TUCSON WATER

A proud part of the City of Tucson

CITY OF TUCSON FOUNDED 1775

DROUGHT PREPAREDNESS AND RESPONSE PLAN

Original Plan Approved: November 28, 2006
Ordinance Approved: March 20, 2007
June 2021 Update

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ACKNOWLEDGMENTS

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For more information, visit Tucson Water's website at tucsonaz.gov/water/drought-preparedness

CHAPTER ONE:
INTRODUCTION

During times of water shortage due to drought, strategic planning to minimize public health and safety impacts on the community is a critical obligation of water providers. Water providers have a responsibility to prepare for drought and other climate change impacts by determining the potential effects of these conditions on both water supplies and delivery infrastructure. Developing plans to minimize those impacts creates a blueprint for preparedness, not just for water professionals but also for the communities they serve. Water providers are also responsible for providing reliable and safe drinking water supplies to their customers while maintaining adequate flows to meet pressure requirements in case of fire.

The *Arizona Drought Preparedness Plan* defines drought as a sustained, natural reduction in precipitation that results in negative impacts to the environment and human activities (Arizona Governor's Drought Task Force, 2004). Although the entire state continues to experience some degree of drought since a statewide declaration in 2007, not all entities will react to, or be affected by drought conditions the same way. That especially holds true for water providers, each of whom must plan for unique water supply and demand circumstances, delivery systems, and customer use patterns.

Tucson Water is a department of the City of Tucson and the largest municipal water provider in southern Arizona (hereafter referred to as the Utility). The Utility serves 731, 226 customer accounts both inside and outside the City of Tucson's municipal boundaries (see Figure 1.1). The City of Tucson's Drought Preparedness and Response Plan (hereafter referred to as the Plan) was approved by Mayor and Council on November 28, 2006, as required by A.R.S. §45-342. An implementation ordinance (No. 10380, see Appendix A) was approved on March 20, 2007. It is enforceable outside the City limits as a condition of water service. The Plan recognizes that drought impacts do not occur suddenly or without warning and acknowledges that with proper planning and review it is unlikely the community will find itself in an emergency situation caused solely by drought. It also ensures that Tucson Water staff will implement drought response measures early enough to avoid crisis-mode decision making and to help the community anticipate what measures will come next if drought impacts become more severe.

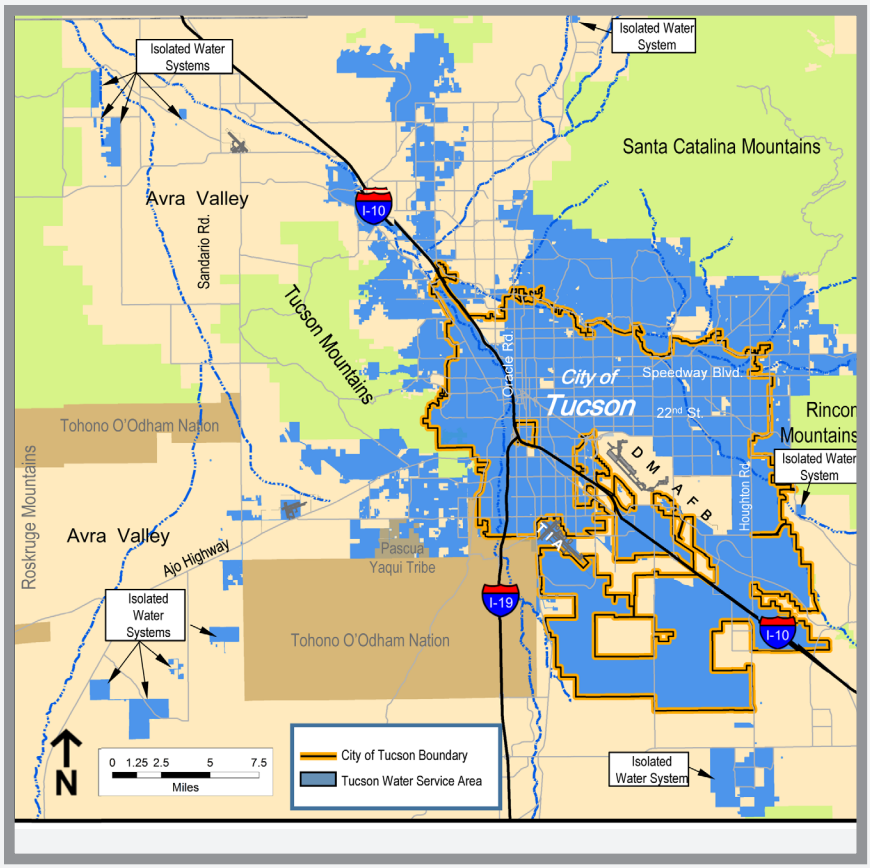


Figure 1.1: Tucson Water service area

Even with built-in flexibility, the Utility's Plan will require occasional review and revision. If drought conditions persist or become more severe, the Plan will require adjustments. To ensure that the Plan remains an effective management tool, Tucson Water staff will review the Plan annually and recommend any necessary revisions or updates needed to meet the challenges of new or changing climate conditions. Based on the relationships between well field and distribution system health, the annual review will also be useful to system planners and operations staff from a maintenance and infrastructure development standpoint. Minor updates to the Plan can be approved by the Utility Director. If significant revisions or updates are recommended, they must be approved by the Mayor and Council and forwarded to the Arizona Department of Water Resources (ADWR). The plan will be formally revised no less than every five years in accordance with ADWR requirements.

The original plan was adopted in 2007, the same year that Governor Brewer declared a statewide drought with Executive Order 2007-10. Updates to this plan have incorporated the experience Tucson Water has gained since the drought began 13 years ago. Key elements of this update include:

- Updating the drought stages and thresholds to be consistent with the 2019 Drought Contingency Plan
- Demonstrating how the Utility has diversified its water supply portfolio, increased water savings, and improved infrastructure redundancy
- Integrating climate change adaptation into both long range and drought planning
- Streamlining the drought responses and incorporating a strategic, data driven approach rather than relying on the Emergency Water Ordinance

Colorado River water is considered a renewable resource. Using Colorado River water allows the Utility to preserve finite groundwater supplies. Tucson's allocation of Colorado River water is delivered through the Central Arizona Project (CAP) canal. The Utility began receiving its full allocation of 144,191 acre feet in 2015. That water is allowed to sink into the ground through recharge basins in Avra Valley. Some of this water is pumped back out to meet the daily demands of Tucson Water customers and the remainder is stored in the ground for future use. The monumental task of building the infrastructure necessary to deliver renewable, Colorado River water to Tucson and recharge the aquifers took decades. During that time, Tucson's growing population was reliant on finite groundwater supplies. Development and expansion of the Utility's conservation program reduced per capita water demand. Currently, the community uses less water than the CAP delivers, so the Utility is able to increase the amount of water stored in the aquifer every year. The Utility has also made significant investments in infrastructure maintenance and redundancy. These issues are explained in depth in Chapter Two.

Climate change impacts in the southwest have increasingly shown that drought may be "the new normal", and not a temporary condition that we experience periodically. The goal of Tucson Water's long range water resource planning efforts is to mitigate the impacts of future supply uncertainty. The Utility recently started the One Water 2100 long range planning effort. More information about that project can be found at onewatertucson.com. Once completed, this plan will replace Water Plan: 2000 – 2050, the previous long range plan (more information about the current long range plan can be found here: https://www.tucsonaz.gov/water/waterplan) Integrating climate change impacts into both long range and drought planning efforts is essential for future proofing the utility. One Water 2100 and the drought plan updates incorporate the most recent information about climate change impacts in both the Colorado River basin and in Tucson. This information will also be used for a City wide climate action and adaptation planning effort led by Mayor Romero's office.

For Tucson Water, water resource availability requires review of both regional indicators that affect our supply of Colorado River water delivered through the CAP and local indicators that may impact both supplies and demand. Local indicators are also used to monitor infrastructure reliability for both the potable and reclaimed water distribution systems. Monitoring both regional and local drought indicators is required in order to trigger or rescind each of the four drought tiers included in this plan. The state statute requires that these indicators be directly tied to a water provider's resource availability and the ability to deliver those resources.

In 2019, representatives of the seven states that share Colorado River Water signed the Drought Contingency Plan (an article about the DCP can be found here: https://new.azwater.gov/news/articles/2019-23-05) to protect and enhance the sustainability of the river system on behalf of the estimated 40 million people who rely on it. This agreement replaced a set of interim guidelines established by the seven states in 2007 that were used to address the operations of Lake Powell and Lake Mead during drought and low reservoir conditions (the guidelines can be found here: https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf). Before the end of 2026, the U.S. Secretary of the Interior will develop new guidelines for the long-term management of the Colorado River system in partnership with the Arizona Reconsultation Committee (ARC). This committee is comprised of the same representatives that negotiated the DCP, including Tim Thomure, the Director of Tucson Water.

Chapter Three describes both climate impacts and how the Utility monitors both regional and local drought indicators. This Chapter also introduces the Federal, State, and local agencies involved in drought monitoring.

The previous version of Tucson Water's drought plan had four stages, but this update aligns those stages with the four tiers in the DCP. The Plan also establishes drought response measures designed to address drought-related impacts for both our supplies and infrastructure. Changes in the response measures for each tier, primarily the replacement of the Emergency Water Ordinance measures with water use guidelines based on historical consumption trends for each customer class, will help the community adapt to longer periods of drought. The following outline provides a brief summary of the updated drought tiers and response measures (a more thorough explanation can be found in Chapter Four):

Drought Response Stages and Response Measures

A **Tier 0** drought response will be declared by the City Manager, on the advice of the Water Director, when the water level in Lake Mead is between 1090' and 1075'. Select response measures for this stage include:

- Public notification and information on drought issues.
- Changes in system operations (such as expedited well maintenance) and/or system modifications (such as well drilling and well maintenance and other system maintenance programs to reduce system losses such as meter replacement and leak detection) deemed necessary by the Water Director.
- Self-administered water audits by City departments to identify water-saving and water efficiency measures for City facilities.
- Tucson Water will develop water use guidelines for customers using their historic consumption data.

A **Tier 1** drought response also will be declared by the City Manager, on the advice of the Water Director, when the water level in Lake Mead falls below 1075'. Select response measures for this stage include:

- Continuation of all Tier 0 actions.
- City departments will implement water audit recommendations.
- Targeted conservation program information will be provided for customers whose consumption exceeds their water use guidelines.

A **Tier 2** drought response will be declared by Mayor and Council, upon the recommendation of the City Manager, When the water level in Lake Mead falls below 1045'. Select response measures for this stage include:

- Continuation of all previous actions under Tiers 0 and 1.
- Audits are required for customers whose consumption exceeds water use guidelines.
- Mayor and Council may consider a drought surcharge.

A **Tier 3** drought response will be declared by Mayor and Council, upon the recommendation of the City Manager, When the water level in Lake Mead falls below 1025' above sea level or the volume of water delivered by the Central Arizona Project to Tucson Water is less than annual potable demand. Select response measures for this stage include:

- Continuation of Tiers 0, 1, and 2 response actions.
- Mayor and Council may consider water restrictions targeted at customers that are not implementing audit recommendations or reducing water consumption within the provided guidelines.

In addition to the investments the Utility has made in water infrastructure and conservation, like expanding the capacity to receive Colorado River water and store excess water supplies, the Utility has also developed other water supplies. Developing multiple supply alternatives, like reclaimed and harvested stormwater, has given Tucson Water the flexibility to respond to changing conditions. These approaches have increased the Utility's resilience and ability to withstand the impacts of sustained drought.

CHAPTER TWO
WATER SUPPLIES AND DISTRIBUTION

Tucson Water's supply sources and the infrastructure (recharge basins, wells, boosters, and pipelines) used to recharge, recover, and distribute water have expanded over time. This chapter examines the Utility's diversified supply portfolio, long-term storage and other water savings, as well as the infrastructure used to produce and distribute the various water supplies. Drought can affect both the availability of supplies and the Utility's capacity to deliver them. Infrastructure assets have to be maintained in order to be reliable. If one aspect of the infrastructure goes out of service, there must be other ways to produce water supplies or route them for distribution. Water supply diversity, water savings, infrastructure maintenance and redundancy are all important aspects of drought resilience.

Water Supplies

Currently four water sources are both physically and legally available to Tucson Water for municipal supply:

- Colorado River water delivered through the Central Arizona Project
- Groundwater
- Reclaimed Water
- Rain and stormwater harvesting

Developing a diversified water portfolio gives the Utility a great deal of flexibility in how it responds to a drought, either on the Colorado River basin or locally in the Tucson basin. Tucson used to be the largest metropolitan area in the United States completely dependent on groundwater. Beginning in the early 2000s, Tucson Water started delivering renewable, Colorado River water. This water supply has largely replaced groundwater supplies. The shift in water supplies can be clearly seen in the following graph:

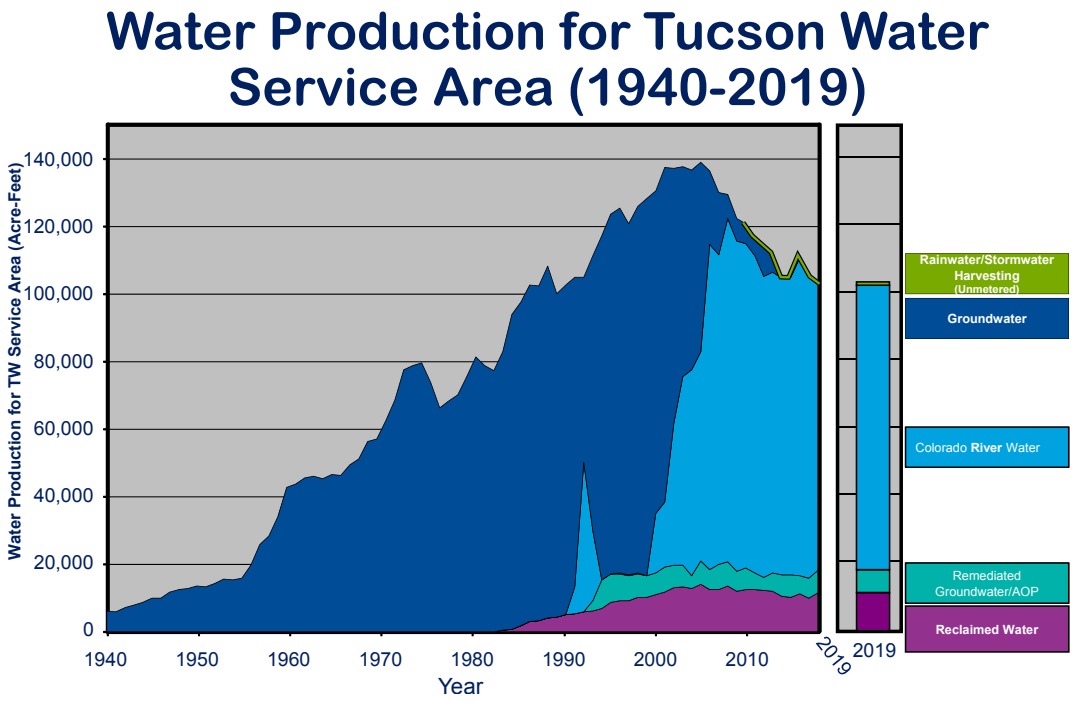


Figure 2.1: Water supply shifts from 1940 to 2019

Colorado River Water

Colorado River water is delivered to the Tucson area via the 336-mile long CAP canal (see Figure 2.2 below). Tucson Water's current CAP allocation is just over 144,191 acre-feet per year. This renewable, surface water source is recharged into the ground in two places; just east of Tucson in Avra Valley and just south of Tucson near Pima Mine Road and Interstate 19.

Figure 2.2: Central Arizona Project

Like any other surface water resource, the availability of Colorado River water depends on precipitation, especially snow-pack, in the Colorado River watershed or basin. Close monitoring of drought conditions in the Colorado River basin is important to Tucson Water because severe drought in that region could trigger a drought declaration. More information about regional drought indicators can be found in Chapter Three.

Tucson Water recovers recharged Colorado River water by pumping it back out of the ground through Avra Valley's wellfield. The Utility's water allocation delivered through the CAP is more than the amount of water used by customers on an annual basis. The surplus water is not recovered through the Avra Valley wellfield, it is stored underground. This long-term storage is our main source of drought resilience. This water is legally protected, or "firmed", through the Arizona Water Banking Authority (AWBA).

The AWBA allows municipal users to store excess Colorado River water in underground facilities. Tucson Water developed the Avra Valley recharge and recovery projects for this purpose (see Figure 2.4). The site was developed in two different phases and the official names are the Central Avra Valley Storage and Recovery Project (CAVSARP) and the Southern Avra Valley Storage and Recovery Project (SAVSARP). The CAVSARP and SAVSARP sites contain a series of recharge basins and wells. Colorado River water is delivered to the site via the CAP canal and allowed to infiltrate the pores in between bits of rock and

sand through the recharge basins. This water eventually settles down to the top of the aquifer. The amount of water needed to satisfy customer demand is pumped back out through wells. Pipelines and boosters deliver the water through the Tucson Mountains and throughout the water service area (see Figure 1.1).

The AWBA was established in anticipation of droughts on the Colorado River. Currently, annual demand is less than the City's annual allocation, so every year more water is added to long-term storage. Most water utilities measure demand in gallons per capita per day demand (GPCD). Tucson's overall GPCD has consistently been among the lowest in the American Southwest. Currently, Tucson has an overall GPCD of 111 and a residential GPCD of 76. By comparison, other Southwestern cities like Mesa, Arizona; Albuquerque, New Mexico, and San Antonio, Texas ranged from 154 total potable GPCD to 124 total potable GPCD in recent years. Figure 3.1 in Chapter Three displays the Utility's GPCD trends since the year 2000.

Tucson has a relatively low GPCD due in large part to a long standing conservation program. Conservation programming is an important element in any comprehensive demand management program. Demand management has been one of the core components of Tucson Water's water resource planning efforts since the early 1970s. The focus of demand management over the last 40 years has shifted from an initial strategy based on reducing peak water demand in the summer months to one with a conservation-driven focus. For Tucson Water, management of available water resources is critical to the community's long-term sustainability. Conservation programs seek to promote more efficient use of existing water resources. The Utility offers rebates for high efficiency toilets, washer machines, and urinals. Training opportunities and incentives for using water efficiently in landscaping are also available. In addition to incentives and training opportunities, the conservation program also enforces the City's water waste ordinance (see Appendix B). More information about the program can be found here: *www.tucsonaz.gov/water/residential-and-commercial-conservation*.

A conservation-based program does not produce additional water resources above and beyond what is physically available. Instead it preserves and extends currently available water supplies by increasing water-use efficiency and reducing per capita use. In fact, the City has enough water in long-term storage to meet about four and a half years of currently projected demand (City of Tucson Water Department, 2020). The storage of Colorado River water for future use provides Tucson with more drought resilience than most cities in the Southwest. If annual demand increases and exceeds the CAP allocation, the Utility can dip into this long-term storage before it has to use groundwater.

Groundwater

The Tucson / Avra Valley aquifer is a naturally-occurring sediment basin that stores water and releases it when pumped. It is very large, well over 1,000 feet deep in many locations and hundreds of square miles in area.

Water in the aquifer, otherwise known as groundwater, has accumulated over thousands of years as rainfall percolated through the sediments. The net natural recharge in this area is estimated to be less than one percent of the total volume of groundwater in storage (City of Tucson Water Department, 2004). This means that natural recharge occurs slowly, so most portions of this aquifer would respond very gradually to local drought conditions. Aquifers that are shallower in some parts of this region may be more responsive to precipitation reductions and demonstrate impacts from relatively short-term drought. Groundwater is considered a finite water resource because the aquifer does not receive much natural recharge each year and developed on a geologic time-scale.

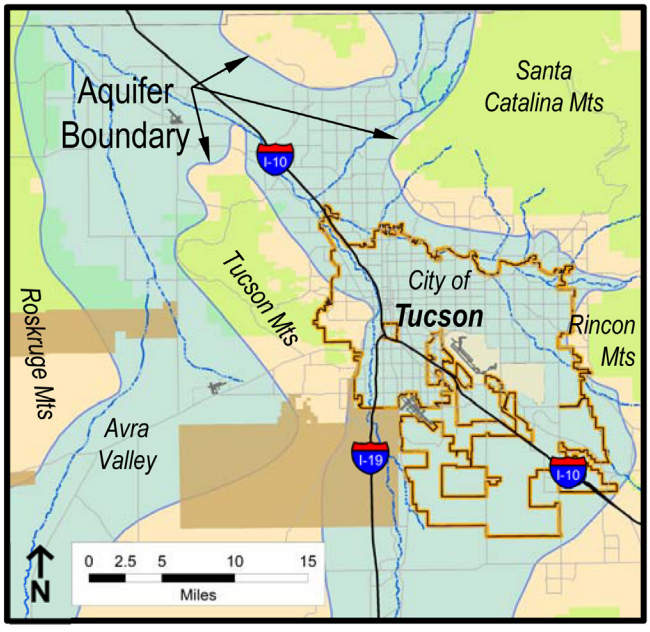


Figure 2.3: Tucson / Avra Valley Aquifer

In contrast, Colorado River water delivered through the CAP is considered a renewable resource because it is fed by snowmelt each year and replenished in a human time-scale.

Tucson was entirely dependent on groundwater before the CAP was built and aquifer levels had started to fall as the City's population grew. The Arizona Groundwater Management Act was established in 1980 to better manage groundwater withdrawals. This law laid out the Assured Water Supply (AWS) rules, which govern the amount of groundwater that the Utility can pump or produce with wells. Tucson's groundwater allowance is 19,261 acre feet per year (Arizona Department of Water Resources, 2014). Ever since the Utility transitioned to renewable water supplies rather than exclusive reliance on groundwater, aquifer levels have been rising in some areas, especially in the vicinity of the Avra Valley recharge and recovery projects. This was the main goal of the Groundwater Management Act, to balance groundwater recharge and withdrawals.

This Act also established Active Management Areas throughout Arizona. As a groundwater user within the Tucson AMA, Tucson Water is required to participate in a mandatory conservation program for large municipal providers with a designation of Assured Water Supply. Tucson Water currently participates in the Gallons Per Capita Per Day (GPCD) program under the Fourth Management Plan for the Tucson AMA, which annually sets a GPCD target for Tucson Water. Tucson Water's GPCD requirement is currently set at 160. The Utility has exceeded this target with a GPCD of 111 as noted in the previous section. More information about the legal framework concerning drought and water management in Arizona can be found in Chapter Three.

Minimizing the impacts of drought on our groundwater is also the principal focus of this Plan. Conservation and efficiency allows the Utility to put excess Colorado River water into long-term storage and prolong the use of groundwater legally available through our Assured Water Supply. Colorado River water and groundwater are the two potable or drinkable water supplies the Utility produces. Reducing or offsetting potable use with reclaimed water is another way to save it for the future.

Reclaimed Water

Re-use of treated wastewater is one of Tucson's most significant water conservation tools. This treated wastewater is referred to as reclaimed water and represents about 10 percent of our water resources. The City of Tucson was one of the first cities in the nation to use reclaimed water beginning in 1984 when the Utility started using it to irrigate the Randolph Park golf course (City of Tucson Water Department, 2020a). Wastewater is generated by interior water usage such as toilets, showers, washing machines etc., and the volume generated is largely unaffected by drought, unlike groundwater and Colorado River water. In 2019, 57,535 acre-feet of effluent were produced at the metropolitan wastewater treatment plants in the Tucson area. The City of Tucson has an entitlement to about 21,818 acre-feet of this effluent.

Currently about half of Tucson's reclaimed water is not used by customers and is discharged into the Santa Cruz River near the city's northwestern edge. The location of this discharge causes Tucson Water to lose physical and legal control of this valuable resource. The Santa Cruz River Heritage Project is a recent example of how Tucson Water continues to be innovative with reclaimed water. The project is capable of adding up to 2.8 million gallons of recycled water daily (or 3,150 acre feet a year) to the Santa Cruz River at a point south of downtown near the heart of the city. The added water established a perennial flow, which has allowed native vegetation and wildlife to flourish in this portion of the river.

Like Colorado River water delivered via the CAP, reclaimed water is also recharged. Before 2019, the Arizona Department of Water Resources only allowed the Utility to claim half the volume of recharged, reclaimed water as groundwater credits. During the Drought Contingency Plan negotiations, Tucson Water was able to increase the amount of credit received for this recharged water to 95%. This means that 95% of the water that flows through the Heritage Project recharges the aquifer and increases the amount of groundwater the Utility has access to. In 2019 the Utility was able to add 407 acre feet of water recharge credits to its supply portfolio through this project (City of Tucson Water Department 2020a).

A prolonged drought, both locally and throughout the Colorado River basin, could result in the implementation of potable water conservation measures that reduce interior demand and associated effluent volumes. However, given anticipated population growth and the amount of unused effluent, it is extremely unlikely that these conservation measures would result in an insufficient supply of effluent to satisfy the demands of the reclaimed system or other direct users of secondary effluent.

Rain and stormwater harvesting

Rain and stormwater harvesting are a small but growing component of the Utility's water supply portfolio. Although it is unmetered, the estimated amount of rain and stormwater collected is represented by the yellow line on top of Figure 2.1.

There are two general categories of rainwater harvesting; active and passive. Active rainwater harvesting refers to a tank or cistern storing rainwater collected from roofs, which provides a means to store the rainwater for later use. Passive rainwater harvesting refers to directing and retaining water in the landscape using site appropriate practices such as basins, berms, terraces, swales, and infiltration trenches.

Stormwater harvesting refers to rainwater collected from non-roof surfaces, such as streets, parking lots, hardscapes, and landscapes. Strategies to capture and utilize this water include landscaping designs to retain water in soil, semi-porous hardscape material, curb cuts, and detention/retention basins.

Rain and stormwater harvesting sites are located throughout Tucson on both private and public property. Tucson Water's conservation program incentivizes both active and passive rainwater harvesting on their customer's private property with rebates. To date, 2,352 rebates have been approved, producing 2.4 million gallons worth of rainwater storage (City of Tucson Water Department, 2019).

Over the course of many years, various City departments in addition to Tucson Water, have built hundreds of stormwater harvesting features in streets, rights-of-way, and public properties. Mayor and Council recently approved a Green Stormwater Infrastructure (GSI) Fund to maintain these features and build more. The GSI fund creates about $3 million in annual revenues from a fee on the City's utility services bill. The fund will support maintenance of existing features, construction of new features, and program administration. More information about the fund can be found here: tucsonaz.gov/gsi

GSI is an adaptable term used to describe an array of products, technologies, and practices that use natural systems—or engineered systems that mimic natural processes—to enhance overall environmental quality and provide utility services including capturing, cleaning, and infiltrating stormwater; creating wildlife habitat; shading and cooling streets and buildings; and calming traffic. As a general principle, GSI techniques use soils and vegetation to infiltrate, evapotranspire, and/or recycle stormwater runoff (Pima County and City of Tucson, 2015). In addition to the reductions in demand for potable water resources (Colorado River water and groundwater) that conservation and efficiency produce, reclaimed and harvested water resources also offset potable use.

PRODUCTION AND DELIVERY INFRASTRUCTURE

This section provides an overview of how the Utility produces potable water supplies and reclaimed water, as well as how the Utility delivers those water resources to customers. Within its 396 square mile service area, Tucson Water manages 4,615 miles of pipelines, 127 boosters, 138 transfer valves, 21,470 hydrants, 87,690 flow valves, approximately 177 potable wells, 4,929 fire services, and 58 storage facilities. Potable water is produced and delivered through the central distribution system. A separate system is used to produce and deliver reclaimed water. The nine isolated systems that the Utility operates are also addressed in this section. Regional and local drought impacts affect each of these systems in different ways.

Potable Well Fields

Historically, Tucson Water relied on groundwater to meet potable demand. Since 2001, Tucson Water has transitioned from groundwater reliance to a renewable supply from the Colorado River. This water is delivered via the Central Arizona Project Canal to three recharge and recovery facilities:

- Central Avra Valley Storage and Recovery Project (CAVSARP) which went into operation in 2001;
- Pima Mine Road Recharge Project (PMRRP – jointly owned by the City of Tucson and the Central Arizona Water Conservation District) which went into full-scale operation in 2001;
- Southern Avra Valley Storage and Recovery Project (SAVSARP) which began operation in 2008.

The recharged Colorado River water is then recovered through new or existing well fields and delivered to customers. The Avra Valley Well Field is now recovering Colorado River water recharged at CAVSARP and SAVSARP. The Santa Cruz Well Field, located down gradient from PMRRP, now produces a blend of local groundwater and Colorado River water recharged at PMRRP.

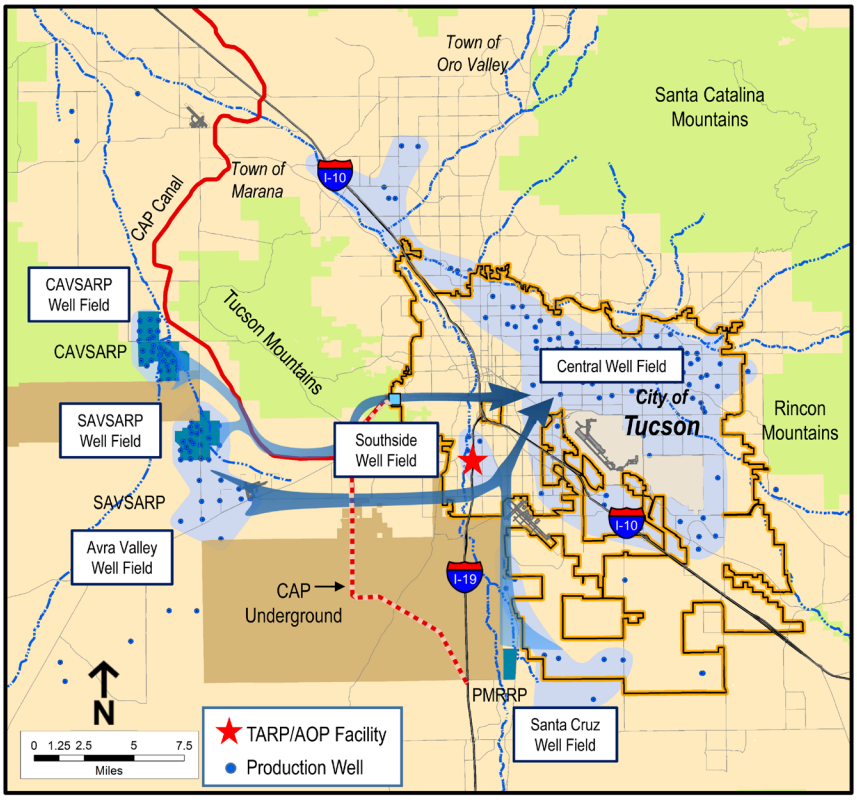


Figure 2.4: Tucson Water recharge and recovery projects and wheeling partners

Tucson Water is not the only water provider in the Tucson Active Management Area directly utilizing Colorado River water as a source of potable supply. The City of Tucson's Mayor and Council have Intergovernmental Agreements (IGAs) with the Pascua Yaqui Indian Nation, the Town of Oro Valley, Vail Water Company, and the Metro Water District to take delivery of their CAP allocations (or a portion thereof) at one of the Recharge and Recovery facilities and then wheel or move the recovered water through the Tucson Water's distribution system. The Utility is in discussions with other local water providers for additional wheeling agreements as the entire region continues to transition towards renewable supplies from the Colorado River, thereby increasing regional climate resilience.

Other water providers in the greater Tucson region may occasionally experience difficulty in meeting customer demand due to a variety of supply or infrastructure issues. The City of Tucson currently has interconnect agreements with some area water providers for such specific needs as fire protection capacity or other emergencies related to water supply or infrastructure. As stated above, drought is not an emergency and these agreements do not cover water shortages due to drought.

However, the Utility might be asked to provide water on an emergency basis to other water providers who may have less resource or system reliability than Tucson Water during a severe drought. Such requests for drought-related, short-term emergency supplies will be reviewed on a case by case basis and will only be provided if the requesting utility can adequately meet the projected needs of its customers on a continuing basis.

Recharged Colorado River water recovered through the Avra Valley and Santa Cruz Well Fields produce the majority of water used to meet the Utility's potable demand. The Southside and Central Well Fields are also continuously maintained and able to provide water service on short notice (City of Tucson Water Department, 2018). These well fields provide redundancy for the Utility, an important component of overall system reliability.

A small percentage (about 5%) of potable supplies are produced with remediated groundwater at the Tucson Airport Remediation Project / Advanced Oxidation Process (TARP/AOP) facility at I-19 and Irvington Road. This facility has been removing trichloroethylene (TCE) and 1,4–dioxane from the groundwater in the Superfund site near the Tucson International Airport since 2014. The TARP/AOP pumps

contaminated water out of the ground and moves it through a treatment system. The water is cleaned to drinking water standards by saturating it with hydrogen peroxide and running it through ultraviolet reactors to oxidize and remove compounds from water. After water quality testing, the remediated water is discharged from the treatment facility into Tucson Water's distribution system. Remediated water blends with the recovered Colorado River water in the distribution system (City of Tucson Water Department, 2018).

Central Distribution System and Isolated Systems

Tucson Water's potable systems are designed and operated to meet or exceed primary drinking water standards and system disinfection standards. The distribution system must also maintain adequate system delivery pressures and meet daily peak and fire-flow demands. About 98 percent of the water produced by Tucson Water's production wells enters the large, integrated central distribution system. Generally, the water produced from these wells can be moved anywhere in the central distribution system via pipelines, boosters, and reservoirs and may travel 40 to 50 miles to reach customers.

In addition to the central distribution system, there are nine small, isolated potable systems supplied by dedicated production wells and associated supply infrastructure (see Figure 1.1). These isolated systems rely entirely on native groundwater and supply infrastructure located in the immediate area. Isolated systems are more operationally vulnerable, since they do not benefit from the system reliability available to the central distribution system, making them potentially more vulnerable to local drought impacts. Conversely, because such systems are not connected to the central distribution system, they cannot be impacted by drought conditions in the Colorado River Watershed and must be monitored separately.

Tucson Water is developing a comprehensive assessment program to systematically identify water leaks within the distribution system. Identifying and repairing leaks will reduce water loss. Water loss reduction is a key focus area for the Utility. Currently, about 9% of the water that flows through the distribution system is lost to leaks before it reaches the customer meters on an annual basis. The Utility has set an ambitious goal of reducing water loss down to 4% (City of Tucson Water Department, 2019b).

Reclaimed Water System

Reclaimed water is wastewater that has been treated to high quality standards and it is used primarily for irrigation (watering golf courses and turf at parks and schools, etc.). Tucson Water's Reclaimed Water Treatment Plant takes some of the wastewater that is produced at Pima County's Regional Wastewater and Reclamation facilities and recycles it with further disinfection and blending. The reclaimed water system is entirely separate from the drinking water system.

Demand for reclaimed water increases during the hotter, drier summer periods in Tucson. The peak-demand period under drought could be extended, arriving earlier and lasting for a longer period of time. Though the availability of effluent will generally not be affected by drought, the demand from new and existing reclaimed customers could potentially outstrip the reclaimed system's capacity to meet demand. The potable system has a limited capacity to provide backup supply at critical times. Potable water will not provide a backup supply to the reclaimed system during drought tiers 1, 2, and 3 unless a delivery system or infrastructure failure occurs.

About 73% (16,000 out of 21,818 acre-feet) of the City's current effluent entitlement was recycled in 2019 and distributed through the reclaimed water system, primarily providing irrigation water to customers with large turf facilities such as golf courses, parks, and athletic fields. An additional 490 acre feet of the City's secondary effluent was used on the Silver Bell Golf Course directly. The recently completed Silverbell Pump & Treat System will add an additional 1.4 MGD to the reclaimed system (City of Tucson Water Department, 2020a). This water treatment or remediation system removes chlorinated solvents like perchloroethylene and tetrachloroethylene (PCE & TCE) from the groundwater impacted by the adjacent Silverbell Landfill site. The Arizona Department of Environmental Quality's Water Quality Assurance Revolving Fund was used to finance this project.

The following pie chart describes how reclaimed water is used in Tucson (City of Tucson Water Department, 2020a):

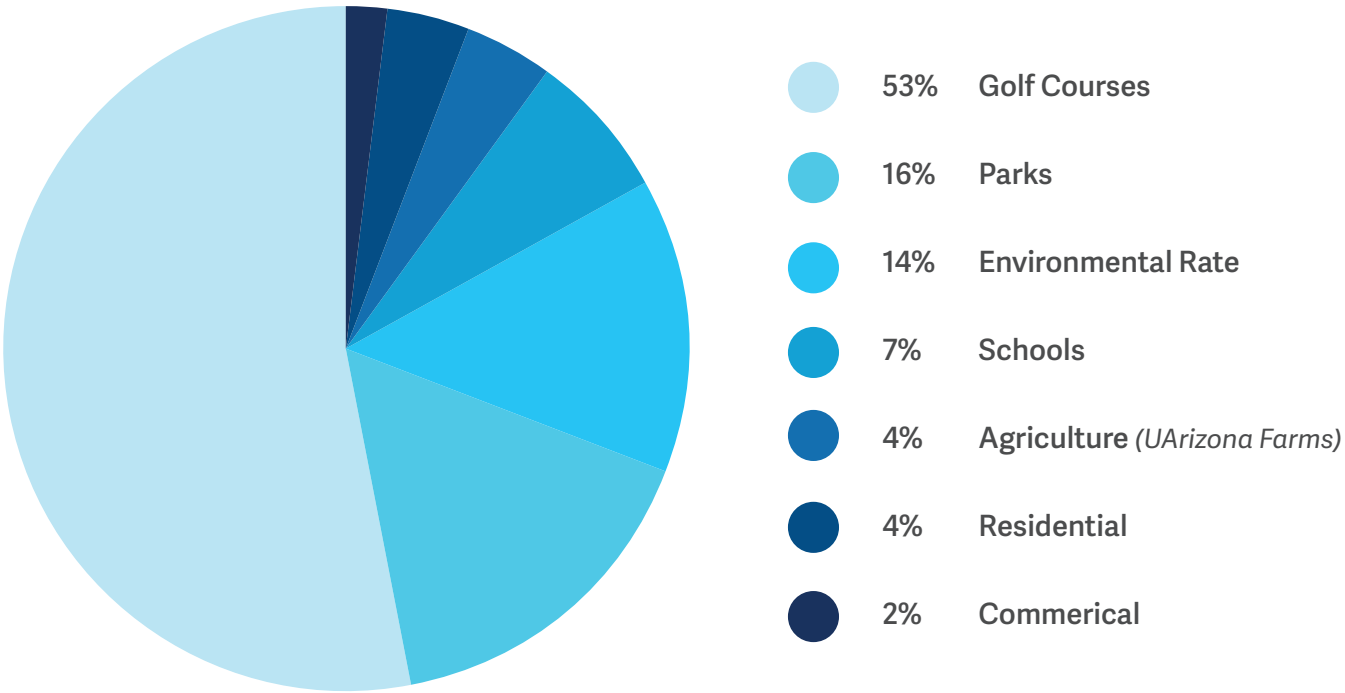


Figure 2.5: End uses of reclaimed water

CHAPTER THREE

CLIMATE CHANGE IMPACTS AND DROUGHT MONITORING

Tucson's average temperature has increased by 4.80 degrees fahrenheit since 1970, making it the third fastest warming city in the country (Climate Central, 2019). Drought conditions result from sustained reductions in precipitation. Analysis of observed and projected hydroclimatic factors suggests that climate change impacts within the Colorado River watershed include, but may not be limited to:

- increasing average surface temperatures
- changes in precipitation magnitude and intensity
- increased evaporation
- reduced surface water flows in the Colorado River due to changes in spring run off and snow pack

In order to better understand how climate change may exacerbate drought conditions, Tucson Water staff routinely examines the latest regional and local climate projections with the assistance of select consultants and climate scientists at the University of Arizona. The Utility recently commissioned a technical memorandum on climate change projections from HDR. This memo reviewed the latest climate models and projections as well as a number of related scientific articles. Both regional and local temperature projections show an increase in temperatures. Precipitation could increase slightly and become more intense during certain storm events. Precipitation projections also show greater variability. For instance, the monsoon season could become less predictable but there could also be stronger winter storm events (HDR, 2020). A recent article by Brad Udall and Jonathan Overpeck, leading climatologists in the Southwest, predicts that flows on the Colorado River will decline by about four percent per degree Fahrenheit increase in basin average temperature (Udall, 2017).

As noted in the previous chapter, the Utility has already taken significant steps to increase resilience to long-term drought and climate-related shortages on the Colorado River. Because the Utility's annual allocation of Colorado River water is greater than annual demand, the long-term storage increases every year. Tucson Water currently has access to four and a half years of Colorado River water in long-term storage, in addition to groundwater rights (City of Tucson Water Department, 2020).

All successful planning requires periodic updates of any written plans to incorporate new data and adjust planning scenarios to reflect real-life conditions. Tucson Water's drought preparedness planning is an ongoing process that is closely linked to long-range water resource planning and the City's climate plan. This Plan ensures that water is used wisely through an emphasis on conservation, efficiency, and water loss prevention. But it is also important to support climate mitigation and adaptation responses like increasing tree canopy and supporting environmental flows. For instance, trees require an initial period of irrigation once they are planted. After a tree becomes established, longer term growth can be supported by rain and stormwater harvesting. But that initial period will require an increase in water consumption. Because the Utility has a diverse water resource portfolio and long-term storage, the City can mitigate climate impacts without risking water security.

DROUGHT INDICATORS

Drought indicators are measurable variables that describe drought conditions. Tucson Water's drought indicators include variables for both regional and local drought and are designed to measure potential drought impacts on Tucson Water's available water supplies and/or potential distribution system impacts related to drought.

The regional indicators are Lake Mead water levels as measured by the Bureau of Reclamation and agreed to in the DCP. This is due to the fact that the majority of our potable or drinking water supply is recovered Colorado River water delivered via the CAP.

Local system indicators for Tucson Water include annual potable demand, gallons per capita per day (GPCD), aquifer levels, and potable and reclaimed production and distribution capacity (i.e.: measures of water supplies and the ability to deliver them where needed). Monitoring annual demand and GPCD allows the Utility to better assess whether or not the drought response measures are having the desired effect. Tucson Water's declining GPCD in the face of long-term drought indicates both the responsiveness and the general drought awareness of the Utility's customers.

Drought indicators do not include specific climate or environmental variables because Federal and State agencies already monitor these indicators and announce drought conditions both locally and across the region. The regional and local system indicators in the Drought Plan reflect drought impacts. For example, increased demand due to drought conditions is reflected in higher annual demand and lower Lake Mead levels.

Regional Indicators

A regional drought on the Colorado River Watershed could lead to a declaration of shortage on the river by the Secretary of the Interior. Section 301 (b) of the Colorado River Basin Project Act of 1968 provides for Arizona to curtail use of its CAP entitlement to assure water availability to satisfy senior water right holders on the river. Two agreements form the basis of how shortage conditions will affect the Utility's CAP allotment: the 2007 Interim Guidelines and the 2019 Drought Contingency Plan.

In December 2007, the Secretary of the U.S. Department of the Interior signed a decision implementing interim operational guidelines for the management of the Colorado River, intended to address operations of Lake Powell and Lake Mead during drought and low reservoir conditions. Since 2008, Lake Powell and Lake Mead have been operated in accordance with the 2007 Interim Guidelines, which remain in effect through the end of 2025.

These guidelines established storage volumes at Lake Mead representing normal, surplus, and shortage conditions. The various conditions are determined by the elevation of the lake surface as projected by the Bureau of Reclamation's August 24-Month Study for the following year. Under the guidelines, lake elevations at or below 1,075' above sea level trigger shortage conditions on the Lower Colorado River.

Increasing levels of shortage severity, or tiers, correspond to decreasing elevations of Lake Mead. Declaration of shortage conditions in any given year result in curtailment of deliveries to Arizona via the Central Arizona Project (CAP).

In the decade following the 2007 Interim Guidelines, severe and persistent drought conditions throughout the Colorado River Basin threatened to push Lake Mead into shortage conditions several years earlier than had been predicted by federal and state water managers. In an effort to prevent reductions in water deliveries the Upper and Lower Basin states, American Indian tribes, and Mexico entered into additional agreements, or drought conservation plans, intended to protect critical reservoir levels throughout the system.

Under the 2019 Lower Colorado River Basin Drought Contingency Plan (DCP), Arizona agreed to make additional, voluntary system contributions to Lake Mead that are supplemental to and in furtherance of the goals of the 2007 Interim Guidelines. As with the 2007 Interim Guidelines, these contributions will correspond to Lake Mead elevations as projected by the Bureau's August 24-Month Study for January 1 of the following year. When combined with the existing shortage tiers established by the 2007 Interim Guidelines, these voluntary system contributions will result in increasing cuts to Arizona's supply of Colorado River water delivered via the CAP.

The overall reductions to Arizona's Colorado River allocation will have different impacts for various users of the CAP, according to their priority level. For example, "excess," agricultural, and non-Indian uses would be reduced before Municipal & Industrial (M&I) or Tribal uses. Tucson Water receives the largest allocation of CAP M&I at just over 144,191 acre feet per year. The CAP estimates that a Tier 3 reduction in the next few years would result in a 13% to 14% reduction to the M&I priority users. However, Tucson Water is unlikely to see a reduction in our allocation because we can use storage credits from the Arizona Water Banking Authority to cover any shortfalls to our order (Basefsky, 2021). Tucson Water's potable demand in 2019 was 91,920 acre feet, which is well below the CAP allocation in Tier 3 (City of Tucson Water Department, 2019a). Absent a significant increase in demand, the Utility will continue storing water in Tier 3.

The Arizona Reconsultation Committee is currently in the process of re-negotiating the terms of and developing a consensus on the next version of the Interim Guidelines. The new guidelines will be developed by 2026. At that point the Drought Plan will be updated to reflect the new guidelines.

Local System Indicators

Local system indicators are measures specific to Tucson Water's customer use patterns and water system that are not only useful in good resource management practices, but also provide a means of forecasting potential system impacts related to drought, and in assessing the implementation of drought response measures. Local system indicators include annual potable demand, GPCD, and aquifer levels. The Utility's capacity to produce and distribute both potable and reclaimed water is also tracked.

The indicators used in the Plan were developed to provide guidelines for the Water Director to:

- determine the level of drought response needed in the Tucson Water service area
- evaluate the potential impacts drought might have on availability of water supplies or the Utility's ability to deliver water to customers; and
- implement the response actions needed to mitigate potential impacts.

To accomplish this, drought indicators must be meaningful and measure something that is:

- critical to Tucson Water's ability to deliver water (including water supply availability and potential system impacts specific to our water system);
- useful for good resource management practices; and
- not already measured by another indicator (i.e. not repetitive or a variable included in another indicator).

Whereas regional indicators are outside the control or influence of Tucson Water, usually reflecting watershed related conditions, the Utility can generally exercise more direct control in responding to local system indicators. Tucson Water staff routinely evaluates a number of variables to examine the performance of the potable and reclaimed systems. However, monitoring and analyzing these variables in terms of their relationship to drought will provide early warning of potential drought related system problems that can signal the need to implement mitigation measures to avoid those problems.

The local system indicators give a general view of the overall "health" of the water production and distribution system. A downward trend in the production capacity indices or aquifer storage index will provide a signal to the Director that a more in-depth evaluation of system components is needed or that specific response measures should be implemented. Further declines in GPCD would indicate that the community is aware of the drought conditions and responding appropriately.

Annual Potable Demand

Tucson Water tracks demand in real time with a supervisory control and data acquisition (SCADA) system. Monitors on wells, boosters, and reservoirs feed data into the SCADA system which is constantly monitored by Tucson Water staff. Daily and annual reports are compiled about potable water production and demand. Annual potable demand has been declining since 2006. In 2019, the Utility produced 91,616 acre feet of potable water. As noted earlier, our annual CAP allocation is 144,191 acre feet. As long as annual demand is less than the supply of Colorado River water delivered via the CAP, the Utility is able to save the surplus water below the recharge basins and increase drought resilience. The Director of Tucson Water monitors this indicator every year, but particularly in Tier 2 drought. If annual demand begins to exceed the Utility's CAP allocation and Lake Mead levels continue to decline, then the Director would recommend moving to Tier 3. Tracking annual demand also helps determine the efficacy of drought response measures. If customers understand the importance of using water efficiently during a drought, and they have the information they need to respond appropriately, then there should be a corresponding decrease in demand.

Gallons Per Capita Per Day (GPCD)

The Utility tracks this indicator to ensure compliance with ADWR regulations and monitor drought response. Per capita water use is simply total potable demand, including lost and unaccounted for water, divided by the population and by the number of days in the year. One of the anticipated effects of local drought is an increase in GPCD because customers traditionally tend to use more water when it is hotter and drier than normal. The response measures included in the drought plan provide customers with the information and tools they need to increase their efficiency and stretch their water resources further. Monitoring GPCD helps the Utility determine how customers are responding to drought. If demand and GPCD are increasing, then the Utility needs to do more outreach about the conservation program and proper drought response measures. The conservation program and drought response measures are described in Chapter 4.

Fortunately, GPCD in Tucson has been relatively low. This is one of the results of Tucson Water's conservation program.

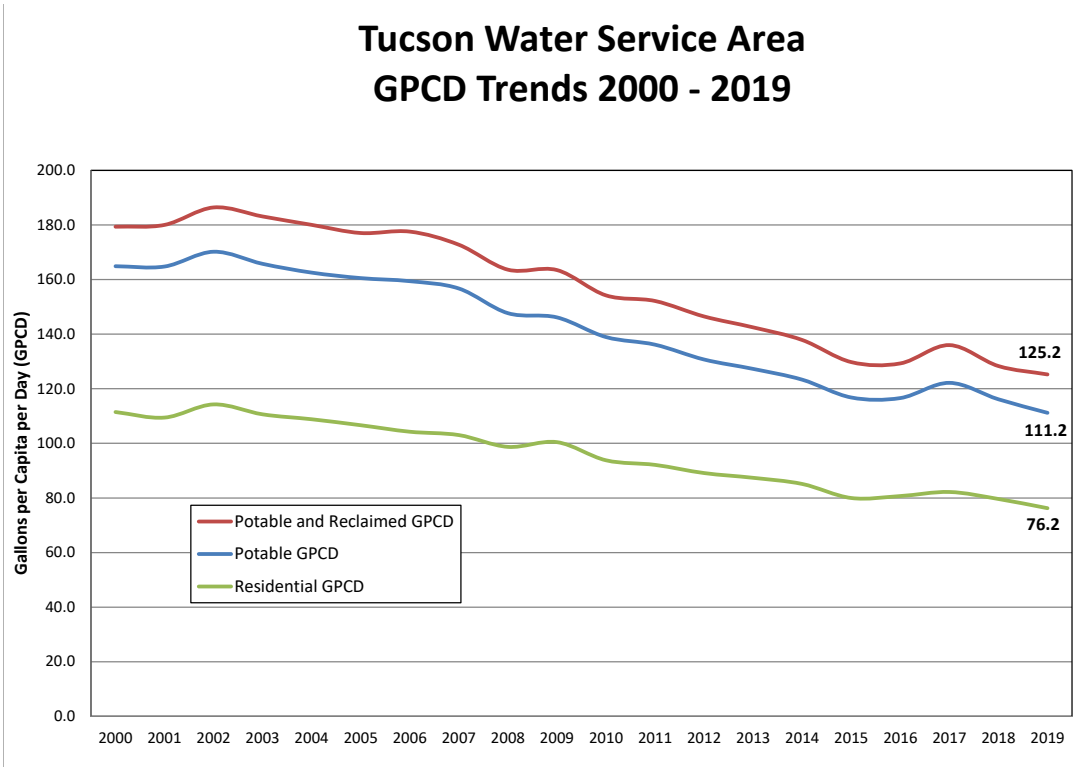


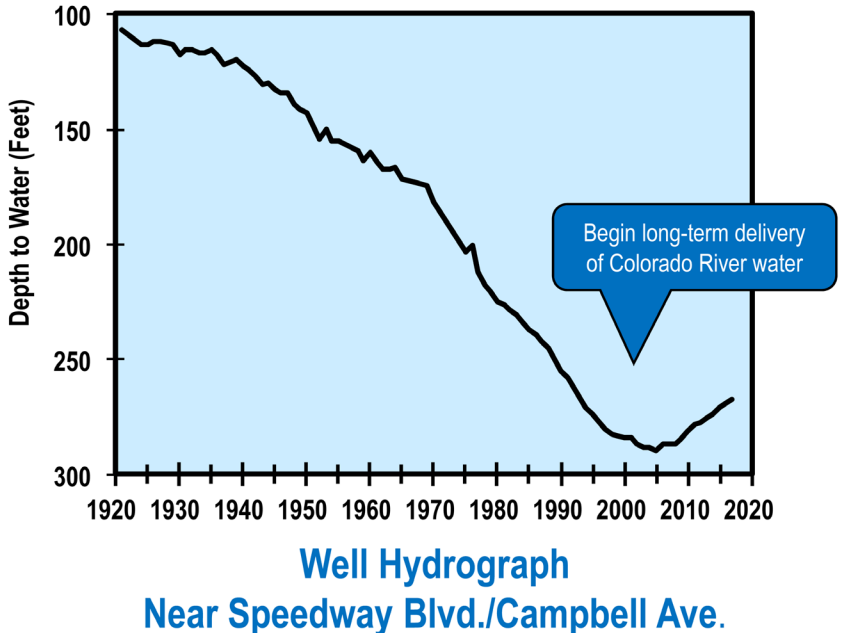
Figure 3.2: Tucson Water GPCD trends 2000 - 2019

Aquifer Level Changes

Aquifer health, regional water table elevations, and the number and depth of wells can all impact the overall productivity of a well field. In addition, drought conditions on the Colorado River could lead to decreased CAP deliveries to the City's recharge and recovery projects. While the design of the recharge projects allow for continued pumping with reduced or no recharge for a considerable time, doing so over sustained periods could negatively impact the productive capacity of those well fields.

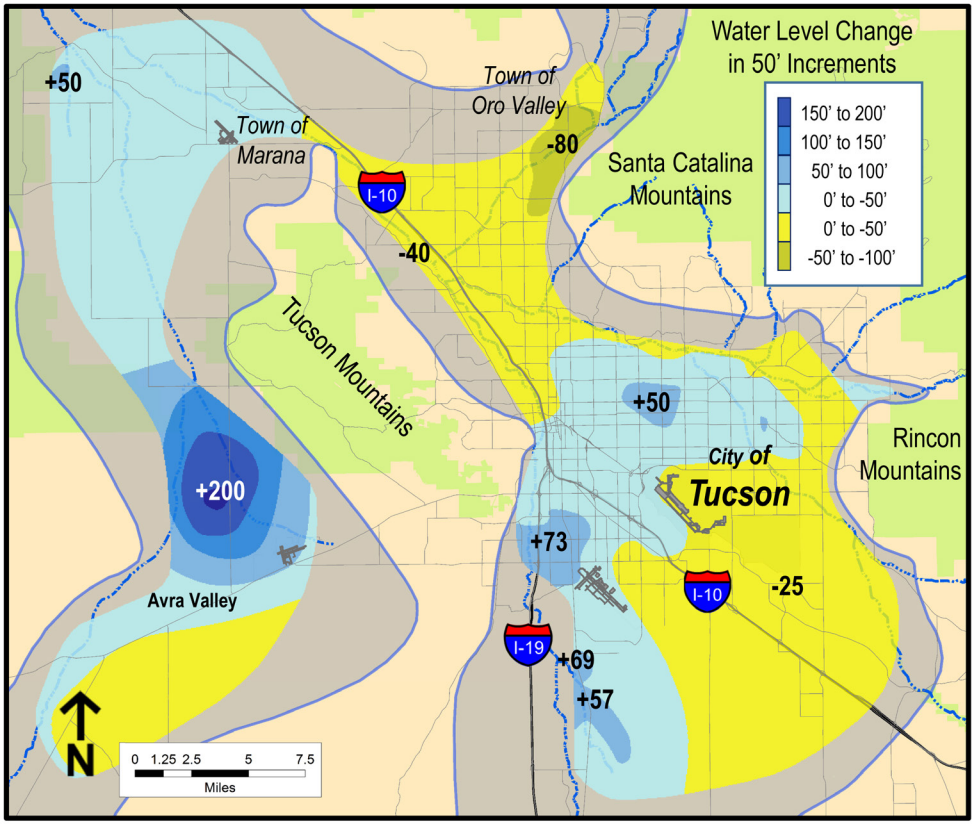
When considering drought impacts, changes to the regional water table in the most productive well fields are of prime concern. Tucson Water measures changes in the depth to the water table or aquifer every year by measuring the water levels in each of the Utility's wells. A well hydrograph is a chart of water levels measured over time in a single well. These hydrographs also show how water levels declined from 1920 through every decade until the early 2000s. Water levels in the Central Well Field area began rising in 2001, when Tucson Water began the long-term delivery of Colorado River water to customers and substantially reduced groundwater pumping in this area (City of Tucson Water, 2018).

Figure 3.3: Well hydrograph



The depth to water data for each of the Utility's wells between 2000 and 2016 was compiled on a groundwater level change map. The depth to groundwater has changed significantly beneath the recharge areas in Avra Valley and Pima Mine road. Water levels have risen moderately in north-central Tucson because of reduced pumping in the central well field. The yellow area east of I-10 and generally north of Prince Road, extending to Oracle and Tangerine Roads, continues to experience water level declines due to groundwater pumping by other others. The yellow area in the southeast corner of the map continues to experience water level declines due to groundwater pumping by Tucson Water and others (City of Tucson Water, 2018).

Figure 3.4: Aquifer level changes 2000 - 2016



Potable and Reclaimed Production and Distribution Capacity

The actual number of potable production wells the Utility is operating at any given time depends on maintenance, replacement, and water quality issues. Pumping capacity varies alongside the number of active wells but it must stay higher than the average daily demand, especially the maximum 30 day demand period in summer. Ensuring that the production and distribution capacity exceeds the peak demand period means that the Utility can meet potable demands even under severe drought conditions.

Production capacity is a combination of the Utility's ability to produce and deliver water. It is largely based on well efficiency measures, including such factors as system pressures, static water levels, specific well capacity and so forth. Storage and distribution factors, like the number of reservoirs and pipe sizes, also play a role in the Utility's ability to move the water that is produced to the end user. Tucson Water's integrated potable system is generally designed to provide supply in excess of the average day of the peak 30-day period. The same is true for the production and distribution of reclaimed water. The following two graphs show the daily demand totals for both the potable and reclaimed systems. The peak 30 day period typically occurs sometime between June and July.

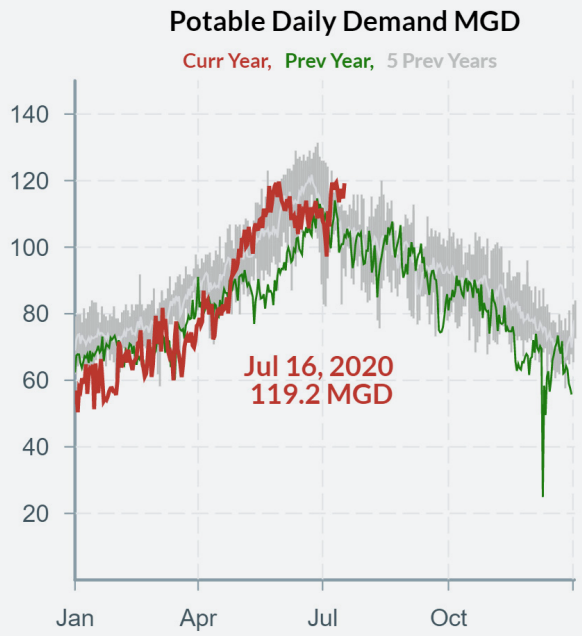


Figure 3.5: Potable daily demand in millions of gallons per day

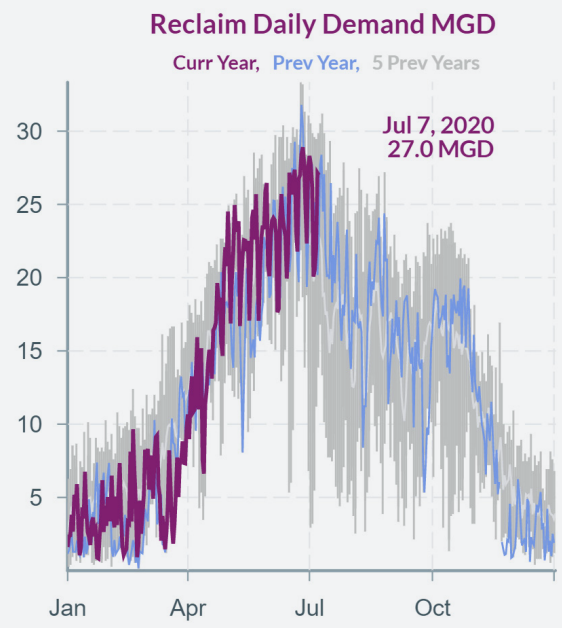


Figure 3.6: Reclaimed daily demand in millions of gallons per day

Tucson Water monitors daily demand in order to ensure that production and distribution capacity are sufficient to meet and exceed the peak period.

Drought monitoring partners

Tucson Water works with federal, state, and local partners that also track various drought indicators.

The National Oceanic and Atmospheric Administration's (NOAA) National Integrated Drought Information System (NIDIS) program coordinates and integrates drought research across federal, tribal, state, and local jurisdictions in support of a national drought early warning system. NIDIS collaborates with the U.S. Department of Agriculture (USDA) and the National Drought Mitigation Center at the University of Nebraska-Lincoln to produce the U.S. Drought Monitor, a weekly map based on measurements of climatic, hydrologic, and soil conditions as well as reported impacts and observations from more than 350 contributors around the US.

State, local, tribal and basin-level decision makers use the U.S. Drought Monitor and local drought indicators to trigger drought responses at the regional and local level.

The Arizona Drought Monitoring Technical Committee (ADMTC) is responsible for gathering data about Arizona drought, climate and weather; producing drought status reports; and disseminating that information to land managers, policy-makers, and the public. Coordinated by the Arizona Department of Water Resources (ADWR) and co-chaired by climatologists representing Arizona State University and the National Weather Service, the MTC is comprised of land and water resource managers, hydrologists, climatologists and other specialists representing a range of state, tribal, and federal agencies.

The ADMTC and ADWR coordinate to improve the accessibility of drought information by resource managers, state decision-makers and the public. ADWR produces a quarterly long-term drought status map and summary based on weekly input from the Arizona ADMTC. ADWR also generates a monthly commentary that summarizes drought status maps issued each month by the U.S. Drought Monitor.

Drought statuses are determined at the watershed level across the state. ADWR calculates long-term drought status by comparing the 24-, 36- and 48-month precipitation and streamflow totals to the same periods across the 30-year record. If precipitation and streamflow are less than the 40th percentile in comparison to the 30-year record, conditions are classified as abnormally dry or worse. The ADWR drought status maps can be found here: https://new.azwater.gov/drought/drought-status

Local drought impact groups (LDIGs) are county-level groups that coordinate drought public awareness, provide impact assessment information to local and state leaders, and implement and initiate local mitigation and response options. These groups are coordinated by local representatives of Arizona Cooperative Extension and County Emergency Management and supported by ADWR's Drought Program.

The Pima County LDIG has been an active component of County operations since 2006 when the Board of Supervisors adopted the Drought Response Plan and Water Wasting Ordinance.

Pima County LDIG consists of water providers and local, state and federal agencies that have an interest in the cause and effect of drought conditions in Pima County. LDIG meets every other month to monitor short- and long-term drought status, discuss drought impacts and coordinate drought declarations and responses.

The Climate Assessment for the Southwest (CLIMAS) program was established in 1998 as part of the National Oceanic and Atmospheric Administration's Regional Integrated Sciences and Assessments program. CLIMAS is part of the University of Arizona's Arizona Institute for Resilient Environment and Societies. The CLIMAS team is made up of experts from a variety of social, physical, and natural sciences who all work with partners across the Southwest to develop sustainable answers to regional climate challenges. Their monthly Southwest Climate Podcast (https://climas.arizona.edu/outreach/southwest-climate-podcast) synthesizes information and data from experts, forecasts, and models to provide listeners with a better understanding of climate and weather in the Southwest.

CHAPTER FOUR

DROUGHT TIERS AND RESPONSE MEASURES

This plan provides guidelines for determining the appropriate drought tier and corresponding response measures based on regional and local drought indicators. The Utility's authority to establish a system of priorities for delivery of potable and reclaimed water during times of shortage is recognized in this plan. Authority for this plan and its enforcement is derived from the Drought Preparedness and Response Plan Ordinance 10380 (Appendix A).

When the original drought plan was written, Tucson Water was in the process of transitioning from groundwater to the Central Arizona Project. As noted in the previous chapter, local drought indicators are used to monitor impacts in the Tucson basin whereas regional drought indicators are used to monitor impacts in the Colorado River basin. The thresholds for the first three tiers are determined by water levels in Lake Mead, consistent with the Drought Contingency Plan. The Tier 3 threshold is a combination of the water level in Lake Mead, Tucson Water's CAP allocation, and the most recent annual demand total.

The City Manager declares drought Tiers 0 and 1 on the advice of the utility's Director. Mayor and Council declare Tiers 2 and 3 on the advice of the City Manager. The utility Director provides the City Manager and Mayor and Council with information about regional and local indicators during all of the drought levels. Tucson is currently in a Tier 0 drought because the elevation of Lake Mead is between 1090' and 1075' above sea level.

DROUGHT TIERS

The plan includes four drought response levels ranging from Tier 0 to Tier 3. The thresholds for each tier are as follows:

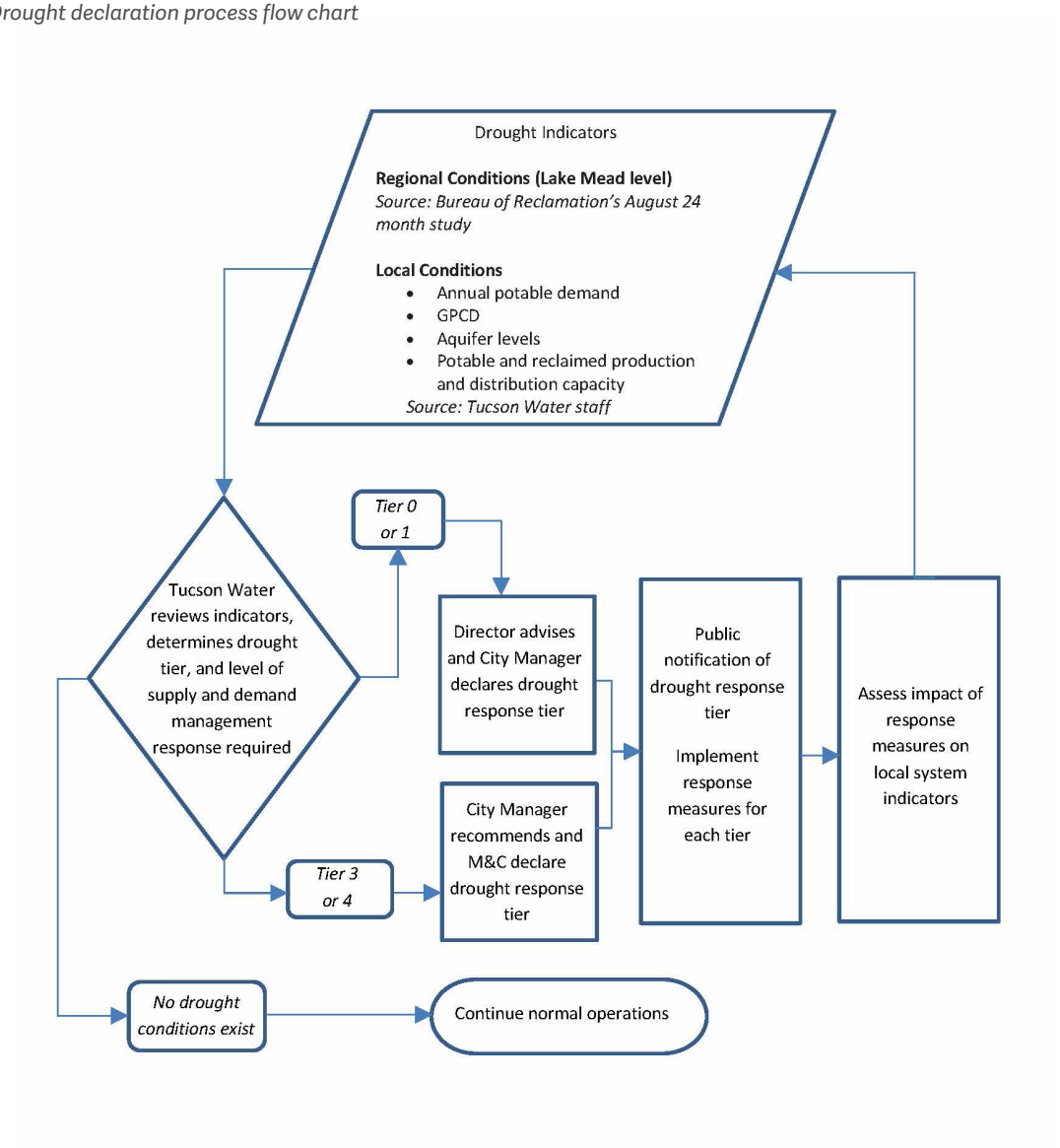
A **Tier 0** drought response will be declared by the City Manager, on the advice of the Water Director, when the water level in Lake Mead is between 1090' and 1075'.

A **Tier 1** drought response will be declared by the City Manager, on the advice of the Water Director, when the water level in Lake Mead falls below 1075'.

A **Tier 2** drought response will be declared by Mayor and Council, upon the recommendation of the City Manager, When the water level in Lake Mead falls below 1045'.

A **Tier 3** drought response will be declared by Mayor and Council, upon the recommendation of the City Manager, when the water level in Lake Mead falls below 1025' above sea level or the volume of water delivered by the Central Arizona Project to Tucson Water is less than annual demand.

Figure 4.1: Drought declaration process flow chart



When the conditions warranting declaration of **Tier 0** or **1** no longer exist, the Director will advise the City Manager that the drought response level should be terminated or reduced. The Manager will declare the change or termination of **Tier 0** and **1**. When the conditions warranting declaration of **Tier 2** or **3** no longer exist, the Director will recommend the change or termination of the drought level to the City Manager and the Mayor and Council. Changes in, or termination of, **Tiers 2** and **3** will require the approval of the Mayor and Council. Response measures will be reduced to the appropriate level as drought levels are terminated or reduced.

Customer Notification

Upon approval by the City Manager and/or Mayor and Council, the Director shall instruct the Utility's Public Information and Conservation Office to notify customers of the drought level. Declaration of any drought level will initiate public education and information programs to advise and educate customers on potential drought impacts in the Tucson Water service area and the need for possible conservation measures. Public notification will be made through various channels including but not limited to media releases and water bill inserts.

DROUGHT RESPONSE MEASURES

This section describes various measures that the City of Tucson and Tucson Water customers will undertake in response to the four drought tiers. Drought response measures supplement rather than replace ongoing water conservation and education programs. The measures were developed based on the following general principles:

1. Emphasize the need for visible leadership from City-maintained facilities.
2. Proactively educate all customers on the importance of using water efficiently regardless of climatic conditions
3. Avoid or minimize economic impacts to the community except under extreme conditions.
4. Ensure that water use recommendations do not impact community health and safety

The City of Tucson will lead by example by implementing drought response measures before customers are asked to implement similar measures. For the purpose of this plan, Tucson Water customers have been categorized into three general categories: residential, commercial, and reclaimed. The residential category includes both single family and multi-family customers. The commercial category includes commercial, industrial, and institutional customers. Reclaimed water customers purchase water through the reclaimed system and most of these customers are commercial, but some are residential.

TIER 0 DROUGHT

City of Tucson response measures:

Continuation of Tucson Water's conservation program as described in the most recent annual report (www.tucsonaz.gov/files/water/docs/FY18-19-Conservation-Report-Final.pdf).

Public notification and education campaign based on current drought conditions and response measures for all customers through public information channels (news media, social media, public events, and bill inserts).

Departments initiate plans to conduct water audits for a representative sample of each department's properties to maintain and/or increase efficiency.

Tucson Water develops water use guidelines for residential, commercial, and reclaimed customers using historic consumption data for both indoor and outdoor end uses.

Tucson Water continues or accelerates ongoing operations such as well drilling and maintenance to ensure that production and distribution capacity exceed peak demand. Other Utility programs, like meter replacement and water loss management, will also be continued or accelerated.

Residential, commercial, and reclaimed customers response measures:

Increased awareness of drought conditions and conservation options.

TIER 1 DROUGHT

City of Tucson response measures:

Continuation of Tier 0 measures:

- Conservation program
- Public notification and education campaign
- City-wide water audits
- Development of water use guidelines for all customers
- Tucson Water well drilling and system maintenance

Additional measures: Departments will implement recommendations that were identified during Tier 0 water audits. Tucson Water will provide targeted conservation program information for customers whose consumption exceeds the water use guidelines. Mayor and Council will initiate an automatic review of the Water Service Area Policy (WSAP) to consider suspending new requests for water service through Pre-Annexation Development Agreements and assess whether other adjustments to the WSAP are needed.

Residential and commercial customer response measures:

Continuation of Tier 0 measures:

- Increased awareness of drought conditions and conservation options

Additional measures: Customers will receive information about water use guidelines that are specific to their historic consumption. If a customer's consumption exceeds those guidelines, they will receive targeted conservation recommendations.

Reclaimed customer response measures:

Continuation of Tier 0 measures:

- Increased awareness of drought conditions and conservation options

Additional measures: Reclaimed customers will receive information about water use guidelines that are specific to their historic consumption. If a customer's consumption exceeds those guidelines, they will receive targeted conservation recommendations.

Potable water will not be available as a backup supply for the reclaimed system, unless a delivery system failure occurs.

TIER 2 DROUGHT

City of Tucson response measures:

Continuation of Tier 0 & 1 measures:

- Conservation program
- Public notification and education campaign
- Tucson Water system maintenance
- Implementation of water efficiency and conservation recommendations based on water audits
- Establish water use guidelines
- Provide targeted conservation recommendations for residential, commercial, and reclaimed customers

Additional measures: Tucson Water will provide water audit assistance for customers whose consumption continues to exceed water use guidelines. Water efficiency and conservation recommendations will be developed based on audit results.

Mayor and Council may consider a drought surcharge to fund possible increases in Central Arizona Project costs, expenses related to establishing water use guidelines, providing targeted conservation outreach, and increased water waste monitoring and enforcement (for more information on the water waste ordinance see Appendix B). The surcharge will be implemented through Tucson Water's rate change process, subject to the same review and approvals as other rates and charges. Mayor and Council will suspend new requests for water service through Pre-Annexation Development Agreements and assess whether other adjustments to the WSAP are needed.

Residential, commercial, and reclaimed customer response measures:

Continuation of Tier 0 & 1 measures:

- Increased awareness of drought conditions and conservation options
- Awareness of water use guidelines
- Implement targeted conservation recommendations, if necessary
- Potable water will not be available as a backup supply for the reclaimed system (with the exception of system delivery failures)

Additional measures: Residential, commercial, and reclaimed customers whose consumption continues to exceed water use guidelines will be required to conduct water audits. Tucson Water will provide water audit assistance and develop water efficiency and conservation recommendations based on those audits.

TIER 3 DROUGHT

City of Tucson response measures:

Continuation of Tier 0, 1, and 2 measures:

- Conservation program
- Public notification and education campaign
- Tucson Water system maintenance
- Implementation of water efficiency and conservation recommendations based on water audits
- Establish water use guidelines and targeted conservation information for residential, commercial, and reclaimed customers
- Provide audit assistance
- Drought surcharges, if necessary

Additional measures: If water consumption does not decrease as a result of earlier drought tier responses, Mayor and Council may consider water use restrictions for customers whose consumption continues to exceed their water use guidelines. Mayor and Council may also consider policy adjustments regarding new requests for water service outside of the City limits (e.g. Pre-Annexation Development Agreements).

Residential, commercial, and reclaimed customers response measures:

Continuation of Tier 0, 1, and 2 measures:

- Increased awareness of drought conditions and conservation options
- Awareness of water use guidelines
- Following water use guidelines and implementing targeted water conservation options
- Potable water will not be available as a backup supply for the reclaimed system (with the exception of system delivery failures)

Additional measures: Customers whose consumption continues to exceed water use guidelines must implement water audit recommendations.

Table 4.1 shows the drought tiers, thresholds, and responses for both the City of Tucson and Tucson Water customers.

Water Director advises City Manager to declare Tier 0 when Lake Mead is between 1090' and 1075'
(current status in 2020)

City of Tucson response measures

- *Continuation of Tucson Water's conservation program*
- *Public notification and education campaign based on current drought conditions*
- *City departments start conducting water audits*
- *Tucson Water develops water use guidelines for residential, commercial, and reclaimed customers using historic consumption data*
- *Tucson Water continues or accelerates ongoing operations and maintenance programs to ensure that production and distribution capacity exceed peak demand.*

Residential, commercial, and reclaimed customers response measures

- *Increased awareness of drought conditions and conservation options*

Water Director advises City Manager to declare Tier 1 when Lake Mead falls below 1075'

City of Tucson response measures

- *Continue Tier 0 measures*
- *City departments begin implementing water audit recommendations.*
- *Tucson Water will provide targeted conservation program information for customers whose consumption exceeds their specific water use guidelines.*
- *Mayor and Council will initiate an automatic review of the Water Service Area Policy (WSAP) to consider suspending new requests for water service through Pre-Annexation Development Agreements and assess whether other adjustments to the WSAP are needed.*

Residential, commercial, and reclaimed customers response measures

- *Continue Tier 0 measures*
- *Customers will receive information about their water use guidelines.*
- *If a customer's consumption exceeds their guidelines, they will also receive targeted conservation recommendations.*
- *Potable water will not be available as a backup supply for the reclaimed system, unless a delivery system failure occurs.*

Continued on next page

City Manager advises Mayor and Council to declare Tier 2 when Lake Mead falls below 1045'

City of Tucson response measures

- *Continue Tier 0 & 1 measures*
- *Tucson Water will provide water audit assistance for customers whose consumption continues to exceed water use guidelines.*
- *Mayor and Council may consider a drought surcharge*
- *Mayor and Council will suspend new requests for water service through Pre-Annexation Development Agreements and assess whether other adjustments to the WSAP are needed.*

Residential, commercial, and reclaimed customers response measures

- *Continue Tier 0 & 1 measures*
- *Customers whose consumption continues to exceed water use guidelines will be required to conduct water audits.*

City Manager advises Mayor and Council to declare Tier 3 when Lake Mead falls below 1025' or the volume of water delivered by the Central Arizona Project to Tucson Water is less than annual potable demand

City of Tucson response measures

- *Continue Tier 0, 1 & 2 measures*
- *If water consumption does not decrease as a result of earlier drought tier responses, Mayor and Council may consider water use restrictions for customers whose consumption continues to exceed their water use guidelines.*
- *Mayor and Council may consider policy adjustments regarding new requests for water service outside of the City limits (e.g. Pre-Annexation Development Agreements).*

Residential, commercial, and reclaimed customers response measures

- *Continue Tier 0, 1 & 2 measures*
- *Customers whose consumption continues to exceed water use guidelines must implement water audit recommendations.*

CHAPTER FIVE

DROUGHT RESILIENCE

The main objectives of the Plan are improving the community's resilience to drought impacts and reducing reliance on groundwater. Decades of water supply and distribution system planning have increased our supply diversity, infrastructure redundancy, water savings, and aquifer levels.

Renewable Colorado River water delivered through the CAP is the Utility's primary potable source of water. Finite groundwater resources are available as a backup, but would only be used in the extremely unlikely event of a complete loss of CAP deliveries and after long-term savings of Colorado River water have been depleted. Reclaimed water is wastewater that has been treated to high quality standards and it is used primarily for irrigation (watering golf courses and turf at parks and schools, etc.). The reclaimed system is completely separate from the potable or drinking water system. Tucson was one of the first communities in the country to reduce potable water consumption with a reclaimed system. Rain and stormwater harvesting are the most recent additions to the Utility's diverse water supply portfolio. Using harvested water to irrigate trees and plants further offsets or reduces potable water use. Tucson Water has an ambitious goal of reducing water loss in the distribution system down to 4% and enforces a rigorous water waste ordinance. These approaches, as well as the Utility's highly successful conservation program, have helped reduce overall water consumption. In fact Tucson's GPCD is among the lowest in the southwest.

Having access to groundwater as a backup supply in case there are any issues with the CAP delivery system provides the Utility with infrastructure redundancy, increasing our overall system reliability. Isolated water systems depend solely on groundwater but can be backed up with recovered CAP water if need be. Supply diversity and infrastructure redundancy provide a great deal of resilience to the Tucson Water supply system during water emergencies as well as during times of local drought.

Tucson Water's resource planning and system design staff acknowledge the similarity in certain operational responses to water emergencies and severe drought conditions while recognizing that drought itself is not an emergency situation. Drought does not occur suddenly and without warning. Rather, careful observation of key drought indicators will allow for implementation of responses to avoid reaching emergency conditions. This is the primary motivation for replacing the Emergency Water Ordinance responses in Chapter 4 with a more strategic, data driven approach like targeting customers whose consumption exceeds expected water use guidelines. The Utility's conservation program is developing water use guidelines for each customer category that incorporates information about their specific building types, business types, and landscape types. Customers will receive tailored information about efficiency incentives and how their consumption compares to the expected use guidelines.

Although water demands are projected to increase based on growth in the residential and commercial customer sectors, Tucson Water's robust and reliable water resources portfolio is capable of meeting customer needs for decades to come. Preliminary demand projections for the One Water 2100 master plan indicate that even in a high growth scenario, demand will not exceed the Utility's current CAP allocation for the next 80 years (Jacobs, 2020).

The demand projections do not include wheeled water, but it is important to note how wheeling bolsters regional drought resilience. Because Tucson Water wheels renewable Colorado River water to other water providers, it is less likely that they would need to request emergency supplies from Tucson Water.

Long-term reliance on groundwater is not a preferred alternative, and is not advisable from a regulatory or environmental standpoint. If demand begins to exceed the City's CAP allotment, the long-term storage of Colorado River water would be used first. Groundwater supplies that are described in the City's Designation of Assured Water Supply are also available as a back up to the Utiity's annual CAP allocation. Groundwater supplies are also augmented every year by reclaimed recharge projects like the Santa Cruz River Heritage Project.

Diversifying water supplies and increasing water savings has made the Utility more drought resilient, not just now but well into the future. Integrating climate change adaptation into both long range and drought planning will be a key aspect of maintaining our drought resilience. The 2020 update of Tucson Water's drought plan also makes the thresholds for each drought level consistent with the Lake Mead water elevations used for each tier in the DCP. The DCP formalized the commitment of seven states and the federal government to take collaborative action to protect and enhance the sustainability of the Colorado river system on behalf of the estimated 40 million people who rely on it.

GLOSSARY

Aquifer: A body of rock or sediments sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

Aquifer Storage Index: Groundwater levels in the aquifer as measured at selected wells and compared to groundwater levels in a particular (index) year.

Arizona Department of Water Resources (ADWR): A department of state government responsible for water management and administration of water-related programs within the State.

Arizona Drought Monitoring Technical Committee (ADMTC): This committee was formed by the Governor's Drought Task Force. It monitors data like climate, weather forecasts, and physical drought conditions. The committee determines drought conditions based on these data.

Arizona Water Banking Authority: An institution established in 1996 by the legislature to help secure the state's full entitlement of Colorado River water through the Central Arizona Project.

Assured Water Supply: An ADWR requirement that all new developments in "active management areas" (geographical regions of the state subject to regulation by ADWR) must demonstrate a 100-year water supply that is of adequate quality, continuously available, consistent with the management plan and management goal of the AMA, and that there is financial capability to construct the water facilities available for the proposed use.

Central Arizona Project (CAP): A federal water project designed to bring water from the Colorado River to central and southern Arizona. The Central Arizona Project includes 336 miles of canal and pipeline and 14 pump stations.

Conservation: Techniques for saving water that reduce demand.

Climate Change: Any trend or persistent change in the statistical distribution of climate variables (temperature, humidity, wind speed, etc.).

Cycles of Concentration: A principal measure of water use efficiency in a cooling tower, which are commonly used for cooling in large-scale commercial and industrial facilities. Cycles of concentration refers to the ratio of chemical constituents in cooling tower bleed-off water to constituents on the make-up (fresh) water that is added to the tower to perform its cooling.

Demand: The amount of water being used.

Demand Offset: A program whereby a water user agrees to reduce water use in one area in order to consume water in another. (Example: A developer agrees to pay to retrofit older housing with water-efficient plumbing fixtures in order to construct new homes.)

Demand Reductions: Measures taken by a water utility to reduce the use of potable water in response to drought or supply insufficiency conditions.

Drought: A sustained natural reduction in precipitation that results in negative impacts to the environment and human activities.

Drought Impact: The effects of a drought.

Drought Preparedness: The act of planning to decrease the impacts of drought by implementing measures and or developing other water supplies to reduce water demand as drought conditions worsen.

Drought Tier: The level of drought severity. There are four tiers in the drought plan.

Economic Hardship: A threat to an individual's or business' primary source of income.

Effluent: Treated municipal wastewater.

Essential Uses: Water uses related to maintaining the health, welfare, safety, and public sanitation needs of the community.

Firm or Firming: The act of securing Colorado River water supplies by recharging and storing available excess supply in underground recharge basins in order to meet anticipated future declared shortages on the Colorado River.

Fountain: An ornamental water-using fixture for purely aesthetic purposes.

Gallons per Capita per Day (GPCD): As used in the Plan, GPCD is calculated by taking all potable water produced divided by the population the water system serves, and dividing the result by 365.

Groundwater: That portion of water beneath the surface of the earth that can be recovered with wells or that flows naturally to the earth's surface via seeps or springs.

Indicator: A variable that changes as drought conditions change (example--Colorado River water availability).

Long-term Drought: When sustained precipitation deficits over time periods of one to several years affect surface and subsurface water supplies.

Mitigation: Actions or programs that reduce drought risk and impacts and enhance recovery.

Ordinance: A municipal regulation.

Potable Water: Water that meets the U.S. Environmental Protection Agency and/or the State's drinking water (water-quality) standards.

Potable Water Production Capacity: The amount of potable water that can be delivered reliably by the potable system for a 30-day (peak) time period.

Public Notification: Notice of drought response stage provided to Tucson Water customers and the general public through local media sources as a result of news releases and/or Tucson Water bill inserts.

Reclaimed Water: Wastewater treated to a quality suitable for non-potable applications such as landscape irrigation, decorative water features, non-food crops, and certain industrial uses.

Reclaimed Water Production Capacity: The sustainable amount of water that can be extracted from the Sweetwater Recharge and Recovery Facility.

Recharge: Water that replenishes an aquifer by surface infiltration or by other natural or induced means.

Recovery or Recover: The practice of pumping water that has been artificially recharged to an aquifer.

Secondary effluent: Wastewater that has been treated to a higher quality.

Short-term Drought: Measured by the departure of precipitation or another drought indicator from average conditions on a time-scale from one to several seasons, an example being a dry winter with little rain for a year.

Supervisory Control and Data Acquisition (SCADA): a computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control a plant or equipment in various industries and utilities. Tucson Water uses a SCADA system to monitor the water production and distribution system described in this plan.

Supply Insufficiency: Supply insufficiency occurs when water available in an area is not sufficient to meet immediate unrestricted demand.

Surface Water: Water that is on the earth's surface, such as in a stream, river, or lake.

Total Demand: The volume of water a water provider is required to produce to meet the needs of all potable and nonpotable customers.

Tucson Active Management Area (Tucson AMA): The Tucson AMA is one of five AMAs in the state that were established pursuant to the 1980 Groundwater Management Act. The State's Active Management Areas were established to provide long-term management and conservation of their limited groundwater supplies.

Triggers: The value or combined value of one or more indicators that cause a change from one drought response stage to another.

Vulnerability: For purposes of this Plan, vulnerability is defined as the probable susceptibility to drought impacts (damage) related to economic, social, and environmental conditions in the community, as mitigated by system characteristics such as reliability and redundancy.

Water Resources: A source of water supply or supplies.

Watershed: The area drained by a river system.

Water Year: A timeframe often used by surface water providers to delineate one year's operation, usually October 1 to September 30, to coincide with the federal budget fiscal year timeframe.

APPENDIX A
DROUGHT RESPONSE PLAN ORDINANCE 10380

(Editor's Note: The City of Tucson Mayor and Council unanimously approved the drought response plan on November 28, 2006. The implementing ordinance was subsequently adopted March 20, 2007.)

Sec. 27-110. Purpose.

This article establishes a city drought preparedness and response plan.
(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-111. Declaration of policy.

It is hereby declared that, because of varying conditions related to water resource supply and distribution system capabilities during drought, it is necessary to establish and to enforce drought response stages and drought response measures to ensure that the water resources available to the city are put to the maximum beneficial use; that unreasonable use, or unreasonable method of use is prevented; and that conservation of water is accomplished in the interests of the customers of the city and for the public health, safety, and welfare.(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-112. Application.

(a) This article applies to all departments of the city, and to all city water customers who own, occupy, or control water use on any premises as defined in section 27-10.

(b) No person shall make, cause, use, or permit the use of water received from the department for residential, commercial, industrial, governmental or any other purpose in any manner contrary to any provision in this article.

(c) Mandatory drought response measures shall be implemented based upon the declaration of drought response stages pursuant to section 27-115.

(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-113. Declaration of drought response stages, implementation, termination.

(a) Stage 1 or Stage 2 drought response will be declared by the city manager, or any designee, on the advice of the director. A Stage 3 or Stage 4 drought response will be declared by the mayor and council, or any designee, upon the recommendation of the city manager.

(b) The director shall develop guidelines which set forth general criteria to assist the city manager or mayor and council, or any designee, in determining drought response stages.

(c) Following the declaration of any drought response stage, the department will implement appropriate response actions, including but not limited to public notification and various drought response measures.

(d) The director will continually monitor drought conditions and promptly recommend that the drought stage level increase if conditions worsen. Similarly, the director will advise the city manager to rescind Stage 1 or 2, or to recommend termination of Stage 3 or 4, if warranted by lessened drought conditions.

(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-114. Triggers for each drought response stage.

Each drought response stage will be triggered by specific conditions related to the availability of Colorado River water and/or local water system indicators, such as well and distribution system operating capacities:

(a) Stage 1 trigger: A severe and sustained drought on the Colorado River watershed and/or any declaration of drought status above normal in the Santa Cruz Watershed by the Arizona Drought Monitoring Technical Committee.

(b) Stage 2 trigger: A declaration by the Secretary of the Interior of a shortage on the Colorado River that results in a reduction in Central Arizona Project (CAP) water deliveries to agricultural, other non-municipal users, or to excess users, OR, a deterioration in local water system indicators in conjunction with a drought status above normal for the Santa Cruz Watershed.

(c) Stage 3 trigger: Continuing shortages on the Colorado River resulting in reductions in CAP deliveries to municipal subcontractors, including the city, OR, a further deterioration in local water system indicators in conjunction with a drought status above normal for the Santa Cruz Watershed.

(d) Stage 4 trigger: Additional reductions to CAP municipal deliveries, a further deterioration of local system indicators, and/or a failure to significantly reduce water demand in Stage 3.

(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-115. Response actions for each drought response stage.

Upon declaration of a drought response stage the director shall be authorized to implement and enforce any or all of the drought response measures for a specific drought response stage included in the last-adopted Drought Preparedness and Response Plan on file with the city clerk's office.

(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-116. Variances.

The director, or the director's designee, is authorized to review special cases within which strict application of this chapter would result in serious hardship to a customer. A variance may be granted only for reasons involving health, safety or economic hardship. Application for variance from requirements of this article must be made on a form provided by the director. The department may charge a fee to process a variance request.

(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-117. Violation.

(a) Violations of this article will result in a written notice placed on the property where the violation occurred. A duplicate will be mailed to the person who is regularly billed for the service where the violation occurs and to any person known to the department who is responsible for the violation or its correction. The notice will describe the violation and order that it be corrected, ceased or abated immediately or within such specified time as the department determines is reasonable under the circumstances. The notice of violation will contain a description of the possible fees and penalties associated with said violation. If the order is not complied with, the department may disconnect the service where the violation occurs and the then current disconnection charge will be applied to the customer account. Reconnection of any service disconnected for non-compliance will require payment of the then current complete new service connection charge in addition to other fees or charges imposed by this ordinance for disconnection of service.

(b) In addition to being grounds for discontinuation of service, violation of any provision of this article shall be a civil infraction. An individual or corporation convicted of violating provisions of this section shall be assessed a civil penalty of not less than two hundred fifty dollars ($250.00) or more than one thousand dollars ($1,000.00) per violation.

(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-118. Enforcement.

This article will be enforced by the department. The city manager, in consultation with the director, is authorized to designate additional city employees to assist in enforcement, should conditions warrant.

(Ord. No. 10380, § 1, 3-20-07)

Sec. 27-119. Definitions.

[The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:]

Department means the City of Tucson Water Department (Tucson Water).

Director means the Director of the City of Tucson Water Department.

Economic hardship means a threat to a primary source of income for an individual or business.

Notification to public means notification through local media, including interviews and issuance of news releases and/or department bill inserts.

(Ord. No. 10380, § 1, 3-20-07)

APPENDIX B
RELATED CITY PLANS, POLICIES, and CODES

Plans:

City of Tucson General & Sustainability Plan, 2013.
Plan Tucson.

(https://www.tucsonaz.gov/pdsd/plan-tucson)

City of Tucson Water Department, 2012. Water Plan 2000-2050, 2012 Update

(https://www.tucsonaz.gov/water/waterplan)

City of Tucson Water Department, 2008. Water Plan 2000-2050, 2008 Update

(https://www.tucsonaz.gov/water/waterplan)

City of Tucson Water Department, 2004. Water Plan: 2000-2050 (Final Draft)

(https://www.tucsonaz.gov/water/waterplan)

City of Tucson Water Department, 1997. Tucson Water Emergency Response Plan.

Policies:

City of Tucson, 1998. Mayor and Council Water Policies (Roman Numeral 3, Policies; Section C., Water Supply Management, and Development, Number 2--Contingency Plans).

Codes:

Water Waste Ordinance #9407 amending the City of Tucson Code, Chapter 27, Section 15: Waste or unreasonable use of water; violation declared a civil infraction.

It is declared that, because safe, high quality potable water and reclaimed water are a precious resource, the general welfare requires that the water resources available to the city be put to maximum beneficial use, and that the waste or unreasonable use, or unreasonable method of use, of water be prevented. For the purposes of this section, the person, corporation, or association in whose name the water utility of the city is or was last billed or who is receiving the benefit of the water supply on the premises, as defined under section 27-10, is presumed to have knowingly made, caused, used, or permitted the use of water received from the city for in a manner contrary to any provision of this section, if the water has been used in a manner contrary to any provision of this section.

A. The following uses are a waste or unreasonable use or method of use of water and are prohibited:

1. Allowing water to escape from any premises onto public property, such as alleys or streets, or upon any other person's property.
2. Allowing water to pond in any street or parking lot to a depth greater than one-quarter (1/4) inch or to permit water to pond over a cumulative surface area greater than one hundred fifty (150) square feet on any street or parking lot.
3. Washing driveways, sidewalks, parking areas, or other impervious surface areas with an open hose, or with a spray nozzle attached to an open hose, or under regular or system pressure, except when required to eliminate conditions that threaten the public health, safety, or welfare. This restriction does not apply to residential customers.
4. Operating a misting system in unoccupied non-residential areas.
5. Operating a permanently installed irrigation system with a broken head or emitter, or with a head that is spraying more than ten (10) percent of the spray on a street, parking lot, or sidewalk; this prohibition does not apply unless the head or emitter was designed to deliver more than one (1) gallon of water per hour during normal use.
6. Failing to repair a controllable leak, including a broken sprinkler head, a leaking valve, or a leaking faucet.
7. Failure to meet the fifty (50) percent rainwater harvesting requirement for landscape irrigation set forth in Chapter 6, Article VIII of the Tucson Code.

B. Any person who violates any portion of this section is guilty of a civil infraction, and shall be fined upon the first offense, a minimum of two hundred fifty dollars ($250.00); and upon the second offense within a period of three (3) years and upon each subsequent conviction within such period, a minimum of five hundred dollars ($500.00). The imposition of civil liability shall not preclude the city from taking any other enforcement actions permitted under section 27-14 or section 27-97 of this chapter.

(1953 Code, ch. 25, § 16; Ord. No. 6096, § 1, 10-1-84; Ord. No. 7547, § 2, 1-7-91; Ord. No. 9407, § 1, 6-19-00; Ord. No. 10597, § 2, 10-14-08)

Emergency Water Conservation Ordinance #8564, amending Chapter 27, Article VII of the Tucson City Code

Sec. 27-90. Purpose.

This article establishes a city emergency water conservation response plan.

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-91. Declaration of policy.

It is hereby declared that, because of varying conditions related to water resource supply and distribution system capabilities, it is necessary to establish and to enforce methods and procedures to ensure that, in time of emergency shortage of the local water supply, the water resources available to the city are put to the maximum beneficial use, that the unreasonable use, or unreasonable method of use is prevented, and that conservation of water is accomplished in the interests of the customers of the city water department and for the public health, safety, and welfare.

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-92. Application.

A. This article applies to all departments of the city, and to all city water customers who own, occupy, or control water use on any premises as defined in section 27-10.

B. No person shall make, cause, use, or permit the use of water received from the city water department for residential, commercial, industrial, governmental or any other purpose in any manner contrary to any provision in this article.

C. Mandatory emergency conservation measures shall be implemented based upon the declaration of an emergency pursuant to section 27-93.

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-93. Declaration of water emergency authorized.

The mayor and council or, in the absence of a quorum, the mayor or the mayor's designate, upon the recommendation of the director of the city water department is hereby authorized to declare a water emergency and to implement mandatory conservation measures as set forth in this article.

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-94. Implementation, termination.

A. The director of the water department shall develop guidelines which set forth general criteria to assist the mayor and council, or in the absence of a quorum, the mayor or the mayor's designate in determining when to declare a water emergency. Upon declaration of a water emergency, the city manager shall report in writing to the mayor and council providing the reasons for and expected duration of such emergency and describing implementation of emergency water conservation measures.

B. Upon the cessation of the condition or conditions giving rise to the water emergency, or upon majority vote of the mayor and council, or in the absence of a quorum, the mayor or the mayor's designate shall declare the water emergency terminated. Upon such termination, the mandatory conservation measures shall no longer be in effect.

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-95. Mandatory emergency water conservation measures.

Upon declaration of a water emergency and notification to the public, the following mandatory restrictions upon nonessential uses shall be enforced:

1. All outdoor irrigation, except for those areas irrigated with reclaimed water, is prohibited. If the city manager deems it appropriate, a schedule designating certain outdoor watering days may be implemented in place of the irrigation ban.
2. Washing of sidewalks, driveways, parking areas, tennis courts, patios or other paved areas with water from any pressurized source, including garden hoses, except to alleviate immediate health or safety hazards, is prohibited.
3. The outdoor use of any water-based play apparatus connected to a pressurized source is prohibited.
4. Operation of water cooled space and equipment cooling systems below an operating efficiency level of two cycles of concentration is prohibited.
5. Restaurants and other food service establishments are prohibited from serving water to their customers, unless water is specifically requested by the customer.
6. Operation of outdoor misting systems used to cool public areas is prohibited.
7. The filling of swimming pools, fountains, spas or other exterior water features is prohibited.
8. The washing of automobiles, trucks, trailers and other types of mobile equipment is prohibited, except at facilities equipped with wash water recirculation systems, and for vehicles requiring frequent washing to protect public health, safety and welfare.

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-96. Variances.

The city manager, or the city manager's designate, is authorized to review hardship cases and special cases within which strict application of this chapter would result in serious hardship to a customer. A variance may be granted only for reasons involving health, safety or economic hardship. Application for variance from requirements of this chapter must be made on a form provided by the director.

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-97. Violation.

A. In the event of any violation of this article, a written notice shall be placed on the property where the violation occurred and a duplicate mailed to the person who is regularly billed for the service where the violation occurs and to any person known to the department who is responsible for the violation or it's correction. Such notice shall describe the violation and order that it be corrected, ceased or abated immediately or within

such specified time as the department determines is reasonable under the circumstances and shall contain a description of the fees and penalties associated with such violation. If such order is not complied with, the department may forthwith disconnect the service where the violation occurs. A two hundred fifty dollar ($250.00) fee shall be imposed for the reconnection of any service disconnected pursuant to noncompliance, which shall be in addition to other fees or charges imposed by this chapter for disconnection of service.

B. In addition to being grounds for discontinuation of service, violation of any provision of this article shall be a civil infraction. An individual or corporation convicted of violating provisions of this section shall be assessed a civil penalty of not less than two hundred fifty dollars ($250.00).

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-98. Enforcement.

The city manager is authorized to designate city employees to enforce the provisions of this article.

(Ord. No. 8461, § 1, 3-20-95)

Sec. 27-99. Definitions.

Department means the city water department.

Director means director of the city water department.

Economic hardship means a threat to an individual's or business' primary source of income.

Notification to public means notification through local media, including interviews and issuance of news releases.

Outdoor watering day means a specific day, as described in a specific outdoor watering plan, during which irrigation with sprinkler systems or otherwise may take place.

(Ord. No. 8461, § 1, 3-20-95)

Xeriscape Ordinance #7522, amending Section 7.6 of the Unified Development Code

WHEREAS, the City of Tucson is located in the Sonoran Desert, an area with limited water resources; and

WHEREAS, water conservation is vital to the future health, safety and economic well-being of the residents of Tucson; and

WHEREAS, the City of Tucson has entered into an agreement with the State of Arizona, Department of Water Resources, to adopt a landscape ordinance containing regulations and standards for water conservation in landscaping design; and

WHEREAS, the use of drought tolerant plantings, xeriscape landscape design and the minimum use of turf reduce water use for landscaping; and

WHEREAS, unpaved areas with vegetation assist in groundwater recharge; and

WHEREAS, areas of vegetation reduce urban heat islands which can result in overall temperature increases within the City; and

WHEREAS, the retention of native vegetation and the use of drought tolerant plants promote the southwestern image of the City and create an attractive appearance along City streetscapes;

The full text of the xeriscape code can be found here: https://codelibrary.amlegal.com/codes/tucson/latest/tucson_az_udc/0-0-0-5860

Mayor and Council adopted the 2018 International Building Codes and they became effective as of January 1st, 2019. The following parts of the code are most pertinent to water conservation:

- International Plumbing Code, 2018 (https://codes.iccsafe.org/content/IPC2018?site_type=public)
  - Section 604.4 establishes the maximum flow rates for fixtures.
- International Energy Conservation Code, 2018 (https://www.iccsafe.org/codes-tech-support/codes/2018-i-codes/iecc/)
  - Section C404.5 regulates hot water supply in buildings and establishes maximum piping runs.

APPENDIX C
REFERENCES

American Water Works Association (AWWA), 2002. Drought Management Handbook AWWA Water Shortage Subcommittees, AWWA Water Conservation Committee

Arizona Department of Water Resources, 2006 System Water Plan Guidance Document www.water.az.gov/dwr

Arizona Department of Water Resources, 2006 Drought Monitor Report (various issues), Governor's Task Force Monitoring Technical Committee

Arizona Department of Water Resources, 2014 Designation of Assured Water Supply for the City of Tucson (DWR No. 86-400957 .000 l)

Arizona Governor's Drought Task Force, Governor Janet Napolitano, 2004. Arizona Drought Preparedness Plan: Operational Drought Plan https://drought.unl.edu/archive/plans/Drought/state/AZ_2004.pdf

Arizona Hydrological Society Symposium, 2006 Climate Change and Drought Workshop, Glendale Civic Center, Glendale, Arizona

Basefsky, Mitch (Stakeholder Outreach Coordinator with the Central Arizona Project). "RE: LADCP tiers and correlation to CAP cuts" Message to Kris LaFleur (Intergovernmental Affairs with Tucson Water). June 21, 2021. Email.

City of New York, 1998 Drought Management Plan and Rules City of New York Department of Environmental Protection

City of Peoria, Arizona, 2003 Drought Contingency Plan City of Peoria Utilities Department, Water Resource and Conservation Division

City of Phoenix, Arizona, 2000 Drought Management Plan City of Phoenix Water Services Department

City of Scottsdale, Arizona (not dated) Drought Management Plan City of Scottsdale Water Department

City of Tucson Water Department, 2004 Water Plan: 2000-2050 (Final Draft)

City of Tucson Water Department, 2008 Water Plan 2000-2050, 2008 Update

City of Tucson Water Department, 2012 Water Plan 2000-2050, 2012 Update

City of Tucson Water Department, 2018 Status of the Aquifer

City of Tucson Water Department, 2019 Conservation Program FY 2018 – 2019 Annual Report

City of Tucson Water Department, 2019a Hydronet https://hydronet-test.central.tucsonaz.gov/

City of Tucson Water Department, 2019b Focus 21

City of Tucson Water Department, 2020 Annual Update of Water Checkbook and Savings Account Report

City of Tucson Water Department, 2020a Reclaimed Annual Report

Climate Assessment for the Southwest (CLIMAS) Project; University of Arizona Cooperative Extension 2006 Southwest Climate Outlook (various issues) https://climas.arizona.edu/

Climate Central, 2019 American Warming: The Fastest-Warming Cities and States in the U.S.

HDR, 2020 Draft Climate Change Technical Memorandum

Jacobs, 2020 Draft Water Use Projections Technical Memorandum

National Drought Mitigation Center, U.S. Drought Monitor web site: www.drought.unl.edu/dm/monitor.html

Pima County and City of Tucson, 2015 Low Impact Development and Green Infrastructure Guidance Manual

Pima County, Arizona, 2006 Pima County Drought Management Plan (draft)

Southern Nevada Water Authority, 2005 Drought Plan (supplement to the Authority's Water Resource Plan.)

Udall, B. and J. Overpeck. 2017. The twenty-first century Colorado River hot drought and implications for the future. Water Resouces Research.https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016WR019638