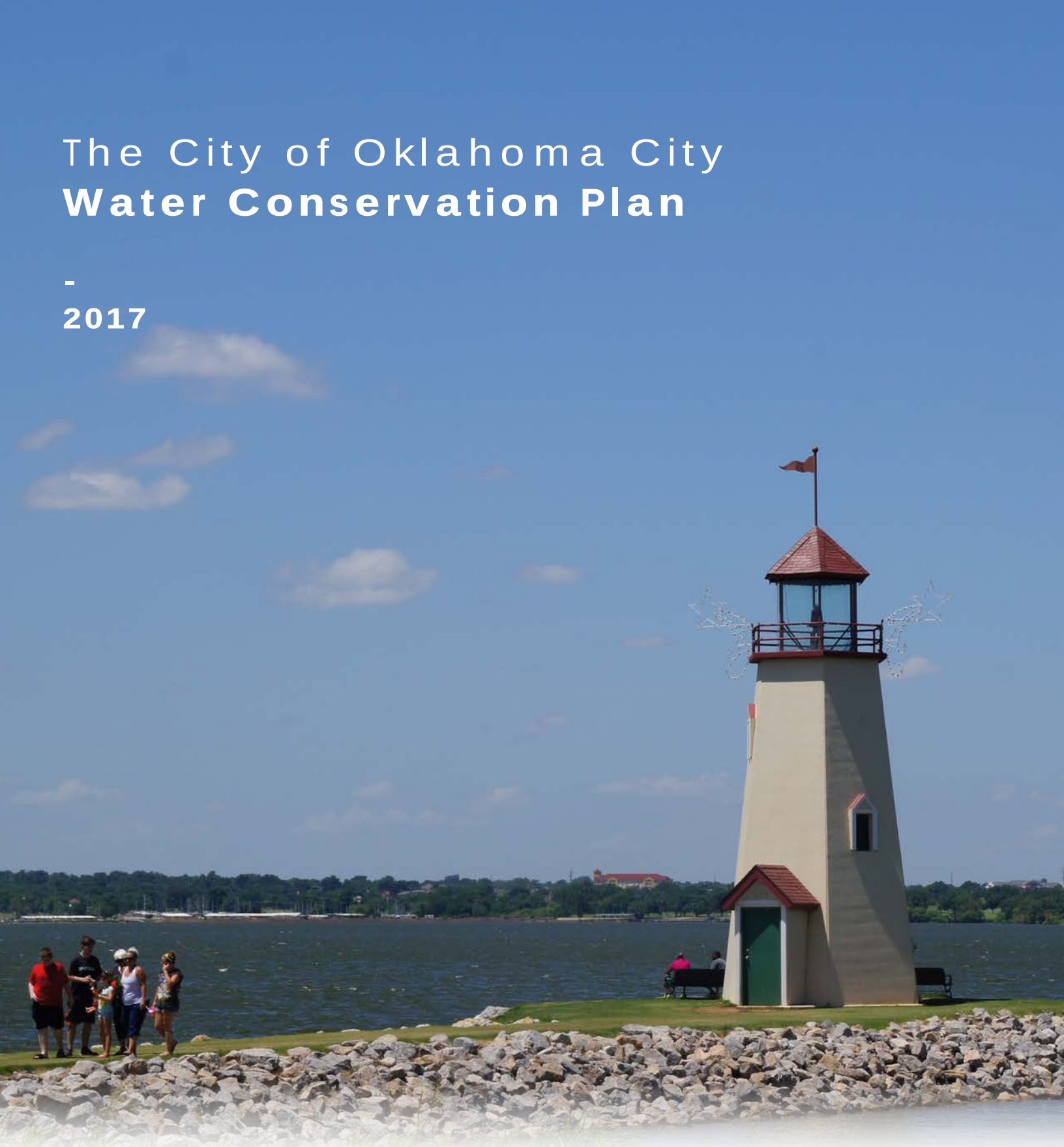
The City of Oklahoma City
Water Conservation Plan

-

2017



Oklahoma City Water Utilities Trust

Squeeze Every Drop.com

OKLAHOMA CITY WATER UTILITIES TRUST

The Oklahoma City Water Utilities Trust (OCWUT) is the policy making body for the water and wastewater utilities. The Trust ensures Oklahoma City residents and businesses receive outstanding, quality municipal water and wastewater services and that these services operate efficiently, effectively, and professionally.

MEMBERS AND SURROGATES
Carl Edwards, Chairman, Independent Trustee
Cody Graves, Independent Trustee
Mick Cornett, Mayor Trustee
Mark Stonecipher, Surrogate Trustee
David Greenwell, Council Trustee
James D. Couch, City Manager Trustee
Dennis Clowers, Surrogate Trustee
Chris Browning, General Manager
Craig Keith, General Counsel
Frances Kersey, Secretary

THE CITY OF OKLAHOMA CITY

Oklahoma City has a Council-Manager government, which combines the strong political leadership of elected officials with the managerial experience of an appointed manager. Oklahoma City is divided into eight geographical areas called wards. The Mayor and eight City Council members are elected to four-year terms. The voters of each ward elect a council member to represent them and the Mayor is elected at large. The Mayor and Council appoint a City Manager to serve as the city's chief administrative official.

Mick Cornett, Mayor
James D. Couch, City Manager
M.T. Berry, Assistant City Manager
Laura Johnson, Assistant City Manager
Dennis Clowers, Assistant City Manager

CITY COUNCIL
James Greiner, Ward 1
Ed Shadid, Ward 2
Larry McAtee, Ward 3
Todd Stone, Ward 4
David Greenwell, Ward 5
Meg Salyer, Ward 6
John A. Pettis, Jr., Ward 7
Mark K. Stonecipher, Ward 8

EXECUTIVE SUMMARY

The Oklahoma City metropolitan area is a thriving community with growing water needs that support urban growth and development. The City of Oklahoma City and OCWUT have a continuing history of long-term planning for the acquisitions, impoundment, and transportation of raw water supply to meet the drinking water needs for Oklahoma City residents, businesses, surrounding cities, and rural water districts. The Utilities Department has prepared this comprehensive water conservation plan to further enhance the city's capacity to meet our growing area's long-term water needs by adopting more efficient practices. This plan provides a water system overview, existing water conservation strategies, and recommended water conservation programs to increase awareness and promote efficient use of water.

The Oklahoma City Water Utilities Trust (OCWUT) is the policy-making body for the water and wastewater utilities. Oklahoma City provides water for single-family, multi-family, industrial/commercial, and 17 wholesale communities. The City of Oklahoma City owns and operates and OCWUT leases and finances the water supply system commonly referred to as the Oklahoma City water system. OCWUT was established on August 1, 1960 under the name Oklahoma City Municipal Improvement Authority, and was re-named OCWUT in 1990, when Trustees adopted the Oklahoma City Water Utilities Trust Indenture. The Trustees are composed of the Mayor, City Manager, appointed Council member, and two citizens of the City. The City of Oklahoma City is the sole beneficiary of OCWUT.

OCWUT finances, refinances, manages, and administers the water and wastewater utilities of the Oklahoma City water system. All revenue generated from water and wastewater charges are utilized to fund the operation, maintenance, and construction of all water and wastewater facilities, assets, and appurtenances. The Trust also generates non-rate payer revenue in the form of land leases, cell tower leases, oil and gas leases, boat stall rentals, and permit fees. This revenue funds recreational improvements and other non-water related service improvements on the Trust Estate.

In 2016, Oklahoma City provided over 33 billion gallons of water to 208,670 accounts including residential, commercial, industrial, and wholesale customers, inside and outside of Oklahoma City limits. The Oklahoma City Utilities Department employs approximately 787 positions in eight divisions including: Administration, Engineering, Fleet Services, Line Maintenance, Solid Waste Management, Utility Customer Service, Water Quality, and Wastewater Quality.

Oklahoma City comprises over 621 square miles and is in the top ten largest cities in the United States in terms of geographic area, spreading into four counties including Oklahoma, Canadian, Cleveland, and Pottawatomie. In partnership with the McGee Creek Authority, Oklahoma City also provides raw water service along a 117 mile pipeline system extending to southeastern Oklahoma. This combination of geographic magnitude and political structure creates unique challenges for providing water and wastewater services to customers.

The goal of water conservation is to improve efficiency, control losses, and decrease water waste by incorporating best management practices. In 2013, Oklahoma City adopted Water Conservation Measures to manage system demand and demonstrate the importance of conserving our limited water supplies. Consistent community messaging to encourage customer adoption of water conservation practices was initiated. Short-term water restrictions are a useful drought management tool; however, this plan recommends long-term improvements to move our community towards adopting effective water efficiency strategies. Water conservation and efficiency are community-wide efforts that support water resource longevity, sustainability, and security without affecting quality of life or citywide growth. This plan addresses

both utility level (supply side) and customer level (demand side) measures.

To ensure adequate water supply for Oklahoma City beyond 2060, The State of Oklahoma, Choctaw Nation of Oklahoma, Chickasaw Nation, and The City of Oklahoma City reached a water rights settlement in August 2016 and legislation was enacted in December 2016. As a component of the Agreement, Oklahoma City will update its water conservation plan to generally follow the American Water Works Association Conservation Standards. The plan will include a periodic review and update to conform to changes in American Water Works Association Water Conservation Standards.

The adoption of this water conservation plan will subsequently provide Utilities Department staff with express guidance for implementing program components and a uniform standard as it periodically reviews City efforts to assist customers as they seek to adopt water efficiency measures and practices in homes, businesses, and landscapes.

The conservation plan strategies will be guided with three main purposes; education and outreach, City-led initiatives and partnerships, and reasonable regulation and enforcement. Oklahoma City offers information to incorporate water efficient practices into their homes, businesses, and landscapes via a dedicated website: http://www.SqueezeEveryDrop.com to support the efforts of our community to use water wisely.

Water conservation and efficiency planning is distinctive in regards to region, customer preference, and water supply availability. Implementation of the conservation plan will require citywide support and community participation to achieve water use efficiency. Periodic progress reports that evaluate and monitor program results will be provided to OCWUT and the public.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DEFINITIONS

Acre-foot per year (AFY)	Enough water to cover an acre of land one-foot deep (325,851 gallons) for a period of one year.
Apparent losses	In a distribution system water audit, losses in customer consumption attributed to inaccuracies associated with customer metering, systematic data handling errors, and unauthorized consumption.
Demand management	Measures, practices, or incentives organized by utilities to change the pattern of demand for a service by its customers or slow the rate of growth for that service.
Demand-side measures	Programs which encourage customers to modify the amount or timing of water use. These measures may include encouraging customers to implement hardware or behavior changes, or change the volume or timing of their use, depending on the time of day or time of year.
Evapotranspiration (ET)	The quantity of water evaporated from soil surface and transpired by plants during a specific time.
Non-revenue water	In a distribution system water audit, non-revenue water equals the volume of unbilled, authorized consumption (water for firefighting, system flushing, and similar uses) added to real losses and apparent losses.
Peak use	The maximum demand occurring in a given period, such as hourly or daily.
Per capita residential use	Average daily water use (sales) to residential customers divided by population served.
Real losses	The physical loss of water from the distribution system prior to reaching the customer, including leakage from piping and reservoir walls, as well as storage overflows caused by faulty control equipment or operator error. Real losses, being volumes of water extracted from a source, and treated to prevailing standards, but never subject to beneficial use are a waste of water and energy resources.
Treated wastewater	Municipal wastewater effluent that is given additional treatment and distributed for reuse in certain applications.
Supply-side measures	The use of specific measures by water utilities to enhance their capability to supply water, including additions as well as efficiency improvements in the water supply infrastructure.
Water conservation	Activities designed to (1) reduce the demand for water, (2) improve efficiency in use and reduce losses and waste of water, and (3) improve land management practices to conserve water.
Water efficiency	The accomplishment of a function, task, process, or result with the minimal amount of water feasible, or an indicator of the relationship between the amount of water required for a particular purpose and the amount of water used or delivered.
Winter period average (WPA)	The average of water bills for December, January, and February.

INTRODUCTION

Water conservation and efficiency are critical components for long- term water resource planning. The City of Oklahoma City and OCWUT recognizes the benefits of water conservation and demand management for both the utility and its customers. Oklahoma City has a history of water planning as evidenced by the completion of water master plans. The water master plan is periodically analyzed and reexamined by the Utilities Department with the assistance of nationally-recognized engineering consultants. The most recent water master plan was completed in 2003 and stressed the importance of incorporating water conservation activities and programs to reduce water demand during drought conditions and recommended the construction of a second pipeline from the Atoka Reservoir to the Stanley Draper Reservoir.

Public water utilities across the United States are recognizing the value associated with the adoption of water conservation programs and strategies. Cities have seen both direct and indirect benefits resulting from water savings including decreased pressure on operating systems and cost savings. Historically, water utilities focused on acquiring raw water, treatment, and delivery; however, with increases in population growth, drought conditions, and urban development, utilities are now focusing efforts to promote water efficiency to the end user.

In 2013, Oklahoma City was named one of the 10 fastest growing cities in the United States, and is now the 29th largest city in the nation by population. This quickly growing city will require additional water supplies to meet demand from an expanding population. As part of its effort to meet an increasing demand, Oklahoma City is promoting water use efficiency, through both supply side and demand side measures, with the implementation of price and non-price strategies. In 2014, the Utilities Department hired a Water Conservation Specialist and Coordinator to continue water conservation efforts and promote best management practices to utilities customers. This water conservation plan was developed on a foundation of research and case studies from cities across the United States. It has been tailored to meet the needs of Oklahoma City customers. OCWUT and City Council recently adopted budgets for FY 2018, including an additional two water conservation support positions.

1.1 Purpose and scope

For many years, the American Water Works Association (AWWA) has strongly encouraged water utilities to adopt policies that incorporate efficient use of water by both its customers and through water utility operations management. This comprehensive water conservation plan was prepared with direction from both the manual of water supply practices M52, *Water Conservation Programs-A Planning Manual*, published by the AWWA in 2006, and the AWWA and American National Standards Institute (ANSI) standard G480-13, *Water Conservation Program Operation and Management* published in 2013.

This water conservation plan has been developed to provide guidance to elected officials and community leaders in the interest of sustaining water resource security for The City of Oklahoma City utility system customers. This plan outlines current water conservation strategies, discusses feasibility and effectiveness of possible programs for future consideration, and provides a range of water system information.

The water system is readily capable of meeting demands during normal and wet years, but can become stressed during extended dry periods or ongoing drought conditions. Therefore, this water conservation plan also seeks to increase the community's awareness of Oklahoma City's water system capabilities and limitations, reveal potential opportunities for future current water conservation efforts, summarize previous

Photo courtesy: Gary Warren

studies related to additional water supply sources and treated wastewater use, and provide emergency usage curtailment options for consideration during extended drought conditions.

The State of Oklahoma experienced above average rainfall (Figure 1) and cooler (Figure 2) than average temperatures during the 1980s and 1990s. Periodically, Oklahoma experiences drier than normal conditions and has a historically undergone similar conditions lasting approximately five to ten years each.

These drier conditions have coincided with warmer than average periods, resulting in increased surface water evaporation rates and customer water consumption. Drought conditions, higher temperatures, and demands on water create stress on the water supply and systems.

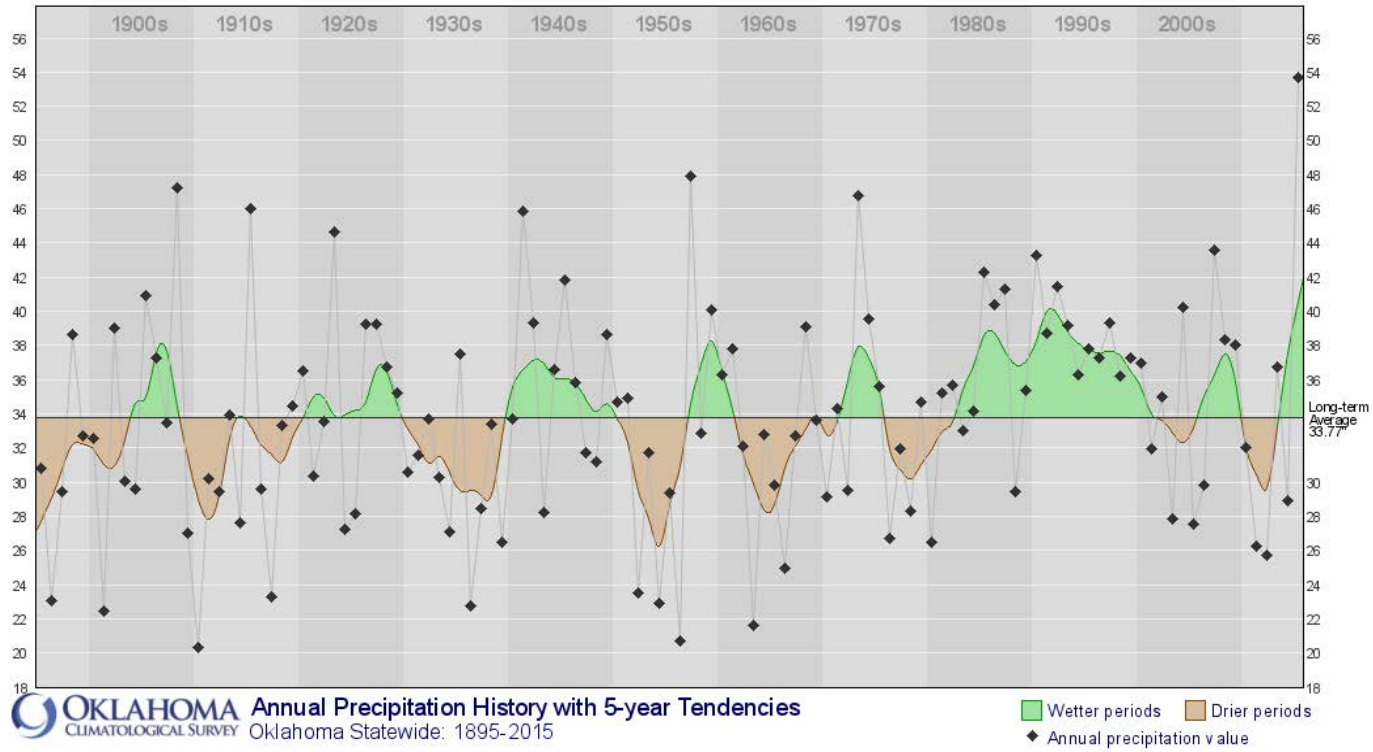


Figure 1: Oklahoma precipitation history

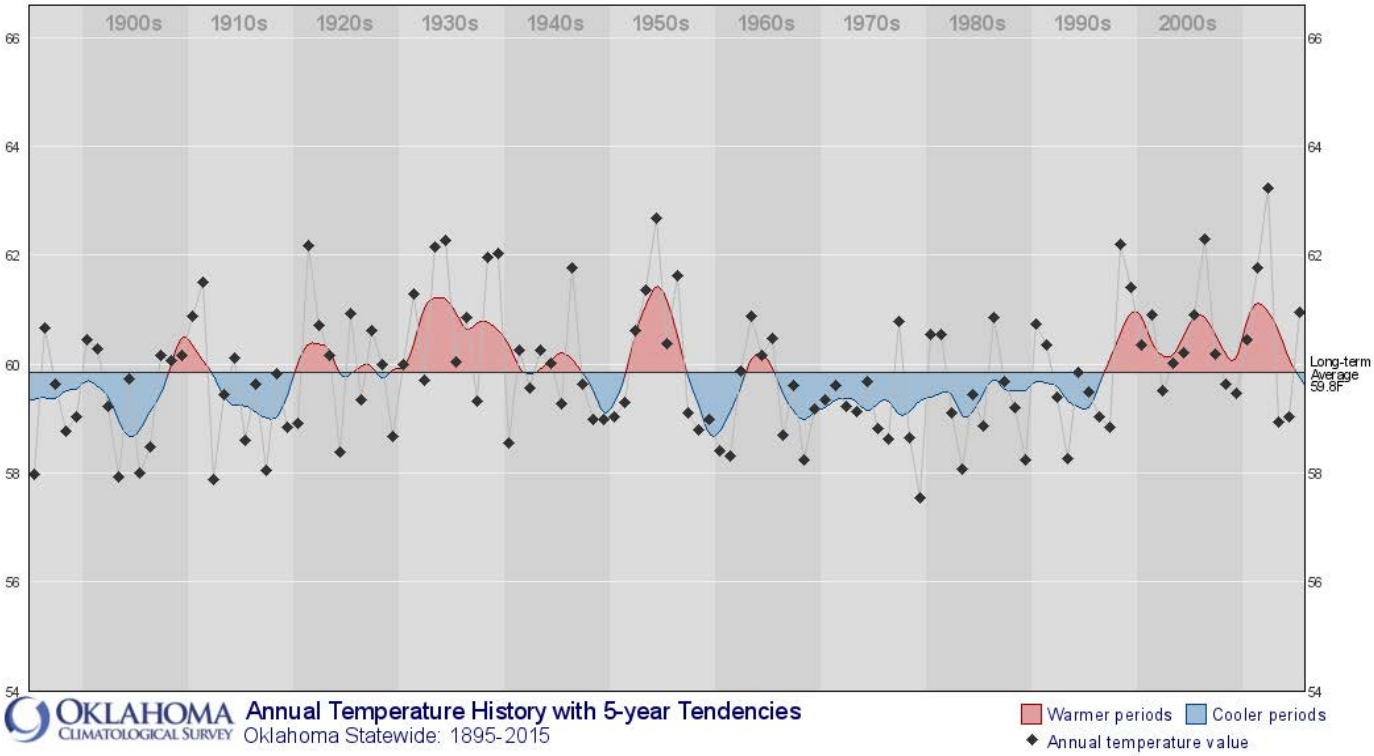


Figure 2: Oklahoma temperature history

Adequate planning for these drought conditions and including water conservation strategies regardless of annual precipitation will reduce stress on water resources while fostering community-wide awareness. The critical need for long-term, comprehensive water conservation programing has become apparent across much of the United States and will continue to be a powerful tool to help communities address their water resource planning needs and demonstrating to the end user the value of our water supply.

The scope of this water conservation plan includes water conservation goals and benefits for Oklahoma City, a description of existing water conservation programs, and selection criteria for future water conservation programs. In addition, the plan provides a review of current and forecasted water demand. This plan focuses on identifying and selecting programs and measures to implement, which extend water conservation practices to the Oklahoma City community and illustrate Oklahoma City's efforts to promote efficient use of water and create communal awareness.

1.2 Plan elements and process

To accomplish the purpose and scope, this water conservation plan is organized into the following sections:

1. Water conservation goals
2. Water system profile
3. Population profile and water use
4. Current water conservation programs
5. Evaluation of potential programs
6. Recommended plan

The planning process includes a prepared list of potential water conservation measures that also support Oklahoma City's comprehensive planokc document, adopted in 2015. The programs were screened by Utilities Department staff and evaluated based on water savings, effectiveness, staff requirements, situational effects, regulatory requirements, partnership opportunities, and social acceptance.

Adapted and native plants reduce landscape water requirements.

WATER CONSERVATION GOALS

Water conservation planning goals are essential to effectively measure water conservation program impacts while monitoring individual project success. Setting goals will provide guidance to measure progress over the program lifespan. Program success will be reevaluated and updated goals will be incorporated, as needed.

2.1 Benefits of water conservation

Water conservation provides Oklahoma City and its customers with opportunities to more effectively use water while potentially limiting increases to water and wastewater bills. Water conservation benefits can be realized by both the Oklahoma City community and the individual water customer. There are many notable motives for increasing water use efficiency including:

- **Supply reliability:** Drought conditions and increases in water demand can quickly shrink water sources. Conservation practices can help extend the availability of our water supply.
- **Improve drought and emergency preparedness:** Promoting awareness during normal weather years acclimatizes residents to drier than normal years.
- **Continue a progressive course of action:** Oklahoma City is committed to meeting its customers' future water needs. Including water conservation in future planning processes will protect resources long-term.
- **Public perception:** The preparation and implementation of a water conservation plan demonstrates Oklahoma City's long-term commitment to using water efficiently all year, regardless of temporary weather conditions.
- **Commitment to stewardship and sustainability:** Provides leadership in Oklahoma by promoting efficient water use to all customers residing in areas Oklahoma City serves including Central and Southeastern Oklahoma.
- **Customer benefits:** Promotes a sense of goodwill for the Oklahoma City community, fostering efficient use of water.
- **Recreation and environmental benefits:** Moderating seasonal withdrawals from reservoirs enhances opportunities for recreational activities and wildlife habitat.
- **Energy savings:** The water treatment and delivery process is an energy intensive process. Reducing water peak demand and per capita usage lessens utility use and associated cost.
- **Advance educational opportunities:** Creates customer awareness regarding the actual value of water.
- **Promote aesthetic value to landscapes:** Incorporating drought-tolerant and native plants into the landscape benefits the community through beautification, reduced water, pesticide, and fertilizer requirements while benefiting wildlife.
- **Cost savings:** Extending the life of existing facilities through demand management and conservation.

2.2 Planning goals

The need for water conservation and efficiency has become an increasingly important component to ensure potable water for Oklahoma City and surrounding communities. Each goal works towards water conservation, supply sustainability, and resource preservation. The goals of this comprehensive water conservation plan include:

Goal 1: Continue and increase water conservation education and outreach

Education is the foundation of any water conservation program. A consistent and visible message creates awareness, places value on water resources, and drives customers to take action towards water efficient practices. In 2013, OCWUT partnered with Oklahoma State University to promote outdoor water efficiency. Additional activities including a sprinkler checkup program and landscape award program are discussed in Section 5.4.

Photo courtesy of Oklahoma State University

Goal 2: Promote efficient water use by City-led initiatives

Reducing inefficient water consumption from public facilities due to both indoor and outdoor water use will be a priority to demonstrate to utilities customers the importance of water conservation. Many residents cite the City's careless water use, particularly in the landscape, as reason why water conservation is not an issue. Increasing water use efficiency on public medians, landscapes, and parks will demonstrate the City's commitment to water use efficiency.

Goal 3: Maximize potential local partnerships

Partnering with successful organizations and association across Oklahoma City will extend water conservation messaging throughout the community. Many grassroots initiatives have started and incorporating additional organizational programs that may already be promoting sustainable behavior will increase awareness. Potential for partnerships are discussed in Section 5.5.

Goal 4: Continue conservation-oriented rate design

In October of 2014, OCWUT began a rate change implementation based on a cost-of-service study. The conservation-oriented rates are discussed in Section 5.3 of this water conservation plan.

Goal 5: Acquire additional water resources to meet growing demand

OCWUT intends to construct a parallel raw water pipeline from southeast Oklahoma to meet expected increases in water demand and provide resiliency for the raw water supply system. This pipeline project, including design and construction, is anticipated to be complete in five to ten years. Additionally, OCWUT is working to acquire additional water resources in southeast Oklahoma to provide added supply for long-term water demand growth. Section 3.4 discusses future supply source planning.

Goal 6: Increase appropriate use of treated wastewater

Treated wastewater use extends the potable water supply by decreasing diversion and treatment of raw water for purposes that do not require potable water, such as industrial processes and irrigation. Section 3.6 discusses treated wastewater use.

Goal 7: Reduce distribution system water loss

Water loss equates to water revenue loss, reduction in stored water, and wasted treatment and power costs. Utilities Department staff have completed the AWWA water loss audit for fiscal year 2016. Staff will continue to develop procedures to properly monitor and manage distribution system losses. A number of key staff attended an AWWA Water Loss Seminar for training to learn the methods and technologies to economically control water losses. Water accounting and loss is discussed in Section 5.6.

Goal 8: Continue to support the statewide goal established in the Water for 2060 Act

In 2012, Oklahoma established a statewide goal of consuming no more fresh water in 2060 than was consumed in 2010 with the passage of House Bill 3055, the Water for 2060 Act. Water for 2060 emphasizes education and incentives rather than mandates alone.

Goal 9: Establish a gallons per capita water use reduction schedule

Evaluate current and recommended future residential per capita water demand and establish a reduction goal schedule over time. Typically, average customer water use is reported as gallons per capita per day (gpcd) which is typically calculated by dividing the average daily production by the total population served.

Goal 10: Adopt water efficiency and irrigation standards

The current water conservation measures seek to increase water use efficiency and reduce peak demand. Incorporating irrigation system design, installation, and maintenance standards will increase the quality of irrigation systems in Oklahoma City and the efficiency of water applied to the landscape. Irrigation standards will create built- in water efficiency and savings for new construction.

Goal 11: Support The City of Oklahoma City's comprehensive plan, planokc

Planokc serves as a guide for policy, infrastructure, and planning decisions. The plan identifies initiatives for water conservation including education, partnerships, and City participation. The comprehensive plan is available by visiting www.planokc.org.

WATER SYSTEM PROFILE

3.1 History of the water system

Oklahoma City continues to invest wisely in its water system and provide quality water service to Central Oklahoma. Comprehensively planning for reliable water service began two months after the Land Run of 1889, and the City has continued providing water service since.

The water supply system for the 10,000 new citizens back then was one well and "bring your own bucket." It wasn't long before more wells were drilled. In 1908, the City purchased the water supply – 14 wells and some pipe. However, the wells often went dry in the summer when life-sustaining water is most critical.

By 1910, City leaders began work on a water supply reservoir to ensure its 35,000 citizens would always have water. The Overholser Reservoir was completed in 1917 and is part of our water system today. Plans began immediately for a second water supply reservoir.

In the 1930s, the state suffered the worst droughts and floods in recorded history. At the same time, Oklahoma City was enjoying economic growth. Construction of the Hefner Reservoir began but stopped during World War II for lack of materials and manpower. The reservoir was completed in 1945, and the Hefner water treatment plant went into operation shortly thereafter.

During the drought of record in the 1950s and the sensitivity of the North Canadian River to drought that resulted in insufficient water supply, Oklahoma City determined that additional, reliable water supplies were necessary. A water master plan completed in 1954 evaluated several options for water supply to Oklahoma City but ultimately recommended obtaining water from southeast Oklahoma. In the late 1950s and early 1960s, with a population of 324,000, the City undertook a $62 million project to bring water from 100 miles away. Oklahoma City bought land and built the Atoka Reservoir and the Stanley Draper Reservoir, a 100-mile pipeline, six pump stations, a water treatment plant, and transmission lines to deliver tap water. In 1986 the McGee Creek Reservoir and pipeline were completed. In addition to the original pipeline, the 1954 master plan ultimately envisioned three pipelines from southeast Oklahoma.

OCWUT and Oklahoma City regularly complete water master plans to ensure that water can be delivered to customers safely and reliably. Master planning has been ongoing since 1910. The most recent water master plan (2003) recommended the construction of a second pipeline from the Atoka Reservoir to Draper Reservoir. Subsequent to and building upon the 2003 master plan, a water supply study completed in 2009 estimates central Oklahoma's water needs will increase to 315 million gallons a day (MGD) by 2060.

In June 2010, OCWUT completed a water storage contract with the Oklahoma Water Resources Board (OWRB) for water in Sardis Reservoir. A water rights permit application was also submitted for the beneficial use of 115,000 acre-feet per year of water from the Kiamichi River Basin in which Sardis Reservoir is located. Subsequent to the storage contract and submittal of the permit application, a lawsuit was filed that objected to the use of this water. A settlement agreement has been reached and legislation was enacted in December 2016. Conceptual planning is still ongoing for the raw water conveyance system to get water from the Kiamichi River basin to Oklahoma City.

3.2 Service area

The Oklahoma City water service area includes the corporate limits of Oklahoma City, most other communities within its combined statistical area, and areas along the raw water pipelines to Atoka Reservoir and McGee Creek Reservoir. In addition to Oklahoma City, retail individual water service is also provided to

all customers located in the cities of Warr Acres and The Village.

Wholesale drinking water service is provided to the following communities: Bethany, Blanchard, Edmond, El Reno, Moore, Mustang, Newcastle, Norman, Piedmont, Yukon, Canadian County Water Authority, the Deer Creek Rural Water Corporation, and Tinker Air Force Base. Raw water supply is provided to the communities of Atoka, Coalgate, Pottawatomie County Rural Water District #3, and Shawnee. The McGee Creek Authority provides raw water to the Atoka Rural Water District #4. Private raw water service is provided to Oklahoma Gas & Electric Company (Mustang and Seminole Electric Generating Plants), Lattimore Material Corp., and Cedar Valley Nursery. Oklahoma City's water service areas are shown in Figure 3

The wastewater system currently provides retail wastewater service to customers within the corporate limits of Oklahoma City, The Village, Nichols Hills, and Tinker Air Force Base. Wholesale wastewater service is provided to Piedmont and Moore. Treated wastewater supply is provided to Oklahoma Gas & Electric for two other power plants (Redbud Energy and McClain). Individual water and wastewater service is also provided to a number of unincorporated areas within the counties surrounding Oklahoma City. Discussions are underway to potentially expand service to meet surrounding community water needs in future years. Additionally, a Treated Wastewater Option and Sale Agreement with the City of Oklahoma City and Devon Energy Production Company, L.P. for the purchase of a maximum of 25 million gallons per day of the treated wastewater from Deer Creek and/or Chisholm Creek facility, as available, during the purchase term was approved by City Council in May of 2017.

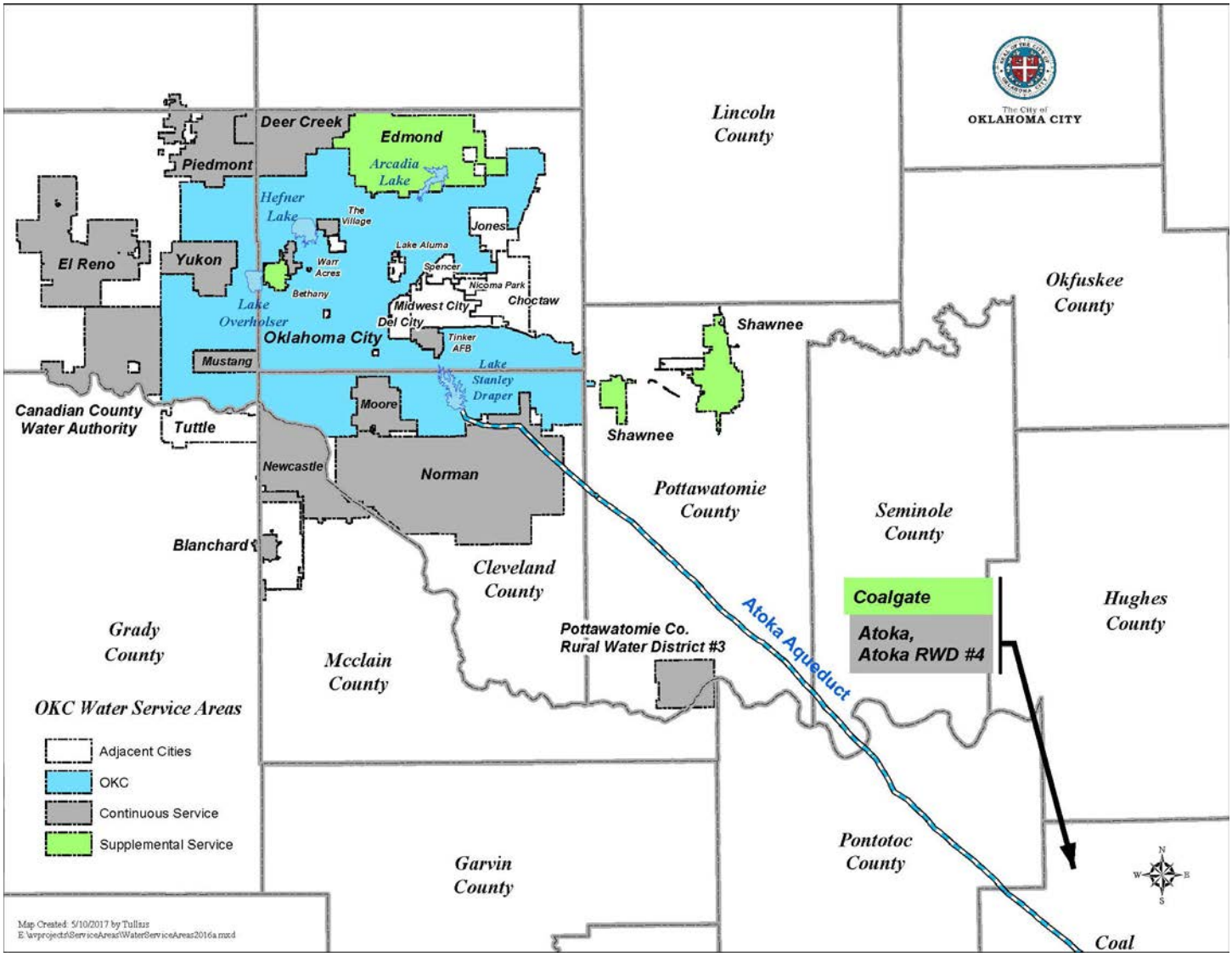


Figure 3: Oklahoma City water service areas

3.3 Supply sources

Oklahoma City relies on water from two sources, the North Canadian River supply and the southeastern Oklahoma supply. Canton, Hefner, and Overholser Reservoirs receive water from the North Canadian River. Stanley Draper Reservoir receives water from the Atoka and McGee Creek Reservoirs via a 100-mile pipeline from the Atoka Reservoir to Stanley Draper Reservoir and a 17.2 mile pipeline from McGee Creek Reservoir to the Atoka Reservoir, which comprises the southeastern Oklahoma supply.

OCWUT has total permitted rights for 211,667 acre-feet per year (AFY), 80,000 AFY from the North Canadian supply and 131,667 AFY from the southeastern supply. Although this is the permitted right, during years of drought, lack of rainfall ,and increased evaporation can reduce the volume of available surface water below the permitted amount.

Oklahoma City owns four water supply reservoirs including Overholser, Hefner, Atoka, and Stanley Draper and water storage rights in Canton and McGee Creek Reservoirs.

Overholser, Hefner, and Stanley Draper Reservoirs are within City limits. Atoka and McGee Creek Reservoirs are in southeast Oklahoma and Canton Reservoir is located in northwest Oklahoma. The extent of Oklahoma City's supply sources is shown in Figure 4.

3.3.1 North Canadian River supply

OCWUT has water rights for 80,000 AFY from the North Canadian River between Canton Reservoir and Overholser Reservoir. Hefner Reservoir is located in the Arkansas River Basin; water is diverted to the reservoir from the North Canadian River by impounding water from the Overholser Dam allowing water to flow into the Hefner Reservoir via the Hefner canal. The North

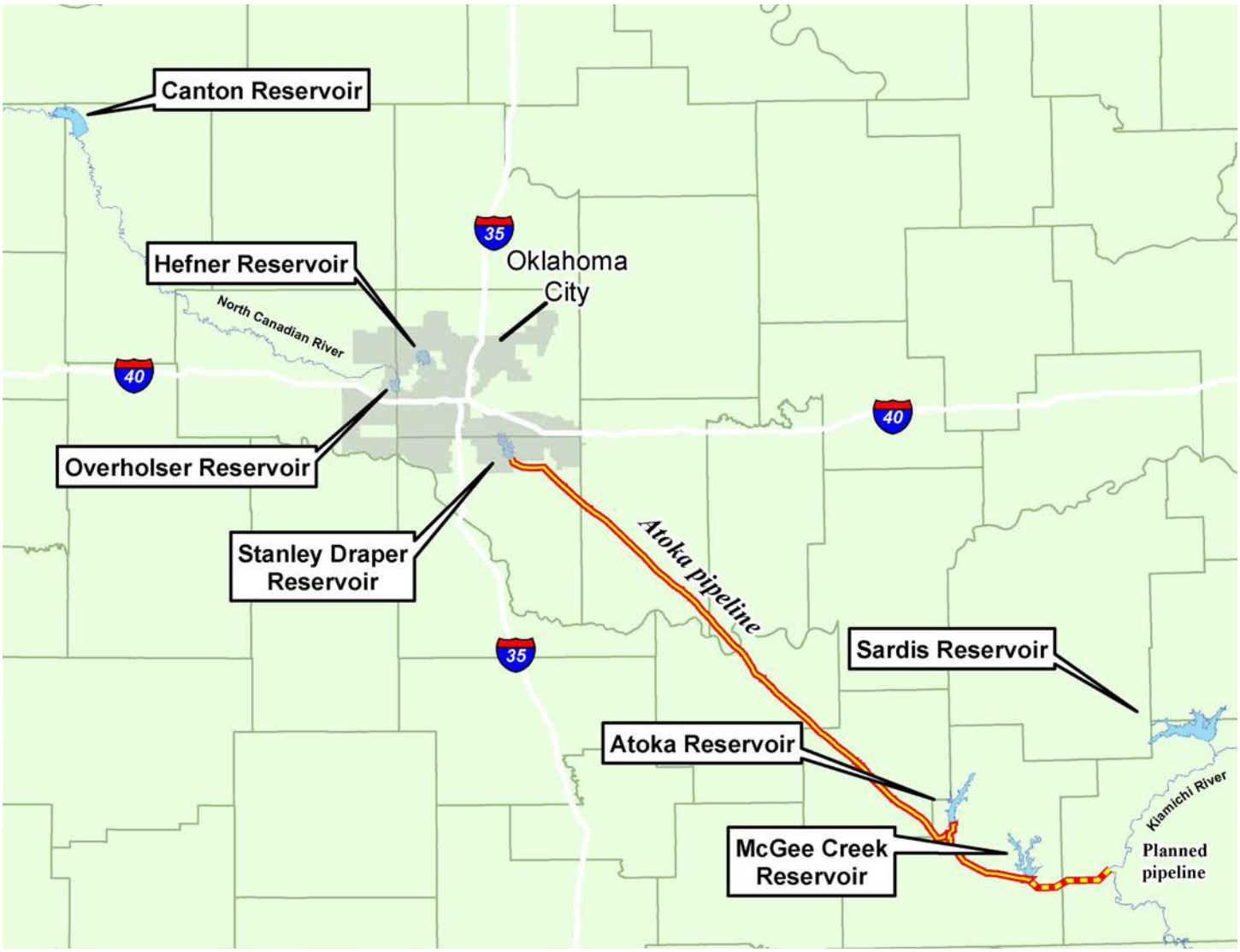


Figure 4: Oklahoma City water supply sources

Figure 5: Hefner Reservoir

Figure 6: Overholser Reservoir and dam

Figure 7: Canton Reservoir

Canadian River supply includes Hefner, Overholser, and Canton Reservoirs. Although OCWUT retains water rights for 80,000 AFY from the North Canadian River supply system, the reliable supply is approximately 50,000 AFY due to evaporation, dry, and drought conditions which affect stream flow and reservoir storage. The North Canadian River supply flow has been as low as 43,475 during recent drought conditions in 2012.

Hefner Reservoir

The Hefner Reservoir, an off-stream terminal storage facility, is located in northwest Oklahoma City and supplies raw water to the Hefner water treatment plant. The plant was completed in 1947 and is owned and operated by the City of Oklahoma City. When full, the reservoir level is 1,199 feet above sea level and has a capacity of 69,894 acre-feet (22.8 billion gallons). The surface area of the reservoir when full is approximately 2,500 acres (3.9 mi^2). Hefner Reservoir is part of the Arkansas River Basin (or watershed) and it receives inflow from the North Canadian (or Beaver) River being impounded by the Overholser Dam allowing water to flow into the Hefner Canal and then five miles to the northeast to Hefner Reservoir (Figure 5).

Overholser Reservoir

The Overholser Reservoir is located off the North Canadian River in western Oklahoma City and supplies raw water for the Overholser water treatment plant. It was completed in 1922 and is owned and operated by Oklahoma City. When full, the reservoir level is 1,241.5 feet above sea level and has a capacity of 13,514 acre-feet (4.4 billion gallons). The surface area of the reservoir is 1,500 acres (2.3 mi^2) when full. Overholser Reservoir is part of the Arkansas River Basin (or watershed). It receives inflow from the North Canadian (or Beaver) River by impounding water at the Overholser Dam (Figure 6).

Canton Reservoir

The Canton Reservoir owned and operated by the U.S. Army Corps of Engineers is located on the North Canadian River approximately 75 miles northwest of Oklahoma City and supplies raw water to both Hefner and Overholser Reservoirs via the North Canadian River. The reservoir was completed in 1948 and Oklahoma City acquired storage rights in 1991. When full, the reservoir level is 1,615.4 feet above sea level and has a capacity of 97,176 acre-feet (22.8 billion gallons). The

Figure 8: Stanley Draper Reservoir

Figure 9: Atoka Reservoir

Figure 10: McGee Creek Reservoir

surface area of the reservoir is 7,930 acres (12.4 mi^2). Canton Reservoir is part of the Arkansas River Basin (or watershed). It receives inflow from the North Canadian River (or Beaver) and water can be discharged to supply water to Hefner and Overholser Reservoirs via the North Canadian River. Canton Reservoir is shown in Figure 7.

3.3.2 Southeastern Oklahoma supply

OCWUT has water rights of 131,667 AFY from southeast Oklahoma. A 100-mile pipeline has the capability to transfer up to approximately 90 MGD from Atoka Reservoir through a series of pump stations to the Stanley Draper Reservoir. The McGee Creek pipeline can supply approximately 56 MGD from the McGee Creek Reservoir to Atoka Reservoir. The 2003 water master plan calculated the reliable yield of McGee Creek Reservoir and Atoka Reservoir as 71,800 AFY and 92,000 AFY, respectively. The Stanley Draper Reservoir yield is dependent on pumpage from Atoka and McGee Creek Reservoirs.

Stanley Draper Reservoir

The Stanley Draper Reservoir, a terminal storage facility, is located in southeast Oklahoma City and supplies raw water for the Draper water treatment plant. It is located on East Elm Creek, a Little River tributary. It was completed in 1963. When full, the reservoir level is 1,191 feet above sea level and has a capacity of 87,155 acre-feet (28.4 billion gallons). When full, the surface area of the reservoir is 2,459 acres (3.8 mi^2). Stanley Draper Reservoir receives inflow from the Atoka Pipeline. The Stanley Draper Reservoir is shown in Figure 8.

Atoka Reservoir

The Atoka Reservoir, a water supply reservoir located on the North Boggy Creek, is located in southeast Oklahoma in Atoka County and supplies raw water for the Stanley Draper Reservoir and to local communities. It was completed in 1959. When full, the reservoir level is 590 feet above sea level and has a capacity of 105,075 acre-feet (34.2 billion gallons) and the surface area of the reservoir is 5,700 acres (8.9 mi^2). The Atoka Reservoir is shown in Figure 9.

McGee Creek Reservoir

The McGee Creek Reservoir, a water supply reservoir located on Muddy Boggy River, is located in southeast

Oklahoma in Atoka County and supplies raw water for Atoka and other local entities. It was completed in 1986. When full, the reservoir level is 577.1 feet above sea level and has a capacity of 113,980 acre-feet (37.1 billion gallons). The surface area of the reservoir is 3,810 acres (5.95 mi^2). The McGee Creek Reservoir is shown in Figure 10.

3.4 Future water resource planning

OCWUT has been taking steps to ensure future water supplies to meet the demands of a growing community. This water conservation plan is not intended to be a water supply plan, and is not designed to eliminate, reduce, or otherwise replace future water and wastewater system planning or construction.

Water conservation planning serves to extend existing water supply resources, preserve and protect environmental resources, and reduce demand on distribution system facilities. It also plays a pivotal role in educating residents of the value of water and demonstrating how end users can effectively support efficient water use practices. Oklahoma City consistently plans for facility improvements and additions through water and wastewater master plans and other engineering research and studies designed to forecast water and development needs.

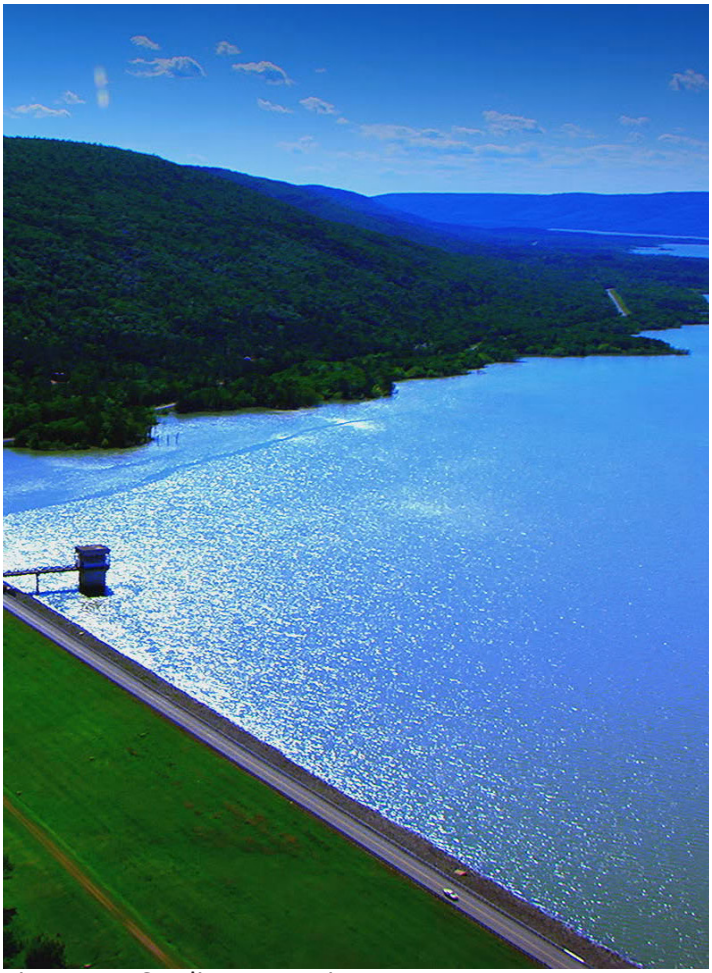


Figure 11: Sardis Reservoir, *Photo courtesy Water Unity Oklahoma*

In May 2017, OCWUT approved a capital improvement plan (CIP) for the fiscal years of 2018 through 2022. The projects will focus on system reliability and growth for water and wastewater services. The need for the water improvement projects were addressed in the 2003 water master plan, the 2009 regional raw water supply study, and the 2014 southeast Oklahoma raw water supply system conceptual plan as well as evaluations by Utilities Department engineers and consultant studies. As a part of the CIP projects, a second Atoka pipeline will be built and a system-wide interconnection will be completed. The second Atoka pipeline is currently in design and, upon completion, will significantly increase the ability to transport raw water from southeast Oklahoma to the Stanley Draper Reservoir. This pipeline is scheduled to be completed around 2023.

In June 2010, OCWUT entered into a Storage Contract Transfer Agreement with the State of Oklahoma to acquire water storage rights in Sardis Reservoir (Figure 11) in the Kiamichi River basin in southeastern Oklahoma. The reservoir was built by the United States Army Corps of Engineers to provide flood protection and storage for water supply. The City of Oklahoma City has submitted an application with the OWRB for additional water rights in the Kiamichi basin. An amended water rights permit application for the beneficial use of 115,000 acre feet per year was submitted and legislation was enacted in December 2016. A second Atoka pipeline will provide some capacity for transmission of future supplies from the Kiamichi River and allow repairs along the existing pipeline without stopping service. In addition, the interconnection of the Draper and Hefner water service areas will create system-wide reliability. Water conservation will play a pivotal role in meeting the water demand projection through 2060.

3.5 Water treatment plants

Oklahoma City uses three water treatments plants which have a combined capacity to treat and deliver 253 MGD of potable water per day with plans to increase within the next five years. From FY 2004 to 2016, the city pumped an average of 97 MGD with a

peak day delivery of 203 MGD in August 2012. Treated water is distributed throughout the water system through 3,650 miles of pipe ranging in size from 2-inch to 72-inch diameters. Service is provided to all major developed areas within the City and to water users of most adjacent cities. Twelve elevated and ground tanks provide a total storage in the distribution system of 23.4 million gallons (MG). Sixteen remotely controlled booster pumping stations, via supervisory control and data acquisition (SCADA) system, and three fire pump stations, maintain line pressure for service to outlying areas.

Hefner water treatment plant

The Hefner water treatment plant (Figure 12) is located in northwest Oklahoma City, adjacent to the north side of Hefner Reservoir. It was originally constructed in 1947 and was expanded in 1955. Chlorine facilities were added in the early 1970s, a 5 MG clearwell was added in 1976, upgraded in 1984, expanded in the 1990s, and a pre-ozonation system was added. Recent improvements concluded in 2015 expanded the majority of the water treatment processes to a capacity of 100 MGD but the plant is still currently rated at 75 MGD. Additional improvements, including a new sludge handling system, updates to raw water feed, and chemical systems, are under construction and will allow the plant to treat and be re-rated to 100 MGD. Additional improvements are planned within the currently approved CIP from 2017 to 2021 including ozone and lime system upgrades. The Hefner treatment plant uses the Hefner Reservoir as a raw water source and generally serves the north and northwest portions of Oklahoma City. Water in the Hefner Reservoir originates from the North Canadian River and is generally hard and high in organic matter.

Water is treated to Oklahoma Department of Environmental Quality (ODEQ) drinking water standards through a process involving pre-ozonation, coagulant and lime addition, flocculation, clarification, recarbonation, fluoridation, phosphate addition, filtration, chloramination, clearwell storage, and high-service pumping. The Hefner water treatment plant includes clearwells with 20 MG storage capacity and a 0.5 MG surge tower. Once treated, water is pumped into the citywide distribution system which serves the north and northwestern side of Oklahoma City.

Overholser water treatment plant

The Overholser water treatment plant is located in Central Oklahoma City and treats water from the Overholser Reservoir. It is the oldest plant in the City, having been originally constructed in the 1920s, and has undergone many upgrades to maintain reliable operation in accordance with ODEQ regulations. Improvements are in construction including upgrades to the high service pump station and reliability developments. Overholser receives water from the North Canadian River via the Overholser Reservoir and the gravity 54-inch pipeline that runs approximately 8 miles to the water treatment plant.

Water is treated through a process involving potassium permanganate addition into the raw water conduit, chlorine addition, coagulant, ammonia, and lime addition to the rapid mix tanks, flocculation,

Figure 12: Hefner water treatment plant

clarification, re-chlorination, final sedimentation, filter aid polymer addition, filtration, fluoridation, phosphate addition, chloramination, clearwell storage, and high-service pumping. The Overholser water treatment plant includes clearwells with 13 MG storage capacity. Once treated, water is pumped into the citywide distribution system serving the downtown area of Oklahoma City. The Overholser water treatment plant has an annual average pumpage of 2.3 billion gallons, though it is primarily used only during peak demand in the summer months. It is rated to treat 28 MGD.

Draper water treatment plant

The Draper water treatment plant is located in Southeast Oklahoma City and treats water from the Stanley Draper Reservoir or directly from the Atoka pipeline with water from the Atoka and McGee Creek Reservoirs in southeastern Oklahoma. It is the newest water treatment plant, originally constructed in 1964 and expanded in 1973 and 1979. Improvements are planned for 2017 to 2021 including low lift station and intake upgrades, new clearwells and piping, and other improvements necessary to expand treatment to 200 MGD. Water is pumped to the Stanley Draper Reservoir using six pump stations and since water originates from a different source, is much softer and does not require treatment for hardness removal.

The treatment process begins with low-lift pumping from the Stanley Draper Reservoir, pretreatment in a pre-treatment basin, additional chemical feed to rapid mix tanks, flocculation, clarification, sedimentation, filtration, fluoride addition, clearwell storage, and high-service pumping. The Draper water treatment plant includes clearwells with 15 MG storage capacity. Once treated, water is pumped into the citywide distribution system serving the southern, western, and eastern portion of Oklahoma City. The Draper water treatment plant has an annual average pumpage of 18 billion gallons. It is rated to treat 150 MGD.

3.6 Treated wastewater use

Utilizing treated wastewater for irrigation and commercial purposes preserves drinking water resources for human consumption. The City of Oklahoma City began selling treated wastewater to large industrial water users including OG&E Redbud in 2002, OG&E McClain in 2000, and to the Gaillardia Country Club in 1996. Currently, the maximum contracted treated wastewater volume is 11 MGD for Redbud, 5 MGD to McLane, and 0.75 MGD to Gaillardia Country Club and the current volume sold is about 2.2 billion gallons per year.

All four major wastewater treatment facilities in Oklahoma City can produce and deliver treated wastewater to industrial consumers, reducing the demand on other water supplies. The North Canadian, South Canadian, and Deer Creek wastewater treatment plants are currently selling treated wastewater and the Chisholm Creek wastewater treatment plant would be a viable source of treated wastewater for a future user. Treated wastewater volume sold accounts for approximately 12 percent of the total wastewater treated and fluctuates based on season and demand. Additionally, a Treated Wastewater Option and Sale Agreement with the City of Oklahoma City and Devon Energy Production Company, L.P. for the purchase of a maximum of 25 million gallons per day of the treated wastewater from Deer Creek and/or Chisholm Creek facility, as available during the purchase term, was approved by City Council in May of 2017.

Figure 13: Draper water treatment plant

POPULATION PROFILE

4.1 Population projections and future demand

The 2003 water master plan projected population out to 2051 using growth rates for low (0.8 percent), expected (1.3 percent), and high (1.8 percent) scenarios. The 2009 Regional Raw Water Supply Study for Central Oklahoma utilized the expected growth rate of 1.3 percent to extend the population projections out to the year 2060. Table 1 shows the projected population for Oklahoma City to 2060 as used to determine the projected water demand. Since 2000, Oklahoma City's population has grown at 1.45 percent exceeding the expected growth rate of 1.3 percent. The combined statistical area which includes data for Canadian, Cleveland, Grady, Lincoln, Logan, McClain, Oklahoma, Pottawatomie, and Oklahoma City has increased at a higher rate with a combined growth rate of 1.9 percent since 2000.

In the 2009 Regional Raw Water Supply Study for Central Oklahoma, population projections from the 2003 water master plan were expanded out until 2060 and demands were calculated based on a per capita usage of 180 gallons per day, which includes all uses of water. Demands from base cities and other participants were provided by those entities. Table 2 shows the projected water demand through 2060 for Oklahoma City, base cities, and other participants within the 2009 Regional Raw Water Supply Study for Central Oklahoma.

Table 1: Oklahoma City population projection

Year	Oklahoma City Population Projection*
2020	648,599
2025	691,868
2030	738,024
2035	787,259
2040	839,779
2045	895,802
2050	955,563
2055	1,019,311
2060	1,087,311

Table 2: Projected water demands through 2060

Projected Year	Oklahoma City	Base Cities	Additional from COWRA**	Participants	Combined	Combined
	----------acre-feet/year----------					-----MGD---
2020	132,164	6,432	0	49,466	188,062	168
2025	140,994	7,026	0	57,575	205,595	184
2030	150,414	7,659	0	65,450	223,523	200
2035	160,464	8,430	2,576	71,062	242,533	217
2040	171,186	9,379	5,713	76,651	262,929	235
2045	182,623	10,544	8,737	82,118	284,021	254
2050	194,826	11,874	11,762	87,909	306,371	274
2055	207,028	13,206	14,898	94,182	329,313	294
2060	219,230	14,537	17,922	101,339	353,029	315

*Data from 2009 Regional Raw Water Supply Study for Central Oklahoma, March 2009

**Central Oklahoma Water Resources Authority

4.2 Customer water use profile

Evaluating customer water use data is critical to understand the customer profile for complete water conservation planning and implementation of effective water efficiency measures. Water-use indicators segment the customer base to guide conservation program selection and provide a consistent method to track and measure water use changes that occur due to program strategies. Several water use indicators for conservation were calculated[1] and are discussed in this section. Measured water use data for inside city customer categories for 2010 to 2016 is shown in Table 3 in thousand gallons.

In FY 2016, inside city single-family customers made up about 89 percent of all accounts, and used about 52 percent while commercial customers made up about 8 percent of accounts and used about 32 percent. Multi-family customers used about 12 percent of the total water for inside city accounts and make up about 1 percent of accounts as shown in Figure 14 and Figure 15.

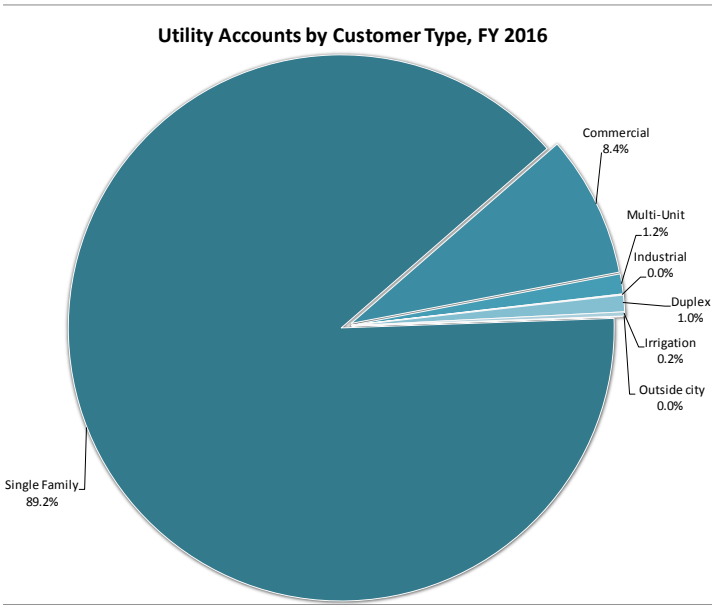


Figure 14: Utility accounts by customer type

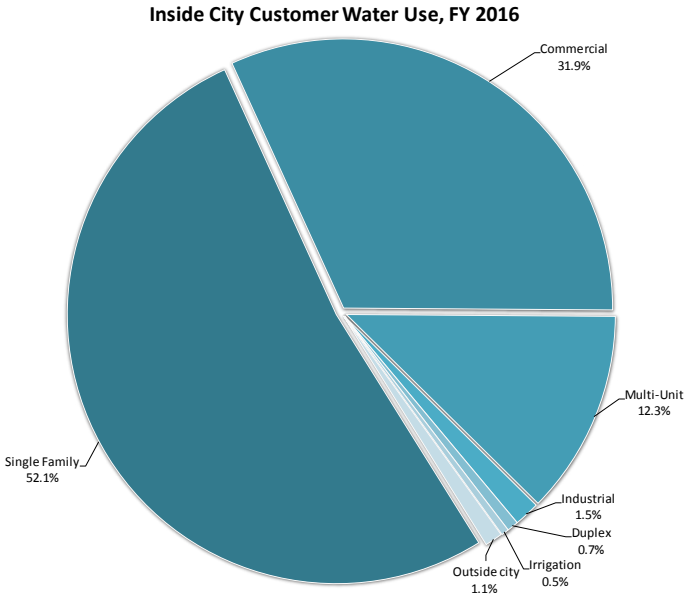


Figure 15: Customer water use by category

Average water use

Customer average water use is a typical metric used for conservation planning, reported as gallons per capita per day (gpcd). This metric has limitations since it is based on population served. The population data is based on the U.S. Census which counts residents nationwide every 10 years and relies on projected population to fill in the gaps. Due to these limitations, a more reliable water use number is gallons per account per day (gpad). This number is calculated using monthly account counts and water use data from the corresponding month. The gpad from 2010 to 2016 is shown in Table 4. Since

Table 3: Water use for inside city customer categories

Year	Single-Family	Duplex	Multi-Unit	Commercial	Industrial	Irrigation
	----------Thousand gallons----------					
2010	14,086,706	201,340	3,421,810	8,651,913	455,675	37,011
2011	16,185,748	208,541	3,512,896	9,676,770	492,568	87,175
2012	15,059,787	191,963	3,341,757	8,951,293	420,420	131,442
2013	12,659,231	177,828	3,170,097	7,669,926	395,641	99,038
2014	13,428,340	180,261	3,261,703	8,185,755	388,190	137,132
2015	12,830,170	166,131	3,176,188	8,252,256	349,264	143,524
2016	13,946,173	165,756	3,250,937	8,806,593	382,645	216,865

1 Vickers, A., M.W. Tiger and S. Eskaf. 2013. A Guide to Water-Use Indicators for Conservation and Financial Planning. American Water Works Association.

Table 4: Weather-normalized gallons per account per day for inside city customer categories

Year	Single-Family	Duplex	Multi-Unit	Commercial	Industrial	Irrigation
	---------- Gallons per account per day, weather-normalized ----------					
2010	240	285	4334	1490	14778	2332
2011	260	283	4193	1580	15222	2388
2012	235	255	3939	1434	12905	1796
2013	215	259	4089	1344	13305	1267
2014	212	251	3899	1347	12157	1286
2015	207	241	3906	1406	11576	1077
2016	203	218	3554	1357	11480	1212
Average	225	256	3987	1423	13060	1623
Max	260	285	4334	1580	15222	2388
Min	203	218	3554	1344	11480	1077

water use is impacted by precipitation and temperature, a weather-normalized value was calculated using the methods outlined by the AWWA *Water Conservation Metrics Guidance Report* (2010)[2]. The two key values of precipitation and temperature are used in modeling the effects of weather. The calculated monthly gallons per account per day for inside city residential customers from 2010 to 2016 is shown in Figure 19. Peak demand after adoption of the demand management program in 2013 was reduced for inside city residential customers.

Average water use provides one description for all inside city single-family households[1]. A percentile of customer average water use further characterizes high water users from low water users that may already be using water efficiently. Individual customer average water use was ranked relative to other customers. After determining the rank of individual average use, customers were grouped into percentiles based on their rank. The customers in the first percentile shown in Table 5 represent the group of single-family customers with the highest demand. The top ten percentile of water users may reflect discretionary water use where water use efficiency programs would provide the greatest return. Average account outdoor water demand was calculated using February water usage as a baseline.

Peaking ratio

The peaking ratio compares the highest water demand to the calculated baseline demand. As an example, a

Table 5: Percentile of single-family residential customer average use

Single-family customers	Number of active accounts	Average account demand	Average indoor demand	Average outdoor demand	Estimated outdoor water use
		----------Gallons per day ----------			%
All accounts	226,586	168	121	47	28%
Top 1% accounts (1st)	2,266	1,300	570	730	56%
Top 10% accounts (10th)	22,659	579	302	277	48%
Top 25% accounts (25th)	56,647	393	242	151	38%
Top 50% accounts (50th)	113,293	279	192	87	31%
Bottom 50% accounts	113,293	57	49	8	14%

2 Dziegielewski, B. and Kiefer, J.C. 2010. Water Conservation Measurement Metrics Guidance Report. The American Water Works Association.

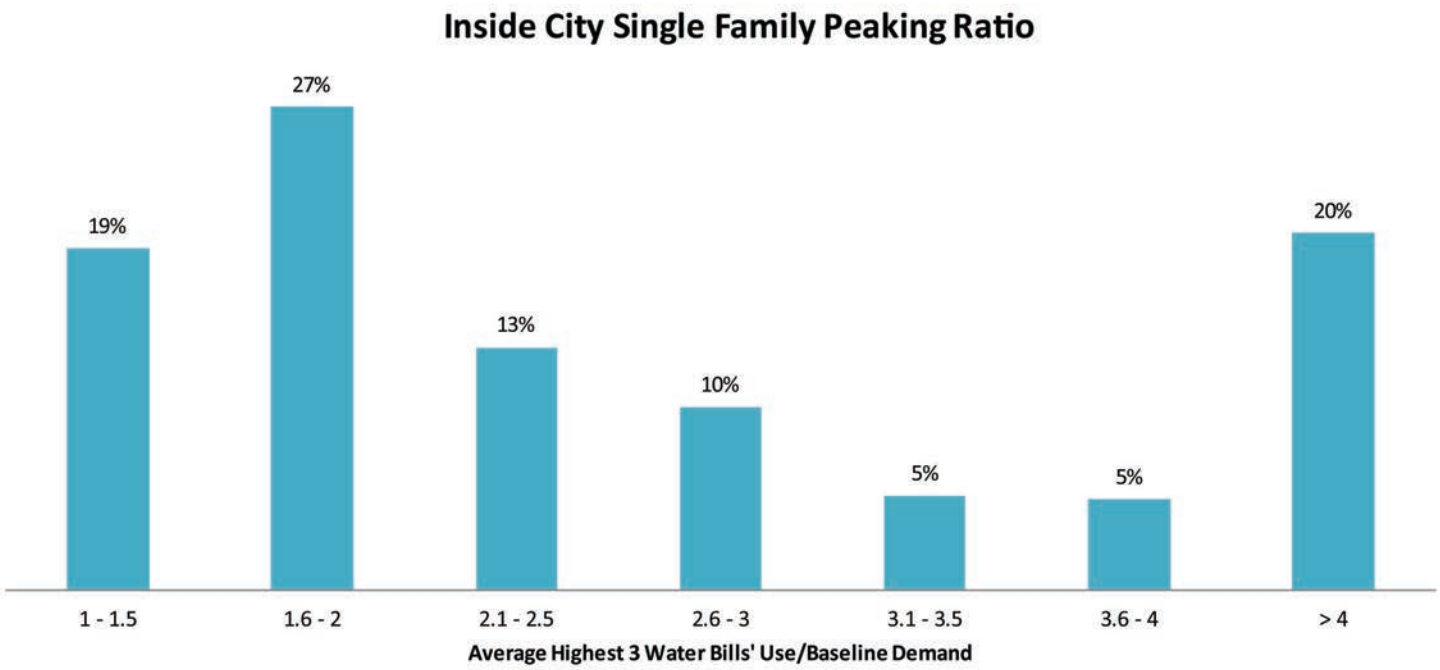


Figure 16: Inside city single-family peaking ratio for 2016

peaking ratio of 4.0 reveals a customer that used four times as much water on their average highest three water bills compared to their baseline demand. It reveals customers with discretionary water use and helps target conservation messaging.

The indicator does not take into account customers that may be away from their home for parts of the year. In Oklahoma City, 20 percent of single-family accounts use more than 4 times as much water for three months out of the year than during their baseline year while 27 percent used between 1.6 and 2.0 times their baseline usage, as shown in Figure 16.

Winter period average

The winter period average (WPA) is the average of water bills for December, January, and February. It is an indication of indoor water usage. The calculated WPA for inside city single-family residential accounts from 2011 to 2017 is shown in Table 6. Although WPA does not take weather into account, monitoring the raw data provides some insight into customer water use behavior.

Table 6: Winter period average, fiscal years 2011 to 2017

Fiscal Year	WPA in thousand gallons
2011	6.28
2012	5.04
2013	5.45
2014	5.20
2015	4.70
2016	4.54
2017	4.53

Customer use profile

The customer use profile accounts for the peaking ratio and baseline water use to further define customer water use. Figure 17 identifies if a customer is a high or low water user all year or only during part of the year.

Comparing the four groups in Oklahoma City, the low baseline, high peakers make up approximately 33 percent of the single-family accounts or 63,312 households, showing they most likely have discretionary water use, irrigation, or a pool. High baseline, high peakers show customers that at least double their water use during some months of the year. Low baseline, low peakers are typically efficient water users year round or have a small or no yard. High baseline, low peakers may have a large family or live in a large home.

Treated water demand

In FY 2016, OCWUT billed 29 billion gallons of water, coming from the City's three water treatment plants. The average annual daily amount of water pumped in FY 2016 was 92.3 MG. The total water pumpage,

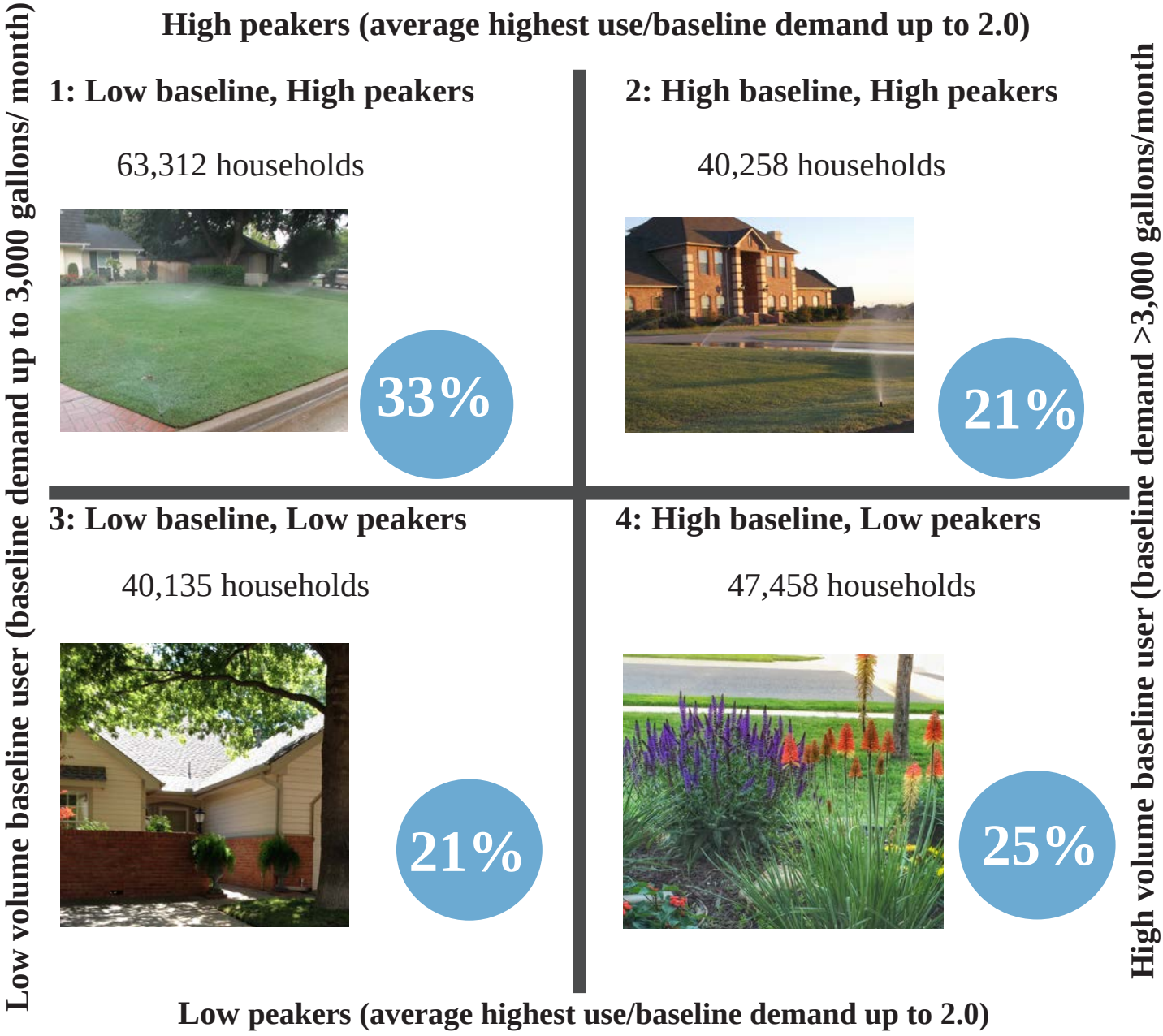


Figure 17: Inside single-family household customer water use profile for 2016

average day demand, and peak day demand for FYs 2004 through 2016 is shown in Figure 18.

The highest daily demand on record was in August 2012 with a peak demand of 203 MG. Oklahoma City covers 621 square miles and has an extensive water distribution network which transports treated water from water treatment plants to both wholesale and retail customers throughout Oklahoma City.

Separating treated inside city water demand by customer category, single-family customers represent the largest water users. Of the 29 billion gallons consumed in 2016 FY, single-family customers used approximately 14 billion gallons, commercial customers used about 9 billion gallons, and combined, multi-family and duplex customer water use accounted for over 3 billion gallons. The wholesale category represents outside city accounts which totals 3 billion gallons. In 2016, there were 208,670 active accounts. In FY 2016 the total water pumped was 33,695 MG.

The permanent odd/even watering schedules have successfully reduced peak demand as shown in Figure 19. The water conservation measures apply to all customer categories and a similar trend is apparent for non-residential accounts.

Seasonal water use

Water use peaks in the summertime due to irrigation and outdoor water use (Figure 19). Water use typically peaks in July or August and is lowest in December, January, and February. The peak water usage has been reduced due to the community-wide effort to follow the water conservation measures that went into place in April 2013, with odd/even watering in effect year round.

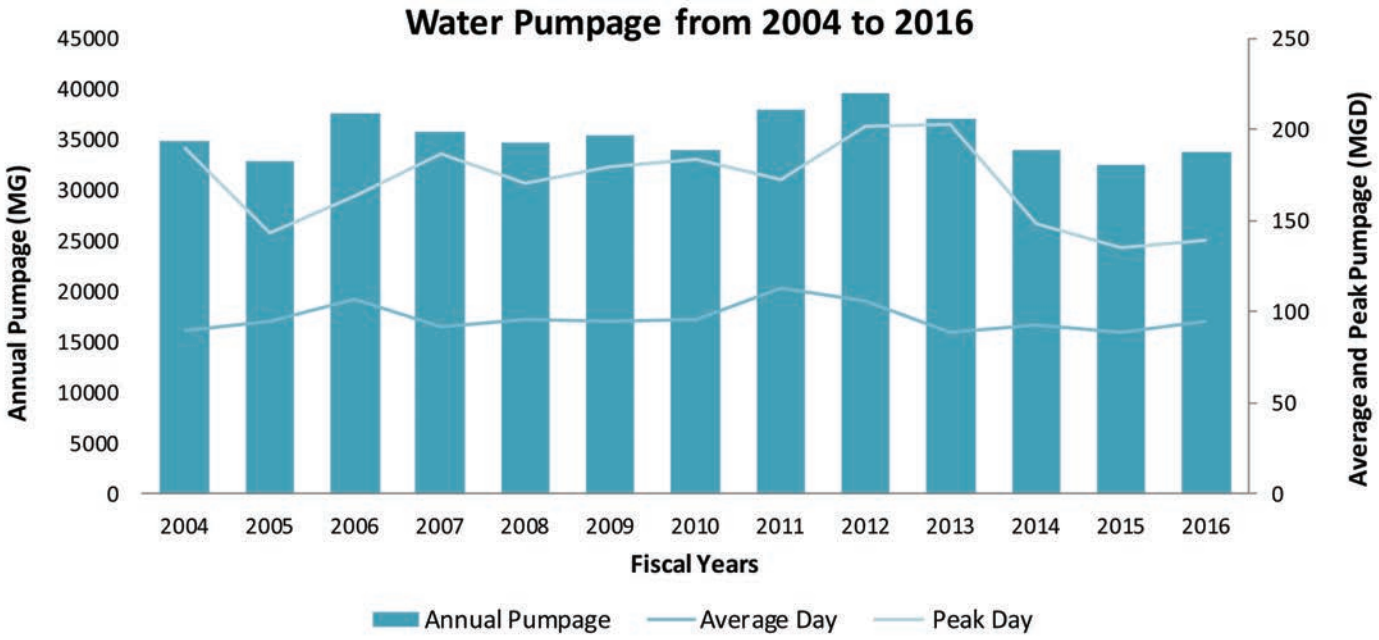


Figure 18: Water pumpage history from fiscal years 2001 to 2016

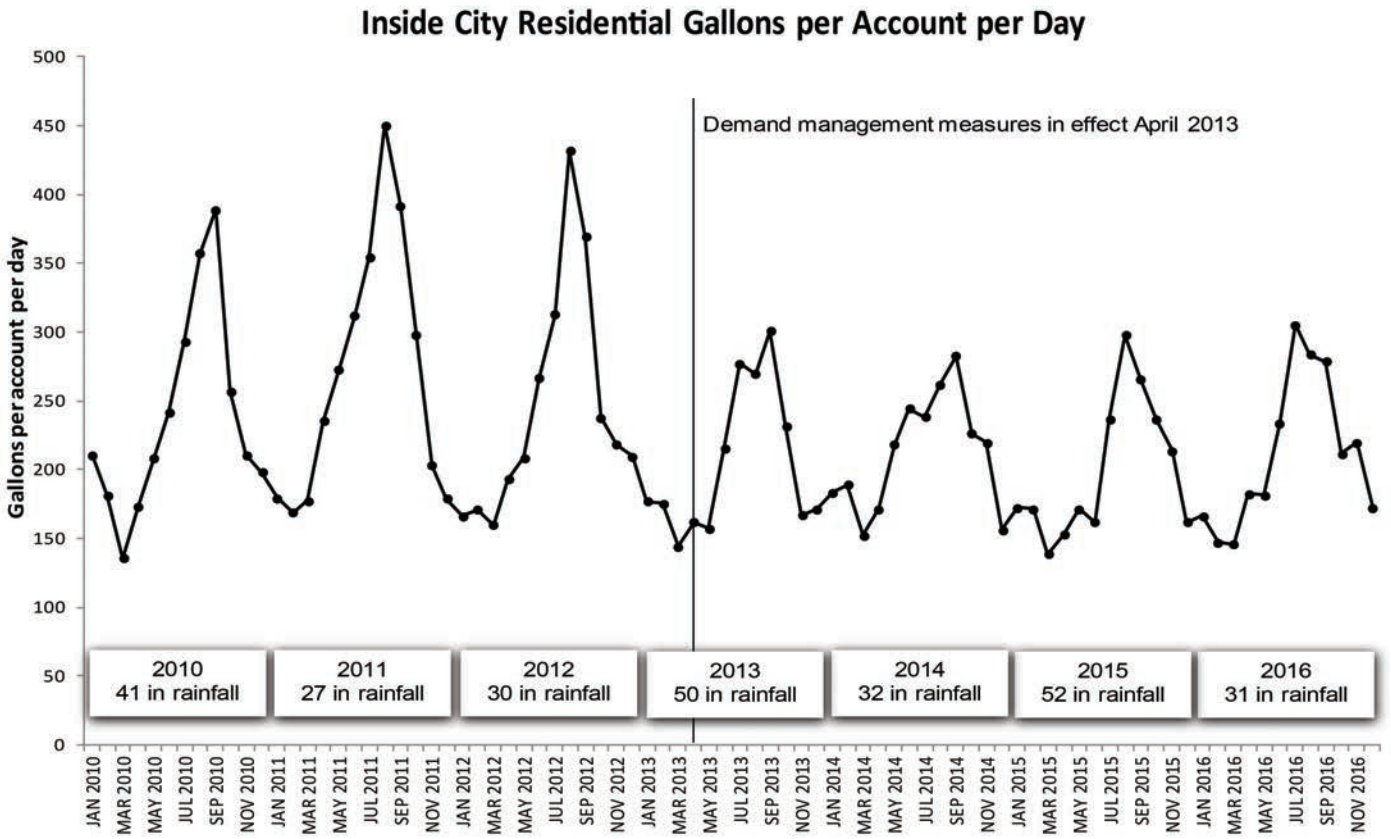


Figure 19: Inside city residential monthly gallons per account per day from 2010 to 2016

CURRENT PROGRAMS

Communities in Central Oklahoma are becoming more dependent on Oklahoma City for water due to limiting factors associated with ground water supplies and growth. These growing demands have created a burden on the water system by increasing peak demands. Therefore, Oklahoma City migrated to water conservation oriented rate structures for wholesale service to encourage these communities to implement demand management practices too.

Oklahoma City has created the Squeeze Every Drop website as a resource for central Oklahoma (http://www.SqueezeEveryDrop.com). It includes water conservation information which is designed for all cities that purchase water to support area-wide efforts for efficient use of water resources. The Oklahoma City Utilities Department is also an active WaterSense® Partner. This beneficial partnership provides free, useful resources and information for staff to share with the Oklahoma City community.

Effective and comprehensive water conservation planning will create positive community change while reducing water waste in Oklahoma City. The current program action plan includes balanced areas of education and outreach, City-led initiatives and partnerships, and reasonable enforcement efforts, which are described in this section.

5.1 Water conservation staff

The City of Oklahoma City has two current positions with the responsibility to develop, implement, and monitor water conservation programs and activities. The Water Conservation Specialist is responsible for developing and managing the department's water conservation program which involves public education and outreach activities, planning, and enforcement. The recent adopted budget included the addition of two conservation support positions.

The primary purpose of the Water Conservation Coordinator position is to provide programs that educate the public about water conservation practices and principles, and to supervise staff responsible for communicating municipal water conservation rules and regulations to the public. The water conservation team can be contacted by emailing: WaterConservation@OKC.gov.

5.2 Demand management measures

In April 2013, City Council adopted a Joint Resolution with OCWUT to establish Progressive Water Conservation Measures; and authorize the City Manager or designee to monitor the water system, implement appropriate water conservation measures as conditions warrant, such as drought, water shortages, pressure and delivery problem(s), or use of water that adversely affects or may adversely affect the public health, safety, or welfare (Council Agenda Item No. VIII.H.). The measures progress to manage demand to ensure adequate water supply through drought conditions and low reservoir volumes serve as use reduction triggers. The five (5) stage program starts with odd/even watering and progress to a ban on outdoor watering depending on the combined accessible reservoir capacity. Under the Restrictions on Use of Water Ordinance (57-2) and Joint Resolution, the following outdoor water restrictions are permanently in effect. A summary of the water conservation stages is shown in Figure 20.

Stage 1: Mandatory Odd/Even Lawn Watering

Mandatory odd/even lawn watering is in place year-round. All lawn watering systems using sprinkler devices (hand watering with a hose is permitted any day) shall be limited to odd/even lawn watering based upon the location address. Odd number addresses water lawns and landscaping on odd number calendar days. Even number addresses water lawns and landscaping on even number calendar days. This applies to all customer classifications: single family residences, duplexes,

triplexes, homeowner association general properties, commercial, industrial, government, etc.

Stage 2: Fixed Two (2) Day Lawn Watering

In the event lake capacities are 50 percent or less full, mandatory fixed two (2) day per week lawn watering is implemented. In addition to all voluntary indoor water conservation efforts, outdoor lawn watering systems using sprinkler devices (hand watering with a hose is permitted any day) shall be limited to fixed two (2) day per week lawn watering. Odd number single family residences water lawns and landscaping on Saturdays and Wednesdays. Even number single family residences water lawns and landscaping on Sundays and Thursdays. All other customer classifications such as: duplexes, triplexes, homeowner association general properties, commercial, industrial, government, etc.; water lawns and landscaping on Tuesdays and Fridays.

Stage 3: Fixed One (l) Day Lawn Watering

In the event lake capacities are 45 percent or less full, mandatory fixed one (1) day per week lawn watering is implemented. In addition to all voluntary indoor water conservation efforts, outdoor lawn watering systems using sprinkler devices (hand watering with a hose is permitted any day) shall be limited to fixed one (1) day per week lawn watering. Single family residences with addresses ending in 1 or 3, shall water lawns and landscaping on Saturdays. Single family residences with addresses ending in 5, 7, or 9, shall water lawns and landscaping on Wednesdays. Single family residences with addresses ending in 0 or 2, shall water lawns and landscaping on Sundays. Single family residences with addresses ending in 4, 6, or 8, shall water on Thursdays. Duplexes, triplexes, and homeowner association general properties shall water on Tuesdays. Commercial, industrial, government, etc.; shall water lawns and landscaping on Fridays.

Stage 4: Hand Watering Garden & Flower Beds Only, Commercial Car Washes with Water Recycling Operations Only

In the event lake capacities are 40 percent or less full, only hand watering of garden and flower beds is permitted. In addition to voluntary indoor water conservation efforts, individual water customers at all service locations, regardless of street address, may continue to hand water garden and flower beds only. This applies to all customer classifications: single family residences, duplexes, triplexes, homeowner association general properties, golf courses, commercial, industrial, government, etc., except commercial car washes. Only commercial car washes that utilize water recycling systems will be permitted to operate.

Stage 5: Ban All Outdoor Watering

In the event lake capacities are 35 percent or less full, all outdoor watering is banned. Individual water

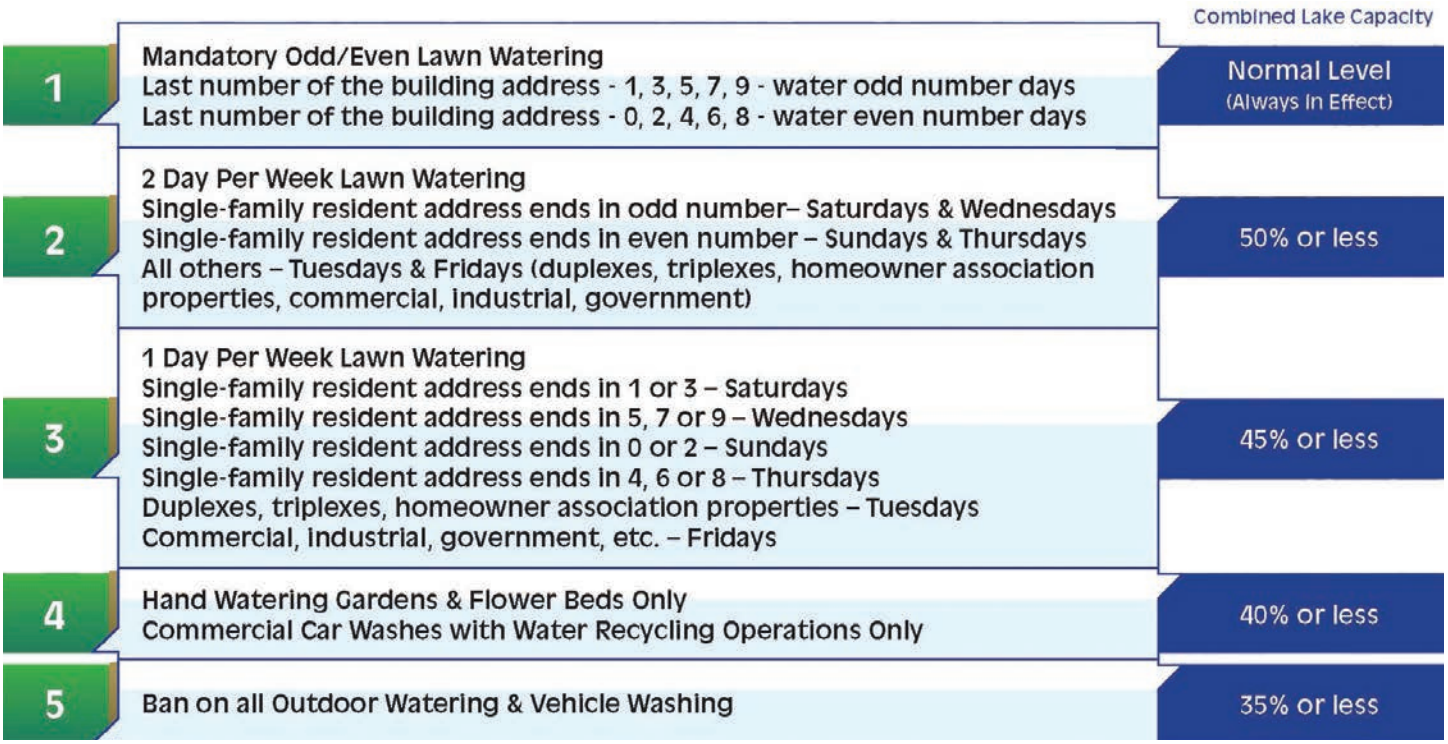


Figure 20: Oklahoma City demand management program stages

customers at all service locations, regardless of street address, are prohibited from all outdoor watering and/or washing of vehicles. This applies to all customer classifications: single family residences, duplexes, triplexes, homeowner association general properties, golf courses, commercial, industrial, government, etc.

Variance program

Property owners may apply for a variance under circumstances when the water conservation watering schedules cannot reasonably be followed. A variance may be granted for new landscape installation or for in-ground systems that are determined to make compliance physically impossible. Variance application forms can be found on the Squeeze Every Drop website. The use of soaker hoses and drip irrigation is encouraged and is not subject to the mandatory watering schedules until Stage 5 is implemented. The Utilities Department is currently evaluating program changes to its self-service billing application to allow customers to request variances online.

Enforcement

The measures are enforced year round and violations may result in a fine. Warnings are issued for a first violation and information on landscape irrigation requirements and the water conservation program are provided to customers. Listed fines do not include additional court costs.

- First violation: Warning issued
- Second violation: $119 fine
- Third violation: $269 fine
- Fourth violation: $519 fine
- Fifth violation: $750 bond and up to $1,200 fine for those who continue to violate the program

Studies[3] have found that voluntary programs actually increased net consumption while mandatory conservation programs decrease consumption by 13 to 53 percent. The Utilities Department promoted the above-mentioned water conservation schedules through billing inserts, websites, print and media outreach, and press releases, since the measures are only successful if the public is adequately aware of the program. The range of water savings from watering measures are attributed to program strategies and stringency limits on watering frequency, information dissemination, and enforcement.

Wholesale water reduction targets

Wholesale water customers are expected to reduce water use with the implementation of each Oklahoma City water conservation stage as outlined in Table 7. The target efficiency goals were calculated to be equivalent to the anticipated water reduction for Oklahoma City retail customers.

Table 7: Wholesale customer reduction targets

Demand Management Stage*	Wholesale customer reduction target
1	Normal Operation
2	15%
3	20%
4	25%
5	30%

*Corresponds to the stages outlined in Figure 20.

5.3 Conservation pricing

Indoor water usage is relatively inelastic compared to outdoor water usage, most likely because indoor water use is associated with necessity rather than recreation and landscaping. Customers typically decrease outdoor and non-residential water use as prices rise. Water price rate increases can be used as an appropriate pricing signal for water consumers to conserve water. A survey conducted by Cole Hargrave Snodgrass & Associates of 600 OKC Utilities customers demonstrated that 57 percent of respondents agreed that the price of water restricts users' landscape irrigation.

In 2003, a survey of water rate structures in the southwest United States showed that per capita water use is usually lower in cities that utilized inclining block rates. OCWUT hired a cost-of-service study consultant to review pricing options. The study recommended conservation-oriented inclining tier rate structures that were approved in September 2014 by Oklahoma City Council. The 3-year approved rate plan more appropriately reflects the cost to provide water and wastewater services. The conservation-oriented rates are available by visiting http://www.OKC.gov. The new rate structure was put in place to encourage water

3 Kenney, D.S., Klein, R.A., and Clark, M.P. 2004. Use and Effectiveness of Municipal Water Restrictions During Drought in Colorado. Journal of the American Water Resources Association. 40(1):77-87.

conservation and to fairly recover cost of service, which equitably recovers costs based on usage patterns and peaking characteristics. The Utilities Department operates on ratepayer revenue only, no property, or sales tax funds are used to provide water and wastewater services. The existing water conservation programs are supplemented by informational resources to provide residents with opportunities to adopt water saving practices which reduce water usage and potentially avoid the second tier.

OCWUT and the City Council have each tasked the Utilities Department and the cost-of-service consultant with developing further water conservation-oriented rate blocks for consideration to additionally stimulate residential and non-residential water conserving behaviors.

Residential rates

OCWUT utilizes the recommended practices of the AWWA M1 manual for water rates, fees, and charges. In accordance with the AWWA's M1 manual, the residential blocks sizes were established by taking the bill distribution of the water utility and customers' usage patterns. Currently, the first tier rate of consumption is calculated for water usage up to 10,000 gallons and the second tier rate is calculated for water usage over 10,000 gallons. It is anticipated that staff and the cost-of-service consultant will be presenting a three or four tier inclining block fee structure for consideration in the fall 2017. This multi-tier inclining block fee structure is being designed to identify and charge for water uses based on their actual financial burden on the Utility in order to encourage customers to conform to the City's water conservation and demand management plan goals.

Non-residential rates (commercial, industrial, multi-family)

The non-residential rate tiers were established by using individual customer's average winter water consumption (AWC), which is calculated as an average of usage during December, January, and February. These winter months typically provide an indication of indoor water usage, since irrigation is not common in the winter season. The first tier for non-residential customers is the customer's AWC and the second tier is the customer's water usage over AWC. Utilities Department management has tasked the cost-of-service consultant with formulating a large manufacturing class fee structure that recovers the costs of providing services while not discouraging such uses. This fee structure would only be available for water directly used in the product manufacturing process, excluding landscape irrigation.

Wholesale rates

The cost-of-service study recommends fees and charges for wholesale customers designed to recover base year-round and peak expenses. Those wholesale customers implementing a stronger water conservation practices in their own communities will have a lower per 1000 gallon cost than those choosing not to support conservation. It is anticipated that Oklahoma City will need to become more involved in assisting its wholesale customers in designing and implementing their own water conservation plans. This effort will require staff legal, financial, engineering, and water conservation expertise.

5.4 Outreach and education efforts

Outreach and education are fundamental for any water conservation program to generate awareness and provide guidance to customers to realize water savings. In January of 2013, OCWUT partnered with the Oklahoma Cooperative Extension Service and Oklahoma State University Department of Horticulture and Landscape Architecture (OSU) to further promote outdoor water conservation.

Engaging the public on the importance of water conservation issues is vital for the realization of any water conservation program. Public support is crucial for water conservation program acceptance and success. Typically, public awareness campaigns are expected to reduce demand by 2 to 5 percent, but the conservation effects due to publicity only exist as long as the publicity continues. Therefore, continued education and awareness campaigns are needed for long-term success.

Some studies have found that informational education alone does not facilitate behavioral change and a community-based social marketing strategy is more effective to encourage outside water use efficiency[4].

4 McKenzie-Mohr, D. 2000. Promoting Sustainable Behavior: An Introduction to Community-Based Social Marketing. Journal of Social Issues. 56 (3): 543-554.

Community-based social marketing is based on the principle that behavior change campaigns are most effective when they are delivered at the community level using personal contact. A survey of 600 OKC water utilities customers found that while individuals have some knowledge of how to save water, an eagerness for water saving education exists.

Community awareness and participation is a necessary component for the continual success of Oklahoma City's water conservation strategy. Water conservation education can be approached from multiple directions and will be incorporated through partnerships, education, and outreach.

A survey of 600 water utility customers in Oklahoma City showed that 91 percent want to help long-term water supply security. Seventy percent believe it is likely or highly likely of a water shortage over the next five years, which should be used as a marketing motivator. Many homeowners are interested in saving water, but may be unaware of water saving practices. Successful campaigns assist individuals as they move from ignorance to awareness to interest to a desire to adopt a behavior[5]. This movement eventually leads to water reduction actions by the customer.

Currently, the Oklahoma City Utilities Department is supporting education outreach through the OSU partnership, demonstration garden partnership, sprinkler checkups, landscape award program, SqueezeEveryDrop.com website, a series of "how-to" videos, eNewsletter, and outreach events. Encouraging community members will cultivate and promote positive motives for change. Continuing education programs through partnerships with local restaurants and businesses will further extend water conservation awareness. A public effort by leaders in the business community will drive change. A restaurant program has been initiated along with a sprinkler checkup program for homeowner and neighborhood associations (Figure 21). Additional steps will be taken to support and provide resources for property managers, multi-family, commercial development, and office parks.

Water conservation staff will continue to develop education and outreach programs and involve community partners to drive change in their areas and thereby extending the reach of the conservation program.

As a part of the partnership, OSU created four water conservation demonstration areas available for residents to visit at Oklahoma State University- Oklahoma City Campus (OSU-OKC), the Myriad Botanical Garden, The Oklahoma City Zoo and Botanical Garden, and Bluff Creek Park. Upon completion of construction, OCWUT has entered into Memorandum of Understandings with the Myriad Botanical Garden, the Parks and Recreation Department, and the Oklahoma City Zoo for ongoing maintenance and educational programming.

Hands-on training and the ability to visualize water conservation concepts and practices is critical for Oklahoma City Utility customers. This will increase their chances to change behavior and to adopt and implement water conservation practices. The seven principles of a water-wise landscape, or xeriscape, provide simple ways to reduce outdoor water use while maintaining an attractive lawn and garden. The principles include:

1. Planning and design
2. Soil improvement
3. Turf management
4. Plant selection and placement
5. Mulch cover
6. Efficient irrigation
7. Maintenance

Figure 21: Broken sprinkler head found at a neighborhood association checkup

5 Howarth, D. and S. Butler. 2004. Communicating Water Conservation: How Can the Public be Engaged? 3rd Editions, IWA Publishing, 4: 33-44. 2001.

Figure 22: Myriad Botanical Garden signage program

Figure 23: OSU-OKC Conservation Garden area


Figure 24: OKC Zoo and Botanical Gardens area

The Myriad Botanical Gardens

The Myriad Botanical Gardens include a signage program in the southeast geometric garden beds, 301 West Reno Avenue. The garden staff holds free Walking Tours that highlight plants for water conservation the last Saturday of each month or residents can pick up a handout in their south lobby for a self-guided tour. An example sign is shown in Figure 22.

Additionally, the Myriad Botanical Gardens is introducing new conservation garden areas, including efficient irrigation and an annual Irrigation and Water Conservation School.

Oklahoma State University-Oklahoma City

The OSU-OKC garden located south east of the John E. Kirkpatrick Horticulture Center completed and formally opened in May 2014. The garden is open to the public daily during daylight hours. Over 15 companies supplied materials and labor at-cost or donated. The garden will continue to be utilized for workshops, classes, and for teaching purposes, Figure 23.

The Oklahoma City Zoo and Botanical Gardens

The water conservation garden is located on the southwest side of the pachyderm building. The garden displays drought tolerant plants and the principles of a water conservation landscape. Zoo visitors can read about water saving ideas and all plants are labeled. The OKC Zoo water conservation demonstration garden site is shown in Figure 24.

In 2017, Oklahoma City Zoo staff provided monthly tours featuring the water conservation demonstration garden to the public. The tours were advertised by both the OKC Zoo and Botanical Garden and through the Utilities Department.

Bluff Creek Park

Bluff Creek Park (Figure 25) is a joint effort between the Oklahoma City Parks and Recreation Department, OSU, and the Oklahoma City Utilities Department. The entrance to Bluff Creek Park is on North Meridian Avenue off of West Hefner road. The park has walking and biking trails and is now home to a water conservation garden. The garden features many Oklahoma native plants and illustrates to homeowners that they can have an attractive landscape that also saves water.

Figure 25: Bluff Creek Water Conservation Garden

Figure 26: 2016 H2Outstanding Landscape winner

Figure 27: Staff marking sprinkler heads for a sprinkler checkup

H2Outstanding landscape award program

In 2015, water conservation staff created an H2Outstanding landscape award program to recognize individual homeowners taking steps to increase water efficiency in the landscape. The top three landscapes were awarded gift cards to their choice of a local nursery. Figure 26 shows the 2016 winner.

Homeowner and neighborhood association sprinkler checkup program

During the summer of 2016, water conservation staff began a new program conducting sprinkler checkups for homeowner and neighborhood association common areas (Figure 27). Oklahoma City has 450 registered neighborhoods so there is a potential for an ongoing program. The team met with neighborhood leaders and visually checked each irrigation zone, flagged issues, and reported findings. A detailed report was provided and revealed system deficiencies and proposed solutions for improved water efficiency.

Early results from a follow-up survey indicate many respondents plan to make schedule changes or fix some or all issues. Generally, anticipated water savings, assuming changes are implemented, range from 20 to 50 percent based on existing system conditions.

The program has received positive feedback from participants who were pleased with the process and report. Overall, survey respondents noted the sprinkler checkup was worthwhile and would recommend the program to other associations.

H2Outstanding restaurant program

Water conservation staff has developed a program to include restaurant partners to increase water use efficiency. The program provides free low-flow pre-rinse spray valves to participating restaurants and was launched in August 2016 (Figure 28). A list of participating restaurants is available on SqueezeEveryDrop.com

Efficient irrigation on medians

Poor irrigation system management and design in medians creates runoff and wastes water. Utilities Department staff teamed up with Oklahoma City Beautiful, Urban Lawn and Landscape, The Toro Company, Hunter Industries, and the Rain Bird Corporation to update inefficient sprinklers on three highly visible medians in Oklahoma City. The sprinkler

Figure 28: Restaurant program participant


Figure 29: Median retrofit project on Classen Boulevard

heads were retrofitted with pressure regulated internal assemblies and the standard nozzles were updated with more efficient ones (Figure 29). Staff is monitoring water consumption on the median and continues to promote efficient irrigation systems to local contractors and irrigation system installers.

Many homeowners and commercial property managers can expect beneficial water savings and quick return on investment for retrofitting typical spray heads operating at high water pressure with pressure-regulated versions.

A sprinkler head operating at an incorrect pressure creates misting, reduces distribution uniformity, and increases runoff. Pop-up sprays and gear-drive rotors have an optimum operating pressure of 30 psi and 45 psi, respectively. Pressure regulated pop-up sprays and gear-drive rotors are available that maintain these optimum operating pressures. Water savings varies, depending on the pressure and number of heads on an irrigation system. Example water savings from a typical residential landscape is shown in Table 8.

5.5 Public communication methods

The Squeeze Every Drop website (http://www.SqueezeEveryDrop.com) complements the water conservation measures and outreach efforts. The current reservoir volume and water conservation stage is updated regularly. The website includes water saving information for inside and outside of the home.

An Oklahoma tough plant database, a leak calculator, and information about upcoming events are also available on the website which was designed and created to serve residents throughout the state.

Table 8: Example water savings from switching to pressure regulated sprinkler heads

Sprinkler Type	Number of heads	Runtime (minutes)*	Water use at optimum pressure**	Water use with high pressure***	Anticipated water savings with pressure regulation
		---Minutes/Year---	----------Gallons/year ----------		
Pop-Up Spray	20	1800	66,600	105,304	38,704
Gear-Drive Rotor	15	3600	166,320	214,718	48,398
Total water savings					**87,102**

**15 minutes for sprays, 30 minutes for rotors, 4 days per week from April through October*
***Assume 15-foot half-circle nozzles on pop-up sprays with flow 1.58 gpm at 30 psi, gear-drive rotors that flow 3.08 gpm at 45 psi*
****High water pressure of 75 psi*

The information is available to any resident or municipality to further promote regional water conservation.

Water bill and billing inserts

The Oklahoma City Utilities Department sends a paper bill and provides a website for online bill payment for Utilities customers. Currently about 13 percent of all customers receive e-bills. Water conservation messaging is periodically included in the monthly billing insert with seasonally appropriate information concerning responsible indoor and outdoor water conservation practices. The information in the bill insert is also included on the bill pay website. A survey of 600 Oklahoma City Utilities customers found that 56 percent of respondents said they read the water bill most or every month. The water conservation measures, information about upcoming events and water conservation activities are also included. The current water conservation stage is printed on the water bill along with the big trash pick- up schedule to ensure water customers have access to stage updates and information.

Seventy-six percent of 600 Utility customers surveyed responded they read the bill every time, most of the time, or sometimes. The survey responses evidence the importance of clearly presented information contained within the water bill.

A focus group of Oklahoma City Utility customers conducted by Cole Hargrave Snodgrass and Associates determined that many residents lack understanding of actual water usage, but residents have a desire to know how to measure success. Providing water usage information with a comparison may provide the motivation to move residents to adopt water saving practices. The water bill inserts provide practical, easy steps to implement ideas to help reduce water use.

H2OKC eNewsletter

Continuous education and outreach efforts are necessary to remind water customers of conservation benefits. The eNewsletter, H2OKC, was created to disseminate information to remind and notify customers about the current water stage, seasonal irrigation maintenance information, and history of the water system. The eNewsletter is designed for Oklahoma City customers and surrounding communities. Residents can sign up by going to http://www.SqueezeEveryDrop.com.

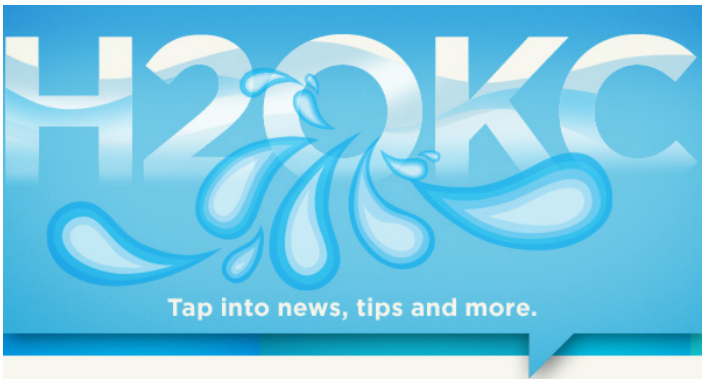


Figure 30: H2OKC eNewsletter

Figure 31: Sprinkler basics workshop with system demonstrations

Social media

The water conservation team manages a Twitter (http://www.twitter.com/squeezeverydrop) and Facebook account (https://www.facebook.com/SqueezeEveryDrop). These accounts are used to promote water conservation throughout the year and inform residents about related workshops and events. How-to videos are periodically posted and social media accounts allow for timely information updates related to water schedule changes, based on current reservoir capacity. Social media accounts remove barriers associated with contact with residents.

Outreach through community events

A highly visible, multifaceted program provides valuable resources for customers. Water conservation staff attend Home and garden shows and various community events to provide leak detection dye tablets and information about how to reduce water use in the landscape.

Additionally, water conservation staff work with OSU and other community partners to provide workshops for the public about irrigation, plants, and landscape design. The workshops are interactive and help further promote the importance of water conservation to residents. Figure 31 shows residents at a sprinkler basics workshop discussing irrigation nozzles, controllers, drip irrigation, and valves.

Upon request, water conservation staff attends homeowner and neighborhood association meetings to discuss the water conservation measures, ways to reduce water use, and answer questions.

Potential partnerships

Oklahoma City Utilities staff have reached out to many organizations, businesses, non-profits, and various community groups to continue spread awareness for water conservation and efficiency. Creating partnerships with local associations and businesses provides opportunities to further extend water conservation outreach efforts and embolden those partners to encourage others. Supporting the water saving actions of community members will create a positive environment for others to join efforts.

Incorporating sustainable and efficiency standards by collaborating with City of Oklahoma City departments and community members will be an ongoing effort.

5.6 Water accounting and loss prevention

Evaluating and controlling distribution system leakage has proven to be one of the most effective supply-side conservation strategies. Non-revenue water is the difference between water entering the distribution system and water that is metered. Apparent losses are due to meter inaccuracies, data handling errors, and unauthorized consumption while real losses occur due to leakage at water service lines, breaks or leakage on mains, hydrants, or at storage facilities (Figure 32).

Distribution system leakage was assessed as a part of the water master plan completed in 2003. The three Oklahoma City water treatment plants described in Section 3.5 provide the City with potable water through high service pumping stations which pump treated water into the distribution system. The total night flow method was employed to estimate the service area leakage rate. The night flow method involves subtracting night consumption (relatively small flows) from large flows. The difference is non-revenue water. Oklahoma City was separated into three service areas to determine the leakage rate of each individual area.

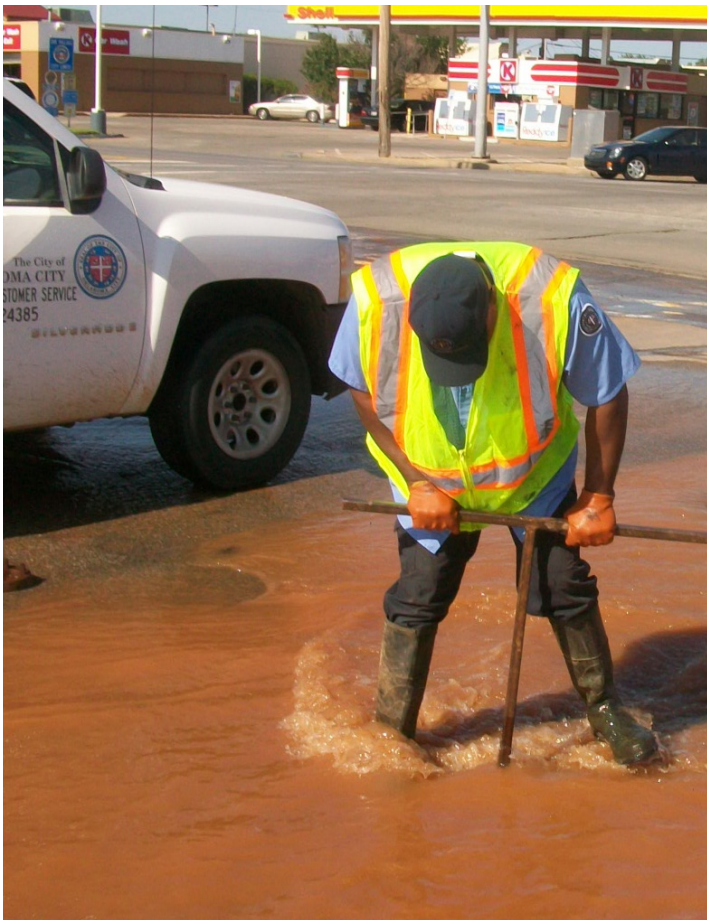


Figure 32: Shutting off water to repair a break

The non-revenue water was estimated to be 4,826 MG or 14.8 percent of the total water produced in 2000.

As a comparison, a survey project in 2000 administered by the American Water Works Association (AWWA) found non-revenue water ranged from 7.5 to 25 percent across the United States. In 2002, the EPA determined a national average of municipal unaccounted for water was 8.4 percent. Water losses can never be completely eliminated; however, the AWWA encourages a 10 percent or less standard for non-revenue water.

In 2017, Utilities Department staff collected data to complete the AWWA Water Audit Software tool to identify areas for data improvement and increased efficiency. Water auditing provides accountability and a standardized format for tracking and comparison. The Water Audit Report calculates water losses, Unavoidable Annual Real Losses (UARL), Current Annual Real Losses (CARL) and the Infrastructure Leakage Index (ILI) and other performance indicators. It may also reveal potential inaccuracy introduced into the water audit during the data collection phase. A summary of performance indicators is shown in Table 9.

The collected data was graded by Utilities staff with guidance from a grading matrix and a total validity score of 67 out of 100 was determined. The validity score is a calculated weighted scale for the components of consumption and water loss. The current data validity score is below the average of 77 from the AWWA compiler. The validity score identifies areas to improve audit accuracy and guidance to increase the level of confidence in the results. A data validity score of 70 or less indicates the focus should be on data improvement before moving forward with significant projects.

Table 9: Water audit summary and AWWA 2015 validity complier results of 32 water suppliers

	Measure	OKC Utilities Department	Average of AWWA water validation	Minimum of AWWA water validation	Maximum of AWWA water validation
System Attributes	Apparent Losses (MG/Y)	695.721	599.836	0.594	7,039.000
	Real Losses (MG/Y)	2,730.583	3,151.503	12.940	25,577.210
	Water Losses (MG/Y)	3,426.304	3,751.339	18.195	32,616.210
	Unavoidable Real Losses (UARL) (MG/Y)	1,524.43	934.25	20.69	3,745.24
	Annual cost of apparent losses	$5,558,813	$3,560,835	$8,491	$56,621,716
	Annual cost of real losses	$1,141,609	$3,512,168	$6,923	$39,057,382
Performance Indicators	Non-revenue water as % by volume of Water Supplied	13.8%	-	-	-
	Non-revenue water as % by cost of operating system	5.6%	9.8%	2.3%	35.7%
	Apparent losses per service connection per day (gal/conn/day)	7.81	10.61	1.68	59.23
	Real losses per service connection per day (gal/conn/day)	30.67	64.85	16.60	156.05
	Real losses per service connection per day per psi pressure (gal/conn/day/psi)	0.40	0.87	0.28	2.42
	Current annual real losses (CARL) (MG/Y)	2,730.58	3,151.50	12.94	25,577.21
	Infrastructure Leakage Index (ILI)	1.79	3.26	0.88	10.27
	Water Audit Data Validity Score	67/100	77	64	90

The performance indicators calculate the operational efficiency, non-revenue water, and the ILI. The AWWA compiled the water audit data of 32 other water providers in a summary of 2015 results. Table 9 reviews the performance indicators from the water audit software for the Utilities Department and the average and range from the AWWA Validated Water Audit Data Compiler for comparison.

The ILI, a ratio of the annual real losses of water to an estimated value of unavoidable leakage was calculated at 1.79, an ILI of 1.0 indicates the current losses are equal to the technical minimum.

To help reduce water loss, OCWUT approved the $1.16 billion water capital improvement plan for fiscal years 2018 to 2022 on May 9, 2017. As part of the capital plan, approximately 20 miles of small diameter water mains are planned for replacement annually.

Regular meter replacement is conducted to ensure inaccurate meter readings are prevented. To further reduce non-revenue water, Oklahoma City Utilities Line Maintenance personnel are available to repair system leaks as they occur or as they are reported. A total of 15,158 leaks were repaired from 2012 to 2016 (Figure 33). To report a water main leak or break, residents are encouraged to call Utilities Customer Service Emergency Dispatch, 405-297-3334.

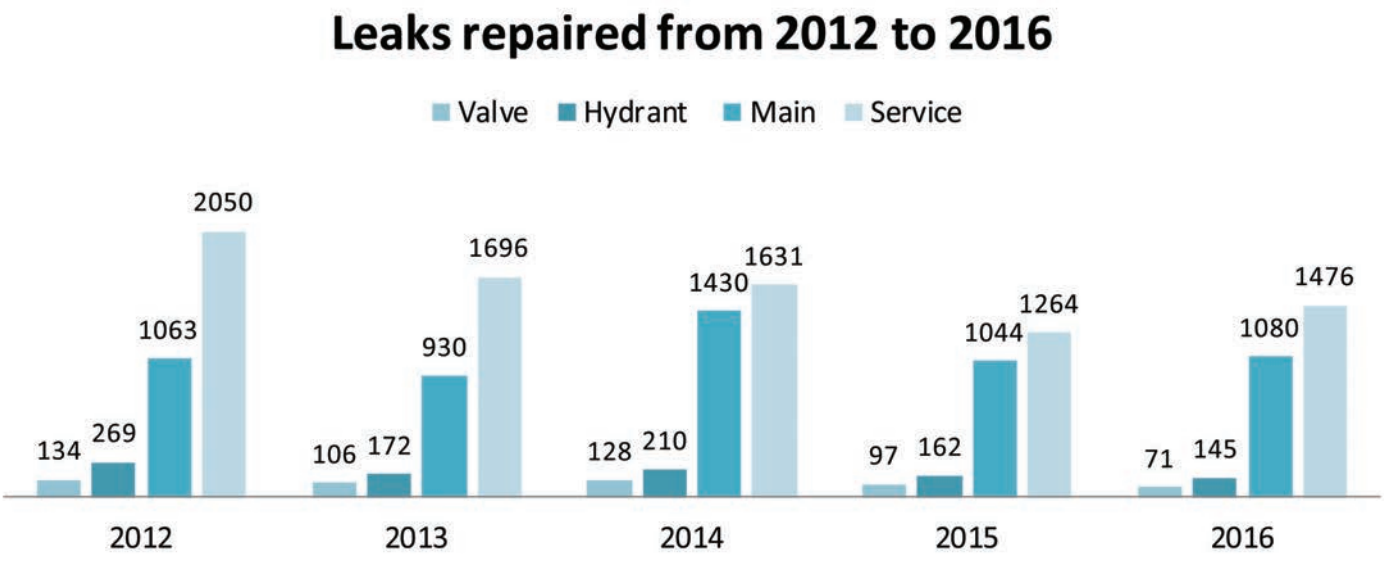


Figure 33: Leaks repaired from 2012 to 2016

EVALUATION OF POTENTIAL PROGRAMS

Oklahoma City has made a commitment to water conservation and continually plans and implements strategies to support water efficiency in the community. Evaluation of potential water conservation programs supports the planning process and identifies the most effective water conservation efforts for Oklahoma City. An investigation of probable water conservation measures and activities was completed. The following strategies may be periodically reevaluated as the program needs change overtime. Program effectiveness will continuously be monitored and assessed through the implementation process. Oklahoma City water conservation staff utilized an analytical approach to identify and determine the applicability of potential water conservation activities and programs. A broad list of potential programs was created and is shown in Table 10. After reviewing case studies from various cities, peer-reviewed studies, independent consulting reports, and goals defined in planokc, final programs were prioritized based on the plan selection criteria outlined in Section 6.1.

Table 10: Broad list of potential water conservation strategies

Education and outreach	
Water surveys/audits	Water conservation gardens
Sprinkler assessments	Landscape water calculator
Public information program	Landscape award program
Conservation garden workshops	Tradeshows and events
Irrigation and landscape classes	Plant tag program
Indoor/outdoor water surveys	Marketing and advertising
School programs	Target messaging to high water use groups
Plant database	Utility Customer Service Training
Teacher resource packet	Website, social media, mobile applications
System	
System water audit	Conservation pricing
Compute ILI on an annual basis	Water budget based billing
Apparent loss reduction	Mobile home park sub metering
Distribution system pressure management	Meter testing
Real water loss reduction	Active leak detection
AMI/AMR	Universal metering
Source water metering	Treated wastewater use
Regular and easy to read water bill	
Technology	
Indoor	**Outdoor**
High efficiency toilets (HET), direct install	Smart irrigation controller rebates
High efficiency toilets,bulk purchase	Automatic shutoff nozzles
HET, Exchange day	Flow control devices
HET, Requirement	Sprinkler nozzle rebates

HET in City Facilities	Soaker hoses
High efficiency showerheads	Rain/freeze sensors
Toilet retrofit devices	Rain gauges
Low flow faucets	Soil moisture sensors
Faucet aerators	Drip irrigation
Low flow or waterless urinals	Mulch and compost
High efficiency washing machine	Pool covers
Water efficient dishwashers	Irrigation updates at City facilities
Leak detection tablet giveaway	Cooling tower
Shower timers	Pressure reducing valves
Tankless water heaters	Greywater technology
Pre-rinse spray valve distribution	Landscape conversion program
City facility retrofits	Rainwater harvesting
Retrofit kits	Spray ground recirculation
Coin operated laundry equipment	Flushometer bowl & valve combo
Ordinances and Regulation	
Require fixture replacement	Water conservation policy in new supply contracts
Prohibit once through cooling, non-recycling fountains	Irrigation and landscape requirements
Prohibit water waste	Cooling tower regulations
Require multifamily sub metering	Consistent enforcement activities
Require efficient dishwashers	Water efficiency in building codes
Require high efficiency clothes washers	Irrigation sub metering
Update irrigation system requirement	No non-circulating car washes/decorative fountains
Require Irrigation contractors to be certified	Require soil amendments
Retrofit upon resale	Upon change of ownership require fixture updates
Time of day watering restriction	

Selected programs will be monitored and reevaluated annually based on the actual water savings and cost effectiveness as well as the community impacts and public acceptance. Oklahoma City is committed to achieving real water savings which will occur over several years. Implementation of this water conservation plan will be accomplished after adoption by OCWUT and City Council. A purposeful, deliberate plan will ensure actual water savings are achieved.

6.1 Plan selection criteria

Oklahoma City staff evaluated each potential measure based on the following plan selection criteria:

Potential water savings
Real water savings should be realized, both for the customer and the water purveyor, as a result of this water conservation plan. The programs selected should aim to increase water use efficiency by all customer categories.

Specific goal accomplishment
The recommended plan, in its entirety, should fulfill the goals outlined in Section 2.2 of this water conservation plan.

Cost effectiveness
The cost effectiveness in relation to the benefits must be considered. A higher benefit-cost ratio will produce a more cost-effective program. The money expended for water conservation activities should result in water savings.

Partnership opportunities
The overall effectiveness of water conservation activities may be expanded by partnering with other agencies. Working with various groups throughout Oklahoma City will create awareness of the water conservation program, and provide customers and potentially large water users with the motivation to maximize water use efficiency.

Budget and staffing requirements
The potential program selection includes the feasibility based on current budget and staffing requirements. Currently, the City has two dedicated water conservation employees and has staff on loan from various divisions within the Utilities Department. OCWUT and City Council recently adopted budgets for FY 2018, including two additional water conservation support positions. Considerations to staff time and program needs were included.

Community impacts
Engaging and assessing public opinions of specific program activities provides water conservation staff with valuable information regarding public support or resistance towards individual programs. Ensuring positive community impact will support conservation activities.

Conservation programming is relatively new to Oklahoma City and will therefore be implemented through a series of trial programs to determine feasibility and success of each activity. This will allow water conservation staff and OCWUT the opportunity to evaluate and assess program impacts and determine applicability for future development and planning.

Classroom talk on where water comes from and how to save it

RECOMMENDED PLAN

In accordance with the AWWA water conservation planning manual, Oklahoma City Utilities Department staff built a program framework through careful review of conservation activities. Each program includes a foundation of various levels of public education and outreach and builds on separate program components. Table 11 summarizes the recommended water conservation and efficiency strategies.

The benefits of water conservation and efficiency are realized through efforts by both the City of Oklahoma City and members of the community. The creation and implementation of measurable water efficiency programs and strategies demonstrates the value of Oklahoma City's water resources. The recommendations outline in Table 11 necessitate efforts by community members and City involvement for the purpose of achieving more efficient use of water supply resources. The recommended plan supports the policies outlined in the comprehensive planokc document and builds upon existing framework to create a more robust and complete strategy that works to reach all Oklahoma City water customers.

Table 11: Recommended water conservation strategies

Continue and expand outreach and education programs *Supports planokc policies: G-36; E-6; P-27*	
Current outreach activities • Homeowner and neighborhood association sprinkler checkups • Water wise landscape award • H2Outstanding restaurant program • Water conservation garden tours and workshops • Water bill information dissemination • Website, social media, and eNewsletter communications • Oklahoma State University partnership • Tradeshows and speaking events • Participation in local events • Irrigation contractor training	**Potential activities** • Create curriculum to support educators in water efficiency teaching • Increase complete messaging to all customer groups • Target outreach and education information to high water use customers • Prepare and disseminate specific information tailored to each customer category
Encourage water efficiency in City projects and irrigation installation *Supports planokc policies: G-34; GR-2; GR-9; SV-8; G-35; P-3; P-27; SE-13; G21*	
Current activities • Water conservation measures • Rain sensor ordinance • Utilities facilities water use assessment • Median irrigation system retrofits with pressure regulation	**Potential activities** • Partner with City Departments to identify areas for water savings • Facility water use assessments • Landscape water use assessments • Seek out funding opportunities

Revise the landscape ordinance to include irrigation system design installation and irrigation contractor registration, certification, and/or training requirements *Supports planokc policies: GR-2; GR-9; EN-2; SV-8; G-22; P-27; SE-12*	
Current codes • Water conservation measures (§55-82 and §57-2) • Isolation valve (§ 55-82 (h)) • Rain sensor ordinance (§ 59-11350) • Backflow device (§42-2)	**Potential additions** • Design and installation requirements, residential, and non-residential • Irrigation contractor certification and/or training requirements
Incorporate multifamily, commercial, and industrial sector strategies *Supports planokc policies: E-6; P-27*	
Current activities • Restaurant program • Homeowner and neighborhood sprinkler checkups	**Potential activities** • Irrigation system assessments • Industry specific information and education • Partnerships with the business community • Water budgets • Multi-family dwelling education campaign • WaterSense Hotel Challenge
Continue to expand efforts through local partnerships *Supports planokc policies: G-36; E-6; P-27*	
Current partnerships • Myriad Botanical Garden and Irrigation School • Oklahoma City Zoo Garden • Oklahoma City Parks Department, Bluff Creek • Oklahoma State University Horticulture and Landscape Architecture Department • OKC Beautiful, irrigation manufacturers and local irrigation contractors • Plant nurseries, Water Smart program	**Potential partnerships** • Local schools • Expand nursery partnerships • Wholesale water customers • Local agencies, non-profits, and private entities

7.1 Implementation and monitoring

Each of the five strategies outlined in Table 11 prioritize community-wide water efficiency efforts and support planokc policies and implementation. The three main objectives of the water conservation program; 1) education and outreach, 2) City-led initiatives and partnerships, and 3) reasonable regulation and enforcement are represented in each tactic. Current activities and strategies will be evaluated annually for effectiveness, participation, customer feedback, and alignment with the goals of this conservation plan. The primary purpose of this plan is to encourage the effective and efficient use of water resources in the community. The Utilities Department will work with customer groups to encourage the efficient use of water and emphasize the true value of our water resources.

The implementation schedule is dependent on several factors including plan adoption, budget, and staffing. Utilities Department staff will periodically review and update programs and activities to ensure actual water savings are occurring.After official adoption by OCWUT and concurrence of City Council, the water conservation plan will be implemented.

The water conservation program will be flexible to meet the changing needs of a growing community. Oklahoma City staff will re-evaluate programs and activities and assess the effectiveness and value of individual program continuation.