WASHINGTON COUNTY WATER CONSERVANCY DISTRICT DROUGHT CONTINGENCY PLAN

FOR

Bureau of Reclamation

WASHINGTON COUNTY WATER CONSERVANCY DISTRICT

Drought Contingency Plan

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Presented to:

Washington County Water Conservancy District
St. George, Utah

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WASHINGTON COUNTY WATER CONSERVANCY DISTRICT

DROUGHT CONTINGENCY PLAN

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EXECUTIVE SUMMARY

As Utah's hottest and driest region, and one of the nation's fastest growing metropolitan areas, Washington County is vulnerable to impacts of reduced water supply and drought. To prepare for emergency drought conditions, the Washington County Water Conservancy District (District) developed this Drought Contingency Plan (Plan) with funding from the United States Department of Interior, Bureau of Reclamation (BoR). The plan was developed in partnership with the Regional Water Supply Agreement (RWSA) members to provide a collaborative system for prioritizing drinking water under circumstances of diminishing water supply. The RWSA is comprised of representatives from the District and partnering municipalities—the cities of St. George, Washington, Hurricane, Santa Clara, Ivins, Toquerville, La Verkin, and the town of Virgin. Additional stakeholders and an established Task Force were also involved to help guide and inform the process.

Plan Elements

The Plan was developed using a working framework approved by the BoR, as a requirement of the funding agreement. This framework includes an overview of the steps involved as well as the schedule for development and feedback on key elements: mitigation measures, drought monitoring, identification of drought stages, response actions, and a vulnerability assessment.

Mitigation Measures

The District and the members of its water service area have invested heavily in conservation measures such as rebate and incentive programs to reduce water demand, successfully reducing per capita usage by more than 30% from the year 2000. The county's conservation efforts serve to increase their drought resiliency, mitigating significant impacts of water supply issues. The District and member agencies will need to continue to plan for drought emergencies by evaluating both institutional and water supply augmentation strategies.

Drought Monitoring

The District developed a drought monitoring tool for identifying drought, quantifying the drought conditions, and assessing its severity. The monitoring tool consists of a drought model and a drought dashboard. The drought model processes historical and current data to categorize water supply conditions into five numerical categories of increasing drought severity. These categories, or Drought Stages, will be directly linked to drought response actions. As the region moves from one stage to another, the drought monitoring tool will signal that change to the District. The results of the drought model with be conveyed in a comprehensible manner via the drought dashboard.

Drought Stages

The five Drought Stages (Stages) range from "0" (normal conditions) to "4" (extreme drought). The descriptors for each drought stage were carefully selected with consideration of public perception, and response actions were set to best communicate desired responses to varying drought conditions. The response actions describe, in one word, how the District, municipal partners, and the public should respond to the drought stage (see figure below).

WATER AVAILABILITY AND RESPONSE STAGES					
	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
	Normal Sustainable Supply	Abnormally Dry Decreasing Supply	Prolonged Drought Diminished Supply	Escalated Drought Deteriorated Supply	Extreme Drought Depleted Supply
Response Stage	Conserve	Caution	Concern	Alarm	Crisis

Executive Summary Figure: Five Drought Stages Identified for the District

Action Plans

The Drought Response Actions (Actions) are directly linked to the drought stages, prioritized by drought severity. The Actions are tailored toward three response groups: Residential (the public at large), Community (municipal partners), and Water Provider (the District). The Actions aligns with necessary reductions in water consumption at each drought stage and are detailed for each response group.

Vulnerability Assessment

The vulnerability assessment will identify areas of vulnerability in existing facilities, system capabilities, and water practices of the District and its customers. Additionally, the vulnerability assessment factors in climate and water demand, Utah state policy, water supply and demand, and climate change.

Communications Plans and Maintenance and Update Schedule

The Task Force will meet monthly to review technical information and make recommendations to the WCWCD Board, who will decide whether to announce a drought stage change.

The District will coordinate with its municipal partners to provide information to the public via websites, social media, and newsletters. As necessary, public outreach will extend to press announcements, advertising, signage, and enhanced collaboration.

The District will evaluate and update the Plan every five years. Evaluation of the Plan will focus on:

- The Model,
- Response Actions, and the
- Communication Plan.

Chapter 1 Introduction and Background

To prepare for emergency drought conditions and comply with Utah's water conservation requirements, the Washington County Water Conservancy District (District) developed this Drought Contingency Plan (Plan) with funding from the United States Department of Interior, Bureau of Reclamation (BoR). The plan was developed in partnership with municipal partners including: of St. George, Washington, Hurricane, Santa Clara, Ivins, Toquerville, La Verkin, and the town of Virgin. This collaborative process designed a system for prioritizing drinking water under circumstances of diminishing water supply. An official Task Force was developed to help guide this system, including representatives from the municipal partners and additional stakeholders.

1.1 Washington County Water Conservancy District

The District, a not-for-profit public agency, was established in 1962 to manage Washington County's water resources. It's charged with conserving, developing, managing and stabilizing water supplies within the county in an ongoing effort to provide a safe, sustainable water supply for current and future generations. The District is governed by an appointed board of trustees who act as county-wide representatives in overseeing District activities[1].

Initially, the District was formed at the request of local property owners for developing and managing the County's water supply. Today, the District manages reservoirs, pipelines, wells, water storage tanks, treatment plants, hydro power plants, diversion dams and sells water wholesale to several municipal customers, or municipal partners, including the cities of: St. George, Washington, Hurricane, Santa Clara, Ivins, Toquerville, La Verkin, and the town of Virgin[1].

[1] Washington County Water Conservancy District. 2022. *Washington County Water Conservancy District Website*. September 2022.

1.1.2 Plan Location

Washington County's water supply comes from a combination of surface and ground water from the Virgin River watershed which is a tributary of the Colorado River. Figure 1.1 identifies the District Municipal Partners and the Virgin River[2].

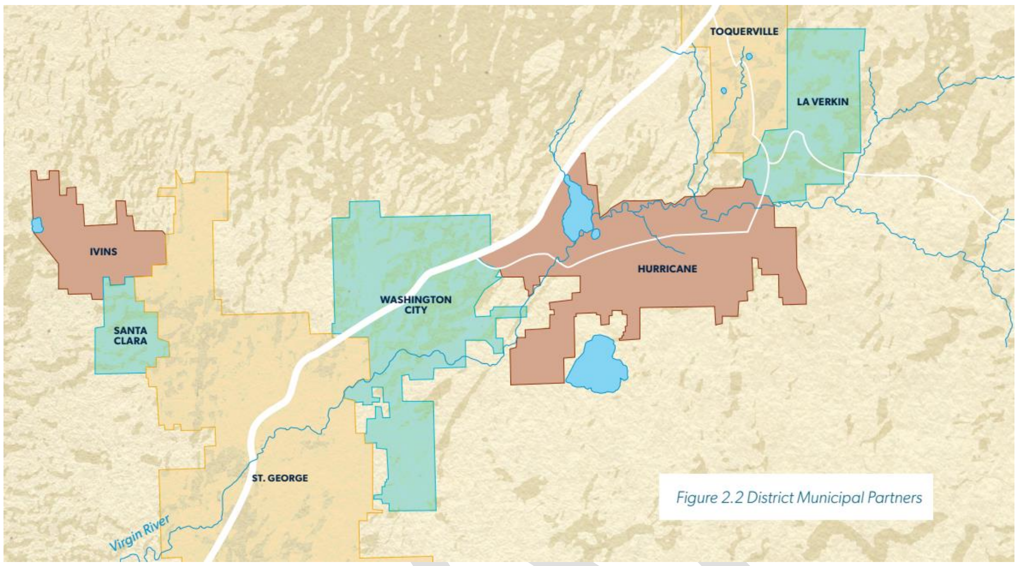

Figure 1-1 District Municipal Partners

In addition to servicing municipalities, the District manages small retail, secondary and wastewater systems, as well as an entire collection and distribution system. The District's water system includes a number of reservoirs, pipelines, wells, water storage tanks, treatment plants, hydro power plants, diversion dams and more. Figure 1-2 shows the District's current and planned components of this comprehensive water supply system[2].

[2] Washington County Water Conservancy District. 2021. *Washington County Water Conservation Plan.* Updated October 2021.

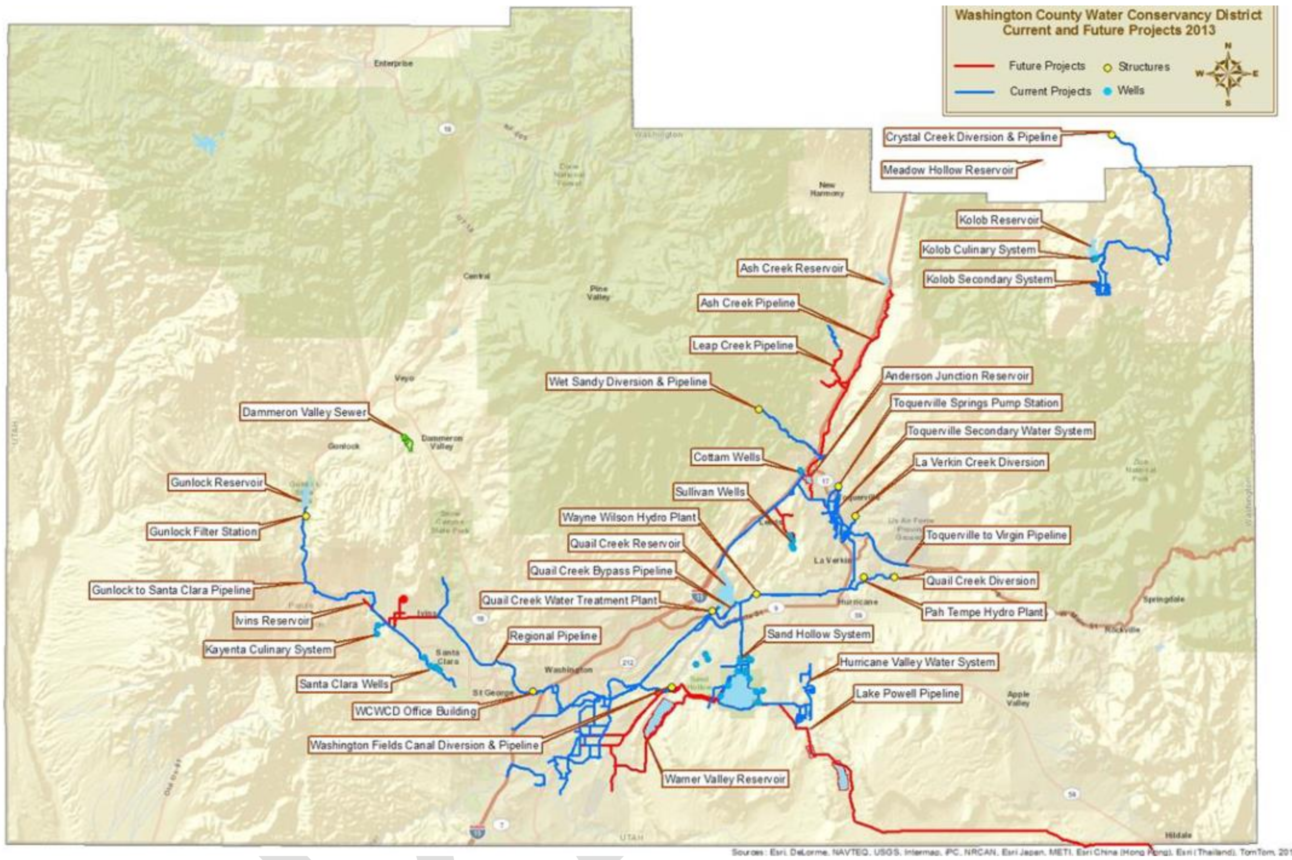

Figure 1-2 District Current and Planned Projects

Washington County is Utah's hottest and driest region, and is one of the nation's fastest growing metropolitan areas. Current state population projections estimate a 155% increase in the county by the year 2060. The main water source for Washington County, the Virgin River basin is a small desert tributary prone to drought and climate variability. As the county approaches full utilization of its annual reliable water supply, the need for more stringent water resource management increases[3].

Groundwater sources within the District's service area are closed to further appropriations by the Utah State Engineer, and most of the water in the county has been developed. Local member agencies depend on the District for future water supply. The District currently uses

[3] Washington County Water Conservancy District. 2021. *Washington County Water Conservation Plan.* Updated October 2021.

approximately 43,000-acre-feet (AF) of potable water and 15,000 AF of secondary water annually[4].

1.1.3 WCWCD Water System Overview

District water system users include the cities of St. George, Washington, Hurricane, Santa Clara, Ivins, Toquerville, La Verkin, and the town of Virgin. Table 1-1 provides information on each of the Municipal Partners and their respective conservation efforts as outlined in their individual conservation plans.

Table 1-1 WCWCD Water System Users

Municipal Partners
City of St. George • Population: 95,342[5] • Location: Located in southwestern Utah in the northeastern part of the Mojave Desert, adjacent to the Pine Valley Mountains. • Customer base: The city serves approximately 26,750 connections comprised of residential, commercial, industrial, and institutional water users • Conservation planning: The City conservation efforts include education, a rebate program for replacement of older high flow toilets, system improvements, a tiered rate structure, and adopting water conservation policies and ordinances[6].
City of Washington • Population: 27,993[5] • Location: Situated within the St. George Basin to the north are sandstone hills and the Pine Valley Mountains. • Customer base: The city serves approximately 8,681 connections, these are 92 percent residential, 6 percent commercial, and the remaining 3 serve agricultural, industrial, and wholesale • Conservation planning: The City has achieved a 24% reduction in total per capita usage in 2010 from a 2000 baseline, the City commits to achieving an additional 11 percent by

[4] Washington County Water Conservancy District. 2022. *Washington County Water Conservancy District Website*. September 202ss2.

[5] United States Census Bureau. 2022. *Census Quickfacts Website*. September 2022. Available at: https://www.census.gov/quickfacts

[6] City of St. George. 2018. *City of St. George Water Conservation Plan Update*.

2060. The City continues to support improving data collection, increasing best management and conservation measures, improving public outreach, and expanding the real water loss reduction strategies[7].

City of Hurricane

- Population: 20,036[8]
- Location: Southwestern Utah, making up the easternmost part of the St. George Metropolitan area.
- Customer base: The city serves approximately 1,343 connections
- Conservation planning: Hurricane's policy is to provide water wise education materials and the City has implemented tiered potable water rates that encourage limited use of water for outside landscaping. Additionally, the City is developing a water loss audit system to better track high water loss areas, with a goal to reduce water loss to less than 10 percent annually[9].

City of Santa Clara

- Population: 7,553[6]
- Location: Santa Clara is in the St. George Basin, to the north are Snow Canyon State Park and the Pine Valley Mountains
- Customer base: The city serves approximately 2,736 connections
- Conservation planning: The goal of Santa Clara City is to reduce the City's water use rate by 7 percent within 5 years, maintain a quality water distribution system with up-to-date technologies, educate the public about the importance of water conservation practices, and continue converting schools and parks from potable water to secondary water where feasible[10].

[7] Washington City. 2015. *Water Management and Conservation Plan.*

[8] United States Census Bureau. 2022. *Census Quickfacts Website.* September 2022. Available at: https://www.census.gov/quickfacts

[9] City of Hurricane. 2020. *Hurricane City Water Management and Conservation Plan.*

[10] City of Santa Clara. 2020. *Santa Clara City Water Conservation Plan.*

City of Ivins

- Population: 8,978[6]
- Location: West side of Washington County between the City of St. George and the City of Santa Clara on the east and Shivwits Indian Reservation on the west
- Customer base: The city is served by two water systems, one system serves approximately 370 connections, the other serves approximately 3,500
- Conservation Planning: Ivins City has implemented nearly all of the best management practices that have been recommended by the state in order to reduce water usage. Ivins City has the most expensive water rate structure in Washington County, a monthly newsletter is sent to residents, and while the City is too small to have one person in a role as conservation coordinator, the Public Works Director takes on the duties of the position[11].

City of La Verkin

- Population: 4,573[12]
- Location: La Verkin is about 20 miles northeast of St. George
- Customer base: The city serves approximately 1,505 residential connections, 269 business connections, and 194 other connections
- Conservation planning: The City plans to reduce potable water usage 5 percent by 2025, reduce irrigation usage 10 percent by 2025, reduce the average potable water system leakage slippage rates to 5 percent by 2025, and begin irrigation system metering[13].

City of Torquerville

- Population: 1,689 [14]
- Location: Toquerville is located about 30 miles south of Cedar City and Less than 20 miles north of St. George
- Customer base: The City currently has 489 customers that pay for water
- Conservation planning: The City will continue to provide new and existing users with information of xeriscaping, water usage, and conservation methods. The City has three

[11] City of Ivins. 2018. *Ivins City Water Conservation Plan.*

[12] United States Census Bureau. 2022. *Census Quickfacts Website*. September 2022. Available at: https://www.census.gov/quickfacts

[13] City of LaVerkin. 2020. *LaVerkin City Water Conservation Plan.*

[14] United States Census Bureau. 2022. *Census Quickfacts Website*. September 2022. Available at: https://www.census.gov/quickfacts

main water conservation goals: reduce the city's per capita water use rate by at least 15% in five years, maintain a financially viable water system, and maintain or improve the appearance of street landscapes, open spaces, and yards[15].

1.2 Drought Contingency Plan

1.2.1 Development of DCP

The Plan was developed using a working framework approved by the BoR, as a requirement of the funding agreement. This framework includes an overview of the steps involved as well as the schedule for development and feedback on subtasks identified. The six main subtasks outlined in this framework include: Drought Monitoring, Vulnerability Assessment, Mitigation Actions, Response Actions, Operational and Administrative Framework, and Plan Development and Update Process.

1.3 DCP Task Force and Technical Expertise

The District formed a Task Force with a representation of downstream water users and municipalities, and subject matter experts to provide insight and guidance through the planning process. The goal of the Task Force was to receive planning information and advise the planning process. The Task Force evaluated modeling efforts and were able to provide feedback on action steps and drought stages as the planning moved forward. Table 1-2 provides the names and affiliations of Task Force members.

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[15] City of Toquerville. 2013. *City of Toquerville Water Conservation Plan.*

Table 1-2 Task Force Members

Ken Richins Hurricane Representative ken@cityofhurricane.com	Dallan Wadsworth Hurricane Representative dallanw@cityofhurricane.com
Steve Meismer Virgin River Program Representative Steve.mismer@wcwcd.org	Chuck Gillette Ivins Representative cgillette@ivins.com
Tom Jorgensen Ivins Representative tjorgensen@ivins.com	Derek Imlay La Verkin Representative Drek.imlay@laverkincity.org
Dustin Mouritsen Santa Clara Representative dmouritsen@sccity.org	Kristelle Hill Santa Clara Representative khill@sccity.org
Lester Dalton Washington Representative ldalton@washingtoncity.org	Lance Gubler Toquerville Representative lance@toquerville.org
Zach Renstrom WCWCD Representative zach@wcwcd.org	Brie Thompson WCWCD Representative brie@wcwcd.org
Ryan White WCWCD Representative RyanW@wcwcd.org	Dave Jessop WCWCD Representative DaveJ@wcwcd.org
Whit Bundy WCWCD Representative Whit@wcwcd.org	Julie Gillins WCWCD Representative Julie@wcwcd.org
Marie Owens AE2S Representative Marie.owens@ae2s.com	Scott Taylor St. George Representative Scott.taylor@sgcity.org

1.3.2 Plan Development

The Task Force meets to review technical information and make recommendations to the District Board. The Board services as the policy arm of the district and is responsible for the decision making of Plan implementation. The Task Force membership is comprised of representatives of member agencies who are well versed in water supply and the technical resources of the District, while the Board is also made up of representatives of municipal partners who are policy and political decision makers. The Task Force oversaw the development of the Vulnerability Assessment, Mitigation Measures, Drought Stages, and Action plan as advisors prior to approved by the Board and implemented in the Plan.

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Chapter 2 WCWCD Service and Operations

2.1 WCWCD Service Area

Washington County is one of the fastest growing regions in Utah, comprised of several municipalities. The area covers 2,430 square miles, spanning from the most southwestern corner at the Arizona and Nevada borders, east to Zion National Park, and just north beyond the Pine Valley Mountains. Washington County is unique in that it is made up of three geographic areas: the Colorado Plateau, the Great Basin, and the Mojave Desert. Within this dry, arid region, the Virgin River Watershed is the sole source of water for the entire county.

2.2 WCWCD Water Sources

Current water supplies come from a combination of groundwater (springs and wells) and surface water (rivers) within the Virgin River Watershed.

Potable water is treated to meet or exceed drinking water standards. Secondary water is untreated water or reclaimed wastewater that does not meet drinking water standards.

Groundwater sources within the District's service area are closed to further appropriations by the Utah State Engineer. New diversions and uses can be accomplished by changing applications filed previously for approved water rights.

Washington County's municipal partners have water supplies in addition to the District. These partners are required to retain their existing water resources, rights and facilities, except to the extent that they may choose to integrate them into the District's system.

The following tables: Table 2-1 through 2-3 inventory the District's water sources and can be found in the District's Conservation Plan[16].

[16] Washington County Water Conservancy District. 2021. *Washington County Water Conservation Plan.* Updated October 2021.

Table 2-1 District's Reliable Water Supply Scenarios

Table 2.1 Washington County Water Conservancy District's Reliable Water Supply Scenarios (acre feet)

RELIABLE WATER SUPPLY	MEDIAN CLIMATE CHANGE ADJUSTED POTABLE [6]	DRIER CLIMATE CHANGE ADJUSTED POTABLE [7]	MEDIAN CLIMATE CHANGE ADJUSTED SECONDARY [6]	DRIER CLIMATE CHANGE ADJUSTED SECONDARY [7]
Cottam Well System	82	61		
Crystal Creek Pipeline	1,819	511		
Kayenta Water System (Ence & Santa Clara Wells)			359	266
Quail Creek and Sand Hollow Reservoirs	24,920	7,000		
Sand Hollow Groundwater Rights (no recharge)	3,880	2,880		
Sand Hollow Recharge and Recovery	2,728	766		
Toquerville Secondary System			658	488
TOTAL	**33,429**	**11,218**	**1,017**	**754**

Table 2-2 District's Future Potential Reliable Water Supply Scenarios

Table 2.2 Washington County Water Conservancy District's Future Potential Reliable Water Supply Scenarios (acre feet)

RELIABLE WATER SUPPLY

Ash Creek Project	1,582	444		
Culinary Well Systems	1,793	1,331		
Kayenta Water System (Ence & Santa Clara Wells)			918	681
Additional System Storage and Reuse Facilities			~20,000	~10,000
TOTAL	**3,375**	**1,775**	**~20,918**	**~10,681**

Table 2-3 District's Municipal Partner Reliable Water Supply Scenarios

Table 2.3 District Municipal Partner Reliable Water Supply Scenarios (acre feet)

TOTAL	**30,307**	**24,908**	**24,502**	**21,206**

2.3 WCWCD Water Delivery and Supply

District facilities include reservoirs, pipelines, wells, water storage tanks, treatment plants, hydropower plants, diversion dams and more. The following provides a high-level inventory of these facilities, ND information on these resources is publicly available on the District's website[17].

2.3.1 Reservoirs

The District currently operates seven reservoirs and has plans to construct additional reservoirs. The primary function of these reservoirs is to supply potable and secondary water to residents, but they also provide recreational, environmental, and social benefits as well.

Sand Hollow Reservoir

Sand Hollow Reservoir stores water from the Virgin River with 51,360 acre feet storage capacity. The reservoir is located on a natural Navajo sandstone aquifer with an underground storage capacity in excess of 300,000 acre feet.

Quail Creek Reservoir

Quail Creek Reservoir provides storage for potable water deliveries and recreational opportunities. The reservoir stores water from the Virgin River with 40,325 acre feet storage capacity.

Gunlock Reservoir

Gunlock Reservoir was developed by irrigation companies for agricultural needs. The reservoir stores water from the Santa Clara River, a tributary to the Virgin River with a 10,884 acre feet capacity.

Kolob Reservoir

The District purchased the reservoir in 1995, as well as the adjacent land. The reservoir stores water collected in the Virgin River watershed and has a 5,586 acre feet capacity.

Ivins Reservoir

Ivins Reservoir was built by early Mormon settlers and is primarily used for irrigation. The reservoir stores water from the Santa Clara River and has a 778 acre feet capacity.

[17] Washington County Water Conservancy District. 2022. *Washington County Water Conservancy District Website*. September 2022.

Three reservoirs are planned for future development: Toquer Reservoir, Dry Wash, and Warner Valley Reservoir. Toquer Reservoir is planned as part of the Ash Creek Project to store 3,640 acre feet and is anticipated to be constructed by 2025. Dry Wash Reservoir is planned for a similar timeline with an estimated storage capacity of 1,500 acre feet. Warner Valley Reservoir is still in the early stages and does not have a foreseeable timeline.

2.3.2 Treatment Plants

Quail Creek Water Treatment Plant receives water via 2 60-inch pipelines from Quail Creek Reservoir, Sand Hollow Reservoir, and the Virgin River. The plant is capable of treating 60 million gallons of water per day, sending it through pre-treatment, chemical treatment, solids removal, filtration, and disinfection before distribution. The plant was first constructed in 1986 and was expanded in 1997, 2005, 2009, and finally in 2015 to reach the 60 million gallons per day capacity. The District assumed operation and management of the plant in 2006 from the City of St. George and added a 10 million gallon storage tank in 2011 to improve operational efficiency.

The Sand Hollow Treatment Plant treats ground water pumped from several wells near the Sand Hollow Reservoir. It treats ground water by removing dissolved metals, making it an acceptable source of drinking water. The plant was built for $11 million and delivers three million gallons of water per day to the Sand Hollow Regional Pipeline. The water treatment facility also has the capacity to expand to 6 million gallons per day as demand increases.

2.3.3 Pipelines

The District supplies its municipal partners with a network of pipelines. Over 200 miles of pipeline transport water to sustain Washington County and support the population and economy. Pipelines allow for reliable water supply, easy transfer of municipal water, and a regional approach to water management and delivery.

The District is currently working with the Utah Division of Water Resources on the Lake Powell Pipeline project to provide a second water source for Washington County, nearly doubling its current water supply.

2.3.4 Diversion Dam

The Quail Creek Diversion Dam diverts water from the Virgin River with a 20-foot tall, 40-foot wide dam. The water is transported via an 8.7 mile, 66-inch steel pipeline to the Hurricane Hydropower Plant where it is delivered to either Sand Hollow or Quail Creek Reservoirs. The significance of this diversion is its location upstream from the La Verkin Hot Springs which contaminate the river system.

A 2013 improvement project replaced the dam's original gate with an upgraded stainless-steel version and rebuilt the hydraulic cylinders. The District is responsible for daily monitoring of the dam.

2.3.5 Hydropower Plants

The District owns and operates two hydropower plants: Hurricane and Quail Creek Hydropower Plants. The Hurricane Hydropower Plant was completed in 1987 and returns water to the Virgin River below the La Verkin Hot Springs. This satisfies the downstream water rights at the Washington Fields Diversion. Power generated by the Hurricane plant is sold to the power company in Hurricane City. Quail Creek Hydropower Plant was completed in 1985. All of the water transported by pipeline goes through this hydropower plant and produces power that is also sold to Dixie Power for local municipal use. Water is sent from the Quail Creek Hydro to the Quail Creek or Sand Hollow Reservoirs.

2.3.6 Hot Springs

The La Verkin Hot Springs is a natural sulfuric spring located on the Virgin River. The La Verkin Hot Springs produces approximately 5,000 gallons per minute, or more than seven million gallons daily, of 107-degree Fahrenheit water. The springs release 109,000 tons (6,813 semi-truck loads) of salt annually, making it one of the top three natural pollutants of the Colorado River system.

2.3.7 Wells

The District currently owns and operates more than two dozen production wells in the Virgin River watershed. The wells produce an average of 4,000 acre feet of water per year. Additional well development is planned for the future. Well development has been in the District's plan for some time, and in 2022 an application to appropriate water from deep wells in the Hurricane Fault was filed with the Utah State Engineer for consideration. Figure 2-1 shows a map of wells managed and maintained by the District.

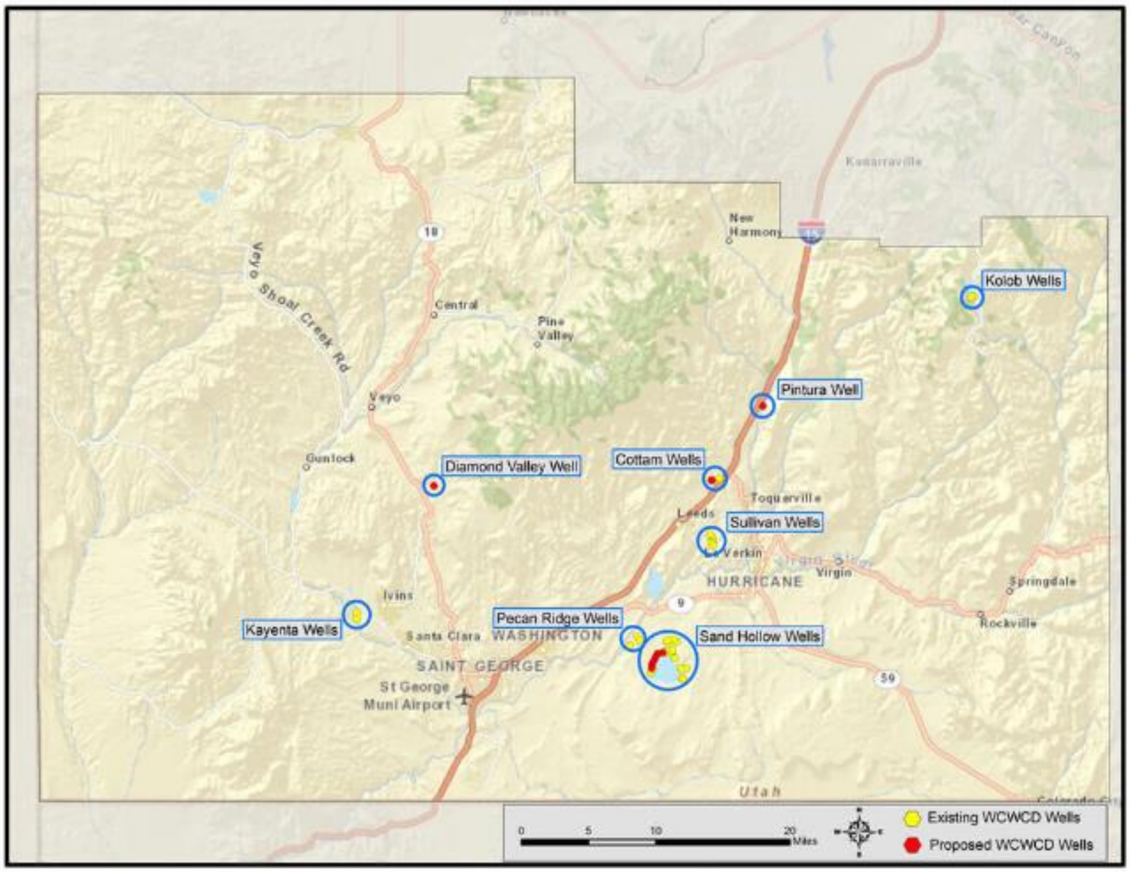

Figure 2-1 Wells Owned and Operated by the District

Figure 2-2 shows the current and planned projects for the District, while Figure 2-3 shows the water demand for Washington County.

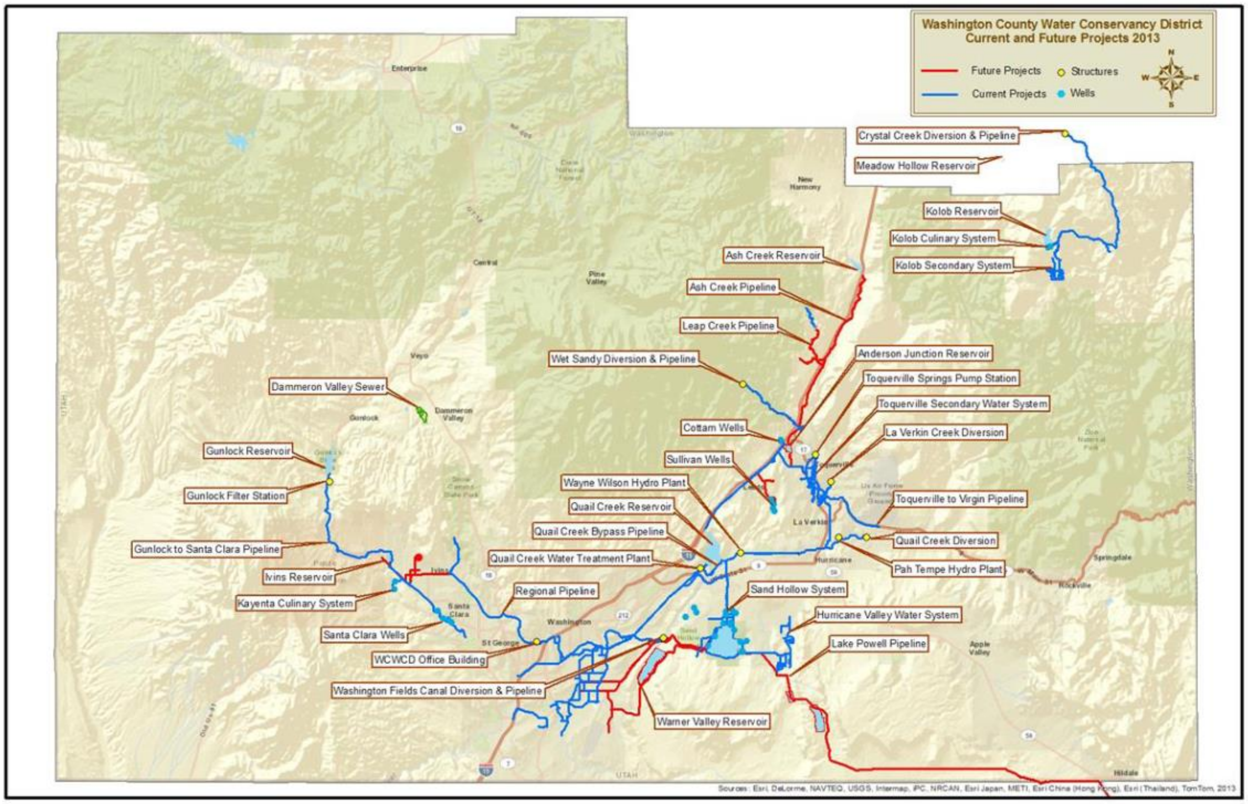

Figure 2-2 District's Current and Future Projects

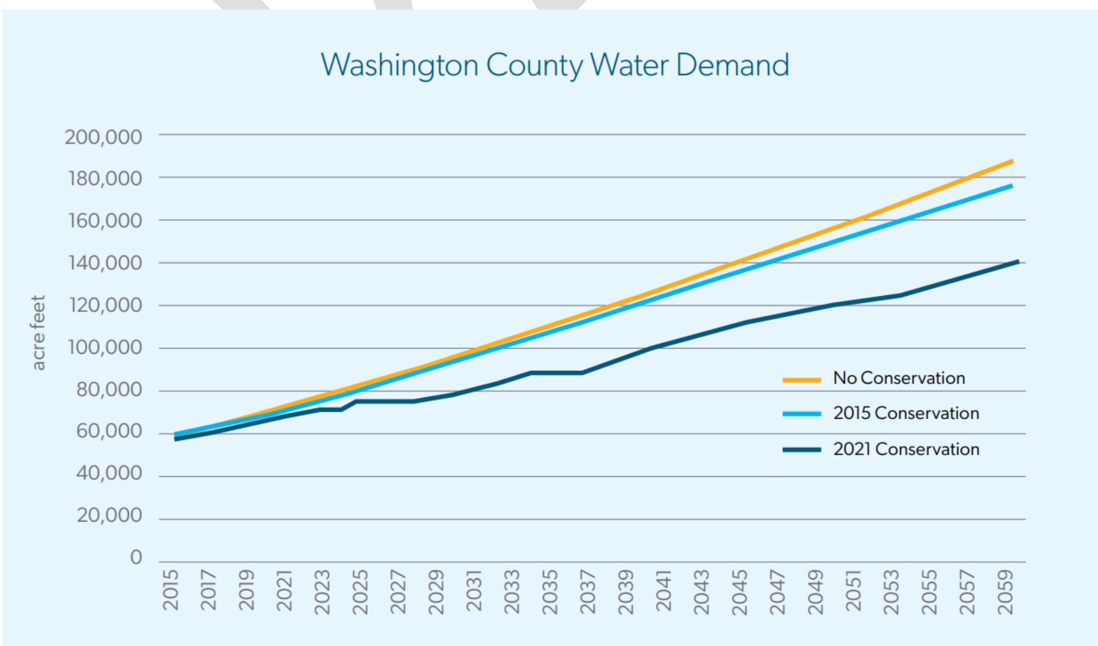

Figure 2-3 District's Water Demand

2.4 WCWCD Current and Future Demands

As of 2023, most of the available water in the county has been developed and water rights are not available. Additionally, water demand has increased with population growth and development, and the region often experiences long periods of drought. As a result, the District and local municipalities are pursuing a strategy of maximizing their locally available water through conservation, development of a regional reuse system, desalinization of the La Verkin Hot Springs, and market-based conversion of agricultural to potable water. As growth continues, the county's population will require additional water from sources outside the area via projects such as the Lake Powel Pipeline.

2.4.1 State Policy

The Division of Water Resources is responsible for leading on water conservation efforts for the state of Utah. To comply with the Water Conservation Act, the state has its own plan and goals. The 2030 water conservation goals set forward in Utah's Regional Municipal & Industrial Water Conservation Goals require significant effort, attention, participation, and funding.

The Division has three pillars of water efficiency: do your part, every step counts, and efficiency is Utah's ethic[18].

1. Do Your Part: "There is not an entity or individual that is entirely responsible for or is the exception to water efficiency. We all need to do what we can to use water wisely."
2. Every Step Counts: "Taking a shorter shower, updating infrastructure and appliances, fixing a leak, adjusting sprinkler timers, installing secondary water meters, using a tiered rate, running or following an education campaign, or installing waterwise landscaping. It all adds up to big water savings and helps us become waterwise."
3. Efficiency is Utah's Ethic: "We do not conserve water because we have a wet or dry year. We conserve because, as Utahn's, we are not wasteful."

To support its goals, the State has several best management practices for water conservation[19]:

1. Develop a comprehensive water conservation plan updated every 5 years
2. Ensure all connections are metered and read on a regular basis
3. Implement pricing that encourages water conservation
4. Adopt ordinances that promote water conservation such as time of day watering, prohibiting general waste of water, and requiring water efficient landscaping

[18] Utah Division of Natural Resources. 2022. *Utah Division of Water Resources Conserve Water.* September 2022. Available at: conservewater.utah.gov

[19] Utah Division of Natural Resources. 2019. *Utah's Regional M&I Water Conservation Goals.*

5. Designated a water conservation corridor
6. Promote public information programs
7. Reduce leaks in the system
8. Promote large landscape conservation programs and incentives
9. Provide water audit programs for residential customers
10. Ensure plumbing standards and codes to support conservation
11. Promote school education programs
12. Promote conservation programs for commercial, industrial and institutional customers
13. Use reclaimed or recycled water where feasible
14. Use "Smart" controller technology

Utah's municipal and industrial per capita water use declined by at least 18 percent from 2000 to 2015. Considered together, the 2030 regional goals constitute a 16 percent reduction in per capita use from the new 2015 baseline[20].

Ultimately, the responsibility for making many decisions regarding water use and utilizing water resources resides with local leaders and the District. These efforts can be enhanced by educating the public and seeking their input and participation in water discussions and implementing policy initiatives.

2.4.2 WCWCD Water Use Policy and Conservation Planning

Washington County has a growing population, who all require access to water. The County currently uses an average of approximately 43,000 ac-ft of potable water and 15,000 ac-ft of secondary water, with the averages staying steady over the past few years due to conservation efforts throughout the County. The District has a 2021 water conservation plan that cities and major towns within the county use as a baseline for their own individual water conservation plans. The four major components of the plan are water pricing using tiered-rate structures applying higher rates as water use increases, incentives like rebates, regulations including ordinances, and education of public and in schools to help communities understand the importance of responsible water use. Each of the member agencies' water conservation plans mention using tiered water rate structures to try to reduce extreme water usage, and education of communities for individuals to implement water reduction strategies like low water usage garden and landscaping.

Table 2-4 provides highlights from the member agencies' respective plans.

[20] Utah Division of Natural Resources. 2019. *Utah's Regional M&I Water Conservation Goals.*

Table 2-4 City Conservation Plan Summaries

City of St. George Saint George has a large population that requires water and so has a large water system. Their unique water conservation strategies include system piping material changes from cast iron to PVC, SCADA controls to reduce tank overflow and increase the efficiency of their pumping system.
City of Washington Washington City has four main categories of conservation practices: utility operations , education, incentives, and mandates. These practices are being implemented to reach a goal of 35% reduction from 2000, and they had a 24% reduction already reached in 2010. Each category has different measures to continue toward the total water use reduction goal. Utility operations practices include assessing changes and updates to pricing structures, universal meter through installation of meters on all connections and continue the maintenance and replacement schedule. Education measures raise public awareness and provide information of the conservation measures available. Incentives and mandates from the city are aimed to reduce water used in normal water uses.
City of Hurricane The city of Hurricane has several goals for reducing water consumption within its boundaries. A goal unique to Hurricane is expanding their existing pressurized irrigation system to reduce outdoor usage of potable water. They also plan to extend usage of a computerized irrigation system responsive to real time water needs on areas of city owned property.
City of Santa Clara Santa Clara decided to emphasize conservation pertaining to outdoor water use in their water conservation plan. The city is promoting xeriscaping and has converted several irrigation systems to secondary water from potable water. Another large piece of their plan is to reduce water loss by replacing aging lines and having an active meter management system.
City of Ivins Ivins city is a partner with WCWCD in water conservation planning, and the city encourages water users to use the programs such as water audits for residential customers that are offered free through the Water Conservancy District. One area the city is focusing on is water loss, they are improving their accounting of water by watching the amount of water being flushed and replacing meters to produce more accurate readings.

City of La Verkin
La Verkin's water conservation plan identifies several challenges, including a lack of metering in their irrigation system. Goals for continuing their water conservation are to add meters to the irrigation system and reduce irrigation water usage by 10% by 2025. Another goal is to change out potable water meters that have reached the end of their lives to reduce potable water system loss to 5% by 2025, which they have been working on to great success since 2016, when their water leakage rate exceeded 20%.
City of Torquerville
Toquerville has some simple programs to reach a goal of the city's per capita water use decreasing by 15% in 5 years. The programs include encouraging water-wise landscaping like xeriscaping, planting drought resistant trees and plants, as well as bringing customers an understanding of individual irrigation systems and watering needs. City goals besides reducing the water use rate is to maintain a financially viable water system, and maintain or improve the appearance of street landscapes, open spaces and yards.

Chapter 3 Vulnerability Assessment

The goal of the vulnerability assessment is to identify areas in which the District and its municipal partners are vulnerable to drought. The assessment will include existing facilities, system capabilities, and water practices.

3.1 Climate and Water Demand

The District is in an arid climate subject to frequent and prolonged dry periods. It also happens to be one of the fastest growing areas in the U.S. These environmental and demographic dynamics make it challenging to plan for, manage, and operate a water system. Climate uncertainty further compounds this challenge and presents additional vulnerabilities. The District is extremely vulnerable to drought for the following primary reasons:

- The District relies exclusively on the Virgin River basin for its supply. The basin is relatively small and within Utah's hottest and driest region.
- The region is prone to metrological drought with long periods of drier than normal conditions (e.g., 2001-2003).
- Climate change models predict warmer and drier conditions for the region. Virgin River May-July streamflow is predicted to drop on average 20% based on the District's 2014 climate change analysis.
- County population growth over the last decade has averaged nearly 3.5% per year. Over that same period, state-wide growth was 2% annually.
- Current (2021) water demand is estimated to be over 90% of the annual reliable supply.

The District and State of Utah have taken a proactive approach to facing these challenges by frequently assessing water supplies, demand dynamics, and developing plans to improve resiliency. There have been many previous studies and reports that have thoroughly documented the District's supply and demand dynamics which provide a solid basis for this Vulnerability Assessment. These previous efforts include, but are not limited to the:

- Virgin River Climate Change Analysis Statistical Analysis of Streamflow Projects (WCWCD, 2014)
- Virgin River Daily Simulation Model (UDWRe)
- Lake Powell Pipeline Project Water Needs Assessment (MWH, 2016)
- Assessment of Managed Aquifer Recharge at Sand Hollow Reservoir (USGS, 2016)
- Lake Powell Pipeline Water Needs Assessment: Demand and Supply Update (Utah Board of Water Resources, 2018)
- Lake Powell Pipeline Project Draft Environmental Impact Statement, Appendix B: Purpose and Need Report (USBR, 2020)
- Inventory of Existing Water Sources in Washington County (Bowen Collins & Associates, 2020)

- Water Conservation Plan (WCWCD, Update 2021)

Likely one of the most comprehensive of these studies is the Lake Powell Pipeline (LPP) Project Water Needs Assessment completed in 2016.

The LPP Project Water Needs Assessment estimated that the District would experience a water deficit by 2026 under projected operations and growth conditions. Water demand for this analysis was based on a 5.3% annual growth rate and water supply is assumed to increase with the planned local supply improvement projects.

Another seminal study documenting the vulnerabilities to the District's water supplies is the 2014 Virgin River Climate Change Analysis which statistically evaluated several climate change models and showed that the Virgin River May-July streamflow is predicted to drop on average 20%. Approximately 80% of the Districts water supply is from surface water originating from the Virgin River and its tributaries. This predicted reduction in streamflow is a direct result of a shifting runoff season and decreased annual snowpack.

3.2 Utah State Policy

In addition to, and regardless of, changing supply trends and population, water demand is increasing. Implementing water conservation will surely mitigate increasing demand but there will always be an essential amount of water to preserve quality of life. The State of Utah requires that the District supplies at least 0.45 acre-feet per residential connection per year - equivalent to approximately 400 gallons per day per residential connection.

3.3 Water Supply

The District's water supply is approximately 80% surface water (Virgin River) and 20% groundwater. Virgin River water is diverted into the Quail Creek and Sand Hollow reservoir system. Quail Creek Reservoir has a capacity of 40,000 ac-ft, and Sand Hollow Reservoir has a 50,000 ac-ft capacity composed of a 30,000 ac-ft active pool and a 20,000 ac-ft drought reserve.[21] Water from the reservoir system is treated at the Quail Creek Water Treatment Plant which has a build-out capacity of 80 mgd. There are five smaller reservoirs: Kolob, Ash Creek, Gunlock, Meadow Hollow, and Ivins. In addition to these surface water supplies, there are developed groundwater sources including Kayenta Wells, Cottam Wells, and Sand Hollow Recharge and Recovery Wells.

[21] Utah Board of Water Resources. 2016. *Lake Powell Pipeline: Final Water Needs Assessment.* April 2016.

Surface water storage is highly dependent on annual flow in the Virgin River. Streamflow gage data on the Virgin River has shown a gradual decline over the past 100 years. While the precipitation, snowmelt and soil moisture that determine the amount of surface flow in the Virgin River are variable, there has been a demonstratable drop in available yield from this source over the last century as shown in Figure 3-1.

Future planned improvements will add an additional 13,670 ac-ft/yr of potable water and 17,380 ac-ft/yr of secondary water. The total reliable supply (current and planned) within the District from the Virgin River basin is 98,727 ac-ft per year. Additional details on current and planned supplies can be found in the reports referenced in the prior section "Previous Studies and Reports".

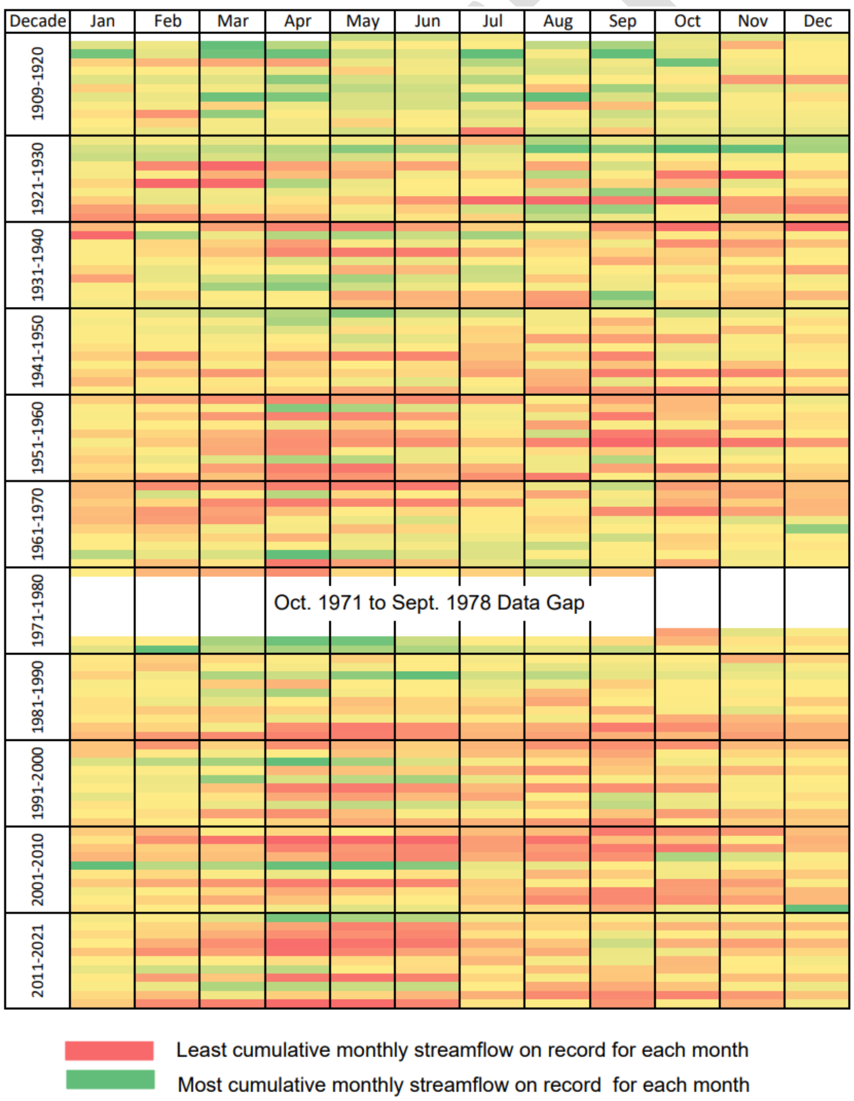

Figure 3-1 Heatmap of Virgin River Streamflow from 1909 through 2021

Water supply and demand are well defined for the District as provided in Table 3-1. The Lake Powell Pipeline Project Appendix B: Purpose and Need Report (June 2020) and the Lake Powell Pipeline Project Water Needs Assessment (April 2016) have detailed the past analyses on the District's supply and demand and future deficits.

Table 3-1 Reliable District Water Supply Sources Quantified by the State of Utah

Reservoir	Capacity	Source
Quail Creek	40,000 AF	Virgin River Quail Creek Diversion
Sand Hollow	50,000 AF 30,000 AF active pool & 20,000 AF drought reserve	Virgin River Quail Creek Diversion
Kolob Reservoir	5,585 AF	Tributary to Virgin River And Crystal Creek Pipeline
Meadow Hollow Reservoir	600 AF (irrigation only)	Spring Creek and LaVerkin Creek, Iron County
Ash Creek Reservoir	3,275 AF	Ash Creek
Gunlock Reservoir	10,884 AF	Santa Clara River
Ivins Reservoir	778 AF	Santa Clara River

Figures 3-2 and 3-3 futher highlight Virgin River water supply availability with the actual and 10-year rolling average, as well as the monthly and 12-month rolling average.

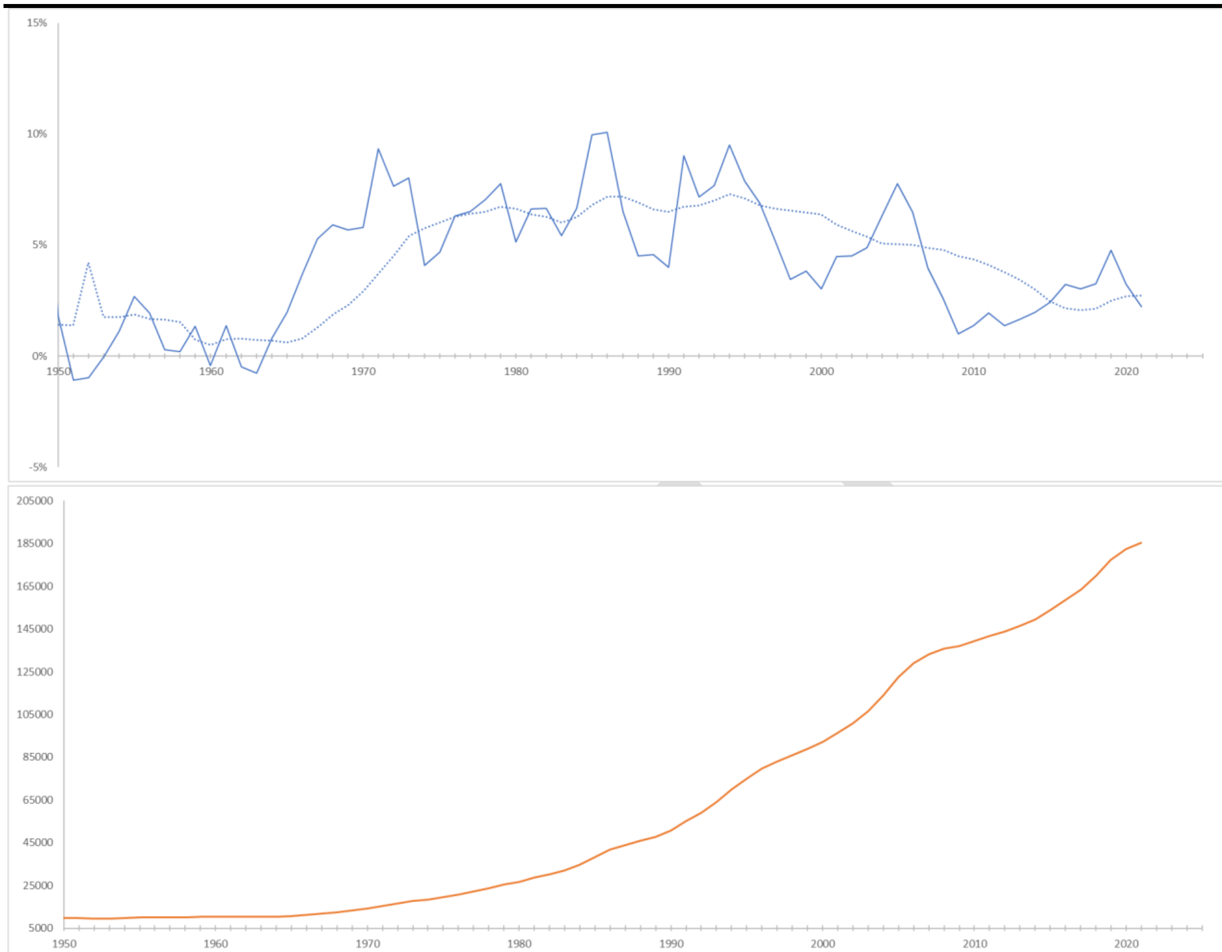

Figure 3-2 Actual and 10-Year Rolling Average Virgin River Annual Streamflow Volume at Virgin, Utah

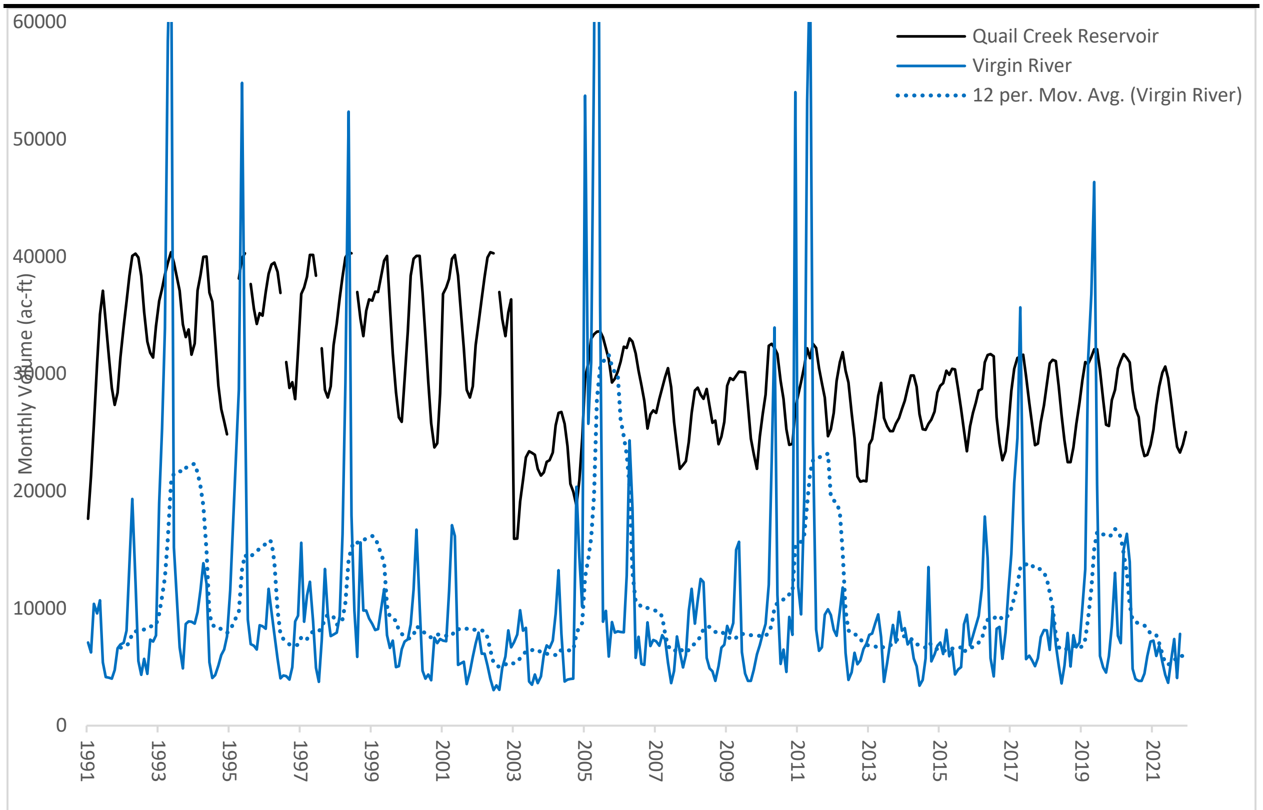

Figure 3-3 Virgin River at Virgin, Utah monthly and 12-month rolling average streamflow and Quail Creek Reservoir monthly volume

3.4 Water Demand

The District provides water at wholesale to the retail providers of its member agencies, many of which have their own baseline water supply. Based on the 2017 to 2021 five-year average, the current monthly demand for District water is 584 ac-ft in the winter (December through February), and 3,376 ac-ft in the summer (June through September). The combined volume of water reported by the partner cities is 1,465 ac-ft for the winter months and 2,503 ac-ft for the summer months.

The District and its users have implemented numerous conservation measures over the past two decades which have resulted in a 30% reduction in per capita water use. Continued conservation efforts are expected to reduce per capita water demand by an additional 20% by 2045.

Population growth has averaged 3.5% annually over the past decade in the County. As of the 2020 Census, the County population was over 180,000. Utah Long-Term Planning Projections

(Gardner Policy Institute, 2022) show the County's population increasing 155% by 2060 to approximately 554,441 residents.

Since the predicted population growth is estimated to outpace the conservation reduction projections, the total demand volumes will continue to increase into the future. At these estimated rates, the current developed supply will be fully utilized by 2035. The District continues to pursue a variety of water development projects to prepare for this eventual need.

3.5 Regional Drought History

The District is within a naturally drought-prone climate. Figure 3-4 shows the Standardized Precipitation Index (SPI) for Washington County from 1980 through 2021. SPI provides a good characterization of meteorological drought, or relative dryness and wetness. Over the past four decades, Washington county has experienced both relatively dry and wet periods.

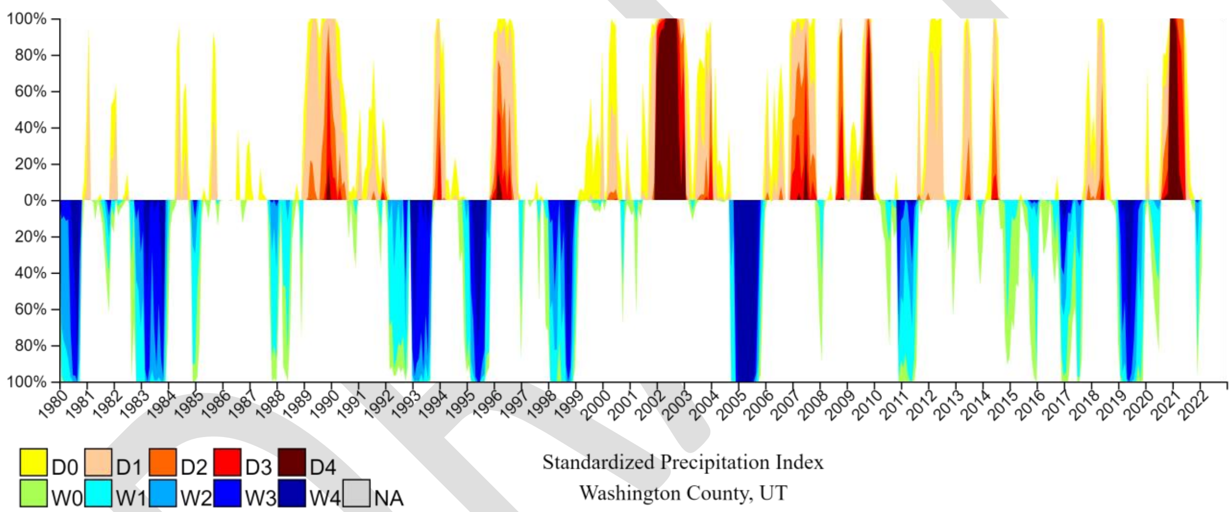

Figure 3-4 Standardized Precipitation Index (SPI) for Washington County from 1980 through 2021

Figure 3-5 represents the historical Palmer Drought Severity Index (PDSI) map from 1895 to 1995. Based on the figure, Washington County was in severe or extreme drought 15% to 19.9% of the time between 1895 and 1995.

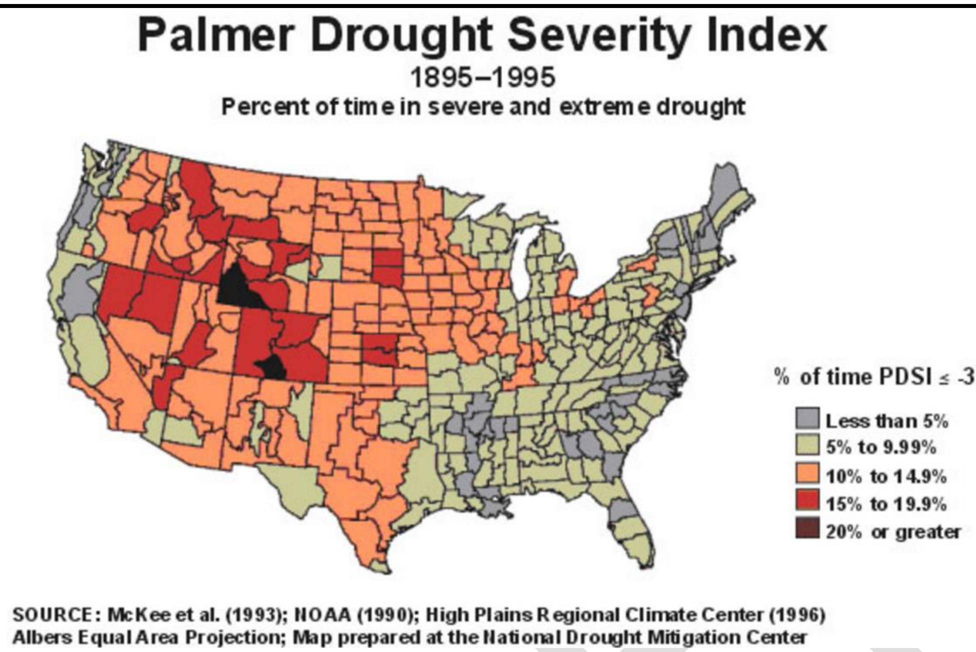

Figure 3-5 Palmer Drought Severity Index (PDSI) Map from 1895 to 1995

The District is somewhat resilient to metrological drought because of its reservoir and groundwater supply. However, future climate models predict more extreme drought conditions in both magnitude and duration, and such prolonged drought could result in water shortages.

3.6 Climate Change

Recent climate change studies have shown that the Colorado River Basin will likely see hotter and drier patterns in the future. Climate change models for the Virgin River predict a reduction in streamflow of 20% from May through July – coinciding with peak water demand. This reduction in streamflow is illustrated in Figure 3-6, which shows the simulated historic and predicted future streamflow at gauge USGS 09415000 Virgin River at Littlefield. A four to five cfs decrease in Virgin River streamflow, which is the 50th percentile climate change prediction by 2050, would reduce the overall WCWCD system yield by 11%.[22] Additional details on this analysis can be found in the USBR report Virgin River Climate Change Analysis Statical Analysis of Streamflow Projections[23].

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[22] Utah Board of Water Resources. 2016. *Lake Powell Pipeline: Final Climate Change Study Report.* April 2016.

[23] United States Bureau of Recreation. 2014. *Virgin River Climate Change Analysis Statistical Analysis of Streamflow Projections.*

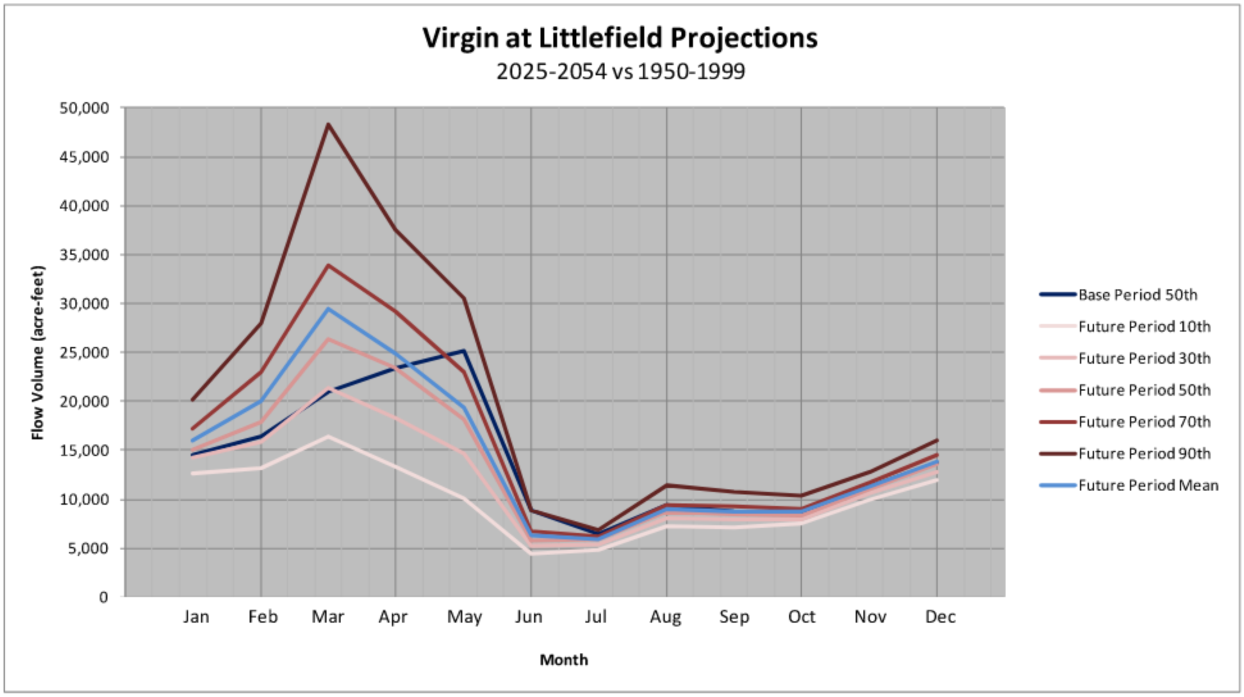

Figure 3-6 Simulated monthly flow volumes on Virgin at Littlefield for the Future Period (2025-2054) and Based Period (1950-1999)

In addition, climate change is predicted to cause the runoff season to arrive one month earlier in the year. With temperatures in the Virgin River Basin anticipated to be 4.5 to 5°F warmer from 2050 to 2079 compared to the 1950 to 1979 historical mean, precipitation in Washington County will shift from snow to rain.[24] Figure 3-7 shows the modeled decline of low elevation snowpack in the Basin with the 1990s as a baseline. Combined with intense rainstorms, river flows could exceed the Quail Creek diversion pipeline capacity and result in precipitation not being captured in the District's reservoirs. This issue cannot be resolved by increasing water storage.

[24] Reclamation. 2009. Technical Memorandum 86-68210-091. *Literature Synthesis on Climate Change Implications for Reclamation's Water Resources.* Prepared by Technical Service Center, Water Resources Planning and Operations Support Group, Water and Environmental Resources Division.

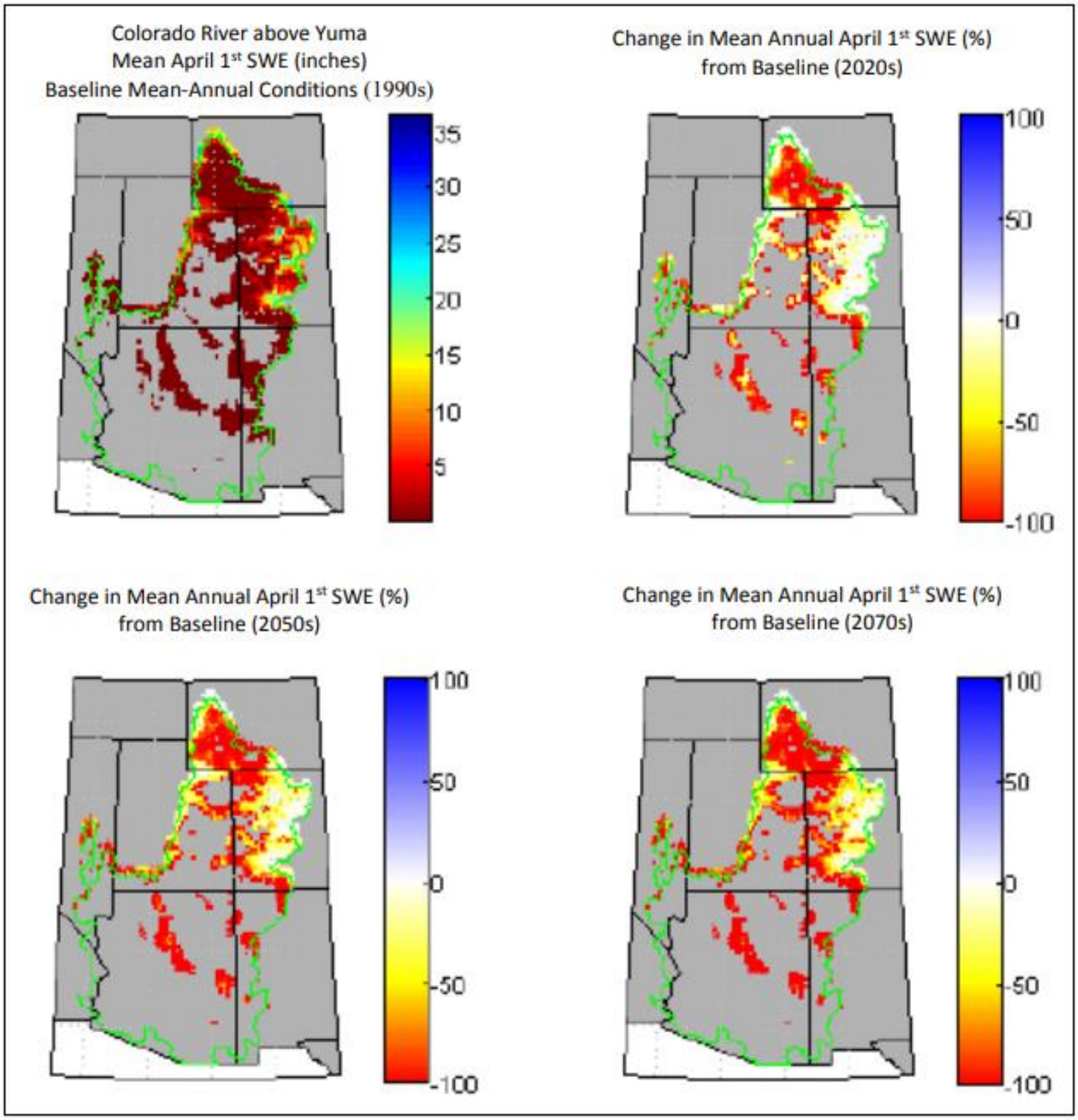

Figure 3-7 Simulated decade-mean April 1st snowpack over the Colorado River Basin[25]

[25] Reclamation. 2011. SECURE Water Act Section 9503(c) – Reclamation Climate Change and Water 2011. April.

Chapter 4 Mitigation Measures

Drought mitigation refers to actions and strategies outside of regular water management activities that a water supplier can implement to reduce the risks and impacts associated with a drought. Proactive mitigation efforts are more efficient than reactive strategies: FEMA estimates that taking steps to prevent the known impacts of a natural disaster can save $4 for every $1 spent. The mitigation strategies outlined here are intended to reduce the risk of a drought causing a water shortage and to increase the preparedness of the District's water systems for a drought. Some goals of this plan are to:

- Protect and extend the District's limited water resources.
- Prepare for a rapidly expanding population.
- Provide economic resiliency for the District and its customers.
- Preserve the natural environment.
- Prolong the life of the District's water facilities.

All mitigation measures described are generally compatible with the 2021 Washington County Water Conservancy District Water Conservation Plan and Best Management Practices suggested by the Utah Division of Water Resources. These include current, in-progress, and future or planned mitigation strategies, and can be further broken down into two general categories:

- **Institutional Strategies:** These are implemented by the District that are non-engineered, administrative or legal strategies and include economic incentives, education and outreach, and development standards.
- **Water Supply Augmentation:** Engineered strategies that increase the resiliency of the District's water supply to drought and water shortages. These may include new water sources, increased storage capacity, and expanded distribution systems; this applies to both potable and secondary water supplies.

4.1 Current Mitigation Strategies

The currently employed institutional and watery supply augmentation mitigation strategies are highlighted in Table 4-1. These strategies are described in more detail in this section.

Table 4-1 Summary of current drought mitigation strategies.

Mitigation Strategies	Description
Institutional Strategies	
Tiered Water Conservation Rate	Increased charges for higher use customers to incentivize conservation.
Financial Incentives for Water Conservation Efforts	Includes rebates for weather-based irrigation controllers, high efficiency appliances, drought resistant landscaping, and school building retrofits.
Education and Outreach	Efficient outdoor water education, public and school education, residential landscape consultations, hotel/motel, and outdoor water audits.
New Development Standards	Coordinate with municipalities to enact new construction standards requiring water efficient fixtures and landscapes.
Advanced Metering Infrastructure (AMI)	Support efforts by municipalities to install AMI systems and make consumption data easily accessible to all users.
Water Supply Augmentation Strategies	
Aquifer Recharge at Sand Hollow Reservoir	Recharge of the Navajo Sandstone Aquifer by the Sand Hollow Reservoir to be stored and reserved for dry periods to supplement supply.
Secondary Reuse Treatment Facility at St. George WWTP	The reuse plant chlorinates and filters effluent from the St. George WWTP to be used for irrigation purposes. Currently treats 7 MGD but can be expanded to 10.5 MGD.

4.1.1 Institutional Strategies

Water use in Washington County has remained relatively constant at about 60,000 ac-ft per year despite its increasing population, due in part to the District's ongoing conservation efforts. Washington County was the first conservancy district in Utah to adopt a conservation plan in 1996 with the approval of the Washington County Water Management and Conservation Plan (WCWMCP). This conservation plan has been updated frequently, with the most recent revision coming in 2021 and has been referenced throughout this Plan. The District budgeted over $3,000,000 in 2023 for conservation programs to help support this effort.

Tiered Water Conservation Rate

Currently all seven partner agencies in the Regional Water Services Agreement (RWSA), Hurricane, Ivins, La Verkin, St. George, Santa Clara, Toquerville, Washington City, and the District have adopted inclining block rate structures in order to encourage conservation efforts. Block rates, in general, charge increasing amounts as usage increases. For example, a city might charge $1.00 per 1000 gal for the first 5,000 gal, and $2.00 per 1000 gal for usage between 5,000 and 10,000 gal, and so on. Some municipalities also use separate rates for secondary or irrigation water to discourage the use of potable water for irrigation.

Financial Incentives for Water Conservation Efforts

The District offers a variety of financial incentives to private citizens, businesses, and public entities for their conservation efforts. Grants are available for schools to replace fixtures and irrigation systems with high efficiency systems and to replace grass fields with artificial turf on public athletic fields. A number of rebates are offered as well:

- Irrigation equipment rebates
    - For weather-based irrigation controllers, eliminating irrigation stations, adding pressure reducing valves, and conversion to high-efficiency nozzles.
- Landscape conversion and tree rebates
    - Up to $2 per square foot incentive to remove turf and permanently replace with low water use plants/trees or hardscape.
- Commercial rebates
    - Up to 50% of the cost of high efficiency commercial washing machines, and $100 for the installation of EPA water Sense labeled high efficiency toilets and urinals.
- Hot water on demand
    - Up to $250 to equip homes with efficient hot water on demand systems.
- Leak devices/flow sensor rebates
    - Up to $200 for qualifying flow sensors that provide water users instant access to use data.
- High efficiency fixture giveaway
    - Free multifamily residential high efficiency showerhead and commercial pre-rinse spray nozzles for eligible customers

Individual partner agencies within the RWSA have personalized financial incentives for conservation as well.

Advanced Metering Infrastructure

The District also supports municipal partners in the process of modernizing distribution systems and metering infrastructure. Specifically, cities such as Hurricane and St. George are investigating increased automation of controls for improved water efficiency. Automated Metering Infrastructure (AMI) is also undergoing a feasibility study to aid in conservation and leak detection. WCWCD has also implemented a metering and telemetry project that monitors diversions along the Santa Clara and Virgin Rivers to reduce water loss and increase the accuracy of water deliveries allocations.

4.1.2 Water Supply Augmentation Strategies

Aquifer Recharge at Sand Hollow Reservoir

The District has undertaken several projects to increase the resiliency of its water supply. In addition to its 50,000 ac-ft surface capacity, the Sand Hollow Reservoir operates as a groundwater recharge system, storing over 100,000 ac-ft in the Navajo Sandstone Aquifer in case of drought.

Groundwater or aquifer recharge refers to either artificial or natural methods that convey water underground. These can take place naturally, via infiltration from precipitation or surface water, or, in the case of deep aquifers where infiltration is deemed ineffective, water can be injected and extracted via wells. Excess drinking water is injected into the subsurface where it can be stored until times of need.

In the case of the Sand Hollow Reservoir, water percolates naturally into the aquifer at a rate between 5,000 and 18,000 ac-ft per year. Currently, groundwater withdrawals from wells within the aquifer have fallen under permits governing the natural recharge from Sand Hollow Reservoir. Withdrawal rights for monitored aquifer recharge (MAR) have yet to be exercised. Expansion of the Sand Hollow Well Field is expected to increase the utilization of these water rights. Most of the water stored by this strategy is expected to be reserved for periods of drought to make-up supply shortages.

Secondary Reuse Treatment Facility at St. George WWTP

Completed in 2006, the St. George Reuse Treatment plant filters and chlorinates effluent from the WWTP for use as secondary untreated water. The facility is composed of two filters each with a capacity of 3.5 MGD, for a total of 7 MGD and has the capability to add a third filter to expand capacity to 10.5 MGD. As part of the Shivwits Band of Paiute Indians water rights settlement, St. George agreed to deliver 2,000 AF/year of reuse water to the Band.

4.2 Future Water Supply Augmentation Strategies

The District and its municipal partners also have several projects that are in-progress and are to be completed in the near term intended to increase the resiliency of their water supply. These projects encompass both potable and secondary water supply or distribution improvements and are summarized in Table 4-2. Additional information can be found in the District's 10-Year Capital Improvement and System Replacement Recommendations dated 2022.

Table 4-2 Summary of planned water supply augmentation projects (Recommended 10-Year Capital Improvement Projects)[26]

Water Supply Project	Estimated Supply Gained (ac-ft)	Cost (2022)
Cottam Well 3	960	$1,977,000
Sand Hollow Well 7	1200	$1,815,000
Sand Hollow Well 15		$1,815,000
Ash Creek Pipeline/Toquer Reservoir Project	1582	$92,395,000
Sullivan Wells Project (Wells, Pipelines)	1405	$14,663,000
Quail Creek WTP 80 MGD Expansion	NA	$130,000,000
Dry Wash Reservoir	1500	$15,465,000
Graveyard Wash Reservoir	1500	$17,794,000
Cottam Well 3 MG Tank	NA	$6,330,000
Sand Hollow 2 MG Tank B	NA	$6,050,000
Quail Creek 10 MG Tank B	NA	$25,988,000
Sullivan Wells 1 MG Tank	NA	$3,307,000
Sand Hollow North Dam to West Dam Pipeline	Unknown	$3,660,000
Quail Creek to Cottam Pump Stations and Pipeline, Phase 1	Unknown	$10,610,000
Quail Creek to Cottam Pump Stations and Pipeline, Phase 2	Unknown	$11,922,000

Additional Secondary Untreated Water System Expansion

The District and several municipalities that it serves are proposing to expand secondary water systems to offset potable water use. Expanding secondary water systems in existing communities is often expensive and less efficient than utilizing a potable only water system; however, the water quality of remaining potential supplies in Washington County makes this alternative preferrable in many communities. The expansion of secondary water systems to supply high demand existing users and areas of new development will allow better utilization of high salinity and reuse water supplies. Partner agencies are in the process of, or have completed, converting open air irrigation ditches to closed pipelines to reduce evaporative losses. The Toquerville Secondary Water System, the Gunlock to Santa Clara pipeline, the Ash Creek project, and the St. George Washington Fields Canal Company have either already begun the process of converting secondary water systems or are slated to be completed within the planning period of this document. *Well Field Expansions, Water Storage, and Distribution System Flexibility*

[26] Bowen Collins and Associates. 2022. Washington County Water Conservancy District Regional Water Master Plan. *Chapter 7: 10-Year Capital Improvement and System Replacement Recommendations.*

Groundwater is generally more resilient to drought because the source is less influenced by short-term climate disturbances. Expanding and optimizing groundwater use in the District is a key long-term strategy. The well expansion projects are intended to maximize the use of the Districts limited groundwater water rights. Expansions are planned for Cottam, Sullivan, Sand Hollow, and Toquer wells, adding additional wells to maximize yield.

The Sullivan well field will be developed to tie into the Cottam well system or to supply developments in Leeds. Toquer wells will be developed to take advantage of increased capacity provided by the Ash Creek project, and Sand Hollow wells will take advantage of aquifer recharge in the Navajo Sandstone aquifer.

One of the limiting factors in water use (both potable and secondary) in Washington County is storage during periods of low demand. Dry Wash and Graveyard Wash Reservoirs are planned to add 3,000 ac-ft of storage to provide increased reliability during peak demand periods.

Additional storage and conveyance infrastructure is planned to increase the flexibility of the District's distribution system. These projects do not add additional supply to the District's portfolio but allow for source water to be distributed to more customers. For example, the Sand Hollow Pipeline will connect the Sand Hollow Well Field to existing water lines for distribution to the cities of St. George and Washington, providing redundancy in supply. The District also plans to invest heavily in potable storage projects in the near term, adding 16 MG of storage in the form of Cottam Well, Sand Hollow, Quail Creek, and Sullivan Well storage tanks by 2025.

Quail Creek WTP Expansion

The Quail Creek Water Treatment Plant supplies potable water to the majority of customers in the District's Regional Water Supply Agreement and is sized to treat 60 MGD. It can receive surface water from Quail Creek Reservoir, Sand Hollow Reservoir, and the Virgin River and is slated to be expanded to treat 80 MGD by 2025.

Ash Creek Pipeline/Toquer Reservoir

The current Ash Creek Reservoir receives snowmelt and peak flow runoff from the Ash Creek drainage basin. Its use is significantly limited as it has a high leakage rate. The Ash Creek Pipeline would convey water from this reservoir to the proposed 3,640 ac-ft Toquer Reservoir where it will be delivered to the Toquerville Secondary Water System for irrigation use. This increases potable supply because it will free up water from the high quality Toquerville Spring currently being used for irrigation. Also included in this project is a collection system to replace open irrigation ditches on Leap Creek, Wet Sandy Creek, and South Ash Creek.

Lake Powell Pipeline Project

The Lake Powell Pipeline (LPP) Project was authorized by the Utah State Legislature in 2006 to supplement future water supplies in southwest Utah. It would transport a portion of the state's Colorado River water right from Lake Powell approximately 140 miles to Washington and Kane counties. The projected LPP potable and secondary supply for WCWCD is 82,249 and 17,120 ac-ft/yr, respectively. The project is estimated to be $1 billion. The uncertain timeline of the LPP project makes it an unlikely drought mitigation tool within the 10-year timeframe.

4.2.1 Demand Hardening

Demand hardening is a phenomenon that decreases the potential for increased conservation during periods of drought. If conservation measures have decreased water use to the point that it has become normal use, there will be fewer short-term options to reduce non-essential uses. Ongoing analysis of changes in demand dynamics and estimates of reliable yield are required to ensure that adequate water supply is managed and maintained.

4.3 Drought Planning

The District and the members of its RWSA have all invested heavily in conservation measures and continue to actively increase their drought resiliency. The county as a whole has decreased its per capita use by more than 30% from the year 2000 baseline and is targeting another 14% reduction from 2015 demands. The District and member agencies will need to continue being proactive in planning for drought which will include ongoing evaluation of both institutional and water supply augmentation strategies.

Chapter 5 Drought Monitoring

The District developed a drought monitoring tool, which will quantify current drought conditions to help recognize drought in its early stages and assess its severity. The monitoring tool consists of both a drought dashboard and a drought model. The purpose of the dashboard is to convey the results of the drought model in an easily digestible manner. The drought model processes historical and current data to characterize the state of the system into five numerical categories of increasing drought severity (see Drought Stages). These categories will be directly linked to drought response actions (see Action Plans). The drought model is programmed using Python to automatically communicate with existing data sources to minimize the need for manual data upload; however, some datasets will still need to be routinely updated by the District.

5.1 Model Framework

The drought model condenses significant data sources into a single drought trigger value. A range of drought trigger values constitute a drought stage, which is associated with a series of drought response actions of increasing consequence as outlined in the upcoming sections of this document. There are multiple readily available drought triggers; however, these drought triggers do not include all the local supply and demand data sources necessary to determine appropriate response actions.

The Palmer Drought Severity Index (PDSI) and U.S. Drought Monitor (USDM) are two examples of readily available meteorologic drought triggers, which can be obtained via direct download without any calculations required by the user. The PDSI is a good indicator when concerned with drought impacts to agriculture as it considers precipitation and temperature alone. Data sources used by the USDM include the PDSI, CPC soil moisture model, USGS weekly streamflow, standardized precipitation index (SPI), and objective drought indicator blends. The variables involved in the USDM are precipitation, temperature, streamflow, and soil moisture.
The hydrologic drought trigger developed as part of this project was adapted from the Reclamation Drought Index described by Weghorst[27]. The trigger considers the balance of the District's supply and demand by calculating non-exceedance probabilities for the data sources identified in Water Supply Data Sources and Demand Data Sources. Non-exceedance probability (NEP) is defined as the probability a data source will be less than a predicted value over a given time period. For example, there is an 80% chance the average temperature in July will not exceed 92.8°F (33.8°C). NEPs were calculated by fitting the historic monthly time series of each data source to the best fitting probability distribution. The distribution methods used were Beta, Log-normal, and Gamma.

[27] Weghorst, Karen. *The Reclamation Drought Index: Guidelines and Practical Applications.* Available at: RDI_paper.pdf (wamis.org).

The forecasted drought trigger components are illustrated in Figure 5-1 with Figure 5-2 showing the observed components. Drought trigger components are calculated according to precise equations, which can be found in Appendix B.

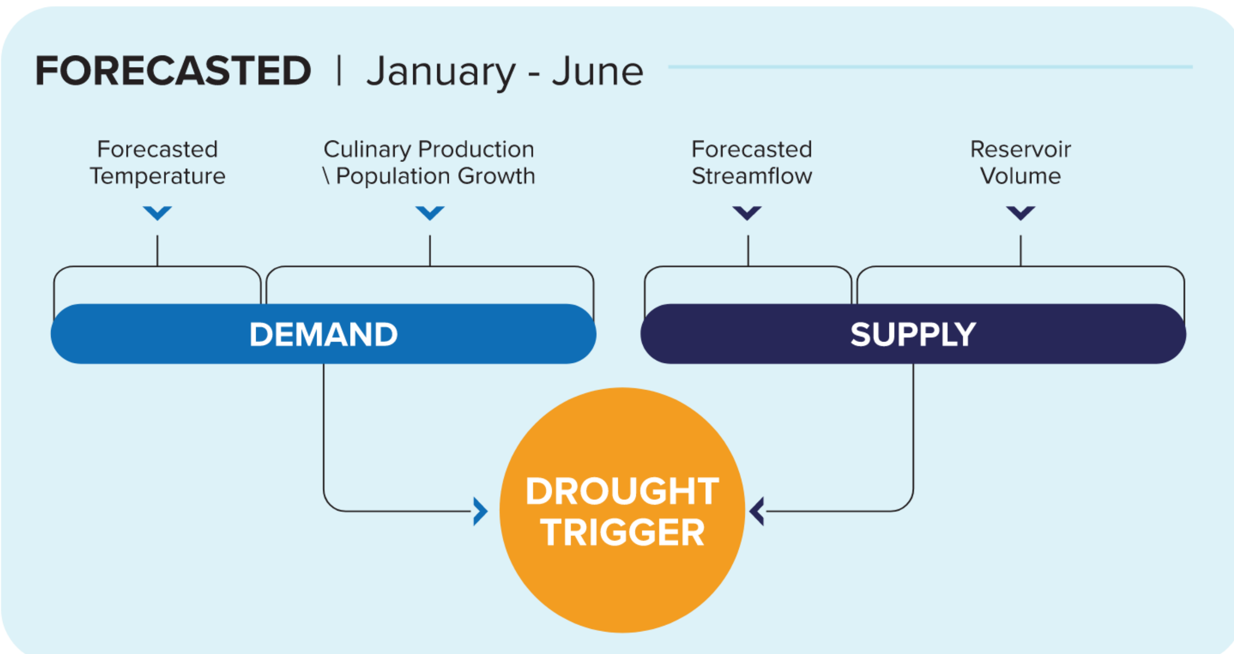

Figure 5-1 Model Framework

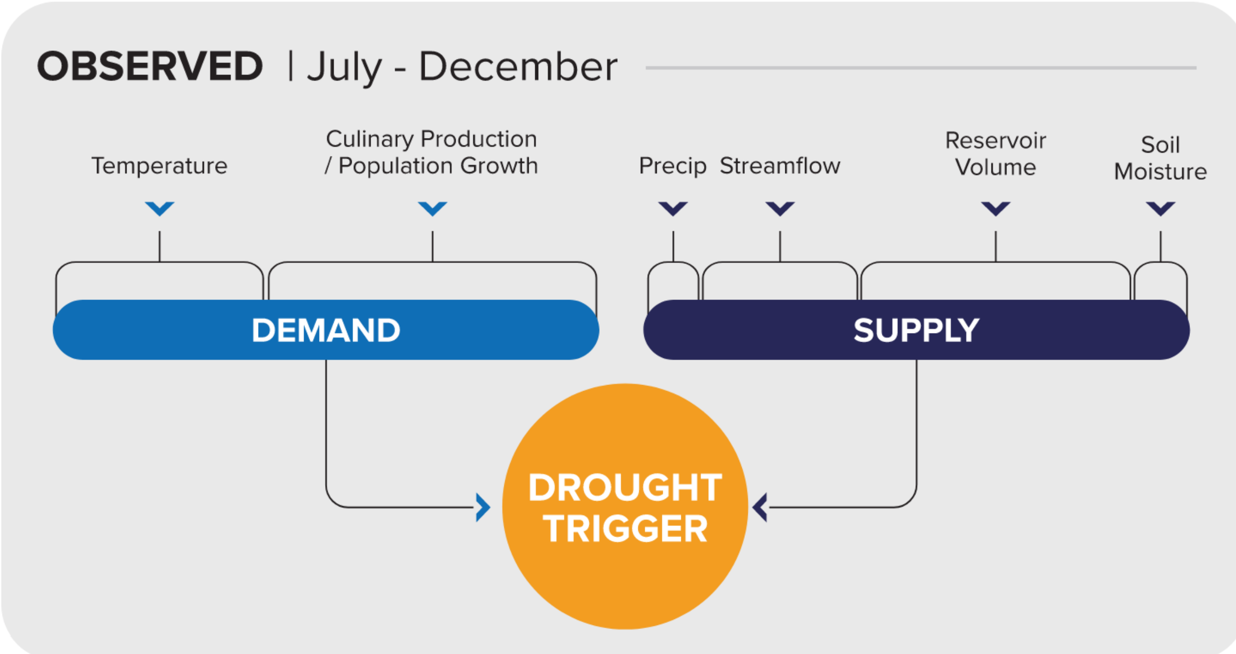

Figure 5-2 Model Framework

5.2 Water Supply Data Sources

Precipitation, reservoir volumes, streamflow, and soil moisture are used to calculate the supply component of the drought trigger. Non-exceedance probabilities are based on monthly values for the full period of record fit to a standard hydrologic probability distribution using Python. The distributions were limited to Beta, Gamma, Gumbel, Log Normal, Pearson 3, and Weibull. The best-fitting distribution for each data source was visually chosen based on plots of the cumulative density functions as shown in the Appendix.

Within the Python drought monitoring model, parameters such as alpha and beta for each data source's monthly distributions are calculated. Best fit distributions and the starting parameters (Jan 2022) for each distribution based on all data up until December 2021 are included in Appendix A. The distribution parameters for each data source will be recalculated with the current month's data following the current month's drought score calculation, and the new parameters will be used in the following month's calculation. Thus, the probability distributions for the current month will not include the current data points. Distribution type (e.g. Beta, Gamma, Gumbel, Log Normal, Pearson 3, Weibull) will not be changed monthly but may be manually changed during any major model recalibration or update in the future (see Appendix B).

5.2.1 Precipitation

The precipitation record used was collected from the PRISM Climate Group website from Oregon State University[28]. The data consist of measurements taken from nearly 13,000 stations owned by COOP, SNOTEL, Snowcourse, RAWS, CDEC, Agrimet, and EC (Canada). The data period of record ranges from January 1895 to the present. The datasets are modeled using climatologically-aided interpolation, which uses the long-term average pattern (i.e., the 30-year Normal) as first-guess of the spatial pattern of climatic conditions for a given month or day based on whatever station networks and data sources are available for the relevant period. For this project, the 4-km cell size grid was clipped to the extent of Washington County and the monthly volume over the county area was computed in acre-feet.

5.2.2 Reservoir Volumes

The reservoirs considered for use in the model include Gunlock, Ivins, Kolob, Quail Creek, and Sand Hollow. Some of the datasets had gaps in the monthly record, which are summarized in the Existing Data Review technical memorandum prepared by AE2S in March of 2022. Quail Creek and Sand Hollow Reservoirs were used in the drought monitoring model as a combined indicator in terms of percent capacity. Both of these reservoirs have minimal data gaps and together they constitute 86% of the District's reservoir supply by surface storage capacity as of April 2022.

5.2.3 Observed Streamflow

For the model, monthly streamflow volumes were calculated from daily average flow and then ranked against the period of record. Because of this, gaps in the daily record must be filled or ignored to ensure complete monthly total volumes.

For purposes of calculating monthly streamflow volumes, months without any data, such as the large gaps in gauge 09406000, could be ignored, in addition to the incomplete months at the beginning and end of the large gaps. Small gaps in the future could be filled with linear interpolation. If data from selected stations becomes unavailable in the future, another gauge that correlates could be used to fill gaps.

5.2.3.1 Forecasted Streamflow

Streamflow forecasts in the winter are used to help predict water supply in the spring. Forecasts for the Santa Clara River near Pine Valley (USGS 09408400) and Virgin River at Virgin, UT (USGS 09406000) stations are available through the Natural Resources Conservation Service (NRCS) Web Service tool. The NRCS uses statistical models to produce streamflow forecasts. These

[28] PRISM Climate Group. 2022. *PRISM Climate Data Website.* Available at: PRISM Climate Group, Oregon State U.

statistical models are equations expressing a fitted mathematical relationship between the target streamflow volume and predictor variables, including snow water equivalent, precipitation, and antecedent streamflow. The NRCS tool produces a probabilistic forecast given as a cumulative volume over the entire forecast period from April to July. The NRCS continues to provide streamflow forecasts after April, though the forecast period still ends in July. The forecasted probability exceedance values are determined from a combination of observed conditions beginning in January and the 30-year normal. The streamflow forecasting schedule used in the drought monitoring plan is outlined in Table 5-1. Due to the presence of snow in June at several SNOTEL stations in the 9,000-10,000 ft elevation range upstream of the Virgin River, streamflow forecasts are extended through June and switch to observed streamflow in July. Figure 5-3 depicts SNOTEL station 626 (elev. 9827 ft) which reported high levels of snow in June for several years since 2006. As the season progresses, antecedent streamflow becomes more significant than SWE in the forecasted streamflow calculation.

Table 5-1 Streamflow Forecasting Schedule

Month	Streamflow Data Source
JAN-APR	APR-JUL Forecasted Streamflow
MAY	MAY-JUL Forecasted Streamflow
JUN	JUN-JUL Forecasted Streamflow
JUL-DEC	Observed Streamflow

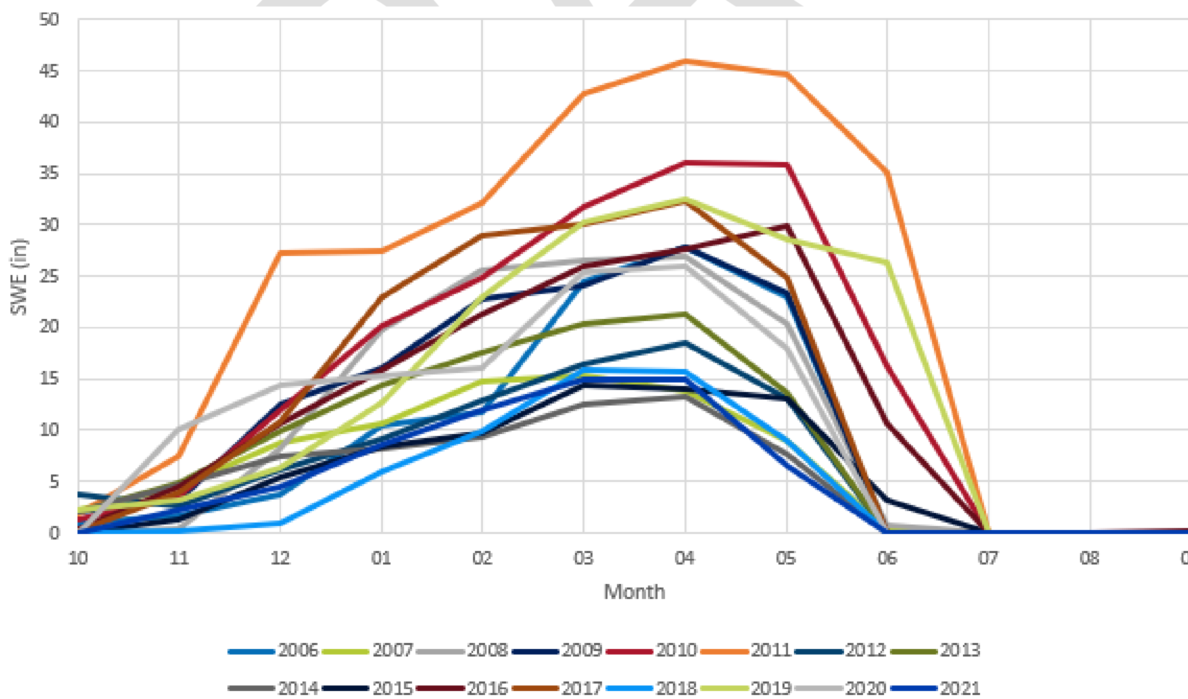

Figure 5-3 SNOTEL Station 626 by water year with Elevation at 9827 ft.

5.2.4 Soil Moisture

Modeled soil moisture information was obtained from NASA's North American Land Data Assimilation System (NLDAS). Soil moisture content is available at different levels, and we used the moisture content from ground level down 100 cm. There are three different model configurations: Mosaic, Noah, and VIC. Each model has a monthly aggregation, and the soil moisture content is the monthly average of the instantaneous value. The VIC soil moisture model configuration was used in this drought model as it better matches the Washington County drought record (2002-2003, 2013-2014, 2018, 2020). The monthly average was spatially aggregated by averaging the gridded output over Washington County. The data was accessed from online data server[29].

5.1 Demand Data Sources

5.1.1 Air Temperature

Air temperature measurements are used to calculate the irrigation-driven component of the demand score due to its cause-and-effect relationship. Records for air temperature over the Washington County area will be accessed using the same methodology as the Precipitation data through PRISM[30]. The period of record covers January 1895 to the present day on a monthly timestep. The county-wide monthly average temperature can be calculated by taking the average of all grid cells within Washington County.

5.1.2 Forecasted Air Temperature

Forecasted air temperatures in Winter are used to predict irrigation-driven demand in Spring. Seasonal temperature forecasts are available in 3-month increments and provided by the National Weather Service's Climate Prediction Center. Forecasts are given in terms of percentages above and below normal. Seasonal temperature forecasts are based on climate and weather models, recent trends, and historical records showing what temperature conditions resulted from similar patterns in the past.

[29] National Aeronautics and Space Administration. 2022. *North American Land Data Assimilation System Soil Moisture Content.* Available at: https://hydro1.gesdisc.eosdis.nasa.gov/opendap/NLDAS/NLDAS_VIC0125_M.2.0/2022/NLDAS_VIC0125_M.A202210.020.nc

[30] PRISM Climate Group. 2022. *PRISM Climate Data Website.* Available at: PRISM Climate Group, Oregon State U.

Table 5-2: Temperature Forecasting Schedule

Month	Temperature Data Source
JAN-APR	APR-JUN Forecasted Temperature
MAY	MAY-JUL Forecasted Temperature
JUN	JUN-AUG Forecasted Temperature
JUL-DEC	Observed Temperature

5.1.3 Population

Annual population estimates of Washington County are used to calculate the potable component of the demand score until 2020. Historical population data from 1900-1940 were linearly interpolated from available U.S. Census Bureau decennial census data. Population estimates from 1941-2020 were collected from the Kem C Gardener Policy Institute of the University of Utah. For use in the drought monitoring model, a percentage change from the rolling 3-year average was used as the population indicator.

5.1.4 Production

Production data refers to all groundwater and surface water pumped and diverted into the potable water system by the District and their member agencies. The historical record for production data consists of monthly volumes from 2017-2021 produced by WCWCD, Toquerville, Washington, Santa Clara, Ivins, Hurricane, La Verkin, and St George. Monthly production volumes will be uploaded each month by the District. Table 5-2 lists the potable water sources for each city in addition to what is provided by the District, based on the Technical Memorandum entitled "Inventory of Existing Water Sources in Washington County"[31] (Bowen Collins & Associates, 2020). For use in the drought monitoring model, a percentage change from the rolling 3-year average is used as the production indicator. Production data is used to estimate the potable component of the demand score after 2020.

[31] Bowen Collins and Associates. 2020. Washington County Water Conservancy District Technical Memorandum. *Inventory of Existing Water Sources in Washington County*.

Table 5-3 City Potable Water Sources

City	Potable Water Sources
Hurricane City	Stratton Well #1 & #2 West Well Toquerville Springs & Ash Creek Springs
Ivins City	Snow Canyon Wells (Snow Canyon Compact) Gunlock Agreement with St. George
La Verkin City	Ash Creek Springs & Upper Ash Creek Springs Toquerville Springs
Santa Clara City	Snow Canyon Wells (Snow Canyon Compact) Snow Canyon Wells (Well #6 and Well #7) Sheep Spring, Miller Spring, Beecham Spring, Gray Springs
St George	Mountain Springs City Creek Wells, Millcreek Wells, Ledges Wells, Tolman Wells Gunlock Wells Snow Canyon Wells West City Springs
Toquerville City	Toquerville Springs Ash Creek
Washington City	Well #2, Well #3, Well #4, Well #5, Well #6, Grapevine Well #1, Grapevine Well #2

5.2 FTP Server

For automated monthly updates, most of the datasets discussed in this document will be retrieved directly from their respective sources using Python; however, some data will come directly from the District. Going forward, the District will need to upload two datasets to an FTP Server:

1. Reservoir Volumes (Weekly)
2. Production Data (Monthly)

The model will be programmed to automatically search for and retrieve these datasets from the FTP server. Reservoir data will be uploaded as a CSV file using the format shown in Table 5-6. The specific format for the Production CSV file is shown in Table 5-7.

Table 5-4 Example Weekly Reservoir CSV File

7-Feb-22	Elevation	Volume (AcFt)	Total AcFt	Percent Full	System %
Sand Hollow	3050.08	39309	51124	77	37
Quail Creek	2965.11	27264	40252	68	26
Gunlock	3563	4682	8652	54	4
Kolob	8162.18	3062	5585	55	3
Ivins	3095.13	231	1418	16.29	0
Totals			107031		70.59

Table 5-5 Example Monthly Production CSV File

Water Provider	Month
WCWCD	164,004,100
Toquerville	5,050,691
Washington	47,339,633
Santa Clara	37,133,980
Ivins	
Hurricane	79,800,910
La Verkin	11,372,200
St. George	206,322,336
Total water supplied	**551,023,850**

5.3 Future Model Improvements and Ongoing Calibration

The drought monitoring model will require ongoing calibration. It is recommended the Task Force convenes monthly to review, discuss, and confirm the District's current drought status.

Additionally, whenever a new major supply or demand data source (e.g., reservoir, Lake Powell Pipeline, groundwater monitoring well) is added to the model, a major model revision will be required. Adding a new data source to the model will require someone with python programming capabilities to make modifications to the python script associated with the drought monitoring model. New data sources will also require a model recalibration utilizing the SHARED_WCWCD_DroughtModelCalibration.xlsb spreadsheet provided by AE2S as part of the Drought Contingency Plan project in 2022.

As the building blocks of the programmatic drought monitoring model are updated (e.g. a new version of python is released, data sources update their APIs, or python package updates are released), the model will need to be revised. This may require a handful of hours of work every year or possibly more if drastic changes are made to the code packages or data sources.

Without the addition of new supply or demand data sources, the model should be updated at a maximum of every five years to account for changes in production growth rates, reservoir operation, and a longer period of record on all data sources affecting probability distributions.

Chapter 6 Drought Stages

The drought model applies the variables described in Chapter 5 to generate a value corresponding to one of five drought stages (Stages). Stage 0 is the lowest for abnormally wet and normal conditions up to the maximum drought stage of 4. These Stages will be used to communicate the severity of the drought and water supply condition to the partners and the public rather than the model output number. Care was taken to give each of the 5 Stages meaning, descriptions and associated actions that will help communicate the Plan and its associated response actions (Actions). The Actions are discussed in more detail in Chapter 7. Development of the Stages was a collaborative process with input by Municipal Partners. The Stages are determined by technical calculations and modeling, as described in Chapter 5, taking into account the current drought conditions, historical perspective, as well as the District's storage capacity for water.

WATER AVAILABILITY AND RESPONSE STAGES					
	Stage 0	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**
	Normal Sustainable Supply	**Abnormally Dry** Decreasing Supply	**Prolonged Drought** Diminished Supply	**Escalated Drought** Deteriorated Supply	**Extreme Drought** Depleted Supply
Response Stage	**Conserve**	**Caution**	**Concern**	**Alarm**	**Crisis**

Figure 6-1 Drought Stages

Stage 0 – Conserve

Water Availability – Normal

Stage 0 occurs when the water supply necessary to meet current demands is also adequate to maintain or increase stored supplies. This region is typically dry and arid or experiencing monsoonal rains. This will be the Stage when the District wants to communicate that regular conservation efforts are sufficient to support the water demands being placed on the system for the foreseeable future.

Stage 1 – Caution

Water Availability – Abnormally Dry

Stage 1 describes meteorological conditions when water demands tap into stored supplies faster than they can be replenished. When stored supplies are dropping, additional actions will need to be taken in order to slow that drawdown and bring the demand back in line with sustainable supplies. Between 1910 and 2021, abnormally dry months occurred 386 times.

Stage 2 – Concern

Water Availability – Prolonged Drought

Stage 2 is used when the water supply has already been diminished (reservoir levels are low) and the meteorological conditions have failed to replenish the supply. This can occur if the actions of the previous Stage were not effective enough to reduce the demand to match the available water, or when there is lower than normal precipitation over an extended time. In this Stage, responses become more intrusive and aggressive to reduce demands even further and hold onto what water is available in case the dry meteorological conditions continue to persist.

Stage 3 – Alarm

Water Availability – Escalated Drought

Stage 3 will be used when the available water supply has deteriorated significantly and is approaching critical levels. This Stage will likely occur when there have been abnormally dry meteorological conditions for an extended period of time or the precipitation levels continue to decrease from previous drought conditions. Response actions in this Stage recognize that prioritization of water uses is now required. At this Stage, water will begin to be rationed and redistributed to maintain life sustaining uses. Because of existing reservoirs and infrastructure, a period of escalated drought as defined here has yet to occur within the County's recent history.

Stage 4 - Crisis

Water Availability – Extreme Drought

Stage 4 is the most extreme stage of this drought contingency plan. It will come into effect when storage supplies have been depleted and the region will be required to limit use to only what becomes available in each season. All non-essential water use will be terminated at this point. When in this Stage, even storage infrastructure will not be able to help capture and store what precipitation may fall. All efforts to reduce water consumption demand prior to reaching this Stage should be aggressively employed. Because of existing reservoirs and infrastructure, a period of extreme drought as defined here has yet to occur within the County's recent history.

Because the model is based on both the seasonal water supply conditions as well as the more immediate water usage values, translating the model output into Stages requires grouping the output into bands of values that represent each. The District established the Stages and their descriptions and then calibrated the model to reflect the correct stage based on the current conditions. This calibration was done based on historic data and will need to be fine-tuned as the model begins to use current data.

The descriptors for each Stage were selected to communicate the desired response and public perception of the drought conditions. The descriptors escalate in severity and, in one word, describe how the District, its municipal partners, and the public should respond to the drought condition. Shorter descriptions of what the Stages means or why the region is in that particular Stage are also included. Because the model incorporates both a demand and supply components for the analysis, there may be some months where a given water availability will result in a higher or more severe drought Stage than other times.

Even though the model incorporates meteorological conditions, the Stages refer to the water availability status. This was done intentionally to reinforce the message that not all precipitation is available for public consumption. The meteorological conditions impact how much water is recharging the system and how much of that water will become available to store for potable use; but are not direct drivers of the demand versus supply equation. This Plan strives to connect the public's effectiveness in conservation actions directly to how much water can be left in the existing reservoir storage system and therefore available for future use.

Chapter 7 Action Plans

Drought Response Actions (Actions) correspond to each of the five Stages discussed in Chapter 6. The Actions prioritize the response based on the level of the drought's severity. The Actions have been categorized into the three distinct audiences: Residential (the public at large), Community (local municipalities), and Water Provider (the District). Table 7-1 highlights each of the drought stages and corresponding action plans.

Table 7-1 Drought Stages and Corresponding Response Actions

Water Availability and Response Stages			
Drought Stage	**Residential**	**Local Municipality**	**District**
Stage 0 Conserve	Follow the district's recommended seasonal irrigation schedule. No irrigation in the summer between 10 a.m. and 8 p.m. Repair leaks and water use inefficiencies. Participate in district rebate programs and free community classes.	Encourage / incentivize water wise landscaping. Communicate water consumption data to residents. Model sustainable water use strategies. Encourage restaurants to serve water by request only. Minimize hotel laundry use by encouraging patrons to reuse linens and towels.	Consistently communicate water conservatic objectives. Provide public communication materials to a communities. Reinforce sustainable use messaging. Conserve and secure additional water source for population growth. Develop and maintain infrastructure. Identify and repair leaks. Plan and prepare for future drought.
Stage 1 Caution	Reduce irrigation frequency and/or duration. Raise lawn mower blades to 3-4 inches. Voluntary limit indoor water use.	Reduce irrigation of public facilities by 20%. Communicate drought conditions to the public. Target indoor conservation messaging to high water users.	Update communications for drought stage Focus water management to maintain reservoir and aquifer levels. Increase water user education through smar comparative billing. Monitor groundwater use to avoid depletior
Stage 2 Concern	Follow mandatory irrigation schedule; irrigation of only trees and shrubs recommended. Grass installation prohibited. Enhanced monitoring for failing to comply with irrigation schedule and/or other water waste activities. Car washing restricted to commercial facilities. Non-essential draining and refilling of swimming pools prohibited. Reduce indoor water use by 10%.	Reduce irrigation of public facilities by 40%. Restrict construction water use. Prohibit use of misting systems. Prohibit use of ornamental fountains. Raise tiered water rates. Designate staff to assist with enforcement and public outreach.	Provide communication materials to communication severity of drought stage. Petition State for limitation on aquifer drawdown. Increase leak detection and repair efforts. Begin voluntary transfers of irrigation water rights to potable use. Implement indoor water audit incentive program. Suspend non-essential system maintenance activities, including flushing.
Stage 3 Crisis	Grass irrigation prohibited; irrigation of trees and shrubs only allowed via drip irrigation or by hand watering. Discourage new landscaping. Conduct water audits. Reduce indoor water use by 20%.	Prohibit irrigation of non-functional grass. Implement enforcement measures for failure to comply with conservation measures. Turn off outdoor water features, including recreational water splash pads. Provide indoor water audits. Restrict high commercial water use. Institute a temporary building moratorium. Prohibit use of water for dust control, except as required to protect public health.	Provide crisis communication and enforcement support to municipalities. Rebalance water deliveries by population nc limited by delivery contract. Actively negotiate temporary transition of municipal irrigation water rights to suppleme potable water supplies.
Stage 4 Catastrophic	No outdoor water use. Reduce indoor water use by 30%.	Eliminate all outdoor irrigation. Prohibit recreational water use. Aggressive enforcement including water shutoffs.	Provide emergency communication services. Limit contract water deliveries.

7.1 Drought Stage 0: Conserve

Water availability is at normal supply.

7.1.1 Residential Action Plan

- Follow the district's recommended seasonal irrigation schedule.
- No irrigation in the summer between 10 a.m. and 8 p.m.
- Repair leaks and remedy water use inefficiencies.
- Participate in district rebate programs and free community classes.

7.1.2 Local Municipality Action Plan

- Encourage / incentivize water wise landscaping.
- Communicate water consumption data to residents.
- Model sustainable water use strategies.
- Encourage restaurants to serve water by request only.
- Minimize hotel laundry use by encouraging patrons to reuse linens and towels.

7.1.3 District Action Plan

- Consistently communicate water conservation objectives.
- Provide public communication materials to all communities.
- Reinforce sustainable use messaging.
- Conserve and secure additional water sources for population growth.
- Develop and maintain infrastructure.
- Identify and repair leaks.
- Plan and prepare for future drought.

7.2 Drought Stage 1: Caution

Water availability is abnormally dry, or decreasing supply.

7.2.1 Residential Action Plan

- Reduce irrigation frequency and/or duration.
- Raise lawn mower blades to 3-4 inches.
- Voluntary limit indoor water use.

7.2.2 Local Municipality Action Plan

- Reduce irrigation of public facilities by 20%.
- Communicate drought conditions to the public.

- Target indoor conservation messaging to high water users.

7.2.3 District Action Plan

- Update communications for drought stage.
- Focus water management to maintain reservoir and aquifer levels.
- Increase water user education through smart, comparative billing.
- Monitor groundwater use to avoid depletion.

7.3 Drought Stage 2: Concern

Water availability is at prolonged drought, or diminished supply.

7.3.1 Residential Action Plan

- Follow mandatory irrigation schedule; irrigation of only trees and shrubs recommended.
- Grass installation prohibited.
- Enhanced monitoring for failing to comply with irrigation schedule and/or other water waste activities.
- Car washing restricted to commercial facilities.
- Non-essential draining and refilling of swimming pools prohibited.
- Reduce indoor water use by 10%.

7.3.2 Local Municipality Action Plan

- Reduce irrigation of public facilities by 40%.
- Restrict construction water use.
- Prohibit use of misting systems.
- Prohibit use of ornamental fountains.
- Raise tiered water rates.
- Designate staff to assist with enforcement and public outreach.

7.3.3 District Action Plan

- Provide communication materials to communication severity of drought stage.
- Petition State for limitation on aquifer drawdown.
- Increase leak detection and repair efforts.
- Begin voluntary transfers of irrigation water rights to potable use.
- Implement indoor water audit incentive program.
- Suspend non-essential system maintenance activities, including flushing.

7.4 Drought Stage 3: Alarm

Water availability is at escalated drought, or deteriorated supply.

7.4.1 Residential Action Plan

- Grass irrigation prohibited; irrigation of trees and shrubs only allowed via drip irrigation or by hand watering.
- Discourage new landscaping.
- Conduct water audits.
- Reduce indoor water use by 20%.

7.4.2 Local Municipality Action Plan

- Prohibit irrigation of non-functional grass.
- Implement enforcement measures for failure to comply with conservation measures.
- Turn off outdoor water features, including recreational water splash pads.
- Provide indoor water audits.
- Restrict high commercial water use.
- Institute a temporary building moratorium.
- Prohibit use of water for dust control, except as required to protect public health.

7.4.3 District Action Plan

- Provide crisis communication and enforcement support to municipalities.
- Rebalance water deliveries by population not limited by delivery contract.
- Actively negotiate temporary transition of municipal irrigation water rights to supplement potable water supplies.

7.5 Drought Stage 4: Crisis

Water availability is at extreme drought, or depleted supply.

7.5.1 Residential Action Plan

- Reduce indoor water use by 30%.
- No outdoor use.

7.5.2 Local Municipality Action Plan

- Eliminate all outdoor irrigation.
- Prohibit recreational water use.
- Aggressive enforcement including water shutoffs.

7.5.3 District Action Plan

- Provide emergency communication services.
- Limit contract water deliveries.

Chapter 8 Communication Plan

The Task Force is scheduled to meet monthly to review technical information to make recommendations regarding drought stages to the WCWCD Board. The WCWCD Board is the policy arm of the District and responsible for deciding when to change the drought stage based on the model output, system storage, drought levels, and input from the Task Force. Should the Board make a decision to change the current Stage, the District will inform the municipal partners and would update the website to reflect the current Stage.

The District will encourage each municipal partner to publish the current Stage and link to the District's drought page. The District has developed a toolbox of resources to reflect conditions for each Stage so any changes can be accomplished easily once a Board decision is made.

8.1 Outreach and Communication Plan

Public awareness and adoption are vital to the Plan's success. The District coordinate with its municipal partners to provide information regarding water supply availability and response stages to the public via the following sources:

- **Website** – the district will have dedicated pages on wcwcd.org with information; the district will encourage the county and all municipal customers to link their respective websites to this page
- **Social media** – the district will post information on its various social media platforms and encourage the county and all municipal partners to do the same
- **E-newsletter** – the district will draft and distribute information for its electronic newsletter and share this content with the county and all municipal partners for distribution to their respective subscribers

8.2 Public Outreach

When needed, the District may enhance outreach to include:

- **Press announcement and/or press conference** – the District will prepare and distribute information to media representatives with the intent of generating news coverage
- **Advertising** – the District has a robust media campaign that includes online, social media, broadcast production and billboard advertisements that may be used to communicate messaging
- **Speakers bureau** – District representatives will speak at events hosted by community and civic organizations
- **Signage** – the District will work with the county and cities to post educational materials at public facilities including libraries, community centers, recreational facilities, etc.

- **Enhanced collaboration** – the District will request the use of county and/or city resources to communicate information. Potential resources include newsletters, utility bill inserts, direct mail pieces, marques/signs, etc.

Chapter 9 Plan Maintenance and Updates

The District will update the Plan as needed and at least every five years. The Task Force will continue to meet once per month over the lifetime of the Plan. Evaluation of the Plan will center around three main topics to assure it is working effectively. These topics include:

- The Model;
- Response Actions;
- Communications.

<u>The Model</u>

The model output will be vetted based on in situ experiences. The model takes into account meteorological conditions along with storage in the system and demand. It was built to be sensitive to these input factors. Comparison with the real conditions and actual system demand and storage will all be considered for its effectiveness and any concerns with accuracy or sensitivity.

<u>Response Actions</u>

The regular Task Force meetings will allow for evaluation of the Actions and their effectiveness. While technical issues would be handled by the model and recommendations, the Actions would be responsible for the practical actions to respond to and manage drought conditions. The Task Force evaluation would be capable of monitoring for issues with the Actions being implemented, carried to fruition, or issues with the respective Actions not having a significant impact on drought management.

<u>Communications</u>

Successful implementation of the Plan relies on effective communication with municipal partners and their respective constituents. Ongoing evaluation will allow for the Task Force to revise or implement additional strategies to more effectively communicate.

By year 4 the District would begin the update process to ensure the new Plan incorporates any changes recommended by the Task Force, as well as federal or state requirements that may have changed.