# Summary and Findings: The Condition of and Best Practices for Tennessee Wastewater Systems

Tennessee's wastewater systems face several challenges, including aging infrastructure, complying with federal and state regulations, meeting extra demand caused by population growth, and recruiting employees to replace retiring workers. Because of these and other concerns, County Executive and Tennessee Advisory Commission on Intergovernmental Relations (TACIR) commission member Jeff Huffman asked the Commission to study the operations and financing of Tennessee's wastewater systems. County Executive Huffman asked that the study examine

- the condition of Tennessee's wastewater systems,
- the number of wastewater systems that have enforcement letters from the Tennessee Department of Environment and Conservation,
- the best practices for wastewater system management from other states,
- new technologies for wastewater system management that local governments could consider and would be permissible under Tennessee Department of Environment and Conservation rules,
- methods of wastewater system management that have not worked and should be avoided,
- the best methods for financing sewer lines and wastewater treatment plants, and
- the best methods to reduce the operating costs of wastewater systems.

Based on requests from other TACIR commissioners, the scope of the study was expanded to include looking at

- the governance structures of wastewater systems, whether board members are compensated; and whether the compensation includes benefits, and
- staffing issues at wastewater systems.

## Tennessee has invested heavily in upgrading its wastewater infrastructure, but some systems are struggling to maintain their aging equipment while meeting growing service demands

Tennessee has invested heavily in wastewater infrastructure in recent years—state administered awards from federal American Rescue Plan (ARP) funds alone have totaled $467 million in noncompetitive grants and $43 million in competitive grants for wastewater projects since 2021. But still, most wastewater infrastructure construction and improvements are debt financed by local governments and those governments are struggling to keep up with increased service demand as their systems age. The 2022 Infrastructure Report Card from the American Society of Civil Engineers graded Tennessee's wastewater infrastructure a C-. The report card states that over the past decade, efforts to expand capacity to support a growing population have resulted in neglected maintenance. They noted that this was evidenced by the increased number of sewer overflows, which have at times resulted in sewer tap moratoriums—a temporary restriction on establishing new sewer connections or taps to existing infrastructure—essentially putting a pause on new development. In 2019, there were 12 systems under sewer tap moratoriums and by 2022 moratoriums affected 45 municipalities. As of May 2024, there were 46 active sewer moratoriums. Stakeholders interviewed for the report stated that the state's wastewater infrastructure will need upgrades because of aging pipes that are beginning to fail.

Wastewater systems may also need to spend money to repair or replace their infrastructure in order to comply with their National Pollutant Discharge Elimination System (NPDES) permits or State Operating Permits (SOP). Wastewater systems planning to discharge into the state's surface waters must obtain a NPDES permit from the Tennessee Department of Environment and Conservation. A State Operating Permit (SOP) issued by TDEC is required for wastewater systems that do not discharge into any surface or subsurface waters, like a wastewater system that discharges treated wastewater onto land. As of May 2024, approximately 60 out of 278 public wastewater systems operated by local governments had systems under enforcement orders from the Tennessee Department of Environment and Conservation (TDEC) for violating SOP or NPDES permits. This means 21.6% of all public local government wastewater systems are under orders.

The wastewater systems in the state will also likely need to expand their service in some areas due to population growth. Tennessee's population is projected to reach 7,980,650 by 2042, marking a 13.8% increase from the estimated 2022 population of 7,014,730, according to the University of Tennessee's Boyd Center for Business and Economic Research latest

projections. West Tennessee will be one area that will see additional population growth because of the opening of Blue Oval City.

Wastewater systems in Tennessee will likely need to spend billions to pay for the repair, replacement and expansion of their infrastructure. The state's 2018 report, *TN H2O*, estimated it would cost approximately $8.9 billion to fund the repair and replacement of aging wastewater infrastructure and to extend the wastewater services to support the state's growing population from 2018 through 2040. However, TACIR's infrastructure survey estimated that $3.5 billion is needed to fund wastewater infrastructure projects from FY 2022 through FY 2042.

## There are 57 local governments that operate wastewater systems with active enforcement orders from the Tennessee Department of Environment and Conservation, 36 with sewer moratoriums, and 53 under financial oversight.

TDEC assists systems in complying with the state's environmental laws and regulations, monitors compliance, and takes enforcement action when necessary. TDEC monitors permit compliance through monthly monitoring reports and periodic inspections and has the authority to take enforcement actions against these systems when necessary to ensure compliance with the law. These enforcement actions range from informal notices of violation (NOVs) to formal enforcement orders (EOs), and even formal moratoriums on new sewer connections. As of May 2024, there were 57 local governments that operate wastewater systems with active orders that were either final, signed, or appealed for permit violations from the Tennessee Department of Environment and Conservation. There were also 13 other entities that operate wastewater systems with active enforcement orders—7 of the 13 are privately operated, 4 that are operated by schools, and 2 that are operated by the state. And, also as of May 2024, there were 36 local governments that operated wastewater systems with sewer moratoriums—a temporary restriction on establishing new sewer connections or taps to existing infrastructure. The number of moratoriums essentially pauses any new development.

State oversight is not limited to system operations; the Tennessee Office of the Comptroller identifies financially distressed systems based on audits and then refers the systems to the Tennessee Board of Utility Regulation (TBOUR), which oversees the financial integrity of wastewater systems. Distress is defined to include, but is not limited to, two consecutive years of negative net change (losses exceeding revenue), defaulting on debts, or overall liabilities exceeding assets. As of May 2024, 53 out of 278 public wastewater systems were under the board's oversight for being financially distressed. Thirteen of these systems were under distress specifically because of sewer service. Forty of these systems have a

combined water and sewer fund, making it difficult to determine if they were under distress because of water or sewer service or both.

## Asset management plans and the use of the Effective Utility Management framework can help systems manage more efficiently

An asset management plan helps systems prioritize critical infrastructure needs and direct spending efficiently. These plans can help ensure user rates are set based on sound financial planning. Key components of an asset management plan include assessing the current state of infrastructure, creating a capital improvement plan that outlines the timing and costs of infrastructure rehabilitation or replacement, and developing a long-term funding strategy. Systems like Mount Pleasant Waterworks in South Carolina and Hastings Utility in Nebraska demonstrate the benefits of incorporating computerized maintenance management systems and GIS into their asset management process to help improve planning.

Another best practice comes from the United States Environmental Protection Agency, which along with water and wastewater industry organizations, developed an industry-specific approach to utility management called the Effective Utility Management (EUM) framework. This framework consists of five keys to management success. Effective leadership guides long-term vision, engages stakeholders, and promotes positive organizational change. Strategic business planning aligns utility goals with community values through regular assessment and revision. Knowledge management ensures thorough documentation and shared knowledge among employees, while measurement involves setting and tracking performance goals. Continual improvement management fosters a culture of ongoing enhancement. Systems like Austin Water in Texas and Columbus Water Works in Georgia have used the framework which led to improved employee recruitment and customer satisfaction initiatives.



## Wastewater treatment technologies are enabling efficient resource recovery and cost savings.

Wastewater treatment technologies are evolving to meet the demands of modern systems, with a strong focus on the renewable use of resources. Wastewater treatment systems, to include a few in Tennessee, are using technologies and processes that help them to extract resources from wastewater like water for irrigation, nutrients for fertilizers, and biogas for fuel. With technologies like membrane bioreactors, systems can remove more contaminants from water, and they can process sludge more efficiently with thermal

hydrolysis. And the use of solar photovoltaic (PV) panels can help systems save some money on electricity.

## Prudent management is essential to contain costs and reduce hazards

Commission staff did not identify any valid management practices that should be avoided. Rather, research and interviews confirmed the risks of failing to properly manage equipment and assets. Neglecting regular equipment maintenance can lead to costly repairs and non-compliance with state regulations. Failing to implement an asset management plan can result in poor prioritization of infrastructure needs and inadequate funding for capital improvements. Ignoring energy efficiency measures can lead to unnecessary expenditures and higher operational costs. Improper dosing or monitoring of chemical disinfection can release harmful byproducts or fail to remove pathogens adequately, posing health risks. Additionally, inadequate sludge treatment and disposal can contaminate soil, water, and air.

## The best method for financing wastewater infrastructure projects will likely involve a combination of funding sources

When it comes to financing wastewater infrastructure, systems may want to look at grant opportunities first, as grant money does not need to be repaid and can reduce the amount of money that needs to be borrowed. Bonds may be a viable financing option for some systems but not others. For example, small systems in poor financial condition may struggle to attract bond buyers. Cities, counties, and metropolitan governments can issue general obligation bonds, which are backed by their taxing authority. Revenue bonds, which are backed by a system's revenues, can be issued by counties, cities, metropolitan governments, utility districts, water and wastewater authorities, and municipal energy authorities. The marketability of revenue bonds depends on the project and the system's ability to generate revenue. Because of this, revenue bonds may sometimes have higher interest rates than general obligation bonds. Loans from government or private sources may also be an option for systems that can't issue bonds. Systems that issued bonds could also use loans as another funding source for projects.

## Efficient energy consumption is key to cutting costs

To help cut operating costs, wastewater systems can focus on reducing energy consumption, which can constitute 25% to 40% of a system's annual operating budget. Reducing energy consumption may lower operating costs by 15% to 30%. Implementing energy-efficient technologies and practices, such as idling or turning off non-essential equipment during periods of peak power demand and properly maintaining motors, can

significantly contribute to these savings. Regular energy audits and continuous monitoring of energy usage also play crucial roles in identifying and addressing areas where further efficiencies can be achieved.

## Public wastewater systems in Tennessee are governed by various entities whose compensation methods also vary

Eighty two percent of the wastewater systems in Tennessee are operated by municipalities, and the municipalities' governing bodies oversee their systems. A few municipalities have separate utility boards that govern their systems. Thirteen percent of the wastewater systems in the state are overseen by the boards of utility districts, municipal energy authorities or water and wastewater authorities. Three percent of the systems are operated by counties and metropolitan governments, and these are governed by the county or metropolitan government's governing board, a utility or public works department in the government or a separate utility board. Two percent of the systems are operated by local governments working together jointly, and they are overseen by a board or committee.

Compensation for the people who serve on the systems' governing bodies varies across the state. According to a survey of wastewater systems conducted by Commission staff, 65% of respondents compensate their board members, with amounts ranging from $50 per month to $17,000 per year. Benefits also vary, with 32% of respondents offering health insurance, 23% providing vision insurance, and 20% offering dental insurance. Additionally, 9% of systems offer retirement benefits through the Tennessee Consolidated Retirement System (TCRS). Some systems also provide additional benefits, such as travel for board-related activities.

## Retention and an aging workforce cause staffing challenges for wastewater systems

Some of the wastewater systems in Tennessee face staffing challenges. Sixteen percent of respondents to a Commission staff survey of wastewater systems said they had difficulty attracting and retaining certified wastewater operators. This is due in part to an aging workforce and difficulty in attracting younger workers. Fifty-nine percent of the respondents to the Commission staff survey reported they had at least one certified wastewater operator that would be retiring in the next 10 years. Fifteen percent (12 out of 82) of the survey respondents reported that one hundred percent of their certified operators would be retiring in 10 years.

To help with recruiting new workers, the Tennessee Association of Utility Districts (TAUD) launched its first water and wastewater utility apprenticeship program in 2020. TAUD is an association that provides technical and operation support and training for

Tennessee's water and wastewater systems. The program was designed to help fill the need for certified water and wastewater operators is designed to address the need for certified water and wastewater facility operators in rural Tennessee. It also helps raise awareness of careers in the industry. TAUD also partnered with Fayetteville Public Utilities (FPU) to create pre-apprentice program for local high school students, teaching them about careers in the water industry. Systems in other states have instituted similar programs.

Retention is also an issue, as operators often leave for better-paying jobs at other wastewater systems, with 17% (14 out of 82) of respondents to the TACIR survey saying they were having difficulty retaining certified wastewater operators. Survey respondents noted that operators will move onto larger systems that have more opportunity to advance. Some said they couldn't compete with surrounding communities when it comes to pay and benefits.

## Analysis: The Condition of and Best Practices for Tennessee Wastewater Systems

Wastewater can contain various substances that pose risks to human health, including pathogens such as protozoans, viruses and bacteria, which can cause diseases like encephalitis, hepatitis A, salmonella and typhoid fever.[1] Additionally, wastewater contains numerous chemicals, including but not limited to pesticides, herbicides, metals, household cleaning products, medications, disinfectants, and industrial chemicals.[2] While substances like shampoo and body soap are generally harmless, others like paint thinners and antifreeze can be harmful and pose significant risks to human health when present in untreated wastewater.[3]

Per- and polyfluoroalkyl substances (PFAS) are chemicals commonly found in wastewater that may pose potential risks to human health.[4] They break down slowly and some can build up in the body over time.[5] The US Centers for Disease Control and Prevention (CDC) has measured PFAS levels in the blood of the US population since 1999 and their research shows that most Americans have been exposed to these chemicals and have them in their blood.[6] Scientific research has indicated that PFAS may result in adverse health effects, including decreased fertility, developmental delays in children, increased cholesterol levels and increased risk of obesity and cancer in humans.[7]

PFAS and various other chemicals present in wastewater can adversely impact fish and aquatic life. Research has demonstrated that PFAS can affect the growth and development of fish.[8] Other chemicals may also pose toxicity risks to fish and aquatic life.[9]



[1] Indiana Department of Health 2012 and Olson et al. 2001.

[2] United States Environmental Protection Agency 2004.

[3] Ibid.

[4] Thompson et al. 2022.

[5] United States Environmental Protection Agency 2023c.

[6] United States Centers for Disease Control 2023.

[7] United States Environmental Protection Agency 2023c.

[8] Jantzen, Annunziato, and Cooper 2016.

[9] United States Environmental Protection Agency 2004 and United States Geological Service 2018c.

The organic material and ammonia in wastewater can affect fish and aquatic life as well. Organic material and ammonia are "oxygen demanding" substances.[10] Bacteria will destroy these substances or convert them to other substances if there is enough oxygen in the water.[11] Fish and other aquatic life need oxygen to survive.[12] The breakdown of organic material in the water would take oxygen away the from the fish and other aquatic life that need it to survive.[13] If wastewater with high levels of organic material and ammonia is discharged into surface water, it could lead to the death of fish and other aquatic life in that water.[14]

An excess of nitrogen and phosphorus in wastewater could also harm animal and plant life if it is discharged into surface waters. These nutrients feed the growth of algae.[15] The algae consume oxygen and blocks sunlight from reaching plants below the water's surface which can kill them.[16] The bacteria that feed on the decaying plants consume oxygen that is also needed by fish and other aquatic life to survive[17]. The fish and aquatic life could die because of lack of oxygen. This is known as eutrophication.[18]

Beyond public safety concerns, inefficient or failing wastewater systems could lead to costly repairs, civil penalties, or even lawsuits. Studying these systems can help identify necessary improvements to infrastructure, cost effective operations, and preventative maintenance. Addressing Tennessee's specific wastewater needs may reduce the financial burden on communities.

With these safety and efficiency concerns in mind, County Executive and commission member Jeff Huffman asked the Commission at the January 26, 2023, meeting of the Tennessee Advisory Commission on Intergovernmental Relations to study the operations and financing of Tennessee's wastewater systems. He requested that the study examine



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[10] United States Environmental Protection Agency 2004.

[11] Ibid.

[12] United States Geological Service 2018a

[13] United States Environmental Protection Agency 2004.

[14] United States Geological Service 2018c; and United States Environmental Protection Agency 2023a.

[15] United States Geological Service 2019.

[16] United States Environmental Protection Agency 2024c.

[17] Ibid.

[18] Preisner, Neverova-Dziopak, and Kowalewski 2021.

- the condition of Tennessee's wastewater systems,
- the number of wastewater systems that have enforcement letters from the Tennessee Department of Environment and Conservation,
- the best practices for wastewater system management from other states,
- new technologies for wastewater system management that local governments could consider and would be permissible under Tennessee Department of Environment and Conservation rules,
- methods of wastewater system management that have not worked and should be avoided,
- the best methods for financing sewer lines and wastewater treatment plants, and
- the best methods to reduce the operating costs of wastewater systems.

Based on requests from Commissioners, the scope of the study was expanded to include looking at

- the governance structures of wastewater systems, whether board members are compensated; and whether the compensation includes benefits, and
- staffing issues at wastewater systems.

## Wastewater systems use treatment processes that combine physical, chemical, and biological methods to remove harmful substances from wastewater.

The environment may be able to handle small amounts of wastewater filled with substances like pathogens and chemicals.[19] However, it cannot deal with the large amounts of wastewater that homes and businesses produce each day.[20] This is where wastewater treatment comes into play. Wastewater must be treated before it is discharged to reduce the amount of harmful substances in the water.[21] Wastewater from residences and businesses can be treated in either a centralized or decentralized system.[22]



[19] United States Geological Service 2018c.

[20] Ibid.

[21] Water Environment Federation and Association of Boards of Certification 2018.

[22] United States Environmental Protection Agency 2004.

## Centralized Wastewater Systems

Centralized wastewater systems are systems where wastewater is collected and delivered to a centrally located treatment plant to be processed.[23] The wastewater is typically treated in a plant far from where the wastewater was produced. The treated wastewater is discharged to surface water or groundwater after being treated.[24]

There are three primary levels of wastewater treatment in these systems: primary, secondary and tertiary. In addition, there is also disinfection of the wastewater before it is released and treatment of any solids leftover after the water is treated. In some cases, wastewater may be pretreated before beginning the primary treatment.

### *Preliminary Treatment*

Wastewater might have large solids in it that could interfere with the wastewater treatment processes or cause wear and tear on the equipment.[25] Many of these solids can be removed during preliminary treatment. The process may include a number of processes such as screening, shredding, and grit removal.[26]

During screening, large solids such as rocks and branches are removed with screens.[27] They will vary from coarse screens to very fine ones.[28] With shredding, solids are ground down to a size that can enter the treatment facility without damaging the equipment.[29] Some plants might use comminutors or grinders to grind the solids to a smaller size.[30] After being screened, the wastewater may flow into a grit chamber where grit and small



[23] United States Environmental Protection Agency 2024b.

[24] Jantrania and Gross 2006.

[25] Water Environment Federation and Association of Boards of Certification 2018.

[26] Drinan and Spellman 2013; and Tennessee Department of Environment and Conservation Design Criteria for Review of Sewage Works Construction Plans and Documents Chapter 4 Preliminary and Pretreatment Facilities.

[27] Drinan and Spellman 2013.

[28] United States Environmental Protection Agency 2004.

[29] Ibid.

[30] Water Environment Federation and Association of Boards of Certification 2018.

stones settle to the bottom of the chamber.[31] The solids collected during the preliminary treatment phase are incinerated or shipped to a landfill.[32]

### *Primary Treatment*

After pretreatment, there will still be solids in the wastewater. Remaining solids can be removed using primary clarifiers.[33] The heavier solids settle to the bottom.[34] These solids are called sludge.[35] The lighter weight solids float to the top and are then skimmed off.[36] A dissolved air flotation thickener is another primary treatment process that uses compressed air to get the solids to float so they can be removed.[37] The remaining liquid is then sent onto the secondary phase of treatment.

### *Secondary Treatment*

Secondary treatment breaks down the organic matter in the wastewater. Microorganisms convert the organic matter into material that can be safely discharged into the environment.[38] Most secondary treatment involves either attached growth processes and suspended growth processes.

There are the attached growth or fixed film processes.[39] These systems include trickling filters and rotating biological contractors.[40] They are effective at removing organic material from wastewater.[41] Microorganisms like bacteria, algae and fungi grow on a filter and form a slime, also known as biomass, layer on the filter.[42] When the organic material



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[31] United States Environmental Protection Agency 2004.

[32] Ibid.

[33] Water Environment Federation and Association of Boards of Certification 2018.

[34] Drinan and Spellman 2013.

[35] United States Environmental Protection Agency 2004.

[36] Water Environment Federation and Association of Boards of Certification 2018.

[37] Ibid.

[38] United States Environmental Protection Agency 2004

[39] Ibid.

[40] Water Environment Federation and Association of Boards of Certification 2018.

[41] United States Environmental Protection Agency 2000c.

[42] United States Environmental Protection Agency 2004.

in the wastewater comes into contact with the microorganisms that are attached to a filter, the microorganisms consume the oxygen demanding substances.[43]

Suspended growth processes are secondary treatment processes where the microorganisms mix with the wastewater.[44] These types of secondary treatment processes include activated sludge, oxidation ditches, or sequencing batch reactors.[45] In these methods, the wastewater is mixed with microorganisms and air and the microorganisms break down the organic material in the wastewater.[46]

### *Tertiary Treatment*

The secondary level of treatment is generally sufficient to make the treated water safe to discharge into the receiving surface water. Advanced or tertiary treatment may be needed, for instance, if you are discharging into a delicate ecosystem or plan to reuse the water for irrigation purposes.[47] Some examples of advanced or tertiary treatment processes include nitrogen removal, phosphorus removal, carbon absorption and additional filtration processes.[48]

Nitrogen removal may be needed in some cases. Too much nitrogen in water may encourage excessive growth of algae and other plants and when the plants decompose they may use oxygen that is needed by fish and other aquatic life.[49] Nitrogen can be removed using a biological process known as nitrification/denitrification.[50] In the nitrification process, the water enters a tank where microorganisms thrive and convert ammonia in the wastewater to nitrate and nitrite.[51] There is an additional denitrification



[43] Ibid.

[44] Drinan and Spellman 2013

[45] Tennessee Department of Environment and Conservation Design Criteria for Review of Sewage Works Construction Plans and Documents Chapter 7 Activated Sludge

[46] United States Environmental Protection Agency 2004.

[47] Ibid.

[48] Drinan and Spellman 2013 and Water Environment Federation and Water Professionals International 2022.

[49] United States Geological Service 2018b.

[50] Drinan and Spellman 2013.

[51] Water Environment Federation and Water Professionals International 2018.

process that can convert the nitrate nitrogen into nitrate gas.[52] Ammonia stripping is another method that can be used to reduce the level of nitrogen in wastewater before releasing it.[53] In this method, the pH level in the wastewater is raised by adding lime and dissolved ammonia gas is formed which is then removed from the wastewater.[54]

Like nitrogen, excess phosphorus in water can encourage the excessive growth of algae.[55] Phosphorus can be removed using chemical means. Lime, alum or ferric chloride is added to the wastewater.[56] The addition of one of these chemicals will cause phosphorus particles to clump together into masses.[57] The clumps can then be removed from the wastewater.[58] Phosphorus can also be removed using biological means by using microorganisms that will consume the phosphorus.[59] Additional organic materials can be removed using carbon absorption technology.[60] During this process, the wastewater flows through activated carbon granules or powder.[61] Any trace organic substances that remain in the wastewater will be captured by the carbon.[62] Any suspended solids remaining in the wastewater can be removed using filtration processes. One example is reverse osmosis membranes.[63] These filters have the ability to filter out substances like sodium.[64]

### *Disinfection*

After the wastewater has completed the secondary treatment process or the advanced or tertiary process if that is required, it will be disinfected. This will reduce the level of



[52] United States Environmental Protection Agency 2004.

[53] United States Environmental Protection Agency 2000a.

[54] Drinan and Spellman 2013.

[55] United States Environmental Protection Agency 2024e.

[56] Mackenzie and Cornwell 2023.

[57] Drinan and Spellman 2013.

[58] Ibid.

[59] Oehmen et al. 2007.

[60]. United States Environmental Protection Agency 2000b.

[61] United States Environmental Protection Agency 2004

[62] Ibid.

[63] Water Environment Federation and Water Professionals International 2022.

[64] Ibid.

pathogens to a level that they will not cause disease if discharged into receiving waters.[65] The most commonly used methods include chlorination, ultraviolent (UV) radiation, and ozonation.[66] With chlorination, chlorine or chlorine substitutes like hypochlorite are added to the water to disinfect it. To disinfect wastewater using UV radiation, the water is exposed to UV light of a specific wavelength and intensity for a period of time.[67] Ozonation is a disinfection method where a gas, ozone, is used to disinfect the wastewater.[68]

### *Solids Handling*

There will be solids leftover after the treatment. These are referred to as sludge.[69] It has to be treated before being disposed of through a process involving thickening the sludge and stabilizing it using chemical methods or aerobic or anaerobic digestion. It is also conditioned using chemical or heat treatment and dewatered before it can be disposed of.[70] After being treated, it can be disposed of in a landfill or incinerated.[71]

## Decentralized Wastewater Systems

Wastewater treatment systems that treat wastewater from residences, businesses and other buildings not connected to a centralized wastewater plant are known as decentralized wastewater systems.[72] They treat small volumes of wastewater from home and businesses largely in rural or suburban areas.[73] They treat wastewater close to where its produced.[74] With most decentralized systems, treated wastewater is released in or on



[65] Drinan and Spellman 2013.

[66] Ibid.

[67] Drinan and Spellman 2013.

[68] Ibid.

[69] Drinan and Spellman 2013 and United States Environmental Protection Agency 2004.

[70] Drinan and Spellman 2013 and Tennessee Department of Environment and Conservation Design Criteria for Review of Sewage Works Construction Plans and Documents Chapter 12 Sludge Processing and Disposal.

[71]Drinan and Spellman 2013 and Rules and Regulations of the State of Tennessee 1200-03-16-.15.

[72] United States Environmental Protection Agency 2004.

[73] United States Environmental Protection Agency 2024a.

[74] Jantrania and Gross 2006.

land, unlike centralized systems which discharge into surface waters.[75] Decentralized systems include both onsite systems and cluster systems.[76]

### *Onsite Systems*

Onsite systems, also known as septic systems, treat waste from only one home or business.[77] With an onsite system, the wastewater is piped from the building to a septic tank that is buried underground.[78] Solids, oil and grease are separated from the wastewater.[79] Bacteria in the tank consume organic matter.[80] In a conventional system, the wastewater is discharged from the tank to a series of perforated pipes buried underground.[81] The pipes slowly release the water into the soil.[82] There are alternative systems that use pumps or gravity to help wastewater to filter through sand, organic matter or constructed wetlands.[83] Some also disinfect the water before the discharge into the soil.[84]

### *Cluster Systems*

Cluster systems, also referred to as community systems, serve one or more homes or businesses not connected to centralized wastewater systems.[85] In a cluster system, the wastewater is collected from the buildings and piped to a treatment unit where it is treated to remove organic material using fixed film or suspended growth processes.[86] The treated wastewater will be typically be discharged using subsurface dispersal systems, but it can be discharged into surface waters or dispersed over land.[87]



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[75] Ibid.

[76] United States Environmental Protection Agency 2004 and Environmental Protection Agency 2012.

[77] United States Environmental Protection Agency 2005.

[78] United States Environmental Protection Agency 2024a.

[79] Ibid.

[80] United States Environmental Protection Agency 2004.

[81] United States Environmental Protection Agency 2024a.

[82] Ibid.

[83] United States Environmental Protection Agency 2024a.

[84] Ibid.

[85] United States Environmental Protection Agency 2005.

[86] Lombardo 2004.

[87] Ibid.

## What is the condition of Tennessee's wastewater systems?

Tennessee's wastewater systems will need billions to expand, repair, or replace their infrastructure over the next 20 years. The 2022 Infrastructure Report Card from the American Society of Civil Engineers gave Tennessee's wastewater infrastructure a grade of C—. The report said that over the past decade, Tennessee's wastewater infrastructure supported a 9% population increase. However, the focus on expanding their capacity has come at the expense of neglecting their maintenance needs.[88] They noted that this was evidenced by the increased number of sewer overflows, which have at times resulted in sewer tap moratoriums—a temporary restriction on establishing new sewer connections or taps to existing infrastructure—essentially putting a pause on new development. In 2019, there were 12 systems under sewer tap moratoriums and by 2022 there were upwards of 45 municipalities affected by them.[89] As of May 2024, there are currently 46 sewer moratoriums. See table 2.

Local officials report a $3.5 billion estimated cost of needed wastewater infrastructure to increase capacity and to bring the systems back to a state of good repair based on the Tennessee Advisory Commission on Intergovernmental Relations' (TACIR) *Building Tennessee's Tomorrow: Anticipating the State's Infrastructure Needs July 2022 through June 2027* report. This was a $1.1 billion increase from the previous year primarily driven by a single Nashville project that increased by $506 million because of updated cost estimates.[90] The project, enforced by a federal consent decree from the EPA for violations of the Clean Water Act, includes extensive upgrades and rehabilitation to the city's sewer system to reduce the amount of overflow events and improve capacity.[91]

**Tennessee's H20 plan and TACIR's infrastructure survey results show that wastewater systems will need billions to fund their infrastructure needs over the next 20 years.**

Tennessee's population is projected to reach 7,980,650 by 2042, marking a 13.8% increase from the estimated 2022 population of 7,014,730, according to the University of



[88] American Society of Engineers "A Comprehensive Assessment of America's Infrastructure."; American Society of Civil Engineers "2021 Infrastructure Report Card: Wastewater."; and Interview with Steve Wyatt, Utility Operations Consultant, Municipal Technical Advisory Service, August 16, 2024.

[89] American Society of Engineers "A Comprehensive Assessment of America's Infrastructure."; "A Comprehensive Assessment of America's Infrastructure."; and American Society of Engineers 2022.

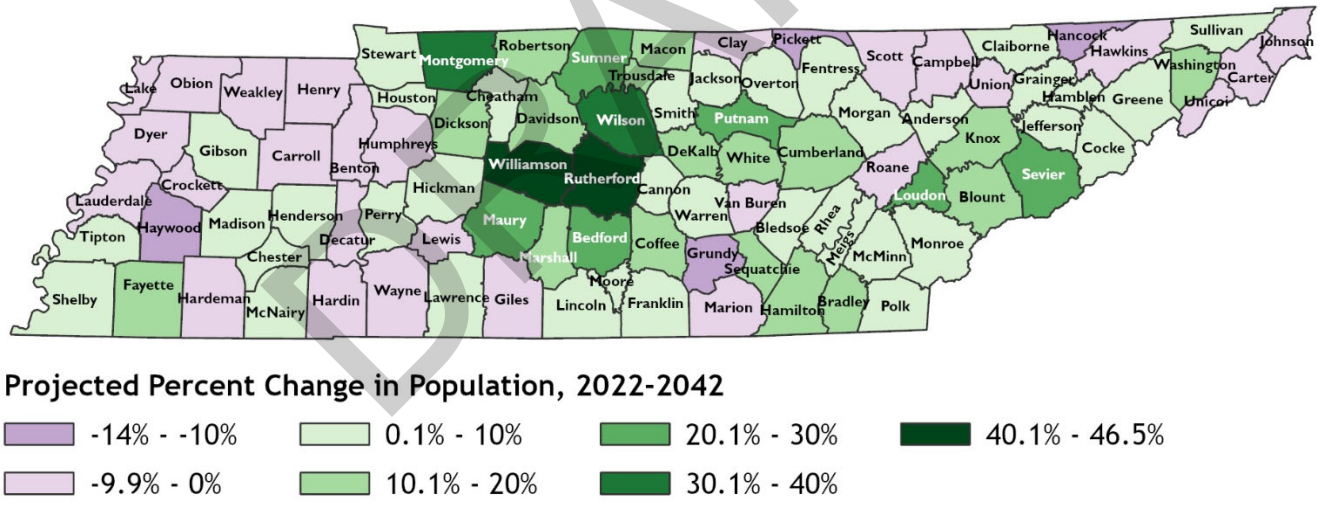
[90] Tennessee Advisory Commission on Intergovernmental Relations 2024.

[91] Metro Water Services 2022.

Tennessee's Boyd Center for Business and Economic Research latest projections.[92] See map 1 for a breakdown of county growth projection estimates. Stakeholders mentioned that the current infrastructure in West Tennessee cannot handle the growth they will be experience because of the opening of Blue Oval City.[93] Stakeholders interviewed for the report stated that the state's wastewater infrastructure will need upgrades because of aging pipes that are beginning to fail. They say these pipes were designed to last only 40 to 50 years, and their deterioration has led to problems like water loss and inflow infiltration in sewer systems.[94]

With the projected population growth in the coming years, Tennessee's wastewater systems will need to spend a significant amount of money to repair and expand their infrastructure. The state's 2018 report, *TN H2O*, estimated it would cost approximately $8.9 billion to fund the repair and replacement of aging wastewater infrastructure and to extend the wastewater services to support the state's growing population from 2018 through 2040, with Middle Tennessee and rural areas of East Tennessee facing the greatest need for increased wastewater capacity in 2040.[95]

**Map 1. Projected Percent Change in Population from 2022-2042 in Tennessee's Counties.**




Source: Boyd Center for Business and Economic Research 2022.

[92] Boyd Center for Business and Economic Research 2022.

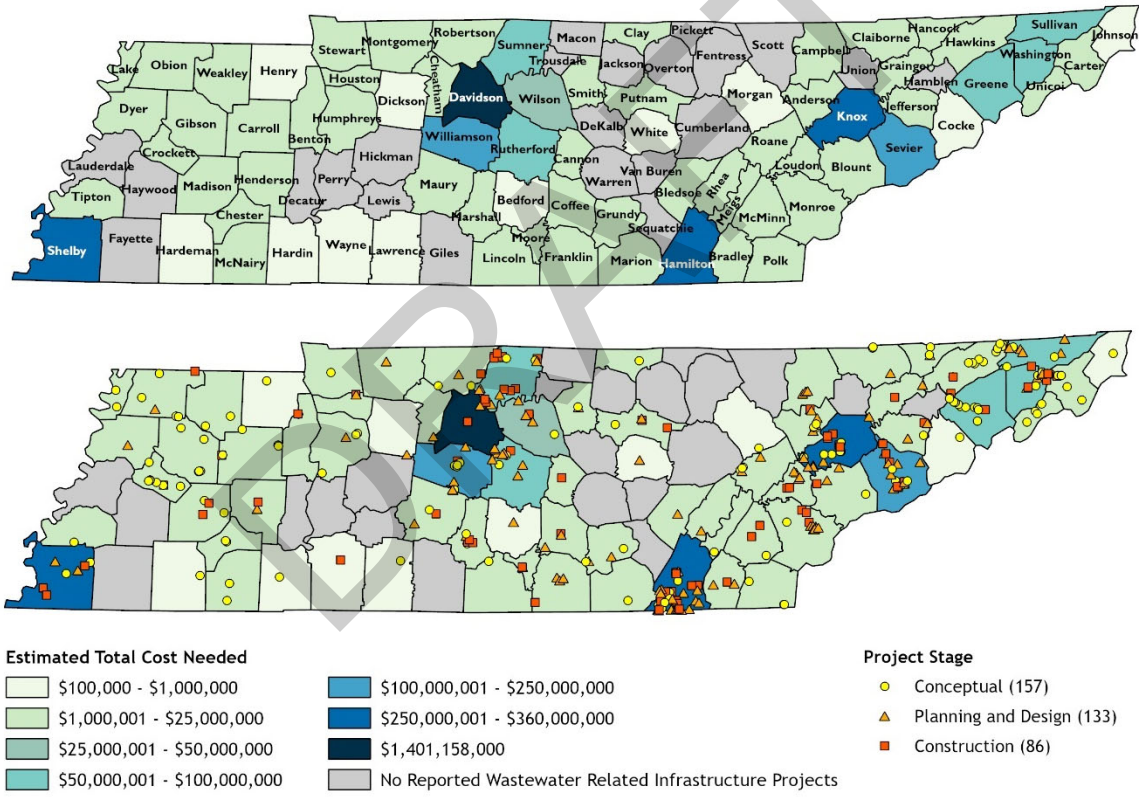
[93] Jeff Huffman, county executive, Tipton County, January 25, 2024.

[94] Interview with Ross Colona, assistant director, Jean Suh, contract audit review manager, and Lisa Bellar, senior contract audit review specialist, Tennessee Comptroller's Office, August 28, 2023.

[95] Tennessee Department of Environment and Conservation 2018a.

The Commission's infrastructure report, which collects and analyzes information sourced from the state's development districts, lists 36 wastewater projects that have reached completion and 377 ongoing projects in various stages. Of the 377 ongoing projects, 158 are in the conceptual stage, which means the project has an estimated cost but is not in planning and design yet, 133 are in the planning and design stage, and 86 are under construction. Hamilton County has the most wastewater related infrastructure projects at a total of 43. See map 2. For a comprehensive list of the state's estimated needs by county, see appendix A. Wastewater projects were reported in 73 counties. There were only 22 counties that did not report any wastewater related infrastructure projects.

**Map 2. The Estimated Cost Reported for Wastewater-Related Infrastructure Projects in Tennessee for July 2022 through June 2027.**




Source: Commission staff analysis of Tennessee Advisory Commission on Intergovernmental Relations 2024.

**As of May 2024, 53 public wastewater systems were under the oversight of the Tennessee Board of Utility Regulation for financial distress.**

The Tennessee Board of Utility Regulation (TBOUR) oversees some wastewater systems, ensuring their financial integrity. They can address customer complaints and approve new utility districts, investigate misconduct, mismanagement, and compliance issues, order corrective actions, including mergers or consolidations, and provide financial assistance to merging or consolidating systems.[96] The board administers a utility revitalization fund that provides money to systems they ordered to merge or that voluntarily consolidated or merged.[97]

The Comptroller's Office identifies financially distressed systems based on their audits and refers them to TBOUR. Distress includes but is not limited to two consecutive years of negative net change (losses exceeding revenue), defaulting on debts, or overall liabilities exceeding assets.[98] The board can order corrective actions for distressed systems, typically including a rate study that would generally lead to a rate increase.[99]

As of May 2024, 53 out of 278 public wastewater systems are under the board's oversight for being financially distressed. Thirteen of these systems are under distress because of sewer service. Forty of these systems have a combined water and sewer fund and it is difficult to determine if they are under distress because of water or sewer service or both.[100]

## What are the number of wastewater systems that have enforcement letters from the Tennessee Department of Environment and Conservation?

The Tennessee Department of Environment and Conservation (TDEC) mandates that any entity intending to treat wastewater must obtain a permit to do so. The type of permit



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[96] Interview with Ross Colona, assistant director, Jean Suh, contract audit review manager, and Lisa Bellar, senior contract audit review specialist, Tennessee Comptroller's Office, August 28, 2023

[97] Interview with Ross Colona, assistant director, Jean Suh, contract audit review manager, and Lisa Bellar, senior contract audit review specialist, Tennessee Comptroller's Office, August 28, 2023; and Tennessee Comptroller of the Treasury 2023c.

[98] Municipal Technical Advisory Service 2023; and email correspondence with Nate Fontenot, Financial Analyst, Tennessee Comptroller's Office, May 07, 2024.

[99] Interview with Ross Colona, assistant director, Jean Suh, contract audit review manager, and Lisa Bellar, senior contract audit review specialist, Tennessee Comptroller's Office, August 28, 2023

[100] Email correspondence with Nate Fontenot, financial analyst, Tennessee Comptroller's Office, May 07, 2024.

issued is contingent on the treatment activities the entity engages in. TDEC also oversees the engineering, design, and construction of wastewater treatment plants, applicable to both centralized and decentralized systems. These wastewater systems are required to submit construction plans for review prior to the start of a project.

Wastewater systems planning to discharge from point sources[101] into surface waters of the state must obtain a National Pollutant Discharge Elimination System (NPDES) permit from TDEC's Division of Water Resources.[102] The federal Clean Water Act prohibits the discharge of pollutants through a point source into any water of the United States without an NPDES permit.[103] These permits establish effluent limits that serve as the primary mechanism for controlling discharges of pollutants to receiving waters. NPDES permits are typically held by centralized wastewater systems. A decentralized system that discharges into a point source would be required to get this permit as well.

A State Operating Permit (SOP) issued by TDEC is required for wastewater systems that do not discharge into any surface or subsurface waters.[104] Decentralized systems that apply treated wastewater to land by spray or drip irrigation would need to obtain a SOP from TDEC's Division of Underground Storage Tanks.[105] The federal Safe Drinking Water Act applies to decentralized systems and regulates parameters like nitrate content through their SOP.[106]

Other permits that wastewater systems may need to obtain depending on their treatment techniques are a Biosolids State Operating Permit or an Aquatic Resources Alteration Permit (ARAP). Biosolids are organic materials produced during wastewater treatment and can be used to fertilize soil. A biosolids SOP authorizes applying these biosolids on land in Tennessee. There are approximately 73 wastewater treatment sites who also have



[101] A point source is defined in the Clean Water Act (33 United States Code, Section 1362) as any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container.

[102] Tennessee Department of Environment and Conservation "National Pollutant Discharge Elimination System (NPDES) Permit."

[103] US Environmental Protection Agency 2023b.

[104] Tennessee Department of Environment and Conservation 2023d.

[105] Interview with April Grippo, deputy director, Division of Water Resources, Tennessee Department of Environmental Conservation, October 16, 2023; and interview with John Buchanan, director, Center for Decentralized Wastewater Management, University of Tennessee, March 27, 2024.

[106] 42 United States Code, Section 300f; and interview with John Buchanan, director, Center for Decentralized Wastewater Management, University of Tennessee, March 27, 2024.

a biosolids SOP.[107] Septic tanks, which treat wastewater for an induvial home, would need to obtain a construction permit as well as a septic installer, pumper, and land disposal permits.

TDEC provides assistance to systems to help them comply with the state's environmental laws and regulations, monitors compliance, and takes enforcement action when necessary. TDEC monitors permit compliance through monthly monitoring reports and periodic inspections and has the authority to take enforcement actions against these systems when necessary to ensure compliance with the law. Enforcement actions include notices of violation (NOVs), enforcement orders (EOs), and moratoriums.[108] See table 1.

**Table 1. Enforcement Actions TDEC Can Take Against Wastewater Systems**

| | Enforcement Agency | Action Type | Description and Penalty |
|---|---|---|---|
| **Notice of Violations (NOVs)** | TDEC | Informal | No legal consequence. Corrective action requested. |
| **Enforcement Order (EO)** | TDEC | Formal | Civil penalty of up to $10,000 per violation, per day. |
| **Director's Order** | TDEC | Formal | Issued when fine amount is under $100,000. Can be appealed within 30 days. |
| **Commissioner's Order** | TDEC | Formal | Issued when fine amount is over $100,000. Can be appealed within 30 days. |
| **Consent Order** | TDEC | Formal | Issued when the initial order terms are negotiated and agreed upon up front. |
| **Agreed Order** | TDEC | Formal | Issued when initial order has been appealed and settled. |
| **Significant Noncompliance (SNCs)** | EPA or TDEC | Formal | Issued when serious violations have occurred during 2 consecutive quarters (i.e., violating an EO) |



[107] Commission staff analysis of Tennessee Department of Environment and Conservation "DWR Permits."

[108] Interview with Jessica Murphy, compliance and enforcement manager, Tom Moss, drinking water enforcement officer, and Sarah Elias, NPDES wastewater compliance manager, Division of Water Resources, Tennessee Department of Environment and Conservation, October 11, 2023.

| | | | |
|---|---|---|---|
| **Sewer Moratorium** | TDEC or Self-Imposed | Formal | Self-imposed when one site or location has more than 5 overflows within one year. Can also be issued by TDEC through EO for chronic overflows or I/I related problems. |

Source: Interview with Jessica Murphy, compliance and enforcement manager, Division of Water Resources, Tennessee Department of Environment and Conservation, March 27, 2024; Tennessee Code Annotated, Sections 69-3-107 et seq.; and US Environmental Protection Agency 1991.

NOVs are typically issued to wastewater systems after an investigation of a complaint or a routine compliance inspection for a number of different offenses ranging from failure to properly monitor or report constituents to violating their NPDES permit requirements.[109] An NOV indicates to the operators of the wastewater system that TDEC believes the wastewater system is violating its permit and need to take corrective action or be prepared to defend its actions in subsequent enforcement. In 2023, 105 NOVs were issued to wastewater treatment systems with NPDES permits. Of those NOVs, 57 were issued to public wastewater systems operated by local governments. For wastewater systems with SOPs, 89 NOVs were issued in the last five years. See table 2. If the violations indicated in the NOV are not resolved within the requested time frame, TDEC can issue an enforcement order. The most common reasons for wastewater systems violations are exceeding effluent limits and excessive sewer overflows, which violates their NPDES permit.

As of May 2024, there were 78 active enforcement orders on wastewater systems in Tennessee.[110] There are 60 local governments that operate wastewater systems with active enforcement orders—57 with enforcement orders from TDEC and 3 with orders from the EPA. There were also 13 other entities that operate wastewater systems with active enforcement orders from TDEC—7 of the 13 are privately operated, 4 that are operated by schools, and 2 that are operated by the state.

Of the 75 enforcement orders issued by TDEC, 68 enforcement orders were issued for violating a NPDES permits while the remaining 7 were issued for violating a SOP permit.



[109] Email from Jessica Murphy, compliance and enforcement manager, Division of Water Resources, Tennessee Department of Environment and Conservation, March 19, 2024; and Tennessee Department of Environment and Conservation 2018.

[110] Commission staff analysis of Tennessee Department of Environment and Conservation "DWR Permits"; Tennessee Department of Environment and Conservation "Report on Sewer Moratoriums."; Tennessee Department of Environment and Conservation "Report on DWR Documents."; and Tennessee Department of Environment and Conservation "Enforcement Program Orders and Cases."

Those 78 enforcement orders affected approximately 73 permittees—the entity who owns or operates the wastewater systems. Sixty (60) public wastewater systems have systems under orders, representing 21.6% of all public wastewater systems. However, only 57 have active enforcement orders from TDEC, while the remaining 3 have enforcement orders from the EPA. The City of Springfield, Knoxville Utilities Board, and Metro-Nashville Water Services all have federal consent decrees from the EPA. See table 2 for a summary of all violations and enforcement actions as of May 2024.

**Table 2. Summary of Violations and Enforcement Actions Taken Against Wastewater Systems in Tennessee.**

| | Estimated Number of Violations Issued to NPDES Wastewater Permittees | Estimated Number of Violations Issued to SOP Wastewater Permittees | Total Number of Violations Issued |
|---|---|---|---|
| **Notice of Violations (NOVs)** | 105 in 2023* | 89 in the last 5 years* | **194** |
| **Active Enforcement Orders** | | | |
| **Director's Order** | 33 | 2 | **35** |
| **Commissioner's Order** | 1 | 0 | **1** |
| **Consent Order** | 27 | 1 | **28** |
| **Agreed Order** | 7 | 4 | **11** |
| **Active Moratoriums** | 39 | 7 | **46** |

*Wastewater systems with NPDES permits are inspected by TDEC annually, while wastewater systems with SOPs are inspected every 5 years.

Source: Commission staff analysis of Tennessee Department of Environment and Conservation "DWR Permits"; Tennessee Department of Environment and Conservation "Report on Sewer Moratoriums."; Tennessee Department of Environment and Conservation "Report on DWR Documents."; and Tennessee Department of Environment and Conservation "Enforcement Program Orders and Cases."



### Infiltration and inflow are a significant challenge to many wastewater collection systems in Tennessee.

Significant increases in wastewater flow caused by wet weather conditions can pose operational challenges and affect treatment efficiency at a wastewater treatment facility.[111] Additionally, deferred maintenance and inadequate wastewater infrastructure can lead to

[111] US Environmental Protection Agency 2024.

sewer overflows or releases.[112] Tennessee classifies any sanitary sewer overflows (SSOs) or combined sewer overflows (CSOs) as a permit violation and requires the self-reporting of these events.[113] SSOs and CSOs involve the release of untreated sewage from the sewer system before reaching a treatment facility. These occurrences happen when the flow into the sewer system surpasses its designed capacity, leading to discharges into storm drains, basements, streets, and water bodies.[114] The Tennessee Section of the American Society of Civil Engineers stated in the *2022 Report Card for Tennessee's Infrastructure* report that 82% of the state's municipal wastewater treatment facilities "exceeded their hydraulic design capacity in the event of a 2-year frequency, 24-hour duration storm—approximately a 3.4-inch rain event.[115]

The primary causes of wastewater overflows are infiltration and inflow (I/I)—the entry of groundwater and stormwater into a sewer system. Inflow refers to rain or snowmelt that enters the sewer system through a direct connection like illicit ones from storm sewers, roof drains, or basement sump pumps.[116] Infiltration refers to stormwater or groundwater that enters a sewer system though defects in the sewer like cracked or compromised sewer pipes or compromised manholes.[117]

For any non-compliance that could endanger public drinking water, human health, or the environment, TDEC rules mandate giving notice to the Division of Water Resources within 24 hours and submitting a report no later than five days after the permittee becomes aware of the circumstances.[118] When wastewater systems are reporting an excessive number of overflows from their collection systems, TDEC will take corrective action by imposing a moratorium. Sewer moratoriums can either be self-imposed when one site or location has more than 5 sewer overflows within a year or issued by TDEC



[112] A "release" means the flow of sewage from any portion of the collection or transmission system owned or operated by a publicly owned treatment works (POTW) or a domestic wastewater treatment plant, other than through permitted outfalls, that does not reach waters. In addition, a "release" includes a backup into a building or private property caused by blockages, flow conditions, or other malfunctions originating in the collection or transmission system. Rules of the Tennessee Department of Environment and Conservation 0400-40-05; and American Society of Civil Engineers 2022.

[113] Tennessee Code Annotation, Section 69-3-114.

[114] United States Environmental Protection Agency 2021.

[115] American Society of Civil Engineers 2022.

[116] 40 Code of Federal Regulations Section 35.2005(b)(21).

[117] 40 Code of Federal Regulations Section 35.2005(b)(20).

[118] Rules of the Tennessee Department of Environment and Conservation 0400-40-05(2)(o).

through an enforcement order for chronic sewer overflows or I/I related problems. A moratorium may be for a small portion of the collection system, or it may encompass the entire system depending on where the chronic overflow occurs.[119] When a wastewater system is under a moratorium no new sewer connections can be added until TDEC determines that the issues resulting in the overflows is resolved. A moratorium on new sewer connections is cause for wastewater systems to redirect their funds toward system rehabilitation rather than expansion, indicating a failure to maintain or upgrade systems.[120] As of May 2024, there were 46 active moratoriums affecting connections in some part of 29 counties.[121] Thirty-six local governments operate wastewater systems with sewer moratoriums.

## What are the governance structures of wastewater systems in Tennessee?

Public local government wastewater systems are governed by several different entities in the state.[122] Eighty-two percent (230 out of 278) of public wastewater systems are operated by municipalities.[123] In most of these municipalities, the wastewater rates are set by the municipality's local governing body.[124] In a few municipalities including Bulls Gap, Clinton and Harriman, the rates are set by utility boards and not the municipality's governing body.[125,126]

Nine percent (24 out of 278) of public wastewater systems are run by utility districts. These districts can be created by filing a petition with the Tennessee Board of Utility Regulation (TBOUR).[127] A petition must be signed by at least 25 real property owners who live within the proposed district's boundaries. TBOUR has the authority to approve the



[119] Email from Jessica Murphy, compliance and enforcement manager, Division of Water Resources, Tennessee Department of Environment and Conservation, March 19, 2024.

[120] American Society of Civil Engineers 2022.

[121] Tennessee Department of Environment and Conservation "Report on Sewer Moratoriums."

[122] A list of public wastewater utilities was provided to staff by the Tennessee Board of Utility Regulation.

[123] Tennessee Code Annotated Sections 6-2-201(11), 6-19-101(11), 6-33-101, 7-3-302, and 7-35-401 – 7-35-432.

[124] Staff review of municipal codes of municipalities with wastewater utilities.

[125] Bulls Gap Municipal Code 18-106, Clinton Municipal Code 18-105(4), and Harriman Municipal Code 18-101.

[126] Cleveland Utilities is in the process of forming an Energy Authority so it can provide broadband service. Cleveland Utilities 2023.

[127] Tennessee Code Annotated Section 7-82-201.

creation of the district. These districts are governed by boards of commissioners.[128] In single county utility districts, the commissioners are appointed by the county mayor. The selection method can be changed to election by customers or appointment by a county probate judge if the district is in a county governed by a metropolitan form of government if the change is approved by the General Assembly. In multi-county districts, the commissioners are elected by customers.[129] A utility district that uses a method other than appointment by county mayor for selecting commissioners may change the method for choosing commissioners to appointment by county mayor if the TBOUR approves it.

Two percent (6 out 278) of wastewater systems are governed by the boards of commissioners of water and wastewater treatment authorities.[130] A municipality, county or metropolitan government can file a petition with TBOUR to create an authority.[131] TBOUR has the authority to approve creation of an authority. Each authority is are governed by a board of commissioners.[132] These commissioners are appointed by the executive officer of the government that petitioned for the creation of the authority, and the commissioners must be approved by that entity's governing body.

Municipal energy authorities operate 2% (5 out of 278) of wastewater systems in the state. A municipal energy authority can be formed by a resolution approved by the two-thirds vote of the county or municipality's governing body.[133] An authority is governed by a board of directors.[134] The board's directors fill any vacancies on the board subject to the approval of the county or municipal governing body that approved the formation of the authority.[135]

Two percent (5 out of 278) of public wastewater systems are operated by counties. The governing body of the utility can be selected by the county governing body by



[128] Tennessee Code Annotated Section 7-82-307.

[129] See Tennessee Code Annotated Section 7-82-307(h)(1).

[130] Tennessee Code Annotated Section 68-221-605. There is also a law that authorizes the creation of regional water and wastewater authorities in Tennessee Code Annotated Sections 68-221-1301-68-221-1309.

[131] Tennessee Code Annotated Section 68-221-604.

[132] Tennessee Code Annotated Section 68-221-605.

[133] Tennessee Code Annotated Section 7-36-103.

[134] Tennessee Code Annotated Section 7-36-109.

[135] Tennessee Code Annotated Section 7-36-110.

resolution.[136] The governing board can also be a county agency in existence, a public works department or a board of public systems.

Metropolitan governments also provide wastewater service in the state. These governments operate 1% (3 out of 278) of the wastewater systems. In the Metropolitan Government of Nashville & Davidson County, the Metro Council sets the rates for wastewater service.[137] A seven-member water and sewer board sets wastewater rates in the Metropolitan Government of Hartsville/Trousdale County.[138] The metro water and sewer department of the Metropolitan Government of Lynchburg-Moore County provides wastewater service. It is governed by a five-member utility board appointed by the metro executive.[139]

A few local governments jointly work together to provide wastewater services. They operate 2% (5 out of 278) of the wastewater utilities in the state. Tennessee's Interlocal Cooperation Act authorizes local governments to enter into agreements to exercise powers and authority jointly with other local governments that have the same powers and authority.[140] The cities of Caryville-Jacksboro jointly operate the Caryville-Jacksboro Utilities Commission that provides water and wastewater service.[141] It is governed by a board of commissioners.[142] Each municipality appoints a member to the board and together they appoint a third member.[143] Benton and Decatur counties entered into an agreement to form the Benton-Decatur Special Sewer District.[144] It is governed by a six-member board.[145] The Mayor of Benton County appoints three members and the Decatur County Mayor appoints three board members as well.[146] The city of Bristol, Tennessee



[136] Tennessee Code Annotated Section 5-16-102.

[137] Code of the Metropolitan Government of Nashville and Davidson County Chapter 15.44.

[138] Metropolitan Government of Hartville/Trousdale County Ordinance No. 119-2015-10 c; and Tennessee Comptroller of the Treasury 2023b.

[139] Winnett Associates 2023.

[140] Tennessee Code Annotated Section 12-9-104.

[141] Mitchell, Emert, and Hill 2023.

[142] Caryville Municipal Code 18-207(5);and Jacksboro Municipal Code 18-207(5).

[143] Mitchell, Emert, and Hill 2023.

[144] Tennessee Comptroller of the Treasury 2023a.

[145] Ibid.

[146] Ibid.

jointly owns a wastewater treatment plant with the BVU Authority of Bristol, Virginia.[147] Each municipality appoints three members to sit on a six-member committee that oversees the utility.[148]

**Private, Investor-Owned Wastewater Systems and Wastewater Cooperatives**

There are 13 private, investor owned, wastewater systems that are under the oversight of the Tennessee Board of Public Utilities Commission (TPUC).* The majority of the systems TPUC regulates are decentralized. They approve the creation of the wastewater systems. The wastewater systems are required to submit annual reports that allow TPUC to gauge how the utility is performing. Cases can be made to TPUC about the need for a rate change. Ultimately, the TPUC makes the decision about the rates. TPUC also handles customer complaints. The systems are required to get NPDES or SOP permits from TDEC depending on where they discharge.

TPUC staff note that they are seeing a rise in big companies acquiring smaller systems across the state and country because they do not have the resources to maintain the facilities and systems under them. There are acquisition rules in place that regulate this process. Following these types of acquisitions, rates generally stay the same, but might increase some when necessary repairs or changes to update the systems are made.

Water cooperatives are non-profit corporations that are member owned.† They are not under the oversight of TBOUR or TPUC. They are required to get NPDES or SOP permits from TDEC depending on where they discharge.

* Interview with David Foster, director of utilities, and Joe Shirley, director, utility audit and compliance, Tennessee Public Utility Commission, December 14, 2023



Tellico Area Services System is a water and wastewater utility co-owned by Monroe and Loudon counties.[149] It is governed by a six-member board of commissioners.[150] The Tellico River Development Agency entered into an agreement with the Tellico Area Services

[147] Brown Edwards 2023.

[148] City of Bristol Finance Department 2023.

[149] Tellico Area Services System 2023.

[150] Warren Jackson 2022.

System to construct a sewer line and pump stations for them.[151] Under the agreement, Tellico Area Services will pay the Tellico River Development Agency $1,500 for each customer that taps onto the sewer line until the Agency is reimbursed for the construction costs.

## Are wastewater utility board members compensated and does this include benefits?

Much like the governance structure of public wastewater systems, the compensation and benefits made available to board members vary greatly across the state. Commission staff conducted a survey of the 278 public wastewater systems overseen by TBOUR to learn more about the compensation rate and benefits provided to utility board members. Respondents from 82 systems reported information about their board and staff landscape, insurance and benefits options, and utility debt levels. See appendix B for additional information on the survey results.

Sixty-five percent of respondents reported that they pay their governing board members, with the amount and frequency of compensation varying widely. Some boards are paid a standard amount for the year while others are paid per meeting. Other board members' compensation is grouped with their services for additional systems, like energy or water. Because of the difference in frequency, the survey results show that board member compensations can range from $50 per month to $17,000 a year depending on the utility board they serve on.

Benefit packages vary as well, with 32% of respondents reporting that their utility offers board members health insurance. Of those systems providing health insurance, 88% pay a portion of the health insurance premium. Fewer systems, 23%, offer vision insurance and even less, 20%, offer dental insurance. Respondents reported that life insurance is made available by 15% of systems.

Retirement benefits are offered by just 9% of the systems that participated in the survey, through the Tennessee Consolidated Retirement System, (TCRS). Board members enrolled in TCRS can access a defined benefit plan that provides lifetime retirement, survivor and disability benefits for employees and eligible beneficiaries,[152] and includes 401K and 457b or deferred compensation plan options. Retirement benefits are not always offered to all members of a utility board, and instead are reserved for chairmen of the boards. This is

[151] Rodefer Moss 2023.

[152] Tennessee Department of Treasury "Retirement."

the case for the Lenoir City Utility Board, where a defined benefit pension plan plus 3% to a 457b deferred compensation plan is available for the chairman of the board only.

Beyond the more standard benefits offered like health insurance, some systems provide board members with additional benefit options. Webb Creek Utility District offers members of their governing body a health reimbursement card up to $2,000 a month. The Ripley Gas, Water, and Wastewater department offers a similar benefit in the form of a flexible benefit card. Other additional benefits reported in the survey include paid travel for board-related activities and training opportunities.

## What are the best methods for financing sewer lines and wastewater treatment plants?

Choosing the best option to finance wastewater infrastructure requires careful analysis of project size, local needs, and long-term financial health. By strategically analyzing these available financing options, communities can ensure their systems remain in working condition. Wastewater treatment requires significant investment. Traditionally, the federal government shouldered a large portion of this burden through grants.

Historically, there was a significant amount of federal grant funding available for wastewater projects. The US Environmental Protection Agency's Construction Grants program provided more than $60 billion of funding for wastewater treatment projects in the 1970s and 1980s.[153] The federal government's share of project costs was originally 75% but was later reduced to 55% by 1981.[154] The grants program ended in 1990 and was replaced with the Clean Water State Revolving Fund (CWSRF) program.[155] Under this program federal funds are provided to states who use the money to fund loans to systems who then repay the loans to the state.[156] As money is paid back to the state's revolving loan fund, the state makes new loans.[157]

Today, the federal government funds a small portion of wastewater projects.[158] Local governments provide most of the funding for capital projects. According to data from



[153] United States Environmental Protection Agency 2023b.

[154] Ramseur and Tiemann 2019.

[155] Ramseur 2018.

[156] Ramseur and Tiemann 2019.

[157] Raftelis 2015.

[158] Ramseur 2018.

TACIR's Infrastructure survey, of the wastewater projects completed between 2007-2022, 83% of the funding came from the systems, 11% came from federal funding sources, 4% came from the state, and 2% came from other sources. These days most wastewater projects are debt-financed.[159]

## Overview of Funding Sources

When considering potential sources of funding for capital projects, a utility could evaluate the advantages and disadvantages of each form of financing available.[160] They may also want to consider how the funding alternative will affect their financial capacity and how it fits in their utility's long-term financial plans.[161] There are several different types of funding opportunities that systems can use.

### *Internal Funding*

Revenues or cash reserves generated from user rates, fees and charges could be used to fund capital projects.[162] It is a convenient way of financing low-cost, short-term capital projects.[163] The public will likely find this form of financing easy to understand and politically acceptable.[164] There may be an equity issue with this type of financing since current ratepayers could be funding projects that will be used by new ratepayers in the future.[165]

### *Grants*

Grants can help systems reduce the total costs of capital projects.[166] They aren't required to be repaid.[167] There are still grant programs that can be tapped for wastewater projects. For example, there is the Community Development Block Grant (CDBG) program, and there are a few grants available through the US Department of Agriculture that can be



[159] Ibid.

[160] Fedder, Hofield, and Mastracchio 2014.

[161] American Water Works Association 2014.

[162] Financing and Charges for Wastewater Systems Task Force 2018.

[163] Grigg 2012.

[164] Ibid.

[165] Raftelis 2015.

[166] Fedder, Hofield, and Mastracchio 2014.

[167] Ibid.

used to finance wastewater projects.[168] The state of Tennessee offers grants as well including Site Development Grants that can be used utility line construction and relocation to improve Select Tennessee certified sites and prepare other sites to achieve certification.

Some of these grants may apply only to specific types of projects. The CDBG Entitlement Program grants, for example, can only be used for projects in the principal cities of Metropolitan Statistical Areas (MSA) and other cities with populations over 50,000.[169] Depending on the grant requirements, they may be competitive, and it may be difficult to qualify for them.[170]

### *Bonds*

Bonds are frequently issued to finance projects because they can provide large sums of money to fund the projects and can be repaid at a uniform level over a set period of time.[171] The interest rates are based on the creditworthiness of the systems; small utilities, for example, that are in poor financial condition may have difficulty attracting bond buyers.[172] General obligation bonds and revenue bonds are two common types of bonds used to issue to finance wastewater projects.

General obligation bonds are backed by the bond issuer's full and credit.[173] These bonds can only be issued by governments that have taxing authority.[174] They are one of the lowest cost sources available to finance projects.[175] Cities, counties, and metropolitan governments that operate wastewater systems are authorized to issue general obligation bonds in Tennessee.[176] These have had widespread use because of low borrowing costs



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[168] United States Department of Agriculture 2024b; and Tennessee Department of Environment and Conservation 2024a.

[169] United States Department of Housing and Urban Development 2024.

[170] Fedder, Hofield, and Mastracchio 2014.

[171] Bloetscher 2009.

[172] Ibid.

[173] Financing and Charges for Wastewater Systems Task Force 2018.

[174] Wastewater Collection System Management Task Force 2021

[175] Financing and Charges for Wastewater Systems Task Force 2018.

[176] Tennessee Code Annotated Sections 9-21-107, 5-16-106(c), 7-34-101 *et seq*; and Tennessee Comptroller of the Treasury 2023d.

and the ease of issuing them.[177] This can make them a good choice for a start-up utility.[178] One disadvantage of these bonds is that they become part of the local government's debt and will be included in determining the bonding capacity of the local government.[179] This may make it more difficult for local governments to use debt to fund other projects.[180] In some cases, a bond issue may also have to be approved by voters.[181]

Revenue bonds are backed by a utility's revenues.[182] Funds have to be allocated from revenues to pay off the bonds.[183] These bonds are available to systems that don't have taxing authority.[184] Counties, cities, metropolitan governments, utility districts, water and wastewater authorities, and municipal energy authorities are authorized to issue revenue bonds for projects.[185] The marketability of the bonds will depend on the project and the ability of the utility to generate revenue.[186] Because of this revenue bonds may sometimes have higher interest rates than general obligation bonds.[187]

Double barrel bonds are a hybrid of both revenue and general obligation bonds.[188] The double barrel bonds are secured first by revenues and secondarily secured by the taxing authority of the local government.[189] They are likely to have interest rates similar to that of a general obligation bond.[190]



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[177] Financing and Charges for Wastewater Systems Task Force 2018.

[178] Fedder, Hofield, and Mastracchio 2014

[179] Bloetscher 2009.

[180] Financing and Charges for Wastewater Systems Task Force 2018.

[181] Bloetscher 2009. Tennessee Code Annotated Section 9-21-206 states that if registered voters present a petition signed by 10% of voters, a referendum must be held on the bond issue and the bonds can't be issued unless approved by a majority of voters.

[182] Wastewater Collection System Management Task Force 2021.

[183] Bloetscher 2009.

[184] Fedder, Hofield, and Mastracchio 2014.

[185] Tennessee Code Annotated Sections 7-82-501, 68-221-611 and 7-36-113; and Tennessee Comptroller of the Treasury 2023d.

[186] Financing and Charges for Wastewater Systems Task Force 2018.

[187] Ibid.

[188] Raftelis 2015.

[189] Financing and Charges for Wastewater Systems Task Force 2018.

[190] Raftelis 2015.

### *Loans*

Loans are available from federal and state agencies provide loans to systems to finance wastewater projects.[191] There are programs such as the federal Water Infrastructure Finance and Innovation Authority (WIFIA) program that makes loans for large capital projects of at $5 million or larger.[192] Government loan programs offer rates that typically are competitive with market rates.[193] For example the Clean Water State Revolving Fund (CWSRF) programs, for example, provides loans for capital projects that are at or below market rates.[194] The specifics of any government loan programs could be assessed to determine their suitability for financing projects.[195]

Bank loans can also be a source of funding, especially on a short-term basis.[196] The process of obtaining a bank loan is more streamlined than the bond issuance process and a utility may be able get funding more quickly if they apply for a loan.[197] One drawback to these loans is that the interest rate could be higher on a bank loan that it would be on a government loan.[198]

### *Notes*

Notes function much like bonds and loans, serving as short-term debt where the issuer commits to repaying the borrowed amount along with interest are.[199] In Tennessee, local governments are authorized to issue several types of notes. Cities, counties and metropolitan governments, for instance, can issue bond and grant anticipation notes.[200] These notes serve as a means for financing expenditures until bonds are issued or grant funds are received.[201] Additionally, they have the authority to issue capital outlay notes,



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[191] Wastewater Collection System Management Task Force 2021.

[192] United States Environmental Protection Agency 2023d.

[193] Wastewater Collection System Management Task Force 2021.

[194] Tennessee Department of Environment and Conservation 2024e.

[195] Wastewater Collection System Management Task Force 2021.

[196] Raftelis 2015.

[197] Financing and Charges for Wastewater Systems Task Force 2018.

[198] Ibid.

[199] Tennessee Comptroller of the Treasury 2023d.

[200] Tennessee Code Annotated Sections 9-21-501 *et seq*. and 9-21-701.

[201] Fedder, Hofield, and Mastracchio 2014; and Tennessee Comptroller of the Treasury 2023d.

primarily utilized for financing short-term capital assets such as vehicles.[202] Moreover, these governments along with energy authorities and utility districts can issue revenue anticipation notes, which can provide necessary funds for operations until revenue collection is possible.[203]

### *Contributions*

Developers may be required to construct components of a wastewater system for a new development and give the infrastructure to a utility.[204] These are known as contributions from developers.[205] They are a way systems fulfill their infrastructure needs in areas where new growth is occurring.[206] It enables systems to reduce the amount they spend on capital projects.[207] Developers may voice opposition to these requirements.

## Federal Funding Sources

The federal government offers several funding sources for wastewater systems. There are both grants and loans available for wastewater systems. The US Environmental Protection Agency, US Department of Agriculture, US Department of Commerce and US Army Corps of Engineers offer funding for these types of projects.

### *US Environmental Protection Agency*

The Water Infrastructure Finance and Innovation Act (WIFIA), a federal credit program administered by the EPA offered loans for eligible water and wastewater infrastructure projects. Because this is a federal credit reform program, when the loans are repaid, they are returned to the US Treasury. The application process consists of two steps, an initial form of request must be submitted—is the project eligible, feasibility, credit worthiness, selection criteria—if the applicant is found suitable then they are invited to apply. WIFIA appropriation levels for the program remain consistent year to year with around $6 to 7 billion available to lend. They can provide a maximum of 49% of project costs, but small communities are eligible for a maximum of 80% of project costs. Tennessee has received



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[202] Tennessee Code Annotated Sections 9-21-601 *et seq*.; and Tennessee Comptroller of the Treasury 2023d.

[203] Tennessee Code Annotated Sections 9-21-801 *et seq*., 7-34-111, 7-36-113 and 7-82-501; and Tennessee Comptroller of the Treasury 2023d.

[204] Fedder, Hofield, and Mastracchio 2014.

[205] Financing and Charges for Wastewater Systems Task Force 2018.

[206] Ibid.

[207] Fedder, Hofield, and Mastracchio 2014.

a total of $342 million in loans for two projects in 2020 and 2022 for the cities of Memphis and Chattanooga respectively.[208]

### *US Department of Agriculture*

The US Department of Agriculture offers various grant and loan programs for wastewater infrastructure projects. The Wastewater Disposal Direct Loan and Grant Program provides infrastructure for rural areas and towns with populations of up to 10,000. Eligible entities include most state and local governmental entities, private nonprofits, and federally recognized tribes. Available funds may be used to build, repair, or improve public water systems, waste collection, and treatment systems. Funding consists of long-term, low-interest loans, but if funds are available, a grant may be combined with a loan to keep user costs reasonable. The repayment period for this program is a maximum of 40 years.[209]

The Water and Waste Disposal Loan Guarantees administered by the USDA offers infrastructure loans for rural areas and towns with populations up to 50,000. However, funds are prioritized in favor of towns with populations of 10,000 or less for fiscal year 2020. Eligible entities include public bodies, federally recognized tribes, and non-profit businesses. The goal of this loan program is to provide affordable financing to qualified borrowers to improve access to clean, reliable water and waste disposal systems for households and businesses in rural areas. This program also provides a loan guarantee to build, repair, and improve water supply and distribution systems, waste collection, and treatment systems.

USDA also offers the Water and Waste Disposal Predevelopment Planning Grants which helps eligible low-income communities plan and develop applications for proposed USDA Rural Development water or waste disposal projects. Eligible entities include most state and local governments, nonprofit organizations, and federally recognized tribes. This program is for low-income communities with initial planning and development of an application for USDA Rural Development Water and Waste Disposal direct loan/grant



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[208] Interview with Karen Fligger, deputy director, Office of Wastewater Management Environmental Protection Agency, November 6, 2023; United States Environmental Protection Agency "Water Infrastructure Finance and Innovation Act (WFIA)|What is WIFIA?"; and commission staff analysis of data from the United States Environmental Protection Agency.

[209] United States Department of Agriculture "Water & Waste Disposal Loan & Grant Program in Tennessee"; and interview with Chris Hampton, program manager, Rural Utilities Service & Community Facilities, United States Department of Agriculture, October 16, 2023.

and loan guarantee programs. Communities include rural areas and towns with populations of 10,000 or less and must have a median household income below the poverty line or less than 80 percent of the statewide non-metropolitan median household income. Partnerships with other federal, state, and local entities are encouraged, but grants are awarded only when the applicant cannot afford to borrow the needed funds. The maximum grant amount is $60,000 or 75% of the predevelopment planning costs and funds cannot be used to pay for work already completed. These predevelopment planning grants do not have to be paid back if the application for the USDA direct loan or loan and grant combination is not awarded.

The Special Evaluation Assistance for Rural Communities and Households (SEARCH) program covers predevelopment planning costs: feasibility studies to support applications for funding water or waste disposal projects, preliminary design and engineering analysis, and technical assistance for the development of an application for financial assistance. Predevelopment planning costs must be related to the project that must construct, enlarge, extend, or improve rural water, sanitary sewage, solid waste disposal and storm wastewater disposal facilities. Eligible entities for this grant include most state and local governmental entities, nonprofits, federally recognized tribes, and rural and financially distressed areas. Rural areas are defined as having a population of 2,500 or less and have a median household income below the poverty line or less than 80% of the statewide non-metropolitan median household income based on the latest Census data.[210]

The Communities Facilities Direct Loan and Grant is a loan and grant program that offers funds to purchase, construct, improve essential community facilities, or purchase equipment and pay related project expenses. Eligible communities include rural areas including cities, villages, townships and towns including Federally Recognized Tribal Lands with no more than 20,000 residents according to the latest U.S. Census Data. Eligible entities are placed on a priority point system based on population and median household income, but higher priority is given to small communities with a population of 5,500 or less or low-income communities having a median household income below 80%



[210] Environmental Finance Center Network "Tennessee Water and Wastewater Funding Sources"; U.S. Department of Agriculture "SEARCH – Special Evaluation Assistance for Rural communities and Households in Tennessee"; and Code of Federal Regulations, Title 7, Part 1774 - 7 CFR 1774 Section 306 of the Consolidated Farm and Rural Development Act

of the state nonmetropolitan median household income. Grant maximum is dependent on the project criteria and ranges from 15-75% of project costs.[211]

### *US Department of Commerce*

The Economic Development Administration Public Works Program and the Economic Development Administration Economic Adjustment Assistance Program are streamlined through the Economic Development Grants Experience (EDGE). The Economic Development Administration Public Works Program provides funding for projects with direct correlation to job creation for publicly owned infrastructure, sewer rehab or wastewater treatment facilities. There is approximately $40 million available for the Southeastern region which includes eight states. Each project is usually awarded $1 to 2.5 million in funds, but funding is competitive. Tennessee is usually awarded funds for 2 to 4 projects a year, depending on how many applications are submitted.[212]

### *US Army Corps of Engineers*

The US Army Corps of Engineers (USACE) provide the Environmental Infrastructure Assistance program, available to specified municipalities, counties, and states for water distribution works, stormwater collection, surface water protection projects, and environmental restoration. Cost sharing is required in order to receive assistance—75% federal and 25% nonfederal.[213]

## State Funding Sources

Like the federal government, the state offers funding opportunities for wastewater systems. The Tennessee Department of Environment and Conservation (TDEC), Tennessee Department of Economic Development (ECD), and the Comptroller's Office offer funding opportunities for wastewater systems. Some of these programs are state-administered programs where the federal government allocates funds to the states, and the states are responsible for distributing the money to systems.



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[211] United States Department of Agriculture "Community Facilities Direct Loan & Grant Program in Tennessee."

[212]Phone call with Lucas Blankenship, economic development representative, Economic Development Administration, March 8, 2024.

[213] Congressional Research Service 2022.

### *Tennessee Department of Economic and Community Development (ECD)*

The US Department of Housing and Urban Development (HUD)'s Community Development Block Grants (CDBG) provides funds for a range of community problems including water and wastewater infrastructure and improvements. City and county governments are eligible for this grant as well as all communities in Tennessee except those in entitlement communities—communities that receive direct CDBG funds from HUD. Utility districts and authorities are not eligible to apply. The level of funding is determined based on Congressional appropriations each year. In recent years, Tennessee has received approximately $25 million per year, and 80-85% of funds are appropriated for water and wastewater projects.[214] Between 2022 to 2024, 30 wastewater projects were funded for a little over $14.2 million.[215]

CDBG projects are evaluated based on scoring, dependent on the category of project type. Sewer projects are scored based on a 100-point scale which include the following criteria: community need, per capita income of area based on most recent ACS or census data, poverty rate, three-years of unemployment data for the county, per capita income if it's based on income survey, project income (cost per person), rate factor, project need (technical score based on level of infiltration and inflow, capacity, ae of system).[216]

The Appalachian Regional Commission (ARC) is an economic development partnership entity of the federal government and 13 state governments focusing on counties across the Appalachian region. ARC provides federal funding support in the form of public infrastructure grants to counties in Middle and East Tennessee. The amount of funding available each year fluctuates, but most recently, the ARC had nine million dollars to offer for eligible projects. Applicants for an ARC grant are required to submit a pre-application in December. If a pre-applicant is moved on to the full application process, they are likely to be approved for a grant. ECD assesses several factors, including community need,



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[214] Interview with Kent Archer, director of community infrastructure, Tennessee Economic and Community Development, October 25, 2023; and interview with Brooxie Carlton, assistant commissioner of community and rural development, Tennessee Economic and Community Development, December 20, 2023; TACIR Commission Meeting January 25, 2024; and Environmental Finance Center Network 2022.

[215] Commission staff analysis of data from the Tennessee Department of Economic and Community Development.

[216] Interview with Kent Archer, director of community infrastructure, Tennessee Economic and Community Development, October 25, 2023; and interview with Brooxie Carlton, assistant commissioner of community and rural development, Tennessee Economic and Community Development, December 20, 2023.

project need, and county designation. Each grantee can expect to receive up to up to $1 million for construction projects and up to $500,000 for non-construction projects. Between 2022 to 2024, five wastewater projects were funded for a little over $3.1 million.

The Delta Regional Authority (DRA) is a regional economic development agency serving local communities in eight states including Tennessee. It provides federal funding to infrastructure projects in west Tennessee, including wastewater facilities. Each year the DRA has two million dollars to grant to eligible applicants, but priority is given to projects that make the most economic impact, including the creation of jobs. Exact award amounts differ based on the number of jobs created and the number of other successful applications. Grantees can expect to receive up to $500,000.[217] In 2023, Stanton, TN received a $3.5 million DRA grant for water and sewer facilities in preparation for BlueOval City--this grant was accompanied by an $8.1 million award from the USDA.

The Infrastructure Planning Grant is state funded and available to assist financially distressed areas with community-wide planning. A distressed county or rural community is defined by having high amounts of debt, or the inability to financially self-support--the Comptroller's Office generates an annual list of these areas and eligible applicants must be a utility serving a county or rural community that has been on the list in any of the last three years. Grant money can be used for up to three of the following categories: water system mapping and modeling, water system analysis, sewer system mapping and modeling, sewer system analysis, asset management related activities, and regionalization studies. Grantees are eligible for up to $500,000.[218] Between 2022 to 2024, 32 wastewater projects were funded for a little over $4.7 million, there were no awarded projects in 2023.[219]

The Site Development Grant is state funded and can be used to improve Select Tennessee certified sites and prepare other sites to achieve certification. The Select Tennessee



[217] Interview with Kent Archer, director of community infrastructure, Tennessee Economic and Community Development, October 25, 2023; and interview with Brooxie Carlton, assistant commissioner of community and rural development, Tennessee Economic and Community Development, December 20, 2023.

[218] Interview with Kent Archer, director of community infrastructure, Tennessee Economic and Community Development, October 25, 2023; and interview with Brooxie Carlton, assistant commissioner of community and rural development, Tennessee Economic and Community Development, December 20, 2023.

[219] Commission staff analysis of data from the Tennessee Department of Economic and Community Development.

Certified Sites Program markets the sites to a targeted group of site selection consultants and business leaders. To be eligible for a grant, the application must be from a governmental entity with a site that is publicly owned, at least 20 acres, and has undergone a site visit for the Select TN certification program. Scoring is based on public benefit and impact, performance measures, resources that the site offers, and project timeline, but priority is given to projects that can be completed quickly.[220] Between 2022 to 2024, three wastewater projects were funded for a little over $3.5 million.[221]

### *Tennessee Department of Environment and Conservation (TDEC)*

Before TDEC applies for capitalization grants—money received from the EPA—projects are placed on a priority ranking list and an annual intended use plan is created. They are then ranked based on criteria and procedures outlined in the Clean Water State Revolving Fund's (CWSRF) Priority Ranking System Rules. This ranking system forms the basis for eligibility determinations and the allocation of CWSRF loans from the SRF Loan Program. Projects can be moved up on the priority list depending on matter of importance deemed by TDEC—significant noncompliance issues, economic stability of the community, impact the project may have to water quality, level of service to the customers—only if they are in compliance with the Comptroller's office.

The Clean Water State Revolving Fund (CSWRF), commonly known as the State Revolving Fund Program (SRF) has been funded through the EPA by congressional allocation every year since 1987. States are required to contribute an additional 20% to match the federal grants. SRF loans offer discounted rates as opposed to market rate loans; a reduced interest rate or additional subsidization or principal forgiveness can be given to disadvantaged communities based on their ability to pay index (ATPI) rating—required by the federal government. There is currently about $26 million in funds available for wastewater projects—a decrease in prospective funding because of earmarked funds proposed by Congress. In 2009, Congress authorized these state funds to provide further financial assistance through additional methods such as grants and principal forgiveness.



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[220] Interview with Kent Archer, director of community infrastructure, Tennessee Economic and Community Development, October 25, 2023; and interview with Brooxie Carlton, assistant commissioner of community and rural development, Tennessee Economic and Community Development, December 20, 2023.

[221] Commission staff analysis of data from the Tennessee Department of Economic and Community Development.

The State Water Infrastructure Grants (SWIG) - American Rescue Plan (ARP) funds are administered and allocated funds from the 2021 American Rescue Plan (ARP) Act by TDEC for water, wastewater, and stormwater infrastructure. ARP funds must be obligated by 2024 and spent by 2026. Eligible communities include counties and cities that own or operate a wastewater utility and must submit their audited financials to the Comptroller's Office to be eligible. There is online training available on how to complete the application process. There has been about $467 million in noncompetitive grants and $43 million in competitive grants for wastewater projects,[222] for a total of 437 wastewater projects executed in ARP grants. The SWIG program also offers Asset Management Plan Grants, financed using funds from SRF, that can be used by systems to help them complete their asset management plans.

### *Tennessee Comptroller's Office*

The Tennessee Board of Utility Regulation (TBOUR) administers a utility revitalization fund to provide money to systems they order to merge. Systems that voluntarily merge may apply to the TBOUR for grants from the fund. TBUUR has the discretion to grant money if they find the merger is in the best interest of at least one utility system, does not harm another utility, and the grant is necessary to achieve the merger. As of May 2024, only one grant has been awarded for a total of $500,000 to the Plateau Utility District for a consolidation with the City of Wartburg's utility to pay off some of Wartburg's debt on its sewer system.[223]

## Private Funding Sources

There are private entities and nonprofits that offer funding opportunities for wastewater systems in Tennessee. This is not an exhaustive list of opportunities. It is an example of what is available to communities from sources other than the state and federal government. There may be funding available from other sources like banks other than the ones mentioned below.

The Tennessee Association of Utility Districts Interim Loan Program partnering with The Rural Water and Financing Agency (Regions Bank) offers an interim loan to communities that have already received a permanent loan commitment from the USDA Office of Rural



[222] Commission staff analysis with data from the Tennessee Department of Environment and Conservation.

[223] Interview with Ross Colona, assistant director, Jean Suh, contract audit review manager, and Lisa Bellar, senior contract audit review specialist, Tennessee Comptroller's Office, August 28, 2023; and commission staff analysis with information from the Tennessee Comptroller's Office.

Development.[224] This program offers funding for water and wastewater construction projects and must be used only for the construction period and once project is complete, must be repaid with Rural Development funds.

Communities Unlimited, a nonprofit corporation, provides national funding of up to $750,000 loans for wastewater projects to communities of 10,000 or less but can offer loans to larger communities.[225] Most of the systems that will be offered loans are recommended by the Communities Unlimited technical staff or USDA, but in order to receive a loan they must first prove that repayment is possible.

CoBank is a bank that provides loans, leases and other financial services to agribusiness, and rural infrastructure customers nationwide.[226] It offers bonds, short term revolving credit, and loans with a fixed rate. CoBank also leases large, costly equipment to systems for their projects.

### Decentralized Systems as an Option to Centralized Systems

Decentralized wastewater treatment systems can be a cost-effective alternative to traditional centralized systems. The decentralized systems treat wastewater close to its source, reducing the need for extensive sewer networks and large treatment plants, which lowers capital investment and maintenance costs.[227] Decentralized systems typically involve smaller initial investments and can be built incrementally to meet local demands, allowing communities to expand their wastewater treatment capacity in phases as needed.[228] This incremental approach helps avoid the large upfront costs associated with centralized systems and enables the use of the latest cost-saving technologies that may exist at the time.[229]



[224] Interview with John Greer, former program manager, Tennessee Association of Utility Districts, October 16, 2023.

[225] Interview with Annie Chiodo, Tennessee environmental state coordinator, Communities Unlimited, and Bryn Bagwell, director of lending, Communities Unlimited, November 6, 2023.

[226] Interview with Michael Griffiths, vice president, CoBank, December 14, 2023.

[227] United States Environmental Protection Agency 2015b.

[228] United States Environmental Protection Agency 2015a.

[229] Ibid.

In rural communities, decentralized systems are particularly effective due to financial and geographical constraints that make large-scale centralized facilities impractical.[230] These communities may lack the financial resources and personnel to manage and operate large systems. Decentralized systems can provide tailored solutions that address specific site conditions, such as challenging terrain issues, and can be implemented to meet local needs efficiently.[231] Decentralized systems can also be integrated into existing urban infrastructure to supplement centralized systems, providing flexibility and scalability.[232] Sometimes connecting new developments to centralized treatment plants is not feasible due to financial costs.[233]

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[230] Water Environment Foundation 2019.

[231] Ibid.

[232] United States Environmental Protection Agency 2015b.

[233] Water Environment Foundation 2019.

[234] United States Environmental Protection Agency 2015b.

[235] United States Environmental Protection Agency 2015a.

[236] Ibid.

[237] Water Environment Foundation 2019.

[238] Ibid.

local needs efficiently.[239] Decentralized systems can be integrated into existing urban infrastructure to supplement centralized systems, providing flexibility and scalability.[240] Sometimes connecting new developments to centralized treatment plants is not feasible due to financial costs.[241]

A disadvantage of these systems could be the operation and maintenance needed.[242] The decentralized systems are located on sites that maintenance staff will have to travel to.[243] There may be disruptions in service due to breakdowns.[244]

Consolidated Utility District in Rutherford County is one utility that has been recognized for how successful it's been in providing sewer services to its customers using decentralized systems.[245] Developers who build within the district's jurisdiction are required to build the systems according to the district's requirements.[246] After they're built, the district takes ownership of the decentralized systems and are responsible for maintaining them.[247] They have maintenance staff on-call to deal with issues that may arise, and their staff regularly visits the sites where the systems are located.[248]

### What are the best practices for wastewater system management from other states and the best methods to reduce the operating costs of wastewater systems?

Systems can improve management of their organizations by identifying and prioritizing areas of improvement. They can also develop asset management plans and engage in practices that can help them operate more energy efficiently.



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[239] Ibid.

[240] United States Environmental Protection Agency 2015b.

[241] Water Environment Foundation 2019.

[242] Jones et al. 2003.

[243] Ibid.

[244] Ibid.

[245] United States Environmental Protection Agency 2015b; and interview with John Buchanan, PhD, director, University of Tennessee Center for Decentralized Wastewater Management.

[246] Interview with Bryant Bradley, director of operations, Consolidated Utility District, May 1, 2024.

[247] Ibid.

[248] Ibid.

**The US Environmental Protection Agency (EPA) along with other water and wastewater organizations developed an effective utility management (EUM) framework systems can use.**

There are many management models that organizations can use to operate more efficiently and effectively. The US Environmental Protection Agency along with water and wastewater industry organizations developed an industry specific approach to utility management.[249] These organizations worked together to create an effective utility management framework (EUM) that water and wastewater systems can use to help improve performance. The group developed five keys to management success and related guiding principles.

### *Key 1 - Leadership*

Effective leadership encompasses both individuals and teams, guiding long-term vision within the utility, while also engaging stakeholders and promoting collaboration with external partners. Leaders should foster an organizational culture that embraces positive change and supports emerging leaders. They should also be committed to continual improvement within the utility and plan for seamless leadership transitions.

### *Key 2 - Strategic Business Planning*

A strategic business plan provides a framework for decision-making in the future. It involves assessing current conditions, forecasting potential future events, analyzing their causes and effects, and establishing objectives, strategies, and organizational values as well as a clear vision for the utility. Preparation of the plan requires a long-term perspective, aligning utility goals with community values and interests. Regular review and revision of the plan is essential for maintaining its relevance and effectiveness.

### *Key 3 - Knowledge Management*

Ensuring thorough documentation of processes by recording standard operating procedures and fostering shared knowledge among employees enables systems to effectively address knowledge loss resulting from employee turnover or absences. Data management systems can help improve the ability of systems to track and manage utility performance.



[249] United States Environmental Protection Agency 2017a.

### *Key 4 - Measurement*

The groups that developed the EUM framework also identified 10 attributes of effectively managed systems that can serve as goals for systems to help them improve their performance. (see appendix C.) These attributes can serve as a starting point and are one example of a framework for how goals can be developed. By identifying areas for improvement and setting goals for improvement, systems can enhance overall performance. Establishing a tracking or measurement system to monitor progress towards these goals can help systems continually improve over time.

### *Key 5 - Continual Improvement Management*

The last key is instituting a culture of continuous improvement. Continual improvement plays a central role in effective utility management. Some organizations adopt formal programs to help achieve this goal. One way this culture can be fostered is through a framework known as "Plan-Do-Check-Act."[250]

- Plan – Plan a change.
- Do- Implement the change.
- Check-Evaluate the results of implementing the change.
- Act – Revise plans as needed.

### *EUM Case Studies*

The EPA prepared case studies of several water and wastewater systems to highlight how they had used the EUM system in their everyday operations and their results after using it. They did a case study on Austin Water in Austin, Texas.[251] One of the attributes the utility chose to work on was employee and leadership development. To help reduce their vacancy rate, they widened their recruitment efforts. Staff attended job fairs and focused on recruiting not only trade school graduates but also veterans, at-risk youth and people who had previously been incarcerated. They also provided training for their previously incarcerated employees to help enhance their skills.

Columbus Water Works in Columbus, Georgia was another utility that performed a case study on. Enhancing customer satisfaction was one attribute they chose to focus on. In surveys, customers indicated that they wanted to know when employees performed

[250] American Society for Quality 2024; and Raftelis 2015.

[251] United States Environmental Protection Agency 2020.

services at their residences. In response, the door hanger program was created. Paper door hangers were left on customers' doors after service calls to let them know the services that had been performed. The hanger also included a survey form that customers could send in. They also chose to work on the employee and leadership development attribute. As a result, they developed partnerships with outside agencies like the Columbus State University Leadership Institute to provide learning opportunities for employees.

### Asset management plans can help wastewater systems manage their infrastructure and ensure there is enough money to repair and replace them.

Determining the best time to repair or replace infrastructure may at times be a challenge for systems.[252] An asset management plan can help systems identify what infrastructure is most critical for them to repair or replace.[253] This enables systems to direct their spending to where it is most needed and better meet their regulatory requirements and customers' expectations.[254] They can help ensure that user rates are set based on sound financial planning.[255] Asset management plans are also required for state revolving fund loans.[256] An asset management plan has five basic components.[257]

- Current State of Assets – The utility identifies what assets the utility owns, where they are located, and what condition they are in.[258]
- Level of Service - At this stage of the planning process, a utility will define the level of service that customers demand and that the law requires and compare that to the level of service being provided.[259]
- Critical Assets -A utility will rank how critical each asset is.[260]

[252] United States Environmental Protection Agency 2008.

[253] Interview with Vena Jones, state revolving fund & water infrastructure grants manager, Tennessee Department of Environment and Conservation, September 6, 2023.

[254] Tennessee Department of Environment and Conservation 2023 and United States Environmental Protection Agency 2008.

[255] United States Environmental Protection Agency 2008.

[256] Tennessee Department of Environment and Conservation 2024b.

[257] Tennessee Department of Environment and Conservation 2023 and United States Environmental Protection Agency 2008.

[258] Tennessee Department of Environment and Conservation 2023

[259] Tennessee Department of Environment and Conservation 2023 and United States Environmental Protection Agency 2008.

[260] Ibid.

- Capital Improvement Plan - The utility completes a capital improvement plan at this that includes the timing and costs of infrastructure that needs to be rehabilitated or replaced as well as any new infrastructure requirements. The capital improvement plan will also include funding sources.[261]
- Long Term Funding Plan – This step involves the utility looking at its long funding strategy and considering if the user rates are sufficient to cover their costs.[262]

To assist the state's systems in developing asset management plans, TDEC offers asset management plan grants.[263] They also have an asset management guide and templates on their website.

### *Asset Management Plan Case Studies*

The American Water Works Association conducted case studies on the best practices employed by some systems in asset management planning. In Mount Pleasant, South Carolina, the Mount Pleasant Waterworks initiated its asset management planning program in 2004.[264] The utility installed a computerized maintenance management system to help them with their planning and hired a full-time asset management coordinator. All utility assets are inventoried in the system including maintenance information for each asset. The computerized maintenance management system tracks both reactive and planned maintenance. As a result of their planning capabilities, they received a bond upgrade.

Like the Mount Pleasant utility, Livingstone County Water and Sewer Authority in Lakeville, New York also uses a computerized maintenance management system. The maintenance history of each asset is tracked on the system. They monitor pump stations and tanks daily using a Supervisory Control and Data Acquisition (SCADA) system. Maintenance questionnaires are sent to maintenance staff on weekly, monthly, semiannual and annual basis. The questionnaires consist of a list of detailed questions and if an issue is identified the Director of Operations is notified.



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[261] Ibid.

[262] Ibid.

[263] Tennessee Department of Environment and Conservation 2024d.

[264] Stillman and Jones 2017.

A GIS system was installed by the Hastings Utility in Hastings, Nebraska. The system enables them to make timely update to their system map. The GIS system has information about the diameter and length of all their pipes, their location, the date installed and who paid for it originally. The staff are also able to respond to requests from the public for information on the location of utility equipment much faster with the GIS system.

Downers Grove Sanitary District in Downers Grove, Illinois uses video cameras to help assess the condition of their pipes. This helps them to identify pipes that need to be repaired or replaced. The utility used to rely on staff's knowledge of the physical assets but now they think they are better equipped to deal with regulators because of the systems and data they have now.

### Wastewater systems may help to decrease their operating costs by improving their energy efficiency.

Providing wastewater service is an energy intensive service.[265] By focusing on energy efficiency systems can cut down on costs. According to the US Department of Energy's *Energy Data Management Manual for the Wastewater Treatment Sector*, it's possible for electricity to "constitute 25% to 40% of a wastewater treatment plant's annual operating budget."[266] Electricity represents the largest controllable cost of providing wastewater services.[267] Reducing energy consumption can lead to a reduction in operation costs.[268] A wastewater utility that incorporates energy efficiency practices may be able to reduce their costs by 15 to 30%.[269]

In its guide *Evaluation of Energy Conservation Measures for Wastewater Treatment Facilities*,[270] the EPA outlines a nine-step process for energy management:

- Create an Energy Sustainability Team. Form a team to implement the energy saving measures.
- Gather Data. Gather data on energy use at the utility.



[265] Drinan and Spellman 2013.

[266] Lemar and de Fontaine 2017.

[267] United States Environmental Protection Agency 2024d.

[268] Drinan and Spellman 2013.

[269] United States Environmental Protection Agency 2024d.

[270] Cadmus Group 2010.

- Benchmark Performance. Create a baseline of energy performance that you can use to measure improvements over time.
- Conduct an Energy Audit. Determine the energy use of various processes and identify opportunities for areas where you can reduce energy use.
- Develop Goals. Identify energy improvement goals.
- Devise a Plan. Identify energy saving measures and develop a plan for implementing them.
- Implement Improvements.
- Monitor and Measure Results. Track performance and review progress towards energy saving goals.
- Communicate Success. Communicate your energy savings successes to employees, utility management, and the community.

Tennessee's has a Plant Optimization Program (POP) that is a free, voluntary program that systems can participate in that can help wastewater systems reduce their energy consumption and improve removal of nitrogen and phosphorus from treated wastewater at their facilities.[271] They help facilities implement low and no-cost measures to reduce their energy use.[272] Wastewater systems that implemented the measures saw an average of a 19% reduction in annual energy costs and resulted in $390,468 annual cost savings.[273]

TDEC did case studies of some of the systems they had helped through the program. One city that participated in the program, Carthage, bought timers with the money they saved that enabled them to automate the operation of their aerators and save additional money.[274] Fayetteville utilized their energy savings to invest in probes which gave them the ability to do real-time monitoring of their system's oxygen levels and gave them better control of their aerators and blowers.[275]



[271] Interview with Karina Bynum, water quality environmental fellow, Tennessee Department of Environment and Conservation, October 13, 2023; and Tennessee Department of Environment and Conservation 2024g.

[272] Tennessee Department of Environment and Conservation 2024g.

[273] Ibid.

[274] Tennessee Department of Environment and Conservation 2024g.

[275] Ibid.

There are many ways wastewater systems can reduce their energy consumption. To help systems identify potential ways to conserve energy, the New York State Energy Research and Development Authority and Focus on Energy through the Wisconsin Public Service Commission published guides detailing best practices for energy conservation in water and wastewater systems.[276] Below is a condensed list of the practices, aimed at helping wastewater systems operate more efficiently. Wastewater systems may find some practices they could implement to operate more energy efficiently.

**Energy Efficiency Practices - Organizational Management**

- Appoint an energy manager.

  Appoint an energy manager with authority and budget for improving energy efficiency.

- Utilize and manager monitored and recorded data.

  Monitor and record facility data so it can be used as a tool in managing operations and energy usage of a wastewater system.

- Manage electric rate structure.

  Review overall energy usage.

- Include energy efficiency in capital-improvement and operations plans.

  Incorporate energy efficiency best practices in capital and operations improvement plans.

- Let energy efficiency pay for itself.

  When calculating the financial impact of an energy efficient project, the utility should include the projected payback period, based on energy savings.

- Use lifecycle cost analysis for purchase selection.

  Utilize lifecycle cost analysis when purchasing equipment rather than lowest upfront cost.

- Design flexibility

  Design and expansion of a system should have the flexibility to serve both current and future needs.

- Facility energy assessments



[276] New York State Energy Research and Development Authority 2019; and Wisconsin Focus on Energy 2020.

An annual energy survey is a common practice to help wastewater systems identify opportunities for improving energy efficiency.

- Energy education for facility personnel

  All employees should understand relationship between energy usage and facility operations. This can be obtained through publications and training.

**Energy Efficiency Practices - Treatment Process**

- Electric peak reduction

  Minimize pumping and specific treatment processes during peak demand periods.

- Pump-station assessments

  Systems should conduct an energy efficiency assessment of their pump stations. Most would benefit from a variable speed drive or new or additional pump.

- Real time energy monitoring

  An energy monitoring system can help staff develop an energy baseline that can be used to help staff set energy reduction goals and monitor results.

- Supervisory control and data monitoring system (SCADA)

  These systems allow operators to remotely monitor equipment operation and adjust their operation.

- Sequence backwash cycles

  Shift backwash cycles to off-peak periods to reduce the energy peak demand.

- Idle or turn off equipment

  When feasible, idle or turn off non-essential equipment during periods of peak power demand.

- Properly maintain motors.

  It can increase motor efficiency and prolong service life.

- Improve power factor

  Minimize the operation of idling or lightly loaded motors by replacing inefficient motors with energy-efficient motors.

- Correctly size motors.

Facility could replace oversized motors with correctly sized, high-efficiency or premium-efficiency motors.

- Install high-efficiency motors.

  Replace existing motors with new premium-efficiency motors.

- Variable frequency drive (VFD) applications

  Match motor-output speeds to the specific load and avoid running at constant full power, thereby reducing energy usage.

- Optimize grit removal system

  Different systems consume different levels of energy.

- Automate to monitor and control

  Automate monitoring and control of dissolved oxygen, pressure and flow rate.

- Optimize pump system efficiency

  Select the pump or combination of pumps that provide peak efficiency. Computer models can help with analysis.

- Reduce pumping flow.

Operators could compare facility's design flow rate with current flow rate and see if pumping rates can be reduced.

- Reduce pumping head.

  Operators should aim to reduce total head losses.

- Avoid pump-discharge throttling.

  Modify the operation of a pumping system to eliminate the use of discharge valve throttling to control the flow rate from pumps.

- Ultraviolet (UV) disinfection options

  Consider UV disinfection system design or redesign options to reduce the number of lights.

- Install dose pacing if using UV disinfection

  Consider installing dose pacing on an existing UV disinfection system with turndown capability. Lamps can be dimmed, and UV does can be varied in proportion to flow.

- Incorporate energy efficiency in membrane-treatment systems

Systems should select the best flux-rate membrane for their application. It should be simple, incorporate reduced air scour during backwashing and include adequate turndown capability.

- Operational flexibility

  Identify, plan and design the most energy-efficient and effective ways to operate the system.

- Staging of treatment capacity

  When planning improvements, stage construction using smaller sized modular equipment so new units can be brought on as needed to allow a system to better manage energy costs.

- Manage for seasonal/tourist peaks

  Flexible system design allows utility to operate more efficiently during tourist peaks and perhaps idle equipment during off-season.

- Flexible sequencing of basin use

  Select the correct basin sizes. Smaller basins could be used initially, and basins could be added sequentially as loads increase until design capacity is reached.

- Cover basins to reduce freezing and aerosol or odor emissions

  Cover basins to reduce the volume of fresh air required for the maintenance of good indoor air quality and dehumidification requirements.

- Reduce fresh water consumption through final effluent recycling.

  Reducing the consumption of potable water through the recycling and utilization of the final effluent in process applications or washdown of tanks may reduce the volume of potable water treated and/or pumped.

- Optimize aeration system

  Assess the system to determine if it is operating as efficiently as possible and consider the costs of improvements like fine bubble aeration, dissolved oxygen control and variable airflow-rate blowers.

- Fine-bubble aeration

  Systems with activated-sludge treatment facilities could assess the feasibility of implementing of fine-bubble aeration which provides energy efficient treatment of wastewater.

- Variable blower airflow rate

Utility could require the aeration system and the aerobic-digester blowers have variable air-supply rate capabilities.

- Dissolved oxygen control

  Use automatic dissolved oxygen (DO) control technology to maintain the DO level in the aeration and post-aeration at preset control point.

- Cascade aeration

  Consider installing a cascade aeration system since it provides re-aeration by increasing the water turbulence as it flows over the steps without a need for electricity.

- Aerobic digestion options

  Utility could assess the operation of its aerobic digester to determine if better control could be achieved through a separate smaller blower or using flexible membrane digesters with surface diffusers with adjustable airflow rates.

- Blower technology options

  Systems should research, assess and use the most energy-efficient blower technology that they can.

- Assess aeration system configuration

  Assess the aeration system to determine if the blowers are supplying air flow to aeration tanks or to aeration tanks and other equipment including aerobic digesters. Assess if each piece of equipment that needs airflow from the blowers could be fit with an individual blower for its specific requirements.

- Improve solids capture in dissolved air flotation (DAF) system

  Optimize the air-to-solids ratio in a DAF system by adjusting the supply air or by feeding the highest possible solids content.

- Evaluate replacing centrifuge with screw press.
- Consider replacing centrifuge with gravity belt thickener.
- Digestion options

  When planning new facilities or expansion of existing ones, assess the energy and production impacts of various biosolids options.

- Mixing options in aeration digesters

Aeration of biosolids may not be the most energy-efficient option for mixing in a digester. Evaluate the energy cost of options.

- Mixing options in anaerobic digesters

  Mechanical mixing options such as jet mixing or linear motion may reduce energy consumption of the mixing process.

- Anoxic zone mixing options

  When a utility incorporates anoxic zones, it should consider mechanical mixing rather than using the existing aeration-system blower to mix the anoxic zones.

- Biotower energy efficiency

  Systems could consider the use of biotowers or trickling filters that could provide energy-efficient treatment of waste.

- Optimize anaerobic digester performance
- Assessment of using biogas

  Biogas can be used as a source of energy to fuel the facility's boilers, fuel an engine, drive a piece of an equipment or generate electricity. CHP systems run on biogas.

- Consider using a solar photovoltaic generation system.

**Energy Efficient Practices - Buildings**

- Monitor lighting operation

  Shutting off lights manually or using occupancy sensors can save money.

- Clean lamps and light fixtures.

  Washing lighting can prevent the accumulation of dirt on the lights. Dirt on lights can decrease light output.

- Properly maintain outside air ventilation devices and ventilation supply fans.
- Replace ventilation air filters.

This will improve the system's energy efficiency.

- Install Variable Frequency Drive (VFD) control on air compressors.

  Utility could consider installing VFDs on rotary-screw air compressors in place of inlet modulation with unloading.

- Install high-efficiency lighting and advanced controls.

Installing high-efficiency lamps can increase energy efficiency of the entire lighting system.

- Evaluate existing Heating, Ventilation and Air Conditioning (HVAC) systems for re-commissioning or replacement.

  Systems could regularly evaluate their HVAC systems to see if they should be re-commissioned or replaced with more energy-efficient systems.

- Evaluate projects for potential Leadership in Energy and Environmental Design (LEED) certification.

  Systems might consider the standards set forth by LEED in the design of new construction or major renovation projects.

## What are methods of wastewater system management that have not worked and should be avoided?

Commission staff did not identify any valid management practices that should be avoided. Rather, research and interviews confirmed the risks of failing to properly manage equipment and assets. Some wastewater system management practices may lead to decreased efficiency or cause environmental harm. Skipping routine maintenance or lacking long term plans like an asset management plan (AMP) can lead to higher costs, environmental compliance issues, or even the inability to address future needs. Neglecting energy saving tactics, inefficient chemical use, or inadequately handling sludge and biosolids treatments can have negative effects on the wastewater system. Avoiding these drawbacks allows systems to have a more sustainable wastewater system.

Failure to regularly maintain wastewater facility equipment and infrastructure are the leading factors in non-compliance for Tennessee wastewater systems.[277] Stakeholders said when maintenance is continuously deferred, it can become costly.[278] AMPs are critical for effectively managing wastewater systems and infrastructure.[279] Without a proper AMP, wastewater systems may struggle to maintain compliance with state regulations, secure

[277] Interview with Jessica Murphy, compliance and enforcement manager, Tom Moss, drinking water enforcement officer, and Sarah Elias, NPDES wastewater compliance manager, Division of Water Resources, Tennessee Department of Environment and Conservation, October 11, 2023; and Vena Jones, manager, State Revolving Funds and Water Infrastructure Grants, and Eliana Blash, administrative assistant, Tennessee Department of Environment and Conservation, September 6, 2023.

[278] Interview with Steve Wyatt, utility operations consultant, Tennessee Municipal Technical Advisory Service, August 8, 2023.

[279] Tennessee Department of Environment and Conservation 2023b.

adequate funding for capital improvements, and address customer needs. Tennessee's *H2O* plan found that a significant number of water and wastewater systems didn't seem to have a comprehensive long-range plan and capital budget.[280] Stakeholders also mentioned that the lack of long-range planning at wastewater facilities was a cause of concern.[281]

Wastewater operations are typically the largest energy expense in a community.[282] According to the US Department of Energy, "For many municipal governments, drinking water and wastewater plants typically are the largest energy consumers, often accounting for 30 to 40 percent of total energy consumed."[283] Neglecting to implement energy-saving measures in the system can lead to unnecessary expenditures. While chemical disinfection can effectively kill pathogens in wastewater, improper dosing or monitoring can result in the release of harmful byproducts or inadequate pathogen removal. Stakeholders said that all wastewater systems face struggles with solids handling improvements especially during the wet season.[284] Sludge treatment and disposal are integral parts of wastewater treatment, and failure to take this into account will affect the overall environmental success of the system.[285] Sludge generated during wastewater treatment can contain concentrated pollutants and pathogens. Improper disposal or management of sludge can contaminate the soil, water, and air.[286]

### What new technologies for wastewater system management that local governments could consider and would be permissible under Tennessee Department of Environment and Conservation rules?

Wastewater treatment technologies are evolving to meet the demands of modern systems, with a strong focus on the renewable use of resources. Innovations in this field are enhancing the effectiveness of wastewater treatment while improving energy savings and



[280] Tennessee Department of Environment and Conservation 2018a.

[281] Interview with Karina Bynum, water quality environmental fellow, Division of Water Resources, Tennessee Department of Environment and Conservation, October 13, 2023.

[282] United States Environmental Protection Agency 2024d.

[283] Ibid.

[284] Interview with Karina Bynum, water quality environmental fellow, Division of Water Resources, Tennessee Department of Environment and Conservation, October 13, 2023.

[285] Krishna, Sachan, and Jatav 2022.

[286] Un 2024; and Li et al. 2021.

resource recovery. This section explores some newer technologies and processes being used by systems today.

### Water Reuse

Water reuse involves treating wastewater and reusing it for beneficial purposes such as drinking, industrial uses, or irrigation.[287] In Tennessee, unrestricted non-potable reuse of wastewater is permitted if the water is properly treated and disinfected.[288] Wastewater treatment facilities must submit a permit application to the Tennessee Department of Environment and Conservation (TDEC) to implement a water reuse system, along with a reclaimed wastewater management plan and proposed service agreements between the provider and purchaser of reclaimed wastewater.[289] Permit applicants for new or expanded wastewater discharges into surface waters must include in their application a consideration of beneficial reuse of wastewater as an alternative to discharging into surface waters.[290]

Franklin was the first entity in the state to operate a water reuse system beginning in 1992.[291] However, water reuse is not a practice that has been adopted widely statewide. Murfreesboro, Franklin, Pigeon Forge, Spring Hill, Smyrna, and the Water and Wastewater Authority of Wilson County wastewater systems in Tennessee are permitted for unrestricted non-potable reuse.[292] The reclaimed water is primarily used for irrigation of golf courses and residential landscaping.[293]

### Nutrient Recovery

Water isn't the only resource that can be recovered from wastewater. Nitrogen and phosphorus are two resources that can be extracted from wastewater and applied to crops as fertilizer or soil amendment.[294] Chattanooga, Knoxville, and Nashville both produce



[287] United States Environmental Protection Agency 2024c.

[288] Rules and Regulations of the State of Tennessee 0400-40-06-.10.

[289] Ibid.

[290] Tennessee Code Annotated Section 69-3-108.

[291] Butler and Hilty 2008.

[292] Tennessee Department of Environment and Conservation 2018a.

[293] Ibid.

[294] Theragowda et al. 2018.

biosolids at their wastewater treatment plants.[295] Nashville's fertilizer is sold under the name Music City Gold.[296] Chattanooga works through a third-party contractor that transports their biosolids to farmers free of charge.[297]

### Biogas as Fuel

Biogas generated during by anaerobic digesters during the wastewater treatment process can be used as an energy source at the wastewater treatment facility.[298] If the biogas is processed further to remove impurities, the resulting methane can be used as fuel.[299] Chattanooga announced it will move forward with plans to install a system at its Moccasin Bend wastewater treatment plan that will convert solids in the wastewater into biogas that can be used as power at the plant or sold as a natural gas substitute after being processed further.[300] The project is expected to cost between $130-150 million.

### Thermal Hydrolysis

Thermal hydrolysis is a method used to treat sewage sludge, making it easier to process through anaerobic digestion.[301] It uses high heat and pressure to break down sludge and destroy pathogens.[302] The city of Franklin uses thermal hydrolysis in its wastewater treatment system.[303]

### Membrane Bioreactors

Membrane bioreactors are used in wastewater treatment to remove a wide range of dissolved contaminants.[304] These systems combine conventional biological treatment with membrane filtration, offering a high level of contaminant removal, including pathogens,



[295] Chattanooga.gov 2023;Knoxville Utilities Board 2024; and Nashville.gov 2024.

[296] Tycowa 2019.

[297] Interview with Mark Heinzer, administrator wastewater division, Tony Kinder director of engineering Steve Sanders, director of maintenance, and Justin Steinman, director of administration, Moccasin Bend Chattanooga, September 11, 2024.

[298] New York State Energy Research and Development Authority 2019.

[299] Ibid.

[300] Walton 2023.

[301] United States Environmental Protection Agency 2006.

[302] Ibid.

[303] City of Franklin, TN 2024.

[304] United States Environmental Protection Agency 2007.

suspended solids, and organic matter.[305] They can be very effective in treating water for reuse in irrigation.[306]

### Solar Photovoltaic (PV)

Solar photovoltaic (PV) technology is being integrated into wastewater treatment plants. A solar photovoltaic (PV) system can provide a source of renewable power for wastewater systems.[307] Chattanooga installed solar panels as its Moccasin Bend wastewater treatment plant and those along with other energy saving measures are helping it to save $1.4 million per year.[308] Franklin, Lebanon, and Nashville have solar panels installed at their wastewater systems as well.[309]

## What are the staffing issues at wastewater systems in Tennessee?

In the 2023 American Water Works Association (AWWA) State of the Water Industry nationwide survey, talent attraction and retention were listed as the 12th most challenging issues for water and wastewater systems.[310] This is due in part to the aging of the wastewater workforce and the difficulty in recruiting younger workers to take their place.[311] Some wastewater systems are having trouble retaining their staff because they can leave for better paying jobs elsewhere.[312] Sixteen percent of respondents to a Commission staff survey of wastewater systems said they had difficulty attracting and retaining certified wastewater operators.

### The need for certified wastewater operators is rising as older operators retire.

One of the reasons for the difficulty in retaining workers is the aging of the wastewater workforce. It has been identified as one area of concern among systems and was listed as the 6th most challenging issue for water systems in the AWWA State of the Water Industry



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[305] Ibid.

[306] Ibid.

[307] New York State Energy Research and Development Authority 2019.

[308] Energy.gov 2022.

[309] Franklintn.gov 2013; Lamb 2023; and Smith 2018.

[310] American Water Works Association 2023.

[311] Interview with John Lawrence, director, Fleming Center, November 20, 2023; and Kane and Tomer 2018.

[312] Interview with John Lawrence, director, Fleming Center, November 20, 2023.

survey.[313] According to US Bureau of Labor Statistics data, nationwide 34% of water and wastewater operators are under the age of 35 and 66% are over the age of 35. Forty-two percent are over the age of 45. Certified wastewater operators tend to skew older in Tennessee as well. In the *TN H2O* plan, it was reported that the average age of wastewater certification holders ranged from the upper forties to the mid-fifties depending on the type of certification.[314] This suggests that a number of the certified wastewater operators in the state are nearing retirement age.

Fifty-nine percent of the respondents to the Commission staff survey reported they had at least one certified wastewater operator that would be retiring in the next 10 years. Fifteen percent (12 out of 82) of the survey respondents reported that one hundred percent of their certified operators would be retiring in 10 years. Twelve percent (10 out of 82) replied that between 50-99% of their certified operators would be retiring in in that time period while twelve percent (10 out of 82) said that less fifty percent would be retiring. Twenty-three percent (19 out of 82) said they did not have any certified operators retiring in the next 10 years and thirty nine percent (32 out of 82) of respondents did not answer the question.

### Efforts are being made to recruit more young people to the field.

Systems are having trouble recruiting young people to replace the retiring operators.[315] Potential applicants may not be aware of the job or the complexity of it.[316] Wastewater systems must have at least one operator in charge who is certified.[317] It is skilled and technical work that requires operators to perform duties such inspecting, maintaining and operating wastewater plant equipment, monitoring meters and gauges, testing wastewater samples and reporting results to regulatory agencies.[318]

Respondents to the Commission staff survey noted that it can be difficult to pass the exams that a person is required to pass to be certified as a wastewater operator.[319] This can make



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[313] American Water Works Association 2023.

[314] Tennessee Department of Environment and Conservation 2018.

[315] Interview with John Lawrence, director, Fleming Center, November 20, 2023; and interview with Steve Wyatt, utility operations consultant, Tennessee Municipal Technical Advisory Service, August 16, 2023.

[316] Tennessee Department of Environment and Conservation 2018.

[317] Tennessee Code Annotated Section 68-221-904.

[318] United States Bureau of Labor Statistics 2024.

[319] Interview with Steve Wyatt, utility operations consultant, Tennessee Municipal Technical Advisory Service, August 16, 2023; and Tennessee Department of Environment and Conservation 2018.

it harder to find people who are certified to work as wastewater operators. They have four different levels, also known as grades, of wastewater treatment certification.[320] There is a certification for biological/natural systems that use natural biological treatment as the predominant form of treatment.[321] There are two grades of certification for wastewater system collection operators; collection systems are the collection of pipes and equipment that convey the wastewater to the treatment plant.[322] To sit for an exam, applicants are required to have at least a high school diploma or GED. They must also have a certain amount of experience working at wastewater treatment plants or collection systems depending on which grade they want to be certified at. In order to pass, applicants must score at least 70% on the exam.

There are two schools in Tennessee that can help applicants prepare for the certification exam. The Fleming Training Center in Murfreesboro provides courses to help people prepare for the exam.[323] It also offers continuing education training for certified operators. Pellissippi State Community College in Knoxville offers an Associate of Applied Science (A.A.S) Degree in Water Quality Technology.[324] The program trains students for careers in water and wastewater treatment operations and graduates are prepared in the program to sit for certification exams.

To help with recruiting new workers, the Tennessee Association of Utility Districts (TAUD) launched its first water and wastewater utility apprenticeship program in 2020.[325] TAUD is an association that provides technical and operation support and training for Tennessee's water and wastewater systems.[326] The program was designed to help fill the need for certified water and wastewater operators is designed to address the need for certified water and wastewater facility operators in rural Tennessee.[327] It also helps raise awareness of careers in the industry.[328]



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[320] Rules and Regulations of the State of Tennessee 0400-49-01.

[321] Ibid.

[322] Rules and Regulations of the State of Tennessee 0400-49-01 and American Water Works Association 2024.

[323] Tennessee Department of Environment and Conservation 2024f.

[324] Pellissippi State Community College 2024.

[325] National Rural Water Association 2020.

[326] Tennessee Association of Utility Districts 2024.

[327] National Rural Water Association 2020.

[328] Ibid.

TAUD's two-year apprenticeship program prepares apprentices for certification as a water or wastewater systems operators.[329] TAUD recruits by word of mouth.[330] Systems will reach out to TAUD with a person they think would be candidate for the program.[331] These are typically people that may not have any experience working at a wastewater plant.[332] The program combines on the job training with training at the Fleming Center.[333]

In addition to the apprentice program, TAUD launched a pre-apprenticeship program with Fayetteville Public Utilities in 2023.[334] It offers a way for high school students to learn more about careers in the water industry.[335] Student meet once a month for 10 months to learn about all aspects of the water utility.[336]

Systems in other states have instituted similar programs to help students learn more about careers in the industry and possibly recruit new workers to the industry. The Metropolitan District of Hartford, Connecticut (MDC) is a water and wastewater utility that offers a month long Learn and Earn program for high school students each summer.[337] The students are paid to learn about water conservation and wastewater treatment and work at a department at the utility. MDC also offers a work-based internship program where students as young as 16 get paid to work up to 20 hours per week at the utility. Six water and wastewater systems in Pennsylvania offer eight-week paid summer internships to high school graduates and other adults interested in exploring careers in the field.[338] Interns rotate through all six organizations gaining exposure to all job opportunities in water and wastewater operations.



[329] Interview with John Greer, former program manager, Tennessee Association of Utility Districts, October 16, 2023.

[330] Ibid.

[331] Interview with John Lawrence, director, Fleming Center, November 20, 2023.

[332] Ibid.

[333] Interview with John Lawrence, director, Fleming Center, November 20, 2023; and National Rural Water Association 2020.

[334] Elk Valley Times 2023.

[335] Ibid.

[336] Ibid.

[337] MDC Metropolitan District Hartford Connecticut 2024.

[338] Water and Wastewater Internship Program 2024.

In addition to apprenticeship and internship opportunities, systems can reach to elementary and high school students to help increase their awareness of the industry. For example, Nashville offers information for middle and high school students about wastewater treatment and careers in the water department on its website.[339] It also offers teachers the opportunity to request tours and speakers on its website as well. Systems in other states have enacted more unique programs to educate students about wastewater treatment. The Los Angeles County Sanitation Districts offer a Sewer Science program, which is a week-long laboratory for high school science students that shows how them how wastewater is treated.[340] The San Antonio water system offers an Academy of Water Influencers that is a virtual institute for high schoolers where they can learn about the value of water and career paths in the water industry.[341] They complete a series of learning modules online.

To help fill vacant wastewater operator positions in its state, the Texas state legislature passed a law in 2023 to allow high school students to work toward becoming a water or wastewater operator while still in high school.[342] The law authorizes individuals without high school diplomas to act as a provisional wastewater operator if they have completed training, passed required exams and work under the supervision of a certified operator.[343] The provisional Wastewater Class D license is only valid for two years. At the end of that time period, they must upgrade the license to a nonprovisional license if they want to continue to work as a licensed wastewater operator.[344]

### Some systems are having trouble retaining operators.

Commission staff surveyed the state's wastewater systems and 17% (14 out of 82) of respondents replied they were having difficulty retaining certified wastewater operators. Survey respondents noted that operators will move onto larger systems that have more opportunity to advance. Some said they couldn't compete with surrounding communities when it comes to pay and benefits.



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[339] Metropolitan Government of Nashville and Davidson County 2024.

[340] Los Angeles County Sanitation Districts 2024.

[341] San Antonio Water System 2024.

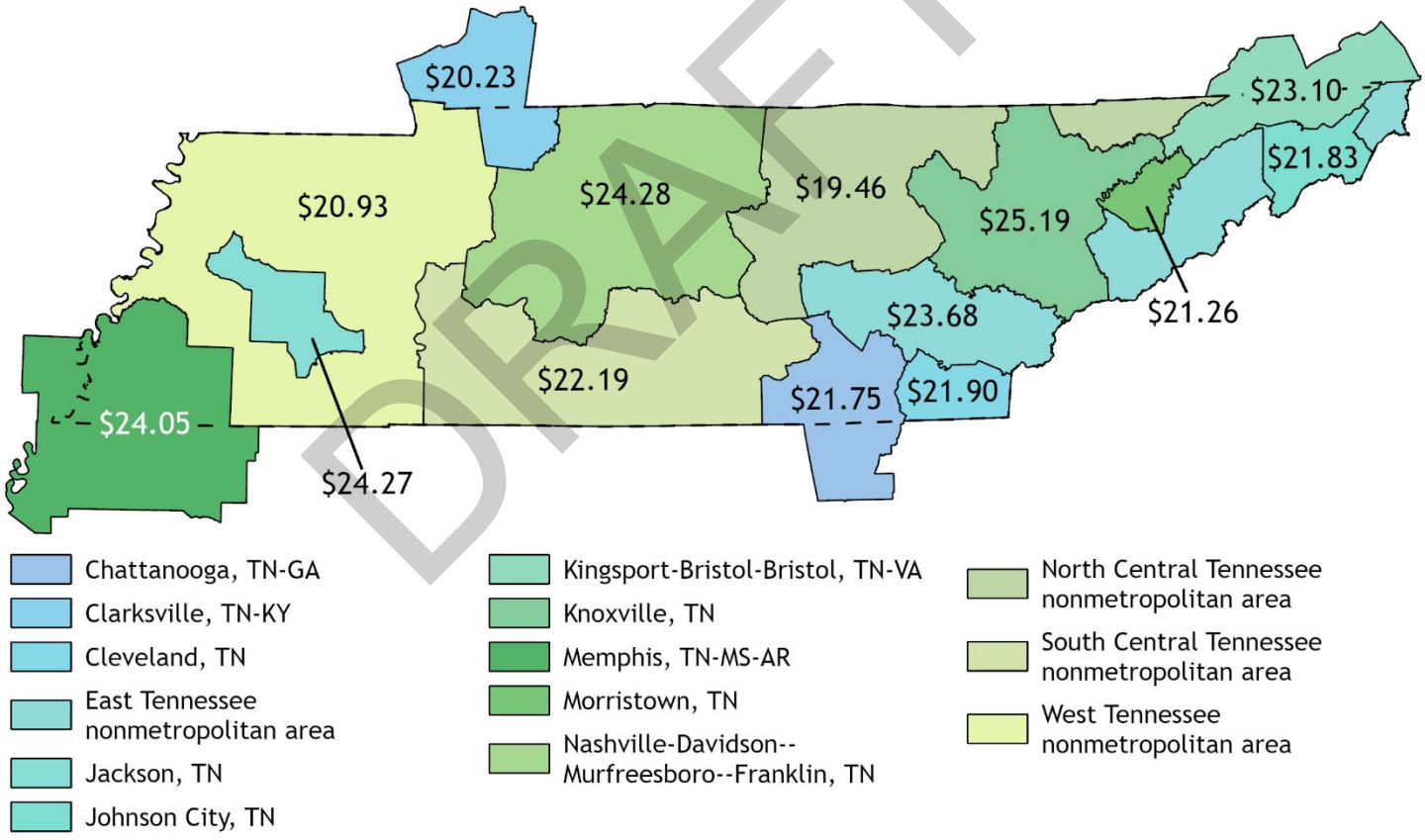
[342] Salhotra and Carver 2023.

[343] Texas Water Code Section 37.0045

[344] Texas Commission on Environmental Quality 2024.

There is some variation in what wastewater operators are being paid statewide. Survey respondents reported that they paid their certified wastewater operators between $3,000 to $138,000 per year in salary. Others survey respondents reporting paying their operators between $20.52 to $37.45 per hour. The US Bureau of Labor Statistics (BLS) data showed salary differences by geographic location. It reports that the median hourly wage for water and wastewater operators in the north central part of Tennessee, for example, is $19.46 while the median hourly wage for water and wastewater operators in the Knoxville area is $25.19 See map 3. Interestingly, the median salary for water and wastewater operators in Tennessee is higher than several of the other surrounding southern states. See map 4.

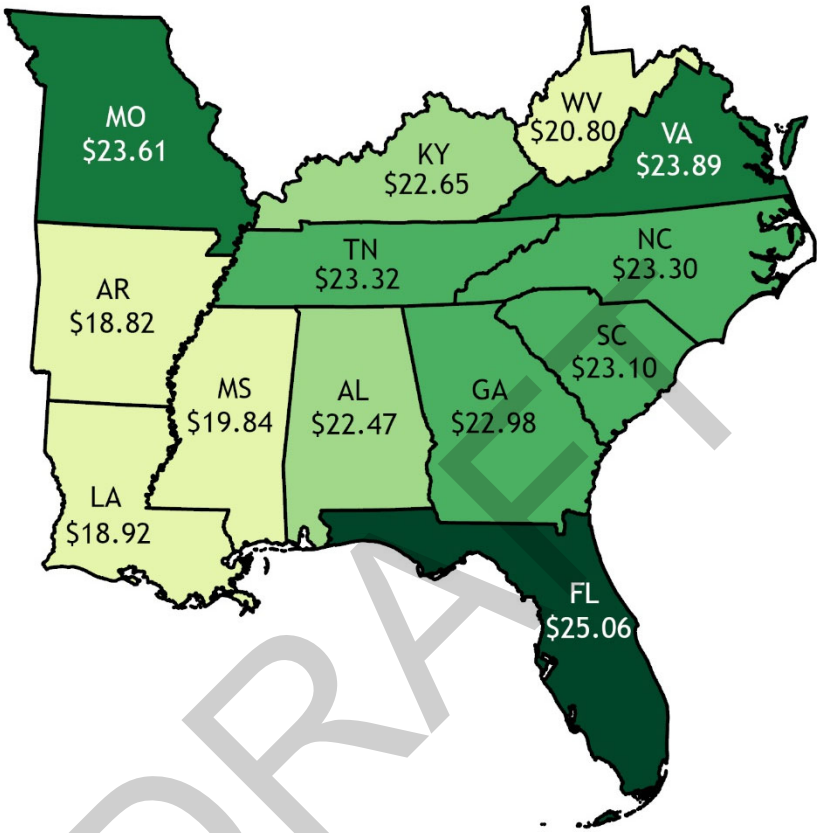
**Map 3. Tennessee Water and Wastewater Treatment Plant and System Operators Hourly Median Wages for Metropolitan and Nonmetropolitan areas, 2023**






Source: US Bureau of Labor Statistics "Occupational Employment and Wage Statistics Query System."

**Map 4. Water and Wastewater Treatment Plant and System Operators Hourly Median Wages in the Southeastern US, 2023**




Source: US Bureau of Labor Statistics "Occupational Employment and Wage Statistics Query System."



This problem is not unique to Tennessee. In 2022, researchers at the Kentucky Water Resources Research Institute at the University of Kentucky conducted a Kentucky Water Workforce Survey (KWWS) of operators and managers at Kentucky's water and wastewater systems on workforce issues.[345] Thirty-nine percent of Kentucky's operators who responded to the survey said they were extremely or somewhat dissatisfied with their wages; only forty-nine percent thought they were being paid a fair wage. Despite their dissatisfaction with their pay, 65% were somewhat or extremely happy with their jobs and 76% liked doing their assigned tasks.

[345] Koyagi et al. 2022.

Based on the survey responses, the researchers developed a set of recommendations to help with retaining and recruiting operators. To help with recruiting employees, they recommended that utility management and decision makers might want to consider the following

- Educate utility decision makers about the magnitude and nature of the problem.
- Increase pay.
- Increase benefits.
- Demonstrate a greater appreciation of employees.
- Develop succession plans for both operators and managers.
- Provide tools and support to management to help address retention issues.

To help with recruiting new operators, they recommended that utility management and decision makers might want to consider the following

- Evaluate utility financials and explore avenues to increase operator salary scales.
- Develop and implement an effective trainee internship and/or apprentice program.
- Develop more effective marketing strategies and techniques to advertise new positions.
- Evaluate utility benefit packages to ensure they are commensurate or competitive with other industries or even other systems.
- Improve communication and interaction with staff.

Researchers at the University of Tennessee are conducting a similar water workforce survey in Tennessee which might provide more insight into the issues related to hiring and retaining certified wastewater staff in the state.[346]



[346] Tennessee Department of Environment and Conservation 2024h.

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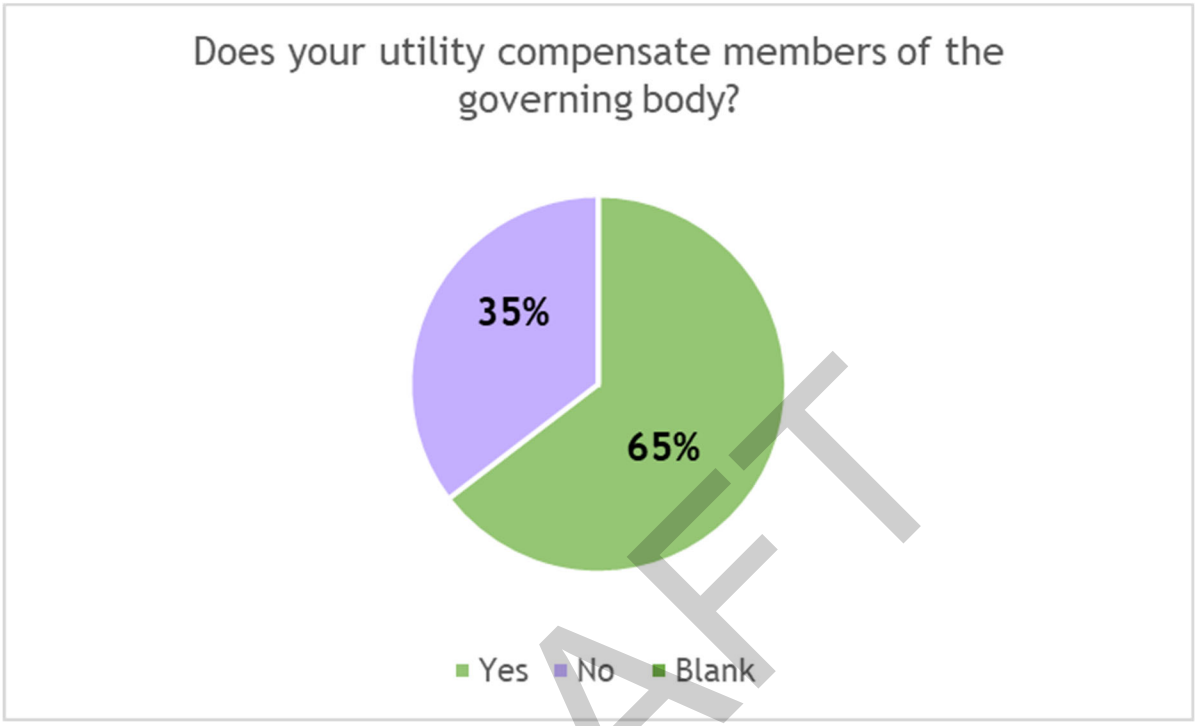
# Appendix A: Estimated Cost Reported for Wastewater-Related Infrastructure Projects

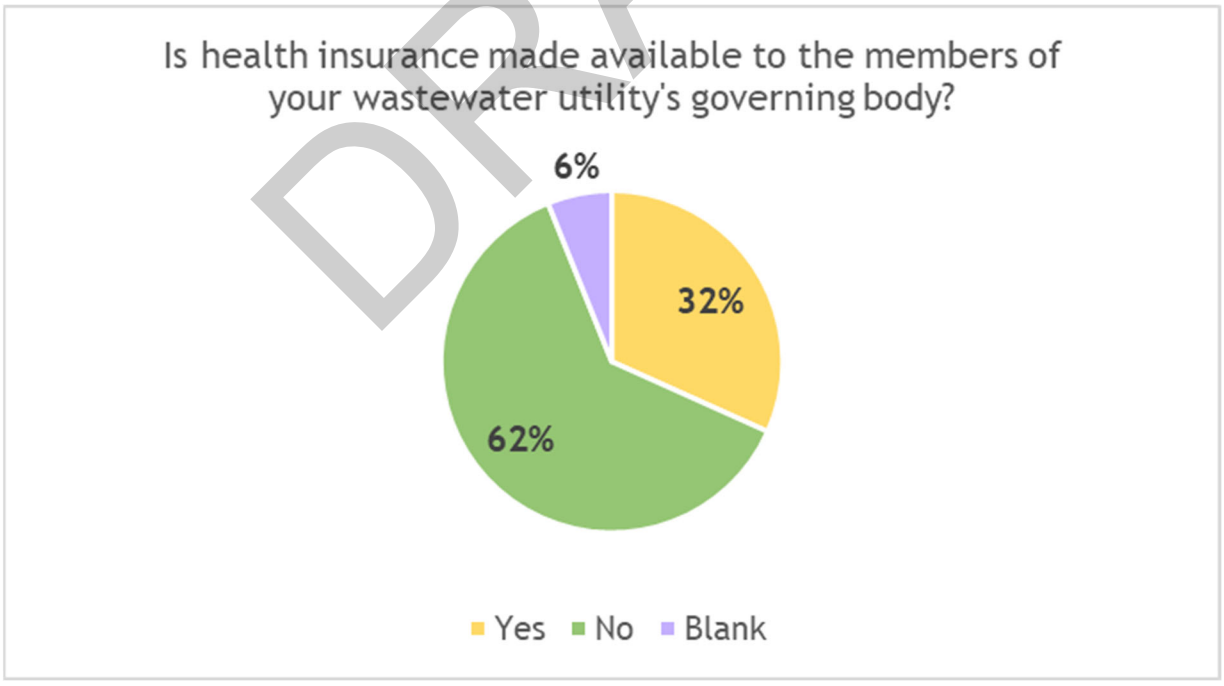
| | Number of Projects | Estimated Cost Needed | Percent of State Total Cost |
|---|---|---|---|
| Tennessee | 377 | $3,509,582,262 | 100%Map |
| Anderson | 11 | $23,450,000 | 0.67% |
| Bedford | 1 | $514,000 | 0.01% |
| Benton | 2 | $1,501,000 | 0.04% |
| Bledsoe | 1 | $8,382,400 | 0.24% |
| Blount | 4 | $11,367,000 | 0.32% |
| Bradley | 3 | $5,700,000 | 0.16% |
| Campbell | 3 | $3,361,000 | 0.10% |
| Cannon | 1 | $2,100,000 | 0.06% |
| Carroll | 6 | $2,534,900 | 0.07% |
| Carter | 7 | $10,550,000 | 0.30% |
| Cheatham | 1 | $2,500,000 | 0.07% |
| Chester | 2 | $3,900,000 | 0.11% |
| Claiborne | 3 | $10,057,682 | 0.29% |
| Clay | 1 | $3,000,000 | 0.09% |
| Cocke | 1 | $543,000 | 0.02% |
| Coffee | 3 | $11,000,000 | 0.31% |
| Crockett | 9 | $4,239,000 | 0.12% |
| Davidson | 3 | $1,401,158,000 | 39.92% |
| Dickson | 1 | $500,000 | 0.01% |
| Dyer | 1 | $9,000,000 | 0.26% |
| Franklin | 4 | $16,160,000 | 0.46% |
| Gibson | 5 | $1,665,000 | 0.05% |
| Grainger | 3 | $4,025,850 | 0.11% |
| Greene | 10 | $57,682,000 | 1.64% |
| Grundy | 4 | $9,875,000 | 0.28% |
| Hamilton | 43 | $319,956,057 | 9.12% |
| Hancock | 3 | $3,042,988 | 0.09% |
| Hardeman | 1 | $750,000 | 0.02% |
| Hardin | 1 | $605,000 | 0.02% |
| Hawkins | 17 | $20,167,617 | 0.57% |
| Henderson | 2 | $1,409,650 | 0.04% |

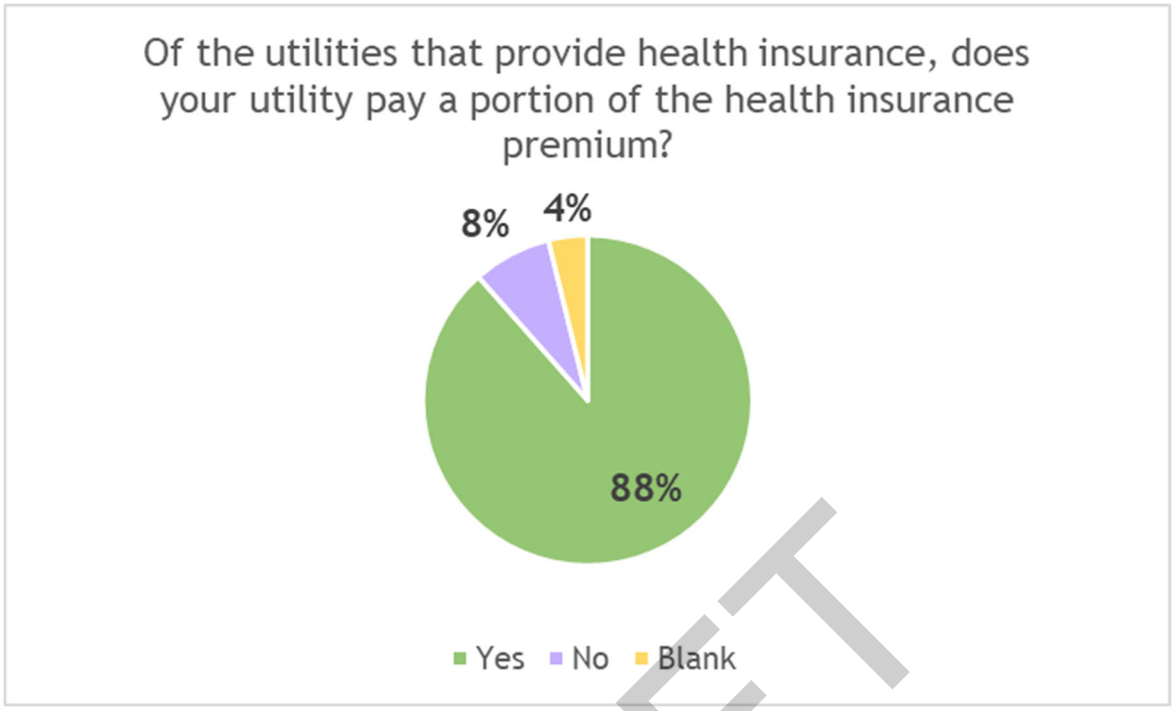
| | Number of Projects | Estimated Cost Needed | Percent of State Total Cost |
|---|---|---|---|
| Henry | 1 | $200,000 | 0.01% |
| Houston | 2 | $10,500,000 | 0.30% |
| Humphreys | 4 | $6,675,000 | 0.19% |
| Jefferson | 4 | $7,801,962 | 0.22% |
| Johnson | 1 | $430,619 | 0.01% |
| Knox | 17 | $355,490,408 | 10.13% |
| Lake | 2 | $1,500,000 | 0.04% |
| Lawrence | 1 | $1,000,000 | 0.03% |
| Lincoln | 1 | $3,000,000 | 0.09% |
| Loudon | 19 | $23,151,558 | 0.66% |
| Madison | 4 | $24,377,533 | 0.69% |
| Marion | 1 | $1,200,000 | 0.03% |
| Marshall | 7 | $6,890,378 | 0.20% |
| Maury | 3 | $17,725,000 | 0.51% |
| McMinn | 3 | $5,646,925 | 0.16% |
| McNairy | 2 | $5,470,000 | 0.16% |
| Meigs | 1 | $3,200,000 | 0.09% |
| Monroe | 3 | $1,876,000 | 0.05% |
| Montgomery | 1 | $5,650,000 | 0.16% |
| Moore | 2 | $16,200,000 | 0.46% |
| Morgan | 1 | $100,000 | 0.00% |
| Obion | 7 | $5,124,000 | 0.15% |
| Polk | 3 | $7,950,000 | 0.23% |
| Putnam | 4 | $5,461,000 | 0.16% |
| Rhea | 1 | $23,800,000 | 0.68% |
| Roane | 5 | $8,195,990 | 0.23% |
| Robertson | 4 | $24,200,000 | 0.69% |
| Rutherford | 11 | $53,246,082 | 1.52% |
| Sevier | 27 | $105,862,648 | 3.02% |
| Shelby | 7 | $309,650,000 | 8.82% |
| Smith | 2 | $7,300,000 | 0.21% |
| Stewart | 1 | $15,000,000 | 0.43% |
| Sullivan | 8 | $63,330,972 | 1.80% |
| Sumner | 19 | $84,900,000 | 2.42% |
| Tipton | 1 | $12,000,000 | 0.34% |
| Unicoi | 4 | $4,413,189 | 0.13% |
| Washington | 14 | $69,390,000 | 1.98% |

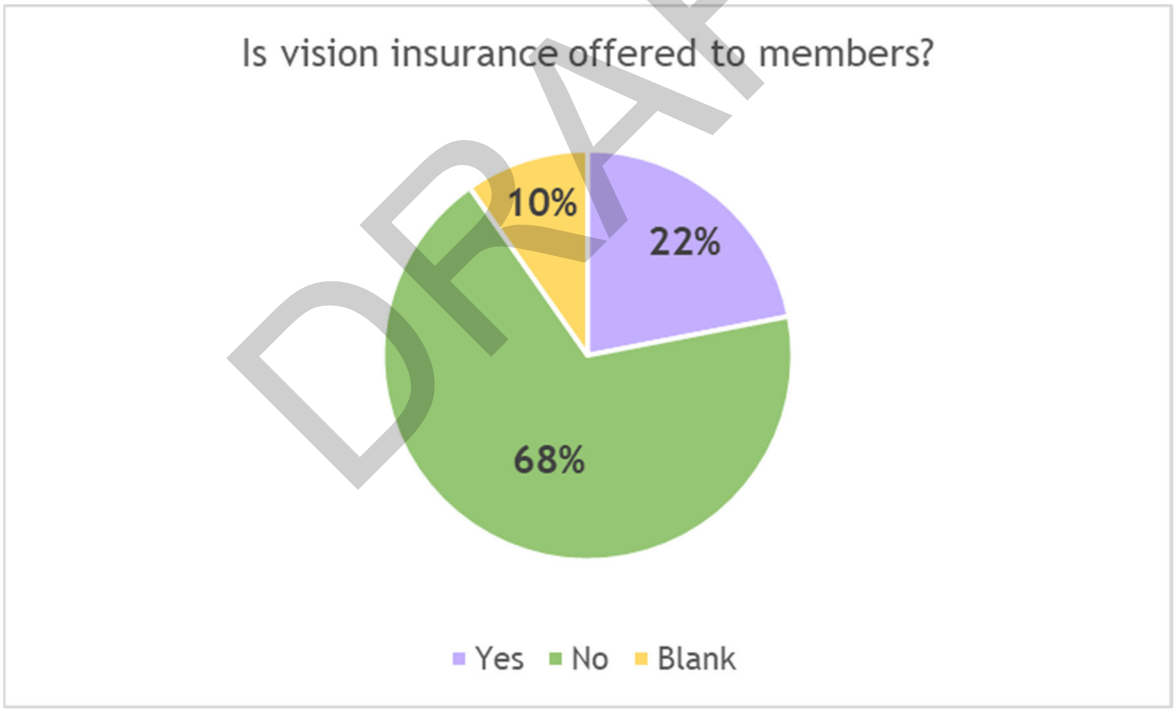
| | Number of Projects | Estimated Cost Needed | Percent of State Total Cost |
|---|---|---|---|
| Wayne | 1 | $1,000,000 | 0.03% |
| Weakley | 2 | $1,500,000 | 0.04% |
| White | 1 | $600,000 | 0.02% |
| Williamson | 13 | $228,863,558 | 6.52% |
| Wilson | 5 | $29,012,296 | 0.83% |

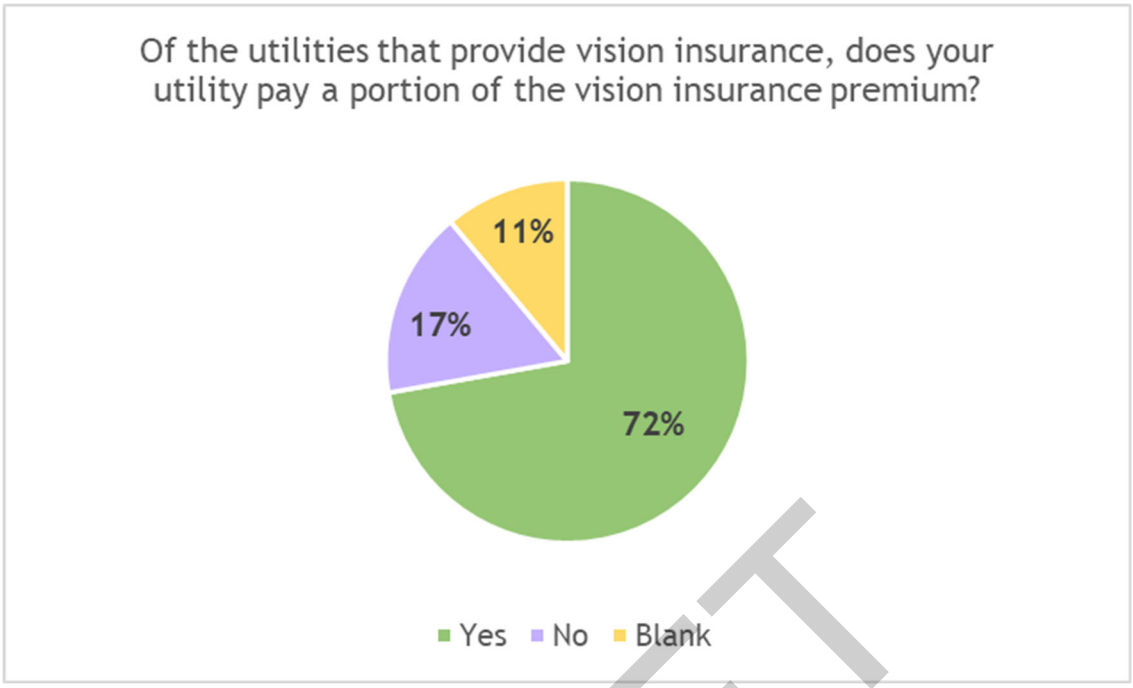
## Appendix B: Wastewater Utility Survey Responses

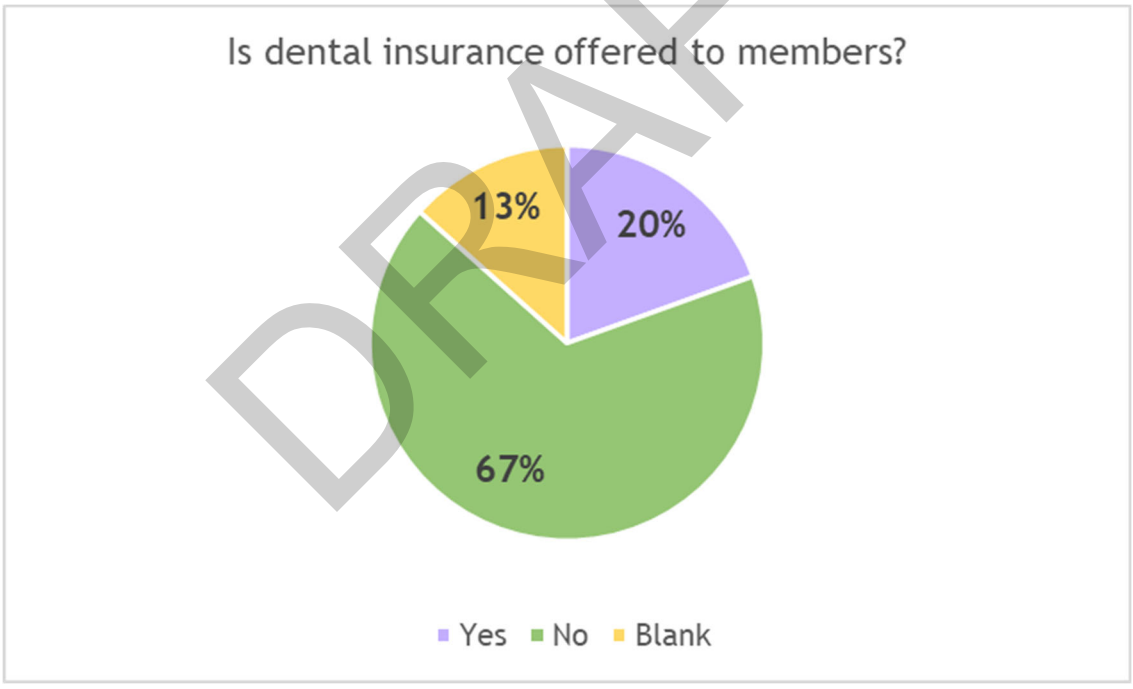


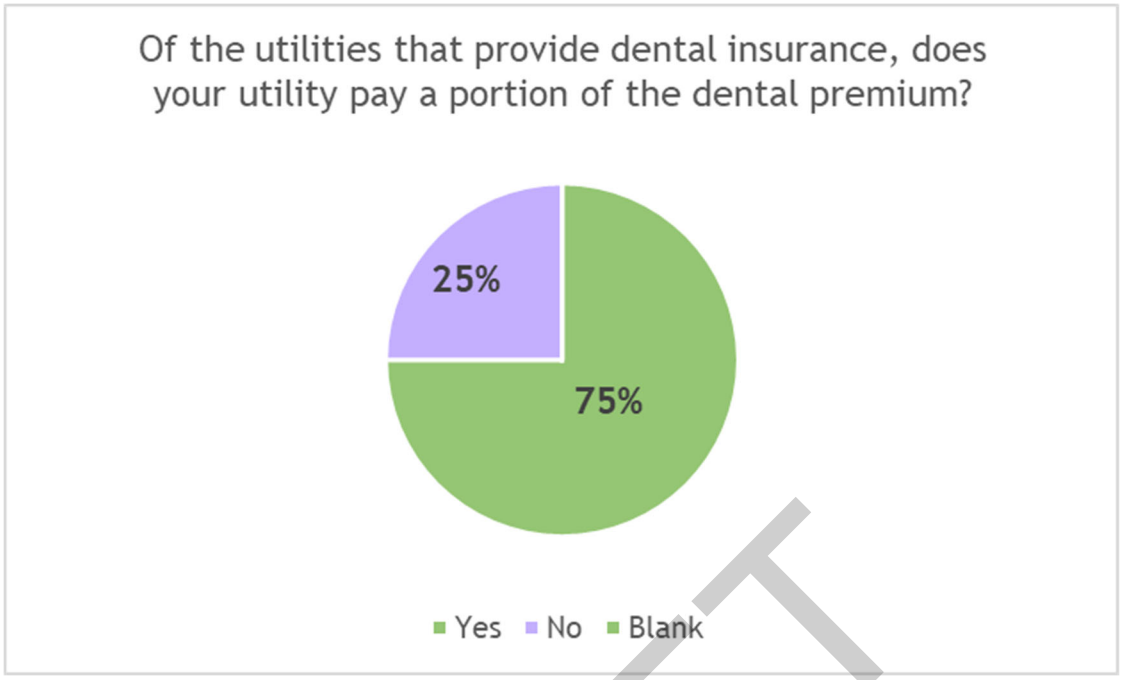



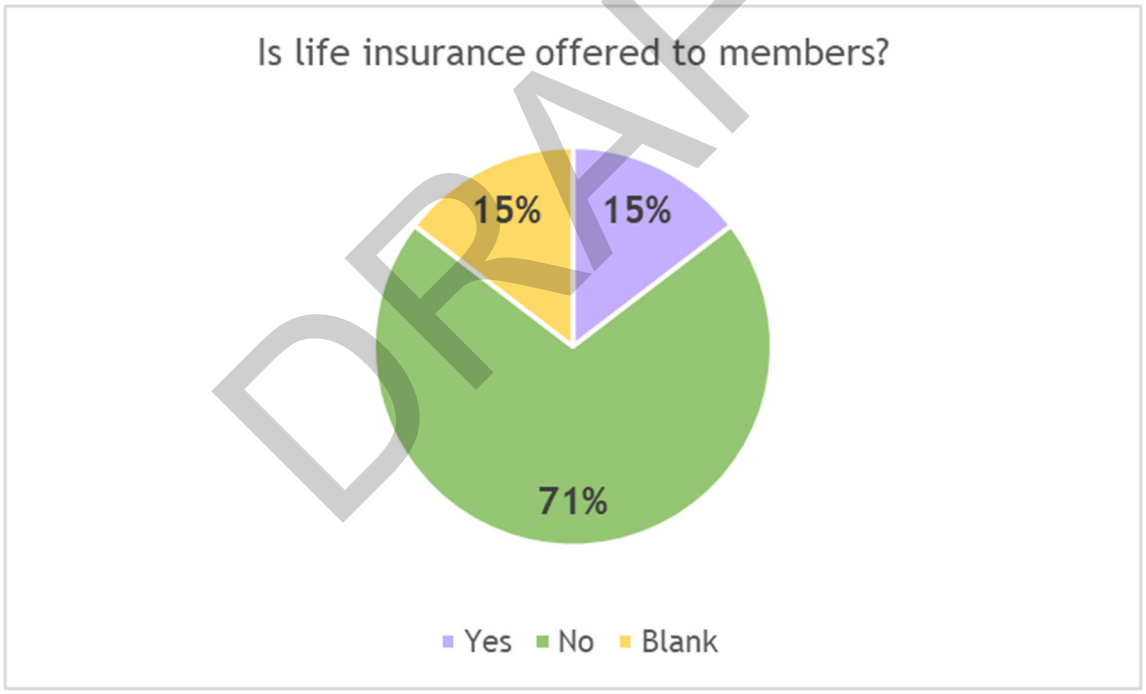

Of the utilities that provide health insurance, does your utility pay a portion of the health insurance premium?
8%
4%
88%
Yes
No
Blank

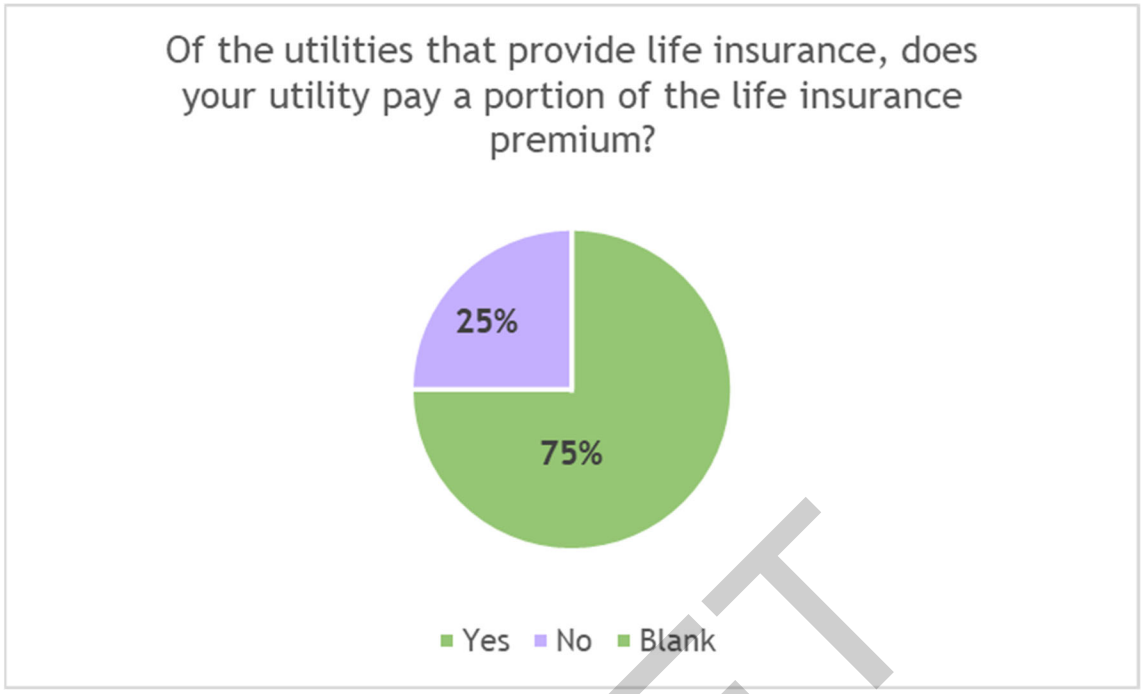

Is vision insurance offered to members?
10%
22%
68%
Yes
No
Blank

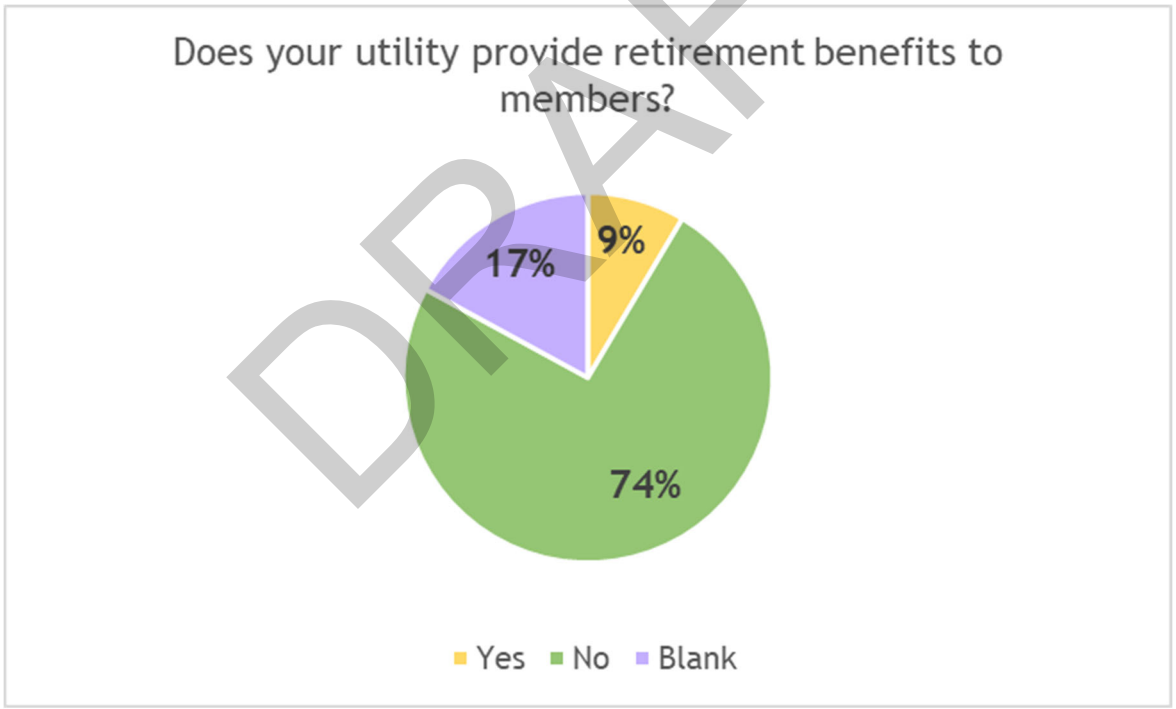

Of the utilities that provide vision insurance, does your utility pay a portion of the vision insurance premium?
11%
17%
72%
Yes
No
Blank

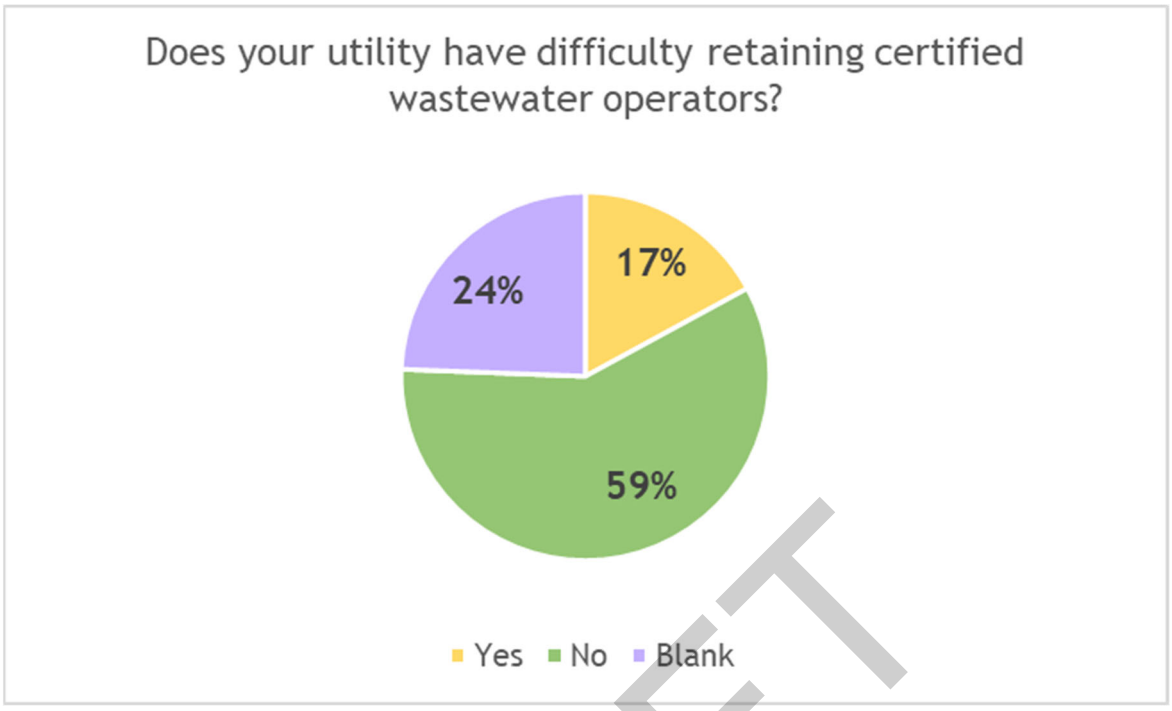

Is dental insurance offered to members?
13%
20%
67%
Yes
No
Blank

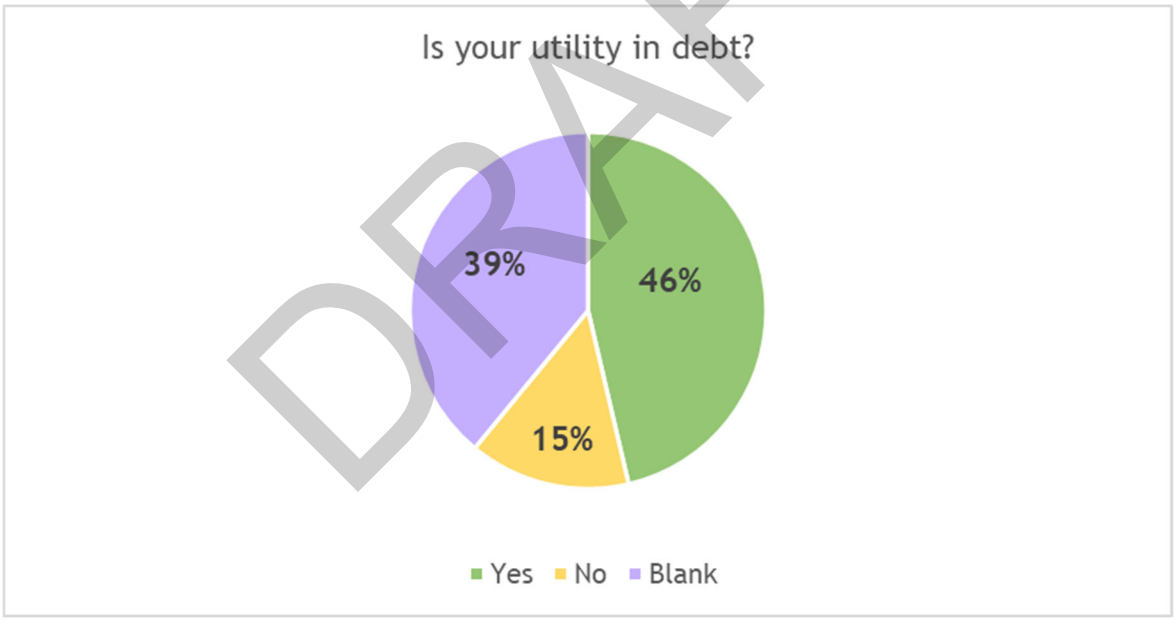

Of the utilities that provide dental insurance, does your utility pay a portion of the dental premium?
25%
75%
Yes
No
Blank

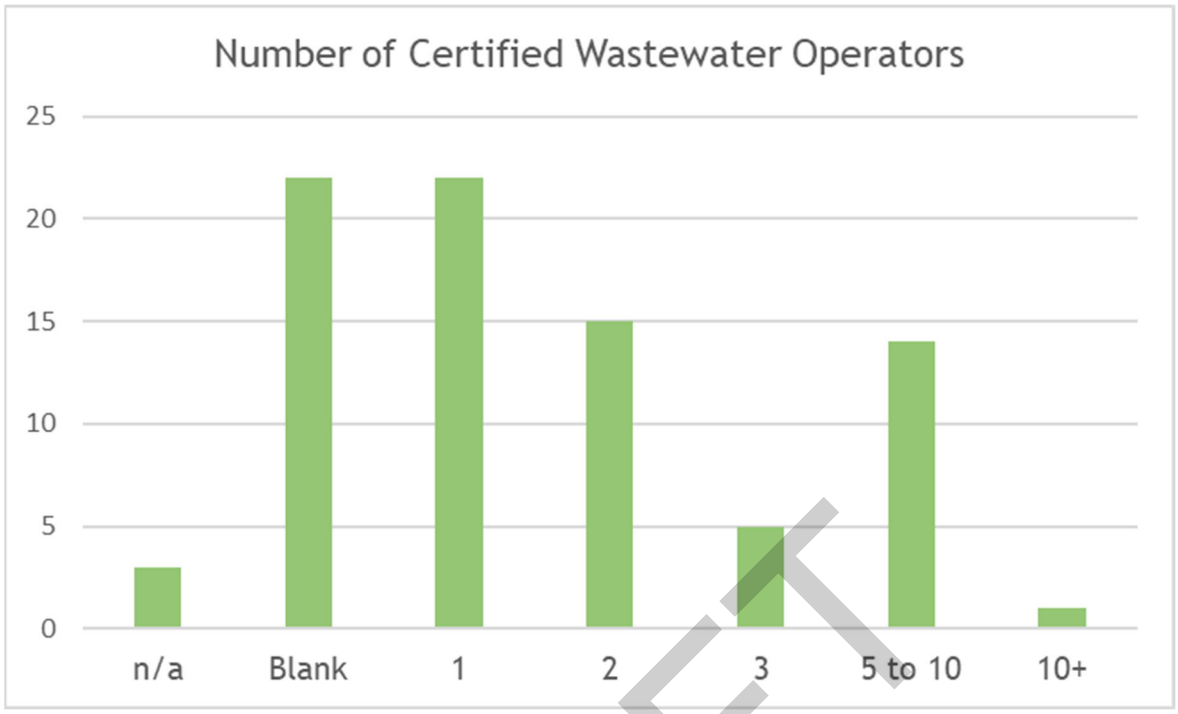

Is life insurance offered to members?
15%
15%
71%
Yes
No
Blank

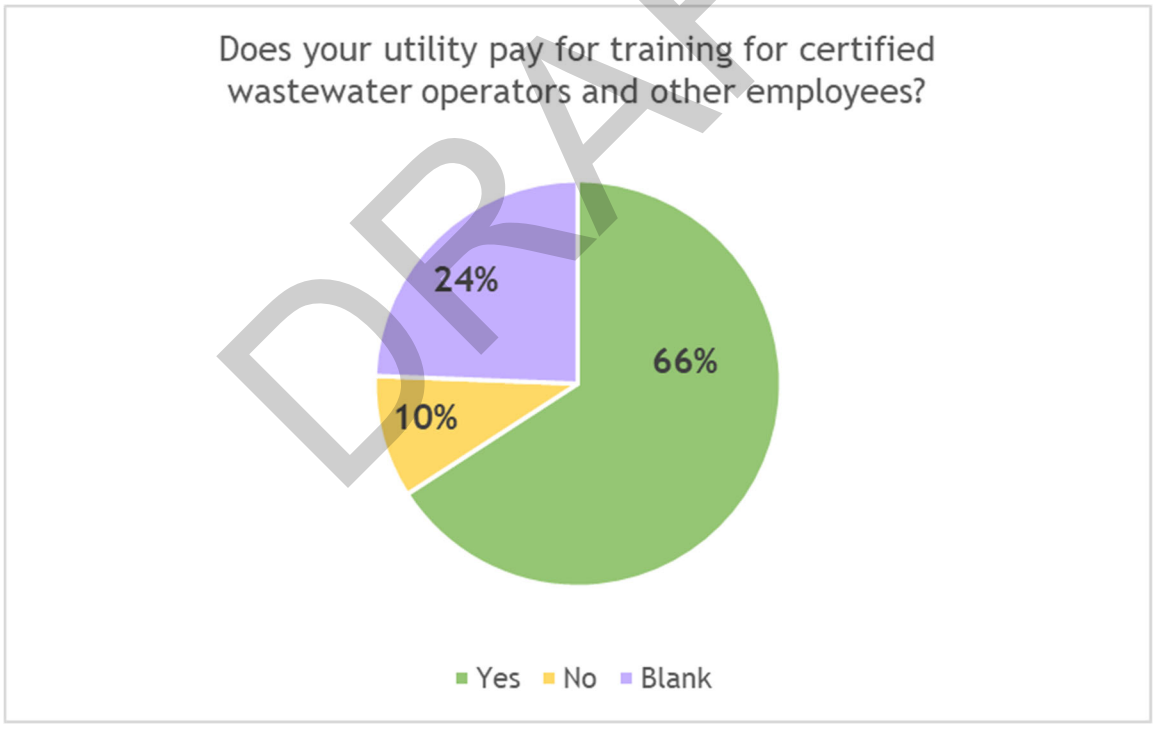

Of the utilities that provide life insurance, does your utility pay a portion of the life insurance premium?
25%
75%
Yes
No
Blank

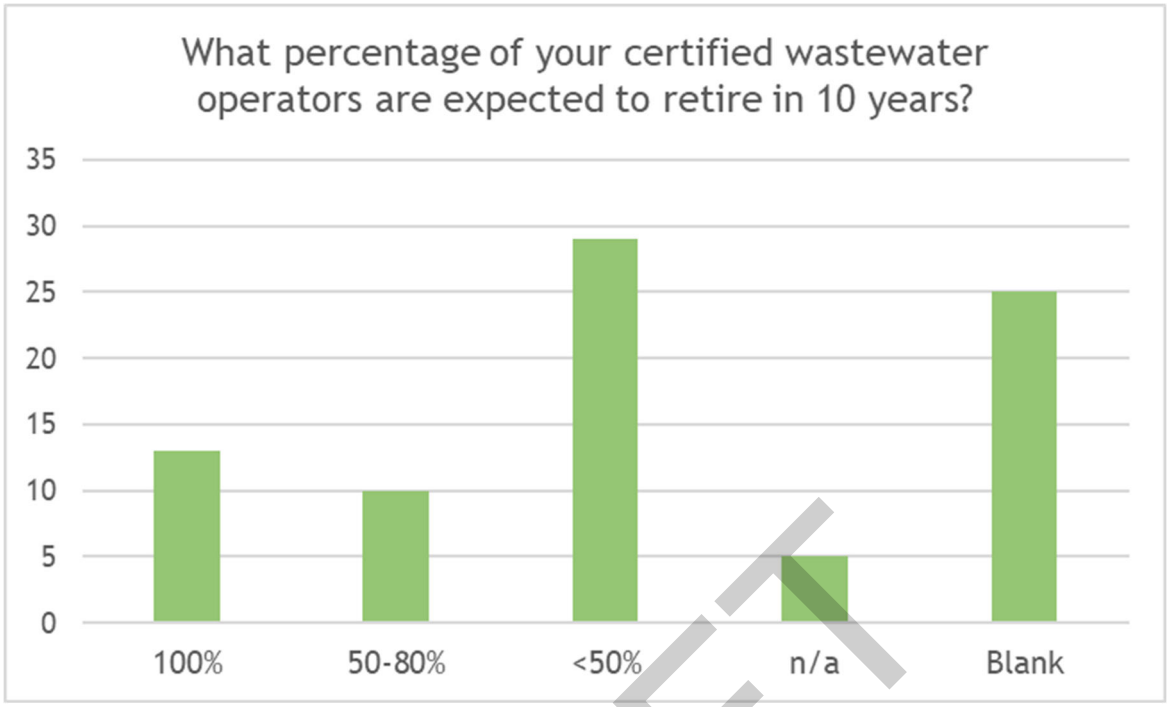

Does your utility provide retirement benefits to members?
9%
17%
74%
Yes
No
Blank


Does your utility have difficulty retaining certified wastewater operators?
17%
24%
59%
Yes
No
Blank


Is your utility in debt?
39%
46%
15%
Yes
No
Blank


Number of Certified Wastewater Operators
25
20
15
10
5
0
n/a
Blank
1
2
3
5 to 10
10+


Does your utility pay for training for certified wastewater operators and other employees?
24%
66%
10%
Yes
No
Blank


What percentage of your certified wastewater operators are expected to retire in 10 years?
35
30
25
20
15
10
5
0
100%
50-80%
<50%
n/a
Blank

# Appendix C: Ten Attributes of Effectively Managed Systems

| Attribute | Characteristics of Attribute from *Rural and Small Systems Guidebook to Sustainable Utility Management* | Characteristics of Attribute from *Effective Utility Management A Primer for Water and Wastewater Utilities* |
|---|---|---|
| **Product Quality** | The system is in compliance with permit requirements and other regulatory or reliability requirements. It meets its community's expectations for the potable water or treated effluent and process residuals that it produces. The system reliably meets customer, public health, and ecological needs. | • Meets or exceeds regulatory and reliability requirements.<br>• Operates consistent with customer, public health, economic, and ecological needs. |
| **Customer Satisfaction** | The system is informed about what its customers expect in terms of service, water quality, and rates. It provides reliable, responsive, and affordable services, and requests and receives timely customer feedback to maintain responsiveness to customer needs and emergencies. Customers are satisfied with the services that the system provides. | • Provides reliable, responsive, and affordable services.<br>• Receives timely customer feedback.<br>• Is responsive to customer needs and emergencies.<br>• Provides tailored customer service and outreach to a range of customer groups (e.g., residential, commercial, industrial, and newly emerging groups such as high-strength waste producers or power companies) |

| Attribute | Characteristics of Attribute from *Rural and Small Systems Guidebook to Sustainable Utility Management* | Characteristics of Attribute from *Effective Utility Management A Primer for Water and Wastewater Utilities* |
|---|---|---|
| **Employee and Leadership Development** | The system recruits and retains a workforce that is competent, motivated, and safe-working. Opportunities exist for employee skill development and career enhancement, and training programs are in place, or are available, to retain and improve their technical and other knowledge. Job descriptions and performance expectations are clearly established (in writing), and a code of conduct is in place and accepted by all employees. | • Recruits, develops, and retains a competent, safety-focused workforce.<br>• Is a collaborative organization dedicated to continual learning, improvement, and adaptation.<br>• Implements procedures for institutional knowledge retention, workplace safety, and continual learning (e.g., standard operating procedures).<br>• Invests in/provides opportunities for professional and leadership development.<br>• Supports an integrated and well-coordinated senior leadership team. |
| **Financial Viability** | The system establishes and maintains an effective balance between long-term debt, asset values, operations and maintenance expenditures, and operating revenues. Rates are adequate to pay its bills, put some funds away for both future capital expenditures and unanticipated issues, and maintain, repair, and replace its equipment and infrastructure as needed. The system discusses rate requirements with its customers, decision making authorities, and other key stakeholders. | • Understands and plans for full life-cycle cost of utility.<br>• Effectively balances long-term debt, asset values, operations and maintenanceexpenditures, and operating revenues.<br>• Sets predictable and adequate rates to support utility current needs and plans toinvest in future needs, taking into account affordability and the needs ofdisadvantaged households when setting rates.<br>• Understands opportunities for diversifying revenue and raising capital. |

| Attribute | Characteristics of Attribute from *Rural and Small Systems Guidebook to Sustainable Utility Management* | Characteristics of Attribute from *Effective Utility Management A Primer for Water and Wastewater Utilities* |
|---|---|---|
| **Operational Resiliency** | The system ensures that its leadership and staff members work together to anticipate and avoid problems. It proactively identifies legal, financial, non-compliance, environmental, safety, security, and natural threats to the system. It has conducted a vulnerability assessment for safety, natural disasters, and other environmental threats, and has prepared an emergency response plan for these hazards. | • Works together with staff internally and coordinate with external partners to anticipate and avoid problems.<br>• Proactively establishes tolerance levels and effectively manages risks (including legal, regulatory, financial, environmental, safety, security, cyber, knowledge-loss, talent, and natural disaster-related).<br>• Plans for and actively manages to maintain business continuity. |
| **Water Resource Adequacy/Water Resource Sustainability** | The system ensures that water availability is consistent with current and future customer needs. It understands its role in water availability, and manages its operations to provide for long-term aquifer and surface water sustainability and replenishment. It has performed a long-term water supply and demand analysis, and is able to meet the water and sanitation needs of its customers now and for the reasonable future | • Ensures water availability through long-term resource supply and demand analysis,conservation, fit for purpose water reuse, integrated water resource management,watershed management and protection, and public education initiatives.<br>• Manages operations to provide for long-term aquifer and surface water sustainabilityand replenishment.<br>• Understands and plans for future water resource variability (e.g., changing weatherpatterns, including extreme events, such as drought and flooding). |

| Attribute | Characteristics of Attribute from *Rural and Small Systems Guidebook to Sustainable Utility Management* | Characteristics of Attribute from *Effective Utility Management A Primer for Water and Wastewater Utilities* |
|---|---|---|
| **Operational Optimization** | The system ensures that its leadership and staff members work together to anticipate and avoid problems. It proactively identifies legal, financial, non-compliance, environmental, safety, security, and natural threats to the system. It has conducted a vulnerability assessment for safety, natural disasters, and otherenvironmental threats, and has prepared an emergency response plan for these hazards. | • Conducts ongoing performance improvements informed by performance monitoring.<br>• Minimizes resource use and loss from day-to-day operations.<br>• Is aware of and adopts in a timely manner operational and technology improvements, including operational technology and information technology.<br>• Manages and utilizes data from automated and smart systems. |
| **Infrastructure Stability/Infrastructure Strategy and Performance** | The system understands the condition and costs associated with its critical infrastructure assets. It has inventoried its system components, conditions, and costs, and has a plan in place to repair and replace these components. It maintains and enhances the condition of all assets over the long-term at the lowest possible life-cycle cost and acceptable level of risk. | • Understands the condition of and costs associated with critical infrastructure assets.• Maintains and enhances assets over the long-term at the lowest possible life-cyclecost and acceptable risk.• Coordinates repair efforts within the community to minimize disruptions.• Plans infrastructure investments consistent with community needs, anticipatedgrowth, system reliability goals, and with a robust set of adaptation strategies. |

| Attribute | Characteristics of Attribute from *Rural and Small Systems Guidebook to Sustainable Utility Management* | Characteristics of Attribute from *Effective Utility Management A Primer for Water and Wastewater Utilities* |
|---|---|---|
| **Customer Sustainability** | The system is active in its community and is aware of the impacts that its decisions have on current and long-term future community health and welfare. It seeks to support overall watershed, source water protection, and community economic goals, where feasible. It is aware of, and participates in, local community and economic development plans. | • Ensures water availability through long-term resource supply and demand analysis, conservation, fit for purpose water reuse, integrated water resource management, watershed management and protection, and public education initiatives.<br>• Manages operations to provide for long-term aquifer and surface water sustainability and replenishment.<br>• Understands and plans for future water resource variability (e.g., changing weather patterns, including extreme events, such as drought and flooding). |

| Attribute | Characteristics of Attribute from *Rural and Small Systems Guidebook to Sustainable Utility Management* | Characteristics of Attribute from *Effective Utility Management A Primer for Water and Wastewater Utilities* |
|---|---|---|
| **Stakeholder Understanding and Support** | The system actively seeks understanding and support from decision making bodies, community members, and regulatory bodies related to service levels, operating budgets, capital improvement programs, and risk management decisions. It takes appropriate steps with these stakeholders to build support for its performance goals, resources, and the value of the services that it provides. The system performs active outreach and education to understand concerns and promote the value of clean, safe water and the services the utility provides, consistent with available resources. | • Engenders understanding and support from oversight bodies, community andwatershed interests, and regulatory bodies for service levels, rate structures,operating budgets, capital improvement programs, and risk management decisions.<br>• Actively engages in partnerships and involves stakeholders in the decisions that willaffect them.<br>• Actively promotes an appreciation of the true value of water and water services, andwater's role in the social, economic, public and environmental health of thecommunity |

Sources: *Rural and Small Systems Guidebook to Sustainable Utility Management* by United States Department of Agriculture and United States Environmental Protection Agency and *Effective Utility Management A Primer for Water and Wastewater Utilities* by United States Environmental Protection Agency.