

SFD Lite Report

St. Louis, MO United States of America

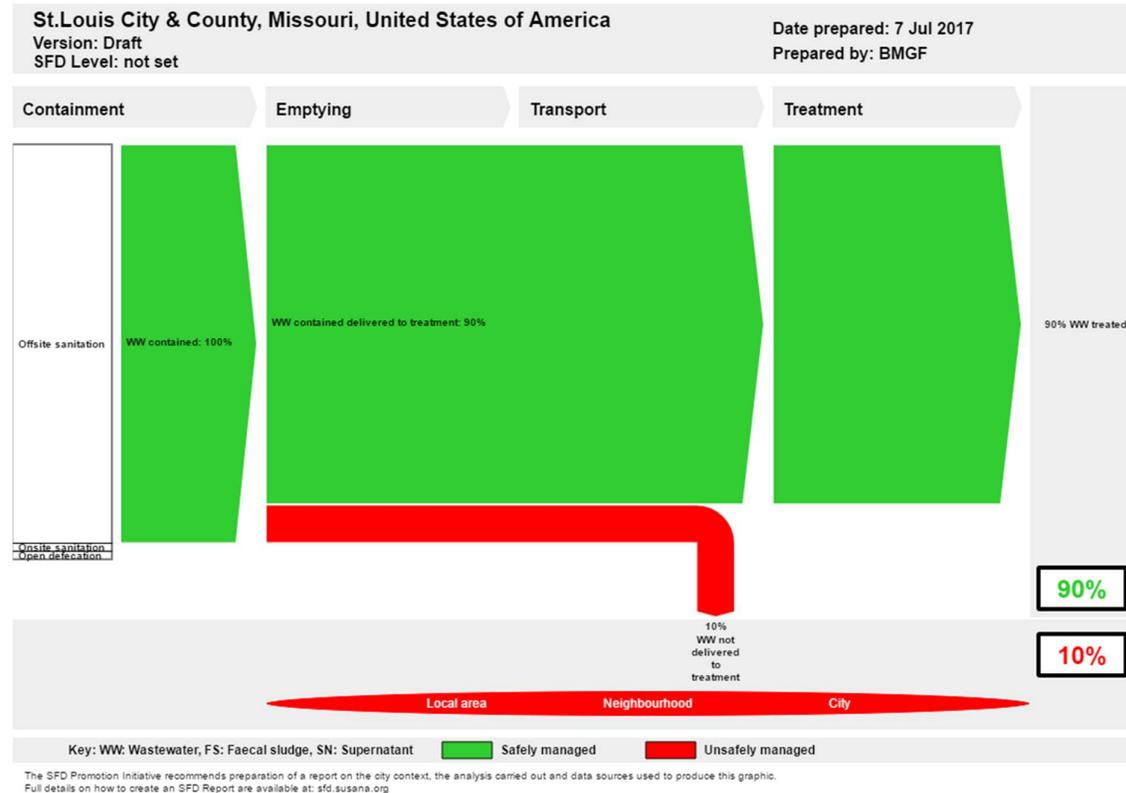
Final Report

This SFD Lite was prepared by the Bill & Melinda Gates Foundation as part of the SFD Promotion Initiative.

Date of production: 19/07/2017

Last update: 05/2018

1 The SFD Graphic



2 SFD Lite information

Produced by:

The Faecal / Excreta / Shit Flow Diagram (SFD) for St. Louis City and County was created using the SFD Generator tool on the SuSanA website through desk-based research by the Bill & Melinda Gates Foundation in Seattle, Washington.

Collaborating partners:

Metropolitan St. Louis Sewer District: Indicators monitored by the Metropolitan St. Louis Sewer district and secondary sources of data such as published statistics and annual reports were used to generate the diagram and this report.

Date of production: 19/07/2017

3 General city information

The City of St. Louis is located within the state of Missouri, USA. It is built along the western bank of the Mississippi River and has a population of about 311,000 people. The city borders St. Louis County but is not a part of it. St. Louis County has a population of about 1.003 million, making it the most populous county in Missouri. The county seat is Clayton.

St. Louis City and St. Louis County together cover an area of about 600 square miles.

The city is built primary on bluffs and terraces that rise 100 to 200 feet above the western banks of the Mississippi River, just south of the Missouri-Mississippi confluence. Much of the area is fertile and gently rolling prairie that features low hills and broad, shallow valleys. Both the Mississippi River and the Missouri River have cut large valleys with wide flood plains.

St. Louis County lies to the southwest of the city, separated from it by the River des Peres. The Missouri River forms the northern border with St. Charles County. The Meramec River forms most of its southern border with Jefferson County. To the east is the City of St. Louis and the Mississippi River. The western boundary with Franklin County. Like the City of St. Louis, the bedrock in St. Louis County is mainly limestone and dolomite, and much of the county near the rivers is Karst terrain, with numerous caves, sinkholes, and springs.

Much of the City of St. Louis and St. Louis County is a karst area, with limestone and dolomite underlying the landscape. There are also numerous sinkholes and caves as well as springs visible along the riverfront. Significant deposits of coal, brick clay, and millerite ore were once mined in the city, and the predominant surface rock, the St. Louis Limestone, is used as dimension stone and rubble for construction.

Water supply in the city and county is from streams, bedrock and alluvial aquifers that underlie the region. Most of the region's water comes from the Missouri and Meramac rivers, with about 3% extracted from bedrock (dolomite, limestone and St. Peter Sandstone) and alluvial aquifers. There are over 160 wells that vary in depth from <30 feet to > 1,800 feet deep.

The region has a continental climate, with neither large mountains nor large bodies of water to moderate its temperature. It is affected by both cold Canadian Arctic air, as well as hot, humid air from the Gulf of Mexico. It experiences four distinct seasons and an average annual precipitation of 36 inches.

4 Service outcomes

St. Louis City & County, Missouri, United States of America, 7 Jul 2017. SFD Level: not set
Population: 1300000

Proportion of tanks: septic tanks: 100%, fully lined tanks: 100%, lined, open bottom tank

System label	Pop	W4a	W5a	W4b	W5b
System description	Proportion of population using this type of system	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of wastewater in sewer system, which is delivered to decentralised treatment plants	Proportion of wastewater delivered to decentralised treatment plants, which is treated
T1A1C1 User interface discharges directly to a centralised combined sewer	27.0	64.0	100.0		
T1A1C2 User interface discharges directly to a centralised foul/separate sewer	71.0	100.0	100.0		
T1A1C3 User interface discharges directly to a decentralised combined sewer	0.0			100.0	0.0
T1A1C4 User interface discharges directly to a decentralised foul/separate sewer	2.0			100.0	100.0

Table 1: SFD Matrix of St. Louis (BMGF 2017)

It is estimated that 90% of faecal sludge and wastewater is treated and safely managed in St. Louis City and County. The 10%* that is not treated is discharged from 177 Combined Sewer Overflows (CSOs) and 120 Sanitary Sewer Overflows (SSOs), which St. Louis MSD is under a Consent Decree with the US EPA to control.

*The 10% estimate is before the implementation of plans outlined to reduce CSO and SSO volumes after the Consent Decree was issued in 2011. It is likely that the total volume is now lower.

4.1 Containment

The St. Louis MSD sewers serve almost all of St. Louis City and County. 98% of the population is connected through the sewerage system to MSD's centralized treatment plants. The remaining 2% of the population is assumed to be sewered as well, but served by smaller decentralized treatment plants (examples include Kirkwood and Eureka municipalities). Based on the miles of combined and separate sanitary sewers, it is assumed that 27% of St. Louis MSD's sewers are combined, and 71% are separate sanitary sewers carrying wastewater only. The 2% of sewers connected to decentralized treatment plants are assumed to be separate sanitary sewers as Eureka municipality seems to have only sanitary sewers carrying wastewater.

Until 2012, there was no attempt to document the usage of septic tanks in the region, but since the Consent Decree with the EPA, there has been an attempt to establish lateral sewer connections and close septic tanks. A total of 59 septic tanks have been closed since 2012.

4.2 Emptying

As 100% of the population is sewered, it is assumed that emptying of faecal waste and wastewater is regular through the sewer pipes when toilets are flushed, with the aid pump stations in the sewerage system. For the few septic tanks that do remain in the region, the Bissell Treatment Plant accepts hauled waste (which includes septic, grease trap waste from restaurants, industrial/commercial waste streams or leachate from landfills). In 2016, 11.2 million gallons of hauled waste were collected at Bissell Treatment Plant at the rate of \$0.08 per gallon.

4.3 Transport

St. Louis has hundreds of points throughout MSD's service area where wastewater discharges into local waterways from the sewer system without treatment during rainstorms. MSD spent \$2.3 billion to cut its number of sewer overflow points regionwide from about 700 to about 400 in the 1990s, and has about 300 more to address. Prior to the Consent Decree with the US EPA issued in 2011, about 13.8 billion gallons of wastewater from sewers were not transported from homes and businesses to treatment plant for processing but rather discharged through CSOs and SSOs into local waterways. This represents about 36% of the wastewater flowing through combined sewers not being transported to treatment plants and <1% of wastewater flowing through separate sanitary sewers that is also not transported to treatment plants. In total, prior to 2012, about 10% of wastewater was not transported and treated in St. Louis.

It is assumed that all wastewater transported to treatment plants is safely managed and treated. St. Louis MSD oversees the operations and management of seven wastewater treatment plants, including the Missouri River, Coldwater, Bissell, Lemay, Grand Glaize, Meramac and Fenton wastewater treatment plants. The only recorded treatment of septage in St. Louis City / County is at the Bissell treatment plant, which received 11,199,113 gallons of waste from non-sewered sources in 2016. Although this raw statistic is used in this table, it is unlikely to be an accurate representation of septage treated in the county because of the period for this data collection when wastewater volumes were higher than average due to the floods at the end of 2015 and beginning of 2016. It also includes all waste, such as grease trap waste from restaurants, industrial/commercial waste streams, or leachate from landfills etc. in addition to septage. In any case, this volume represents < 0.01% of wastewater treated and is not represented in the SFD due to the small volume of septic tank users and septage received / treated. 10% of wastewater that is discharged into the environment through CSOs and SSOs, does not undergo any form of treatment.

4.5 Reuse and disposal

Currently, St. Louis MSD does not recycle any wastewater or faecal sludge, but is looking at initiating biosolids composting in the future, pending the engagement of a third-party provider and the analysis of

faecal sludge. Therefore, all of the wastewater that is treated at the St. Louis MSD treatment plants is discharged into local waterways (eg. the Mississippi River) when it is safe enough to be discharged into the environment without harming it or negatively impacting human health. This usually means that wastewater undergoes secondary levels of treatment. However, when volumes rise during the wet season or otherwise, the excess volume which cannot be accommodated in the secondary treatment process undergoes primary treatment alone before being discharged in a sewer overflow.

5 Data and assumptions

Table 2: Total Population Served

	Offsite Sanitation (Sewers)		Total
	MSD / Centralized Sewer	Other / Decentralized Sewer	
Population served	1,300,000	-	
Proportion / Percentage	98%	2%	100%

Assumptions:

- 1) Based on [definitions of centralized vs. decentralized sewerage systems](#) (sewage can be treated close to where the sewage is created, which may be called a "decentralized" system or even an "on-site" system (in septic tanks, biofilters or aerobic treatment systems) or it can be collected and transported by a network of pipes and pump stations to a municipal treatment plant or a "centralized" system).
- 2) The 2% of homes in St. Louis city / county are not served by St. Louis Metropolitan Sewer District, and they are assumed to be served by decentralized sewers connected to local treatment plants managed by smaller municipalities such as the Kirkwood and Eureka city municipalities.
- 3) The only information known about septic tank users in St. Louis County & City is that there were 59 septic tanks removed in the county since 2012, when the MSD entered into a consent decree with the US EPA (Information from Catherine Politte, MSD)

Table 3: MSD Centralized Sewer Miles

	Centralized Combined Sewers	Centralized Separate Sewers	Total
Miles	1,756	4,717	6,473
%	27%	73%	100%

Source:

All data on sewer miles covered by MSD is from: <http://www.stlmsd.com/our-organization>

Table 4: Population Served by Sanitation System

	Offsite Sanitation (Sewers)			
	Centralized Sewers		Decentralized Sewers	
	Combined Sewer	Separate Sanitary Sewer	Combined Sewer	Separate Sanitary Sewer
% Population Served	98%		2%	
	26.5%	71.5%	0%	2%

Assumptions:

- 1) Population percentages connected to centralized combined versus sanitary sewers were calculated based on miles of sewage and total population served by the centralized sewer system
- 2) All decentralized sewers were assumed to be separate sanitary sewers as cities like Eureka and Kirkwood, MO do not have documentation of combined sewers, but Eureka has some information on [sanitary sewers](#).

Table 5: Total Sewage / Septage Treated or Discharged

	Metropolitan Sewer District Treatment Plant Flows							Septage	SSO	CSO	Total
	MO River	Coldwater	Bissell	Lemay	Grand Glaize	Meramac (Fine Road)	Fenton				
Sewage volume per day (2015) (mgd)	27	28	131	128	14	13	6	-	-		
Sewage volume per year (2015) (mg/year)	9,854	10,332	47,754	46,654	5,068	4,774	2,226	11.2	400*	13,400*	140.5 billion gallons
	= 126,661 million gallons / year (126.7 billion gallons treated per year)							13,800 (=13.8 b)			
% sewage treated or discharged per year	90.2%							0.3%		9.5%	100%

*SSO and CSO data are from 2011, before the implementation of the [Consent Decree](https://www.epa.gov/enforcement/st-louis-clean-water-act-settlement) to control them and reduce the discharge of untreated wastewater into the environment. Source: <https://www.epa.gov/enforcement/st-louis-clean-water-act-settlement>.

Assumptions:

- 1) The only recorded treatment of septage in St. Louis City / County is at the Bissell treatment plant, which received 11,199,113 gallons of waste from non-sewered sources in 2016. Although this raw statistic is used in this table, it is unlikely to be an accurate representation of septage treated in the county because (i) this is higher than average volume due to the floods at the end of 2015, early 2016, (ii) it also includes all waste, such as grease trap waste from restaurants, industrial/commercial waste streams, or leachate from landfills etc. in addition to septage. In any case, this volume represents < 0.01% of wastewater treated and is not represented in the SFD due to the small volume of septic tank users and septage received / treated.

Table 6: Wastewater Treated or Discharged by Transportation Channel

	Centralized Sewers				Decentralized Sewers			
	Combined Sewer		Separate Sanitary Sewer		Combined Sewer		Separate Sanitary Sewer	
% Population Served	98%				2%			
	26.5%		71.5%		0%		2%	
Billion Gallons	37.2		100.5				2.8	
Treated vs. untreated	Treated	Untreated	Treated	Untreated			Treated	Untreated
	23.8	13.4	100.1	0.4			2.8	
%	64%	36%	99.7%	0.3%			100%	

6 List of data sources

- DNR, Missouri Department of Natural Resources. [Online] Available at: <https://dnr.mo.gov/> [Accessed June 01, 2017].
- ECFR, 2017a. Code of Federal Regulations. [Online] Available at: https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title40/40cfr503_main_02.tpl [Accessed July 11, 2017].
- ECFR, 2017b. Code of Federal Regulations. [Online] Available at: <https://www.ecfr.gov/cgi-bin/text-idx?SID=fb3251957978534805da15d6af7268ea&mc=true&node=pt40.32.503&rgn=div5> [Accessed July 11, 2017].
- EPA. April 19, 2017. St. Louis Clean Water Act Settlement. <https://www.epa.gov/enforcement/st-louis-clean-water-act-settlement> .
- Gee, M. M., 2016. Comprehensive Annual Financial Report (2016). [Online] Available at: https://www.stlmsd.com/sites/default/files/annual_report/The%20Metropolitan%20St.%20Louis%20Sewer%20District%202016%20cafr%20Final%20with%20Cover.pdf [Accessed July 11, 2017].
- Government, St. Louis County. "Sewer Lateral." St. Louis County Government. <http://www.stlouisco.com/PropertyandRoads/SewerLateral> [Accessed July 11, 2017].
- MSD, 2014. Metropolitan St. Louis Sewer District. [Online] Available at: <https://www.stlmsd.com/sites/default/files/FY2017%20-%20FY2020%20Rate%20Proposal%20Exhibits/Exhibit%20MSD%2047B%20-%20MSD%20Sanitary%20Sewer%20Overflow%20Control%20Master%20Plan%20Executive%20Summary.pdf>
- MSD, 2016. Constructed Sewer Overflows. [Online] Available at: http://www.stlmsd.com/sites/default/files/education/ConstructedSewerOverflows_04112016.pdf . [Accessed July 11, 2017].
- MSD, 2017. Metropolitan St. Louis Sewer District. [Online] Available at: <http://www.stlmsd.com/our-organization>
- Politte, C., 2014. Collaboration on a Sanitation Service Chain tracking project [Interview] (June 01, 2014).
- Services, M. D. o. H. a. S., 2017. Governing Onsite Wastewater Treatment Systems. [Online] Available at: http://inspectapedia.com/septic/Missouri_Septic_Code.pdf.
- St. Louis and St. Louis County Board Of Freeholders, 2012. Charter (Plan) of The Metropolitan St. Louis Sewer District. [Online] Available at: <https://www.stlmsd.com/sites/default/files/MSD%20Charter%20As%20of%20June%205%202012%20Amendments.pdf>
- Miller, Don E. et al. Water Resources of the St. Louis Area, Missouri. Report no. 30. 1974. Missouri Geological Survey and Water Resources, US Geological Survey. <https://dnr.mo.gov/pubs/WR30.pdf>. [Accessed July 10, 2017].
- Missouri Department of Natural Resources., Groundwater-Level Observation Well Network. [Online] Available at: <https://dnr.mo.gov/geology/wrc/groundwater/gwnetwork.htm?%2Fenv%2Fwrc%2Fgroundwater%2Fgwnetwork.htm>. [Accessed July 10, 2017].
- Missouri Department of Health & Senior Services. <http://health.mo.gov/>. [Accessed July 10, 2017].
- Trickey, Erick. April 20, 2017. How a Sewer Will Save St. Louis. POLITICO Magazine. <http://www.politico.com/magazine/story/2017/04/20/st-louis-infrastructure-sewer-tunnel-water-system-215056>. [Accessed July 11, 2017].
- Wikipedia. July 09, 2017. St. Louis County, Missouri. https://en.wikipedia.org/wiki/St._Louis_County,_Missouri . [Accessed July 10, 2017].
- Wikipedia. July 10, 2017. St. Louis. https://en.wikipedia.org/wiki/St._Louis. [Accessed July 10, 2017].

7 Supplementary data

7.1 Policy & institutional roles

At the federal level, wastewater treatment in the US is regulated under the Clean Water Act (1972), which is implemented by the Environmental Protection Agency (EPA). The EPA has developed evidence-based technical standards for biosolids (ECFR, 2017a) and implements them through the issuance of permits (ECFR, 2017b).

At the state level, the Missouri Department of Health and Senior Services, which houses the Bureau of Environmental Health Services, stipulates the laws behind the installation and maintenance of on-site septic systems in the state, while the Missouri Department of Natural Resources, operated by the Water Resources Center, monitors groundwater sources.

An estimated twenty-five percent of homes in the state of Missouri rely on an onsite wastewater treatment system (OWTS) in areas where public sewers are not available. However, this proportion is likely to be smaller in St. Louis City and County as the St. Louis Metropolitan Sewer District (MSD) serves the entire city of St. Louis as well as 90% of the county (MSD, 2017).

At the local level, the St. Louis MSD is the key body overseeing sanitation in the region, including sewer pipelines, wastewater treatment plants, pump stations and sewer overflows. The St. Louis MSD operates on a charter drafted and approved by voters in 1954, and most recently amended in the year 2012 (St. Louis and St. Louis County Board Of Freeholders, 2012). MSD is defined as a corporate body, a municipal corporation, and a political subdivision of the state (Gee, 2016). As a political subdivision of the state, MSD is therefore comparable to a county or city, such as St. Louis County or the City of St. Louis. MSD is governed by a six-member Board of Trustees with three members appointed by the Mayor of St. Louis and three members appointed by the St. Louis County Executive, with no more than two trustees from each area of the same political affiliation.

7.2 Service provision

The Metropolitan St. Louis Sewer District (MSD) serves the City of St. Louis and 90% of St. Louis County, covering a total area of approximately 525 square miles of sewer (Refer to Figure 1 for the MSD Service Area). This system serves 1.3 million people. MSD owns and operates the sewerage system which consists of wastewater, stormwater and combined collection sewers, pumping stations, and wastewater treatment facilities in its service area. MSD provides sewer collection, pumping and treatment services within three major watersheds located within the MSD's service area including the Mississippi River watershed, the Missouri River watershed and the Meramec River watershed. In addition, MSD provides a variety of other services, including sanitary sewer maintenance, stormwater sewer maintenance, floodwater control, monitoring of industrial waste, issuance of pretreatment discharge permits, engineering design and specification, construction of sewer lines, plan review and approvals, issuance of connection permits, public education and customer service.

The System currently includes approximately 4,717 miles of wastewater sewers, 3,043 miles of stormwater sewers, and 1,756 miles of combined sewers, that handle both wastewater and stormwater flows. Maintenance of the System is controlled and conducted out of three regional facilities. MSD owns and maintains 278 pumping stations and 116 miles of force mains. All pump stations are maintained regularly and monitored continuously. Of the 278 stations, 37 are floodwall, overflow regulation, and wet weather relief tank stations, five are stormwater and the remaining 236 are wastewater and combined sewage pump stations which move the flow of wastewater through the system and into treatment plants. MSD also owns and operates seven wastewater treatment facilities. These facilities treat an average flow of around 350 million gallons of wastewater per day (mgd). The Bissell Point and Lemay wastewater treatment plants are the District's two largest plants that serve the Mississippi River watershed. The

Coldwater Creek and Missouri River wastewater treatment plants service the Missouri River watershed, and the remaining wastewater treatment plants serve the Meramec River watershed. ## Insert information that was collected, following the guiding questions from 'Table 4: Questions and data collection methods to analyse the range of sanitation service chain'; "SFD Manual – Volume 1", chapter 5 Producing the SFD: sanitation service chain analysis.

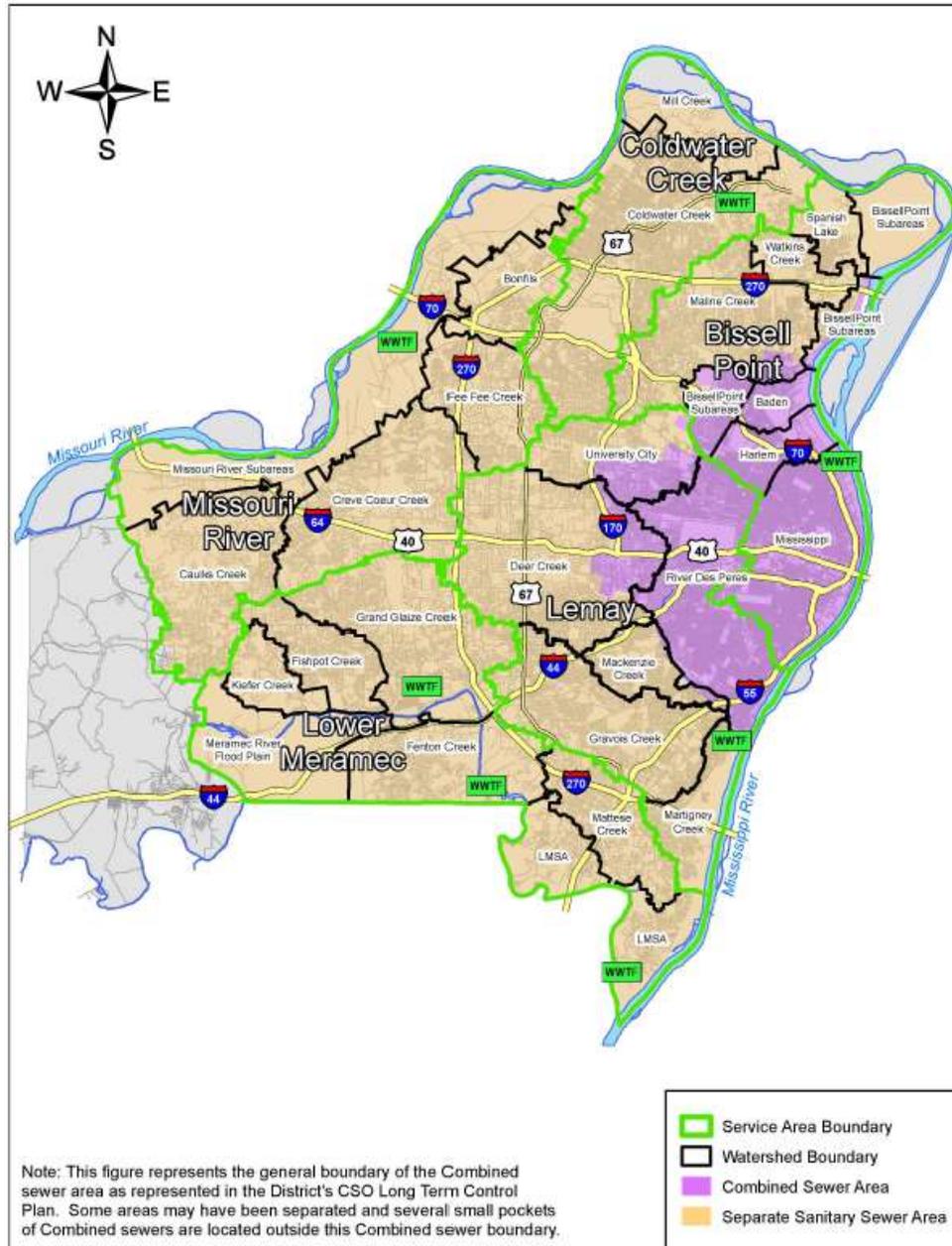


Figure 1: Metropolitan Sewer District Service Area
<http://www.stlmsd.com/sites/default/files/FY2017%20-%20FY2020%20Rate%20Proposal%20Exhibits/Exhibit%20MSD%2047B%20-%20MSD%20Sanitary%20Sewer%20Overflow%20Control%20Master%20Plan%20Executive%20Summary.pdf>



Figure 2: MSD Constructed Sewer Overflows Map
http://www.stlmsd.com/sites/default/files/education/ConstructedSewerOverflows_04112016.pdf

7.3 Evolution of St. Louis’s sanitation service chain

MSD was created in 1954 to provide a metropolitan-wide sewer system to serve the City of St. Louis and most of the more heavily populated areas of St. Louis County. Before MSD’s creation, the City of St. Louis, various municipalities, and private sewer companies provided sewer service that primarily included only collecting and transporting sewage from small geographic areas to nearby rivers and streams with little or no treatment. Most of the municipalities or private sewer companies serving the area did not have the jurisdictional authority or financial resources needed to eliminate health hazards from untreated sewage. When the District began operations, it took over the publicly owned wastewater and stormwater drainage facilities within its jurisdiction and began the construction of an extensive system of collector and interceptor sewers and treatment facilities. In 1977, voters approved the District’s

annexation of a 270 square mile area of the lower Missouri River and lower Meramec River watersheds. The District purchased the Fee Fee Trunk Sewer Company and the Missouri Bottoms Sewer Company in 1978. MSD has since acquired other investor-owned or municipally operated systems.

Since the 1990s, the EPA has enforced the Clean Water Act in 200 cities across the country to control sewer overflows. St. Louis's agreement with the EPA, signed in 2012, is the most expensive in the continental US, at \$4.7 billion in engineering projects to reduce sewer overflows. Even before the Clean Water Act, MSD spent \$2.3 billion to cut its number of sewer overflow points regionwide from about 700 to about 400 in the 1990s.

MSD initiated the Sewer Lateral Repair Program in 1999 and Supplemental Environmental Plan in 2012 to build lateral lines to connect homes and buildings to the public sewer system. Since 2012, MSD has been able to close 59 septic tanks in the county, connecting about half of them through lateral connections, with the main sewer system. MSD has also repaired 7 existing lateral lines since 2012 and is working towards replacing remaining on-site sanitation systems with sewer connections.