TRUCKEE MEADOWS WATER AUTHORITY

Quality. Delivered.

2020-2040 Water Resource Plan

Lake Tahoe Dam

TO OUR CUSTOMERS

Since 2001, Truckee Meadows Water Authority (TMWA) has drafted its Water Resource Plan (WRP) to analyze future conditions and outline strategies to meet the region's drinking water needs. From the lowest snowpack year in recorded history (2015) to the wettest water year on record (2017), TMWA has effectively managed its water resources to provide a resilient and reliable water supply for the region.

Diligent planning requires an analysis of a broad range of future conditions. Accordingly, the 2020–2040 WRP incorporates climate and population scenarios that effectively stress-test the community's water system for the next 20 years and beyond.

To adapt to changes over time, the WRP is updated every five years. This current revision occurred over 18 months and incorporated customer survey feedback from the beginning. Of the customer insights collected, the top concerns related to two topics: population growth and extreme climate variation. These topics are woven throughout this plan. The following pages provide readers insight into TMWA's water resource management strategies and the future of drinking water in the region.

Many contributors were essential to the completion of this plan. TMWA would like to thank its customers for their invaluable feedback, which helped shape the 2020-2040 WRP. Additionally, TMWA extends its appreciation for contributions made by the following organizations and agencies:

- TMWA Board of Directors
- Precision Water Resources Engineering
- Western Regional Water Commission
- Northern Nevada Water Planning Commission
- Truckee Meadows Regional Planning Agency

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LIST OF ACRONYMS

AIS	Aquatic Invasive Species
AF	Acre-Feet
AFA	Acre-Feet Annually
ASR	Aquifer Storage Recovery
CAB	Citizen Advisory Board
CFS	Cubic Feet per Second
CIP	Capital Improvement Plan
CTMRD	Central Truckee Meadows Remediation District
DRI	Desert Research Institute
EPA	Environmental Protection Agency
GCM	General Circulation Model
GPM	Gallons per Minute
GWTF	Groundwater Treatment Facility
ISWPP	Integrated Source Water Protection Plan
JPA	Joint Powers Agreement
MCL	Maximum Contaminant Level
MGD	Million Gallons per Day
NAB	Neighborhood Advisory Board
NDEP	Nevada Division of Environmental Protection
NDOT	Nevada Department of Transportation
NNWPC	Northern Nevada Water Planning Commission
NRCS	Natural Resource Conservation Service
OTR	One Truckee River
PCE	Tetrachloroethylene
PLPT	Pyramid Lake Paiute Tribe
POSW	Privately Owned Stored Water
PWRE	Precision Water Resources Engineering
RCP	Representative Concentration Pathway
RPGB	Regional Planning Governing Board
RWMP	Regional Water Management Plan
RSF	Rate Stabilization Fund
RSWRF	Reno-Stead Water Reclamation Facility
SAC	Standing Advisory Committee
SDF	State of Nevada Demographer Forecast
SNOTEL	Snow Telemetry
STMGID	South Truckee Meadows General Improvement District
STMWRF	South Truckee Meadows Water Reclamation Facility
SWE	Snow Water Equivalent
SWPA	Source Water Protection Area
TCID	Truckee Carson Irrigation District
TDS	Total Dissolved Solids
TMRPA	Truckee Meadows Regional Planning Agency
TMSA	Truckee Meadows Service Area
TMWA	Truckee Meadows Water Authority
TMWRF	Truckee Meadows Water Reclamation Facility
TNC	The Nature Conservancy
TRF	Truckee River Fund
TRFMA	Truckee River Flood Management Authority
TRIC	Tahoe Reno Industrial Center
TRIGID	Tahoe Reno Industrial General Improvement District
TROA	Truckee River Operating Agreement
UNR	University of Nevada, Reno
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USGS	United States Geological Survey
WCF	Washoe County Consensus Forecast
WCM	Water Control Manual
WDWR	Washoe County Department of Water Resources
WHPP	Wellhead Protection Plan
WRP	Water Resource Plan
WRWC	Western Regional Water Commission
WTP	Water Treatment Plant
WUR	Water Usage Review

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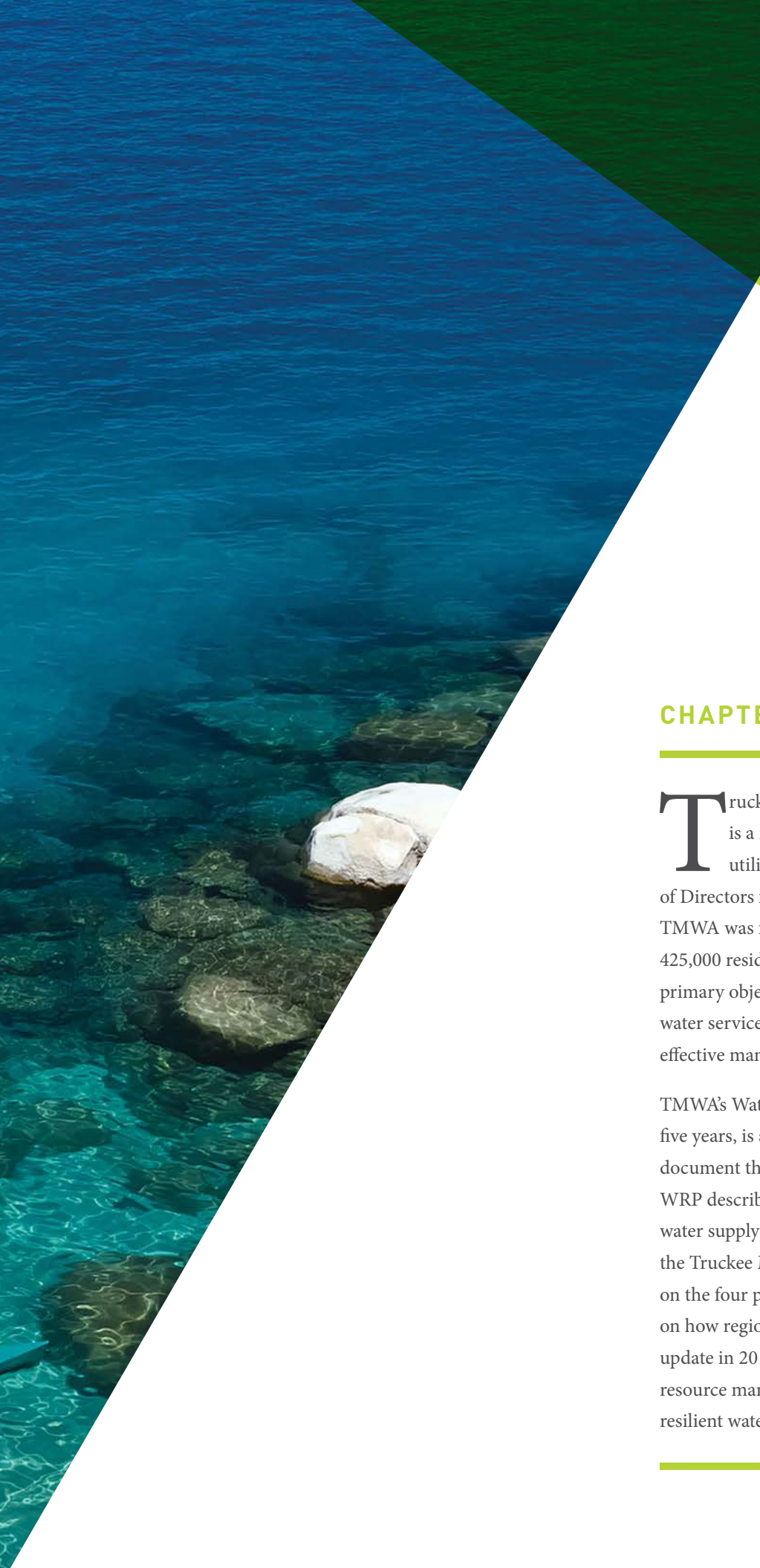
EXECUTIVE SUMMARY

Lake Tahoe



CHAPTER OVERVIEW

Truckee Meadows Water Authority (TMWA) is a not-for-profit, community-owned water utility overseen by a seven-member Board of Directors from Reno, Sparks, and Washoe County. TMWA was formed in 2001 and currently serves over 425,000 residents in the Truckee Meadows. TMWA's primary objective is to provide reliable, high-quality water service to its customers in an efficient, cost-effective manner.

TMWA's Water Resource Plan (WRP), updated every five years, is a long-range planning and management document that spans a 20-year period. The 2020–2040 WRP describes how the utility will meet the drinking water supply needs of current and future customers in the Truckee Meadows. This version of the WRP builds on the four previous versions of the plan and focuses on how regional conditions have changed since the last update in 2016. TMWA's planning efforts and water resource management practices have ensured a reliable, resilient water supply now and into the future.

PLAN UPDATE PROCESS

The 2020–2040 WRP looks different from TMWA's previous plans with more emphasis on future conditions and analysis of TMWA's water resources and their ability to provide a reliable water supply under variable climate conditions and continued population growth. A major goal of this plan update is to increase the usability and approachability of this document for local decision makers and the public. In this regard, community feedback has guided the structure of this plan, with content that directly addresses topics that TMWA customers want to know about.

At the beginning of the plan update process, TMWA distributed an electronic survey to the community. The top three issues the public wanted to see addressed in the WRP were

- Growth and future water demand
- Future availability of existing resources
- The state of our current water resources

These issues are discussed throughout the WRP, providing transparency on how the planning process factors in growth and water availability to ensure a sustainable water supply for the region.

CURRENT WATER RESOURCES

TMWA has a diverse water supply, with a mix of surface and groundwater resources. Surface water includes the Truckee River, upstream reservoir storage, and creek resources. The Truckee River Operating Agreement (TROA), implemented in 2015, provides additional upstream drought storage and operational flexibility for TMWA. Groundwater resources include 89 production wells in nine hydrographic basins, including five production wells in Honey Lake Valley as part of the Fish Springs Ranch water supply project. Through its aquifer storage and recovery (ASR) program, TMWA augments its groundwater supply by injecting treated surface water into many of its production wells during the winter, when customer demand is lower. With this mix of water resources, TMWA is able to conjunctively manage its water supply by utilizing mostly surface water when demand is low and supplementing with groundwater when demand is higher in the summer months or during drought periods.

WATER CONSERVATION

TMWA is a steward of the region's water resources and promotes the efficient use of water in drought and non-drought years. Due to TMWA's ongoing conservation programs, among other factors, municipal residential per capita demand has decreased by 30% since the early 2000s, even though TMWA's customer base has grown by approximately 30%. TMWA has many education and outreach programs focused on water conservation, particularly during the summer months, when customer demand can be three to four times higher than wintertime use, primarily due to landscape irrigation. When the region is experiencing a drought, TMWA can enact enhanced conservation measures to help decrease demand to minimize the use of drought reserves.

ADAPTING TO CHANGE

Many factors can impact the region's drinking water supply and demand, including population growth, economic cycles, and climate conditions. The WRP considers these factors to ensure that available water resources are sufficient for TMWA's current and future customers. A goal of the WRP is to show that TMWA can reliably meet customer demand under a range of potential future conditions, including extended droughts. Accordingly, supply and demand scenarios are incorporated into the plan to indicate any areas where action needs to be taken to address possible water supply challenges in the future.

FUTURE DEMAND & GROWTH

Estimating future demand is largely a function of projected population growth for the Truckee Meadows. TMWA's 20-year water demand projection estimates that water demand will increase 15% from approximately 83,000 acre-feet in 2020 to 96,000 acre-feet in 2040. All new developments

served by TMWA are required to dedicate water rights to meet the project's estimated water demand. For every acre foot of surface water rights needed for new development, an additional 11% of water rights must be dedicated to TMWA for drought storage. To meet anticipated future demand, TMWA will rely primarily on the conversion of Truckee River water rights from irrigation to municipal use along with Fish Springs Ranch groundwater.

WATER SUPPLY SCENARIO PLANNING

Droughts are a common occurrence in Northern Nevada, and to capture a worst-case scenario TMWA uses the worst historic drought on record, lasting from 1987 to 1994, for planning purposes. Climate change is also factored into this plan, as data show that the region has been warming over the past several decades. In recognition of both, TMWA evaluated a range of scenarios featuring historic drought cycles, climate warming trends, and future greenhouse gas emission projections. These scenarios were created using the most up-to-date climate change research for the region. TMWA ran multiple climate scenarios through the operations model for the Truckee River to determine how municipal water supply may be affected from now until 2098. The results of this research give insight into the resiliency of TMWA water resources under various future conditions.

> "TMWA's primary objective is to provide reliable, high-quality water service to its customers in an efficient, cost-effective manner."

In the near and long-term, the modeling effort demonstrates that TMWA has sufficient water resources to meet the growing demand in the region under almost all climate conditions modeled. No water shortages were found under any of the climate scenarios during the 20-year planning horizon. Some water shortages were seen in the latter half of the century, with much higher customer demand levels under the climate change models. Ch. 3 includes a detailed explanation of these results. Shortfalls were identified under a conservative approach that did not account for many of the water resources the region could possibly obtain over the next 50+ years. Uncertainty is a given, especially toward the end of the century when there are many variables that cannot be accurately predicted at this time. TMWA uses the best science available when making resource planning decisions and will continue to model future conditions as the projections and modeling science change.

One of the most significant adaptations that would improve the future water supply outlook for the Truckee River Basin is the reoperation of the federally owned flood control reservoirs in the region, including Prosser, Stampede, and Boca Reservoirs. TMWA and other partners applied for and received a grant through the Bureau of Reclamation in September 2019 to provide the necessary hydrologic modeling and develop new guidelines to allow TMWA and others to store water earlier in the runoff season, based on forecast-informed reservoir operations. Results from this project will be presented in TMWA's next WRP.

FUTURE WATER RESOURCES

TMWA has sufficient water resources and additional water rights are available to meet anticipated demand in 2040 and beyond. To further expand TMWA's water resource portfolio and increase drought supplies and off-river resources, the WRP identifies future water supply projects. Most of the identified projects would provide relatively small quantities of water to the region but are important for expanding and diversifying the community's water supply portfolio. Each future resource includes an analysis of the possible benefits and challenges associated with project implementation. Potential future projects include groundwater expansion and treatment

of existing groundwater resources, increased use of creek water resources, Marlette Lake Water System wholesale service, and water banking projects. Additionally, OneWater Nevada, which includes TMWA and a diverse group of regional partners, is exploring innovative water treatment technologies to determine the feasibility of using advanced purified water to enhance water resource sustainability and drought resiliency.

ENVIRONMENTAL PROTECTION INITIATIVES

TMWA recognizes that a healthy, thriving Truckee River watershed is essential to having a high-quality water supply and providing benefits for the community as a whole. To help protect the watershed and its water quality, TMWA created the Truckee River Fund which provides grants to local agencies and organizations that are working on projects to protect and enhance the river environment. Sustainability is also a key component of TMWA's operational strategy. For example, when its three run-of-the-river hydroelectric plants are running at capacity, TMWA eliminates over 90,000 pounds of CO2 emissions per day, which offsets approximately 75% of the power used by TMWA to produce and deliver treated water throughout the community.

IMPLEMENTING THE WRP

Continued success in managing a resilient water supply for the region will come with the continuation of clear guidance, straightforward action paths, and supportive policies. Based on the findings throughout the WRP, recommended actions fall under three categories for the TMWA Board to consider and act on:

1. **Water Resource Planning**
   These recommendations include the continuation of TMWA's water resource planning process, analysis of the geographic extent of TMWA's planning area, and criteria regarding small water system acquisitions.
2. **Management of Current Water Resources**
   Recommendations in this category address TMWA's current water resource management strategies, which include continued conjunctive use of resources and expansion of the ASR program. Also included are recommended actions related to the acquisition of water rights, implementation of water conservation measures, and continuation of work on source water protection efforts and emergency water supply standards.
3. **Future Water Demand and Resources**
   These recommendations include continued analysis of future population and water demand, adaptive management to address potential climate change conditions, coordination on regional efforts for regional effluent management and advanced purified water pilot projects, and continued investigation and evaluation of potential future water supply projects.

CONCLUSIONS

TMWA's WRP accounts for changes over time, while effectively charting the next 20 years of water resource management for the region. Although this plan is formally updated every five years, TMWA constantly analyzes supply and demand conditions and adapts its water management strategies as needed. The 2020–2040 WRP, and subsequent future updates, will help guide TMWA in confronting any potential water challenges to ensure that it continues to deliver reliable, high-quality drinking water to residents of the Truckee Meadows.

1 INTRODUCTION

Truckee River

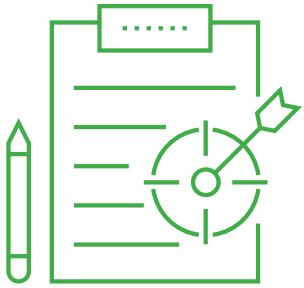
CHAPTER OVERVIEW

While much has transpired since TMWA's inception in 2001, the community has maintained a keen interest in how growth, drought, and extreme climate variation may affect the future of water supply in our region. From environmental factors to technological advancements, each Water Resource Plan update forecasts how to best adapt to change. This chapter introduces major planning considerations, along with an overview of key events and issues that have shifted TMWA's approach to planning over the past two decades.

CHAPTER AT-A-GLANCE

Highlights of Chapter 1 include:

1. The scope of TMWA's integrated planning
2. How and why TMWA was formed
3. The boundaries of TMWA's service area
4. Key aspects that influence TMWA's water resource planning
5. Influential and historical milestones in water resource planning
6. The role of public input in this report



PLAN INTRODUCTION

Truckee Meadows Water Authority's (TMWA) WRP is a planning and management document that spans a 20-year period. Updated every five years, TMWA's *2020–2040 Water Resource Plan* (2040 WRP) builds upon the information developed in prior WRPs and other regional planning efforts. The WRP is important because it details how TMWA manages existing and future water resources for the region. The 2040 WRP is also a valuable resource to educate TMWA's customers about key aspects of the regional water supply.

TMWA's 2040 WRP describes how the utility will meet the drinking water supply needs of current and future customers in the Truckee Meadows, considering factors such as population growth, economic cycles, climate conditions, and available water supplies. With these variables, water resource planning has become increasingly complex in recent years, but this plan will demonstrate that TMWA has sufficient water resources to meet the region's water needs.

Important aspects of water supply planning in the Truckee Meadows will be explained in detail throughout the plan, with a consistent focus on the following key topics:

- **Truckee River Operating Agreement (TROA) implementation:** TROA, which was implemented in December 2015 puts into practice an operational framework that provides greater flexibility in Truckee River operations and provides opportunities for additional upstream reservoir storage. Under TROA, TMWA can store additional water in upstream reservoirs in the years preceding and during a drought. This potentially doubles the amount of TMWA's upstream drought reserves compared to the previous operational agreement. TMWA has successfully operated under TROA for the last four years, benefitting the water supply in the Truckee Meadows region. For details on TROA implementation, see Ch. 2.
- **New service territory and regional growth:** The Truckee Meadows region has been developing quickly since the end of the recession, and TMWA has been diligently working to ensure there is a reliable water supply to meet future demand. The WRP evaluates population growth and future water demand projections to assess the resiliency of the region's water resources.
- **Drought situations and scenario planning:** Drought cycles are common throughout the West, and Northern Nevada is no exception. A key component of the 2040 WRP is its assessment of the availability of TMWA's water resources under a range of future demand and supply scenarios. These scenarios incorporate the most current and relevant research about changing climate conditions in the region. Using climate modeling and growth

projections, TMWA can analyze potential future conditions to ensure a sustainable drinking water supply is available for the Truckee Meadows.

- **Future water resources and technological advances:** While this plan will demonstrate that TMWA has sufficient water resources to meet customer demand well beyond the 20-year planning horizon, developing new water resources to meet future needs takes time. TMWA is actively working to develop innovative new water resources to supplement its existing resources. Through a collaboration called OneWater Nevada, TMWA and regional partners are researching advanced purified water treatment technologies to determine the feasibility of expanding the use of reclaimed water resources in the Truckee Meadows. Ch. 5 details future water resource opportunities and projects.

ABOUT TMWA

TMWA is a not-for-profit, community-owned water utility overseen by a seven-member board of directors made up of elected officials from Reno, Sparks, and Washoe County, as well as an appointed citizen advisory committee. Formerly owned by Sierra Pacific Power Company, the water utility began operations as TMWA in June 2001 through a Joint Powers Agreement (JPA) between the City of Reno, the City of Sparks, and Washoe County. TMWA serves more than 427,000 residents in the Truckee Meadows. TMWA's primary objective is to provide reliable, high-quality water service to its customers in an efficient, cost-effective manner.

One of the main purposes in creating TMWA, as described in the JPA, is to meet the "common interest in assuring that water resources be developed and managed to fulfill the present and future water needs of the greater Truckee Meadows community" and "to assure sufficient water supply to meet the needs of existing and future development."

The Washoe County Department of Water Resources (WDWR) and the South Truckee Meadows General Improvement District (STMGID) water systems were successfully merged into TMWA and consolidated operations began on January 1, 2015. This merger made TMWA the primary water purveyor for the Reno-Sparks metropolitan area and portions of unincorporated Washoe County, also known as the Truckee Meadows. As a result, TMWA provides water for approximately 90% of Washoe County's population.

TMWA'S SERVICE AREA

TMWA's retail service area covers approximately 162 square miles and provides wholesale service to the Sun Valley General Improvement District. The service area expanded by approximately 50 square miles after the consolidation of WDWR and STMGID into TMWA. The service area is within the planning boundary of the Western Regional Water Commission (WRWC) and the Truckee Meadows Regional Planning Agency's (TMRPA) Truckee Meadows Service Area (TMSA), except for several remote satellite service areas in Washoe Valley and near Wadsworth. Figure 1-1 shows TMWA's current service area.

TMWA's service area includes nine hydrographic basins, including Lemmon Valley (hydrographic basin 92A/B), Spanish Springs (hydrographic basin 85), Truckee Meadows (hydrographic basin 87), Pleasant Valley (hydrographic basin 88), and small, satellite systems in Washoe Valley (hydrographic basin 89), Pleasant Valley East (hydrographic basin 88 east), the Tracy Segment (hydrographic basin 83), and Truckee Canyon (hydrographic basin 91). TMWA also manages groundwater in Honey Lake Valley as part of the Fish Springs Ranch water supply project (hydrographic basin 97). Appendix B includes a map of the hydrographic basins.

The portion of TMWA's distribution system located in hydrographic basins 85, 87, 88 (west portion), 91, and 92 provide customers access to Truckee River resources and the benefit of drought reserves made available by TROA. TMWA's satellite systems do not receive Truckee River water because they were developed as stand-alone subdivisions which, upon recordation of a final map, required sufficient groundwater resources to meet the full build-out requirements of the development.

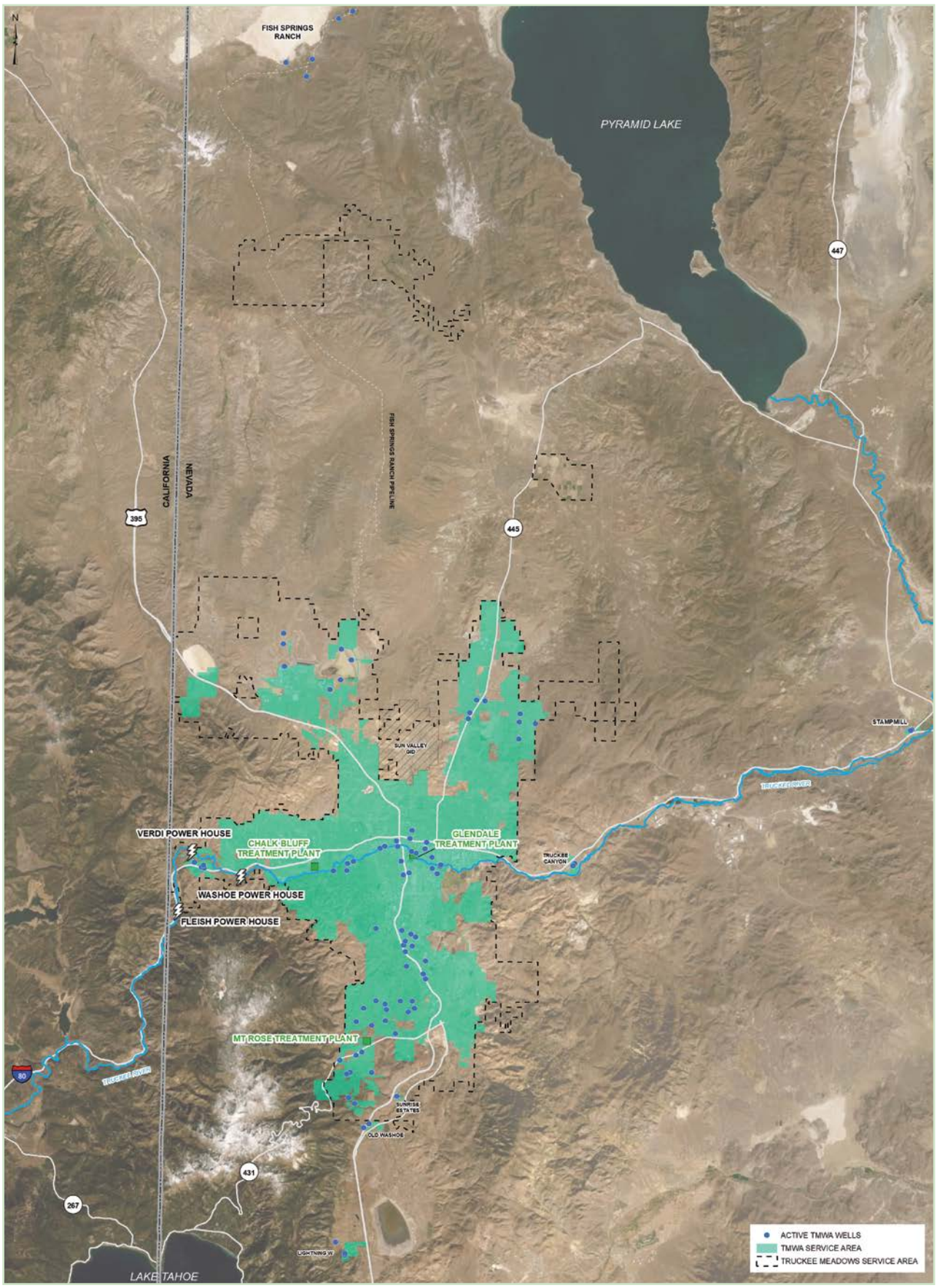


FIGURE 1-1: MAP OF TMWA'S SERVICE AREA, WATER TREATMENT PLANTS, ACTIVE PRODUCTION WELLS, AND SATELLITE SYSTEMS

PLAN GOALS AND OBJECTIVES

As the regional water provider, it is TMWA's responsibility to ensure water supply reliability for the Truckee Meadows. The WRP update process allows TMWA to assess any changes to the system that have occurred over the previous five years to ensure that water supplies are adequate under a range of future conditions. This section outlines the goals and objectives for the 2040 WRP.

GOALS

- Ensure TMWA has adequate water resources to meet the community's needs over the next 20 years and beyond.
- Create innovative solutions to best manage water resources in the region.
- Maintain community confidence in TMWA's planning process.
- Recommend management strategies and proposed polices to guide TMWA over the next five years.

OBJECTIVES

- Provide an overview of TMWA's current water resources and available water rights.
- Analyze alternative supply and demand scenarios to determine the resiliency of TMWA's resources.
- Assess potential impacts of climate change on regional water resources.
- Describe TMWA's current water management and conservation strategies.
- Identify future water resource opportunities and water management strategies.
- Provide opportunities for input from the public and Board throughout the planning process.

PLAN SCOPE

TMWA updates its WRP every five years to address significant changes in the water system and region. TMWA follows an integrated planning approach, and several other planning documents are relied upon in conjunction with the WRP, including TMWA's Facility Plan and Funding Plan (see Figure 1-2).

The scope of TMWA's water planning process, as defined by its JPA directive, does *not* provide for municipal sewer, water reclamation, flood control, storm water drainage, or groundwater remediation. Those functions are planned for by Reno, Sparks, and Washoe Counties. All water-related utility planning efforts, including TMWA's WRP and Facility Plan, are incorporated into the WRWC's Comprehensive Regional Water Management Plan (RWMP), most recently updated in 2016.

The WRWC is charged with improving water resource planning at the regional level (including water, wastewater, stormwater, and flood

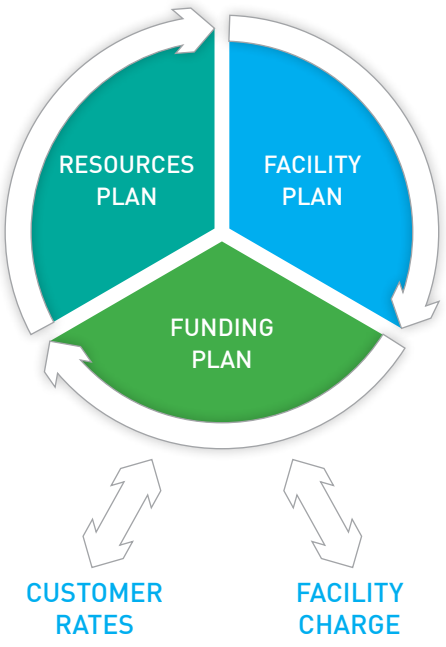


FIGURE 1-2: VISUAL REPRESENTATION OF TMWA'S INTEGRATED PLANNING APPROACH

control) and facilitating coordinated resource management among the Truckee Meadows member entities.

Following an established process, the WRP scope is focused on planning and management of water supplies for existing and future water demand within its existing retail service area as well as those areas where it is deemed appropriate to receive TMWA water service.

PLAN UPDATE PROCESS

Throughout the planning process, TMWA provided opportunities for the public to give feedback on the WRP and regional water resource matters. Initial public outreach for the 2040 WRP included an electronic survey about people's awareness and concerns regarding water resources in the region. The survey was distributed to TMWA customers, employees, and stakeholders via email and social media. Approximately 2,000 responses were received. Input was analyzed and incorporated into the planning process. Appendix A includes a detailed overview of survey responses.

TMWA staff presented information about the WRP to TMWA's Board of Directors throughout the update process. Information about the WRP and survey results were also presented at Smart About Water Day in May 2019. In August 2019, TMWA held a workshop with its Board to discuss possible policy recommendations and management strategies for the 2040 WRP.

In June through August 2020, TMWA presented the draft WRP to its Board, its Standing Advisory Committee, the WRWC, and the Northern Nevada Water Planning Commission (NNWPC). Due to the ongoing restrictions resulting from the COVID-19 pandemic, TMWA held four public webinars to present the draft WRP and to collect public feedback, instead of holding open houses in person. Customers were notified about these events via email and social media. Additionally, TMWA provided public access to the draft WRP and an electronic comment form for feedback on its website from June through August 2020. A question and answer page that addresses public comments received during the outreach process is available at tmwa.com/your-water/resources/.

WRP PUBLIC SURVEY SUMMARY

TMWA surveyed customers, stakeholders, and employees regarding their attitudes toward TMWA's water resource planning efforts. The survey, which was conducted in the fall and winter of 2018, included questions regarding topics the public would like to see addressed in the WRP and concerns over issues that could negatively impact future water supplies. The survey also contained questions on trust in the agency and important issues surrounding the region's water resources such as conservation, drought storage, and the use of reclaimed water. Results from the survey were used to ensure public input was considered in the planning process from the onset. Over a two-month period, approximately 2,000 responses were received.

The top three public concerns for issues that may negatively impact our water supply over the next 20 years:

- Population growth
- More severe droughts
- Wildfire in the upper watershed

The top three issues the public would like to see addressed in the WRP:

- Growth and future water demands
- Future availability of existing resources
- The state of our current water resources

The top three topics of importance to the public:

- Planning water resources around projected growth
- Maintaining drought reserves
- Maintaining groundwater supplies

In general, respondents had a high degree of trust in TMWA to effectively manage regional water resources.

MAJOR EVENTS SINCE PREVIOUS WATER RESOURCE PLANS

Outlined below is a brief overview of the major events that have been covered in TMWA's WRPs over time. The 2040 WRP is the fourth version of the plan since TMWA was established in 2001.

TMWA's *2005–2025 Water Resource Plan*, adopted by the Board in 2003, presented the following:

- History of municipal water supply in the Truckee Meadows;
- Description of the region's water supply system including conjunctive use of surface and groundwater;
- Confirmation of the use of Truckee River flows during the historical 1987–1994 drought period as the basis for TMWA's drought plan;
- Projected population and water demand;
- TMWA's conservation program; and
- Potential future water resource options.

The subsequent plan, the *2010–2030 Water Resource Plan*, built on the foundational strategies from the first plan and expanded upon the following issues:

- Legislative directives to consolidate water purveyors in Washoe County;
- Execution by the five Mandatory Signatory Parties of TROA (TMWA, Pyramid Lake Paiute Tribe (PLPT), California, Nevada, and the United States) and seven other parties on September 6, 2008;
- Changes in population and demand projections as a direct result of the regional economic downturn from 2007 to 2009; and
- Completion of the conversion of flat-rate, single-family residences to the metered rate, which was required as part of the 1989 Preliminary Settlement Agreement.

TMWA's *2016–2035 Water Resource Plan* reviewed and updated TMWA's water resource planning strategies due to several key events, including the following:

- The merger of WDWR and STMGID water utilities into TMWA;
- A reversal of negative or stagnant economic trends dominating the region from 2007 to 2009, which altered the economic activity and growth projections for the Truckee Meadows;
- Purchase of the Truckee Carson Irrigation District's (TCID) 4,750 acre-feet of Donner Lake water rights;
- Successful implementation of TROA with the five Mandatory Signatory Parties on December 1, 2015; and
- Extended meteorological drought from 2012 to 2015, culminating in the driest year on record in 2015.

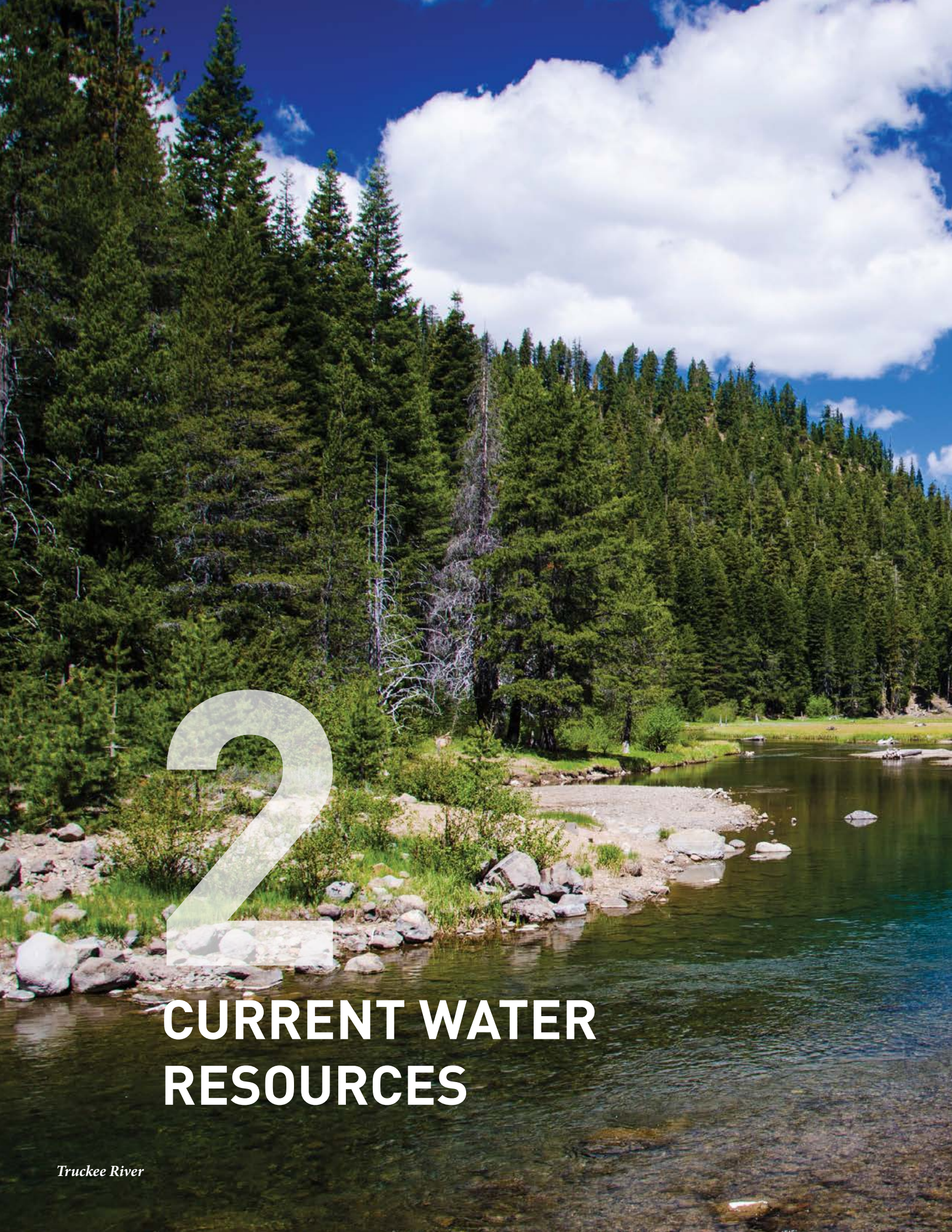
The *2020–2040 Water Resource Plan* builds off the foundation established in the previous plans and addresses important issues that have arisen over the past five years, including:

- Successful operation under TROA in storing credit water to improve total upstream drought storage for the Truckee Meadows;
- Recovery from meteorological drought conditions with a record-breaking winter in 2017;
- Expansion of TMWA's aquifer storage and recovery program to increase the ability to store treated surface water in aquifers to sustain groundwater levels and improve drought preparedness;
- Construction of the Mt. Rose Water Treatment Plant in the south Truckee Meadows to increase the sustainability of the groundwater aquifer that provides water to customers in that area;
- TMWA management of the water resources of Reno, Sparks, Tahoe Reno Industrial General Improvement District (TRIGID), and Nevada Department of Transportation (NDOT) for return flow purposes. This will facilitate implementation of the TRIGID effluent management agreement, enhancing the efficient use of Truckee River resources and facilitating regional water management objectives; and
- Purchase of West Reno Water Company's water system in Verdi in 2019.

SUMMARY

The 2040 WRP update builds upon previous plans and continues to establish the importance of long-range planning to address changing conditions in the Truckee Meadows. Challenges faced by the region in 2020 are different from those faced when TMWA was first established in 2001. TMWA strives to provide a reliable, high-quality water supply for its customers, and the WRP is a critical component to ensure TMWA continues to meet that goal. The following chapters describe TMWA's current water resources, current and future planning environment, water conservation strategies, future water resources, watershed and environmental protection efforts, and recommended actions.

"The Water Resource Plan is important because it details how TMWA manages existing and future water resources for the region."



2 CURRENT WATER RESOURCES

Truckee River

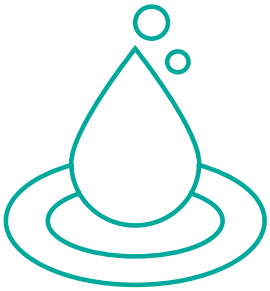
CHAPTER OVERVIEW

The Truckee River is regulated by the Truckee River Operating Agreement, which dictates how much water flows, who gets it, and when. This chapter briefly describes these rules and goes into more detail about TMWA's existing water resources: from surface water reserves stored in six upstream reservoirs to 89 production wells in nine groundwater basins around the Truckee Meadows. This diverse water resource portfolio allows TMWA to efficiently utilize available water by managing the ways in which surface water, groundwater, and storage reservoirs are used.

CHAPTER AT-A-GLANCE

Highlights of Chapter 2 include:

1. Management of the Truckee River and creek resources
2. TMWA's groundwater production
3. Groundwater recharge and management
4. TMWA's conjunctive use strategy
5. Surface water and groundwater rights over time



TMWA serves more than 425,000 people with a service area spanning over 162 square miles. The utility has built a diverse portfolio of surface water and groundwater resources to ensure the region's water supply is resilient and reliable. This chapter describes TMWA's current water resources and how the Truckee River Operating Agreement (TROA) benefits the region and the Truckee River.

TMWA's surface water treatment and groundwater production facilities are also described, which when operated together as an integrated system allows for conjunctive use, making it possible for TMWA to reliably meet demands under drought and non-drought conditions. Lastly, a summary of TMWA's surface water and groundwater rights portfolio is presented, providing

THE TRUCKEE RIVER WATERSHED

A watershed is an area from which runoff resulting from rainfall or snowmelt collects and drains to a common point, such as a river or lake. Reno and Sparks are in the Truckee River watershed, which spans California and Nevada and encompasses approximately 3,060 square miles. The Lake Tahoe Basin is part of the Truckee River watershed, with the Truckee River being as the only outlet of Lake Tahoe. The length of the Truckee River is 121 miles from Lake Tahoe to its terminus at Pyramid Lake. This watershed is unique in that it does not flow to the ocean like many other watersheds in the United States. There are many tributaries to the Truckee River, including the Little Truckee River and Donner Creek in California and Hunter Creek and Steamboat Creek in Nevada. **Ch. 6** includes details about efforts to protect and preserve the Truckee River watershed. The aerial photo included here shows Lake Tahoe on the bottom left and Pyramid Lake on the top right.

an overview of the water resources available to serve existing and future customers.

SURFACE WATER RESOURCES

The Truckee River is the primary source of water for the Truckee Meadows, providing 80–85% of the region's drinking water. TMWA's surface water rights come predominantly from the Truckee River, plus water from several major tributaries, including Hunter, Steamboat, and Whites Creeks.

TMWA has two surface water treatment plants (WTPs) on the Truckee River: Chalk Bluff and Glendale. The Chalk Bluff WTP is TMWA's largest, capable of producing approximately 90 million gallons per day (MGD) of treated water. Raw water at the Chalk Bluff WTP is treated via a conventional water treatment process through settling of heavy solids, screening, flocculation and sedimentation, filtration, and chlorination. The plant is designed for modular expansions to have an ultimate treatment capacity of 120 MGD.

The Glendale WTP is TMWA's supplemental treatment facility and can produce approximately 33 MGD of surface water. The plant is typically operated on a seasonal basis (May through October) to meet summertime demand. Additionally, groundwater from six wells can be pumped to Glendale to be treated for arsenic and blended with surface water to meet water quality standards for distribution into the system. With groundwater included, the combined capacity of Glendale is 45 MGD. The Glendale WTP employs the same treatment process as the Chalk Bluff WTP.

The Mt. Rose WTP will be a relatively small surface-water treatment plant scheduled for completion in 2020. It will treat Whites Creek water to supplement groundwater supplies on the Mt. Rose Fan and will produce up to 4 MGD when sufficient creek flows are available. Construction of the Mt. Rose WTP will further TMWA's conjunctive use of its surface water and groundwater supply, allowing TMWA to rest production wells (passive recharge) and use surface water to meet customer demand. Additionally, the Mt. Rose WTP will allow for the injection of treated surface water into the aquifer (active recharge). This will improve water resource sustainability in the area and will address needed groundwater level recovery. Groundwater elevations were in decline when the area was completely reliant on the groundwater supply to serve residents (prior to consolidation of the utilities).

TMWA has a robust monitoring and operating plan to manage Whites Creek water, which has been approved by the Nevada State Engineer and accepted by the Federal Water Master, Nevada Division of Wildlife, and The Nature Conservancy. To ensure the Whites Creek ecosystem remains healthy and all downstream water rights are satisfied, minimum bypass flows and flushing flows below the Mt. Rose WTP are required. TMWA is exploring options to use additional creek resources, which are described in more detail in Ch. 5.

CHALK BLUFF WATER TREATMENT PLANT

MT. ROSE WATER TREATMENT PLANT CONSTRUCTION (JANUARY 2020)

TRUCKEE RIVER WATERSHED AND THE TRUCKEE RIVER OPERATING AGREEMENT (TROA)

The Truckee River watershed is predominantly snow fed. Mountain snowpack acts as a natural reservoir, accumulating in the winter and melting in the spring and summer months when more water is needed downstream for irrigation and outdoor watering. The Truckee River is the only outlet from Lake Tahoe and is controlled by a dam at Tahoe City that controls the top 6.1 feet of the lake, equalling 744,600 acre-feet (AF) of storage. Truckee River flows are highly dependent on Lake Tahoe's surface elevation at any point in time throughout the year.

In addition to Lake Tahoe, other reservoirs within the Truckee River watershed include Donner Lake, Independence Lake, Stampede Reservoir, Boca Reservoir, and Prosser Reservoir (Figure 2-1). TMWA owns all water rights from Donner and Independence Lakes, referred to collectively as TMWA's Privately Owned Stored Water (POSW). Together, this amounts to 27,000 acre-feet annually (AFA) of surface water storage. In dry years, when river flows are low and additional water resources are required in the Truckee Meadows, POSW can be released to help meet those demands.

TROA, implemented in 2015, governs operations on the Truckee River system. The Federal Water Master manages reservoir releases and the flow of water in the Truckee River system to ensure the operating requirements under TROA are satisfied for all water rights holders, including TMWA. TROA ratified the interstate allocation of water between California and Nevada, ensuring that

Nevada will receive 90 % of Truckee River water. The required flow rates at the state line are known as Floriston Rates. Floriston Rates require an average flow at the US Geological Survey (USGS) Farad Gage, near the California-Nevada border, of 500 cubic feet per second (CFS) from March through September and 400 CFS from October through February. Floriston Rates can be reduced under certain TROA conditions. Reduced Floriston Rates require either 300 CFS or 350 CFS at the Farad Gage and go into effect from November 1 through March 31, whenever the water surface elevation of Lake Tahoe is lower than 6,226 feet.

The Federal Water Master is responsible for releasing water from Lake Tahoe and the other federal reservoirs (Stampede, Boca, and Prosser) as needed to meet Floriston Rates until this water is depleted. Lake Tahoe is considered the best barometer regarding the health of the region's water supply. When the elevation of Lake Tahoe approaches its natural rim (6,223 feet), Floriston Rates drop off shortly thereafter. When the elevation of Lake Tahoe drops below the natural rim, water ceases to flow from the lake into the Truckee River. Under TROA, a drought situation occurs when Floriston Rates are not projected to be maintained through October 31st, or the projected elevation of Lake Tahoe on or before November 15th will be less than 6,223.5 feet. TROA requires the Federal Water Master to determine by April 15th of every year whether a drought situation exists based on the above criteria. Figure 2-2 presents the history of recorded month-end elevations for Lake Tahoe.

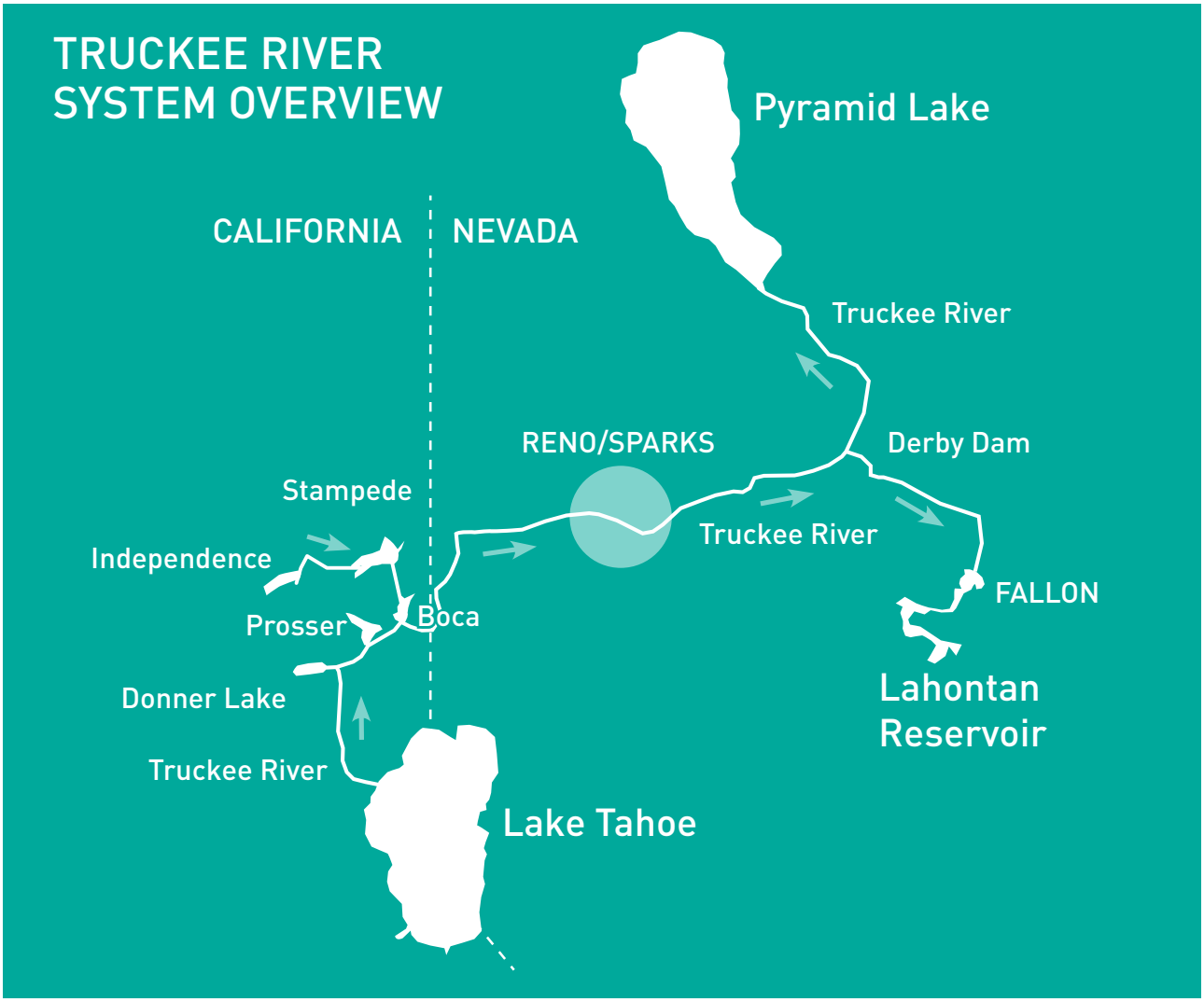


FIGURE 2-1: DIAGRAM OF THE TRUCKEE RIVER SYSTEM

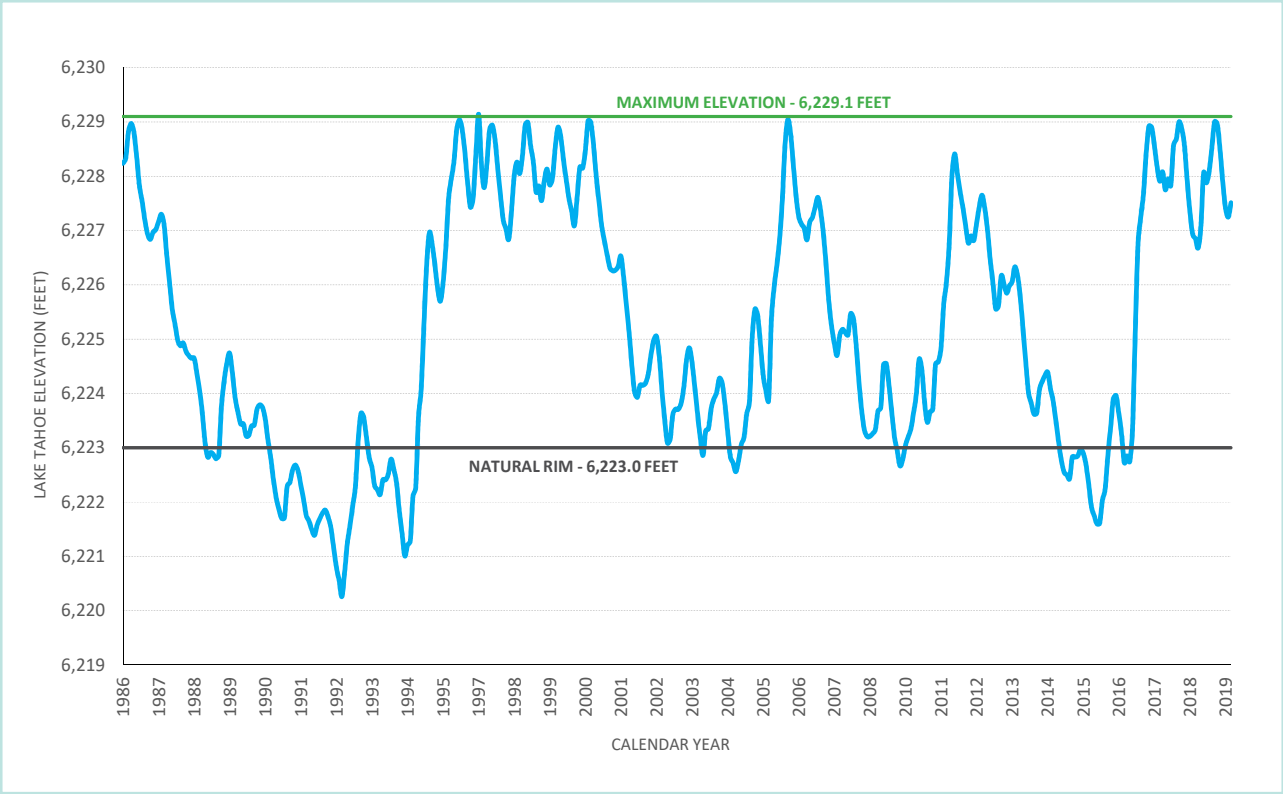


FIGURE 2-2: LAKE TAHOE ELEVATIONS FROM 1986 TO 2019

TROA provides for modified river and reservoir operations that result in multiple benefits for water users, including benefits to endangered fish and significant improvements in drought storage for TMWA. TROA also satisfies the Truckee-Carson-Pyramid Lake Water Rights Settlement Act signed by Congress in 1990. The five signatory parties of TROA include California, Nevada, TMWA, the Pyramid Lake Paiute Tribe (PLPT), and the US Department of the Interior.

TROA addresses two key elements that differentiate it from former operations: 1) the ability of a water right holder, such as TMWA, to exercise a portion of its water rights by storing water (credit water) that would otherwise have been released from storage or passed through the reservoirs to the Truckee River; and 2) the ability to exchange (or trade) stored water between Truckee River reservoirs. Thus, TROA allows TMWA to accumulate and carry over stored water through multiple drought years. Over time, TMWA has the potential to accumulate a significant amount of drought reserves, ensuring that the Truckee Meadows will be protected from prolonged droughts with the increased ability to store water compared to pre-TROA operations.

A designated drought situation affects TMWA's operations and the ability to carry over credit water from year to year. If Floriston Rates cannot be met at any time, especially during the summertime demand season, TMWA's water operations may require the release of POSW and/or other stored water and may require increased groundwater pumping. In a drought situation, TROA allows TMWA to carry over stored water in upstream reservoirs from one year to the next, which provides additional surface water resources when a drought persists. There are several categories of stored municipal credit water under TROA, including emergency, firm, and non-firm. Emergency and firm storage do not suffer evaporative losses unless it is the only water in a reservoir, whereas non-firm water can spill when a reservoir fills. In non-drought situation years, TMWA's non-firm stored water above the base amount is automatically converted to fish credit water, which can

be used by the United States and PLPT for the recovery of endangered fish and to support the fishery in the lower Truckee River. For more information on TROA, see https://tmwa.com/article/truckee-river-operating-agreement.

GROUNDWATER RESOURCES

PRODUCTION WELLS

TMWA has groundwater production wells throughout the Truckee Meadows and surrounding basins that supplement surface water supplies and provide water to the satellite water systems where surface water supplies are not available. The utility operates and maintains 89 active production wells in nine distinct hydrographic basins, with 74 available to meet customer demand in TMWA's main service area and 15 available for service in the satellite systems. TMWA's groundwater wells range in capacity from approximately 100 gallons per minute (GPM) to 3,000 GPM. Table 2-1 summarizes active production well totals for each hydrographic basin. See Appendix B for a summary of each hydrographic basin.

Generally, TMWA diverts as much surface water as possible year-round and begins to bring on groundwater production wells later in the spring when customer demands increase, and when needed during drought situation years. Some production wells, generally located at the far reaches of the distribution system, may continue to pump during the winter months to meet customer demand and provide greater system reliability. All satellite water systems are solely dependent on groundwater, and therefore, the wells operate year-round.

The wellfield TMWA operates in Honey Lake Valley (Nevada) is a product of the Fish Springs Ranch water supply project completed by Vidler Water Company in 2008. The basin is located approximately 38 miles north of the Reno-Sparks metropolitan area. The project is currently permitted to provide up to 8,000 AFA of groundwater supply to the Truckee Meadows region. With additional aquifer testing and basin monitoring, the Nevada State Engineer may allow an additional 5,000 AFA of groundwater pumping from the wells for a total supply of 13,000 AFA.

Two main issues TMWA must contend with to have a successful groundwater management program are poor groundwater quality areas and groundwater production capacity declines. Groundwater from five of TMWA's production wells undergoes treatment for tetrachloroethylene (PCE), and six wells must be treated or managed for naturally occurring metals such as arsenic. Treatment for PCE is completed at the wellhead via air-stripping. Several of the wells contaminated with PCE also have high levels of arsenic and must be treated at the Glendale WTP.

Over time, well production capacity may decline. Capacity declines are typically caused by well screen plugging resulting from chemical reactions that occur between the groundwater, aquifer material, and well screen material. To mitigate this occurrence, TMWA manages an annual well rehabilitation program. The program consists of actively monitoring each production well and prioritizing well rehabilitation based on observed production declines. Drilling a new well to mitigate the loss of groundwater production is considered a last resort due to the expense associated with large-diameter well drilling. However, when replacement wells are necessary, they are constructed with superior casing and screen material to increase well longevity.

PASSIVE AND ACTIVE RECHARGE

Groundwater is pumped to help meet peak summer customer demand and during dry years. In the winter season, most production wells are rested, which allows for passive groundwater recharge. When demand is lower, wells can rest because areas are served instead by surface water resources. For example, during 2017–2019, the Truckee Meadows experienced several above-average water years, which provided adequate Truckee River flows, allowing TMWA to minimize groundwater pumping. With reduced groundwater pumping, passive recharge occurred in many basins. Following the merger with Washoe

TABLE 2-1: ACTIVE PRODUCTION WELLS BY HYDROGRAPHIC BASIN

BASIN #	HYDROGRAPHIC BASIN	NUMBER OF ACTIVE PRODUCTION WELLS
83*	Tracy Segment	4
85	Spanish Springs	8
87	Truckee Meadows	47
88**	Pleasant Valley	9
89*	Washoe Valley	5
91*	Truckee Canyon (Verdi)	4
92A	W. Lemmon Valley	3
92B	E. Lemmon Valley	4
97	Honey Lake Valley	5
TOTAL		**89**

*indicates satellite systems, **Pleasant Valley East contains a satellite system

County Department of Water Resources (WDWR) and South Truckee Meadows General Improvement District (STMGID), TMWA has extended surface water resources to areas previously only served by groundwater, such as the Mt. Rose Fan in the South Truckee Meadows and areas in Spanish Springs and Lemmon Valley. In 2018, TMWA passively recharged approximately 2,240 AF of water by supplying those areas with surface water, thus allowing aquifer levels to recover.

Lower demand in the winter months allows TMWA to undertake its aquifer storage and recovery (ASR) program. Under TMWA's ASR program, treated surface water is injected, or recharged, into groundwater aquifers through many of TMWA's existing production wells to improve water quality at certain sites and enhance groundwater elevations by offsetting the effects of summertime pumping. In the near future, water from Whites Creek and the Mt. Rose WTP will be used to satisfy the ASR program in the South Truckee Meadows.

Since its inception, TMWA's ASR program has helped improve or stabilize groundwater levels in and around many production wells. This has enhanced the ability to utilize groundwater resources to meet peak customer demand during the summertime. ASR is one element of TMWA's integrated management strategy to save drought reserves for use at a later date. Through ASR, TMWA has recharged approximately 38,000 AF of water since the program began in 1993. Figure 2-3 depicts which production wells are equipped for recharge.

FOG OVER FISH SPRING RANCH (HONEY LAKE VALLEY, NV)

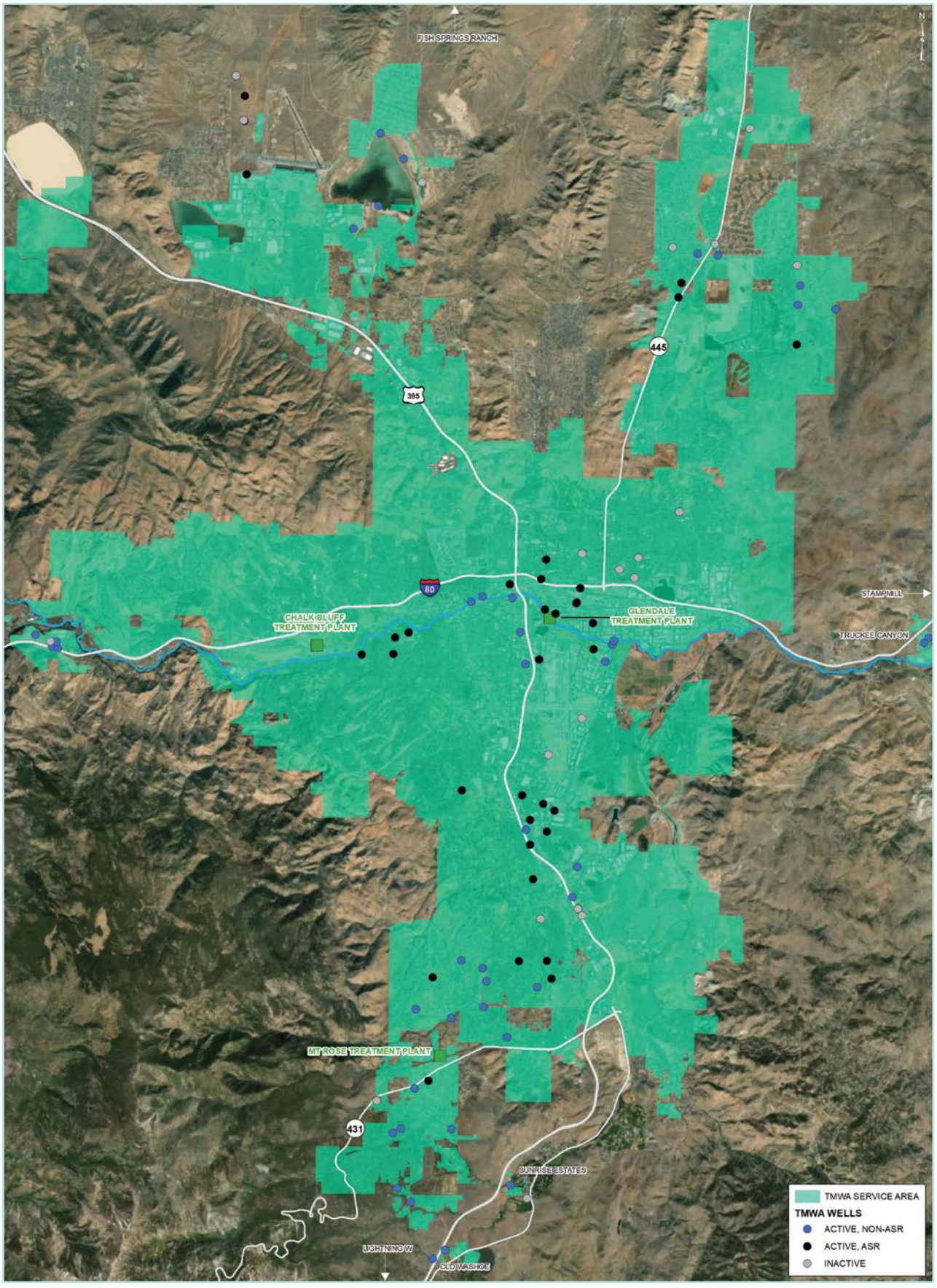


FIGURE 2-3: MAP OF TMWA WELLS PERMITTED FOR RECHARGE

The recharge program is evaluated by TMWA on an annual basis and modified to provide the maximum benefits to aquifer health and water quality. The State of Nevada permits TMWA's ASR program, which requires extensive monitoring to ensure groundwater quality is maintained. Expansion of TMWA's ASR program is discussed in Ch. 5.

CONJUNCTIVE USE

Conjunctive use allows TMWA to optimize surface water, groundwater, and drought reserves to maximize the efficient use of water resources systemwide. This strategy allows sustainable management of resources under both drought and non-drought conditions.

The majority of water supply (80–85%) used to meet TWMA's annual demand comes directly from the Truckee River. Chalk Bluff WTP's ability to operate year-round allows TMWA to efficiently utilize its surface water resources in *any* type of year, thereby preserving groundwater for use during the peak summertime demand months. In the summer months of the driest years when Floriston Rates cannot be met, POSW and credit water from upstream reservoirs are released to help meet customer demand. TMWA has only had to use a small amount of its stored water in five of the last 30 years, including 2015 which had the lowest snowpack year on record. Figure 2-4 shows the historical sources of TMWA's water supply on an annual basis.

WATER RIGHTS

AVAILABLE WATER RIGHTS

The Orr Ditch Decree (the Decree), issued in 1944, adjudicated water rights to the Truckee River and its tributaries. The Decree sets the total volume of mainstem and tributary water rights at 224,000 AF. Although water rights can be divided and converted from one use to another (e.g., agriculture to municipal use), the total number of surface water rights available from the Truckee River does not change from the amount of water rights set by the Decree. Originally, most water rights were for agricultural purposes within the Truckee Meadows. The Decree also granted municipal water rights to TMWA's predecessor, Sierra Pacific Power Company. These decreed municipal water rights, along with storage from Donner and

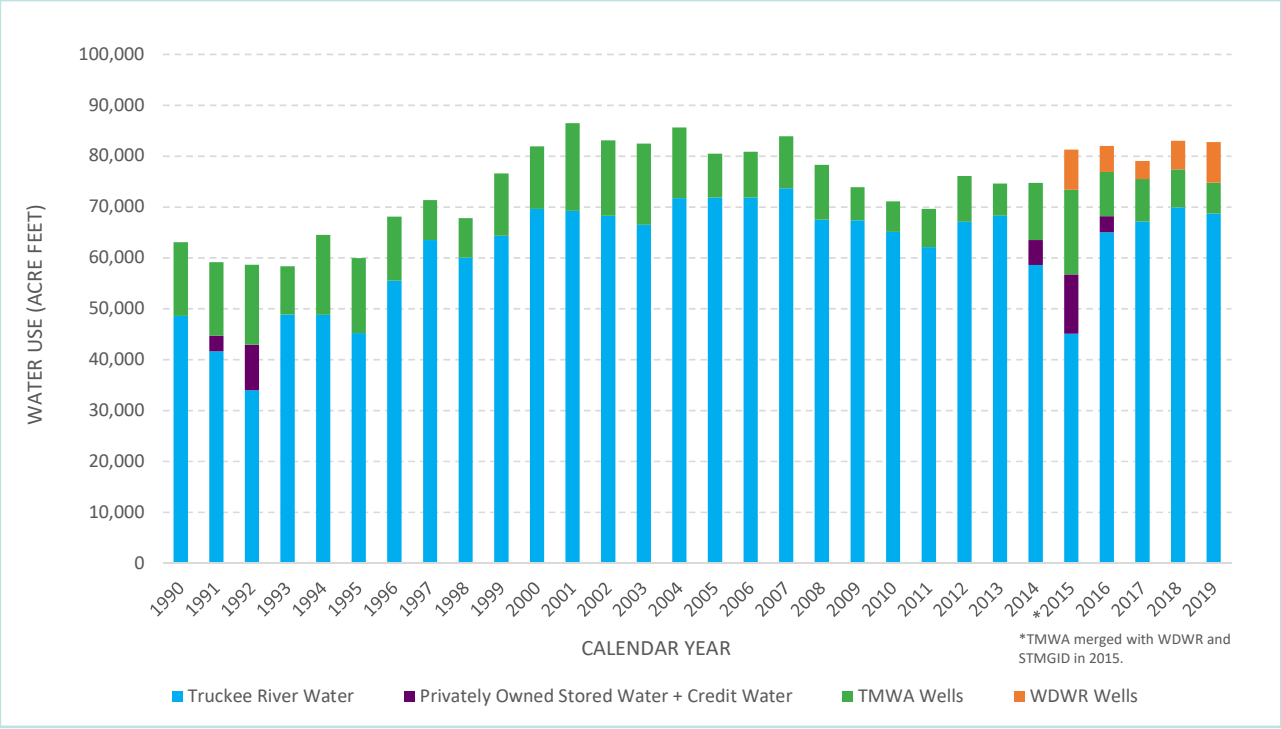


FIGURE 2-4: SOURCES TO MAKE ANNUAL TMWA WATER SUPPLY FROM 1990 TO 2019

Independence Lakes, were used to satisfy customer demand until the 1960s. Since that time, TMWA and its predecessor have been acquiring decreed agricultural water rights and converting them to municipal use. Figure 2-5 shows the conversion of decreed agricultural rights to municipal use over time. To date, TMWA has acquired over 79,000 AF of agricultural rights and converted them to municipal use to meet the wholesale and retail will-serve commitments of its customers. All water rights under the Decree are administered by the Federal Water Master and the Decree court (the US District Court in Reno). The Federal Water Master also administers TROA, which is designed to provide long-term sustainable water operations for the multiple stakeholders of the Truckee River system.

Groundwater resources began to be developed in the late 1950s and 1960s. Adding wells was a less expensive alternative to building additional surface water treatment plants to increase production capacity to meet the growing summer peak demand. Currently, TMWA operates 89 production wells in nine different hydrographic basins, which can supply about 40% of TMWA's summer peak demand.

Although TMWA is allowed to annually exercise, or pump, the total volume of groundwater rights described in Table 2-2, it actively manages its groundwater pumping within each basin to maintain the long-term sustainability of the aquifers. This strategy takes into account water rights, historical groundwater pumping, water levels, and variable hydrologic conditions. For example, TMWA's total annual groundwater pumping over the last five years has ranged from 11,882 AFA to 24,509 AFA, which demonstrates the variability in pumping depending on whether it's a wet year, like 2017, or a drought year, like 2015. TMWA's conjunctive use program, plus active and passive recharge, promotes sustainable groundwater management.

As summarized in Table 2-2, TMWA's surface and groundwater resources, plus TMWA's POSW in Donner and Independence Lakes, comprise the water rights portfolio that makes up the water supply for TMWA's customers.

NEVADA WATER LAW BASICS

Except for prestatutory water law rights established by federal or state court decrees, groundwater and surface water rights in Nevada are administered and managed by the State Engineer. Nevada water law follows the prior appropriation doctrine (also known as "first in time, first in right"), which stipulates that those who first appropriated a quantity of water and put it to beneficial use have the right to continue to use that water. Irrigation, mining, recreation, industrial, and municipal uses are examples of beneficial uses. Senior water rights holders (i.e., those with earlier priority dates) are protected even if new uses for a water source are allocated. Junior water right holders cannot impinge on the rights of senior water right holders. TMWA holds surface water rights to legally divert water from the Truckee River and groundwater rights to pump groundwater to provide water service to customers.

RULE 7

TMWA continuously works to maintain and improve the yield it receives from its existing water rights–decreed, converted agricultural rights, POSW, and groundwater–to generate a water supply that will meet the current and future needs of its customers. TMWA holds sufficient water rights to meet customer demand (83,000 AF in 2019).

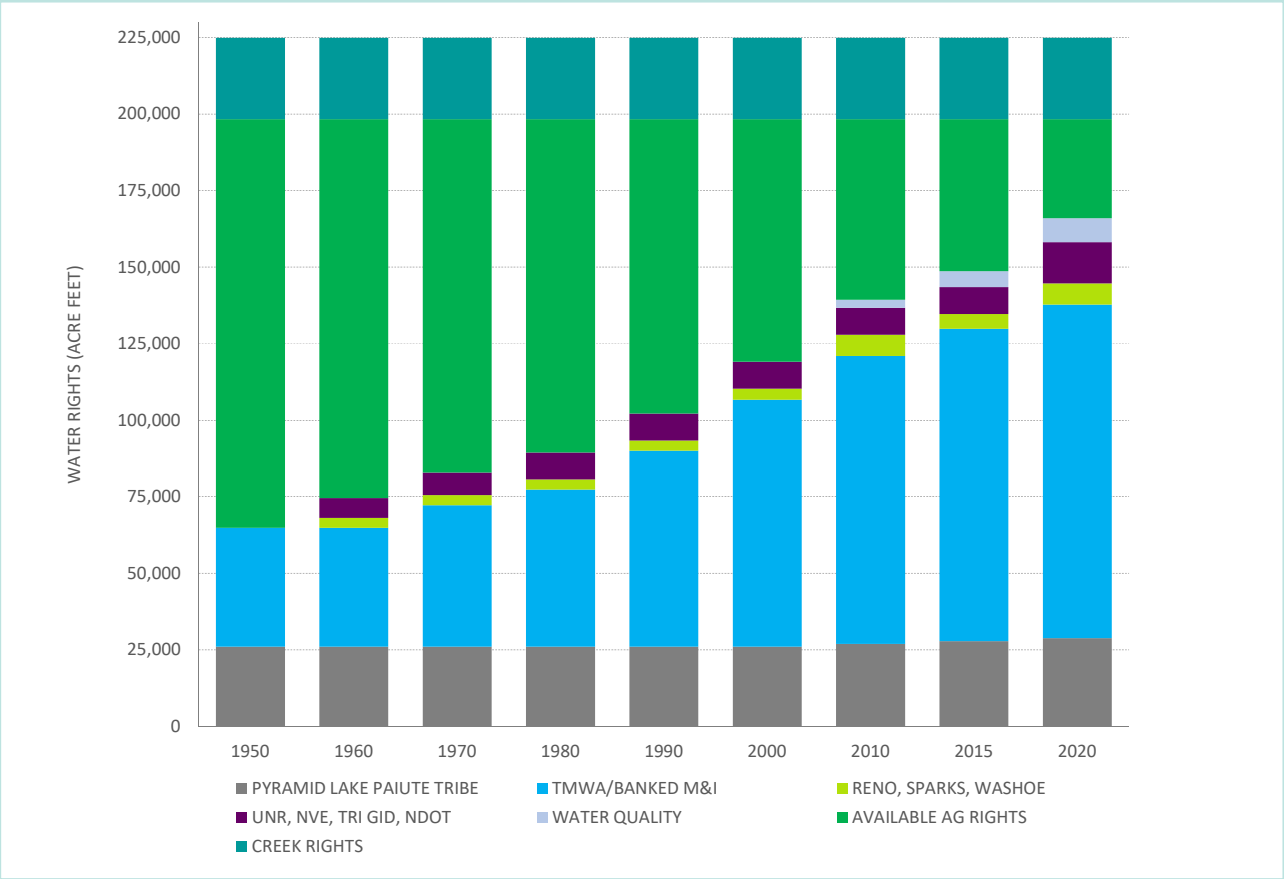


FIGURE 2-5: CONVERSION OF TRUCKEE RIVER WATER RIGHTS OVER TIME

To meet the additional water demand resulting from growth and new development, TMWA requires applicants for new or modified water service to dedicate acceptable water rights to obtain a will-serve commitment. A will-serve commitment is a letter from TMWA stating that it has sufficient water resources to provide the requested water delivery and that the project is within TMWA's service territory. Before accepting a water right for a will-serve commitment, TMWA researches a water right's source, priority, quantity, dry-year supply/yield, and ownership. In this manner, TMWA ensures that existing commitments can be sustained in perpetuity. Alternatively, developers can purchase an allocation of water rights from TMWA's inventory of uncommitted water rights. The price for purchasing an allocation from TMWA's inventory is based on TMWA's costs incurred in acquiring, processing, and maintaining the water rights.

Presently, TMWA estimates there are approximately 35,000 AF of mainstem Truckee River agricultural rights available for future dedication. This includes agricultural rights that are still in decree form and agricultural rights that have been converted to municipal use and banked with TMWA for future service. In addition, 13,500 AF of groundwater rights are banked with TMWA and available for future dedication, primarily from the Fish Springs Ranch water supply project.

RECLAIMED WATER

TMWA does not directly supply reclaimed water but actively works with regional partners to utilize reclaimed water in efficient and innovative ways. Reclaimed water is derived through the process of treating wastewater, or effluent, into water that is suitable for use for other purposes. Reclaimed water has been used for irrigation throughout the Truckee Meadows for years. One of the local benefits of using reclaimed water is that it conserves potable (drinking) water and provides a reliable, drought-resistant water source, even in times

TABLE 2-2: TMWA WATER RIGHTS

TMWA WATER RIGHTS	ACRE FEET
Surface Water–Original M&I decreed rights	38,805
Surface Water–POSW	27,000
Surface Water–Converted decreed ag. rights	79,422
Total Surface Water Resources	**145,227**
Groundwater Rights By Basin	
Tracy	524
Spanish Springs	3,900
Truckee Meadows	23,689
Pleasant Valley	3,955
Washoe Valley	674
Truckee Canyon–Verdi	415
West Lemmon Valley	938
East Lemmon Valley	1,428
Honey Lake Valley–Fish Springs Ranch	8,000
Total Groundwater Resources	**43,523**
TOTAL WATER RESOURCES	**188,750**

of restriction and conservation. Reclaimed water also provides a more predictable way to help water reclamation facilities ensure compliance with discharge permit limitations when compared with river discharge or other effluent management strategies. Table 2-3 summarizes the 2018 reclaimed water usage from each of the region's water reclamation facilities. Reclaimed water currently represents approximately 8% of the region's water supply.

TABLE 2-3: 2018 RECLAIMED WATER USAGE

FACILITY	TOTAL (AFA)
Truckee Meadows Water Reclamation Facility	3,990
South Truckee Meadows Water Reclamation Facility	2,654
Reno-Stead Water Reclamation Facility	496
Total Reclaimed Water Usage	**7,140**

Commercial and industrial development downstream of the Truckee Meadows has been increasing. The Tahoe-Reno Industrial Center (TRI Center) and other developments require water for potable and non-potable uses. Once built out, TRI Center expects to have 10,000 AFA of non-potable demand and approximately 2,300 AFA or more of potable demand. The Cities of Reno and Sparks have agreed to deliver up to 4,000 AFA of reclaimed water to the TRI General Improvement District (TRIGID) for resale to customers in TRI Center. When effluent generated at the Truckee Meadows Water Reclamation Facility (TMWRF) is used as reclaimed water and not returned to the Truckee River, secondary permits require a return flow component to the Truckee River from other water sources.

To promote the efficient use of Truckee River resources, Reno, Sparks, and TMWA collaborated to create a Return Flow Management Agreement with TRIGID. TMWA will help manage the return flow to the Truckee River to ensure that the river and downstream water rights holders are not adversely impacted. TRIGID will reimburse TMWA for all costs incurred in connection to the administration of the Return Flow Management Agreement.

Return flow resources will include some of TRIGID's Truckee River resources, Nevada Department of Transportation's resources, and TMWA's resources. TMWA, as allowed by TROA, has certain water resources that can support reclaimed water service and are either not subject to the return flow requirement (i.e., groundwater component

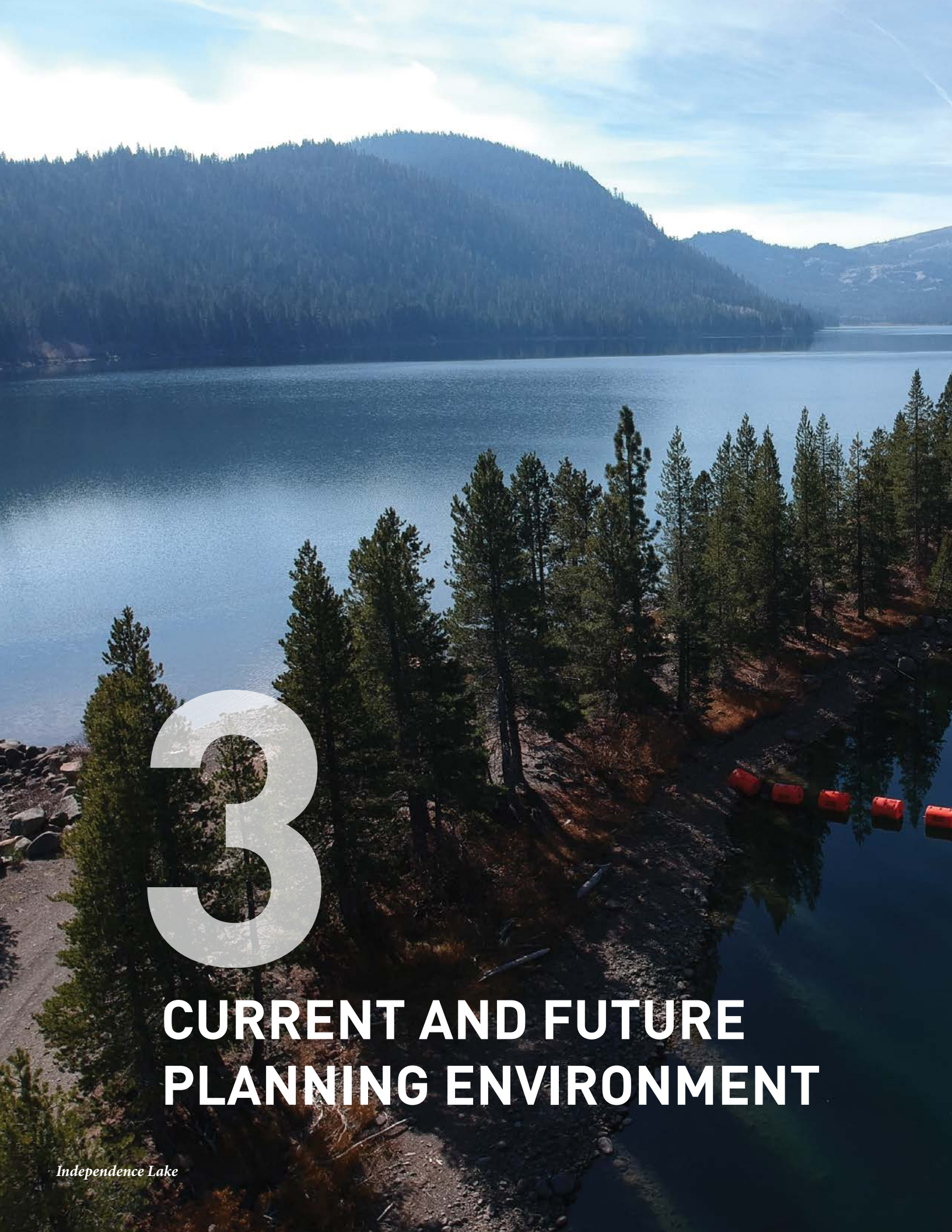
and POSW) or resources which otherwise can satisfy the return flow requirement to the Truckee River. TMWA will seek to promote the efficient use of resources to minimize the use of TMWA's resources, where feasible. See Table 2-4 for sources of return flow resources.

TABLE 2-4: SOURCES OF TRIGID RETURN FLOW RESOURCES

RETURN FLOW RESOURCES	TOTAL (AFA)
TRIGID Resources	1,500
NDOT Resources	1,500–2,200
TMWA Community Resources	300–1,000
Total Resources	**4,000**

SUMMARY

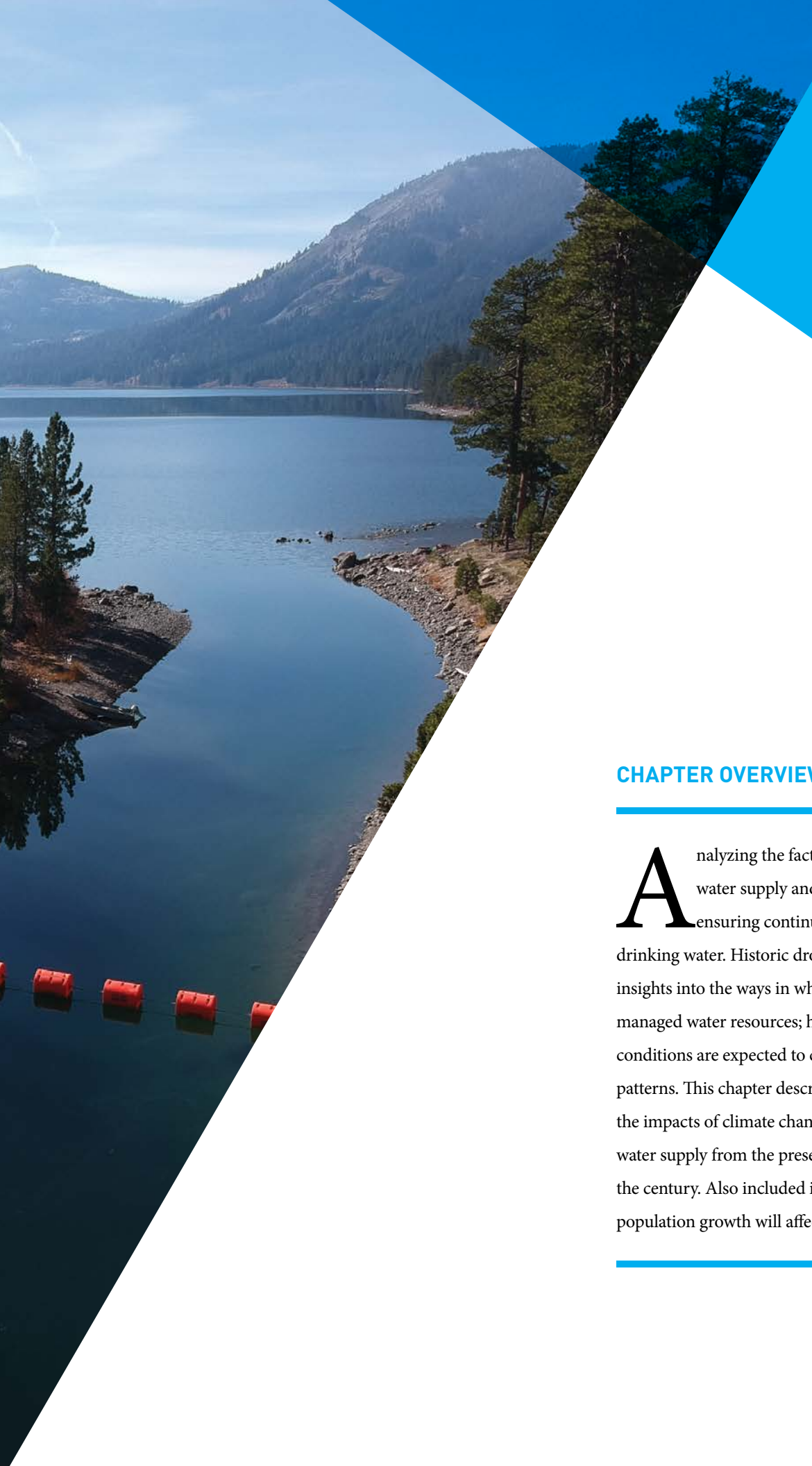
TMWA holds sufficient water rights to meet current customer demand. TMWA's water rights portfolio contains a mix of Truckee River, creek water, and groundwater resources. Water from the Truckee River makes up most of the water supply for the Truckee Meadows. With the implementation of TROA, TMWA has more flexibility to store additional water in upstream reservoirs, which can be released as needed. Through conjunctive use, TMWA maximizes the use of surface water in wet years, thereby preserving groundwater capacity for high demand periods. In dry years, TMWA can utilize a combination of increased groundwater pumping and releases from drought storage when Truckee River flows are reduced. While TMWA manages its existing resources, it will continue to evaluate additional, viable resources to ensure that the region has a resilient and sustainable water supply. An evaluation of TMWA's ability to supply increased future demand under a range of potential climate variability appears in Ch. 3.



3

CURRENT AND FUTURE PLANNING ENVIRONMENT

Independence Lake



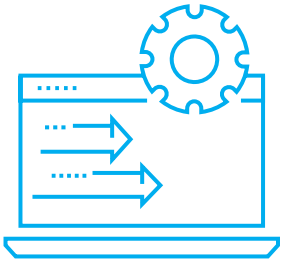
CHAPTER OVERVIEW

Analyzing the factors that can impact future water supply and demand is critical to ensuring continued reliability of the region's drinking water. Historic droughts provide important insights into the ways in which TMWA has effectively managed water resources; however, future climate conditions are expected to change from historic patterns. This chapter describes TMWA's analysis of the impacts of climate change scenarios on the regional water supply from the present through the end of the century. Also included is an evaluation of how population growth will affect future water demand.

CHAPTER AT-A-GLANCE

Highlights of Chapter 3 include:

1. How TMWA has managed water resources through historic droughts
2. Future water demand projections
3. Climate change scenarios that stress-test the region's water supply
4. Growth and development in the Truckee Meadows
5. Water system resiliency during emergencies



This chapter explores the current and future planning environment in the Truckee Meadows, including the reliability of TMWA's water supply under drought, potential future climate change scenarios, and increases in demand due to future development and water use patterns in the region. One of TMWA's goals is to maintain a consistent water supply for its customers under potential future conditions over the 20-year planning horizon and beyond. Information from the historic hydrologic record over the past 115 years provides important insights into water supply for the region. However, with potentially changing climate conditions, looking at alternative future scenarios depicting how the region's water supply may be affected is equally important. TMWA is adept at managing water resources in a highly variable climate but recognizes that new adaptive strategies may be needed in the future to ensure a reliable water supply under climate change.

DROUGHTS

For the Truckee Meadows region, the Truckee River is a crucial component of the water supply. Nevada is the driest state in the country, with the Truckee Meadows receiving an average of only 7.5 inches of rain annually. Due to its proximity to the Sierra Nevada mountains, the climate in Northern Nevada is marked by highly variable weather patterns with alternating periods of flooding and droughts. Water supply planning based on historical droughts is crucial in helping TMWA plan for future water policies and resources.

WHY IS SNOWPACK SO IMPORTANT?

A good indicator of an impending dry year is snowpack accumulation. Measured on April 1st of each year by the Natural Resources Conservation Service (NRCS), the snow water equivalent (SWE), or the water content of the snowpack, is used to forecast the amount of water that will run off each spring to help fill upstream reservoirs and provide river flows. The NRCS uses snow telemetry (SNOTEL) sites (see photo below) throughout the mountains that have automated equipment that measures snowpack. These measurements are key for TMWA to effectively manage its reservoirs and water supply each year.

Photo: Jeff Anderson

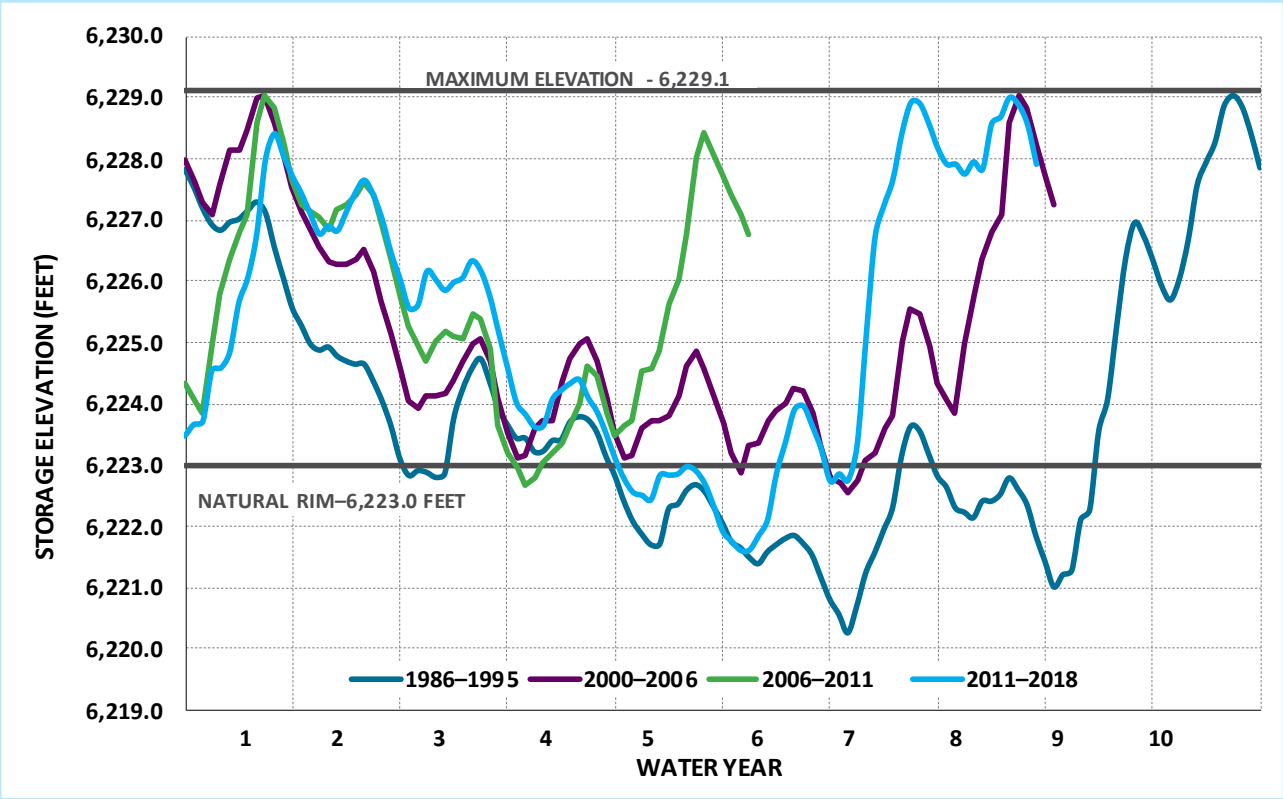
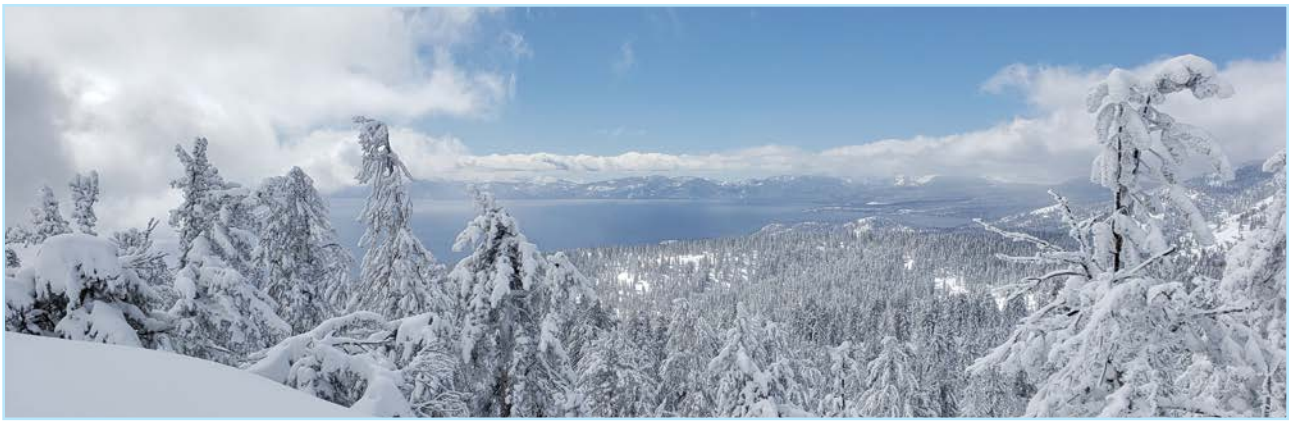


FIGURE 3-1: LAKE TAHOE ELEVATIONS DURING DROUGHT PERIODS FROM 1986 TO 2018

Since 1980, there have been four droughts varying in severity within the Truckee River system: 1987–1994 (eight years), 2001–2004 (four years), 2007–2010 (four years), and 2012–2016 (five years). The 1987–1994 drought was the worst drought in over 115 years and has been the basis for drought planning purposes to date. Although the 2012–2016 drought was unprecedented in terms of its severity (2015 had the lowest recorded snowpack and runoff in history), it was shorter in duration than the eight-year 1987–1994 drought. For a detailed explanation of the historic droughts, see Ch. 2 of TMWA's 2035 WRP. Since the completion of TMWA's last WRP, the region has been experiencing a wetter period, with several above-average water years, including 2017 and 2019.

Important inferences can be made by reviewing the historic hydrology of the Truckee River Basin. With full upstream reservoirs (including Lake Tahoe), Floriston Rates can be met for typically the first two to three years of a prolonged drought, regardless of its severity. As the duration of the drought increases and Lake Tahoe approaches its natural rim or goes below it, required rates of flow are less likely to be met, especially during the critical irrigation season. When upstream storage is depleted and springtime runoff is well-below average in successive years, Floriston Rates have fallen off as early as the middle of April (2015) when there was not enough upstream reservoir storage to provide for the required rate of flow at the CA–NV state line. When the elevation of Lake Tahoe approaches or goes below its natural rim during a drought (Figure 3-1), Floriston Rates cannot be maintained for very long and drop off soon thereafter.

As illustrated in Figure 3-1, water levels in Lake Tahoe are depleted gradually over two to three years in an extended drought but can refill rapidly with a large precipitation event or a large snowpack year, thereby ending a drought period. For example, 2017 was an excellent recovery year for the region, with Lake Tahoe starting below its natural rim and filling to its legal limit by the summer, thus ending the 2012–2016 drought. In fact, 2017 was the largest recovery year in recorded history at Lake Tahoe, with a net rise of 6½ feet between October 2016 and July 2017.



WINTER IN THE LAKE TAHOE BASIN

In the past, TMWA's privately owned stored water (POSW) has been used to meet customer demand during critically dry years. Based on historic droughts, upstream reserves typically do not need to be used until at least the third drought year in a row. Donner and Independence Lakes, TMWA's POSW reservoirs, typically fill each spring; however, Donner Lake may not fill in extremely dry years. During periods of extreme drought, TMWA has used drought reserves to meet customer demand between the months of June and October (1987–1994, 2012–2016). Figure 3-2 shows that TMWA has only had to use its stored water during five years over the last three decades. Even in years when Floriston Rates are not met during the irrigation season, flows in the Truckee River are typically sufficient to meet wintertime production needs by late fall (TMWA's wintertime customer demand is approximately a quarter that in the summertime).

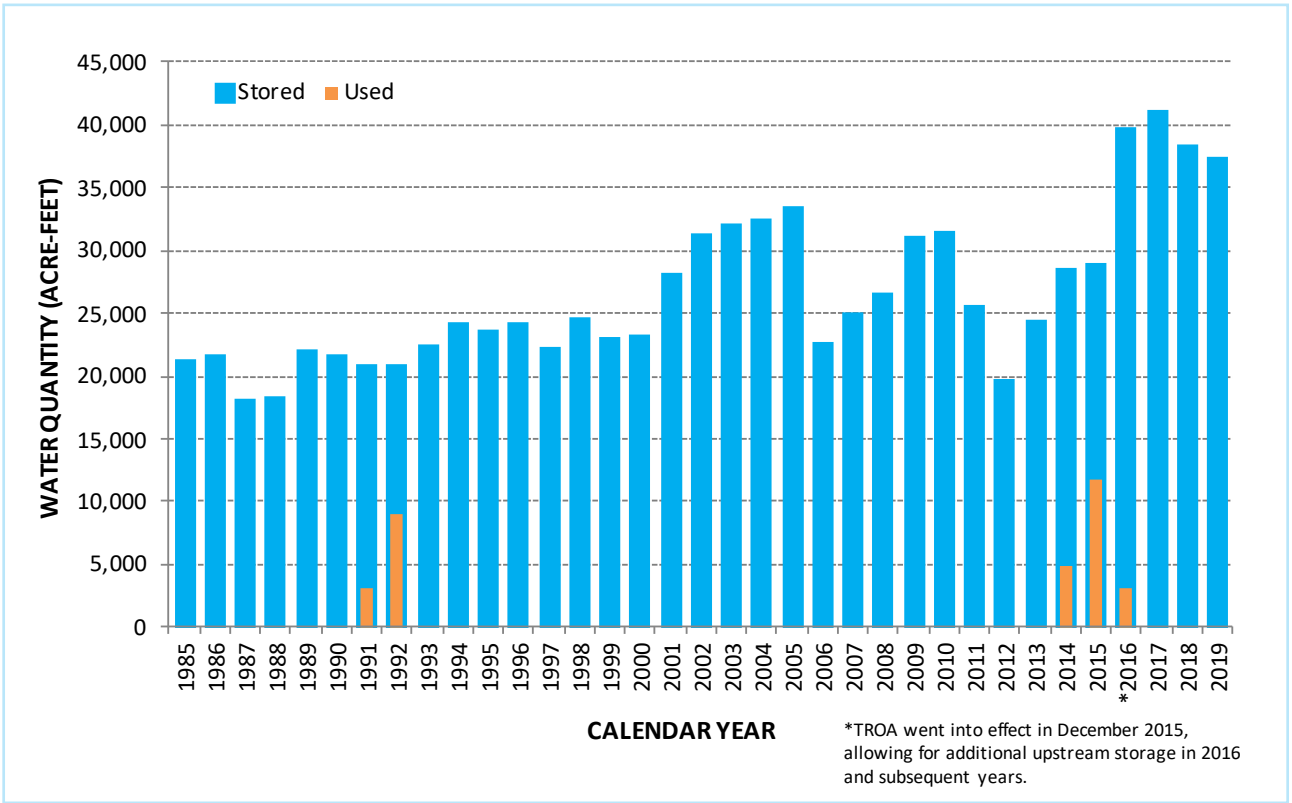


FIGURE 3-2: TMWA UPSTREAM MAXIMUM STORAGE VS. THE AMOUNT OF STORED WATER USED FROM 1985 TO 2019

CLIMATE CHANGE

While the climate of the Truckee Meadows is characterized by cyclical patterns of high and low precipitation, changing climatic conditions may prove more challenging for water supply reliability in the future.[1,2] Climate change is defined as shifts in global or regional weather conditions that persist over multiple decades or longer.[3] To design effective water supply strategies to mitigate against potential shifts in future climate conditions, TMWA incorporates the best available scientific information regarding regional climate change into its planning process.

Historically, TMWA's WRPs considered changes in water supply based on hydrologic data recorded over the past 100-plus years. However, as climate variability is projected to become increasingly more common in the future, managing for a sustainable water supply may become more complex. It is uncertain how exactly the climate will change in the Truckee Meadows and the surrounding region, but altered precipitation and temperature patterns have the potential to affect both supply and demand.

The Lake Tahoe and Truckee River Basins are snowmelt driven systems where snowpack accumulates during the winter and melts during the spring and summer months. Regional temperatures are expected to continue to warm, which is consistent with the increase observed in Nevada over the past several decades (Figure 3-3). As temperatures continue to warm, less snow may accumulate and runoff may occur earlier, significantly altering the timing of peak streamflow runoff.[4]

There is uncertainty about how the magnitude and timing of

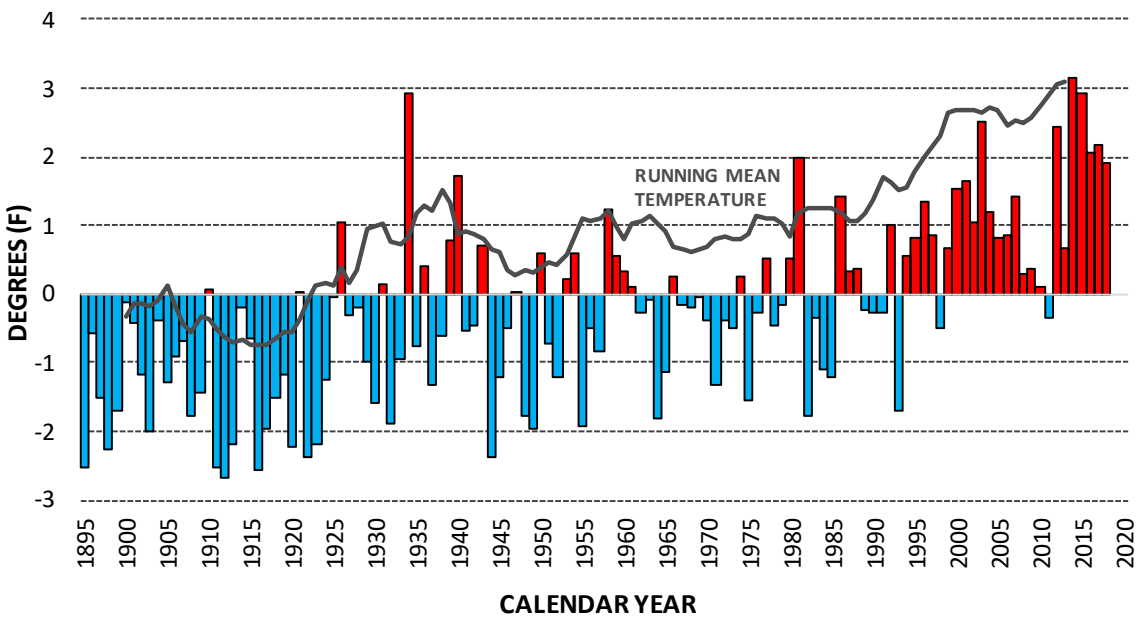


FIGURE 3-3: MEAN TEMPERATURE DEPARTURE FOR NEVADA FROM 1895 TO 2018 (SOURCE: WESTERN REGIONAL CLIMATE CENTER)

[1] Gonzalez, P., G.M. Garfin, D.D. Breshears, K.M. Brooks, H.E. Brown, E.H. Elias, A. Gunasekara, N. Huntly, J.K. Maldonado, N.J. Mantua, H.G. Margolis, S. McAfee, B.R. Middleton, and B.H. Udall. 2018. Southwest. In *Impacts, risks, and adaptation in the United States: Fourth national climate assessment*, Volume II. U.S. Global Change Research Program, Washington, DC, USA, pp. 1101–1184. doi: 10.7930/NCA4.2018.

[2] Karl, T., J. Melillo and T. Peterson, T. (Eds)., 2009. *Global climate change impacts in the United States*. Cambridge University Press.

[3] Gonzalez, P., G.M. Garfin, D.D. Breshears, K.M. Brooks. H.E. Brown, E.H. Elias, A. Gunasekara, N. Huntly, J.K. Maldonado, N.J. Mantua, H.G. Margolis, S. McAfee, B.R. Middleton, and B.H. Udall, 2018. Southwest. In *impacts, risks, and adaptation in the United States: fourth national climate assessment*, Volume II. U.S. Global Change Research Program, Washington, DC, USA, pp. 1101–1184. doi: 10.7930/NCA4.2018.

[4] Erkman, C., S. Coors, A. Powel, and P. Noe. 2020. *TMWA Climate Change Analysis*. Precision Water Resources Engineering.

precipitation will change, but more variability is expected.[5] Appendix C summarizes information from some key climate change research for the Truckee Meadows region.

To analyze the impacts of possible future conditions and to test the reliability of TMWA's water supply, TMWA analyzed specific long-term climatic and hydrologic scenarios in the Truckee River system using results from global climate, hydrologic, operational, and planning models.

Using regional climate modeling results from the Water for the Seasons project, TMWA partnered with Precision Water Resources Engineering (PWRE) to complete an analysis of future hydrologic conditions on the Truckee River system. One outcome of the project was the simulation of regional hydrology within the Truckee and Carson watersheds for a range of future climate scenarios through the end of the century (2098). The results of the hydrologic simulations were fed into the Truckee River planning model (RiverWare) to compare the performance and resiliency of TMWA's water supply under climate change to its performance under historical conditions. PWRE's report about the climate change modeling methodology and results can be found at tmwa.com/your-water/resources/.

Current climate change research uses General Circulation Models (GCMs). For this purpose, GCMs are mathematical models that simulate the physics of the global climate system. The models are typically downscaled to a smaller area, such as the northern Sierra Nevada, to predict the impacts of climate change under a range of possible greenhouse gas emissions scenarios. Rather than relying on one model, an ensemble, or collection of models created by different climate scientists, is used to predict possible future states. Although there are many GCMs applied globally, the eight best GCMs for this region were selected based on existing climate change research completed for the northern Sierra Nevada.[6]

An additional component of climate modeling consists

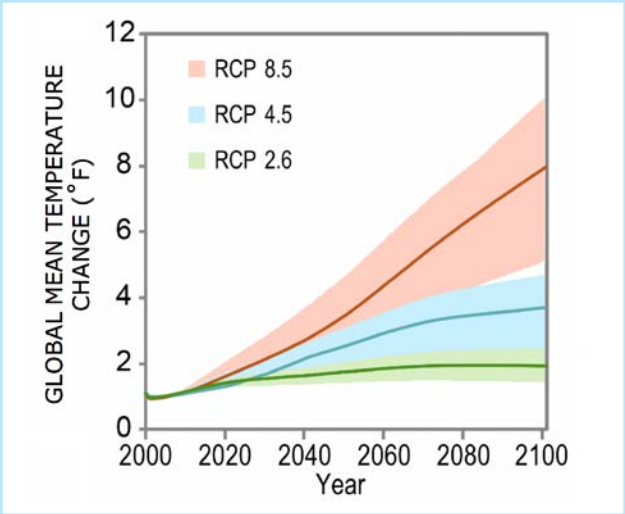


FIGURE 3-4: PROJECTED GLOBAL MEAN TEMPERATURE CHANGE UNDER EACH RCP - RCP 4.5 AND 8.5 ARE USED IN THIS WRP (SOURCE: FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME 1)

of Representative Concentration Pathways (RCPs). An RCP is a future scenario that represents a greenhouse gas concentration trajectory. Higher RCP scenarios result in higher temperatures and increased associated impacts (see Figure 3-4). TMWA used two RCP scenarios representing moderate (RCP 4.5) and very high (RCP 8.5) emissions to provide a range of possible future climatic conditions for the Truckee River Basin. The moderate emissions scenario (RCP 4.5) represents greenhouse gases stabilizing in the mid-21st century, whereas the very high emissions scenario (RCP 8.5) has emissions increasing to the end of the century. These scenarios were used in conjunction with future demand projections, described below.

FUTURE WATER DEMAND PROJECTIONS

To estimate future annual water demand in the Truckee Meadows, TMWA creates water demand models using the following data sources: Washoe County population, historical water services in TMWA's service area, and historical water use data. Population growth is the

[5] Gershunov, A., T. Shulgina, R.E.S. Clemesha, K. Guirguis, D.W. Pierce, M.D. Dettinger, D.A. Lavers, D.R. Cayan, S.D. Polade, J. Kalansky, and F.M. Ralph. 2019. *Precipitation regime change in Western North America: The role of atmospheric rivers, nature: scientific reports*, vol 9, 9944, https://doi.org/10.1038/s41598-019-46169-w

[6] Lynn, E., A. Schwarz, J. Anderson, M. Correa, W. O'Daly, F. Keeley, and J. Woled. 2015. *Perspectives and guidance for climate change analysis*. California Department of Water Resources, Climate Change Technical Advisory Group Report.

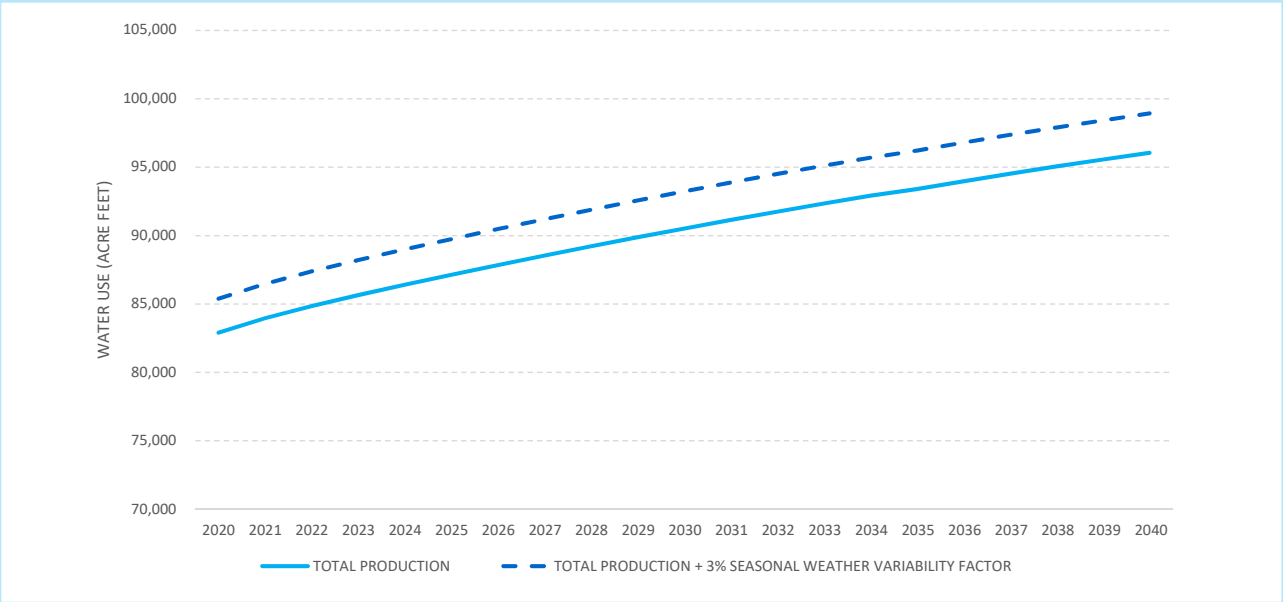


FIGURE 3-5: TMWA'S WATER DEMAND PROJECTION FOR 2020 TO 2040

basis for projecting the number of future active water services. Although several population projections for the region exist, including the State of Nevada Demographer's (SDF) projection and Truckee Meadows Regional Planning Agency's (TMRPA's) Consensus Forecast of Washoe County population (WCF), TMWA's population projection is based on a logistical growth curve and provides an estimate of population equilibrium, assuming that current trends and conditions continue. Using its population projection, TMWA creates water demand projections by modeling future active water services in each customer class. Appendix D includes a detailed overview of TMWA's demand projection methodology.

TMWA's 20-year water demand projection estimates that water demand will increase 14% from approximately 83,000 acre-feet (AF) in 2020 to 96,000 AF in 2040. From 2003 to 2019, per capita water use has been declining on average 3% per year. However, annual water demand is quite variable, driven primarily by seasonal weather patterns, such as hot, dry summers or cool, wet springs. Due to variability in weather patterns, the future water demand may be approximately 3% higher on an annual basis than projected, resulting in an estimated demand of nearly 99,000 AF in 2040 (Figure 3-5).

TMWA's forecast is very similar to the WCF, which is used in regional planning. The demand projection derived from the 2018 WCF shows a demand of 100,188 AF in 2040. While statistically similar to the SDF and WCF projections for the region over the next 20 years, TMWA's model is preferred for the WRP because the long-range projection is useful for long-term resource planning.

To stress-test the reliability and sustainability of TMWA's water resources, a long-term water demand projection to 2098 was run through the Truckee River planning model under multiple historical drought and climate change scenarios. Based on TMRPA's recent master planning effort that projects future development based on zoning and analyzes land use scenarios for the region, TMWA generated a demand projection of 140,000 AF in 2098. It is important to note that this demand projection is hypothetical and is only used for water supply scenario modeling purposes in this plan.

FUTURE WATER SUPPLY SCENARIOS

TMWA modeled three scenarios to explore the strengths and vulnerabilities in TMWA's water supply and operational strategies 80 years into the future. A goal of the 2040 WRP is to determine whether TMWA can reliably meet customer demand under a range of future climatic conditions, including extended droughts. The scenarios included:

1. Historical ensemble of the most extreme droughts in the Truckee Basin
2. Moderate emissions scenario (RCP 4.5)
3. Very high emissions scenario (RCP 8.5)

HISTORICAL ENSEMBLE

TMWA included a historical ensemble as part of this water supply resiliency assessment. This ensemble includes nine different historical hydrologic patterns run through the RiverWare model under current river and reservoir operations. This analysis tested the reliability of TMWA's water supply under the most extreme droughts on record 80 years into the future at projected future customer demand levels. Three major droughts (1925–1937, 1987–1994, and 2012–2016) over the last 115 years were staggered so that each was run through the planning model at TMWA's highest demand levels projected toward the end of the century.

The results of the historical ensemble scenario show that TMWA's water supply is more than resilient enough to withstand a repeat of any of the major droughts on the Truckee River system on record and not sustain any shortages, even at demand levels projected out to the end of the century (70% higher than current demand levels). Model results show that TMWA's total upstream storage never drops below 40,000 AF, with a median end of month storage value of 52,000 AF throughout the 80-year simulation. Each bar in Figure 3-6 represents the worst of the eight GCM traces for that particular year in terms of available supply for TMWA. No shortages were

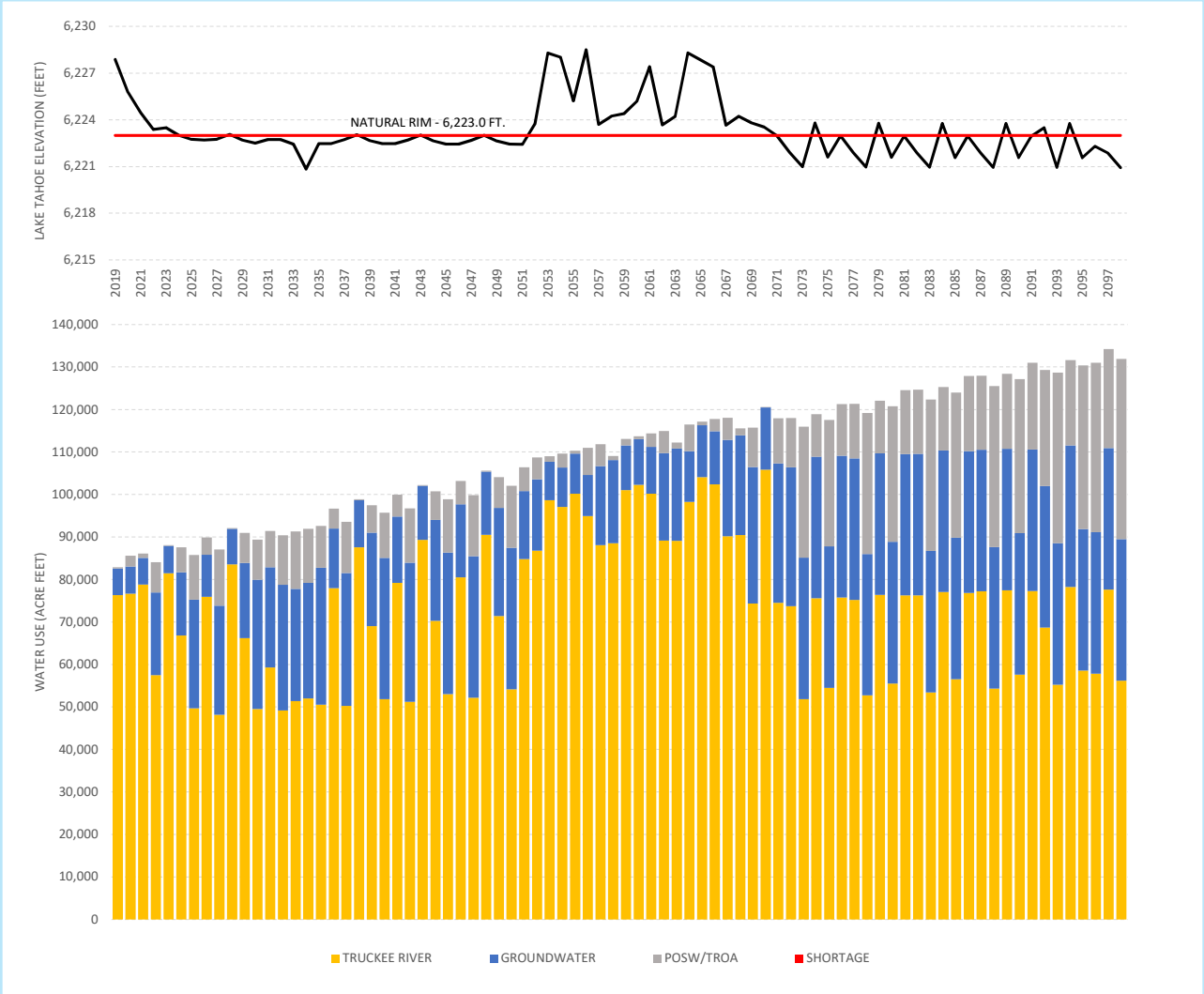


FIGURE 3-6: LAKE TAHOE ELEVATION (TOP CHART) AND TMWA ANNUAL PROJECTED SOURCES OF SUPPLY (BOTTOM CHART) THROUGH 2098 UNDER HISTORICAL SCENARIO

observed at any point under any of the historical drought scenarios through the year 2098. TMWA's modeling clearly demonstrates the robustness of the regional water supply to meet projected water demands 80 years into the future under the most extreme hydrologic conditions ever recorded on the Truckee River system.

MODERATE EMISSIONS SCENARIO

Under the more moderate emissions scenario (RCP 4.5), where carbon emissions are projected to continue to increase until 2050 then level off, results show there would be no water supply shortages in any of the eight GCMs until the year 2083 (Figure 3-7[6]). The shortage in supply is shown in only *one* of the eight GCMs in 2083; shortages do not occur again until 2087 and 2088 (in the same GCM). In 2096, 2097, and 2098, two additional GCMs also show shortages occurring. Overall, out of the eight different GCMs in the RCP 4.5 scenario, there were only 10 years out of 640 simulation years (8 GCMs x 80-year simulations) that showed a shortage (1.5%), with the first shortage occurring 63 years in the future.

The RCP 4.5 scenario results indicate that hydrology in the Truckee River Basin will be more volatile than the historical period. In addition, the RCP 4.5 simulation exhibits more severe and frequent drought periods throughout the 80-year run. The ensemble of eight GCMs under the RCP 4.5 scenario provides a wide range of variability in terms of the number, the timing, and the

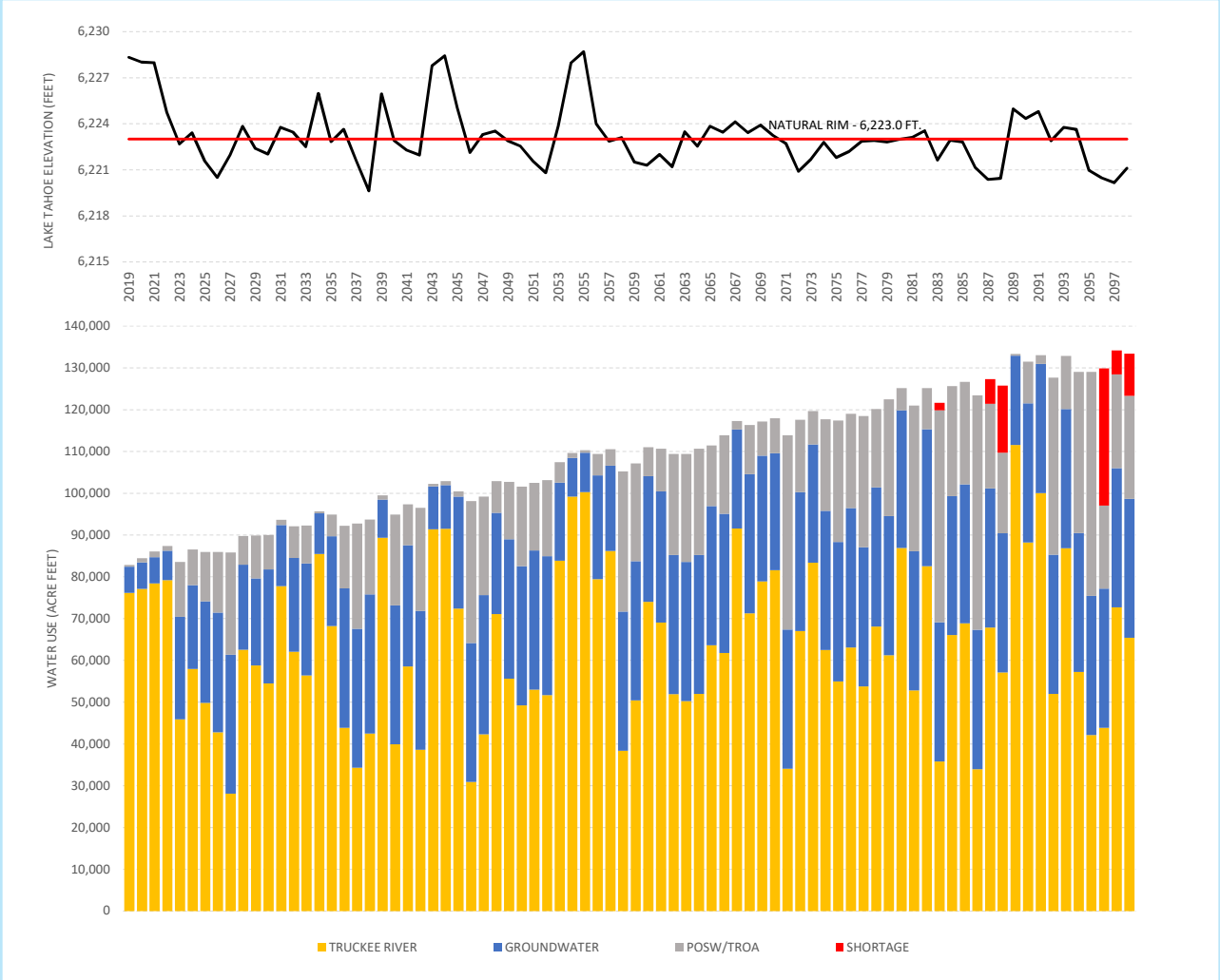


FIGURE 3-7: LAKE TAHOE ELEVATION (TOP CHART) AND TMWA PROJECTED ANNUAL SOURCES OF SUPPLY (BOTTOM CHART) THROUGH 2098 UNDER RCP 4.5

[6] Figure 3-7 represents the worst year out of each of the eight GCMs for the RCP 4.5 scenario.

severity of droughts that could be expected through the end of the century.

VERY HIGH EMISSIONS SCENARIO

Under the worst scenario, RCP (RCP 8.5), carbon emissions would continue to increase through the end of the century. As shown in Figure 3-8[7], results indicate that TMWA would not have a shortage in supply until the year 2069 (in one GCM) at a demand level of approximately 113,000 AF (36% higher than the current demand level of 82,000 AF). The same GCM shows a shortage in year 2070 as well. Then, as emissions levels continue to increase and extreme changes in the climate persist year after year, water supply shortages are shown to begin occurring again in 2085. Under this emissions scenario, model results show shortages occurring over the last 14 years of the run from 2085 through 2098 as Lake Tahoe is projected to be below the rim in at least one of the eight GCMs in each of the last 16 years. Overall, out of the eight different GCMs in the RCP 8.5 scenario, there were 25 years out of 640 simulation years that showed a shortage (3.9%), and the first one did not occur until 49 years in the future.

The volatility in the hydrology is greatest for the RCP 8.5 scenario. In the RCP 8.5 scenario, the duration of droughts is noticeably longer, and the droughts are clearly more extreme. The top chart in Figure 3-8 shows that in the last year of the model run, at least one of the eight GCMs projects the elevation of Lake Tahoe to be almost seven feet below the natural rim.

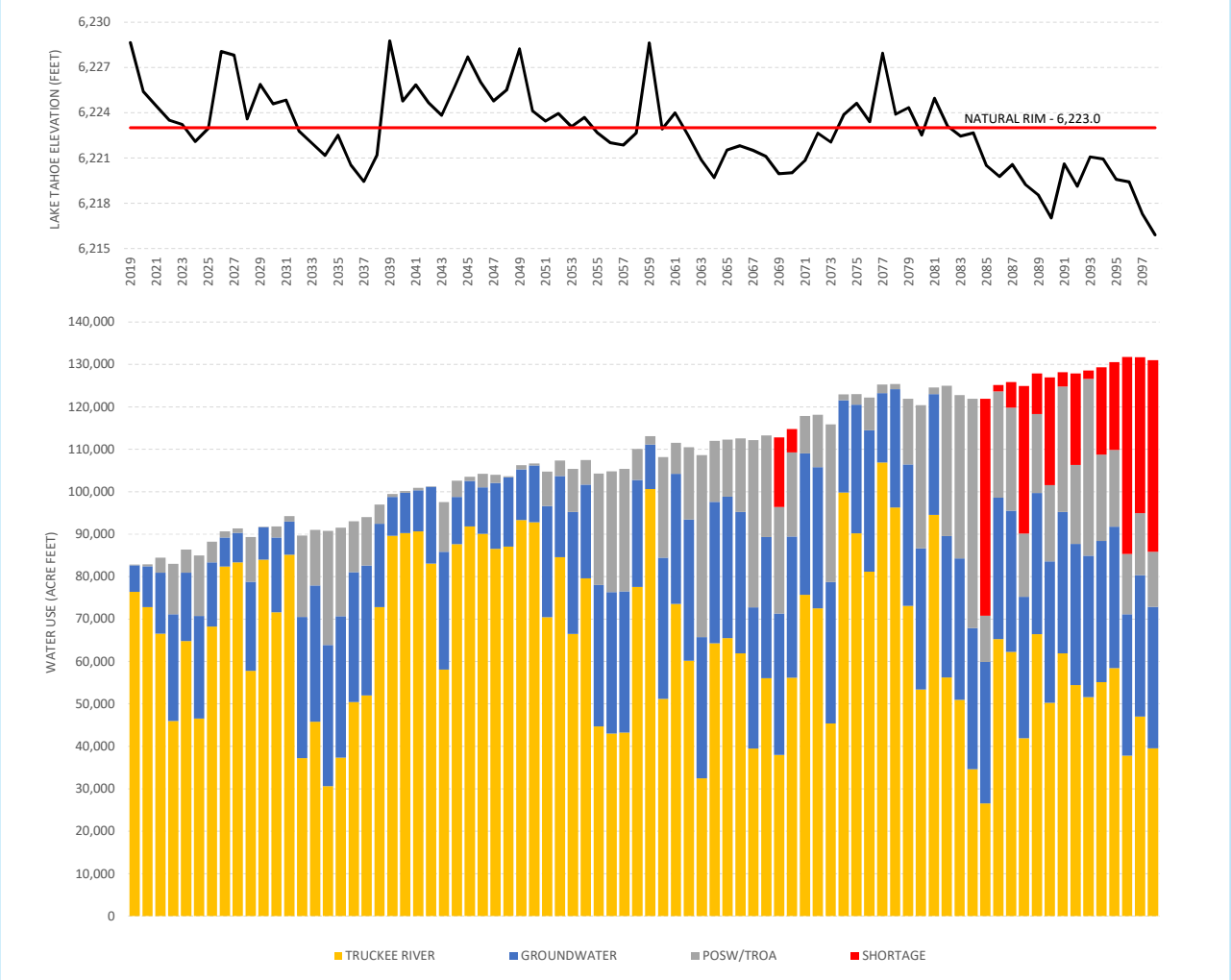


FIGURE 3-8: LAKE TAHOE ELEVATION (TOP CHART) AND TMWA PROJECTED ANNUAL SOURCES OF SUPPLY (BOTTOM CHART) THROUGH 2098 UNDER RCP 8.5

[7] Figure 3-8 represents the worst year out of each of the eight GCMs for the RCP 8.5 scenario.

SUMMARY

Throughout the rest of the century, regional temperatures are expected to warm well beyond 3˚F, which has already occurred since the 1920s. Increased warming could cause less snow to accumulate and lead to earlier runoff. While there is still uncertainty about expected changes in precipitation, model results suggest that more precipitation will be occurring in the region on an annual basis. The timing, form, and magnitude of precipitation could change significantly by the end of the century. There is consensus among the climate change models that more variability in precipitation will occur under continued climate change.

Snowmelt runoff is expected to continue to shift earlier in the season, significantly altering the amount of water able to be captured and stored in upstream reservoirs for water supply during the April through July filling period. Overall, annual runoff in the Lake Tahoe and Truckee River Basins is expected to increase over the next 80 years under both RCPs. Therefore, decreases in April-July runoff are projected to be offset by significant increases in runoff outside of the historical April-July runoff period. It is projected that there will be a greater frequency of wet years overall on the Truckee River system in terms of volume of streamflow on an annual basis. Droughts are also predicted to occur more frequently. PWRE's modeling shows an increasingly variable future hydrology where the wet years will be wetter, and the dry years will be significantly drier.

Modeling results indicate that TMWA's system is highly resilient, well into the future. The ensemble historical simulations, which emulate extreme drought conditions over the next 80 years, did not show any shortages for the entire simulation period. The climate scenarios (eight GCMs for RCP 4.5 and 8.5) did not show any shortages until 2069 (almost 50 years in the future), even with more volatile hydrologic conditions compared to historical conditions.

TMWA has been through periods of extensive drought historically and has used drought storage to meet customer demand in the past. With TROA in place (effective 2015), TMWA's ability to meet customer demand through an intense, prolonged drought has been significantly enhanced. Even with increased drought frequency under climate change, modeling shows that storage of drought reserves adds significant resiliency, allowing TMWA to reliably create a water supply for its customers under almost all GCMs.

The models show that more water flows down the Truckee River, but the water is less efficient for Floriston Rate users (including TMWA) because more precipitation is occurring outside of the historical snowpack building season. When Floriston Rates are not met during the peak summertime demand months, TMWA must supplement available supply with releases from upstream storage and increased groundwater pumping to meet customer demand.

There are many factors that could change in terms of supply and demand that may not be accurately captured in a model projecting future hydrologic conditions (available runoff and upstream reservoir storage) 80 years into the future. These two RCPs, each using eight different GCMs representing a wide range of potential future outcomes in the Truckee River Basin, offer a glimpse of potential extremes in the climate of the future. Even under the high emissions scenario (RCP 8.5), shortages are not predicted for at least 50 years into the future and for only one GCM. It is also important to note that, for modeling purposes, very conservative assumptions were made in terms of TMWA's future groundwater pumping capabilities, water treatment plant diversion capacities, infrastructure and system intertie improvements, surface water right acquisitions, interbasin transfers, and development of new water supply projects in the future. TMWA will continue to monitor the most current climate change research and will make water resource management decisions to ensure the sustainability of the region's drinking water for future generations.

ADAPTIVE MANAGEMENT

TMWA uses a wide range of strategies to manage its water resources to address droughts and weather variability, as described in Ch. 2. However, one of the most significant adaptations that would improve the

BOCA RESERVOIR DURING DROUGHT SITUATIONS

future water supply outlook for the Truckee River Basin is the reoperation of the federally owned flood control reservoirs in the region, including Prosser, Stampede, and Boca Reservoirs. With the implementation of TROA, TMWA can store credit water in Prosser, Stampede, and Boca Reservoirs. These reservoirs are currently operated for wintertime flood control based on the 1985 US Army Corps of Engineers' (USACE) Water Control Manual (WCM), which requires minimum specific flood space requirements in each reservoir and prohibits the capture of springtime runoff prior to April. Stakeholders throughout the Truckee River Basin recognize that the system can be better operated for both flood control and water supply. Several studies have provided findings that support the importance of modifying the flood control rule curves that govern the operations of these reservoirs to adapt to future climate change.

The Truckee Basin Study, completed in 2015, found that, without extending the time during which the flood control reservoirs can store their inflows under the drier climate change hydrology scenarios, up to 50,000 AF of the inflow is unable to be stored each year.

One of the publications produced as a result of the Water for the Seasons project explored re-operating the Truckee flood control reservoirs to mitigate impacts due to climate change, specifically earlier runoff timing. The hydrology used for this study came from a hydrology model simulating historical precipitation and historical temperatures, with a uniform increase of 4.3°C. The amount of precipitation was the same as it had been historically, such that impacts attributable to changed precipitation were not introduced. Any impacts realized were due exclusively to the altered timing of the runoff due to warming. This analysis focused primarily on Prosser Creek Reservoir to illustrate the growing inefficiencies of storing water under the current WCM flood control criteria under climate change. It was found that whereas Prosser historically fills on average 22,500 AF (76% of capacity) each year, under the warming scenario it only fills to 13,800 AF (46% of capacity) each year. The unstored water flows downstream and is unavailable for release later in the year to help achieve environmental flow targets for endangered fish. Further, the study found that with the ability to start filling one month earlier under continued warming conditions, the average annual storage could be increased to 19,200 AF (64% of capacity) and two months earlier to 22,500 AF (76% of capacity). Prosser is indicative of similar effects on the other flood control reservoirs that store water for other types of demand, such as municipal and industrial uses.

Based on these findings, TMWA and other partners applied for and received a grant through the Bureau of

Reclamation in September 2019 to provide the necessary hydrologic modeling and develop new guidelines required to revise the USACE's WCM, allowing more flexibility in the winter based on forecast-informed reservoir operations. These changes will be instrumental in helping the region adapt to the effects of climate change, such as projections for earlier runoff and more precipitation falling as rain instead of snow. The project proposes to provide additional studies and modeling needed to support necessary revisions to the WCM. New flood control rule curves, adjustments to storage space, and adjustments to downstream flow thresholds for the Truckee River at the Reno gage will be developed based on the historical hydrology and projected hydrology under climate change scenarios. The project is expected to be completed by March 2023.

DEVELOPMENT AND GROWTH IN THE REGION

The Truckee Meadows has been experiencing renewed population growth and increased development since recovering from the economic recession. Economic and population growth has been positive since the completion of TMWA's 2035 WRP in 2016. However, the annual growth rates have not been as fast as those experienced before the start of the Great Recession in 2007.[8] TMWA estimates future population growth and water demand annually to ensure there are sufficient water resources to meet the increasing demand.

During the WRP public outreach process, concerns were expressed about the adequacy of water sources for new growth. Although acceptable water rights are required for new developments to be approved, Reno, Sparks, and Washoe County determine the amount and type of growth within each of their respective jurisdictions. TMWA enters the process to ensure appropriate and sustainable water rights are dedicated and costs for new water supply, treatment, and delivery infrastructure are covered by developers.

ARE PROTECTIONS IN PLACE TO ENSURE THAT GROWTH WON'T EXCEED WATER SUPPLY?

Yes, the following measures are in place:

1. Set by court decree in 1944, new water rights from the Truckee River cannot be created. Existing rights can be bought and sold and are converted from agricultural to municipal use.
2. New development is served only if enough water rights are dedicated to meet the estimated water demand of the project. Dedicated rights are controlled by TMWA to divert, treat, and distribute water to new projects.
3. Water rights from outside sources can also be dedicated to TMWA. An example is groundwater from the Fish Springs Importation Project, which will serve future growth projected in the North Valleys.
4. For every AF of surface water rights needed for new development, an additional 11% of water rights must be dedicated to TMWA for drought storage.

TMWA holds all water rights dedicated to serving existing businesses or residences in its service territory. For any new development, water rights must be dedicated to TMWA or the developer must purchase a will-serve commitment from TMWA's inventory of uncommitted water rights. In most cases in which a developer purchases and dedicates water rights, those rights are decreed agricultural rights that have been converted to municipal use. The amount of Truckee River water available for use was determined by a 1944 court decree and has not changed. Any water rights that are not used in any given year because of water conservation are not rededicated

[8] RCG Economics. 2015. *Northern Nevada Regional Growth Study 2015-2019. Volume I: A Forecast of Northern Nevada's Employment, Population, Households, and Associated Tax Revenues.*

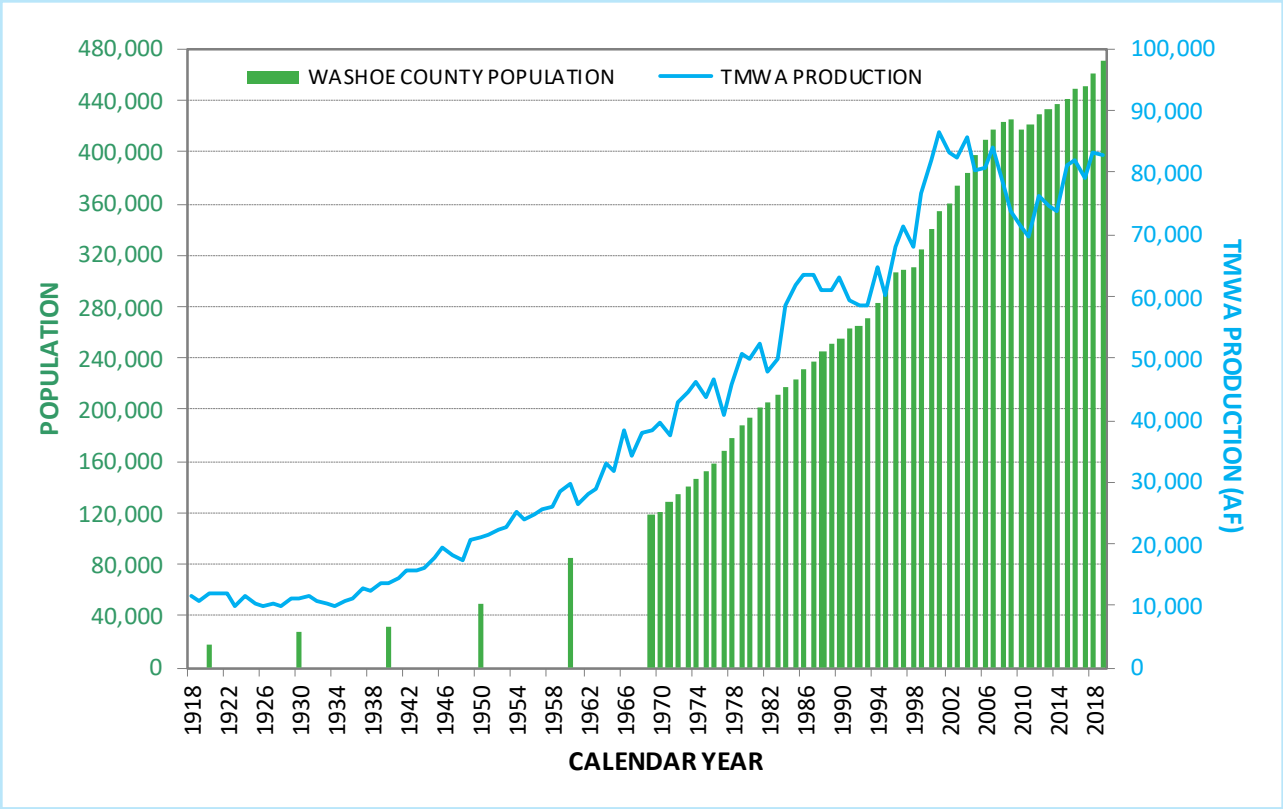


FIGURE 3-9: WASHOE COUNTY POPULATION VERSUS TMWA ANNUAL WATER PRODUCTION

for growth. The water is retained in upstream reservoirs as drought storage or flows downstream to other Truckee River water rights holders. See Ch. 2 for additional information about TMWA's water rights.

Water demand does not necessarily increase due to population growth. Due to increased efficiency and ongoing water conservation measures, TMWA's water demand has decreased over the last 20 years, even with a growing population in Washoe County (Figure 3-9). TMWA has added more than 36,000 service connections since 2003. The decrease is due largely to TMWA's metering of most services within the system, a tiered rate structure that incentivizes efficient water use, a conservation program that helps customers detect leaks and correct inefficient water use practices, and the transition to a three day/week outdoor watering. Additionally, water use has decreased as older appliances and fixtures are replaced with newer models that are required to be more water efficient. TMWA's public outreach regarding the need for water conservation during droughts also decreases water use because customers adapt and use less water.

WASHOE COUNTY QUESTION #3

In a county-wide general election on November 4, 2008, voters approved Washoe County Ballot Question #3 (WC-3). WC-3 required the Truckee Meadows Regional Plan be amended to reflect and include a policy or policies requiring that local government land use plans be based upon and in balance with identified and sustainable resources available within Washoe County. In January 2010, the Regional Planning Governing Board (RPGB) adopted amendments to the Regional Plan in response to WC-3. These amendments require the Northern Nevada Water Planning Commission (NNWPC) and Western Regional Water Commission (WRWC) to compare the draft WCF population to the population that can be supported by the estimated sustainable water resources identified in the Comprehensive Regional Water Management Plan (RWMP). The comparison consists of four parts: the 20-year population projection for Washoe County provided in the draft Consensus Forecast,

the sustainable water resources estimate in the adopted RWMP, a 20-year water demand projection based on the Consensus Forecast provided by TMWA, and a comparison of the water demand projection with the sustainable water resources estimate set forth in the RWMP.

If the NNWPC and WRWC find that the Consensus Forecast population can be supported by the sustainable water resources in the RWMP, the WRWC submits the draft population forecast to Reno, Sparks, Washoe County, and TMRPA, with the finding that the forecasted population can be supported.

The 2018–2038 Consensus Forecast projects the total population in Washoe County in 2038 will be 558,746. The 2016 RWMP provides an estimate of potentially available, sustainable water resources of approximately 190,500 AFA (and 143,800 AFA without additional water importation). The estimated water demand to serve the projected 2038 population is 111,875 AF. This forecast differs from TMWA's forecast because it is a projection for all of Washoe County, whereas TMWA's forecast only covers its service area. The projected 2038 population is significantly less than the population that can be supported by the sustainable water resources identified in the RWMP. For more information, see the WRWC Comprehensive Regional Water Management Plan at http://www.wrwc.us/2016WaterPlan.html

WATER SYSTEM RESILIENCY

In addition to climate conditions, there are events beyond TWMA's control that could affect the reliability of its supply, such as chemical spills, earthquakes, or wildfires. While there is a risk to source water during these events, TMWA has enough well capacity and distribution storage to meet reduced customer demand during a water quality emergency; additional actions are available to TMWA in the event of extended off-river emergencies. An earthquake in 2008 tested TMWA's emergency response plan with a loss in water supply and demonstrated TMWA's ability to respond by providing trained staff and alternative water supplies. For more details on TMWA's management strategies during natural disasters, see Ch. 4.

The water quality of the Truckee River is normally excellent. Surface water is of exceptional quality because flows originate from Sierra Nevada snowpack runoff. Turbidity—the concentration of particulate matter in water—levels are generally very low. However, water in the Truckee River can have higher turbidity at times due to storm runoff and/or algae growth associated with low flows and warm temperatures in summer. To ensure safe, reliable water is always provided to its customers, TMWA utilizes a water quality assurance program comprised of the following components:

- **Source Water Protection**: TMWA has an integrated and coordinated source water protection program designed to protect or improve the quality of TMWA's surface water and groundwater supplies. TMWA, in conjunction with NDEP, is completing an Integrated Source Water Protection Plan for Washoe County that provides management strategies to protect groundwater and surface water. Further information is provided in Ch. 6.
- **Potable Water Treatment**: TMWA's modern treatment facilities for its raw surface water and groundwater supplies complies with all federal and state drinking water regulations. Also, TMWA uses a highly skilled staff of scientists, engineers, and operators who continually monitor water quality in the distribution system. Additional information is available at https://tmwa.com/your-water/water-quality-facts/.
- **Cross Connection Control**: TMWA has an extensive backflow prevention and cross-connection control program. The purpose of the program is to prevent backflow of pollutants or contaminants from customer plumbing systems into TMWA's distribution system.

SUMMARY

Climate change and drought are the most significant variables with the potential to change the quantity of the water supply. Studies indicate that climate change will likely alter the timing and type of precipitation, but to what extent is still uncertain. By stress-testing the system under various climate change scenarios, TMWA can plan for future variability in supply and demand. Drought periods have established historical patterns in the Truckee River Basin, with the most severe drought on record lasting eight years. TMWA plans for drought periods with a combination of natural river flows, release of POSW and credit water, groundwater pumping, and extraction of banked groundwater stored through aquifer storage recovery (ASR). Addressing climate change will require similar strategies; however, the region is extremely fortunate to have TROA, which provides for additional municipal storage under drought conditions and increased operational flexibility. With TROA and TMWA's conjunctive use of its diverse water resources portfolio, TMWA is confident in its ability to meet the region's growing water demand well into the future.

4 CONSERVATION STRATEGIES

Truckee River

CHAPTER OVERVIEW

Northern Nevada goes through cyclic patterns of wet periods and droughts. To help mitigate unpredictability, conservation strategies to build resiliency in TMWA's water supply. While customers are asked to use water efficiently in and around their homes and businesses, TMWA also works on reducing water loss in its delivery system. This chapter reviews TMWA's conservation programs and tactics, addressing how conservation efforts ramp up when drought conditions escalate. The outcomes of conservation efforts are demonstrated in the pages that follow.

CHAPTER AT-A-GLANCE

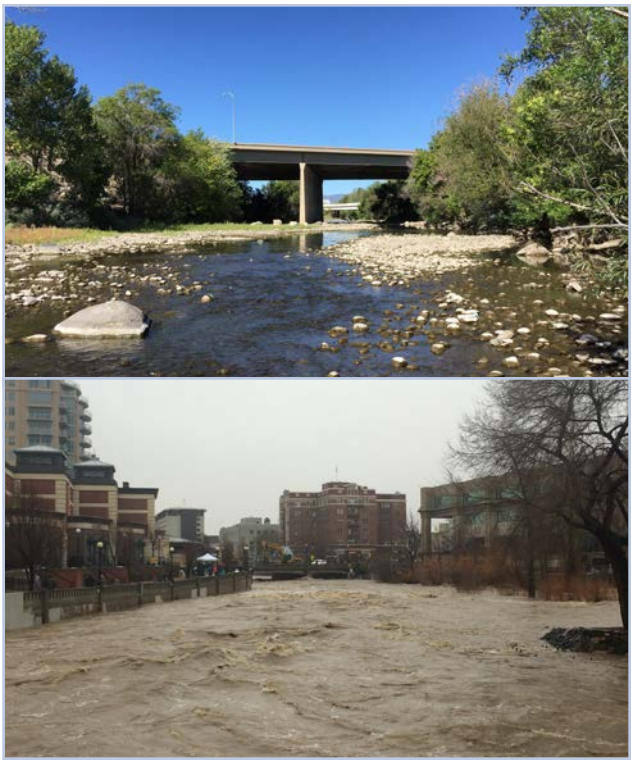
Highlights of Chapter 4 include:

1. How TMWA prevents water loss
2. Customer conservation programs and outreach
3. Demand management during drought situations
4. The effectiveness of conservation efforts

As described in the previous chapters, TMWA has a diverse water portfolio and utilizes conjunctive use of its water resources to address variability in climate and hydrologic conditions. Water conservation is also an essential component of TMWA's water management strategy. Conservation allows TMWA to effectively supply water to the Truckee Meadows, even during prolonged periods of drought. This chapter describes these conservation strategies, which are designed to ensure efficient use of water in the region under a range of conditions.

DROUGHT CONTINGENCY PLAN

Conservation is a major component of TMWA's resiliency strategy. TMWA's Drought Contingency Plan addresses the TROA and state law requirements and allows for proactive conservation strategies that promote both drought resiliency and water resource sustainability.[1] To help customers exercise responsible water use, TMWA employs a suite of demand-management programs tailored around seasonal watering habits in the Truckee Meadows. Whereas the 2040 WRP outlines TMWA's conservation initiatives, its Drought Contingency Plan is a separate plan. To see a detailed description and analysis of the strategies used for TMWA's conservation program go to www.tmwa.com/dcp.



TRUCKEE RIVER—FALL 2014 (TOP) AND WINTER 2017 (BOTTOM)

ONGOING CONSERVATION INITIATIVES

A healthy annual snowpack is vitally important to fill upstream reservoirs and naturally recharge aquifers in the Truckee Meadows. Lake Tahoe is the largest reservoir in the system. Three or more years of consecutive

[1] Per TROA Section 12.A 2(e), TMWA must maintain a conservation plan that ensures water savings equal to, or better than, a plan that requires 10% or more water savings during a drought year.

below-average snowpack in the Truckee River Basin can significantly diminish upstream reservoir storage used to provide Floriston Rates (the TROA required flowrate in cubic feet per second in the Truckee River near the Nevada–California border).

The last four exceptionally dry years in a row (2012–2015) reduced the level of Lake Tahoe to below its natural rim in 2015. During that summer and fall, with no water flowing from Lake Tahoe into the Truckee River, TMWA needed to release its upstream drought reserves to meet customer demand. This event highlights the fact that TMWA's water supplies are typically not impacted until the third year of a drought. It also illustrates the need to effectively manage water resources *before* a drought occurs. Moreover, since climate variability cannot be predicted from year-to-year, and the region is predominantly a high desert, TMWA promotes ongoing conservation measures to help ensure water is used efficiently by all customers. During droughts, any water conserved by TMWA's customers generally can be stored in upstream reservoirs to be used to meet customer demand later. Water conserved by residential customers is not used to support growth.

MANAGING WATER LOSS

A key component of mitigating drought is managing water loss within the delivery system. To efficiently capture and measure the water it delivers to customers, TMWA tracks water loss within its system by conducting a water balance study annually. This information helps ensure TMWA has reliable water resources during drought, minimizing the need to ask customers to reduce their use.

Capital Improvement Plan Projects

TMWA's Capital Improvement Plan (CIP), updated annually, identifies projects that are essential to reducing water loss within the delivery system over the next five years. Through a well-funded program that maintains and expands its existing water system, the CIP further bolsters TMWA's ability to store water.[2]

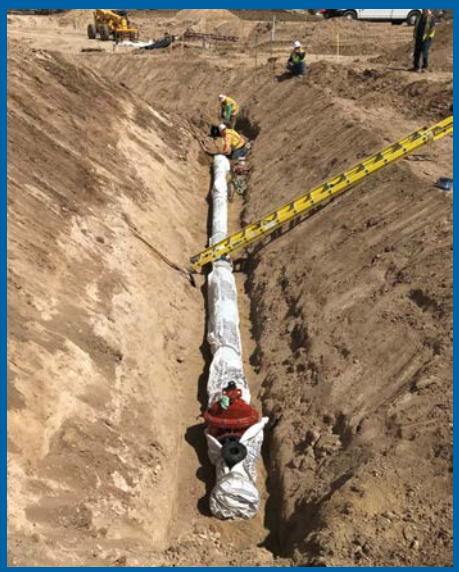
MANAGING WATER DEMAND

Promotion of smart water use in drought and non-drought years is important because efficient use of water within the Truckee Meadows extends this vital resource. TMWA focuses on outdoor watering, typically occurring

HOW TMWA MANAGES WATER LOSS

Much of the drinking water infrastructure nationwide is nearing the end of its life. Fortunately, TMWA's delivery system is generally newer than other parts of the United States. TMWA allocates millions of dollars annually into replacing water mains and conducting service repairs and meter change-outs. This ensures water is delivered and measured reliably. Between 2016 and 2018, TMWA replaced 157 water mains, repaired over 1,600 service laterals, and changed out almost 20,000 pieces of metering equipment. Its proactive efforts have resulted in an average of 6–8% water loss per year, which is significantly below the national average.

When planning large water-main rehabilitation jobs, TMWA will often coordinate the project with others (e.g. city street reconstructions, utility projects, etc.) to reduce overall costs and provide the least amount of disruption to customers.



[2] For more information on the most current CIP, visit https://tmwa.com/financial-information/

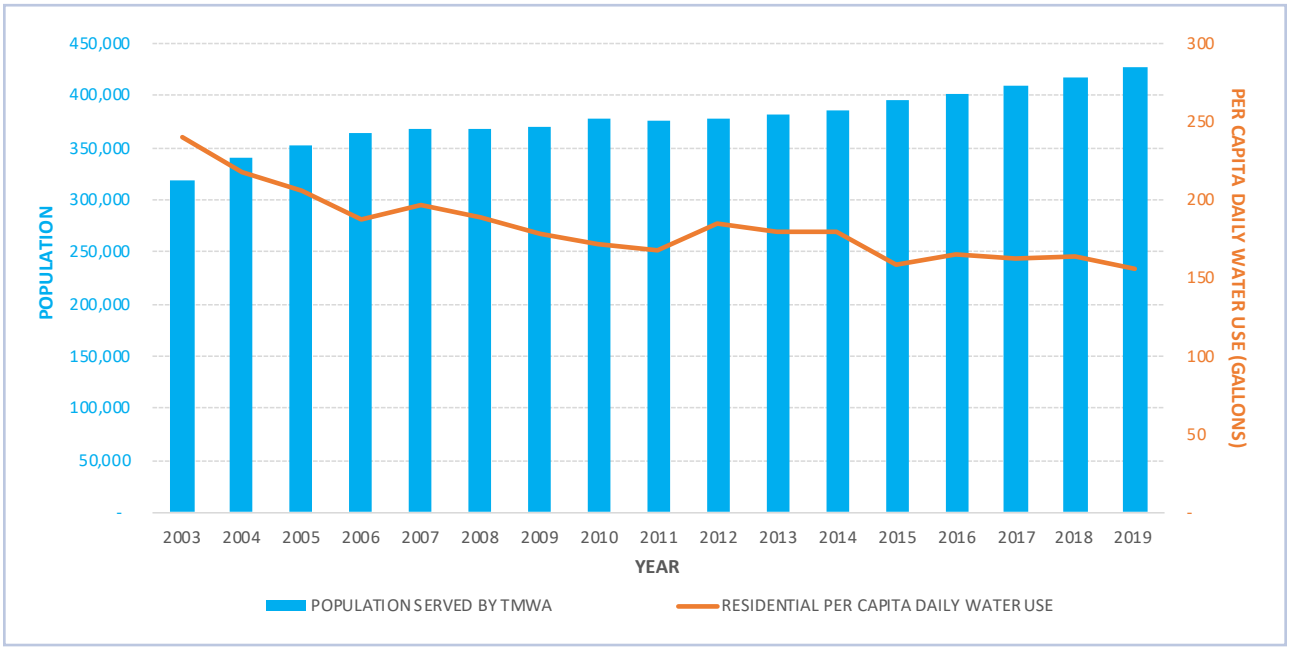


FIGURE 4-1: POPULATION SERVED BY TMWA AND RESIDENTIAL PER CAPITA DAILY WATER USE.

from April through mid-October. During this time, customer demand can be three-to four times higher than wintertime use. Therefore, TMWA conservation efforts are seasonally relevant and targeted to address customers' usage patterns. TMWA's outdoor watering programs also reduce peak-day demand on the system, helping minimize the need for infrastructure expansion. This continual demand management has aided in the general decline in per-capita water consumption within the Truckee Meadows. Proven effective over the years, conservation has resulted in residential per-capita water usage declines of 30% over the last 15 years (Figure 4-1). The following section outlines TMWA's ongoing conservation programs.

Water Conservation Education and Outreach Program

TMWA has numerous educational initiatives designed to help customers learn the benefits of water conservation while providing tools, tips, and techniques to foster smart water use.

These educational initiatives include:

- A free workshop and tour series
- A native landscape planting guide designed specifically for the Truckee Meadows region (available in print or online at tmwa.com/landscape)
- A formal, one-week lesson plan on water conservation, targeting fifth grade students
- Partnerships with other organizations that provide water resource, water quality, and watershed protection activities to students
- Participation in public presentations and events (e.g., speaking engagements, Earth Day festivals, and other community activities)
- Xeriscape, tree care, and smart-watering-tips information provided at all events
- A TMWA YouTube channel containing how-to videos on fixing leaks and conducting water audits at home

TMWA's website provides online resources regarding the programs listed above.

"Residential per-capita daily water use has declined by approximately 30% while TMWA's customer base has increased by 30% since the early 2000s."

LANDSCAPING IN THE TRUCKEE MEADOWS

TMWA offers the only comprehensive landscaping guide to the trees, plants, and shrubs that thrive in the Truckee Meadows region. The guide, which is offered electronically, in print, and in a searchable online format, is tailored to help customers create water-efficient landscaping that makes sense in the Truckee Meadows region. Users can select vegetation based on a variety of attributes including color, light requirements, wildlife attraction, drought tolerance, and fire resistance. The goal of the guide is to take the guesswork out of creating a beautiful, vibrant, and water-efficient yard that is compatible with our high-desert climate. Visit **tmwa.com/landscape** for more details.

Year-round outreach strives to promote useful and seasonally relevant information and programs to all customers. These communication channels include:

- Direct communication to customers via bill inserts and e-newsletters
- TV, radio, newspaper, and local magazine advertisements
- Social media engagement including Facebook, Twitter, and Instagram

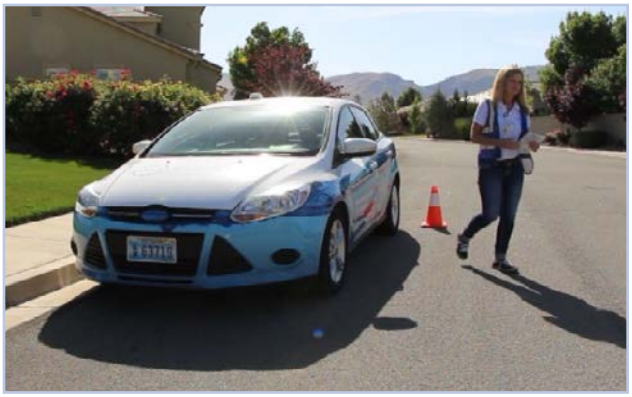
Water-Efficiency Codes

TMWA's Rule 2 provides water-efficiency codes to which customers must adhere.[3] These codes have been effective at managing customer demand over time. As a condition of service, customers must not engage in any act which results in excessive use of water (i.e., no waste). The rule requires that customers follow an assigned, three-day-a-week irrigation schedule for lawns. Assigned-day watering helps prevent overwatering and reduces peak-day demand. Customers with even addresses may water Tuesday, Thursday, and Saturday and those with odd addresses may water Wednesday, Friday, and Sunday. No watering is allowed on Mondays to allow the system to adequately recover. Additionally, lawn irrigation is not permitted between 12 p.m. and 6 p.m. from Memorial Day through Labor Day. Drip systems and hand watering are allowed anytime, as long as no waste occurs. Variances to water anytime will be granted annually for newly seeded lawns or newly laid sod, lawns in public parks, playgrounds, athletic fields, common areas, and parkways (if done in an efficient manner).

Water Watcher Program

To monitor the water-efficiency codes outlined in Rule 2, TMWA hires additional staff during the outdoor watering season. These water conservation consultants drive around the TMWA service territory and are trained to assist customers in following TMWA's water use rules. They also respond to water waste reports submitted by the public and provide customers with information about TMWA's water-efficiency codes and identify any observed leaks or sources of water waste. The rule also contains penalty charges for individuals who repeatedly violate TMWA's water-efficiency codes (from $25 up to $75). TMWA also distributes water-saving devices such as low-flow

[3] For more information, please refer to https://tmwa.com/wp-content/uploads/docs/Customer_Services/rules/Rule02_20120119.pdf.



WATER WATCHER IDENTIFYING WATER WASTE

showerheads, automatic hose nozzles, and hose timers upon request.

Water Pricing Structure

TMWA has an inverted, tiered-rate billing structure in which customers are charged increasing rates based on the amount of water they use. This billing structure provides a "price signal" to customers whose usage crosses into a higher tier, thereby encouraging efficient use of water. In 2015, TMWA's Board approved the conversion of all flat-rate customers to a metered rate (applicable if a meter existed at the service location). Since that time, nearly all services have been metered and are being billed at the metered rate.

Water Usage Review Program

The Water Usage Review (WUR) includes reviews of services to determine water usage behavior and help customers determine the sources that contribute to high consumption levels. When a WUR is requested, TMWA staff visit customer premises to check meter accuracy and detect potential leaks in the customer's system. If a leak is detected, staff help customers identify its location and provide information on fixing the leak. When completed, staff provide an overview of leaks detected and review customer watering habits that may be leading to high consumption. Finally, staff make recommendations on how to reduce water use and teach customers how to monitor for future leaks. On average, TMWA provides over 2,000 WURs annually and has conducted over 28,000 WURs since 2003.

Landscape Retrofit Fund

The Landscape Retrofit Fund provides financial support for approved educational projects that improve water efficiency. The fund supports landscape-augmentation projects that focus on public agency grass removal and replacement with artificial turf or xeriscape to reduce water requirements. The fund also supports educational programs designed to inform customers about drought-tolerant landscaping (e.g., xeriscape) and conservation practices. Prior projects supported under this program include replacement of traditional turf grass with drought-tolerant vegetation and native vegetation, free arborist consultants, and educational classes and workshops targeted toward smart landscaping, such as TMWA's free workshop series and the WaterSense-approved Qualified Water Efficient Landscaper certification class.

DROUGHT RESPONSE

Under average Truckee River flow conditions, Floriston Rates are maintained through October. When Floriston Rates are sufficient, TMWA's surface and groundwater supplies can be used to meet customer demand without using stored water or drought reserves. When a drought situation occurs and Floriston Rates *cannot* be met, TMWA must rely more heavily on groundwater, and conservation efforts increase as needed. In instances where conditions are severe enough that drought reserves must be released, TMWA may implement enhanced conservation measures to minimize the use of drought reserves, including temporary, voluntary reductions. This approach was effective during the recent drought of 2012–2015. During the 2015 drought, TMWA was able to temporarily reduce customer usage by 9–16%, on average. Enhanced conservation efforts are used to heighten awareness regarding drought conditions and highlight the importance of responsible water use.

TMWA DROUGHT LEVEL DESIGNATION

As described in Section 2.1, TROA defines a drought situation based on Lake Tahoe's elevation and on the loss of Floriston Rates. When a drought situation exists under

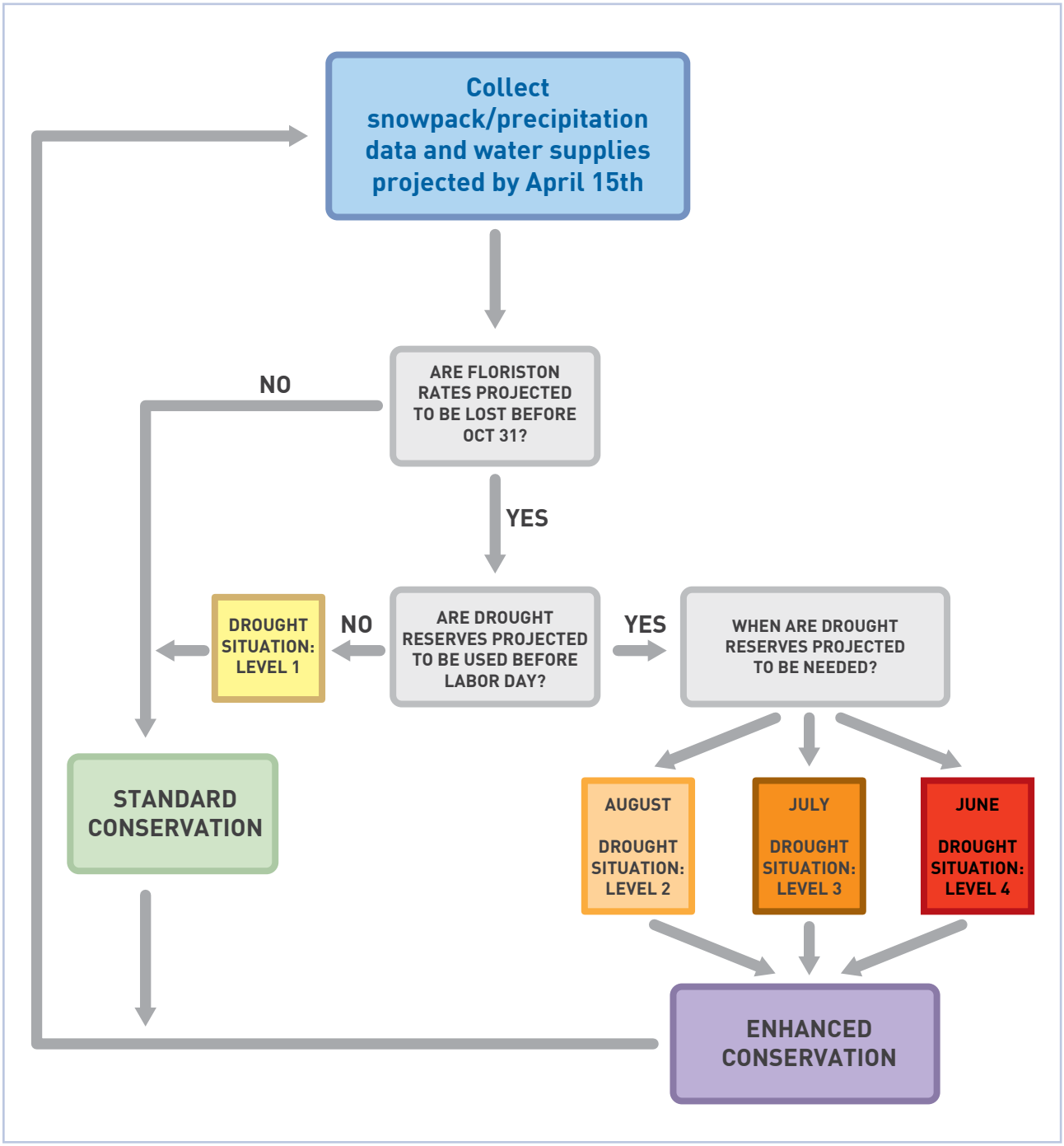


FIGURE 4-2: TMWA DROUGHT SEVERITY LEVEL FLOWCHART

TROA, TMWA has four categories for drought severity, which are based on when TMWA's upstream drought storage is projected as necessary to meet anticipated customer demand later in the year. If the release of upstream storage projected need is in June, July, and August, drought severity is designated as level 4, 3, or 2, with 4 the most severe. If upstream storage is not expected to be needed until after Labor Day, TMWA's drought severity is a level 1. When the drought severity is a level 4, 3, or 2, TMWA implements enhanced conservation. When the drought severity is a level 1, enhanced conservation is not required, and standard conservation practices are used. Figure 4-2 provides a flowchart of the triggers required for each of TMWA's drought severity levels.

DEMAND MANAGEMENT DURING DROUGHT SITUATIONS

TMWA orients conservation initiatives to better manage demand over the course of a drought situation, with the goal of minimizing the use of upstream drought reserves. The level of response depends on the total amount of drought reserves available and the amount required to meet the demand projected during the summer. To minimize the use of drought reserves, TMWA will enhance existing conservation initiatives when drought severity is at a level 4, 3, or 2. TMWA can also implement additional restrictions and temporary cutback requests, as necessary.

TMWA begins enhancing conservation efforts the month before drought reserves are needed to meet customer demand. Table 4-1 provides the timeline for enhanced conservation based on drought severity.

Table 4-2 shows the different initiatives used for TMWA's standard and enhanced conservation efforts. Enhanced conservation begins with TMWA ramping up its education and outreach efforts during the months when outdoor watering occurs (typically May through mid-October). TMWA increases media advertising to promote awareness of drought conditions and any additional watering restrictions needed. TMWA utilizes expanded media coverage to highlight its programs and online resources that help customers conserve water. Table tents asking that water only be served by request are provided to local restaurants. Mirror stickers encouraging customers to use water efficiently are placed in public restrooms. TMWA also sends letters to homeowners' associations (HOAs), requesting they not penalize residents who let their lawns turn brown during the drought.

TMWA also increases its water-efficiency requirement during drought severity levels 2–4. Time-of-day restrictions are expanded to prohibit watering between 11 a.m. and 7 p.m. from Memorial Day through Labor Day. Depending on the severity of the drought and how many years a drought has been in effect, TMWA can request that customers reduce their water consumption by a targeted amount during the months when reserves are needed. The cutback amount depends on the quantity of drought reserves TMWA has accumulated and the projected level of demand during peak-use months.

DEMAND MANAGEMENT AND EMERGENCY SUPPLY CONDITIONS

Natural disasters and other unforeseen events can interrupt TMWA's available water supplies; these include floods, earthquakes, equipment failure, or distribution leaks. Sometimes the events are localized within the distribution system and sometimes the whole community

TABLE 4-1: DROUGHT SEVERITY LEVEL RESPONSE TIMELINE CHART

	Outdoor Watering Months					
Level of Severity	May	June	July	August	September	October
	Drought reserves are not needed before Labor Day.					
Level 1	Standard Conservation					
	Drought reserves are needed before Labor Day.					
Level 2				Drought Reserves Needed		
	Standard Conservation		Enhanced Conservation			Standard Conservation
Level 3			Drought Reserves Needed			
	Standard Conservation	Enhanced Conservation				Standard Conservation
Level 4		Drought Reserves Needed				
	Enhanced Conservation					Standard Conservation

TABLE 4-2: CONSERVATION ACTIONS AND DROUGHT SITUATION SEVERITY

CONSERVATION INITIATIVE	DROUGHT SITUATION LEVEL OF SEVERITY	
	LEVEL 1	LEVEL 2 - 4
Communication and Outreach Campaign	Standard campaign	Enhanced campaign
Water Efficiency Codes	Time-of-day: No lawn watering from 12 p.m. to 6 p.m.	Time-of-day: No lawn watering from 11 a.m. to 7 p.m.
Water Watcher Programs	Standard staffing level	Increase staffing level
Water Usage Review Program	Standard staffing level	Standard staffing level
Landscape Retrofit Fund	Standard funding level	Standard funding level
Temporary Cutback*	No cutback request	Temporary cutbacks may be requested
Water Pricing Structure**	Standard pricing structure	Drought rates or increased fines may be implemented

* The exact amount of curtailment requested is determined based on projected demand levels, drought storage availability, and estimated surface and groundwater available.

** While historically this measure has never been used in the Truckee Meadows, increasing the price of water during a drought has been an effective measure used by other water purveyors.

can be affected. During such events, TMWA's goal is to minimize customer disruptions. During states of emergency, the community may be required to comply with increased conservation measures such as mandatory temporary cutbacks or severe watering restrictions (e.g., no outside watering or once per week during summer months). Additionally, commercial properties may be asked to reduce laundry, use paper plates in restaurants, and to not use potable water for non-potable purposes.

Increased conservation by TMWA customers during emergencies is just one element of the successful management of emergency water supply interruptions. TMWA's personnel train for and practice responding to various emergency situations. This has shown success during past emergencies in which water supply interruptions have been mitigated as swiftly and efficiently as possible. For example, the April 2008 earthquake in Mogul destroyed the Highland Flume, thereby preventing gravity-fed delivery of water to the Chalk Bluff Water Treatment Plant (WTP). TMWA mitigated the incident by 1) turning on its Orr Ditch Pump Station and installing temporary pumps to feed Chalk Bluff, 2) turning on its Glendale WTP, 3) turning on its wells as needed for demand, and 4) installing temporary piping around the Highland Flume failure to deliver more water to Chalk Bluff. These actions avoided any water supply interruptions for TMWA customers.

SUMMARY

Conjunctive use allows TMWA to efficiently store drought reserves and recharge underground aquifers for potential use during dry periods. In addition, its robust conservation plan includes actions to reduce water loss on the distribution side and demand management programs to keep customer usage down. Such initiatives include a well-funded CIP, an extensive education and outreach program, tier-based water rates structure, water efficiency codes and enforcement, and other programs tailored to reducing specific customers' usage. Demand management programs can be enhanced to respond to drought. Deployment of these programs is based on the severity of the drought, as defined within TMWA's drought severity index. The conservation strategies outlined in this chapter have proven effective over the past several decades. To enhance existing conservation programs, TMWA will be employing smart meter technology over the next three to five years to allow automated meter monitoring and advanced leak detection. TMWA will continue to research new and innovative ways to further help customers manage their water use in the future.

5

FUTURE WATER RESOURCES

Lake Tahoe

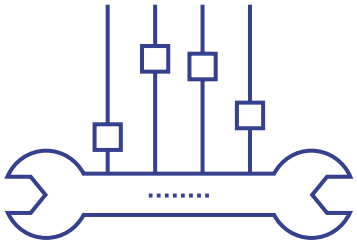
CHAPTER OVERVIEW

Accounting for continued growth and climate impact on the water supply, all projections confirm TMWA will continue to meet the water needs of this community over the next 20 years and beyond. To further bolster TMWA's water supply resiliency, there are several small-volume water resources identified in this chapter that will be investigated within the 20-year timeframe of this plan. Additionally, technologies to purify reclaimed water to enhance water resource resiliency and sustainability are being explored. If proven feasible, the implementation of these projects will require an investment of time and funds over multiple years.

CHAPTER AT-A-GLANCE

Highlights of Chapter 5 include:

1. Overview of future groundwater development
2. Additional applications for reclaimed water
3. Feasibility studies for advanced purified water
4. Exploration of water banking projects
5. Potential water importation projects



TMWA has a diverse water resource portfolio that will sufficiently meet the projected needs of the Truckee Meadows over the 20-year planning horizon. Currently, and for the foreseeable future, TMWA will rely on the conversion of Truckee River water rights from agriculture to municipal use and Fish Springs groundwater to meet projected growth. The merger and integration of the Washoe County Department of Water Resources (WDWR) and South Truckee Meadows General Improvement District (STMGID) water systems brought additional groundwater and creek resources and facilities to TMWA. Future water resource projects and management strategies will be pursued and implemented as needed to further increase drought reserves and to continue to meet the region's water needs into the future.

The water resources and projects outlined in this chapter would provide relatively small quantities of water to the region but are important to expand the community's future water supply portfolio. The 2040 WRP is a high-level

TABLE 5-1: ESTIMATED YIELD OR CAPACITY OF FUTURE WATER RESOURCE PROJECTS

RESOURCE/PROJECT	RANGE OF YIELD OR CAPACITY
Treatment of Existing Groundwater Resources	
Sparks Groundwater Treatment Facility	11.9 MGD
Spanish Springs Valley Nitrate Treatment Plant	3-4 MGD
Longley Lane Groundwater Treatment Facility	4-6 MGD
South Truckee Meadows Groundwater Treatment Facility	4-6 MGD
Additional Groundwater Capacity	
New Well Development*	2 MGD (every 5 years)
ASR Expansion**	9,000 AFA
Additional Fish Springs Ranch Water	5,000 AFA
Expansion of Water Conservation	Varies
Creek Water Resources	
Mt. Rose Water Treatment Plant	4 MGD
Marlette Lake Water System – Wholesale Service	Varies
Reclaimed Water	
Expanded Irrigation	Varies
Advanced Purified Water	2,000 AFA
Water Banking	Varies

*New well development does not increase the total amount available for withdrawal annually.
**Targeting 9,000 acre-feet (AF) of recharge systemwide annually.

planning document and is not intended to be used for specific project details (i.e., detailed costs estimates, facility layouts, precise yield values). More detailed information for specific projects will be developed in the future. Table 5-1 (see previous page) summarizes the estimated ranges for the yields and capacity for each project currently being considered. A description of each resource or project, including a summary of the benefits and implementation challenges, is presented in the next section.

ABOUT ARSENIC AND OTHER CONSTITUENTS IN GROUNDWATER

The US Environmental Protection Agency (EPA) develops and sets regulatory standards that limit the amount of contaminants in public water supplies. The EPAs standards are enforced by the Nevada Division of Environmental Protection and Washoe County Health District. Some of TMWA's groundwater wells have naturally occurring constituents, such as arsenic, manganese, and iron. Many of these contaminants occur naturally in the geology of the region and erode from natural deposits. However, these constituents are below the maximum contaminant levels (MCL) set by the EPA, are treated to a level below the MCL, or are blended with other water to attain a level below the MCL. An MCL is the highest level of a contaminant that is allowed in drinking water. TMWA has never had a drinking water quality violation. For more information on TMWA's water quality, visit https://quality.tmwa.com/.

TREATMENT OF EXISTING GROUNDWATER RESOURCES

TMWA's production wells provide peaking capacity to ensure reliable service during the typical irrigation season and provide critical drought capacity in dry years. In areas where there are groundwater quality issues, TMWA is exploring opportunities for small-scale treatment plants to continue utilizing these important resources.

SPARKS GROUNDWATER TREATMENT FACILITY

TMWA has four production wells and two additional potential well sites in Sparks that have not been used due to water quality issues, including elevated levels of arsenic, iron, and manganese. These wells are not currently equipped but will be needed in the future to provide additional peaking capacity to serve future growth and to enhance TMWA's ability to provide reliable service during drought or emergency conditions affecting the Truckee River. Water from these wells will be treated in the proposed Sparks Groundwater Treatment Facility (GWTF), located along East I Street and East Prater Way. The Sparks GWTF will be designed with magnesium dioxide pressure filters to remove arsenic, iron, and manganese to meet federal and state drinking water quality standards. As described in TMWA's 2015–2035 Water Facility Plan, the Sparks GWTF is scheduled to be built in two phases beginning around 2030. Phase 1 will produce up to 7.6 MGD, and Phase 2 will add another 4.3 MGD of treated water production capacity.

TABLE 5-2: BENEFITS AND CHALLENGES OF THE SPARKS GROUNDWATER TREATMENT FACILITY

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Provides opportunities to use existing wells with arsenic, iron, and manganese water quality issues • Provides new off-river resource • Increases drought supply and peaking capacity	• Requires extensive phased construction of well buildings and treatment facility over several years
Cost	• Time frame to build the water treatment plant is expected around 2030, based on TMWA's Water Facility Plan.	• High cost

SPANISH SPRINGS VALLEY NITRATE TREATMENT FACILITY

Due to the high density of septic systems, over-watering of turf and impacts from livestock in the Desert Springs area of Spanish Springs, some of TMWA's municipal wells are contaminated with nitrate. TMWA completed a one-year pilot study to assess the effectiveness of using two-stage, fixed-bed (FXB) biological treatment for the removal of nitrate from Desert Springs Well 3 groundwater. Biological treatment is not presently an approved technology in Nevada for nitrate removal. The pilot study demonstrated that the biological treatment system consistently reduced nitrate from groundwater. With additional chemical treatment, naturally occurring arsenic can also be removed from the groundwater. Based on the findings of the pilot study, a conceptual design was created for a full-scale treatment facility with a capacity of 3–4 MGD to treat water from Desert Springs Wells 1, 2, 3, and 4. TMWA is evaluating various options to ensure its continued ability to use the wells in Desert Springs to meet existing customer demand.

TABLE 5-3: BENEFITS AND CHALLENGES OF NITRATE TREATMENT

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Allows continued use of TMWA's wells by mitigating water quality issues due to nitrates • Will help maintain existing groundwater capacity in Spanish Springs	• Good location to site the nitrate treatment plant has not been identified. • Requires the construction of a pipeline to the treatment plant site • Requires permits for operating a new treatment facility
Cost	• A treatment facility may be used to help mitigate a regional water quality issue.	• Relatively high cost to existing customers

LONGLEY LANE GROUNDWATER TREATMENT FACILITY

With an existing capacity of approximately 4 MGD, the Longley Lane WTP was owned and operated by WDWR prior to the merger with TMWA. TMWA currently does not use this facility for water treatment; however, it is used as a booster pump station serving the Hidden Valley area. Hidden Valley wells 3 and 4 used to be treated at the Longley Lane WTP when it was operated by WDWR, but TMWA is investigating treating these wells individually on site. TMWA recently completed a preliminary design report defining the necessary improvements to allow these wells to be brought back online. These improvements consist of ultraviolet light (UV) treatment at Hidden Valley 4 for pathogen inactivation and blending with Hidden Valley Well 3 to reduce arsenic concentrations to acceptable levels.

In the future, TMWA plans to retrofit the Longley Lane treatment facility with magnesium dioxide pressure filters to remove iron and manganese from existing and future wells. The combined capacity of Hidden Valley Wells 3 and 4, plus the modified treatment facilities is expected to be approximately 4–6 MGD. These supply facilities are not currently being used but will be needed in the future to provide additional peaking capacity to serve growth and enhance TMWA's ability to provide reliable service during drought or emergency conditions affecting the Truckee River.

TABLE 5-4: BENEFITS AND CHALLENGES OF THE LONGLEY LANE WATER TREATMENT FACILITY

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Allows continued use of TMWA's wells by mitigating water quality issues • Increases drought supply, reliability, and peaking capacity	• Requires implementation of creative UV/ blending treatment process for two wells • Requires retrofitting existing treatment facility using media filtration rather than membranes
Cost	• Improves conjunctive use and operational flexibility and lowers operating costs • Construction can be phased as needed.	• Relatively high cost to existing customers

SOUTH TRUCKEE MEADOWS GROUNDWATER TREATMENT FACILITY

Double Diamond Wells 1, 3, and 5 were owned by WDWR prior to the merger with TMWA. Of the three wells, only Well 1 was equipped for operation due to naturally occurring arsenic in Wells 3 and 5. TMWA has since made improvements to Well 3, which is currently blended with treated surface water and operated during peak summertime demand. TMWA is also investigating the feasibility of blending at Well 5. In the future, when needed for peaking capacity, drought protection, and/or reliability, TMWA plans to replace Well 1 with a higher capacity well and route all three to an arsenic groundwater treatment facility. TMWA acquired a 10-acre site off Double R Blvd. during the merger with WDWR that is permitted for a treatment facility. The ultimate capacity is expected to be 4–6 MGD.

TABLE 5-5: BENEFITS AND CHALLENGES OF THE SOUTH TRUCKEE MEADOWS WATER TREATMENT FACILITY

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Allows expanded use of TMWA's wells that have water quality issues • Increases drought supply and peaking capacity	• Requires construction of pipelines to the treatment plant site • Requires permits for operating a new treatment facility
Cost	• Improves conjunctive use and operational flexibility • Construction can be phased as needed.	• Relatively high cost for construction

ADDITIONAL GROUNDWATER CAPACITY

There are some opportunities within TMWA's current service area where new wells could be developed, and TMWA is constantly analyzing opportunities to expand its groundwater resources. These projects, besides Fish Springs Ranch, would not increase the total amount of withdrawal annually from the groundwater basins. This section outlines projects TMWA could implement to expand groundwater capacity in its service area, including new wells and ASR expansion.

NEW WELL DEVELOPMENT

Because of the merger with STMGID and WDWR in 2015 and the acquisition of West Reno Water Company in 2019, TMWA has expanded its groundwater well count to approximately 89 active production wells in nine hydrographic basins. TMWA plans to increase its groundwater pumping capacity from 63 million gallons per day (MGD) to 77 MGD

DRILLING A NEW PRODUCTION WELL

over the next 20 years, primarily to help meet peak summertime irrigation demand. It is highly likely that development of new groundwater sources will require new treatment facilities for naturally occurring constituents such as arsenic, iron, and manganese as TMWA expands its well network into areas with poorer water quality.

TMWA replaces existing wells when efficiency declines and/or a well's physical condition necessitates new well construction. When replaced, the new well is often drilled in proximity to, or on the same parcel as, the existing well. Recent replacement-well drilling includes Army Air (basin 92B), Thomas Creek (basin 89), and Spring Creek 5 (basin 85). In areas where there are no existing wells, exploratory drilling programs are implemented to characterize the groundwater capacity and quality. If the exploratory program results are favorable, the site may later be developed into a full-scale production well. To minimize the need to replace wells, TMWA uses an extensive well rehabilitation program, described in Ch. 2, to maintain and improve well efficiency and capacity.

TABLE 5-6: BENEFITS AND CHALLENGES OF NEW WELL DEVELOPMENT

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Provides added off-river water resources • Increases drought supply and peaking capacity • Is a resource that the public readily accepts	• Lack of good locations to site new wells due to water quality constraints
Cost	• Costs to drill and equip new wells can be incorporated into TMWA's capital improvement budget when needed.	• New wells are relatively expensive to drill and equip. • Wells drilled in areas with low water quality may require expensive treatment systems.

AQUIFER STORAGE AND RECOVERY (ASR) EXPANSION

TMWA has been expanding its existing ASR program by equipping additional wells for recharge in the acquired WDWR and STMGID water systems. Over the last several years, wells in Spanish Springs, South Truckee Meadows, and Pleasant Valley have been retrofitted to increase ASR capacity. In Spanish Springs, Desert Springs Wells 1 and 2 have recently been equipped for ASR. In the South Truckee Meadows and Pleasant Valley, Arrowcreek 2, Tessa East Well, and STGMID 11 have also been retrofitted.

For planning purposes, TMWA is targeting a total annual recharge volume of 9,000 acre-feet annually (AFA). Of this 4,000 AFA is planned within the Central Truckee Meadows and Spanish Springs Valley. The completion of the Mt. Rose Water Treatment Plant (WTP) will allow for approximately 3,000 AFA of recharge opportunities using treated Whites Creek water at production wells on the Mt. Rose Fan. In the North Valleys, a planned recharge volume of 2,000 AFA is being investigated.

TABLE 5-7: BENEFITS AND CHALLENGES OF ASR EXPANSION

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Provides opportunity to use available surface water in winter months when demand is low • Aligns with TMWA's strategy of conjunctive use of water resources	• Requires complex state permits and drilling of new monitoring well sites • Only able to recharge a relatively small amount of water in comparison to demand
Cost	• Costs to equip existing wells for ASR can be incorporated into TMWA's capital improvement budget.	• Costs may increase at certain locations due to potential treatment requirements.

ADDITIONAL FISH SPRINGS RANCH WATER

TMWA's current use of water from the Fish Springs Ranch is discussed in Ch. 2. As Stead, Lemmon Valley, and Cold Springs continue to develop, Fish Springs Ranch water will be the primary supply for these areas. As of December 2019, TMWA has committed 227 AF of the 8,000 AFA of Fish Springs Ranch water to development. Currently, TMWA is permitted to use 8,000 AFA, but there is the potential to increase the water supply in the future by an additional 5,000 AFA. This would be subject to favorable water level and water quality monitoring and by securing all necessary permits. These additional water rights may be increasingly important, given that this water will be available to serve future development throughout the North Valleys and potentially to Spanish Springs.

As a condition of the existing water rights filed with the State Engineer, TMWA has a monitoring plan to track hydrogeological impacts on the southeast side of Honey Lake Valley. The annual monitoring report includes groundwater pumping, groundwater levels, groundwater chemistry, and surface water and spring flow measurements. To predict possible impacts of increased groundwater withdrawal, a groundwater flow model for Honey Lake Valley is maintained. This model will help TMWA analyze the possibility of future water quality concerns, such as the potential to draw in water high in total dissolved solids (TDS) from beneath the playa to the north. In addition to monitoring, multiple permitting approvals will be required prior to TMWA accessing the additional Fish Springs Ranch water.

TABLE 5-8: BENEFITS AND CHALLENGES OF ADDITIONAL FISH SPRINGS RANCH WATER

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Expands utilization of existing infrastructure • Increases drought supply and peaking capacity, especially for the North Valleys	• Requires environmental permitting to use additional 5,000 AFA • Need to prove ability to pump the additional 5,000 AFA from the basin without impacting water quantity and/or water quality
Cost	• Limited infrastructure will need to be constructed.	• Operating cost is relatively high.

CREEK WATER RESOURCES

Creeks throughout the South Truckee Meadows represent a valuable resource that TMWA can use to increase off-river reliability of its water supply. TMWA will be diverting Whites Creek water to the Mt. Rose WTP (to be completed in 2020) to decrease reliance on groundwater in that area. Mt. Rose WTP will be used to provide treated water for ASR and will also allow for passive recharge of the aquifer by allowing production wells to rest when Whites Creek water is available to serve customers.

Whites Creek water can also be used through a creek exchange permit. Creek exchange allows TMWA to measure the quantity of Whites Creek water left instream and exchange that water for Truckee River water. In addition to Whites Creek, TMWA holds water rights on Thomas and Galena Creeks. TMWA is currently investigating the feasibility of using additional creek resources through creek exchange permits.

WHITES CREEK

TABLE 5-9: BENEFITS AND CHALLENGES OF CREEK WATER RESOURCES

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Provides new off-river resources • State allows permits for creek exchange for Truckee River water • Decreases reliance on groundwater in regions with declining water levels	• Lacks infrastructure to use many creek resources currently • Creek flows likely to be affected by changing climate and hydrologic conditions • Not reliable during severe drought conditions
Cost	• Creek exchange is a low-cost option	• New water treatment plants or other infrastructure needed to use creek resources directly are expensive

MARLETTE LAKE WATER SYSTEM—WHOLESALE SERVICE

In late 2018, the Nevada Department of Administration approached TMWA to determine TMWA's interest in purchasing wholesale water supplies from the Marlette Lake Water System, which includes Marlette Lake, Hobart Reservoir, and the so-called "East Slope" facilities. The water system currently provides water from Hobart Reservoir and its East Slope Facilities to Carson City and Virginia City. The water system includes water rights totaling approximately 11,500 AF, only a portion of which are currently used by the state for water service deliveries. Since late 2018, TMWA staff has conducted due diligence and held several discussions with the Nevada Department of Administration and staff from the State Engineer and Federal Water Master's offices. Based on TMWA's due diligence, purchasing available wholesale water from Marlette Lake Water System under a long-term contract could prove beneficial for TMWA customers and the greater Reno, Sparks, and Washoe County community. For instance, possible uses of the water include return flow augmentation for the Truckee Meadows Water Reclamation Facility (TMWRF) and drought storage augmentation.

TMWA, the Department of Administration, Carson City, and Virginia City have initiated discussions to conduct analyses and investigate necessary authorizations for the long-term use of a portion of the water available from Marlette Lake Water System. The goal is to develop the following:

1) Provide agreeable terms and conditions for establishing a long-term operating agreement that maximizes the beneficial use of the state's available water resources from the Marlette Lake Water System among TMWA, Carson City, and Virginia City.
2) Provide an agreed-upon delivery schedule, special conditions of service, and pre–determined adjustments to the quantity of water available for sale each water year to address variable hydrologic conditions.
3) Provide predictable revenue sources to the state and reduce the per-acre-foot charge to each water user by fully allocating the available water resources.

TABLE 5-10: BENEFITS AND CHALLENGES OF THE MARLETTE LAKE WATER SYSTEM WHOLESALE SERVICE

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Provides new water resources • Marlette Lake water could be delivered through the Truckee River • Maximizes the beneficial use of the state's available water resources among TMWA, Carson City, and Virginia City	• Requires development of a complex, cooperative agreement among numerous parties • Flows may be impacted under changing climate and hydrologic conditions. • Not reliable during severe drought conditions • Involves water rights and permitting considerations
Cost	• Wholesale service to TMWA requires few infrastructure improvements.	• Unclear whether Marlette Lake Water System improvements required at this time

The water service agreement would also address future rate setting procedures, memorializing the Nevada Department of Wildlife's operating restrictions on Marlette Lake for the benefit of fisheries, water rights permitting requirements, and other general terms and conditions.

RECLAIMED WATER

Reclaimed water provides both local and regional benefits. Reclaimed water use provides a sound method of effluent management and beneficial use through irrigation and other uses. The main local benefit of reclaimed water is that it conserves potable water and provides a reliable, drought-resistant water source, even in times of restriction and conservation. Using reclaimed water provides a more predictable way to ensure compliance with discharge limitations when compared with river discharge but likewise competes with water needs for instream flows. Dedicated Truckee River water that does not return to TMWRF as wastewater, such as in the Stead and South Truckee Meadows areas, generally requires additional water rights to be dedicated to provide for that return flow depletion.

TMWRF currently supplies reclaimed water to numerous sites in Sparks, including Wildcreek Golf Course, Reed High School, Shadow Mountain Sports Complex, Golden Eagle Regional Park, and numerous other parks and streetscapes; and in Reno, this includes the University of Nevada, Reno (UNR) Farms property and Mira Loma Park. Reclaimed water is treated to very high standards that meet both the discharge limits to the Truckee River and the standards required for reclaimed water use.

The Reno-Stead Water Reclamation Facility (RSWRF) has an annual average flow of 1.85 MGD. During the winter and when reclaimed water flows are greater than the irrigation demand, excess reclaimed water is discharged into a natural drainage channel that flows to Swan Lake. This is the primary disposal site for RSWRF, which is permitted to discharge an average of 2.35 MGD (2,630 AFA), with 1.85 MGD being allocated to discharge to the lake after meeting reuse demand. Under present operation, the RSWRF reuses an average of 0.50 MGD, or about 27% of its total flow primarily for irrigation of the Sierra Sage Golf Course, the North Valleys Sports Complex, Mayors Park, and a truck fill station at the treatment plant. Starting in 2019, approximately 0.5 MGD was pumped (aka, "shaved") to TMWRF for treatment to reduce the discharge to Swan Lake due to high lake levels. In the future, when lake levels drop, this practice of flow shaving will likely transition to serve as capacity augmentation for RSWRF, until such time as treatment capacity at RSWRF is expanded and additional effluent management practices are implemented, making the flow shave unnecessary for normal operations.

TABLE 5-11: BENEFITS AND CHALLENGES OF RECLAIMED WATER

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Reliable under changing climate and hydrologic conditions • Allows reuse of water for uses when potable water is not needed (e.g., irrigation) • TMWA has been actively involved in partnerships to expand reclaimed water use in the region. • Offsets wastewater flows to the Truckee River • There is strong public acceptance of reclaimed water for non-potable uses	• TMWA does not have the ability to supply reclaimed water • Infrastructure to use reclaimed water is only in place in certain areas • Water right return flow requirements must be satisfied
Cost	• Reclaimed water rates are typically less than potable water rates	• Reclaimed water distribution systems are expensive

South Truckee Meadows Water Reclamation Facility (STMWRF) is one of the few water reclamation facilities in the United States that operates a zero-discharge system with 100% reuse. STMWRF reclaimed water meets or exceeds the State of Nevada's Category A designation, which permits unrestricted use of reclaimed water. Reclaimed water is used for irrigating parks, schools, golf courses, commercial landscapes, and thoroughfare median landscapes. Specific reuse areas include the South Meadows Industrial Park, Double Diamond and Damonte Ranch residential areas, the Arrow Creek and Wolf Run Golf Courses, the South Valley Regional Park, and Manogue High School, among others.

SIGN IDENTIFYING RECLAIMED WATER USE AT MIRA LOMA PARK

Although TMWA does not supply reclaimed water, TMWA recognizes the value of using this resource to meet non-potable demand and collaborates with partner agencies to implement regional strategies for its use. As described in Ch. 2, TMWRF will be providing 4,000 AFA to TRIGID, primarily for cooling systems for large companies in the industrial park. TMWA has been a key player in creating operational strategies for this large-scale reclaimed water project. There are future opportunities for TMWA and the region to innovatively use reclaimed water. TMWA strives to use all regional water resources as efficiently as possible. Therefore, TMWA will continue to collaborate with regional partners and pursue projects such as advanced purified water, water banking, and other reclaimed water opportunities, as described in the next several sections.

ADVANCED PURIFIED WATER (ONEWATER NEVADA)

In 2016, Nevada adopted new regulations to permit the use of "Category A+" reclaimed water, or advanced purified water, for groundwater augmentation. These new regulations have the potential to provide many benefits for the Truckee Meadows region. TMWA is a key partner in OneWater Nevada, a collaborative effort involving TMWA, University of Nevada Reno, Washoe County, City of Reno, City of Sparks, WRWC, NNWPC, and TMWRF. The goal of OneWater Nevada is to evaluate treatment technologies and determine if advanced purified water can offer long-range regional benefits and opportunities to the Truckee Meadows' water portfolio.[1] Although new to the Truckee

ONEWATER NEVADA ADVANCED PURIFIED WATER TREATMENT DEMONSTRATION PROJECT

[1] For more detail on advanced purified water treatment in the Truckee Meadows, visit https://onewaternevada.com/.

BENEFITS OF ADVANCED PURIFIED WATER

SAFE, RELIABLE WATER SUPPLY

Advanced purified water uses proven technology that cleans water to a level that meets or exceeds state and federal drinking water standards.

SUSTAINABLE WATER SUPPLY OPTION

Advanced purified water could diversify the region's water supply portfolio. It provides a sustainable water supply option that is less energy intensive than alternative options.

DROUGHT-PROOF WATER SUPPLY

Having a safe, sustainable water supply ensures water is available even during periods of drought.

INDEPENDENT OF WEATHER VARIABILITY

Advanced purified water may enhance the region's water supply resiliency to help address future climate change uncertainties, such as longer growing seasons, changes to snowpack, and changes in the timing of runoff.

Meadows, advanced purified water has been used to replenish underground aquifers and surface water reservoirs throughout the United States for over 40 years.

OneWater Nevada is assessing the feasibility of multiple field-scale advanced water treatment demonstration projects. The feasibility study will occur over two to three years and consists of technical, social, environmental, and financial analyses; regulatory compliance; public engagement; advanced treatment pilot testing; geotechnical investigations; and field-scale treatment demonstration projects. UNR is leading the treatment technology demonstrations with multiple demonstration trailers that will be equipped with advanced water purification treatment technology including filtration, ozonation with biologically activated carbon, ultraviolet light and advanced oxidation process, and granular activated carbon. These treatment trailers, most recently located at RSWRF and previously at the STMWRF, will be operated as a technology demonstration project for 9–12 months. Following treatment, about 14 gallons per minute (GPM) of purified water will be injected in and recovered from a controlled, test-site aquifer to confirm that the water quality meets all requirements.

Augmenting groundwater or surface water supplies with advanced purified water is generally referred to as indirect potable reuse. This is a process whereby highly purified water is stored in an environmental buffer such as a lake or

TABLE 5-12: BENEFITS AND CHALLENGES OF ADVANCED PURIFIED WATER

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Maintains local control of the water resource • Drought-proof and sustainable resource • Nevada has adopted regulations that allow use of Category A+ water for groundwater augmentation • Potential to offset development of other water resources that could benefit the environment • Public outreach efforts are underway	• Requires construction of advanced treatment facilities • Large-scale advanced purified water projects are a long-term goal • Requires extensive public outreach and education • Public acceptance for using advanced purified water for potable uses is uncertain
Cost	• Potential to generate revenue from sale of will-serve commitments	• New advanced treatment facilities and other infrastructure required will be expensive

aquifer before eventually reentering the drinking water supply. Conceptually, an indirect potable reuse project might be well suited for areas such as the North Valleys or the South Truckee Meadows, because the water reclamation facilities for these areas do not return the treated water to the Truckee River. Purified water could be recharged using infiltration basins or injection wells in areas generally isolated from domestic wells and blended with ambient groundwater. Months or years later, the stored water would be recovered using TMWA's municipal wells, providing "banked water" for future use. TMWA is exploring potential areas where the hydrogeology may be favorable to create a water bank which, as described in the following sections.

WATER BANKING PROJECTS

BEDELL FLAT

As part of TMWA's overall conjunctive use management strategy, TMWA is working with the City of Reno, Washoe County, and the US Geological Survey (USGS) to evaluate the feasibility of an integrated ASR program in Bedell Flat. Bedell Flat is located about 13 miles north of Stead and was identified in a previous analysis performed by the City of Reno in 2007 as having potentially favorable geologic conditions for the storage of advanced purified water. See Figure 5-1 for the regional project location.

Bedell Flat is a relatively small (53 square miles), undeveloped hydrographic basin composed of federal lands administered by the Bureau of Land Management. Depths to water in the aquifer range from less than five feet in the northwest, where surface drainage exits the basin, to at least 180 feet near the middle of the basin.

Several ASR options have been under consideration within Bedell Flat. TMWA and its partners have completed hydrogeological investigations and environmental clearance and permitting work to gain an understanding of the feasibility, scope, and cost of a water banking program in Bedell Flat. Based on initial findings, the geology of the basin does not appear favorable for water banking. However, TMWA is continuing to investigate the feasibility of water banking projects in other basins.

AMERICAN FLAT

Similar to the Bedell Flat project, TMWA is actively working on an ASR feasibility study at the north end of West Lemmon Valley (basin 92A). See Figure 5-1 for regional project location. The purpose of the study is to

AMERICAN FLAT DRILLING

TABLE 5-13: BENEFITS AND CHALLENGES OF WATER BANKING PROJECTS

OBJECTIVE	BENEFITS	CHALLENGES
Implementation	• Feasibility studies at multiple sites are currently ongoing • Ability to store water underground for future use • Diversifies the water supply and reduces reliance on Truckee River resources • Potential to provide drought backup	• Water banking projects are a long-term goal, in conjunction with groundwater augmentation and using advanced purified water • Substantial feasibility testing and permitting
Cost	• Potential to generate revenue from the sale of future will-serve commitments	• High cost due to advanced treatment and proximity to existing infrastructure

characterize aquifer storage potential through localized field testing, data acquisition, and groundwater modeling. Three wells were installed at the American Flat Road site. Related activities included geophysical surveying, well siting and drilling, small-scale pump/injection testing, and groundwater flow and transport modeling.

A 124-day injection test using potable water was performed to determine the ability of the aquifer to store water over long periods. Preliminary results of the study indicate the site may be favorable for storage, transmission, and recovery of water. Flow modeling results indicate that up to 2 MGD could be recharged for 25 to 50 years, but only if a nearly equivalent amount of water is pumped to ensure that undesirable shallow groundwater conditions do not develop.

TMWA will continue to collect information to determine if a full-scale ASR program can be implemented and sustained at the site. Should the site be deemed suitable for full-scale ASR program implementation, it will enhance TMWA's ability to safely store, recover, and distribute an additional water resource that could be utilized in the region.

OTHER CONCEPTUAL RESOURCES

The following descriptions are of privately prepared water supply projects that are conceptual in nature and are promoted by project proponents as possible regional water resources. These projects have not been vetted for feasibility by TMWA, permitted, or constructed. Identification of a conceptual project shall not be construed as an indication of TMWA support or opposition of any project nor an indication of project viability. The list is not exhaustive and is intended to merely identify some potential projects for informational purposes. TMWA will continue to monitor project progress. See Figure 5-1 for project locations.

IWS BASIN, LLC (FORMERLY INTERMOUNTAIN WATER SUPPLY, LTD.), DRY VALLEY, BEDELL FLAT, NEWCOMB LAKE VALLEY

This project seeks to import approximately 3,500 AFA of groundwater to Lemmon Valley from three relatively undeveloped hydrographic basins approximately 20–30 miles north of Reno. In 2018, the State Engineer canceled IWS's water right permits because it failed to show reasonable diligence in placing the water to beneficial use. As of this writing, the status of IWS Basin's water right permits is uncertain and subject to legal proceedings. IWS Basin has other pending applications to appropriate water in these basins; however, they are protested by other parties and have not been acted on by the State Engineer.

LOWER SMOKE CREEK

The Lower Smoke Creek project is located just north of Pyramid Lake in the Smoke Creek Desert groundwater basin. Much of the water in the basin is held by the Jaksick family through various entities, including Bright-Holland Co. and Jackrabbit Properties LLC. Jackrabbit and Bright Holland executed a water development agreement with LSC Development, which intends to develop a

FIGURE 5-1: LOCATIONS OF POTENTIAL FUTURE WATER RESOURCES FOR THE TRUCKEE MEADOWS

water importation project. The first phase of the water importation project is intended to capture the water in the southern portion of the basin and pipe the water to Winnemucca Ranch and other planned developments consistent with the relevant water resource plans. The second phase would extend the pipeline to transport water from the northern portion of the basin. The Smoke Creek Desert basin has a perennial yield, substantiated by the USGS, of 16,000 AFA and is currently being adjudicated. With existing monitoring information, including USGS gages in place since 1986, the abovementioned water rights will support approximately 10,500 to 14,000 AFA of municipal water, subject to State Engineer approvals and additional hydrogeological monitoring.

RED ROCK

The Red Rock Valley Importation Project holds 1,273 AFA of water rights in the Red Rock Valley groundwater basin for use in West and East Lemmon Valley. Through 2008 Red Rock's project sponsors progressed with design and planning, which led to filing an application for a Special Use Permit with Washoe County in December 2008. The Board of Adjustment denied the application at its March 4, 2009 meeting, and the Board of County Commissioners also denied an appeal in May 2009. The denial was ultimately upheld by the Nevada Supreme Court in 2011.

SIERRA VALLEY

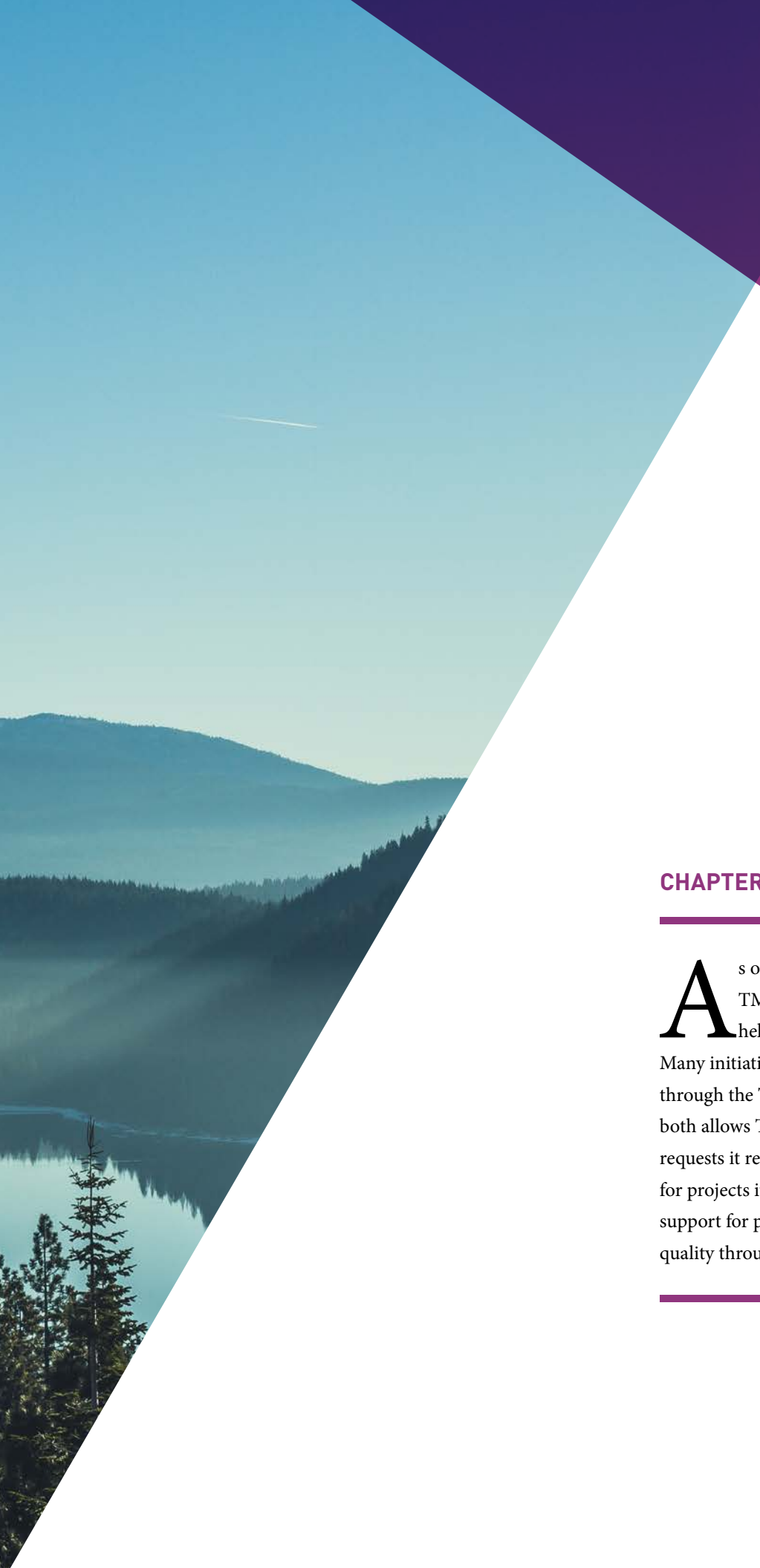
Since the late 1800s, a diversion ditch has carried up to 60 cubic feet per second of water for agricultural use from the Little Truckee River above Stampede Reservoir out of the Truckee Basin to Sierra Valley, California, in the Feather River Basin. The Little Truckee River diversions are inversely proportional to the Sierra Valley natural runoff, meaning that the lower the available flows in the native Sierra Valley streams, the higher the diversions from the Little Truckee River. Thus, these rights have a higher drought yield than a normal year yield, but the ability to store these rights would be required.

SUMMARY

While the region has adequate water resources to meet future demand, TMWA is constantly analyzing options to further expand its water supply portfolio. TMWA is committed to researching innovative ways to increase water resource resiliency, especially to increase its drought-resistant and off-river resources. There are opportunities for TMWA to expand its groundwater resources and retrofit its existing infrastructure to increase its ability to pump groundwater when needed. Additionally, TMWA is furthering its utilization of creek water resources, especially in the South Truckee Meadows. TMWA is collaborating with many regional partners through OneWater Nevada to explore innovative ways to use advanced purified water and the possibility of creating water banks for additional drought storage. TMWA has an extensive water resource portfolio that has been further bolstered by the implementation of TROA; however, TMWA will continue to identify and develop safe and sustainable local water supplies to ensure that a reliable, high-quality product is delivered to customers into the future.

6 PROTECTING THE WATERSHED AND THE ENVIRONMENT

Donner Lake



CHAPTER OVERVIEW

As one of the users of the Truckee River, TMWA understands its intrinsic duty to help steward the protection of the watershed. Many initiatives outlined in this chapter are supported through the Truckee River Fund, a vehicle that both allows TMWA to manage the numerous grant requests it receives and also leverage matching funds for projects it supports. TMWA provides funding and support for projects that protect and restore water quality throughout the Truckee River watershed.

CHAPTER AT-A-GLANCE

Highlights of Chapter 6 include:

1. Truckee River Fund project spotlights
2. TMWA's collaborative efforts to help restore upstream forest health
3. Integrated source water protection with state, county, and municipalities
4. Assisting the recovery of the Lahontan cutthroat trout
5. Long-term energy sustainability through hydroelectric power

TMWA recognizes the importance of protecting the region's unique natural resources by using sustainable business practices to minimize environmental impact. By working cooperatively with community organizations throughout the Truckee River watershed, TMWA has improved the protection of the region's drinking water supply. TMWA participates in and supports many efforts to improve water quality, forest health, and riparian habitats in the watershed. Additionally, TMWA uses renewable energy, including hydropower and solar, to offset most of its power costs and reduce CO_2 emissions.

WATERSHED RESTORATION AND PROTECTION INITIATIVES

TRUCKEE RIVER FUND

The Truckee River and its tributaries provide key wildlife habitats and important recreational opportunities, while being an essential water source for the community. Because TMWA relies on the Truckee River for most of its water supply, it established the Truckee River Fund (TRF) in 2004 to facilitate source water protection. TRF utilizes

TRF HELPS FUND FOREST THINNING PROJECTS TO IMPROVE FOREST HEALTH AND DECREASE WILDFIRE RISK.

TRF PROJECT SPOTLIGHT: WATERSHED AQUATIC INVASIVE SPECIES PROGRAM

In 2009, the Tahoe Resource Conservation District (TRCD) initiated the pilot Watercraft Inspection program for the Truckee River watershed. Working with partner agencies, the purpose was to begin monitoring and conducting watercraft inspections to prevent and control aquatic invasive species (AIS). This included an education and outreach program and was designed to protect the recreational, economic, and ecological resources of the region.

Over the next few years, the AIS program continued to benefit from funding from the TRF. It was implemented at Lake Tahoe; Donner, Weber, and Independence Lakes; and Stampede, Boca, and Prosser Reservoirs. Since 2013, TRCD was able to fully support the AIS program with funding from other partner agencies such as the US Fish and Wildlife Services.

After extensive public education and outreach, the TRCD established enforceable, mandatory watercraft inspection programs across local jurisdictions (Town of Truckee and Nevada, Sierra, and Placer Counties). Since 2008 no new species have entered Lake Tahoe.

an Advisory Committee of nine appointed members that equally represent Washoe County, the City of Reno, and the City of Sparks.

TRF is used to support projects that protect and enhance water quality or resources of the Truckee River or its watershed, which also benefits TMWA's customers and the community. The projects funded by the TRF normally involve areas of the watershed that are multi–jurisdictional in nature, which makes a watershed improvement project difficult, if not impossible, to implement solely through one entity or agency. In addition, TRF provides TMWA a vehicle for responding to funding requests from outside groups and organizations involved in promoting and improving the health of the Truckee River system and watershed. The TRF has been highly successful in leveraging matching funds for the projects it supports. This allows TMWA to help local organizations and agencies complete projects at a lower cost and support projects outside of its jurisdictional boundaries, without additional impacts on customer rates.

TRF PROJECT SPOTLIGHT

TRUCKEE RIVER WATERSHED COUNCIL
DONNER CREEK RESTORATION

In 2018, TRF provided $125,000 in funding for the design and construction of two restoration projects along Donner Creek. These projects will reduce erosion, decrease sedimentation, and improve water quality. Improved water quality from restoration work can lead to decreased water treatment costs for municipal supply downstream in addition to providing benefits for instream habitat and flood attenuation. Truckee River Watershed Council leveraged $900,000 in construction funding from Caltrans in 2019 to implement this work.

NEVADA LAND CONSERVANCY
CAUGHLIN FIRE EMERGENCY WATERSHED STABILIZATION & RESTORATION EFFORT

In 2011, TRF granted this project approximately $220,000 to stabilize and restore public and private lands severely damaged by the Caughlin Fire. Work included installation of debris basins, channel clearing and debris removal, reseeding, hydro seeding, straw waddles, check dams, willow waddles, and the installation of other appropriate Best Management Practices (BMPs) to reduce erosion potential and sediment loading to drainage courses and tributary creeks terminating at the Truckee River.

TRUCKEE DONNER LAND TRUST
WEBBER LAKE, LITTLE TRUCKEE RIVER HEADWATERS MANAGEMENT

In 2016, TRF granted $18,750 to launch a multi–year program on the trust's Webber Lake property, which is located at the headwaters of the Little Truckee River. The objective was to address areas of tree disease and overstock and assist with the prevention of catastrophic wildfires. Both will aid in source water protection and reduction in the amount of sediment entering waterways due to erosion, which affects water quality.

SIERRA NEVADA JOURNEYS
WATERSHED EDUCATION INITIATIVE

This program has been funded since 2011. The Watershed Education Initiative program has proven results in empowering youth to protect and enhance the quality of the Truckee River. Over time, there have been significant increases in parent engagement and student volunteerism. This initiative bolsters improved protection of the community's primary water source.

TRUCKEE MEADOWS PARKS FOUNDATION
TRUCKEE MEADOWS NATURE STUDY AREA PROJECT

In 2018, TRF granted this project $38,400 to repurpose the former Rosewood Lakes Golf Course into the Truckee Meadows Nature Study Area, a wetland habitat that will serve as an outdoor learning laboratory and public recreational park.

CITY OF RENO
VIRGINIA LAKE WATER QUALITY IMPROVEMENTS

In 2015, TRF provided $100,000 in funding to construct a new primary outlet structure for Virginia Lake. The project improved circulation and water quality by relocating the primary outlet structure near the lake's north end.

To date, TRF has approved and funded over 174 diverse projects that further the fund's goals. Since its inception, TRF has approved distribution of nearly $14.1 million to qualifying projects. Partner organizations provided additional funding of over $22.3 million in cash and in-kind services. Examples include riparian cleanup, river restoration, forest management, watershed education, aquatic invasive species inspections and removal efforts, and many other activities. Projects completed or underway are listed at www.truckeeriverfund.org.

PREVENTING LARGE WILDFIRES IN THE HEADWATERS

Large wildfires in the heavily forested headwaters of the Truckee River watershed can potentially have major impacts on downstream communities. Although fire can be good for forest health, unnaturally large fires can result in high levels of sediment, ash, and debris in waterways. Among many devastating impacts to the community, headwater wildfires can increase the cost of water treatment and degrade source water quality.

The Nature Conservancy—Nevada Chapter (TNC) conducted a study in 2016 to define areas susceptible to high-intensity wildfires in the headwaters of the Truckee River watershed. In collaboration with TMWA and the US Forest Service (USFS), this modeling effort identified areas at increased risk of high-intensity wildfires in forested headwaters. In addition, the study analyzed how fires might impact the community and identified strategies to reduce large wildfires in the watershed. Research shows that restoring forest health can be economically efficient because fire impact costs are often greater than proactive forest treatment costs. Based on findings from the headwater forest study, TNC plans to assist the USFS with leveraging funding and support to increase the pace and efficacy of forest restoration projects in the Truckee River watershed.

ONE TRUCKEE RIVER MANAGEMENT PLAN

TMWA has been an active participant in the implementation of the One Truckee River Management Plan (OTR Plan) since its inception. Phase 1 of the OTR Plan was completed in 2017 by a wide range of public and private partners in the Truckee Meadows. The overarching goal of the effort is to manage, protect, and provide stewardship of the Truckee River across all jurisdictional boundaries. Areas of focus include water quality, connectivity to community resources, health and wellness opportunities, habitat protection and restoration, stewardship, and long-term funding strategies. Recognizing the efforts to improve conditions

INDEPENDENCE LAKE & LAHONTAN CUTTHROAT TROUT

TMWA works with The Nature Conservancy (TNC) to promote the health of the federally threatened Lahontan cutthroat trout (LCT) population at the Independence Lake Preserve. Independence Lake hosts one of only two wild, self-sustaining lake populations of LCT in the world. TNC has been working toward recovering the LCT population by removing non-native brook trout, brown trout, and kokanee salmon from Independence Lake and Upper Independence Creek. When operationally feasible, TMWA draws down the lake level at appropriate times to dry out established kokanee salmon redds (spawning nests) in the nearshore areas of the lake in the late fall and early winter. By decreasing the non-native kokanee population, TNC expects that the native LCT population will be able to increase over time.

Photo: Mike Conner/The Nature Conservancy

on the Truckee River, TRF funding of OTR continues with specific focus on protecting the community's drinking water supply. TMWA participates in the stewardship of the river and continues to be involved in the implementation of the four primary goals and over 140 strategies and action items identified in the plan. More information can be found at http://onetruckeeriver.org/.

TRUCKEE MEADOWS INTEGRATED SOURCE WATER PROTECTION PLAN

The Nevada Division of Environmental Protection (NDEP) initiated the development of an Integrated Source Water Protection Plan (ISWPP) for the Truckee Meadows in 2016. The final plan, titled the 2020 Integrated Source Water and 319(h) Watershed Protection Plan for Public Water Systems and the Truckee River in the Truckee Meadows, will be finalized and brought to relevant boards for approval in 2020. Prior to the creation of the ISWPP, TMWA updated its Wellhead Protection Plan (WHPP) in 2016 for the coordinated protection of public drinking water resources. TMWA's existing WHPP was a key component in the development of the ISWPP. The ISWPP expounds upon the existing WHPP and takes a collaborative approach with other local agencies, including those in Reno, Sparks, and Washoe County to ensure the protection of groundwater and surface water supplies from future contaminants.

The ISWPP identifies Source Water Protection Areas (SWPAs) for drinking water sources. An interdisciplinary team of scientists and stakeholders identified SWPAs and the susceptibility of those areas to contamination or pollution. SWPAs take into consideration buffer areas around drinking water supplies and the modeling of groundwater systems to determine areas at the most risk for contamination. The final plan describe implementation strategies to help protect the Truckee Meadows' drinking water sources into the future. A key outcome of the planning process was is increased communication between TMWA and regional jurisdictions regarding potential contaminant sources in SWPAs. When identified activities that could impact drinking water supplies are occurring in the SWPAs, TMWA and/or other public water systems will be notified and will work with property owners to help mitigate potential risks to groundwater and surface water quality. The plan includes a map viewer with the SWPAs, watershed descriptions, and water quality improvement projects. To view, visit https://gis.rtcwashoe.com/portal/apps/webappviewer/index.html?id=59c200e46b5f48d18ba8169f95445c62.

VERDI HYDROELECTRIC PLANT

SUSTAINABILITY

Power is one of TMWA's largest expenses. TMWA can offset more than 90% of the power it uses to provide drinking water to its customers on an annual basis through hydroelectric generation. TMWA owns and operates three run-of-the-river hydroelectric power plants: Fleish, Verdi, and Washoe. These hydroelectric plants were constructed in the early 1900s and continue to play an important role in TMWA's operations. Run-of-the-river hydroelectric plants rely on gravity to move diverted river water through canals to the power generation facilities. After the water passes through the generators, the water is returned to the river. TMWA's hydroelectric plants produce an average of 6.7 megawatts of power, which is enough to power approximately 3,500 households. The hydroelectric plants provide a source of clean, renewable energy, generating on average 40 million kWh per year. Every day TMWA runs its three hydroelectric plants at capacity, over 90,500 pounds of CO_2 emissions are effectively eliminated from our atmosphere, equating to to roughly 15,000 metric tons a year.

Due to improvements to the Highland Canal raw water delivery system, the installation of a 30-kWh solar power generation project, and multiple improvements in efficiency at TMWA's treatment plants, TMWA anticipates continuing to increase efficiency and optimize its renewable energy generation. In addition, TMWA is currently investigating the feasibility of partnering with a solar project in Honey Lake Valley that could be used to help power the Fish Springs Ranch wells and pump station.

SUMMARY

TMWA uses a range of approaches to support restoration and protection efforts in the Truckee River watershed to maintain the excellent quality of the region's drinking water supply. The TRF effectively leverages funding from diverse partners throughout the watershed and allows TMWA to support projects it could not complete otherwise due to jurisdictional limitations, such as land ownership. TMWA will continue to support projects through TRF and will be involved in collaborative watershed management efforts, such as One Truckee River and the Integrated Source Water Protection Program. Additionally, TMWA values its role in being a good environmental steward for the community and will continue to improve efficiency and utilize renewable energy when feasible to minimize impacts on the environment.

7

RECOMMENDED ACTIONS

Truckee River

CHAPTER OVERVIEW

Each WRP details recommendations for the Board of Directors to consider. Some become new policies when warranted. Completed recommendations and policy adoptions from the 2016–2035 WRP are highlighted in this chapter. Many ongoing recommended actions from that plan have been carried over, with new recommendations added to this 2020–2040 update. Actions noted here may need to be amended if new challenges or information should arise.

CHAPTER AT-A-GLANCE

Highlights of Chapter 7 include:

1. Completed recommendations from the 2016–2035 WRP
2. Conversion of Meter Retrofit Fee to Water Resource Sustainability fee
3. Adoption of a Rate Stabilization Fund
4. Water resource management recommendations for TMWA Board consideration

The 2040 WRP is a planning document that outlines TMWA's water resource management strategy options through 2040. The preceding chapters have explained TMWA's current water management strategies, future impacts from climate conditions and growth, conservation practices, and possible future water resources. Based on the information and findings presented throughout the plan, this chapter includes recommended actions and policies for the TMWA Board to consider and act upon.

COMPLETED RECOMMENDED ACTIONS AND POLICIES

TMWA's *2016–2035 WRP Volume I: Abstract* included "Findings & Recommended Actions" based on the findings from that plan. This section includes an overview of those recommended actions that have been completed. Also included are two important policies that have been approved by the Board and implemented since the adoption of the previous WRP.

COMPLETED RECOMMENDED ACTIONS FROM THE 2016–2035 WRP

Consolidation of TMWA and Washoe County Department of Water Resources (WDWR) Water Operations

In response to the Western Regional Water Commission (WRWC) legislative directive to evaluate the potential consolidation of water purveyors in the Truckee Meadows, WDWR and South Truckee Meadows General Improvement District (STMGID) were effectively merged into TMWA on December 31, 2014.

Truckee River Operating Agreement Implementation

The five mandatory signatory parties—TMWA, Pyramid Lake Paiute Tribe (PLPT), the United States, California, and Nevada—implemented the Truckee River Operating Agreement (TROA) on December 1, 2015.

Donner Lake Acquisition

In March 2016, TMWA purchased the Truckee Carson Irrigation District's (TCID) share (4,750 acre-feet (AF)) of Donner Lake water rights, thereby acquiring all 9,500 AF of Donner Lake water rights.

NEW POLICIES ADOPTED SINCE THE 2016–2035 WRP

Rate Stabilization Fund

In September 2018, TMWA's Board adopted a Rate Stabilization Fund (RSF) with an intended outcome of decreasing, avoiding, or deferring rate increases to customers. The designated maximum amount of funding for the RSF is 3% of annual water sales forecast for the subsequent three years. To be used at the discretion of the board, the fund may be applied toward operating costs, capital improvements, and other necessary expenses related to serving the current customer base as needed (e.g., for years where there is a shortfall in water sales revenue due to drought, weather variations).

Water Resource Sustainability Fee

In January 2018, TMWA's Board adopted a rule change to allow the Meter Retrofit Fee to be changed to the Water Resource Sustainability Fee. The meter retrofit fee was charged to new development projects and was required by TMWA Rule 7(H)(3) to finance and install water meters. With nearly all services metered, this decision broadens the use of the fee to support projects such as expanded conjunctive use, aquifer storage and recovery (ASR), demonstration and validation of advanced purified water uses, future water resource research and acquisition, and other projects that enhance water resource sustainability and drought resiliency.

2020–2040 WRP RECOMMENDED ACTIONS

Many ongoing recommended actions have been carried over into this plan from the 2016–2035 WRP, and several new actions and policies have been included. It is important to note that while many of these actions have been carried over from the previous plan, the numbering for the recommendations has changed due to plan format changes for the 2040 WRP. Recommendations in this plan also take into consideration Regional Water Planning Policies and Criteria from the WRWC's Comprehensive Regional Water Management Plan to further guide the utility's proposed actions.
http://www.nnwpc.us/2016waterplan.html

OBJECTIVE 1. WATER RESOURCE PLANNING

RECOMMENDATION 1.1. TMWA's Water Resource Planning

Background: TMWA's WRP is a planning and management document that spans a 20-year period and is updated every five years. The WRP is a key component of TMWA's integrated planning approach in conjunction with its Water Facility Plan and Capital Improvement Plan. The 2040 WRP is the fourth version of the plan since TMWA's inception in 2001.

Recommendation: Continue monitoring, reviewing, and revising its water resource management strategies at least every five years through TMWA's planning efforts in response to current and future conditions including but not limited to changing conditions in hydrology, climate patterns, economic development, regulatory constraints, and customer demand.

RECOMMENDATION 1.2. Geographic Scope of TMWA's Planning Area

Background: The Truckee Meadows has been steadily growing since recovering from the recession. Historically, TMWA's planning for the delivery of water has been focused on areas adjacent to its retail service area. As the region continues to grow, TMWA's service area will likely expand, including through the acquisition of smaller water systems in the region. Moving forward, TMWA will continue to expand its service area as needed and in conformance with regional planning efforts.

Recommendation: Continue to analyze the geographic extent of TMWA's water resource planning area subject to the guidelines of TMWA's Joint Powers Authority.

"The recommended actions outlined in this chapter will help guide TMWA to effectively manage its water resources."

RECOMMENDATION 1.3. Small Water System Acquisitions

Background: There are many private or cooperatively-owned small water systems throughout the region. Although TMWA has acquired small water systems, such as the West Reno Water Company in Verdi in 2019, these water systems often present a range of financial and technical challenges. Other small water systems

SUSPENSION BRIDGE OVER THE FLEISH DAM ON THE TRUCKEE RIVER

have inquired about possible acquisition in recent years; however, TMWA typically requires systems to be improved to TMWA standards prior to acquisition, as demonstrated by the Verdi Business Park acquisition in December 2014.

Recommendation: Encourage local jurisdictions to analyze all conforming regional master plans to determine what growth pressures may be placed on existing small water systems and identify which water utilities could be integrated into TMWA in the future, especially in growth-prone areas. When small water systems approach TMWA, TMWA should perform its due diligence to assess the resource benefits, financial impacts, and technical challenges of each system prior to considering acquisition. When applicable, other options besides acquisition may be more appropriate to assist small water systems by other means (e.g., providing a wholesale meter to a small system).

OBJECTIVE 2. MANAGEMENT OF CURRENT WATER RESOURCES

RECOMMENDATION 2.1. Conjunctive Use of Water Resources

Background: TMWA uses a combination of surface water and groundwater resources to meet customer demand. Following the merger with WDWR and STMGID, TMWA now provides access to Truckee River water resources to much of its service area, excluding its satellite systems which are supplied solely by groundwater. Access to these resources has allowed TMWA to conjunctively manage its resources for most of its customers. Under TROA, TMWA can store additional drought reserves to provide adequate supply for existing and new customers through future droughts. Based on the results from this WRP, TMWA has sufficient drought reserves to meet demand through 2040 in all scenarios tested. Therefore, TMWA does not need to alter its existing planning criteria or water management strategies at this time and will continue to conjunctively use its resources.

Recommendation: Continue to rely on TMWA's pool of resources to meet current demand, acquire additional water rights to meet future demand, and recognize that TROA provides additional drought-year reserves. Continue to monitor TMWA's ability to meet current

and future demand by modeling the 1987–1994 drought period and include factors such as increased future demand, conservation improvement, hydrologic cycles, climate change, and additional water resources. Analyze management strategies under TROA to ensure that the community is receiving the maximum benefits from the agreement. Update the Board when future conditions evolve that require changes to the planning criteria or supply operation.

RECOMMENDATION 2.2. Groundwater Management

Background: TMWA's 89 production wells, spanning nine hydrographic basins, are an essential component of TMWA's water supply, particularly in the summer months when additional water resources are needed to meet peak demand. The wells are also critical in drought years when Truckee River flows are depleted. Groundwater level declines have historically occurred due to increased pumping in the southwest Truckee Meadows, west Pleasant Valley, and east Lemmon Valley, whereas water levels have remained stable in most other hydrographic basins. TMWA monitors water levels quarterly in all hydrographic basins where TMWA has production wells to track trends in aquifer health. Efficient management of TMWA's wells is important to ensuring continued groundwater level recovery and stabilization throughout the region.

Recommendation: Continue to: (1) use TMWA's wells to meet demand while maintaining the sustainability of the aquifers and (2) maintain or improve water levels through passive and active groundwater recharge.

RECOMMENDATION 2.3. Aquifer Storage & Recovery

Background: TMWA's ASR program started in 1993 and is important to maintaining water levels in aquifers where TMWA has production wells. ASR augments the existing water supply to proactively improve water levels and increase drought storage. The ASR program is currently robust, but TMWA is constantly looking to expand the program, especially in areas where water levels have been declining due to historic over pumping. Once the Mt. Rose Water Treatment Plant (WTP) is operational, TMWA will be able to divert and treat Whites Creek water for ASR in the winter months on the Mt. Rose Fan, which will help increase groundwater levels in that area of the Pleasant Valley hydrographic basin.

Recommendation: Continue to expand passive and active groundwater recharge to: (1) augment groundwater supplies that provide additional drought and peak-demand capacity; (2) reduce water quality concerns in specific areas; and (3) maintain and improve groundwater levels. Increase ASR with the ultimate goal of recharging 9,000 AFA. Increasing the breadth and scope of all three of these activities throughout the service area will help maintain sustainable groundwater levels and lessen the impact from septic, industrial, and naturally occurring contaminants.

RECOMMENDATION 2.4. Water Rights Availability

Background: As a result of the merger in 2014 of the WDWR and STMGID water systems formerly operated by Washoe County, TMWA has integrated most of the region into its distribution system, which allows the area to more effectively utilize Truckee River resources. A review of available Truckee River water rights shows a sufficient number of water rights exist to meet TMWA's average water service demand through the 2040 planning horizon and beyond. However, TMWA needs to continue to acquire Truckee River water rights to be able to issue will-serves for new development. Demand for Truckee River water rights has increased in response to a competitive development market, difficulties in finding willing sellers of large blocks of water rights, and competition for water rights from environmental and lower river uses. TMWA has been working proactively to acquire water rights to meet future demand.

Recommendation: Continue to accept the dedication of Truckee River water rights in the growth-prone Truckee Meadows, Spanish Springs, and west Pleasant Valley. Recognize Fish Springs Ranch is available to meet future demand in the North Valleys.

Continue to acquire water rights to meet future water

demand and maintain an inventory of water rights for future growth, pursuant to Rule 7.

TMWA should continue to pursue strategic water rights purchases where TMWA is uniquely positioned to obtain the maximum benefit through its pooling of resources, upstream storage, and TROA.

RECOMMENDATION 2.5. Water Conservation

Background: TMWA's conservation initiatives include measures to enhance efficient use of water and reduce or eliminate water waste. Specific programs include leak detection and repair, landscape design guidance, assigned-day watering, and water audits. TMWA works with WRWC in developing conservation plans for the region and cooperates with WRWC in implementing its conservation programs. While this WRP contains an overview of TMWA's conservation strategies, a more in-depth Drought Contingency Plan will be updated pursuant to Nevada Revised Statute (NRS) 540.131 and will be a separate document that is not included in the WRP.

Recommendation: Continue to implement, and revise as needed, TMWA's Drought Contingency Plan to promote smart and efficient use of the community's water resources in compliance with all federal and state regulations.

RECOMMENDATION 2.6. Source Water Contamination

Background: Generally, TMWA has excellent source water quality given that most of its water supply comes from the Truckee River which flows from Lake Tahoe. However, there are concerns about contaminants reaching the Truckee River, and its tributaries from anthropogenic sources, such as overflows from industrial areas or chemical spills from the railroad or highway. Additionally, some of TMWA's groundwater wells have been contaminated by human activity, including historic tetrachloroethylene (PCE) contamination from dry cleaning businesses, nitrate contamination from high-density septic systems, and leaching from fertilizer. TMWA works closely with the Central Truckee Meadows Remediation District (CTMRD) to identify PCE-contaminated groundwater and remove PCE contamination at the affected wells.

Recommendation: Continue to work with the Nevada Department of Environmental Protection (NDEP) to implement the Integrated Source Water Protection Plan for Washoe County to preserve and enhance available water supplies and address known and potential threats to water quality. Continue to work with the CTMRD to address PCE contamination. Work to find solutions in other areas with water quality issues, such as nitrate contamination in Spanish Springs Valley.

RECOMMENDATION 2.7. Emergency Water Supply Standard

Background: There are events outside of TMWA's control that could lead to an emergency condition in which the water supply could be affected over multiple days, such as a chemical spill into the Truckee River, an earthquake, or a wildfire. Research conducted in 1996 and 2007 by the University of Nevada (UNR) on behalf of TMWA has shown no recorded river contamination events from rail or highway transportation. TMWA has completed analyses of the impacts of theoretical spill events on the Truckee River, but the likelihood of these events is extremely rare and there have been no historically recorded toxic spills that have rendered the Truckee River unusable. TMWA has dealt with supply outages due to earthquakes, such as the 2008 earthquake that damaged TMWA's Highland Canal, which conveys water from the Truckee River to its Chalk Bluff WTP. TMWA has sufficient well capacity and distribution system storage to meet non irrigation customer demand during a water quality emergency and has an extensive emergency action plan in place in the event of an extended river outage.

Recommendation: Maintain, as a minimum, the ability to meet daily indoor water use with TMWA wells. For river outages lasting up to seven days during the summer, maintain the ability to meet average daily indoor water demand using wells, treated water storage, and enhanced conservation measures.

HYDROELECTRIC FLUME ALONG THE TRUCKEE RIVER

OBJECTIVE 3. FUTURE WATER DEMAND & RESOURCES

RECOMMENDATION 3.1. Water Demand Forecast

Background: TMWA's 2018 population forecast estimates total Washoe County population will increase by 74,000 from approximately 471,500 in 2020 to 545,500 by 2040. The population estimates may change over time as the pace of development within the region varies and as the region moves toward greater density of land use. TMWA's forecast results are statistically similar to the State Demographer's near-term projections.

Water demand per service within TMWA's service area has been decreasing over time, resulting in slower total demand growth in TMWA's extended forecast. Based on the review of current growth and economic trends in the region, future water demand is anticipated to grow in the Truckee Meadows, but at a slower pace than historically seen. Projected water demand is expected to increase by 13,000 AF from approximately 83,000 AF in 2020 to 96,000 AF in 2040.

Recommendation: Continue to complete future population forecasts, in coordination with other regional planning entities. Accept for planning purposes that TMWA's water demand projections based on these population forecasts are reasonable estimates for use in TMWA's planning areas.

RECOMMENDATION 3.2. Future Climate Change Impacts

Background: TMWA recognizes the importance of addressing the potential impacts of a changing climate, like increased temperatures and more variability in precipitation patterns. Since the adoption of the last WRP, TMWA has been involved in studies with research partners, including UNR, Desert Research Institute (DRI) and Precision Water Resources Engineering (PWRE), to assess the impact of climate change on regional hydrology and water supply. As climate change effects become more pronounced, TMWA will need to adapt to new conditions that may be different from historical hydrologic and demand patterns. Because climate change science is

constantly evolving, TMWA recognizes the importance of being involved in ongoing research in the field.

Recommendation: Continue to consider new findings from climate change research for the greater Truckee Meadows region and continue working with UNR, DRI, and other researchers to assess potential climate change effects on TMWA's sources of supply and regional hydrology. Adaptively manage resources by working with partners to rewrite the existing flood control requirements for the federal storage reservoirs in the Truckee River Basin.

RECOMMENDATION 3.3. Coordination with OneWater Nevada

Background: TMWA supports ongoing regional effluent management efforts with a diverse group of partners including Reno, Sparks, Washoe County, Truckee Meadows Water Reclamation Facility, UNR, and others. This collaborative effort is known as the OneWater Nevada initiative. The initial effort is to evaluate whether advanced purified water offers significant water resource management benefits for the Truckee Meadows region, including improving water use efficiency, providing operating flexibility during periods of water scarcity, and diversifying the region's water supply portfolio.

Recommendation: Remain actively engaged in a leadership role of OneWater Nevada in evaluating the feasibility of using advanced purified water to enhance TMWA's water resource sustainability, drought resiliency, and efficient use of water resources in the region.

RECOMMENDATION 3.4. Future Water Resources

Background: TMWA has adequate water resources to meet expected demand through 2040 and beyond. However, given that water resource development projects can take years to analyze, permit, and implement, TMWA will continue to investigate and pursue other resource development projects to meet future water demand beyond the 20-year planning horizon. The selection of a project is typically a function of a project's yield, ease of implementation, sustainability, and financial feasibility. It is possible that as new technology becomes available or as regulatory requirements or public opinions change, new projects may be developed, or projects previously thought infeasible may become feasible. TMWA is actively pursuing projects related to ASR expansion, new well development, water banking, and the feasibility of using advanced purified water.

Recommendation: Continue to investigate and evaluate potential future water supply projects consistent with and in addition to TROA to further increase the region's water security.

SUMMARY

TMWA has adequate water resources to meet future projected demand through 2040 and beyond under a range of hydrologic and climate conditions. However, because the factors influencing both supply and demand are constantly changing, TMWA recognizes the importance of adapting its management strategies to address new challenges. The recommended actions outlined in this chapter will help guide TMWA to effectively manage its water resources through the next WRP update, recognizing that these actions may be amended if new challenges or information should arise.

8 APPENDICES

Lake Tahoe

APPENDICES

APPENDIX A
TMWA 2020–2040 WATER RESOURCE PLAN PUBLIC SURVEY RESULTS

APPENDIX B
HYDROGRAPHIC BASIN SUMMARY UPDATE

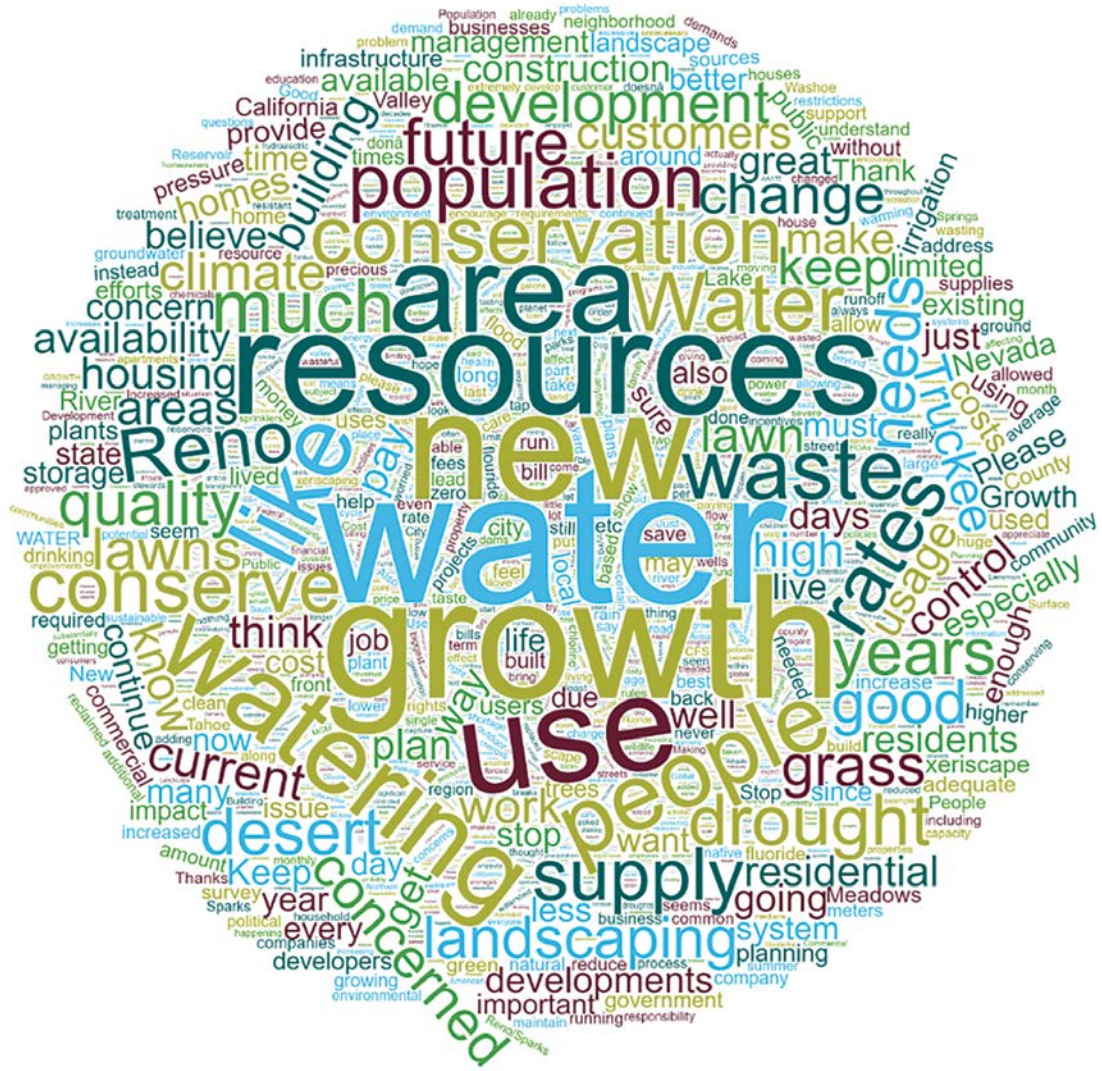
APPENDIX C
OVERVIEW OF CLIMATE CHANGE IN THE TRUCKEE MEADOWS

APPENDIX D
TMWA DEMAND PROJECTION METHODOLOGY

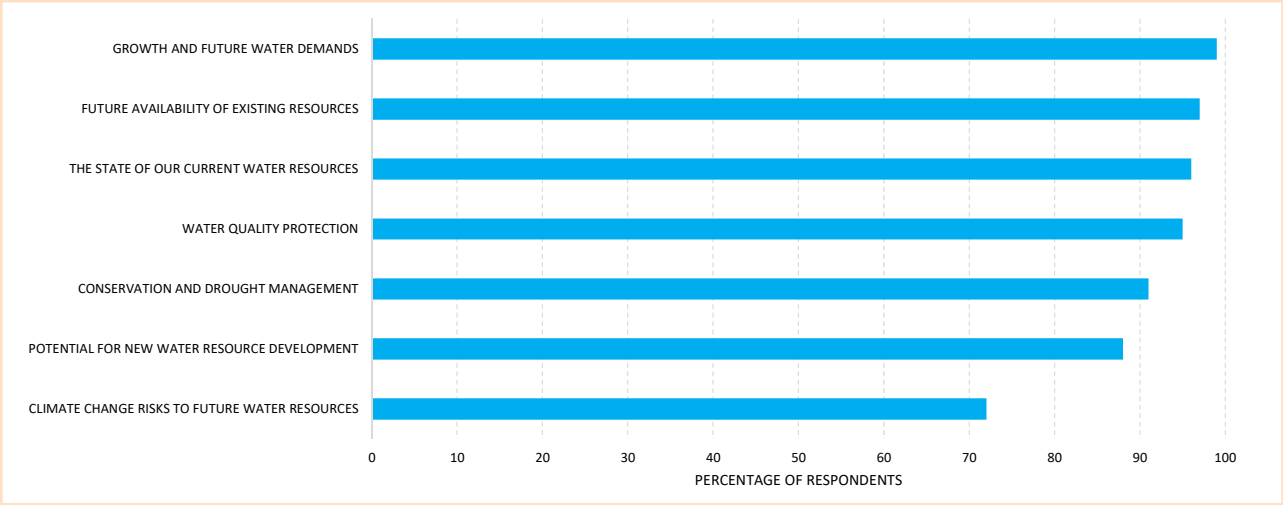
APPENDIX A

TMWA 2020–2040 WATER RESOURCE PLAN PUBLIC SURVEY RESULTS

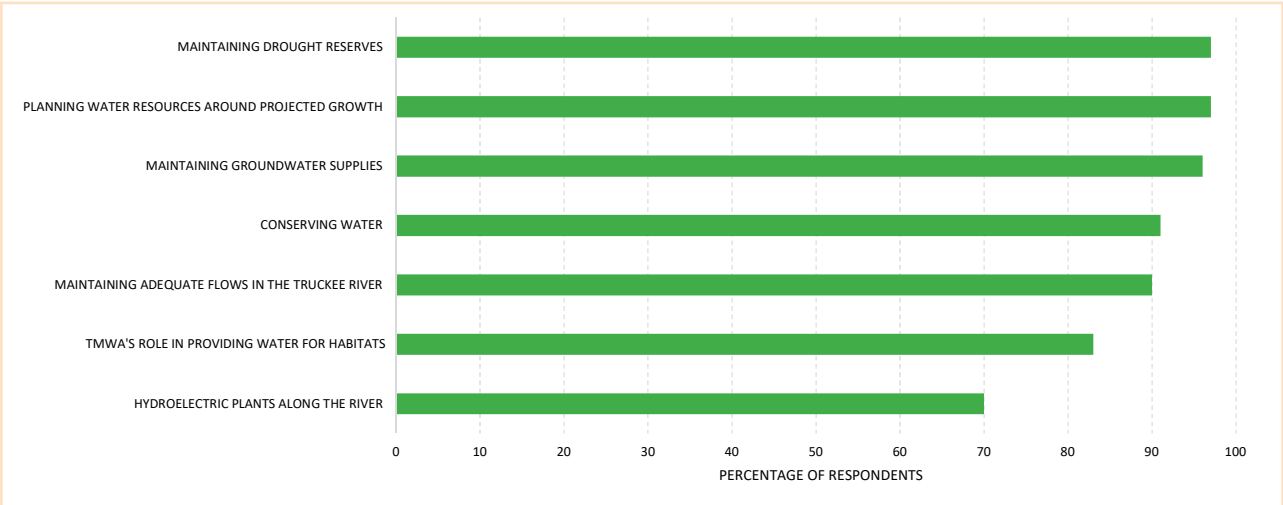
As part of the update process for the 2020–2040 Water Resource Plan (WRP), TMWA surveyed its customers, stakeholders, and employees regarding their attitudes toward TMWA's water resource planning efforts. The survey, which was conducted electronically from November 2018 to January 2019, included questions regarding topics the public would like to see addressed in the WRP and concerns over issues that could negatively affect future water supplies. The survey contained questions on trust in the agency and important issues surrounding the region's water resources, such as conservation, drought storage, and use of reclaimed water. Results from the survey were used to ensure public input was considered in the planning process from the onset. During the two-month survey period, approximately 2,000 responses were received. The word cloud below shows the top words and phrases provided by the public in the open-ended questions. Answers including the words *growth*, *conservation*, *drought*, and *future water resources* were a few of the most common responses. Results from specific questions are presented on subsequent pages.



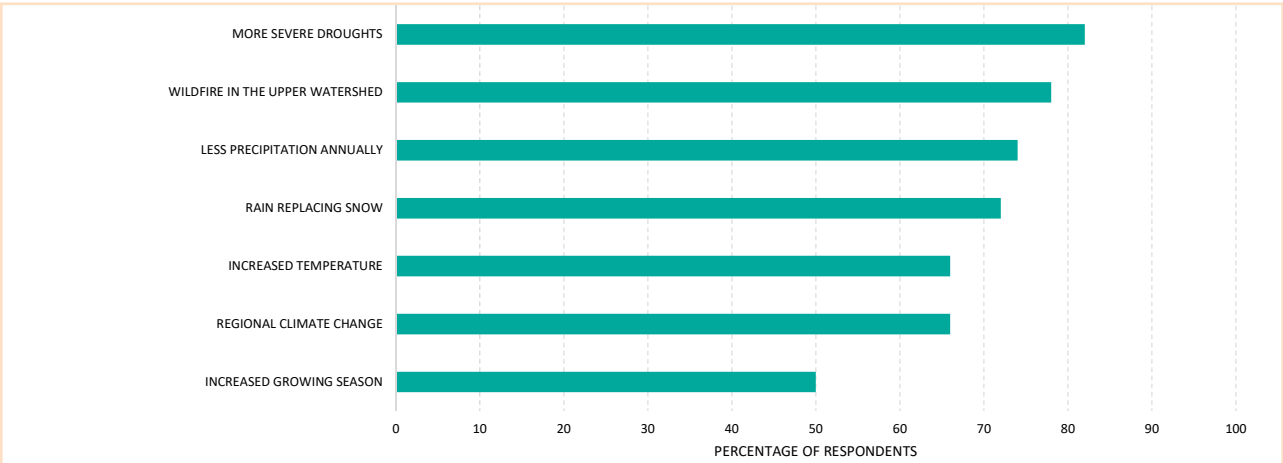
WHAT TOPICS WOULD YOU LIKE TO SEE ADDRESSED IN THE PLAN?
(PERCENTAGE OF RESPONDENTS WHO ANSWERED YES OR DEFINITELY YES)



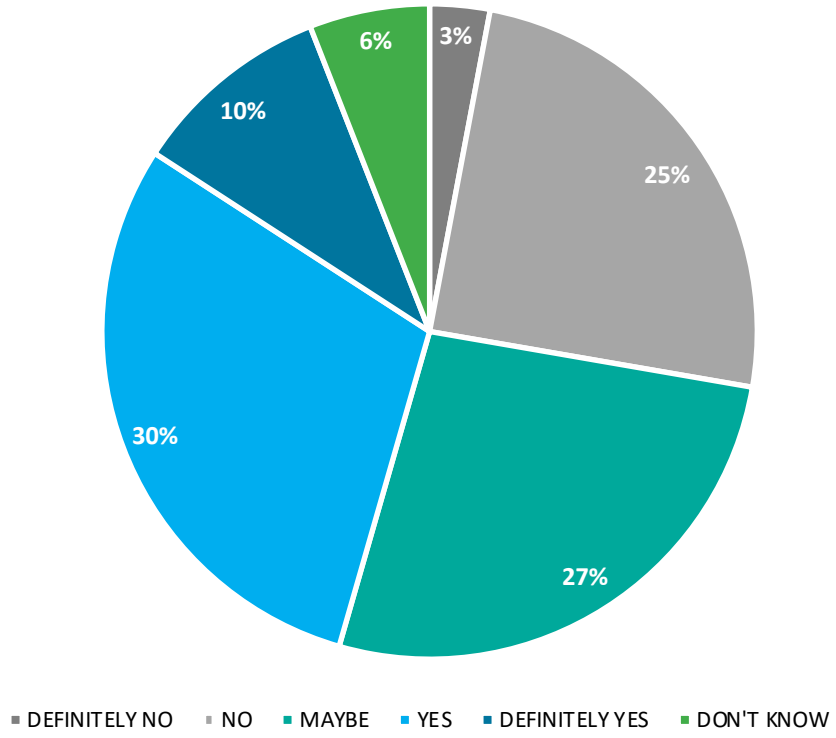
ARE THE FOLLOWING IMPORTANT TO YOU?
(PERCENTAGE OF RESPONDENTS WHO ANSWERED YES OR DEFINITELY YES)



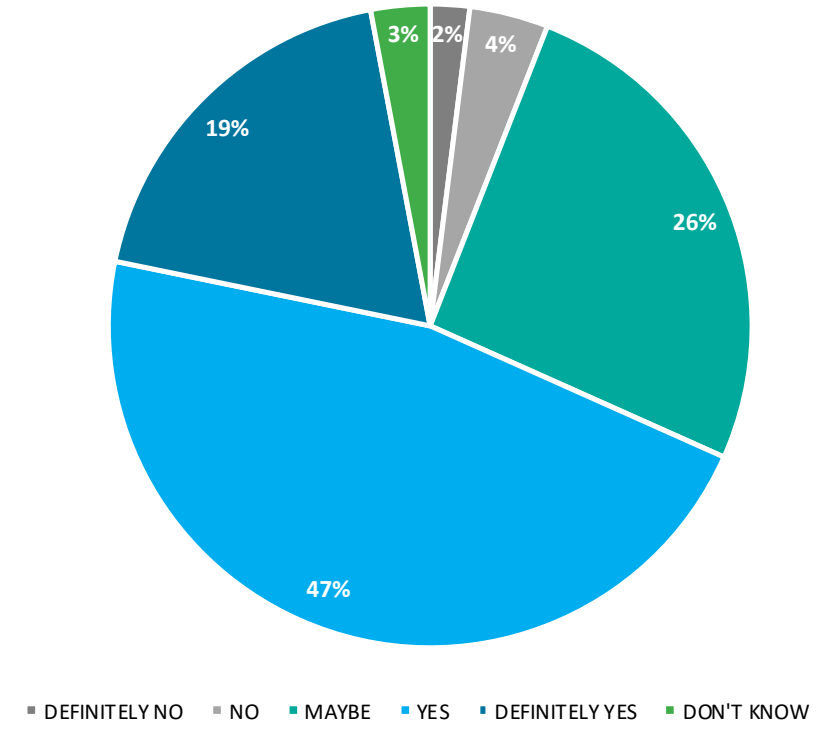
TO WHAT EXTENT ARE YOU CONCERNED THAT THE FOLLOWING MIGHT NEGATIVELY IMPACT OUR WATER SUPPLIES OVER THE NEXT 20 YEARS?
(PERCENTAGE OF RESPONDENTS WHO ANSWERED CONCERNED OR DEFINITELY CONCERNED)



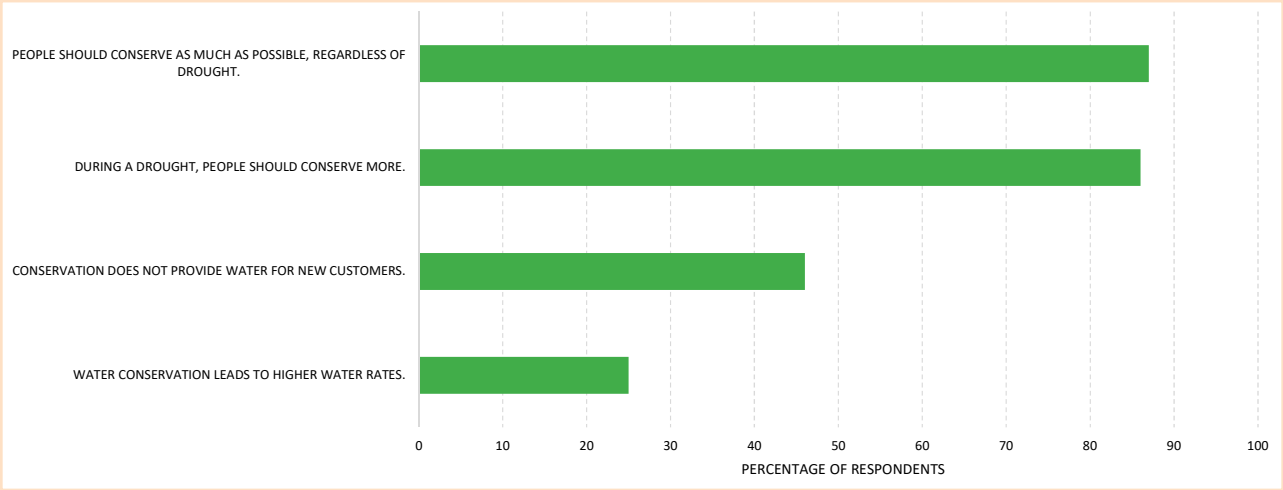
DO YOU UNDERSTAND HOW TMWA MANAGES THE REGION'S WATER SUPPLIES?



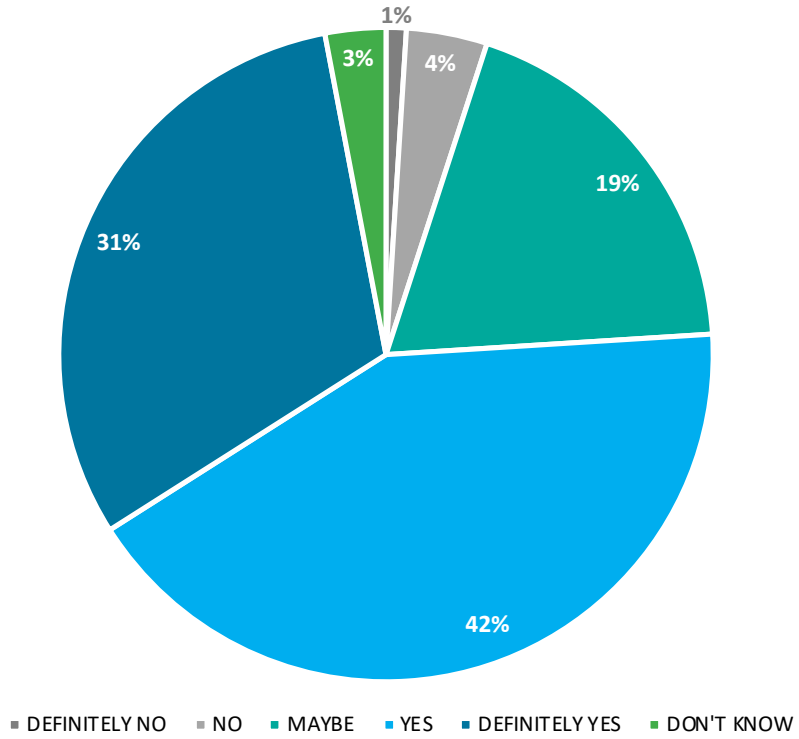
DO YOU TRUST TMWA TO EFFECTIVELY MANAGE TRUCKEE RIVER WATER SUPPLIES?



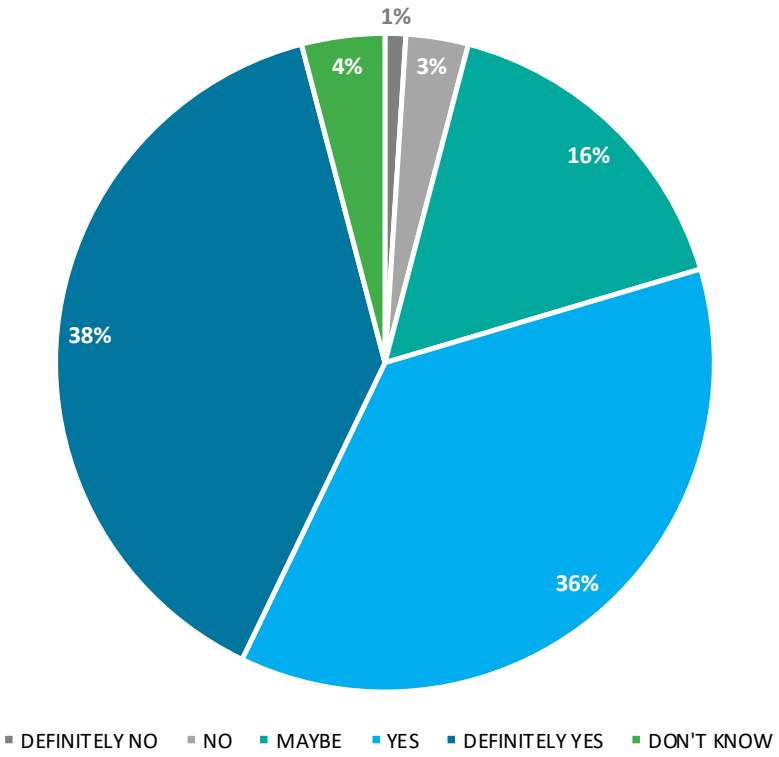
TO WHAT EXTENT DO YOU AGREE WITH THE FOLLOWING?
(PERCENTAGE OF RESPONDENTS WHO ANSWERED YES OR DEFINITELY YES)



DO YOU THINK ALTERNATIVE WATER SOURCES SHOULD BE INVESTIGATED IN OUR REGION?



DO YOU THINK A STUDY ON ADVANCED PURIFIED WATER SHOULD BE INVESTIGATED?



APPENDIX B
HYDROGRAPHIC BASIN SUMMARY UPDATE

INTRODUCTION

Truckee Meadows Water Authority (TMWA) operates groundwater production wells in nine hydrographic basins including:

- Tracy Segment (083)
- Spanish Springs Valley (085)
- Truckee Meadows (087)
- Pleasant Valley (088)
- Washoe Valley (089)
- Truckee Canyon (091)
- Lemmon Valley West and East (092A and 092B)
- Honey Lake Valley (097)

This appendix provides an update to the basin summaries provided in the previous (2016–2035) Water Resource Plan. The updates include new and rehabilitated wells, groundwater level trends in response to recharge and pumping, and water quality issues since 2015.

NEW AND REHABILITATED WELLS

TMWA manages an annual well rehabilitation program. This program consists of actively monitoring each production well and prioritizing well rehabilitation based on observed production declines. Drilling a new well to mitigate the loss of groundwater production is considered a last resort because of the high cost associated with large-diameter well drilling. However, when replacement wells are necessary, they are constructed with superior casing and screen material to increase well longevity. Figure B-1 shows the location of the 34 wells that have been rehabilitated, and Figure B-2 shows the five wells that have been drilled since 2015.

GROUNDWATER LEVEL TRENDS

TRACY SEGMENT (083)

TMWA operates four production wells in the Tracy Segment. Total production from these wells has decreased from 44 acre feet annually (AFA) in 2015 to 26 AFA in 2018. There have been no discernable trends in groundwater levels at the Truckee Canyon wells since 2015, and groundwater levels have increased approximately two feet from 2015 to 2018 at the Stampmill wells.

SPANISH SPRINGS (085)

TMWA operates eight production wells in the Spanish Springs hydrographic basin. Three wells are in the western portion and five are in the eastern portion of the valley. Groundwater pumping continues to decline in the west side of the valley, with net pumping (pumping—recharge) declining from 240 AFA in 2015 to 160 AFA in 2018. Pumping has increased in the east side from 630 AFA in 2015 to 1,100 AFA in 2018.

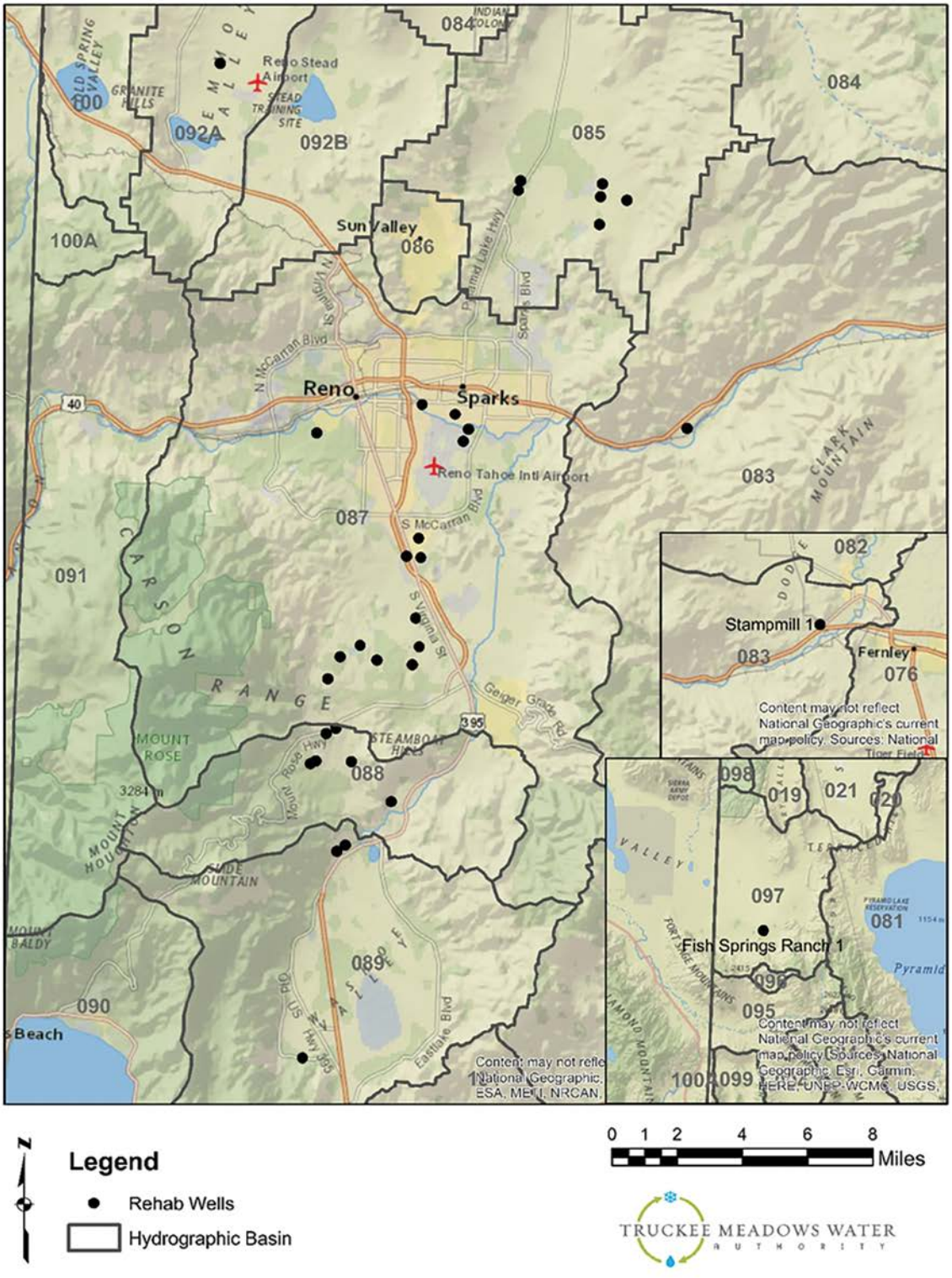


FIGURE B-1: TMWA PRODUCTION WELLS THAT HAVE BEEN REHABILITATED SINCE 2015

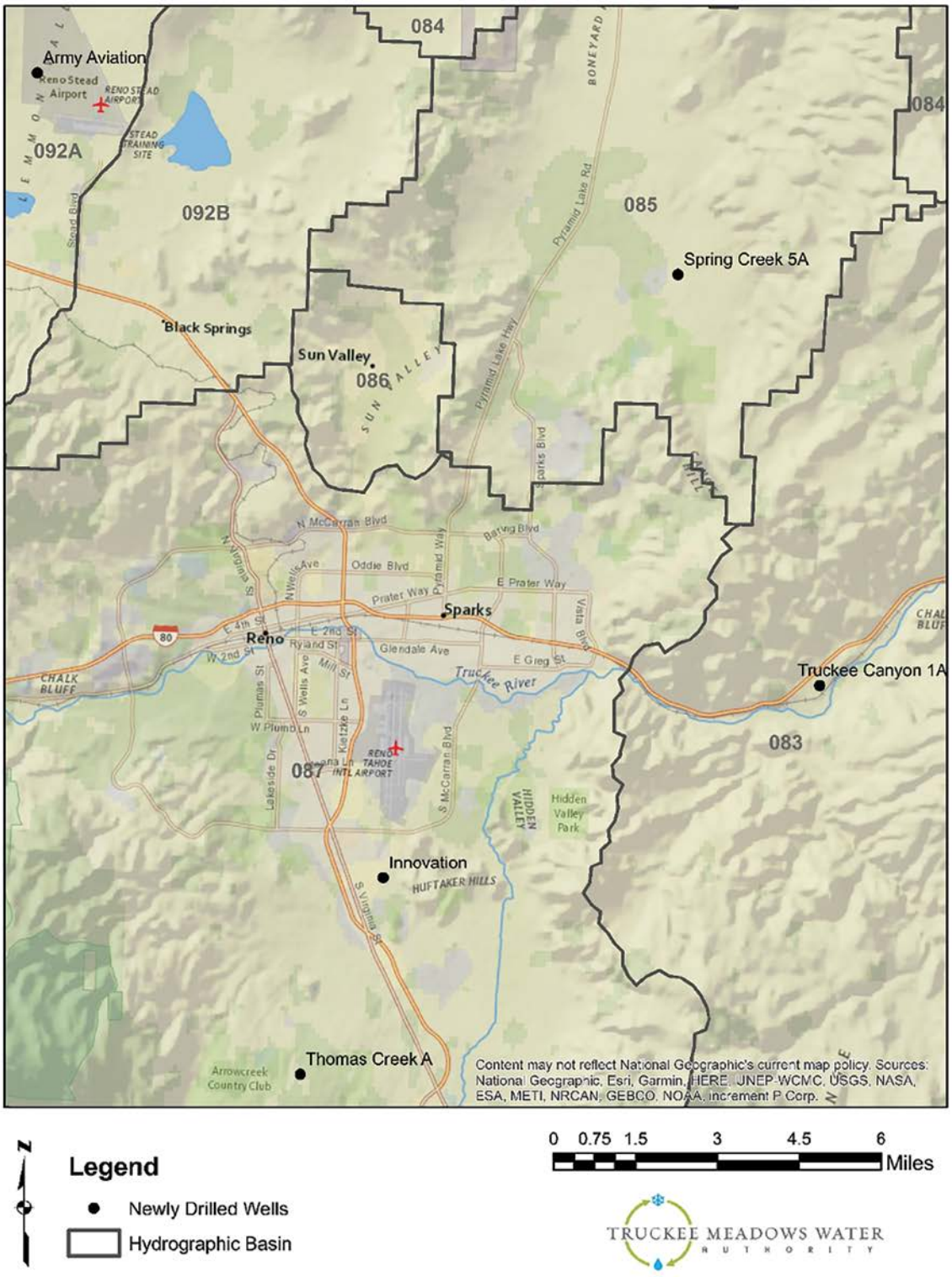


FIGURE B-2: NEWLY DRILLED PRODUCTION WELLS SINCE 2015

The following groundwater level trends have been observed since 2015:

- West side water levels remain stable since 2015, as shown in Figure B-3 (Desert Springs 4).
- East side water levels have continued to decline since 2015, in locations where a majority of the domestic and municipal groundwater pumping occurs. Springtime water levels have declined approximately 10 feet in the Hawkings well since 2015 (Figure B-4).

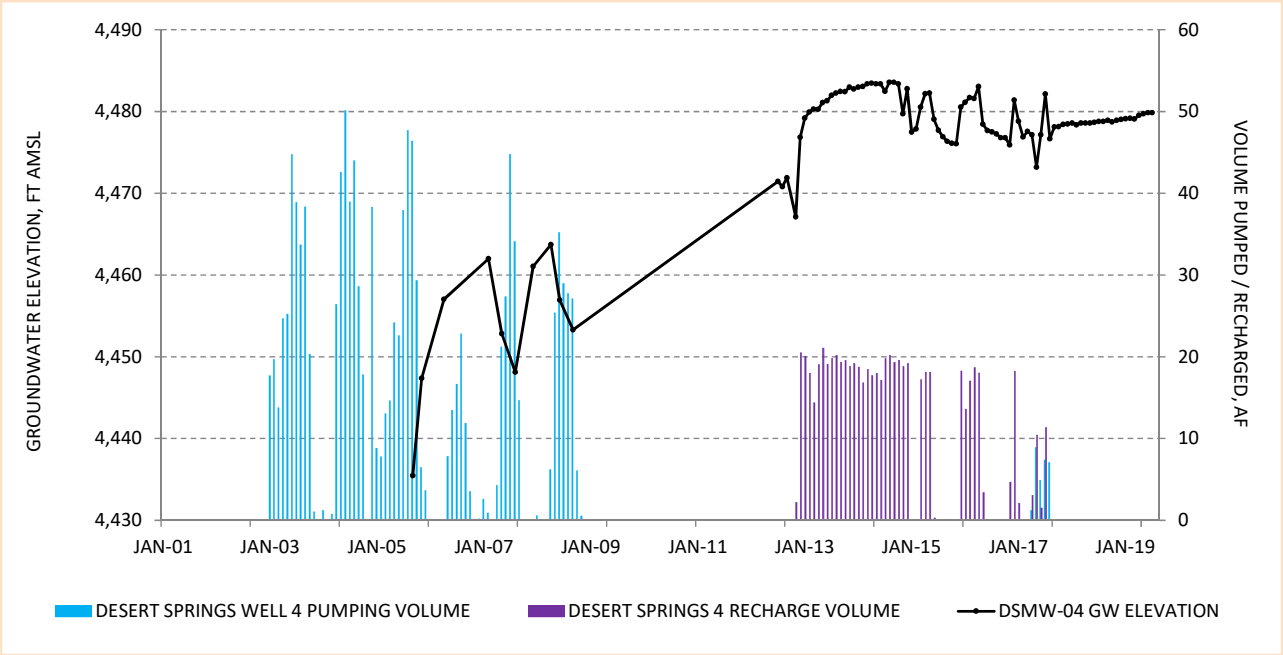


FIGURE B-3: PUMPING AND RECHARGE VOLUMES AND GROUNDWATER LEVELS AT DESERT SPRINGS 4, WHICH IS IN THE WEST SIDE OF SPANISH SPRINGS VALLEY

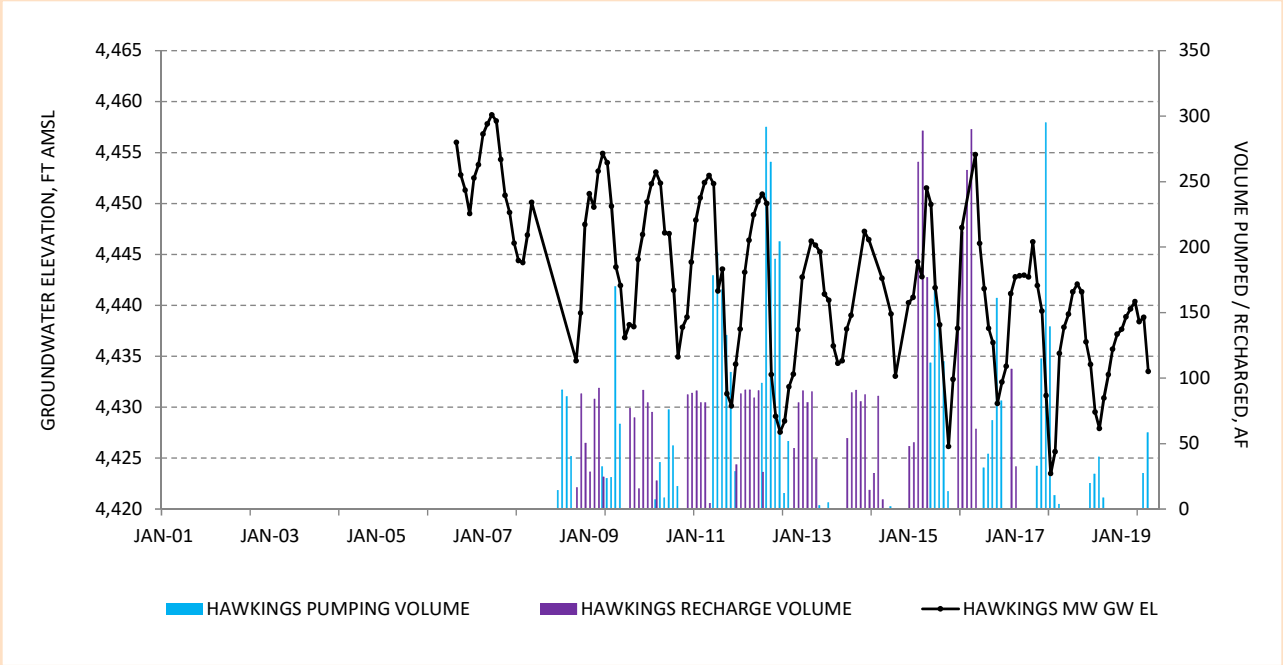


FIGURE B-4: PUMPING AND RECHARGE VOLUMES AND GROUNDWATER LEVELS AT HAWKINGS, WHICH IS IN THE EAST SIDE OF SPANISH SPRINGS VALLEY

TMWA is currently developing a groundwater management plan for the Spanish Springs hydrographic basin. An important aspect of the management plan will include increasing recharge on the east side of the basin to mitigate observed groundwater level declines.

TRUCKEE MEADOWS (087)

TMWA operates 47 production wells in the Truckee Meadows hydrographic basin. Groundwater pumping has declined significantly since 2015, with net pumping (pumping—recharge) declining from 17,400 AFA in 2015 to 9,100 AFA in 2018.

The following groundwater level trends have been observed since 2015:

- In the northern portion of the basin, continued recharge efforts and decreased pumping volumes have reduced the annual groundwater swings. This can be seen in the View Street well (Figure B-5), where water levels dropped 130 feet between the winter and summer months in 2015, but water levels only dropped 50 feet over the same period in 2018. Springtime water levels have remained relatively stable from 2015 to 2018.
- A similar trend is found in the central portion of the Truckee Meadows hydrographic basin. This can be seen in Figure B-6, where water levels dropped 120 feet between winter and summer months in 2015, but only 10 feet over the same period in 2018. Springtime water levels have remained relatively stable from 2015 to 2018.
- Groundwater levels have risen significantly in the southwest part of the basin in response to decreased pumping volumes. This is evidenced by the rising water levels in Arrowcreek 2, as shown in Figure B-7, where springtime water levels have increased 20 feet from 2015 to 2018.

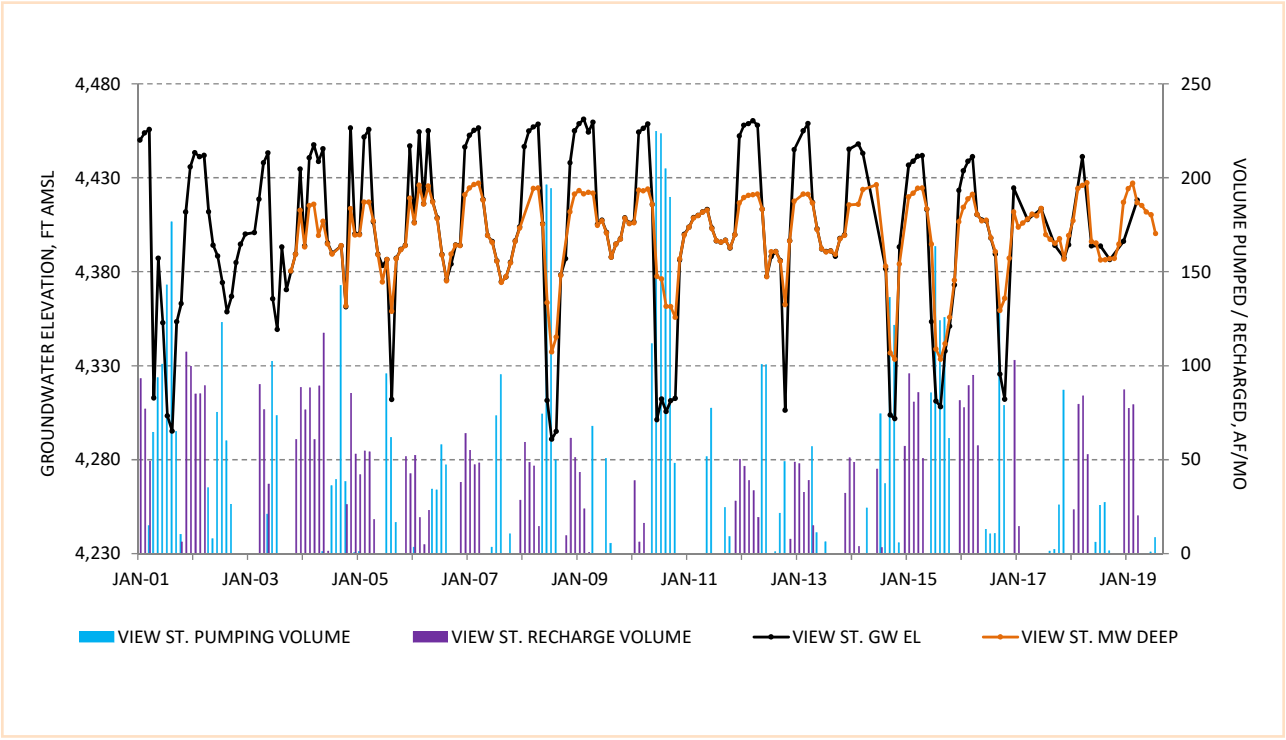


FIGURE B-5: PUMPING AND RECHARGE VOLUMES AND GROUNDWATER LEVELS AT THE VIEW STREET WELL, WHICH IS ON THE NORTH SIDE OF THE TRUCKEE MEADOWS HYDROGRAPHIC BASIN

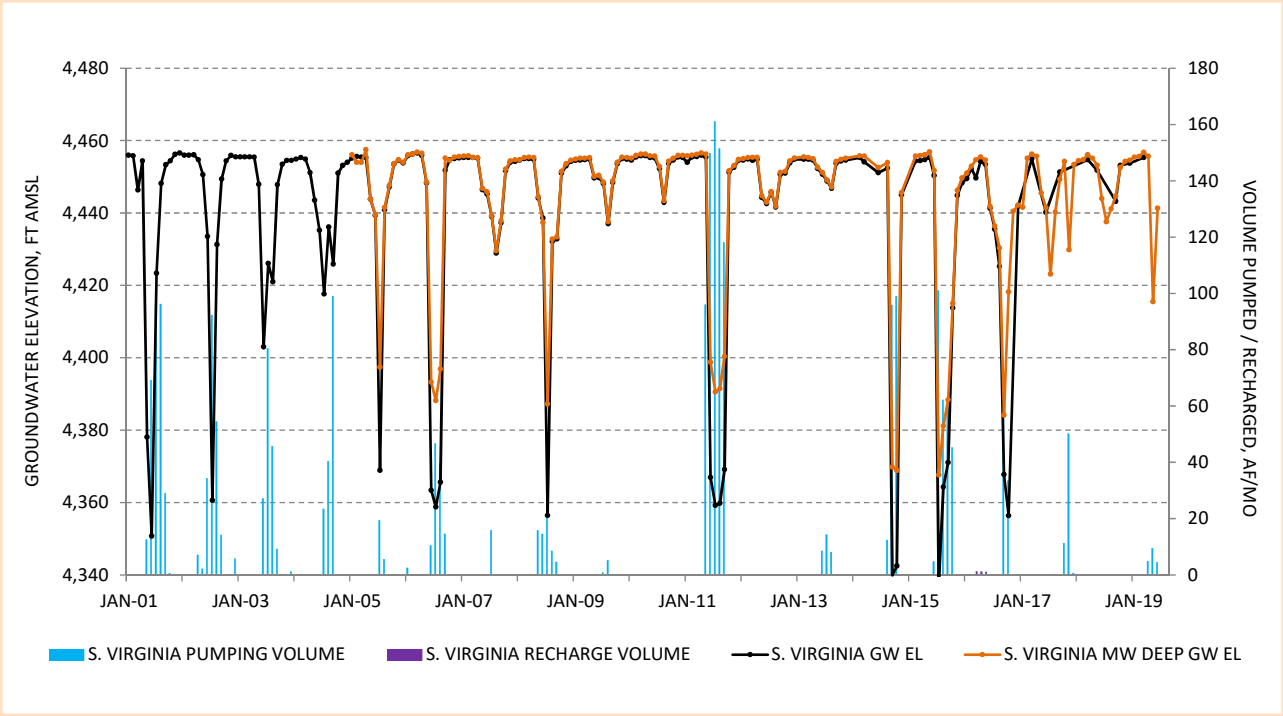


FIGURE B-6: PUMPING AND RECHARGE VOLUMES AND GROUNDWATER LEVELS AT THE SOUTH VIRGINIA STREET WELL, WHICH IS IN THE CENTRAL PORTION OF THE TRUCKEE MEADOWS HYDROGRAPHIC BASIN

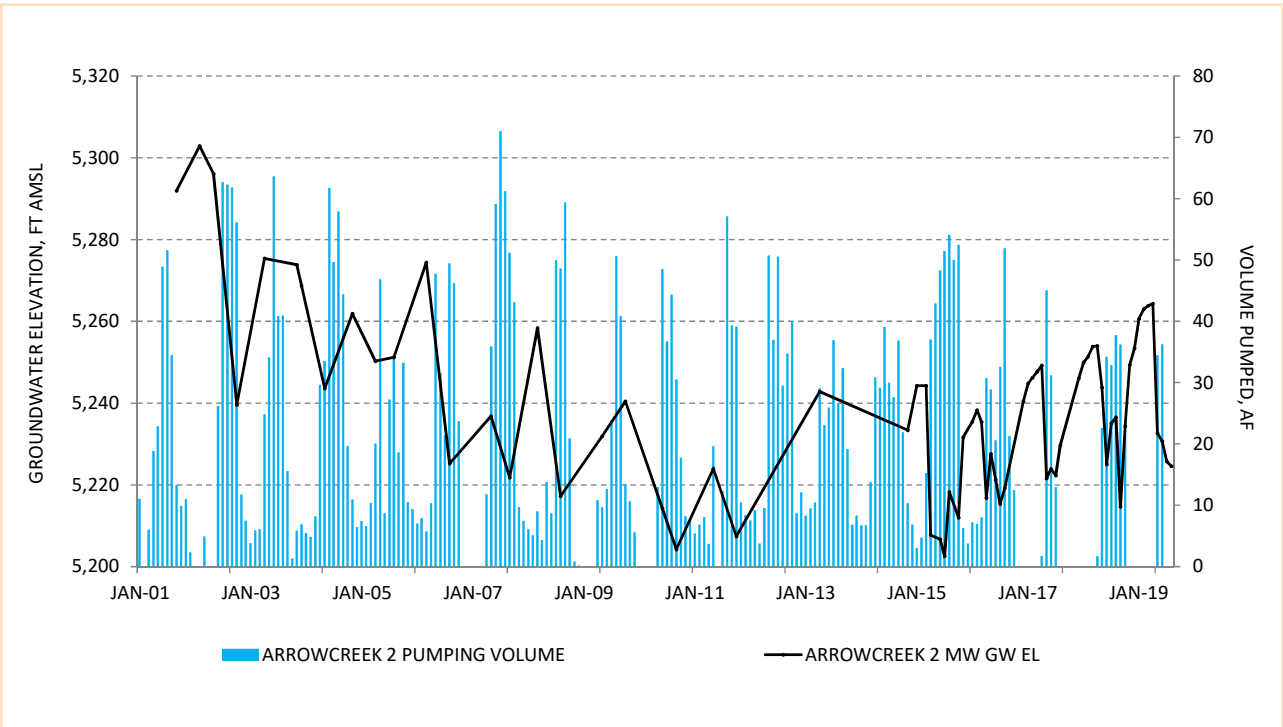


FIGURE B-7: PUMPING AND RECHARGE VOLUMES AND GROUNDWATER LEVELS AT THE ARROWCREEK 2 WELL, WHICH IS IN THE SOUTHWEST PORTION OF THE TRUCKEE MEADOWS HYDROGRAPHIC BASIN

PLEASANT VALLEY (088)

TMWA operates nine production wells in the Pleasant Valley hydrographic basin. Groundwater pumping declined from 1,400 to 900 AFA from 2015 to 2018.

The following groundwater levels trends have been observed since 2015:

- Groundwater levels have risen significantly in the southwest part of the basin in response to decreased pumping volumes. Increasing groundwater levels are seen at the Tessa East well (Figure B-8) which shows springtime water levels increasing in excess of 30 feet from 2015 to 2018.

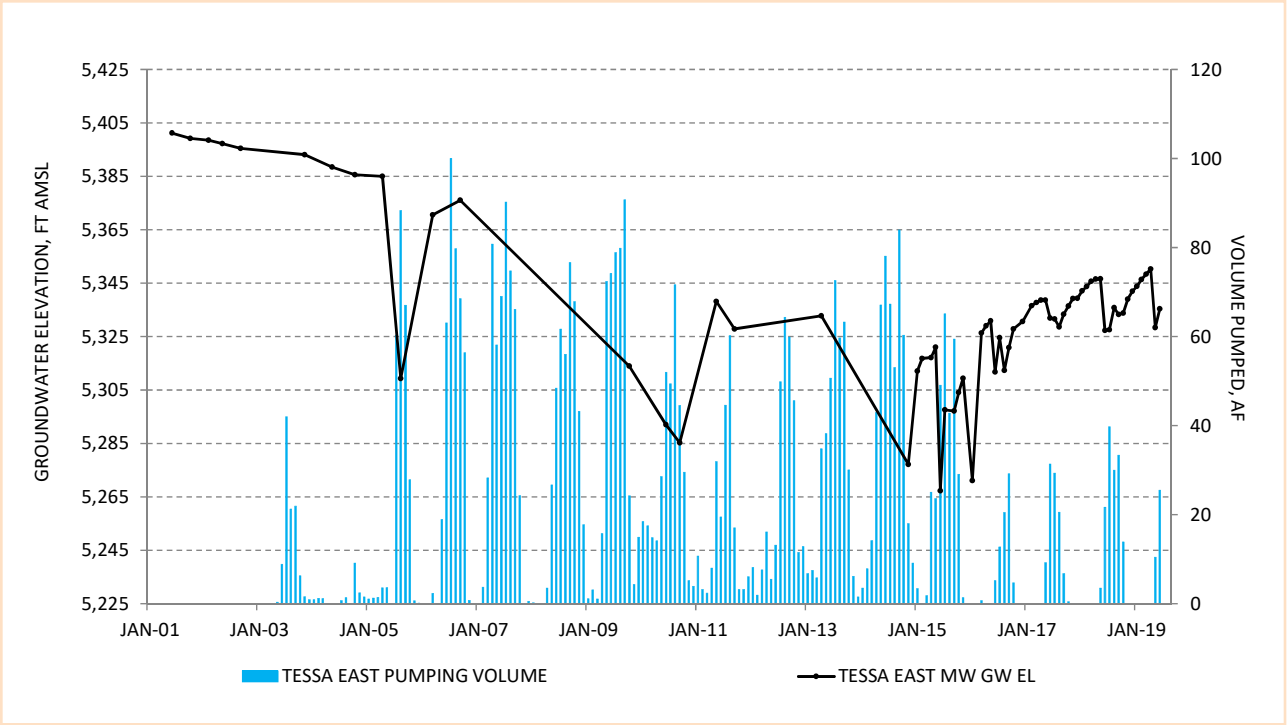


FIGURE B-8: PUMPING VOLUMES (TESSA EAST) AND GROUNDWATER LEVELS AT THE TESSA EAST MONITORING WELL, WHICH IS IN THE PLEASANT VALLEY HYDROGRAPHIC BASIN

WASHOE VALLEY (089)

TMWA operates five production wells in the Washoe Valley hydrographic basin. Groundwater pumping has declined from 160 to 140 AFA from 2015 to 2018. There have been no discernable trends in groundwater levels since 2015.

TRUCKEE CANYON (091)

TMWA operates four production wells in the Truckee Canyon hydrographic basin. Groundwater pumping has increased from 170 to 220 AFA from 2015 to 2018. There are no discernable trends in groundwater levels since 2015.

LEMMON VALLEY (092A AND 092B)

TMWA operates seven production wells in the Lemmon Valley hydrographic basin. Groundwater pumping has declined from 220 AFA in 2015 to a net recharge of 40 AFA in 2018.

The following groundwater level trends have been observed since 2015:

- Groundwater levels have risen significantly since 2015. Increasing groundwater levels are seen at the Lemmon Valley 7 well (Figure B-9), which shows water levels have increased 10 feet from 2015 to 2018.

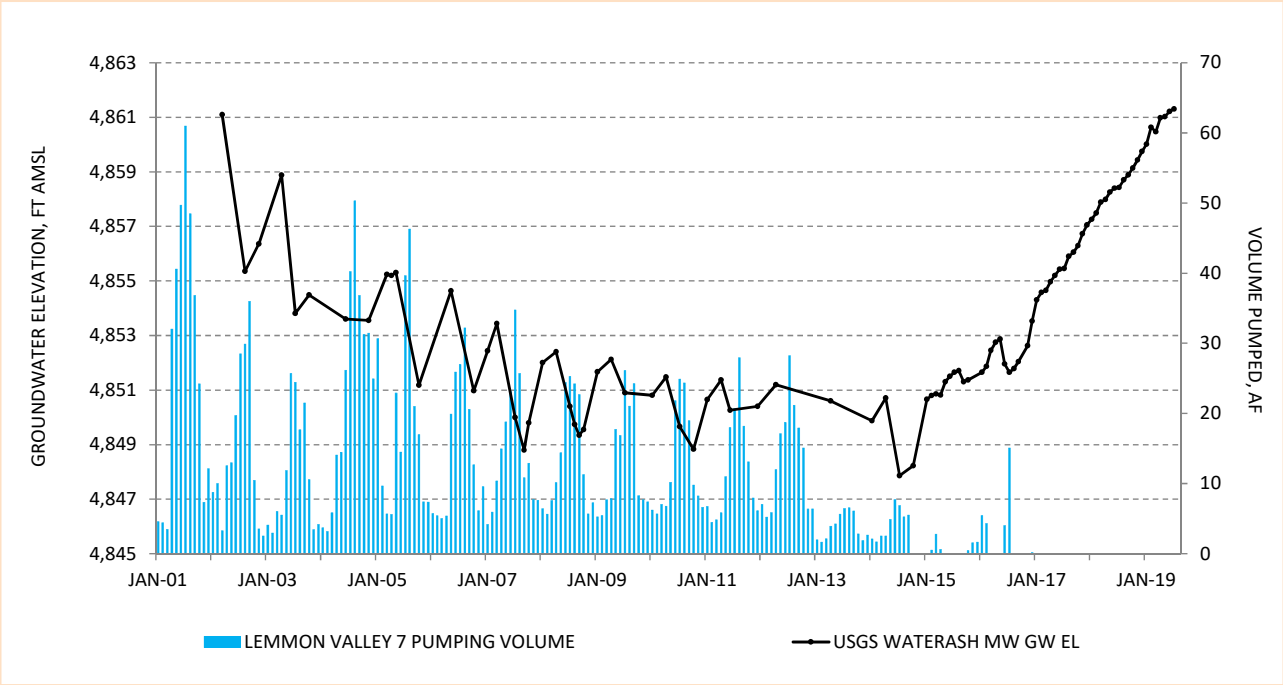


FIGURE B-9: PUMPING VOLUMES (LEMMON VALLEY 7) AND GROUNDWATER LEVELS AT THE USGS WATERASH MONITORING WELL

HONEY LAKE VALLEY (097)

TMWA operates five production wells in the Honey Lake Valley hydrographic basin. Groundwater pumping has declined from 960 AFA in 2015 to no pumping in 2018. There have been no discernable trends in groundwater levels since 2015.

TRUCKEE CANYON (091)

TMWA operates five production wells in the Truckee Canyon hydrographic basin. Groundwater pumping increased from 170 to 220 AFA from 2015 to 2018. There are no discernable trends in groundwater levels since 2015.

WATER QUALITY ISSUES

TRACEY SEGMENT (083)

Wellhead treatment is ongoing at the Truckee Canyon wells to treat elevated concentrations of arsenic.

SPANISH SPRINGS (085)

The following water quality issues have been observed in the Spanish Springs hydrographic basin:

- Nitrate, from septic tanks and natural sources, continues to increase in shallow groundwater in the western portion of the valley and is migrating deeper into the aquifer over time under the influence of pumping and existing downward gradients. Nitrate concentrations have been measured as high as 45 mg/L (DS3—2017).
- The wellhead treatment pilot project on the Desert Springs Well 3 indicates that nitrate and arsenic can be removed effectively. A groundwater treatment plant is being considered for the area to treat nitrate- and arsenic-impacted groundwater from Desert Springs Wells 1, 2 and 3 and Spring Creek Wells 2 and 3.

TRUCKEE MEADOWS (087)

The following water quality issues have been observed in the Truckee Meadows hydrographic basin:

- TMWA continues to monitor the highly mineralized geothermal waters discharged from the Steamboat Geothermal Area at the far southeast end of the basin. Arsenic concentrations continue to increase in the Double Diamond #3 production well, with the highest concentration at 8 ug/L in January 2019 (MCL is 10 ug/L).
- TMWA continues to work with the Washoe County Central Truckee Meadows Remediation District (CTMRD) to monitor the tetrachloroethylene (PCE) plume and associated treatment at TMWA wells (Kietzke, Mill, High, Morrill, and Corbett). No significant changes in PCE have been observed since 2015.
- TMWA continues to treat high arsenic levels in four production wells (Greg, Pezzi, Poplar #1, and Terminal) located in the northeast portion of the valley.
- TMWA continues to work with the Nevada Division of Environmental Protection (NDEP) to monitor other groundwater contaminant sites, including the Sparks Solvent Fuel Site. Concentrations are increasing at the edge of the plume and may be moving offsite toward the Sparks Marina and the Truckee River.

PLEASANT VALLEY (088)

The following water quality issues have been observed in the Pleasant Valley hydrographic basin:

- TMWA continues to monitor the highly mineralized geothermal waters discharged from the Steamboat Geothermal Area. TMWA production wells in Pleasant Valley continue to be outside of the geothermal outflow zone.

WASHOE VALLEY (089)

Wellhead treatment is ongoing at the Lighting W wells to treat elevated concentrations of uranium.

TRUCKEE CANYON (091)

The following water quality issues have been observed in the Truckee Canyon hydrographic basin:

- Elevated levels of aluminum have been measured in Well 9 and 12, with the highest concentration measured in well 9 at 0.19 mg/L (MCL = 0.20 mg/L). Well 9 is scheduled to be abandoned once the Verdi area is connected to the surface water distribution system.
- Iron and manganese are elevated in Well 12 but not in exceedance of the EPA secondary standards (iron MCL = 0.3 mg/L; manganese MCL = 0.05 mg/L) TMWA continues to monitor the water quality in this area to ensure that the aesthetic quality of the water is not impaired.

LEMMON VALLEY (092A AND 092B)

The following water quality issues have been observed in the Lemmon Valley hydrographic basin:

- TMWA continues to work with NDEP to monitor the solvent-related contamination at the Stead Solvent Site near the southern boundary of the Stead Airport in West Lemmon Valley. Remediation activities have successfully reduced the migration of the contaminant plume.
- Groundwater from the Silver Lake well is blended with groundwater from other wells and/or surface water to reduce slightly elevated concentrations of arsenic.

HONEY LAKE VALLEY (097)

There are currently no water quality issues in production wells, but TMWA continues to monitor total dissolved solids (TDS) beneath the playa to ensure that saline water does not migrate toward the production wells.

APPENDIX C
OVERVIEW OF CLIMATE CHANGE IN THE TRUCKEE MEADOWS

Although the climate of the Truckee Meadows is characterized by cyclic patterns of flood and drought, changing climatic conditions may prove more challenging for water supply reliability in the future throughout the American West (Gonzalez et al. 2018; Karl et al. 2009). Climate change is defined as shifts in global or regional weather conditions that persist over multiple decades or longer (Gonzalez et al. 2018). To design effective water supply strategies to mitigate against potential shifts in future climate conditions, TMWA incorporates the best available scientific information regarding regional climate change into its planning process. This includes the use of global climate models that are representative of the western United States and hydrologic models of the Truckee River watershed (Lynn et al. 2015; Huntington et al. 2013).

Regional temperatures are expected to warm, which is consistent with warming trends observed in the state over the past several decades (see Figure C-1). A 2018 study completed by the UCLA Center for Climate Science predicts that by 2041–2060, the Sierra Nevada will warm by 4°F on average (Reich et al. 2018). A concern identified in multiple studies is the impact of warmer temperatures on the timing of snowpack melt and the subsequent filling of storage reservoirs (US DOI 2015; Reich et al. 2018). Most climate models predict earlier snowmelt and changing streamflow patterns as spring temperatures increase (Reich et al. 2018). Currently, peak runoff from snowmelt to rivers and streams in the Truckee River Basin typically occurs in May or June. With increased temperatures, peak runoff in the Sierra Nevada could begin to shift as early as March or April by the end of the 21st century (Reich et al. 2018).

Higher average annual temperatures also lead to higher evaporation rates on lakes and reservoirs, thereby potentially reducing the available water supply (Huntington et al. 2015; USBR 2015). Evaporation on Lake Tahoe is expected to increase by an estimated 3% by 2050 and 5% by 2080 (Huntington et al. 2015). However, these evaporation increases could be offset by precipitation and inflow increases in some climate change scenarios.

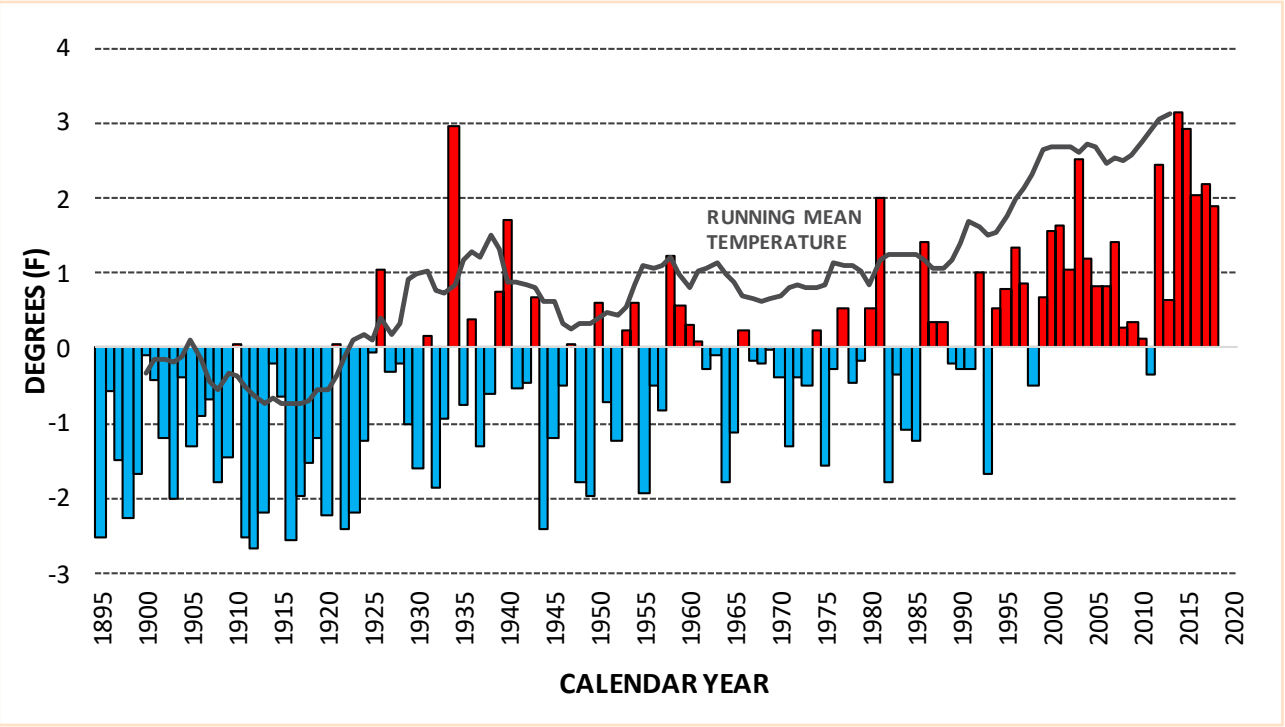


FIGURE C-1: MEAN TEMPERATURE DEPARTURE FOR NEVADA FROM 1895 TO 2018 (SOURCE: WESTERN REGIONAL CLIMATE CENTER)

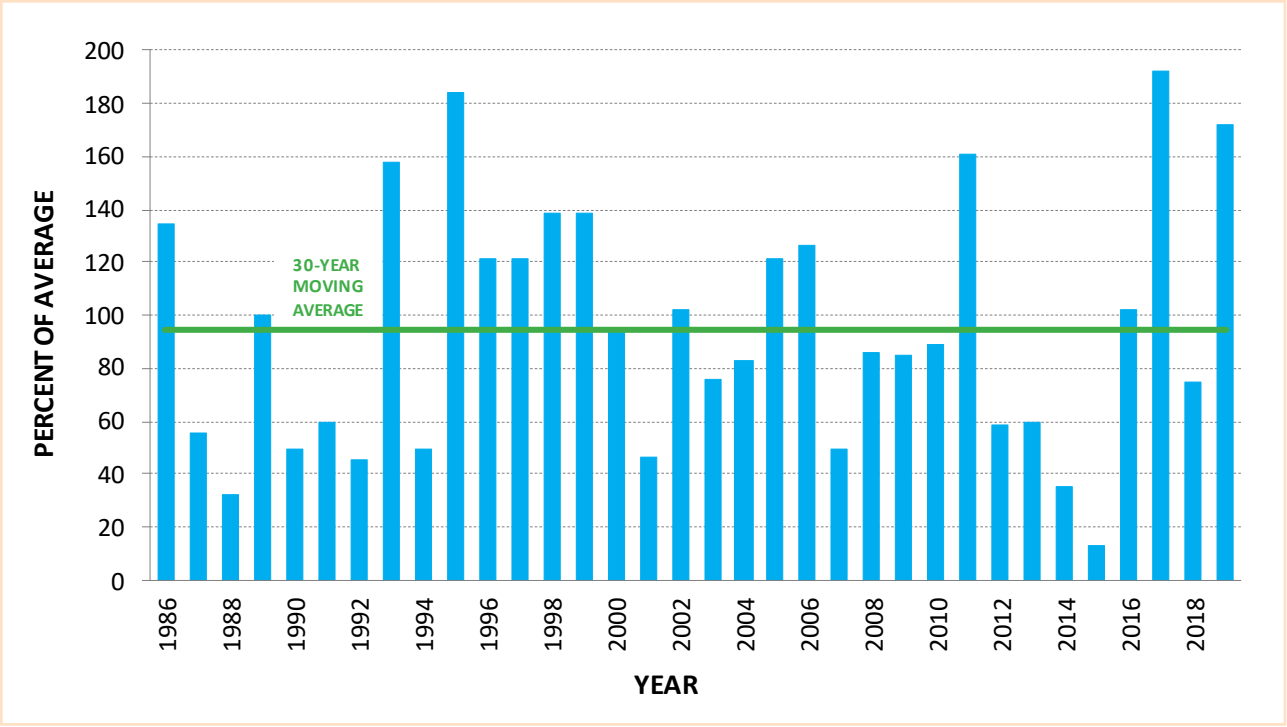


FIGURE C-2: TRUCKEE RIVER BASIN AVERAGE APRIL 1 SNOWPACK FROM 1986 TO 2019

There is a lack of consensus and a high degree of uncertainty about future annual precipitation in the Truckee River watershed. Many climate scenarios suggest that the northern Sierra Nevada may receive more precipitation in the future, whereas others suggest that the region may receive less (US DOI 2015; Lynn et al. 2015). However, in addition to the quantity of precipitation, the distribution, timing, and type of precipitation is projected to vary. Warming trends will likely result in more precipitation falling as rain instead of snow, which has the potential to decrease the region's winter snowpack, leading to snow droughts (Harpold et al. 2017; Hatchett et al. 2018; Cooper et al. 2017). Snow levels have already been increasing in elevation in the Sierra Nevada, with more rain falling at mid-elevations from 5,000–8,000 feet, which historically received more snow (Hatchett et al. 2017; Reich et al. 2018). Snow droughts can occur in years with average annual precipitation, but with low snow water equivalent (SWE) (Hatchett et al. 2018). Snowpack is typically variable in the Truckee River system (see Figure C-2), but a prolonged or permanent decrease in snowpack would impact the water supply, because mountain snow acts as a reservoir that melts throughout the spring and summer during the highest demand periods.

Additionally, climate change has the potential to increase the severity and frequency of extreme weather events, such as atmospheric rivers and droughts (Gonzalez et al. 2018; Cayan et al. 2001; Dettinger et al. 1995). Several large atmospheric river events during the winter of 2017 caused flooding throughout the Truckee Meadows region; these heavy precipitation events and the associated flooding may become more common in the Sierra Nevada in the future. The frequency of prolonged droughts may also increase (Cayan et al. 2010). Frequent shifts, or hydrological cycle intensification between extreme dry years (e.g., 2015) and extreme wet years (e.g., 2017), are predicted, which may make water resource operations more complex (Swain et al. 2018).

TMWA also relies on groundwater to supply water to its customers, which serves as a "buffer" during dry times because it acts as a huge storage reservoir underground. Several studies have investigated the implications of climate change on groundwater systems in the western

United States, with wide-ranging results. Estimates range between declines to little change, to even slight increases in groundwater recharge and associated groundwater resources (Meixner et al. 2016; Huntington et al. 2012; Pohll et al. 2018). The uncertainty in the groundwater recharge estimates largely rests on the large uncertainty in future precipitation estimates. Regardless, TMWA's ASR program increases groundwater recharge through ongoing injection of treated surface water during non-drought periods. This strategy ensures sustainable management of groundwater resources under a wide range of future climate conditions.

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APPENDIX D
TMWA DEMAND PROJECTION METHODOLOGY

PROJECTIONS OF POPULATION, ACTIVE WATER SERVICES, AND TOTAL WATER DEMAND

As part of its financial and natural resource planning, Truckee Meadows Water Authority (TMWA) maintains a collection of projection models of population, active water services, and water demand. These models produce high-resolution projections suitable in the short run for operational and financial planning and can be aggregated to a resolution suitable for long-term water resource planning. The models are used in a chain where the output of one model serves as an input to the next model.

For the 2020–2040 WRP, the following models are used: Washoe County population, active water services, and water use coefficients. The population projection is a required variable for the projection of active water services. The water use coefficients model provides an estimate of how much water is used by each type of water service. The water demand is a product of active water services and water use coefficients. The active water services and use coefficients are both dependent on TMWA's extensive billing history database to produce meaningful projections in both the short and long term.

Because the model is based on historical information, it assumes current socio economic trends will continue. Therefore, future changes in economic growth, building and landscaping trends, climate conditions, and water-saving technology are not captured. Because these factors can ultimately influence true demand up or down, the model is reestimated on a semiannual bias. Analysis of prior water demand models have shown estimations to be slightly higher than actual demand.

WASHOE COUNTY POPULATION PROJECTIONS

In Washoe County, there are three prominent population projections commonly produced: State of Nevada Demographer's projection (SDF), TMWA's Washoe County population projection, and Truckee Meadows Regional Planning Agency's (TMRPA) Washoe County Consensus Forecast of population (WCF). Each projection is based on a different model/methodology and thus each can meet different needs in the community. TMWA's population projection is the preferred projection to be used with long-term (greater than 20 years) water resource planning.

The TMWA population projection is based on a logistical growth curve and provides an estimate of population equilibrium, assuming that current trends and conditions continue to 2099. TMWA's model is used to project population through 2099. The SDF and WCF projections are each based on a 20-year horizon. The state's model is a statewide economic and demographic model that produces projections for all counties and most major cities in Nevada and is updated annually by the State Demographer. TMRPA's WCF is an average of four different population projects, two of which are the SDF and TMWA projections. In the short run, all three produce very similar population projections. They differ greatly in the long run, and if extrapolated out to year 2100, the differences are very pronounced. To create comparative projections, SDF and WCF are simply extrapolated out to the year 2100 and used to create alternative projections for active water services and water demand.

ACTIVE WATER SERVICES PROJECTIONS

Active water services are a function of population and the businesses that provide services and jobs to the community. All active water services can be grouped into four major classes: single-family homes, multi-family dwelling units, commercial (businesses) services, and irrigation services. Using active water service counts derived from billing history and the historic population, a time series model was developed using a vector autoregression methodology (VAR) model. In this model, each month's service counts are explained by a relationship between the population, active services in prior months, and relationships between different service classes. Given a good model that explains past counts of active service with respect to population, the population projection is used to project future active water service counts. As a result of the differences between the three population forecasts in the long term (beyond 20 years), the number of active water services varies. However, TMWA uses the active water service projection based on the TMWA population forecast for planning purposes.

TOTAL WATER DEMAND PROJECTIONS

The active water services are multiplied with water use coefficients by customer rate class and service size to produce a projection of water demand for each rate class. The water use coefficients are computed monthly as an average of the same month for the prior three years and are the same for all projections. The assumption in each projection is that water use per service does not change moving forward. These models provide very granular details at a monthly level that are well suited for short-term operations. For water resource planning, the monthly values are summed to provide annual values, and customer class details are combined to provide total water demand.