$ 96.90	$ 12.50	$ 84.40
2,500 to 4,999	$ 36.25	$ 36.95	$ 83.00	$ 13.30	$ 69.70
5,000 to 9,999	$ 40.67	$ 31.82	$ 88.33	$ 10.25	$ 78.09
10,000 to 24,999	$ 33.09	$ 28.09	$ 46.50	$ 15.37	$ 31.13
25,000 and Over	$ 26.91	$ 27.45	$ 42.69	$ 16.42	$ 26.27
MCES Service Area (All Communities)					
	Average	**Median**	**High**	**Low**	**Range**
	$ 23.23	$ 27.45	$ 56.00	$ 10.23	$ 45.77

Variability of residential sewer charges

The overall range of sewer charges collected by Minnesota communities is considerable. The city of Lanesboro, which has the highest reported residential sewer charges in the State (as reported in 2015 WINS) collected $185.00 monthly as compared to several communities that charge less than $2.50 monthly. While this is the most dramatic contrast, *the variability of charges is the most pronounced characteristic of what local communities collect for sewer use*. Note that on the Table, the smallest range of sewer charges (from highest to lowest) is that of Greater Minnesota communities with a population 25,000 and over and yet even for this group the highest charge is almost 3 times the lowest. Moreover even if we exclude the range of charges of 37 times (from lowest to highest) represented by Lanesboro (i.e., Greater Minnesota communities with populations 500 to 999) and substitute the next

highest monthly charge of $116.25 (Clear Lake) for this group, the typical range as identified in the table for Greater Minnesota is that the highest charge is 13 times the lowest while for the MCES communities the value is approximately five. This remarkable variability of costs can be both puzzling and a matter of significant concern to the residents of a community facing sewer charges that are several times those of a neighboring community – where the neighbor is otherwise quite similar in population and other characteristics. Here are a number of factors that help to account for the variability of charges:

- **Stage in the life cycle** – If Community #1 has recently constructed a new treatment facilities either for the first time or to replace a deteriorated facility, and has correspondingly made major improvements to its collection system, it's residential sewer charges are likely to be quite high; particularly if compared to Community #2 that has fully retired the debt on its existing treatment facility and collection system. Such differences in stage of the life cycle can result in what are perhaps the most dramatic contrasts in sewer charges.
- **Economies of scale** – In constructing wastewater infrastructure, particularly treatment facilities, there are certain threshold costs that must be met to build, for example treatment ponds serving a population of 500. Once these costs are met, it is incrementally less expensive to construct expanded ponds that will serve a population of 1,000 or 1,500. The costs of such expanded ponds in more populous communities can then be "spread out" over a large base of residential customers. As a result, residential customers in smaller communities will likely face higher sewer charges.
- **Population densities and the structure of communities** – In providing sewer collection services, population densities and the physical structure of a community can have a significant impact on capital costs, and to a lesser extent operation and maintenance costs. Consider for example an older, developed St. Paul or Minneapolis neighborhood where residential structures are adjacent on small lots and streets are laid out on a grid – as compared to a suburban or exurban community with very large lots, winding streets, or a community built up around a lake or a small town with scattered development. Clearly the older city grid structure will have lower capital and maintenance costs which should affect residential sewer charges.
- **Meeting permit requirements** – Treatment facilities that fail to meet NPDES or SDS discharge permit requirements – releasing insufficiently treated discharges and excessive volumes – can, at least in the short term, be less expensive to operate, resulting in lower sewer charges. Treatment facilities fail to meet discharge requirements because of some combination of an inadequate physical plant (deteriorated structures or insufficient capacities) or failure to operate and maintain the plant properly. Failure to meet permit requirements can also be brought about by a collection sewer system where excessive infiltration and inflow results in unauthorized discharges from a treatment facilities overwhelmed by the volume of wastewater. The apparent cost "savings" of failing to meet permit requirements will actually result in higher overall costs because of fines and other penalties and because of costs of rehabilitating or replacing neglected treatment and collection systems.
- **Advanced treatment** – Implementation of the EPA – TMDL program to restore, protect, and preserve Minnesota's water resources will result in permit requirements to reduce the discharge of specific pollutants into water resources and watersheds. These advanced treatment requirements, the costs of which are included in the Report, result in additional capital and operation and maintenance expenditures and corresponding increases in residential sewer charges.
- **Asset management** – Asset management is the planned and systematic operation and maintenance of treatment facilities and collection systems structures to ensure that structures and equipment will achieve their maximum service life. While as prudent management asset management can have both short and long term benefits (e.g., avoiding the premature

replacement of a major pump or the deterioration of a tank or other major capital structure) avoiding such costly failures can result in somewhat increased ongoing operational and maintenance costs. Conversely, without effective asset management the costs of reoccurring failures and emergencies can quickly increase residential sewer charges.

- **Recover of costs through assessments and property taxes** – Communities have the option of recovering all of their wastewater costs (i.e., operation and maintenance and the capital costs of treatment facilities and collections systems) through sewer charges. Communities also choose to recover capital costs in particular through property assessments and property taxes. Clearly these choices can have a dramatic impact on residential sewer charges, where the sewer charges can be much higher in a community that recovers all of its costs through the sewer charge, as compared to a community that makes use of property assessments and property taxes – even where when added up the actual overall cost per residential connection is the same.
- **Subsidizing wastewater costs** – Although as a rule, Minnesota communities operate wastewater utilities as dedicated funds (i.e., sewer service income through charges and sewer service expenses are kept separate from other municipal funds), communities may also, on occasion subsidize wastewater costs from other city revenue (e.g., municipal liquors), resulting in residential sewer charges that are below what is required to cover costs.
- **Site availability and conditions for soil based systems** – For small communities where the cost of a conventional wastewater collection and treatment system is prohibitive, SSTS that serve individual residences, clusters of residences or the full community may be the most practicable alternative. Despite reduced costs of some of these systems, site specific conditions such as small residential lots, unsuitable soil types for treatment, or insufficient depth to high water table, may add significant costs to using a soil-based treatment alternative. Significant cost increases may also be related to discharge standards necessary to protect groundwater and related public health.

Appendices to 2016 Future Wastewater Infrastructure Needs and Capital Costs are bound as a separate document available upon request. The Table of Contents above (page 4) briefly describes the Appendices. The Report and the Appendices will also be available early 2016 at the following location on the MPCA website: https://www.pca.state.mn.us/about-mpca/legislative-reports