SOUTHERN NEVADA WATER AUTHORITY℠

2020 WATER RESOURCE PLAN

Colorado Rivere, Nevada

SOUTHERN NEVADA WATER AUTHORITY

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The Southern Nevada Water Authority (SNWA) is a cooperative, not-for-profit agency formed in 1991 to address Southern Nevada's unique water needs on a regional basis.

Bighorn Sheep, Lake Mead, Nevada

SOUTHERN NEVADA WATER AUTHORITY

MISSION

Our mission is to provide world class water service in a sustainable, adaptive and responsible manner to our customers through reliable, cost effective systems.

GOALS

Assure quality water through reliable and highly efficient systems.

Deliver an outstanding customer service experience.

Anticipate and adapt to changing climatic conditions while demonstrating stewardship of our environment.

Develop innovative and sustainable solutions through research and technology.

Ensure organizational efficiency and manage financial resources to provide maximum customer value.

Strengthen and uphold a culture of service, excellence and accountability.

Colorado River, Grand Canyon National Park

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Lake Powell, Utah

EXECUTIVE SUMMARY

SINCE ITS INCEPTION IN 1991, THE SOUTHERN NEVADA WATER AUTHORITY HAS WORKED TO SECURE NEW WATER RESOURCES FOR SOUTHERN NEVADA, MANAGE EXISTING AND FUTURE WATER SUPPLIES, CONSTRUCT AND OPERATE REGIONAL WATER FACILITIES, AND PROMOTE CONSERVATION.

The Southern Nevada Water Authority (SNWA) was formed in 1991 by a cooperative agreement among seven water and wastewater agencies. Collectively, the SNWA member agencies serve nearly 2.3 million residents in the cities of Boulder City, Henderson, Las Vegas, North Las Vegas and areas of unincorporated Clark County. As their wholesale water provider, the SNWA is responsible for water treatment and delivery, as well as acquiring and managing long-term water resources for Southern Nevada.

SNWA Member Agencies:

- Big Bend Water District
- City of Boulder City
- City of Henderson
- City of Las Vegas
- City of North Las Vegas
- Clark County Water Reclamation District
- Las Vegas Valley Water District

The SNWA Cooperative Agreement calls for the adoption of a water resource plan to be reviewed annually by the SNWA Board of Directors. The 2020 SNWA Water Resource Plan fulfills this requirement, providing a comprehensive overview of projected water demands in Southern Nevada, as well as the resources available to meet those demands over time.

THE CURRENT PLANNING ENVIRONMENT

Beginning in 2000 and continuing today, several water supply and demand changes have occurred—both locally and regionally—that create uncertainty for water planning agencies across much of the western United States. Today, the most significant factors affecting Southern Nevada are increased temperatures and decreased runoff in the Colorado River Basin, resulting from drought and climate change.

Between 2000 and 2020, overall snowfall and runoff into the Basin were well below the historical average, representing one of the lowest 21-year periods on record. The persistence of decades-long drought conditions has resulted in significant water-level declines in major system reservoirs. As of late 2020, the combined water storage in the Colorado River's two primary reservoirs (Lake Mead and Lake Powell) was at just 43 percent of capacity.

In the near term, hydrologic modeling indicates a high probability that Lake Mead water levels will continue to decline. Under the Colorado River Drought Contingency Plan (DCP), water users in the Lower Basin, including Nevada, will make DCP contributions to Colorado River storage when Lake Mead is projected to be at or below 1,090 feet. These contributions are in addition to mandatory shortages and together serve to bolster Lake Mead water levels and preserve critical operations.

Climate change is expected to significantly influence the long-term availability of water supplies within the Colorado River Basin. Multiple studies project a warmer and drier future, both locally and regionally. Projected climate change impacts range from decreased snowpack, precipitation and soil moisture to increased evaporation and stronger, longer and more frequent droughts. According to the U.S. Bureau of Reclamation's 2012 Colorado River Basin Water Supply and Demand Study, the Colorado River is projected to experience a median imbalance of 3.2 million acre-feet per year (AFY) between supply and demand by the year 2060 as a result of climate change and increased demands within the Basin.

The current planning environment also includes uncertainty associated with the availability of future resources and the accuracy of long-term water demand forecasts. These considerations, as well as how they are addressed in the 2020 Plan, are detailed briefly in the following sections.

SUPPLY & DEMAND

Water resource planning is based on two key factors: supply and demand. Supply refers to the amount of water that is available or that is expected to be available for use. Water demand refers to the amount of water expected to be needed in a given year. Water demand projections are based on population forecasts and include assumptions about future water use, such as expected achievements toward water conservation goals.

Projecting future demands is uncertain, particularly during periods of significant social and economic change. Assumptions are a necessary part of the planning process and conditions are unlikely to occur exactly as assumed. Likewise, climate variations, policy changes, implementation of new regulations and other factors can influence water resource availability over time.

The SNWA has worked for more than 25 years to develop and manage a portfolio of water resource options that can be used flexibly to meet short- and long-term water demands. The portfolio approach allows the SNWA to assess water demand conditions and resource options, and make appropriate decisions regarding what resources to bring online when necessary.

The SNWA's water resource portfolio includes permanent, temporary and future resources. Some of these resources are available for immediate use, such as Nevada's Colorado River allocation, Las Vegas Valley groundwater, Intentionally Created Surplus (ICS) and banked resources. Other resource options may require changes to rules that govern Colorado River resources, agreements, and/or the construction of additional facilities.

Improving water efficiency is integral to the SNWA's resource planning efforts and conservation remains a top priority for the community over the long-term planning horizon. Conservation helps to reduce demands and extend the availability of current and future water supplies.

To promote conservation, the SNWA continues to implement one of the most comprehensive programs in the nation. The program has helped the region reduce per capita water use by approximately 52 percent between 2002 and 2019, despite the addition of approximately 730,000 new residents.

The SNWA is currently working to achieve its conservation goal of 105 GPCD by 2035. As recommended by SNWA's 2020 Integrated Resource Planning Advisory Committee (IRPAC 2020), a new conservation goal will be evaluated once the current goal is achieved. While future conservation gains are expected to occur over the planning horizon, these gains will require significant additional effort, particularly with upward pressure on water use due to climate change and system age.

The SNWA estimates that climate change and other factors could increase local water demands. When considering these factors, the community will need to reduce demands by approximately 19 gallons per capita per day to meet its current conservation goal. As further recommended by IRPAC 2020, the SNWA will work to bolster conservation gains in Southern Nevada by focusing on consumptive water use reductions associated with non-functional turf, landscape watering compliance, customer leaks, evaporative cooling and new development. This includes ensuring that wastewater associated with future development is captured, treated and returned to Lake Mead for return-flow credits, rather than losing this valuable resource to disposal processes such as evaporation ponds and septic systems (see Chapter 3).

PLANNING FOR UNCERTAINTY

While preparing the 2020 Plan, the SNWA considered other factors related to water supply and demand conditions, including:

- The potential impact of continued drought and climate change on water resource availability, particularly for Colorado River supplies; and
- The potential impact of economic conditions, climate change and water use patterns on long-term water demands.

As in prior years, the SNWA used a scenario-based planning approach for its 2020 Plan. Key factors evaluated include possible reductions of Colorado River supplies, variation in future demands, and additional conservation.

As part of its planning process, the SNWA considered the increasing likelihood that water supply reductions would be imposed for Colorado River supplies in the near-term planning horizon. Mandatory water use reductions and other contributions are based on the projected surface

elevation of Lake Mead. Under federal shortage rules and the DCP, Nevada's obligation starts at 8,000 AFY when Lake Mead's elevation is at or below 1,090 feet. Contributions increase up to 30,000 AFY as the lake level declines.

For planning purposes, the SNWA assumes a further reduction of 10,000 AFY in the event Lake Mead's elevation declines below 1,020 feet. At the time of Plan publication, Lake Mead's elevation was at 1,085 feet. Additional information about Colorado River water use reductions is provided in Chapter 3.

The SNWA also considered economic growth in Southern Nevada. While Southern Nevada faces economic uncertainty related to the Covid-19 pandemic, long-term projections indicate that the region will continue to grow. However, a high level of uncertainty remains as to the magnitude and timing of population change, and what impact that change will have on associated short- and long-term water demands.

As further described in Chapter 4, the SNWA's resource planning scenarios consider these factors and bracket the range of reasonable supply and demand conditions that may be experienced over the 50-year planning horizon. This is a conservative approach that demonstrates how the SNWA plans to meet future needs, even if conditions change significantly over time.

ADAPTIVE MANAGEMENT

The SNWA has implemented several adaptation strategies to respond to the drought, climate change and other factors that affect the community's water supply. From the development of new facilities and aggressive water conservation to water banking and securing future resources, these efforts have reduced the potential for customer impacts.

Water conservation has reduced the potential for near-term supply impacts associated with mandatory shortage reductions and DCP contributions due to declining Lake Mead water levels. Nevada's Colorado River consumptive use was approximately 234,000 AFY in 2019, as described in Chapter 2. This is well below the annual basic Colorado River supply available to Nevada under current policy.

Water conservation has far-reaching benefits to the community and the Colorado River system as a whole. Locally, water conservation increases water efficiency and reduces demands. It also allows the SNWA to store or "bank" unused supplies. This, in turn, provides the SNWA with added flexibility in responding to drought conditions and meeting future demands. As of 2019, the SNWA stored more than two million acre-feet (AF) of water. This is nearly nine times Nevada's 2019 consumptive Colorado River water use.

On a larger scale, water conservation helped the SNWA to meet its commitments with interstate and federal partners to store water in Lake Mead. Together, partners have bolstered Lake Mead storage through Intentionally Created Surplus, as well as System Conservation and other initiatives that benefit the Colorado River system as a whole. Likewise, efforts by interstate and federal partners to develop and implement new Drought Contingency Plans in 2019 are helping to slow the decline of Lake Mead and Lake Powell water levels. To date, collaborations have reduced Lake Mead's water level decline by approximately 40 feet.

These efforts have provided the SNWA with time to complete essential infrastructure, helped to forestall a Colorado River shortage declaration, and allows for greater opportunities for water storage and recovery.

The SNWA completed construction of a new Low Lake Level Pumping Station at Lake Mead to help protect Southern Nevada from potential impacts of continued Lake Mead water level declines. Completed in 2020, the pumping station works in conjunction with SNWA's Lake Mead Intake No. 3 to preserve Southern Nevada's access to Colorado River water supplies to an elevation of 875 feet. These infrastructure additions have helped to ensure reliable water service, even during extremely low reservoir conditions, and provide new opportunities for the SNWA to explore water resource opportunities with Colorado River partners. Other benefits to the community include reduced pumping costs and enhanced operational flexibility.

Other adaptive management efforts include development and implementation of the SNWA's Pandemic Readiness and Response Plan. The plan was developed more than 10 years ago and has been updated to ensure operational continuity

during the Covid-19 pandemic. Southern Nevada's drinking water is treated using a combination of ozonation, filtration and chlorination, which are on the leading edge of water treatment processes and effective at removing contaminants from water.

The SNWA continuously monitors water quality to ensure water meets or surpasses drinking water standards and has plans in place to ensure ongoing reliable water delivery service to the community.

CURRENT PRIORITIES

As discussed in the chapters that follow and with continued progress toward the community's water conservation goals, the SNWA has sufficient permanent, temporary and future resources to meet all future planning scenarios described in Chapter 4. However, continued persistence will be required as the region faces prolonged drought and changing economic conditions, and as the entire Southwest region responds to hydrologic challenges related to climate change.

The SNWA's top priorities are to:

- Ensure water quality, reliability and security are maintained to the highest standards during the pandemic and throughout the long-term planning horizon.
- Reduce water demands and maximize the use of available resources through aggressive water conservation.
- Partner with SNWA's member agencies to develop agreements, policies and facilities to maximize the use of return-flow credits.
- Bank conserved resources and grow temporary supplies that can be used flexibly to meet demands and/or offset potential supply reductions.
- Work with interstate and federal partners on initiatives designed to slow the decline of Lake Mead water levels and reduce the magnitude of potential supply reductions.
- Explore collaborative water resource projects with other Colorado River partners, including emerging opportunities.
- Continue to develop and implement adaptive management strategies that proactively address new and evolving challenges.

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Lake Mead, Nevada

PLAN INTRODUCTION

THIS CHAPTER PROVIDES AN OVERVIEW OF SNWA RESOURCE PLANNING EFFORTS. IT INCLUDES AN ABBREVIATED HISTORY OF WATER IN SOUTHERN NEVADA, FOCUSING ON MAJOR ISSUES AND INITIATIVES THAT OCCURRED DURING THE LAST CENTURY.

INTRODUCTION

For much of its past, the area now known as Clark County was little more than a collection of scarce watering holes for various trails through the Mojave Desert. With the coming of the railroad in 1905, the privately operated Las Vegas Land and Water Company was formed to build and operate the area's first system for conveying local spring water. In these early years, the community viewed its supply of artesian water as virtually inexhaustible and more than adequate to meet the needs of any growth that might occur.[1]

In 1922, the Colorado River Compact defined the geographic areas of the upper and lower basins of the Colorado River, apportioning 7.5 million acre-feet of water per year (AFY) to each. Of the Lower Basin's 7.5 million AFY, the Boulder Canyon Project Act authorized the apportionment of 300,000 AFY to Nevada, 2.8 million AFY to Arizona and 4.4 million AFY to California. At the time, Nevada's negotiators viewed 300,000 AFY as more than a reasonable amount; Southern Nevada had no significant agricultural or industrial users, and groundwater seemed plentiful.[2]

These conditions changed significantly over time. By 1940, local resource managers began expressing concerns about limited groundwater supplies, water waste and declining groundwater levels. While the Colorado River Compact and subsequent construction of Hoover Dam in 1936 made Colorado River water a viable future resource, the lack of infrastructure and sufficient funding for capital improvements precluded any immediate use to support development in the growing region.

In 1947, the Nevada Legislature created the Las Vegas Valley Water District (LVVWD) to help manage local water supplies. The LVVWD acquired the assets of the Las Vegas Land and Water Company and began operations in 1954 as the municipal water purveyor for Las Vegas and unincorporated Clark County.

Shortly thereafter, the LVVWD entered into agreements with what is now known as Basic Water Company (BWC) for the expansion of BWC's small industrial water line to deliver Colorado River water to the LVVWD service area.

Given the astonishing pace of growth that occurred over the next several years and the limits of the existing pipeline, the LVVWD initiated formal engineering studies for new facilities to import additional Colorado River water into the Las Vegas Valley from Lake Mead. This effort ultimately resulted in the construction of the Alfred Merritt Smith Water Treatment Facility and associated intake, pumping and transmission facilities (collectively referred to as the Southern Nevada Water System or SNWS), which became operational in 1971. The SNWS was first expanded in 1982 (and again in the years to follow) in response to increasing demands.

By the latter part of the 20th century, water planners estimated that the region would soon reach the limits of its Colorado River apportionment.[3] In 1989, as a result of profound uncertainty created by population growth and future resource availability, the LVVWD filed applications for unappropriated groundwater in eastern Nevada and began storing its remaining unused Colorado River water for future use (see Chapter 2). During this time, the community also implemented its first significant conservation effort—Operation Desert Lawn. The program resulted in ordinances by the local municipalities restricting landscape irrigation during the hottest times of the day.

CREATION OF SNWA

By the end of the 1980s, resource challenges had reached a critical point; with the new decade, local leaders began to aggressively explore different options for extending and managing water resources, while meeting the ongoing demands of the community.

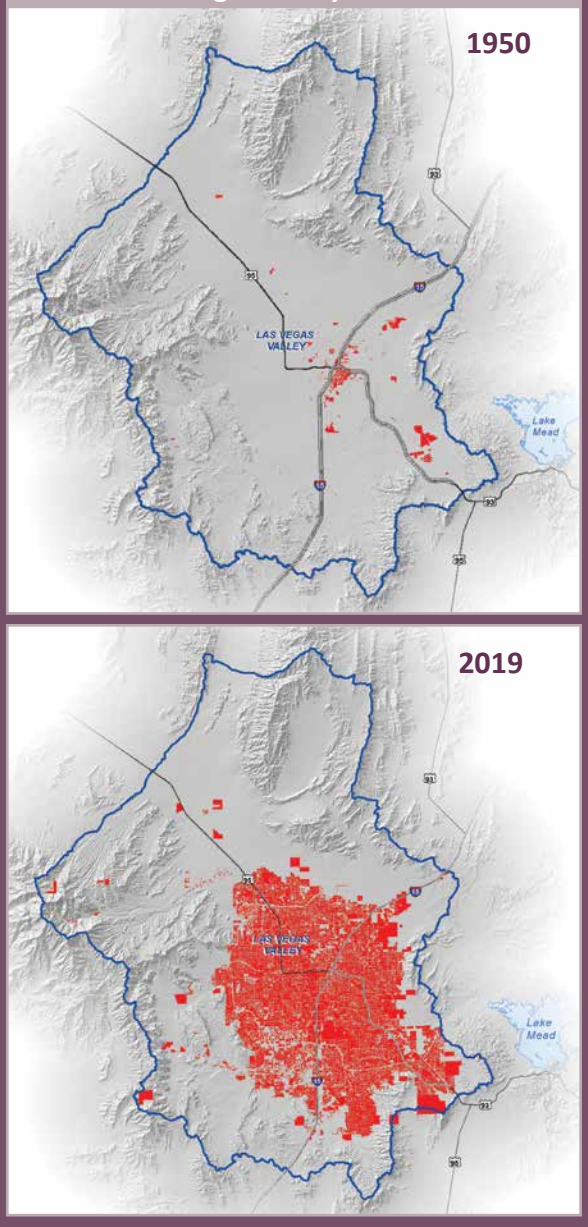
A Century of Change

With the birth of Las Vegas in 1905 as a way station for the San Pedro, Los Angeles and Salt Lake Railroad, Southern Nevada began to attract a large number of residents and businesses.

From an estimated population of more than 40,000 in 1950 to more than 2.3 million in 2019, the Southern Nevada region has experienced change faster than almost any other region in the nation during this same time. Population density in the Las Vegas area is the highest in the interior western U.S.[4]

Today, Southern Nevada is home to 74 percent of Nevada's total population. The region uses less than five percent of all water available for use in the state.

Las Vegas Valley Land Use



One of the most significant events to occur during this time was the formation of the Southern Nevada Water Authority (SNWA) in 1991 through a cooperative agreement among seven water and wastewater agencies:

- Big Bend Water District
- City of Boulder City
- City of Henderson
- City of Las Vegas
- City of North Las Vegas
- Clark County Water Reclamation District
- Las Vegas Valley Water District

Today, these seven agencies provide water and wastewater service to nearly 2.3 million residents in the cities of Boulder City, Henderson, Las Vegas and North Las Vegas, and portions of unincorporated Clark County (Figure 1). Since its inception, the SNWA has worked to acquire and manage water supplies for current and future use; construct and operate regional water facilities; and promote conservation.

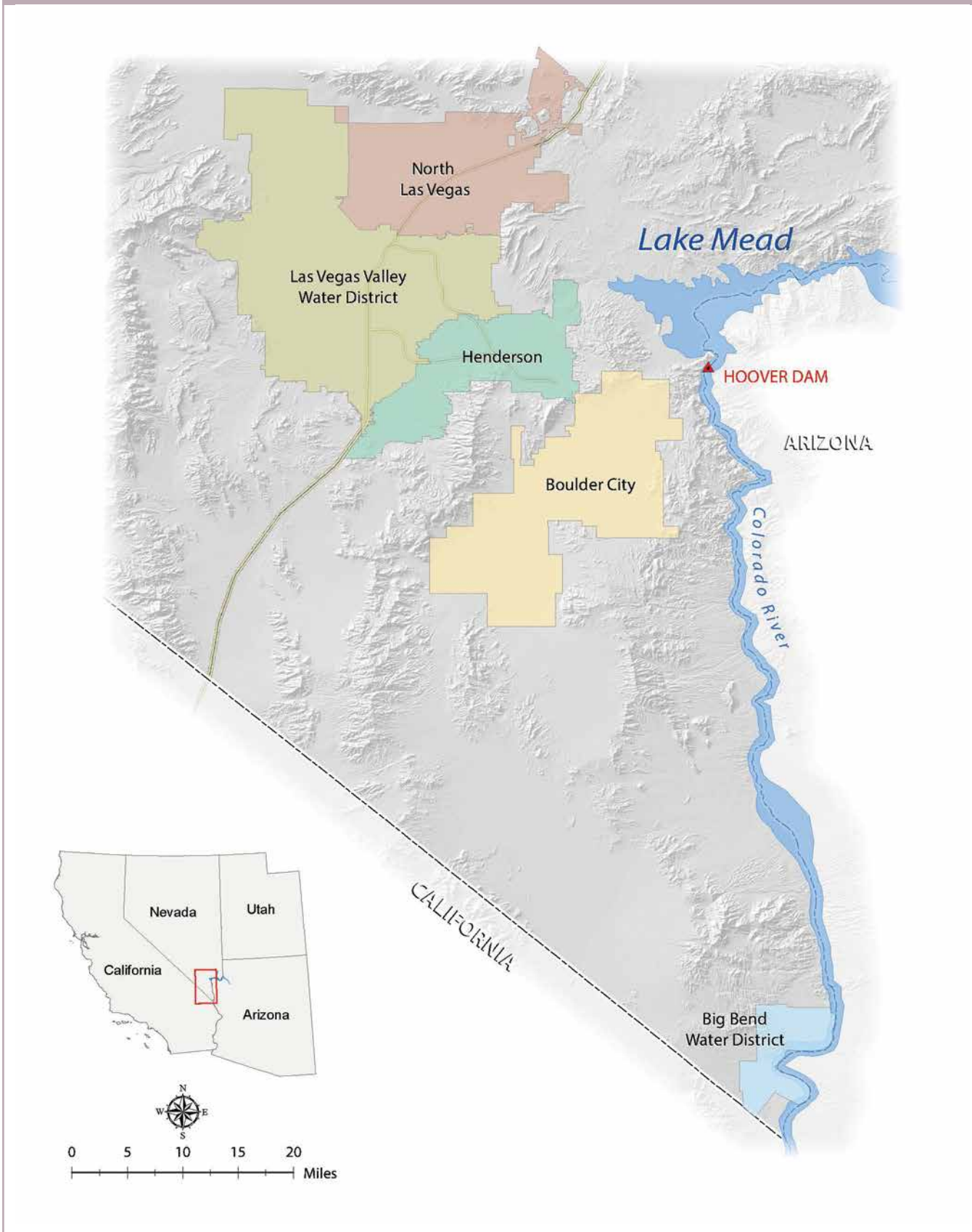
Water Supply Acquisition and Management

Since 1991, the SNWA has worked diligently to develop and manage a flexible portfolio of diverse water resource options resulting from years of in-state, interstate and international collaborations. These resources include groundwater and surface water rights in the state of Nevada, Colorado River water, as well as temporary resources that are stored in the form of storage credits. A detailed summary of the SNWA Water Resource Portfolio is provided in Chapter 3.

Construction and Operation of Regional Water Facilities

To meet the community's current and long-term water resource needs, the SNWA is responsible for constructing and operating regional water facilities, including the SNWS, which was expanded in 2002 to include the River Mountains Water Treatment Facility. The SNWA has completed several improvements and expansions to these facilities over the years to increase capacity to 900 million gallons per day (MGD). Pumping facilities and state-of-the-art treatment and laboratory facilities were also constructed and updated to ensure the availability of high-quality, reliable water supplies. These efforts were phased, coming online just in time to meet demands.

FIGURE 1 **SNWA Purveyor Service Areas**



The SNWA is responsible for managing Southern Nevada's long-term water resources, constructing and operating facilities and encouraging water conservation.

Planning for the Future

The SNWA's 2020 Plan is based on an integrated resource planning process that involved public stakeholders.

The SNWA Cooperative Agreement was amended in 1996 to require adoption of a Water Resource Plan. The SNWA adopted its first Water Resource Plan that same year.[7] The plan is reviewed annually and updated as needed to reflect changing developments in Southern Nevada's overall water resource picture.

The SNWA's 2020 Plan is based on input from public stakeholders. The SNWA has a long history of engaging the public in major planning decisions and has formed a number of citizen advisory committees over the years to make recommendations on critical issues. Committees have considered topics ranging from regional water facilities, water resources and water quality issues to capital funding and drought response.

The SNWA's latest committee process—the Integrated Resource Planning Advisory Committee 2020 (IRPAC 2020)—was formed in 2019 to evaluate and make recommendations on issues of interest to the SNWA's long-term planning efforts. The committee met nine times through mid-2020 and made recommendations on the topics of water infrastructure, water resources, water conservation and regional water rates. The SNWA Board of Directors considered and approved the committee's recommendations in September 2020 (Appendix 3).

As discussed in Chapter 2, the SNWA recently completed construction of a new raw water intake (Intake No. 3) and Low Lake Level Pumping Station (L3PS) at Lake Mead in response to extraordinary drought conditions in the Colorado River Basin. These facilities offset risk associated with future Lake Mead water level declines and preserve the community's access to available Colorado River water supplies, even under extremely low reservoir conditions. As detailed in Chapter 3, the SNWA is pursuing water projects with Colorado River partners and will use these facilities to access current and future Colorado River supplies.

Water Conservation

The SNWA and its member agencies have worked diligently over the years to maximize the availability of existing water supplies and reduce overall water demands. The community's first water conservation plan was adopted in 1995[5] and the SNWA's current plan was adopted in 2019.[6] During this time frame, the community has consistently set and achieved aggressive water conservation goals. As noted on left and described in Chapter 3, the SNWA's 2020 Integrated Resource Planning Advisory Committee (IRPAC 2020) made recommendations on additional conservation activities. These recommendations are being addressed now and will be included as part of SNWA's next Conservation Plan update.

To promote conservation efforts, the SNWA developed and implements a comprehensive water conservation program consisting of regulation, pricing, education and incentives designed to work together to improve water efficiency and reduce demands. The SNWA member agencies also implemented a number of water use and development ordinances, which have since become a permanent part of the community's overall conservation effort. Information on Southern Nevada's conservation efforts is provided in Chapter 3. Detailed program information and other conservation resources are available online at snwa.com.

2020 Water Resource Plan

The SNWA's 2020 Plan provides a comprehensive overview of water resources and demands in Southern Nevada, and discusses factors that will influence resource availability and use over a 50-year planning horizon. The plan does not intend to specifically address all aspects of water resource management and development; rather, it serves as a companion to other detailed planning documents, including:

- SNWA Major Construction and Capital Plan
- SNWA Water Conservation Plan
- Regional Water Quality Plan for the Las Vegas Valley Watershed
- Annual Operating Plan for the Las Vegas Valley Watershed
- SNWA Financial Budget and Comprehensive Annual Financial Report
- SNWS Operating Plan
- SNWA Water Budget

Integrated Resource Planning

As part of its overall water resource planning efforts, the SNWA has completed a number of integrated water resource planning processes. Integrated resource planning applies important concepts to traditional resource and facility planning, including involvement of the public early in the planning process as well as frequent reassessment, particularly as conditions change. These efforts have helped identify the appropriate combination of resources, facilities, conservation programs and funding formulas needed to meet current and future water demands in Southern Nevada.

Recommendations resulting from these integrated resource planning processes are presented to the SNWA Board of Directors for consideration and incorporated into overall water resource planning efforts as approved. The 2020 Plan incorporates the recommendations from IRPAC 2020, which were approved by the SNWA Board of Directors in September 2020. Among other things, recommendations address specific water conservation efforts needed to help the community meet its water conservation goal.

CHAPTER SUMMARY

The SNWA Water Resource Plan is an important tool designed to help the SNWA anticipate and plan for future water supply and related facility needs, which have changed significantly over the years.

Since its formation in 1991, the SNWA has worked closely with its member agencies to meet the region's long-term water demands by acquiring and managing current and future water supplies; constructing and operating necessary facilities; and promoting conservation. In addition, the SNWA has developed partnerships with other Colorado River Basin States (Basin States), working collaboratively to maximize opportunities for the flexible use of Colorado River resources.

These efforts will continue to be of paramount importance in the years to come, particularly as climate change and drought are anticipated to reduce the availability of supplies, and as changing economic conditions create new uncertainties for Southern Nevada's short- and long-term water resource needs. These challenges, as well as the SNWA's associated response efforts, are discussed in Chapter 2. The balance of this document provides a comprehensive overview of the SNWA Water Resource Portfolio (Chapter 3); a detailed discussion of how the SNWA plans to meet current and future regional water demands (Chapter 4); and a discussion on environmental initiatives underway to support water resource development and management efforts (Chapter 5).

ENDNOTES

1 "Water: A History of Las Vegas, Volume 1," 1975, Florence Lee Jones and John F. Cahlan, p.53.

2 "The Hoover Dam Documents," 1948, Ray Lyman Wilbur and Northcutt Ely.

3 "WRMI Process—Water Supply Planning for the Las Vegas Region," January 1991, published May 1992, prepared for Las Vegas Region Water Utilities by Water Resources Management, Inc.

4 Metropolitan Statistical Area Distance Profiles 2010, U.S. Census Bureau.

5 "Memorandum of Understanding Regarding Southern Nevada Water Authority's Water Conservation/Efficiency Programs," January 26, 1995, amended March 18, 1999, SNWA.

6 "Southern Nevada Water Authority Joint Water Conservation Plan," November 2019, SNWA.

7 "Southern Nevada Water Authority 1991 Cooperative Agreement," between Big Bend Water District, City of Boulder City, City of Henderson, City of Las Vegas, City of North Las Vegas, Clark County Water Reclamation District (previously Clark County Sanitation District), and Las Vegas Valley Water District. Amended 1994 and 1996.

Hoover Dam and Lake Mead, Nevada

CURRENT PLANNING ENVIRONMENT

THIS CHAPTER PROVIDES AN OVERVIEW OF CURRENT AND EMERGING ISSUES THAT ARE LIKELY TO INFLUENCE WATER SUPPLY AND DEMAND CONDITIONS IN SOUTHERN NEVADA OVER THE 50-YEAR PLANNING HORIZON.

INTRODUCTION

As discussed in Chapter 1, water supply and demand conditions have evolved significantly in Southern Nevada over the past century. As a result, resource strategies have needed to adapt. Time and again, the community rose to these challenges, developing new water resources and facilities, and significantly reducing water demands through aggressive water conservation efforts.

At the beginning of the 21st century, new issues began to emerge that have required a similar approach: close monitoring and adaptive response. Drought, climate change and changing economic conditions have become the persistent challenges of this century. Individually or combined, these factors significantly influence local water demands, as well as the resources and facilities needed to support those demands over time.

This chapter describes the challenges that exist within the current planning environment, as well as the planning and response efforts taken by the SNWA, with community support, to minimize those impacts and ensure reliable water supplies. As described in Chapter 3 (SNWA Resource Portfolio) and Chapter 4 (Meeting Future Demands), the SNWA has sufficient resources to meet the needs of the community over the 50-year planning horizon.

The SNWA is well prepared to respond to evolving conditions as they arise through close monitoring, proactive planning and adaptive management. As discussed later in this chapter, the SNWA has taken a number of actions to minimize the effects of drought and climate change in the Colorado River Basin on Southern Nevada's water supply and demand.

DROUGHT AND CLIMATE CHANGE

Colorado River water supplies are derived primarily from snowmelt and runoff from the Rocky Mountains, as well as the Wind River, Uintah and Wasatch mountains (collectively referred to as the Upper Colorado River Basin). Beginning in 2000 and continuing today, the Colorado River Basin has experienced drought conditions that quickly developed into the worst drought in the Basin's recorded history (Figure 2.1).

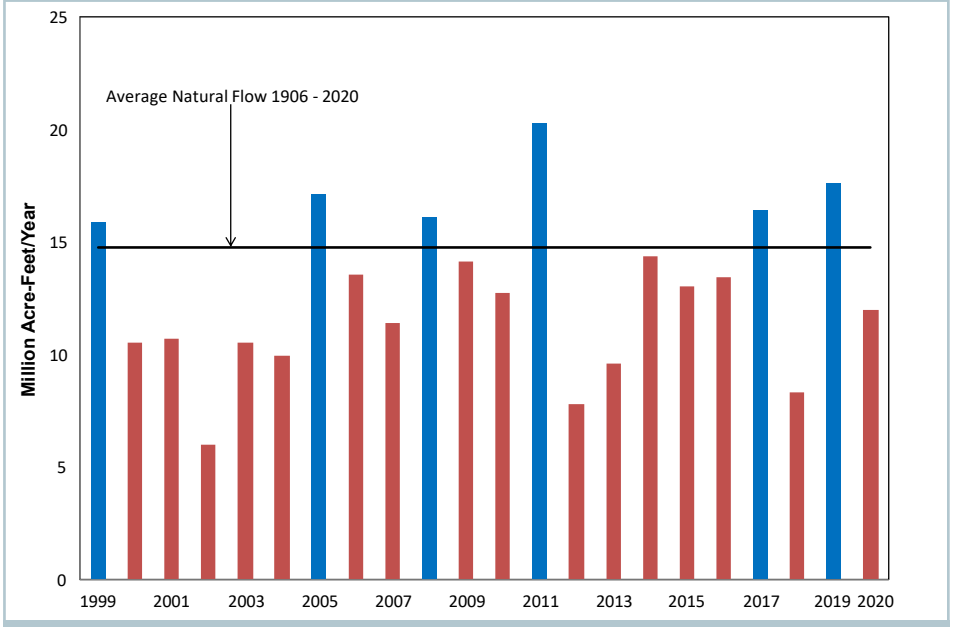


FIGURE 2.1 **Annual Colorado River Natural Flow 1999–2020**[1]

Between 2000 and 2020, overall snowfall and runoff into the Basin were well below the historical average, representing one of the lowest 21-year periods on record. While conditions in the Basin improved during 2019, the persistence of decades-long drought conditions has resulted in significant water level declines at major system reservoirs. As of late 2020, the combined water storage in the Colorado River's two primary reservoirs (Lake Mead and Lake Powell) was at just 43 percent of capacity.[2] As described in Chapter 4, further water-level declines are expected.

Recent studies provide evidence that current drought conditions, including reduced streamflows, are at least partially due to warming temperatures within the Colorado River Basin.[3] This warming is primarily a result of increased concentrations of greenhouse gases (GHGs) in the Earth's atmosphere. Since the early 20th century, observations indicate that global mean annual air temperatures have warmed 1.8°F.[4] Consistent with global trends, warming has also occurred in the southwestern United States. While climate change models project that warming trends will continue (Figure 2.2), the magnitude of change at a given location will depend in part on global mitigation efforts to reduce GHG emissions.

Locally, projections indicate that Clark County will warm between 5-10°F by the end of the century.[5] Compared to relatively uniform projected temperature increases in the Southwest, precipitation patterns are highly variable and show substantial shifts in where and how the precipitation falls. In addition, rising temperatures will cause a greater percentage of precipitation to occur in the form of rain rather than snow, and snowpack will melt earlier and be less efficient as runoff due to dry soil conditions and increasing temperatures. In some areas, this may result in significant reductions in water supply, while other areas experience greater frequency and severity of flood events.[6]

From a planning perspective, water resource managers can't afford to consider climate change and climate change impacts as something that might happen later on. Evidence supports the fact that climate change is happening now and that it will have a lasting effect on the availability of Colorado River water supplies.

Direct climate change impacts will revolve around water quantity, particularly the form and distribution of precipitation, and increasing water demands. Rising air temperatures can also affect soil moisture, and ultimately reduce the volume and timing of snowmelt runoff. In addition, changes to water quality from rising stream flow temperatures and changes in reservoir volumes are also important considerations.

There are two primary consequences for Southern Nevada associated with continued Lake Mead water level declines: possible reduction of Colorado River resources and operating limitations associated with SNWA's water facilities at Lake Mead.

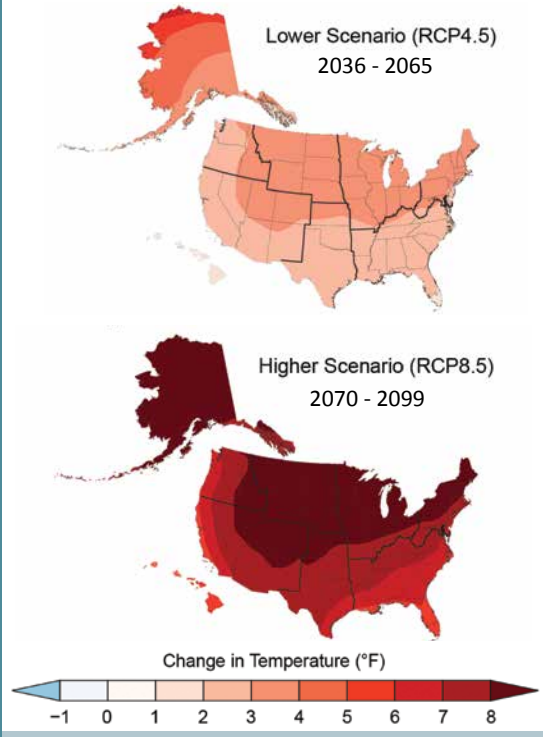


FIGURE 2.2 **Climate Change Range of Possible Future Warming in North America 2036 – 2099** (2018) National Climate Assessment.

Potential Supply Impacts

In 2007, the Secretary of the Interior issued a Record of Decision for the Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, also referred to as "Interim Guidelines."[7] Among other things, the Interim Guidelines established how shortages in the Lower Basin will be implemented.

According to the Interim Guidelines, the Secretary of the Interior will make a shortage declaration based on a projection of Lake Mead water levels as determined by the U.S. Bureau of Reclamation's Colorado River modeling efforts. The forecast is reviewed annually in August; if Lake Mead is forecasted to be at or below

1,075 feet on January 1 of the following year, a shortage declaration will be made.

Modeling efforts conducted by the U.S. Bureau of Reclamation in August 2020 indicate an approximate 23 to 53 percent probability of shortage annually in years 2022-2025. The probability ranges from approximately 50 to 64 percent annually in the years thereafter.[8] The model applies historical flows to simulate future conditions, representing both wet and dry years on the Colorado River. Under a shortage declaration, the amount of Colorado River water available for use to Nevada will be reduced up to 20,000 AFY. When factoring in drier hydrology assumptions related to climate change, the probability for shortage within these time frames increases.

In addition to mandatory shortage reductions defined by the Interim Guidelines, the SNWA and Lower Colorado River Basin water users in Arizona and California will make contributions as defined by the Lower Basin Drought Contingency Plan Agreement (DCP).[9] A summary of shortage amounts/DCP contributions is provided in Appendix 5.

Nevada's DCP contribution will be incurred when the projected elevation of Lake Mead is at or below 1,090 feet. As further described in this chapter, the DCP was approved in 2019 to help mitigate the impacts of drought (see also Adaptive Management). Like the Interim Guidelines, thresholds for DCP contributions are based on the U.S. Bureau of Reclamation's August projection of Lake Mead water levels on January 1 of the succeeding year.

As shown in Figure 2.3, SNWA's DCP contributions and shortage reductions are staged to increase as Lake Mead water levels decline. Nevada's obligation under these

LAKE MEAD WATER LEVEL (FT)	SHORTAGE AMOUNT (AFY)	DCP CONTRIBUTION (AFY)	TOTAL (AFY)
ABOVE 1,090	0	0	0
AT OR BELOW 1,090	0	8,000	8,000
AT OR BELOW 1,075	13,000	8,000	21,000
BELOW 1,050	17,000	8,000	25,000
AT OR BELOW 1,045	17,000	10,000	27,000
BELOW 1,025	20,000	10,000	30,000

FIGURE 2.3 **SNWA Shortage/DCP Contribution**

agreements ranges from 8,000 AFY to a combined maximum of 30,000 AFY. If at any time Lake Mead is projected to fall below an elevation of 1,030 feet, the Secretary of the Interior will consult with Lower Basin stakeholders to determine if additional actions are needed to protect against the potential for Lake Mead to decline below 1,020 feet.[10]

Potential Facility Impacts

Lake Mead's surface elevation is down by approximately 129 feet since 2000. In 2016, the lake's elevation reached its lowest point since it began filling in the 1930s (Figure 2.4).[11] Lake Mead water levels have experienced some improvement due to strong snowpack and above-average runoff within the Basin during 2019, as well as benefits realized from interstate collaboration (see page 19).

As of late 2020, Lake Mead's water level was at approximately 1,085 feet. Based on current and forecasted conditions, however, there remains a high probability that Lake Mead water levels will continue to decline, potentially reaching an elevation of 1,000 feet or lower within the next decade. Protecting Lake Mead from continued water level decline is

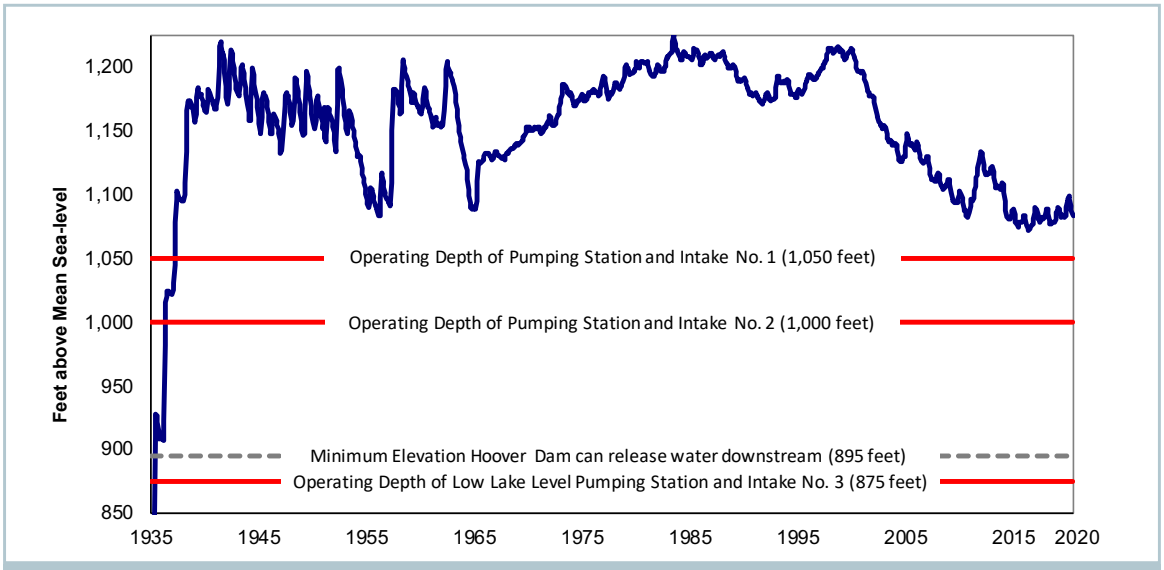


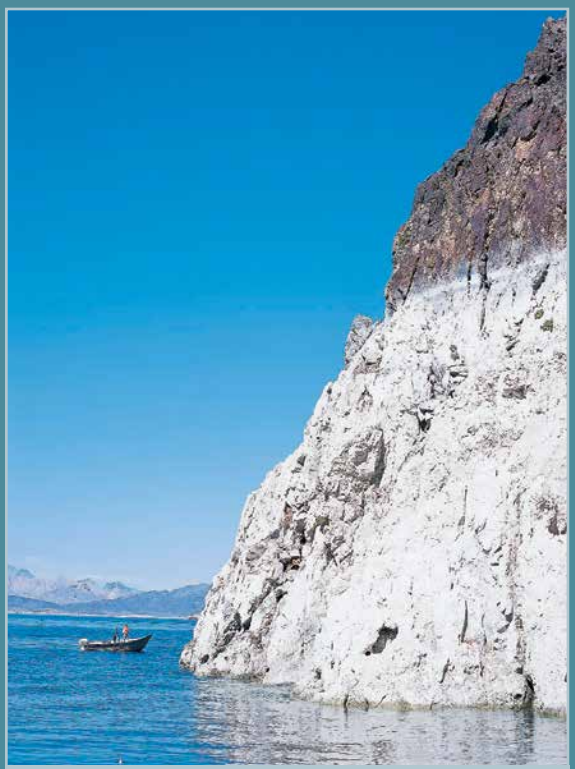
FIGURE 2.4 **Historical Lake Mead Elevations**

State of the Science Report

Increasing water demand, dry conditions and warming temperatures have impacted the Colorado River in recent years, creating greater uncertainty about the basin's future water supply availability. To more clearly understand the latest and best available science on these and related topics, the SNWA and other Colorado River Basin states and water managers pursued the creation of the Colorado River Basin Climate and Hydrology: State of the Science Report. [12]

The report integrates nearly 800 peer-reviewed studies, agency reports and other sources to assess the state of the science and the technical methods relevant to water resources in the Colorado River Basin. Further, it establishes a shared understanding of the physical setting, as well as the latest data, tools and research that underpins Colorado River water resource management.

Report findings confirm that temperature trends are increasing and precipitation, snowpack water volume and annual streamflow trends are decreasing. The SNWA and others will use the report—which identifies both challenges and opportunities—to improve the short-term and mid-term foresting and long-term projections for the Colorado River system. This information and associated work efforts will expand the SNWA's resource management and planning capacity.



Lake Mead Water Level Decline

a priority for Colorado River stakeholders. Below a Lake Mead elevation of 895 feet, Hoover Dam can no longer deliver Colorado River water to downstream users.

The SNWA has a total water treatment and transmission capacity of at least 900 MGD, consisting of raw water intakes and associated pumping facilities. Until 2020, SNWA pumping facilities were limited in their operating range relative to the elevation of Lake Mead (Figure 2.4). As detailed later in this chapter, the SNWA recently completed two major construction projects (Low Lake Level Pumping Station and Intake No.3), which together preserve full capacity under low lake level conditions, allowing the SNWA to pump from a Lake Mead elevation as low as 875 feet.

Completed in 2012, the U.S. Bureau of Reclamation released a study that projects a median imbalance of 3.2 million acre-feet per year (AFY) between supply and demand by the year 2060 due to climate change and increased demands within the Basin.[13] This study and the more recent 2020 State of the Science Report recognize the amount of water apportioned within the Colorado River Basin exceeds long-term average historic inflows, a situation that has been exacerbated over the last 20 years by drought and climate change. Average Colorado River inflows over the last two decades are about 12.5 million AFY. This is lower than the amount of water allocated to the Colorado River Basin states and Mexico (16.5 million AFY), and substantially lower than the 1909 - 1928 historical average flow that was considered in determining compact allocations (about 17.7 million AFY).

These studies recognized that climate change will not only affect the amount of water available for use but overall demands as well. As temperatures warm, water evaporation and evapotranspiration rates will increase, resulting in higher water demands for agricultural irrigation and landscaping uses. Reductions in use among those who share the Colorado River is needed to ensure supply and demand remains in balance, and that the river is sustainably managed.

Potential Demand Impacts

In Southern Nevada, the impacts of climate change are expected to be similar to that of drought. This includes extended durations of low Lake Mead elevations, water quality changes, possible reductions of Colorado River resources, and potential increases in water use to compensate for warmer and drier conditions.

Warmer and drier conditions are likely to increase local water demands, particularly for landscape irrigation and evaporative cooling systems. As described in Chapter 3, upwards pressure due to climate change and system age could increase local water demands. When considering these factors, the community will need to reduce demands by approximately 19 gallons per capita per day (GPCD) to meet its current conservation goal.[14]

LOCAL ECONOMIC CONDITIONS

Southern Nevada's economic situation changed drastically in 2007, when the national economy began to experience its (then) most significant decline since the 1930s. Southern Nevada was hit harder than almost any other region in the nation. This period of recession marked the first time in decades that the Las Vegas area experienced a sustained period of little or no growth (Figure 2.5).[15] For a few years following the downturn, gaming and tourism revenues declined. This was followed by a record spike in unemployment. Most new residential and commercial development projects came to a halt, and home foreclosures flooded the real estate market.

The economy has improved steadily in the region since 2012. However, conditions changed again in March 2020, when a global pandemic quickly spread within the community and throughout the world. Locally, Southern Nevada experienced a profound rise in unemployment due to non-essential business closures and the sudden halt to gaming and tourism activity.

While most business restrictions began to ease in May and June 2020, employment and economic activity remain far from pre-pandemic norms. It remains unclear at this time if additional restrictions will be implemented and, if so, how long they will last. The short and long-term economic impacts associated with the ongoing pandemic create tremendous economic uncertainty in communities throughout the nation and around the globe, including Southern Nevada.

According to the Center for Business and Economic Research (CBER) at the University of Nevada, Las Vegas, the short-term forecasts exhibit high uncertainty due to the current pandemic.[16] CBER forecasts that Southern Nevada population growth will continue over the long-term planning horizon, although actual growth rates will occur faster or slower than forecasted as demonstrated by Southern Nevada's unpredictable past.

While Southern Nevada has demonstrated its ability to recover from challenging economic conditions in its past., it is difficult to predict how current events will affect short and mid-term population changes, and, in turn, local water demands.

ADAPTIVE MANAGEMENT

Adaptive management relies on continuous assessment, flexible planning and action. As the region's wholesale water provider, the SNWA is responsible for anticipating future demands and taking the steps necessary to meet those demands over time. As discussed earlier in this chapter, the current planning environment contains significant uncertainties—drought and climate change have impacted water facilities, water supply availability, water quality and water demands. In addition, factors associated with Southern Nevada's local economy and its rate of growth make predicting future water

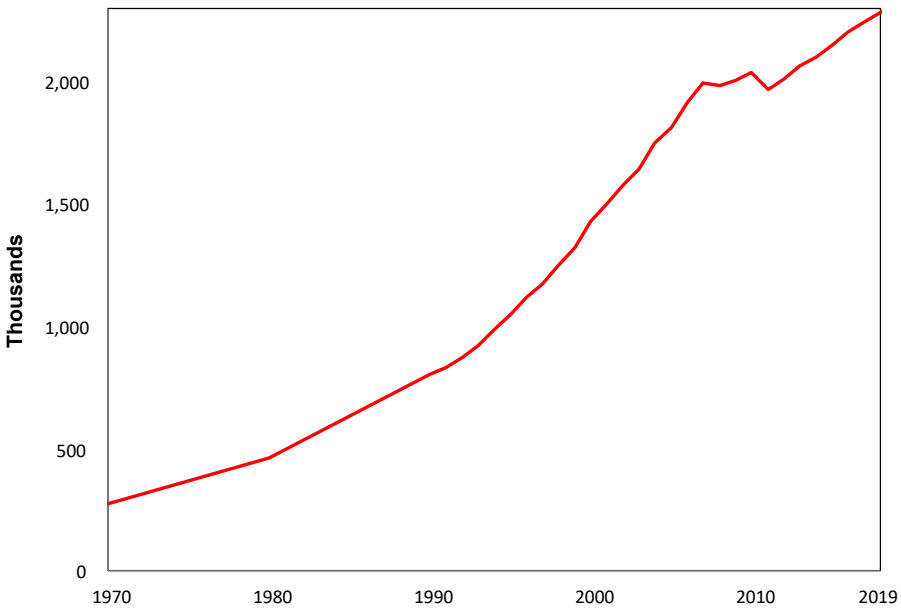


FIGURE 2.5 **Historical Clark County Population**

Adaptive Management in Action

Over the years, SNWA has taken several adaptive management steps to reduce impacts to water supplies and facilities in response to drought and climate change. These include:

- Reduced consumptive use of Colorado River supplies by approximately 108,000 AFY (approximately 35 billion gallons) between 2002 and 2019, even with the addition of more than 730,000 new residents.
- Stored nearly nine times Nevada's 2019 Colorado River consumptive use through increased water banking, storage and recharge efforts.
- Completed new Intake No. 3 and Low Lake Level Pumping Station (L3PS) to ensure continued delivery of Colorado River water supplies under low reservoir conditions.
- Acquired and developed surface water in Clark County through resource leases and purchases.
- Worked with Colorado River stakeholders to develop and implement innovative programs and agreements to improve resource management, preserve Colorado River operations for Lower Basin water users and increase the flexible use of Colorado River resources.

Low Lake Level Pumping Station Construction

demands challenging, particularly in light of the region's previous growth history.

The following sections detail how the SNWA plans to address these challenges—while some steps are being taken now to protect current water supplies from the effects of drought and climate change. Other steps are considered long-term continuous efforts that will remain a priority for many years to come.

Lake Mead Facility Improvements

To mitigate impacts associated with a potential Lake Mead water level decline below 1,000 feet and potential water quality concerns during low reservoir conditions, the SNWA constructed a new intake and pumping station at Lake Mead to ensure continued access to Colorado River resources. These facilities were developed to address drought conditions and climate change.

The SNWA put its new intake (Intake No. 3) and Low Lake Level Pumping Station into service in 2015 and 2020, respectively. Together, these facilities preserve existing capacity and allow the SNWA to pump from a Lake Mead elevation of 875 feet. This is approximately 20 feet below the minimum elevation that Hoover Dam can release water downstream. Major construction efforts were based, in part, on the recommendation of a prior Integrated Resource Planning Advisory Committee, which determined that the risk of Lake Mead's elevation falling below 1,000 feet is not acceptable for Southern Nevada due to the potential impacts on water delivery and resource availability.

These adaptive management measures help to ensure reliable water service, even during extremely low reservoir conditions, and provide new opportunities for the SNWA to explore water supply agreements with other downstream Colorado River water users.

Water Conservation

The SNWA continues to implement one of the most progressive water conservation programs in the nation and will continue to evaluate higher levels of conservation as goals are achieved. As detailed in Chapter 3, the SNWA and its member agencies utilize regulation, pricing, education and incentives to affect necessary water conservation savings.

The SNWA does not anticipate any near-term customer impacts associated with a federal shortage declaration or implementation of the DCP. This is due in large part to the success of local conservation efforts. The Southern Nevada community took both serious and sustained action as the drought took hold in the early 2000s. These efforts have provided a significant buffer against water supply impacts over the near-term planning horizon. By the end of 2019, Southern Nevada's consumptive

use of Colorado River resources was 234,000 AFY. This is well below any Colorado River water supply reduction/DCP contribution that may occur under the Interim Guidelines and DCP. As further described in Chapter 3, conservation will remain an ongoing priority for Southern Nevada, and the SNWA has taken steps to enhance education, outreach and incentive programs to support continued water savings.

Interstate Collaboration

The Colorado River Basin states are collaboratively working with U.S. federal partners and Mexico to augment water supplies, improve system efficiency, and protect power generation and access to water supplies. These efforts range in nature from investing in infrastructure improvements in Mexico to system efficiency and conservation efforts that have mutual benefit to Colorado River Basin water users.

Drought Response Actions. In 2014, the SNWA entered into two agreements with federal, state, philanthropic organizations and other Colorado River water users to help mitigate the impacts of ongoing drought and bolster reservoir elevations.[17] [18] These efforts are intended to protect against critical reservoir elevations that threaten hydropower generation at Glen Canyon and Hoover dams, and access to water supplies for millions of Lower Basin water users.

As part of one agreement, the SNWA and other Colorado River partners agreed to forgo off-stream banking efforts to leave water in Lake Mead. As part of another agreement project partners paid approximately $29.8 million for conservation projects that benefit the Colorado River system as a whole. As part of this effort, partners evaluated and selected projects, and compensated users for voluntary water use reductions. Projects included land fallowing, agricultural water efficiency, wastewater effluent recovery, turf removal and other conservation projects.

Unlike water resources in the SNWA Water Resource Portfolio, water conserved as a part of these agreements benefit the entire Colorado River System by increasing reservoir elevations; these resources cannot be recovered by any individual water user.

Drought Contingency Plan. The Upper and Lower Colorado River Basin states adopted drought contingency plans in 2019 that build upon the Interim Guidelines. Authorized by Congress for immediate implementation, the plans recognize the increased potential for lakes Powell and Mead to reach critically low elevations, as well as the increasing potential for water supply interruptions. Together, the plans commit the states and federal government to additional actions designed to improve reservoir storage and preserve system operations during low lake level conditions.

Beyond the mandatory shortage reductions prescribed under the Interim Guidelines, the Lower Basin DCP requires additional water contributions by the Lower Basin states, including Nevada, Arizona and—for the first time—California. Together, the Lower Basin states will contribute between 200,000 AFY and 1.1 million AFY when Lake Mead is at or below 1,090 feet. Like the Interim Guidelines, DCP contribution amounts are based on Lake Mead water levels. Likewise, with implementation of the DCP and as part of its Water Scarcity Plan, Mexico will join the states' efforts to store additional water in Lake Mead as elevations drop.

Implementation of the DCP will help to keep more water in the Colorado River for the benefit of all water users and the environment; help slow Lake Mead water level declines to preserve critical elevations; and allow states to withdraw some of their contributions when Lake Mead water levels recover. It also expands and modifies creation and recovery provisions for Intentionally Created Surplus (ICS). The SNWA plans to meet its commitments under the Interim Guidelines and DCP with conservation savings and temporary resources as described below and in Chapter 3.

Water Banking Efforts. The Seven States have worked collaboratively over the years to store or "bank" available Colorado River water and other unused supplies through various storage efforts. As of 2019, the SNWA has banked resources in the Southern Nevada Water Bank, in the Arizona and California water banks, and Lake Mead (in the form of ICS). As noted above, the DCP builds upon the Interim Guidelines by requiring Lower Basin states to store additional water in Lake Mead and expands recovery provisions during a declared shortage. This provides increased access to banked supplies and enhances operational flexibility for the SNWA and other Colorado River water users.To the extent possible, the SNWA will continue water banking efforts to build temporary reserves and help stabilize Lake Mead water levels.

As shown in Figure 2.6, water banking and other collaborative drought response actions have reduced Lake Mead's water level decline by an estimated 40 feet in 2019.

Applying Best Available Climate Science

The SNWA continues to work with federal, state and local water agencies to enhance understanding of future water supply and demand uncertainty, and improve short and mid-term forecasts and long-term projections. A key accomplishment of these efforts is the creation of the Colorado River Basin Climate and Hydrology: State of the Science report (see page 16).

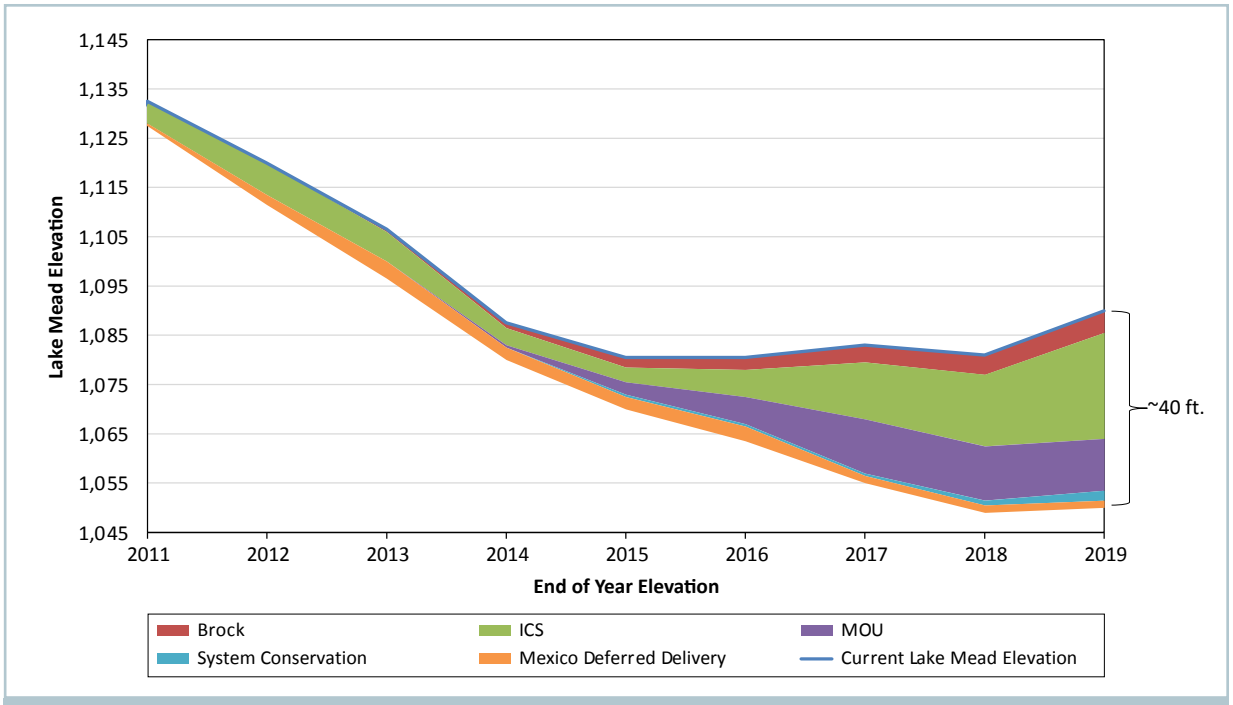


FIGURE 2.6 **Benefits to Lake Mead Storage** [19]

Likewise, to better understand and adapt to climate change effects on water-related infrastructure and water resources, the SNWA initiated collaborative efforts with both climate scientists and other water agencies. The SNWA has received funding through a WaterSMART grant from the U.S. Bureau of Reclamation to evaluate potential changes in Lake Mead water quality using SNWA's advanced Lake Mead model.[20] The Lake Mead study considered potential impacts of low lake elevations and increasing air temperatures due to climate change on a suite of water quality measures.

The SNWA is also a founding member of the Water Utility Climate Alliance (WUCA), which is comprised of 12 of the largest water agencies in the United States. WUCA is dedicated to enhancing climate change research and improving water management decision-making to ensure that water utilities will be positioned to respond to climate change and protect water supplies.

The SNWA is collaborating with other WUCA members to: advocate for climate change research that better meets the needs of the water sector; evaluate methods used to understand the influence of climate change on water providers; and identify decision and adaptation strategies employed to address long-term climate change.[21]

Supply and Demand Forecasting

As in prior years, the SNWA has taken a scenario based planning approach with its 2020 Plan to address possible changes to water supply availability and demands. As detailed in Chapter 4, the SNWA has developed a range of demands that brackets what is likely to be experienced during the planning horizon.

The plan includes a series of future planning scenarios that consider various water demand and supply conditions, including impacts of declared shortage. This is a conservative approach that recognizes that planning assumptions are generally more accurate in the near term and that the potential for change is likely to increase over time.

CHAPTER SUMMARY

The concept of uncertainty is not unique to Southern Nevada. It is a condition increasingly faced by water managers across the United States. This is particularly true in the Colorado River Basin, where climate variability (the result of drought and/or climate change) and economic conditions are influencing both water resource availability and the demand for those resources over time.

While the water supply challenges presented in this chapter need to be taken seriously, the SNWA has worked diligently to ensure both resources and

facilities are available to meet the community's short- and long-term water resource needs.

By applying adaptive management—evaluating, planning and action—the SNWA is well prepared to meet whatever challenges lie ahead. Efforts include:

- Continue setting and achieving water conservation goals through aggressive water conservation efforts;
- Collaborate with Colorado River stakeholders for conservation and flexible use of Colorado River supplies (for example, water banking), as well as protect Lake Mead's elevation against future water level declines;
- Continue to secure temporary resources to offset long-term impacts associated with shortage while working to bring other permanent resources online when needed;
- Work with Colorado River partners to explore collaborative future water resource projects;
- Address uncertainty by planning to a range of future supply and demand possibilities; and
- Collaborate with climate scientists and other agencies to understand and evaluate climate change, and its potential impacts on water supplies and facilities.

ENDNOTES

1 The U.S. Bureau of Reclamation and the U.S. Geological Survey estimate the yearly "natural flow" of the Colorado River at Lees Ferry, defined as the flow of the river without reservoirs, dams or diversions. Natural flow estimates for the period 1906 to 2018 are official, while estimates for the period 2019 and 2020 are provisional, July 2020, U.S. Bureau of Reclamation.

2 August 24-Month Study - most probable forecast, U.S. Bureau of Reclamation, August 2020.

3 Lukas, J. and Payton, E., eds. 2020. Colorado River Basin Climate and Hydrology: State of the Science. Western Water Assessment, University of Colorado Boulder. DOI. https://doi.org/10.25810/3hv-w477.

4 Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, B. DeAngelo, S. Doherty, K. Hayhoe, R. Horton, J.P. Kossin, P.C. Taylor, A.M. Waple, and C.P. Weaver, 2017: Executive summary. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 12-34, doi: 10.7930/J0DJ5CTG.

5 "Kalansky, J., Sheffield, A., Cayan, D., and Pierce, D. 2018. Climate Conditions in Clark County, NV. Southern Nevada Water Authority.

6 Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.). USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief U.S. Global Change Research Program, Washington, DC, USA, 186 pp.

7 "Record of Decision Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, December 2007," signed December 13, 2007 by Dirk Kempthorne, Secretary of the Department of Interior.

8 The U.S. Bureau of Reclamation developed the Colorado River Simulation System (CRSS), a long-term planning and operations model. The probabilities of shortage correspond with August 2020 CRSS results, applying historical Colorado River flows, provided by U.S. Bureau of Reclamation to Southern Nevada Water Authority August, 2020.

9 "Agreement Concerning Colorado River Drought Contingency Management and Operations," 2019.

10 "Exhibit 1 to the Lower Basin Drought Contingency Plan Agreement, Lower Basin Drought Contingency Operations," 2019.

11 "Historical Reservoir Levels, Lake Mead at Hoover Dam," U.S. Bureau of Reclamation.

12 Lukas, J. and Payton, E., eds. 2020. Colorado River Basin Climate and Hydrology: State of the Science. Western Water Assessment, University of Colorado Boulder. DOI. https://doi.org/10.25810/3hv-w477.

13 "Colorado River Basin Water Supply and Demand Study," December 2012, U.S. Bureau of Reclamation.

14 "Changes in Water Use Under Regional Climate Change Scenarios," 2013, Water Research Foundation (Project #4263) prepared by Jack C. Kiefer, John M. Clayton, Benedykt Dziegielewski, and James Henderson.

15 Clark County Population data 1970-1980 are decadal counts from the U.S. Census Bureau. Clark County Population data 1990-2019 are annual estimates prepared by the Clark County Comprehensive Planning Department.

16 "Population Forecasts: Long-term Projections Clark County Nevada Population Forecast 2020-2060," June 2020, Center for Business and Economic Research at the University of Nevada, Las Vegas.

17 "Agreement among the United States of America, through the Department of the Interior, Bureau of Reclamation, the Central Arizona Water Conservation District, the Metropolitan Water District of Southern California, Denver Water, and the Southern Nevada Water Authority, for a Pilot Program for Funding the Creation of Colorado River System Water through Voluntary Water Conservation and Reductions in Use," entered into July 30, 2014 and amended August 12, 2015; March 8, 2016; and July 6, 2018.

18 "Memorandum of Understanding among the United States of America, through the Department of the Interior, Bureau of Reclamation, the Central Arizona Water Conservation District, the Metropolitan Water District of Southern California, the Southern Nevada Water Authority, the Arizona Department of Water Resources, the Colorado River Board of California and the Colorado River Commission of Nevada for Pilot Drought Response Actions," entered into December 10, 2014.

19 At the end of 2019, cumulative water storage in Lake from conservation initiatives was approximately 3.185 million AF, equivalent to approximately 40 feet in Lake Mead. Savings are attributable: 1) Water conserved by the Brock Reservoir System Efficiency ICS project (388,000 AF) and Extraordinary Conservation ICS storage (1.748 million AF); 2) Unused Colorado River saved under a 2014 Memorandum of Understanding (820,000 AF); 3) Pilot System Conservation Program water savings (129,000 AF); and 4) Deferred deliveries by the country of Mexico (100,000 AF).

20 The SNWA's Lake Mead Model was developed with Flow Science Inc., with funding from SNWA member agencies and the National Park Service. Funding for climate change model simulations was provided through a WaterSMART Grant from the Bureau of Reclamation, with matching contributions from the City of San Diego, Metropolitan Water District of Southern California and the SNWA.

21 The Water Utility Climate Alliance (WUCA) has funded and published several reports and white papers on climate change. The publications are accessible at: www.wucaonline.org/html/actions_publications.html.

Colorado River, Utah

SNWA WATER RESOURCE PORTFOLIO

THIS CHAPTER DISCUSSES THE DIVERSE SET OF WATER RESOURCE OPTIONS ACQUIRED BY THE SNWA TO RELIABLY MEET THE COMMUNITY'S CURRENT AND FUTURE WATER RESOURCE NEEDS.

INTRODUCTION

The SNWA has worked since 1991 to establish and manage a flexible portfolio of water resources, an approach commonly used in resource planning. Having a portfolio of resources allows the SNWA to assess its overall water resource options and to make appropriate decisions regarding which resources to develop and use when necessary. Key factors considered in determining acquisition, priority of development, and use of a resource include availability, accessibility, cost and need.

The SNWA's water resource portfolio, along with associated facility planning and permitting efforts, provides the SNWA with flexibility in adapting to changing supply and demand conditions. As detailed in Chapter 2, water resource conditions have changed significantly over the years for many western states, including Nevada. During that time, the SNWA has worked to implement innovative water resource strategies that have increased the efficiency of Colorado River water use to maximize availability of this critical supply of water. The organization has also worked to create new temporary resources that can be used flexibly to meet current and future demands. These efforts have helped to delay the development of costly water projects that may not be needed in the future.

Adaptive management has played an increasingly significant role in the SNWA's water resource and facility planning efforts, helping to reduce demands, bolster supplies and minimize risk associated with drought and climate change in the Colorado River Basin. These efforts have led to the development of new Lake Mead intake and pumping facilities and collaborative partnerships that significantly enhance the reliability of and access to Southern Nevada's Colorado River water supplies.

These accomplishments and other developments described in this chapter prompted the SNWA to make several changes relating to the composition, priority and timing of some resource options. New resource and conservation priorities have been identified for the 2020 Plan, while other resource interests have been deferred. As further detailed in this chapter, these changes are consistent with direction from the SNWA Board of Directors, as well as recommendations from the SNWA's 2020 Integrated Resource Planning Advisory Committee (IRPAC 2020).

Resources in the SNWA water resource portfolio are described in consumptive use volumes and are organized into the following categories:

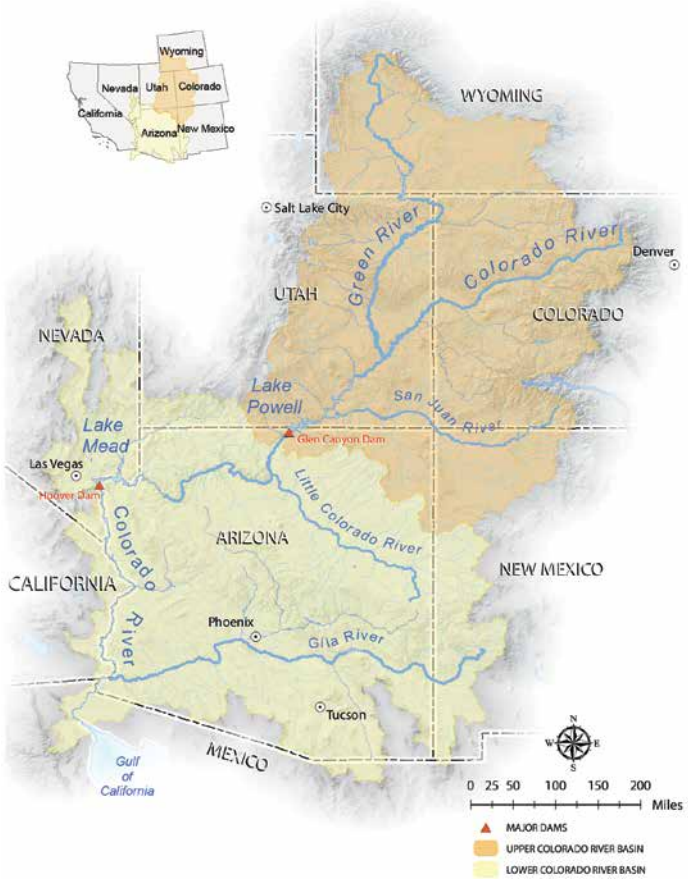
- Permanent Resources
- Temporary Resources
- Future Resources

Consistent with prior plans, water conservation remains a critical component of the SNWA's water resource portfolio. Conservation progress in reducing per capita water use remains a top priority for the SNWA. This chapter highlights new and ongoing strategies being pursued by the SNWA to build upon the community's conservation success over the last two decades.

PERMANENT RESOURCES

For the purpose of this plan, "Permanent Resources" are resources anticipated to be available for use over the 50-year planning horizon. These resources make up a base of supplies and can be used during any Colorado River operating condition, including shortage (subject to certain restrictions).

Permanent resources include Colorado River supplies, Tributary Conservation Intentionally Created Surplus (ICS), permitted groundwater rights in the Las Vegas Valley and reuse, primarily through return-flow credits. Descriptions of these resources and details regarding their availability are discussed in the following section.



The Colorado River Basin

Colorado River operations and water use are governed by a series of contracts, regulatory guidelines, federal laws, compacts, a treaty with Mexico, court decisions and decrees—collectively known as the "Law of the River." The 1922 Colorado River Compact divided the Colorado River Basin into two divisions—the Upper Division and the Lower Division, allocating 7.5 million acre-feet per year (MAFY) to each. As part of the Boulder Canyon Project Act and the 1948 Upper Colorado River Basin Compact, the Upper and Lower Divisions divided their respective share amongst individual states within each division. In addition, 1.5 MAFY was allocated to Mexico as part of a 1944 treaty.[3]

The Compact was forged in a time of abundance, during one of the wettest periods in recorded history. More recent reviews, modeling and studies of Colorado River flows have determined an imbalance in long-term Colorado River resources and future demands. State and federal partners agree that there is a strong potential for significant supply and demand challenges in coming decades, and are working together to offset potential water supply reductions.

Colorado River—Nevada Basic Apportionment

Nevada's 300,000 AFY Colorado River apportionment continues to be Southern Nevada's largest and most critical permanent resource. Nevada's right to this water was established under the 1922 Colorado River Compact and the Boulder Canyon Project Act (BCPA), which together set forth where and how Colorado River water is used.

SNWA Contract. Section 5 of the BCPA requires entities wishing to divert Colorado River water within the states of Arizona, California and Nevada to have a contract with the Secretary of the Interior for that water. Early on, the agencies that would form the SNWA contracted for most of Nevada's Colorado River allocation.

With the creation of the SNWA in 1991, these agencies agreed to collaboratively manage Southern Nevada's current and future water resources, representing a significant shift in the overall management of the region's water supply. In the years that followed, the SNWA determined that additional Colorado River water was available and contracted with the Secretary of the Interior in 1992 and 1994 to acquire these resources.[1]

The SNWA's total estimated Colorado River entitlement is 276,205 AFY of Nevada's 300,000 AFY allocation. This includes 272,205 AFY for use by SNWA member agencies and 4,000 AFY that the SNWA delivers to Nellis Air Force Base. Nevada's remaining apportionment is contracted to other users.[2] The SNWA also holds contracts for any surplus Colorado River water available to Nevada.

Unused Apportionment. As part of its 1992 Colorado River contract, the SNWA has a right to the unused apportionment of other Nevada Colorado River contract holders. The SNWA anticipates some of this water will be available for use in the planning horizon, and plans to utilize this water if and when it is available.

The SNWA's use of Colorado River resources has declined significantly since 2002 due to community water conservation efforts. As a result, Nevada is not currently using its full Colorado River apportionment. As discussed later in this chapter, the SNWA plans to store this water in Lake Mead to help alleviate the impacts of drought conditions and avoid critical Lake Mead elevations. Water also may be stored in other banking programs. In either case, Nevada will maximize the availability and use of its water conservation savings to offset risk, increase operational flexibility and help meet future demands.

Return-Flow Credits. The BCPA defines all Colorado River apportionments in terms of "consumptive use."

Consumptive use is defined as water diversions minus any water that is returned to the Colorado River. These returns are also referred to as "return-flow credits." With return-flow credits, Nevada can divert more than 300,000 AFY, as long as there are sufficient flows returned to the Colorado River to ensure the consumptive use is no greater than 300,000 AFY.[4]

Return-flow credits constitute a significant portion of Southern Nevada's Colorado River resource, expanding the SNWA's Colorado River supply. Nevada's Colorado River return-flows consist mostly of highly-treated wastewater that is returned to Lake Mead via the Las Vegas Wash.

Flood Control Surplus. If Lake Mead is full or nearly full, the Secretary of the Interior can declare a flood control surplus. This allows Lower Basin states to use Colorado River water, in excess of their apportionment, that would have been released to control potential flooding along the Colorado River system.[5]

Based on current Lake Mead water levels and climate variability in the Colorado River Basin, the SNWA does not assume that flood control surplus water will be available during the planning horizon. However, the SNWA will utilize this resource as a priority when it is available.[6]

Domestic Surplus. As discussed in Chapter 2, the Interim Guidelines defined both surpluses and shortages, and detailed provisions for water use during each condition. Under a "Domestic Surplus," the SNWA is allowed to consumptively use up to 400,000 AFY of Colorado River water when Lake Mead is above 1,145 feet. The 2020 Plan does not assume the availability or use of domestic surplus water during the planning horizon. However, the SNWA will utilize this resource as a priority when it is available.

Intentionally Created Surplus

In 2007, as part of the Interim Guidelines, the SNWA entered into a series of agreements that ensure the availability and delivery of water resources developed under provisions for ICS.[7] As discussed below, Tributary Conservation ICS and Imported ICS enable the SNWA to develop some of its surface and groundwater rights that are located in Nevada, near the Colorado River. The SNWA may develop these rights as needed by allowing them to flow into Lake Mead in exchange for Tributary Conservation ICS and Imported ICS credits.

Tributary Conservation and Imported ICS credits can be used during the year created and under any operating condition, including shortage (taken as Developed Shortage Supply or "DSS" during a declared shortage).[8] As required by the DCP, these resources are subject to a one-time deduction of 10 percent to offset evaporative loss and benefit Lake Mead system storage.

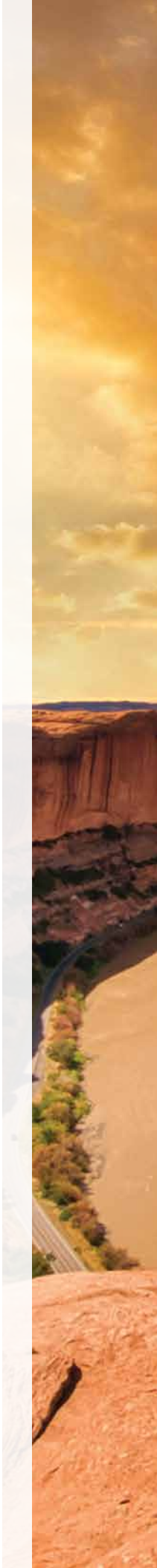
As discussed in the "Temporary Resources" section on the following pages, water that is not used in the year it is created may be converted to Extraordinary Conservation ICS. When needed, the credits will be withdrawn as Colorado River water through SNWA facilities and returned to the system for return-flow credits.

Tributary Conservation ICS. The SNWA is allowed to develop the portion of its Muddy and Virgin River surface water rights that have a priority date that precedes the BCPA (pre-1929 rights) as Tributary Conservation ICS. The SNWA can develop up to 50,000 AFY of Tributary Conservation ICS credits.

To date, approximately 14,700 AFY of permanent rights have been acquired. In addition to its permanent rights, the SNWA has acquired approximately 17,200 AFY of leased rights, with remaining terms through 2026. The SNWA anticipates acquiring and delivering a total of 36,000 AFY of Tributary Conservation ICS over the planning horizon.

Imported ICS. Under the Interim Guidelines, up to 15,000 AFY of Imported ICS can be created in an entitlement holder's state by introducing non-Colorado River water into the main stem of the Colorado River.

The SNWA has 9,000 AFY of permitted non-Colorado River groundwater rights in Coyote Spring Valley that would qualify as Imported ICS. However, these and other groundwater rights within the Lower White River Flow System are under review, subject to an ongoing process initiated by the State Engineer in 2018 to evaluate the amount of water that can be sustainably pumped. For the 2020 Plan, the SNWA assumes no use this resource.



Las Vegas Valley Groundwater Rights

All surface water and groundwater rights in the state of Nevada are administered by the Nevada State Engineer and fall under the purview of Nevada Water Law.[9]

Of the seven SNWA member agencies, the LVVWD and North Las Vegas have permanent groundwater rights totaling 40,760 and 6,201 AFY, respectively. These rights are among the most senior groundwater rights in the Las Vegas Valley. As such, they are protected even though new rights were granted to other users. Groundwater remains a critical component of SNWA's Resource Portfolio.

Water Reuse

The term water reuse generally means to recycle wastewater to support a secondary use. In the SNWA service area, nearly all water used indoors is recycled for either direct or indirect reuse. Direct reuse involves capturing, treating and reusing wastewater flows for non-potable uses such as golf course and park irrigation, and other uses. Indirect reuse consists of recycling water by way of treatment and release to the Colorado River for return-flow credits.

Boulder City, City of Las Vegas, Clark County Water Reclamation District, City of Henderson and City of North Las Vegas each operate wastewater treatment facilities that contribute to the region's direct and/or indirect reuse.

As shown in Figure 3.1, approximately 40 percent of water used in the SNWA service area results in highly-treated wastewater. Of that, approximately 99 percent is recycled.

While direct reuse of Colorado River water may have advantages over indirect reuse in terms of lower pumping cost, additional direct reuse does not extend Southern Nevada's Colorado River supply where return-flow credits are available. This is because an increase in direct reuse will reduce the amount of water available for indirect reuse through return-flow credits by a similar amount.

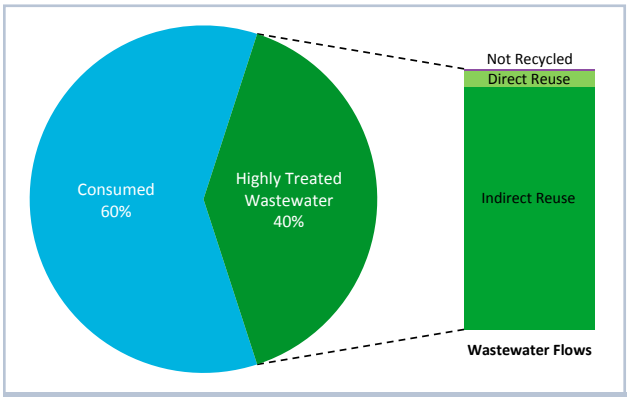


FIGURE 3.1 **SNWA Water Use and Recycling**

In 2017, SNWA adopted a policy to address water use outside the Las Vegas Valley, prioritizing the return of treated wastewater to Lake Mead for return-flow credits. IRPAC 2020 further recommended that the SNWA require out-of-valley development to return wastewater to Lake Mead and further limit consumptive uses of water outside the Las Vegas Valley.

TEMPORARY RESOURCES

Beginning in the early 1990s and continuing today, the SNWA has worked closely with other basin states to maximize opportunities for flexible use of Colorado River water. Through local and interstate arrangements, the SNWA has acquired a number of temporary resources that serve as an important management tool—these resources can be used to meet potential short-term gaps between supply and demand, serving as a bridge to meet demands while other future resources are being developed. In some cases, temporary resources can be used to offset reductions in permanent supplies due to shortages.

For the purpose of this plan, "Temporary Resources" are defined as banked resources. As part of its overall water resource strategy, the SNWA has reserved water in years when Nevada's Colorado River allocation exceeds the community's demands. To the extent possible, these resources are "banked" for future use in the form of storage credits. The volume of storage credits can change over time based on continued storage and use of supplies. As discussed below, the SNWA stores banked resources locally, as well as through banking agreements with other states.

Southern Nevada Water Bank

As of 2019, the SNWA has stored more than 346,000 acre-feet of water in the Southern Nevada Water Bank for future use through an agreement with LVVWD. The SNWA may recover water banked under this agreement in any water supply condition. This plan assumes a maximum recovery rate of 20,000 AFY.[11]

California Water Bank

Between 2004 and 2012, the SNWA entered into various agreements that allow it to store Nevada's unused Colorado River water in California. As of 2019, Nevada has banked more than 330,000 acre-feet of water in California. This plan assumes a maximum recovery up to 30,000 AFY during normal and shortage conditions, subject to agreement terms.[12]

Arizona Water Bank

In 2013, the SNWA approved an amendment to the 2001 water banking agreement with the Arizona Water Banking Authority.[13] The SNWA stored approximately 614,000 acre-feet of Colorado River water underground in Arizona's aquifers for the SNWA's future use as of 2019. Additional water can be banked on a pay-as-you-go basis up to 1.25 million acre-feet.

For the SNWA to recover this stored water, Arizona will utilize the banked water and forgo the use of a like amount of Colorado River water. The SNWA will then divert the water from facilities at Lake Mead. SNWA can recover up to 40,000 AFY during any water supply condition and may recover up to 60,000 AFY during a declared shortage. This plan assumes a maximum recovery of up to 40,000 AFY during normal and shortage conditions.

Intentionally Created Surplus

The SNWA has participated in several efforts to expand its portfolio of temporary resources under provisions specified in the Interim Guidelines and DCP.

As discussed earlier in this chapter, the Interim Guidelines created several forms of ICS: Tributary Conservation ICS and Imported ICS (discussed under "Permanent Resources"), as well as System Efficiency ICS and Extraordinary Conservation ICS. In 2012, an additional form of ICS was created as part of an international pilot program, referenced here as Bi-National ICS. Provisions for Bi-National ICS were extended through 2026 with the approval of a new agreement between the U.S. and Mexico in late 2017.

Additional provisions for the creation and delivery of ICS were authorized and implemented in 2019 under the DCP. As further described in this chapter, DCP ICS was created to provide an incentive for additional water storage in Lake Mead and, in turn, to help slow the decline of Lake Mead water levels. The SNWA can use its DCP ICS credits without penalty or payback when Lake Mead is above an elevation of 1,110 feet. The SNWA can access up to 300,000 AFY of its combined System Efficiency ICS, Extraordinary Conservation ICS, Binational ICS and may "borrow" DCP ICS during a declared shortage and when the elevation of Lake Mead is above 1,025 feet. These resources are further described below.

System Efficiency ICS. In 2007, the SNWA collaborated with the U.S. Department of the Interior and other project partners to fund construction of the Warren H. Brock Reservoir. This System Efficiency ICS project provides

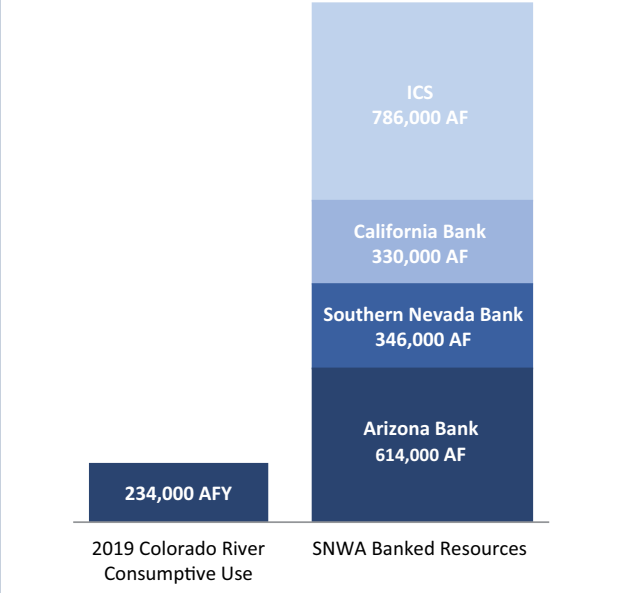
Recharge & Banking

The LVVWD began storing or "banking" water in the Las Vegas Valley in the late 1980s. In Southern Nevada, banking is accomplished through artificial recharge or in-lieu recharge.[14] Artificial recharge involves direct injection of treated unused Colorado River water into the local groundwater aquifer; in-lieu recharge is accomplished by not pumping non-revocable groundwater rights to acquire storage credits that are available for future use. Through various programs and agreements , the SNWA has expanded banking efforts to include storage in the Arizona Water Bank and California Water Bank, and in Lake Mead in the form of ICS (see sidebar on page 28).

As described later in this chapter, the 2019 DCP and associated agreements expanded Lake Mead water banking opportunities for Southern Nevada with the authorization of a new SNWA Extraordinary Conservation ICS project that allows the SNWA to leverage its past and future conservation savings and forgone banking to obtain ICS credits.

Ongoing accruals will be based on conservation achievements since 2002. Subject to certain conditions, provisions for the recovery of stored ICS credits also were expanded to allow for greater flexibility and use of ICS resources during a declared shortage.

Through 2019, the SNWA has accrued nearly 2.1 million acre-feet of water. This is nearly nine times Nevada's 2019 consumptive Colorado River water use.



SNWA Banked Supplies Through 2019

Intentionally Created Surplus

The Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead (Interim Guidelines) were adopted in 2007 by the Secretary of the Interior. Among other things, the Interim Guidelines established requirements for the creation, delivery, and accounting for a new form of surplus called Intentionally Created Surplus.

ICS was instituted to encourage the efficient use and management of Colorado River water and to increase the water supply in Colorado River system reservoirs. The creation of ICS was designed to help reduce the likelihood, magnitude and duration of shortages in the Lower Basin. Additional provisions for the creation and recovery of ICS were authorized and are implemented under the 2019 Drought Contingency Plan.

Efforts to help stabilize Lake Mead water levels are of key importance to the SNWA – the agency has made significant investments in new intake and pumping facilities that will allow for reliable access to community water supplies in the event of low lake level conditions (below 1,000 feet).

Tributary Conservation ICS Creation

Southern Nevada with 400,000 acre-feet of ICS credits; no more than 40,000 acre-feet are available for consumptive use each year through 2036. These credits are stored in Lake Mead and are helping to bolster Lake Mead water levels.

In 2009, Nevada also collaborated with municipal water agencies in California, Arizona and the U.S. Bureau of Reclamation in a pilot operation of the Yuma Desalting Plant. The plant was constructed in 1992 to treat brackish agricultural drainage water in the United States for delivery to Mexico as part of its treaty obligation. Flood damage in 1993 caused the facility to cease operations.

As part of the 2009 collaborations, the facility was operated at one-third capacity to collect data on operational viability for long-term use. In exchange for funding the pilot test, the states received System Efficiency ICS. The SNWA's share was 3,050 acre-feet. These resources are temporarily stored in Lake Mead as System Efficiency ICS.

Extraordinary Conservation ICS. With approval and implementation of the DCP in 2019, the SNWA can create up to 100,000 AFY of Extraordinary Conservation ICS under a newly authorized project.[16] For 2017 and 2018, and through 2026, the SNWA's Extraordinary Conservation ICS account will be credited for SNWA's investments in municipal conservation and off-stream storage, which have reduced Nevada's Colorado River water use below the state's apportionment and created the opportunity for the SNWA to store this water in one of its off-stream water banks. Using an established methodology to determine water savings, the SNWA will accrue Extraordinary Conservation ICS credits when it stores these water savings in Lake Mead as ICS. Tributary Conservation and Imported ICS credits also are converted to Extraordinary Conservation ICS credits if they are not used in the year they are created.

These ICS credits are banked in Lake Mead and are subject to a one-time deduction of 10 percent for system benefit and evaporative loss. As of 2019, the SNWA has stored approximately 328,000 acre-feet of Extraordinary Conservation ICS.

DCP Contributions and ICS. The Lower Basin States will begin making DCP contributions when the elevation of Lake Mead is projected to be at or below 1,090 feet on January 1. Contribution amounts vary by state and are based on Lake Mead water levels. Nevada's DCP contribution ranges from 8,000 to 10,000 AFY. This volume of water is in addition to any mandatory reductions

associated with a federally declared shortage. Mandatory shortage reductions cannot be recovered.

Subject to storage limitations, Nevada's DCP ICS account will be credited each time Nevada makes a DCP contribution. The SNWA can utilize its DCP ICS credits with no penalty or repayment obligations when Lake Mead is above 1,110 feet. Below this elevation, the SNWA can access or borrow credits, subject to repayment.

As shown in Figure 3.2, access to DCP ICS credits are not available in years when the elevation of Lake Mead is projected to be at or below 1,025 feet. Borrowed DCP ICS credits must be replenished within one to five years, depending on Lake Mead water levels. Beginning in 2027, any unused DCP ICS credits will be reduced by three percent annually to benefit the Colorado River system.

YEAR	ABOVE 1,110 FT.	1,110 TO ABOVE 1,075 FT.	1,175 TO ABOVE 1,025 FT.	1,125 FT. OR BELOW
2020 - 2026	AVAILABLE	REPAY IN 1 YEAR		NOT AVAILABLE
2027 - 2057 *	AVAILABLE	REPAY IN 5 YEARS	REPAY IN 1 YEAR	NOT AVAILABLE

*2020 Water Resource Plan assumes availability through 2071.

FIGURE 3.2 **Availability of DCP ICS Credits**

Bi-National ICS. The United States and Mexico finalized Minute 323 to the 1944 U.S./Mexico water treaty in 2017. Minute 323 extends and modifies key provisions of historic Minute 319, which enhanced Colorado River system sustainability by quantifying water deliveries to Mexico under high- and low-reservoir conditions. In addition, Minute 323 contains Mexico's commitment to a Water Scarcity Plan that requires Mexico to store additional water in the United States as Lake Mead elevations drop. With approval and implementation of the DCP, Mexico will join Arizona, California and Nevada in required storage contributions designed to mitigate the impacts of ongoing drought and slow the decline of Lake Mead water levels.

Effective through the year 2026, Minute 323 authorizes Mexico to defer its Colorado River water deliveries and to store water in the United States for later delivery to Mexico. The agreement will help maintain Lake Mead water levels, delay potential shortages, and create additional certainty for all water users, particularly during shortages.

Like Minute 319, Minute 323 allows for the SNWA to invest in conservation and infrastructure projects in Mexico in exchange for Bi-National ICS credits. Through Minutes 319 and 323 and the accompanying domestic agreements,

Drought Contingency Plan

In addition to the mandatory shortage reductions defined by the Interim Guidelines, the SNWA and other Colorado River users approved the Lower Basin DCP for Colorado River operations in 2019.[15] Authorized by Congress for immediate implementation, the agreement requires the Lower Basin states to make additional contributions designed to reduce the magnitude and likelihood of continued Lake Mead water level declines, and reduce the risks of potential water supply interruptions for Lower Basin water users.

The DCP:

- Keeps more water in the river for the benefit of all water users and the environment.
- Helps slow Lake Mead water level declines to preserve critical reservoir elevations.
- Authorizes new ICS projects and supplies that contributing states can access during a federally declared shortage and when Lake Mead water levels recover.
- Draws participation from new stakeholders, including California, and promotes continued collaboration.

Federal, state and municipal partners have worked collaboratively for years to reduce the risk of a Lake Mead water level decline below 1,000 feet, a critical elevation for operation of Hoover Dam and Lower Basin water deliveries. With implementation of the DCP and other related agreements in 2019, the risk of Lake Mead reaching this critical elevation has decreased substantially. Authorization and implementation of the DCP provides greater certainty for Lower Basin water users and represents a significant collaboration milestone among Colorado River stakeholders.

DCP Signing Ceremony at Hoover Dam, Lake Mead

Colorado River, Devil's Elbow, California

the SNWA has agreed to fund projects yielding a minimum of 51,025 and a maximum of 78,300 acre-feet of Bi-National ICS credits. As of late 2019, the SNWA has accrued 23,750 acre-feet of Bi-National ICS credits.

FUTURE RESOURCES

For the purpose of this plan, "Future Resources" are defined as those resources expected to be available to the SNWA at some point during the planning horizon. In some instances, water resources are quantified subject to water right permitting, while the availability and development of others requires further research and analysis. Some water supply options have been deferred as further described on page 31.

Development of most future resource options described in this Plan will require additional environmental permitting, as well as construction of water delivery infrastructure. Likewise, implementation of some Colorado River options may require changes to the Law of the River to provide increased flexibility.

Colorado River Transfers/Exchanges

In concept, water transfers involve moving water resources from willing sellers to willing buyers. There are a variety of ways in which this can occur: interbasin, intrastate and interstate transfers. Full-scale transfers and exchanges among Colorado River water users could involve transfers/exchanges associated with participation in desalination or agricultural fallowing projects, or through participation in other conservation and reuse initiatives. As part of Colorado River negotiations slated to begin in 2021, the SNWA will work with other Colorado River Basin states to create a more concrete framework for these types of exchanges.

Desalination. The SNWA is engaged with other Colorado River Basin states and water users, the U.S. Bureau of Reclamation and the country of Mexico to actively explore and investigate potential seawater and brackish water desalination projects in the state of California and the country of Mexico.

Other projects are being considered by a Binational Projects Work Group. These include opportunities for seawater desalination and wastewater reuse facilities in Mexico. The latter are noted as areas of

interest under Minute 323. To support these efforts, the SNWA and Basin State partners funded a feasibility study to examine desalination opportunities along the Sonoran coast of the Sea of Cortez. The study was completed in 2020 and is available online.[17]

Colorado River Partnerships. The SNWA is actively exploring future resource options that may involve financial participation in major capital projects under development in other states. For example, the SNWA is exploring participation in a major reuse project currently being reviewed by the Metropolitan Water District of Southern California (MET).

MET is planning for a full scale regional recycled water program that would produce up to 150 million gallons of water daily (or about 168,000 AFY). An initial pilot project is currently underway to support planning and research efforts. While the project is still in an early phase of development, the SNWA and MET are collaborating to identify a path for the SNWA's participation and to determine what approvals might be needed to implement the partnership. The SNWA anticipates that 20,000 - 40,000 AFY will be available to the SNWA in exchange for funding participation.

The SNWA will continue to collaborate with MET and other Colorado River water users to evaluate the potential for participation in collaborative Colorado River partnerships of mutual benefit.

Colorado River Augmentation

The SNWA was permitted 113,000 AFY of Virgin River water rights in 1994. Under an agreement, the SNWA transferred 5,000 AFY to the Virgin Valley Water District. In accordance with the 2007 Seven States' Agreement, the SNWA has agreed to suspend development of these Virgin River surface water rights in exchange for agreement with the other Colorado River Basin States to cooperatively pursue the development of 75,000 AFY of permanent water supplies to augment the Colorado River for Nevada.[19]

In State Groundwater

The SNWA has permits and applications in southern and eastern Nevada based on applications filed by the LVVWD in 1989. Some of these applications have been permitted by the Nevada State Engineer in accordance with Nevada Water Law while others require further review and analysis. As described below, some resource interests have been withdrawn and/or deferred.

MET Water Project

The Metropolitan Water District of Southern California is working with Sanitation Districts of Los Angeles County on the planned development a Regional Recycled Water Advanced Purification Center. Planning efforts are currently underway, including development and operation of a demonstration facility to inform project planning and test treatment processes.

As planned, the full-scale program will recover and treat up to 150 million gallons of water per day (or about 168,000 AFY) from homes, businesses and industries within METs service area. Water will be cleaned and treated as part of a three-step purification process involving membrane bioreactors, reverse osmosis and ultraviolet/advanced oxidation processes. Treated water will be stored in groundwater basins until it is needed to meet municipal demands.

The SNWA is pursuing opportunities with MET for participation in this project. Any future agreement would likely involve a Colorado River water transfer/exchange in return for SNWA's financial participation in the project.

Once approved by regulators, the full-scale facility will take MET about 11 years to design and construct.

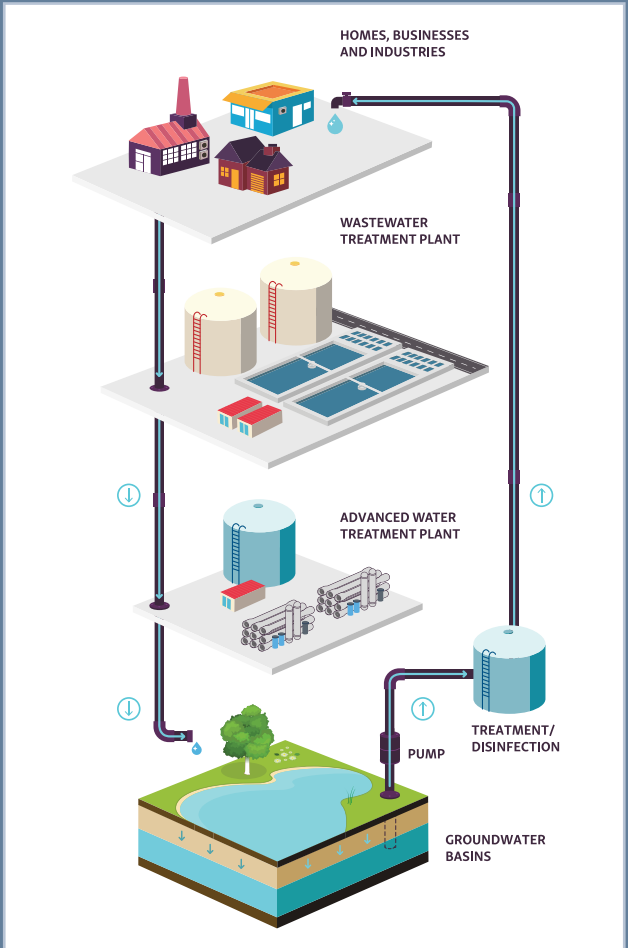


FIGURE 3.3 **Water Recovery and Treatment Process**

Garnet and Hidden Valleys. The SNWA has permitted rights to 2,200 AFY of groundwater in Garnet and Hidden valleys. The majority of these rights have been leased to dry-cooled power plants located in Garnet Valley. [18] As noted earlier in this chapter, these and other groundwater rights within the Lower White River Flow System are subject to an ongoing process initiated by the State Engineer in 2018 to evaluate the amount of water that can be sustainably pumped from the system.

Three Lakes Valley (North and South) and Tikaboo Valley (North and South). Between 2003 and 2006, the Nevada State Engineer issued a series of rulings granting the SNWA rights to 10,605 AFY of groundwater in these basins. The SNWA is working to develop options for delivery of 8,018 AFY of the groundwater rights from Three Lakes Valley North and South and Tikaboo Valley South into the northwest portion of the Las Vegas Valley. Remaining applications for groundwater not acted upon by the Nevada State Engineer were withdrawn by the SNWA in 2020.

Delamar, Dry Lake, Cave, Spring and Snake Valleys. The SNWA placed its Clark, Lincoln and White Pine Counties Groundwater Development Project into deferred status in 2020. Consistent with this decision, the SNWA terminated federal permitting processes associated with the project, including the withdrawal of pending water right applications, right-of-way grant and federal stipulations for water resource development activities in Delamar, Dry Lake, Cave, Spring and Snake valleys. These actions were made possible due to conservation advancements and the completion of new Lake Mead infrastructure. These new facilities offset risk associated with ongoing drought and climate change, and allow the SNWA to pursue collaborative future resource opportunities with Colorado River partners in the Lower Basin.

WATER CONSERVATION

Water conservation is a resource. However, unlike typical "wet" resources, which are acquired and conveyed to meet demands, conservation reduces existing and future demands, and extends available supplies.

Gallons Per Capita Per Day (GPCD) is a metric used by many communities to measure water uses. It also is an effective tool to measure efficiency over time. GPCD varies across communities due to several factors, including differences in climate, demographics, water-use accounting practices and economic conditions.

The SNWA's conservation progress and goal is stated in consumptive use terms. This approach reflects water resource implications associated with conservation progress. SNWA GPCD is calculated by dividing all SNWA water sources diverted (excluding off-stream storage less corresponding Colorado River return-flow credits by total SNWA resident population served per day (GPCD = water diverted - return- flow credits / resident population / 365 days). This approach recognizes that not all water that is delivered is consumed. This is because the SNWA recycles nearly all indoor water use, primarily through return-flow credits.

Approximately 60 percent of all water delivered by the SNWA is consumed, primarily for landscape irrigation and cooling. Unlike water used indoors, water used outdoors and for cooling is lost to the system as it cannot be treated and reused. As a result, outdoor uses continue to be a primary focus area for future conservation gains.

Conservation Goals

Since its inception in 1991, the SNWA and its member agencies have worked collaboratively to set and achieve aggressive water conservation goals. These efforts have yielded a 52 percent decrease in per capita water use between 2002 and 2019, even as growth within the SNWA service area increased by approximately 48 percent during that same timeframe (Figure 3.5).

The SNWA is currently working to achieve its conservation goal of 105 GPCD by 2035. As recommended by IRPAC 2020, a new conservation goal will be evaluated once the current goal is achieved. Chapter 4 provides an illustrative look at how additional conservation—beyond the current goal—might impact long-term (50-year) water demands, as well as short- and mid-term water supply needs.

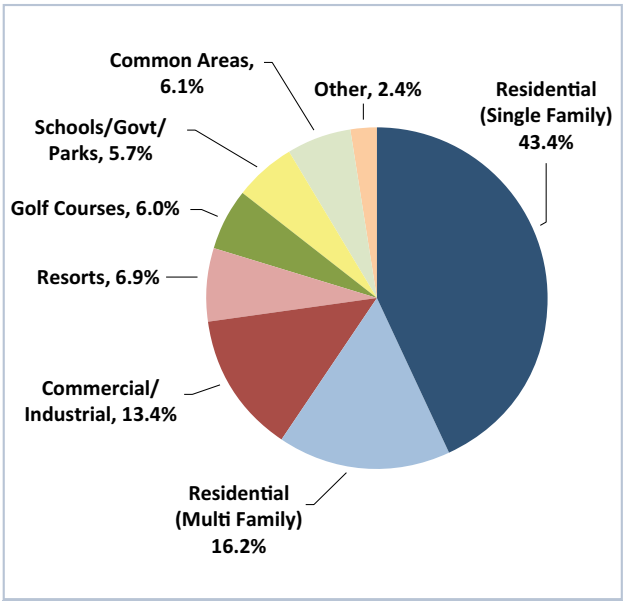


FIGURE 3.4 **Municipal Metered Use (2019)**

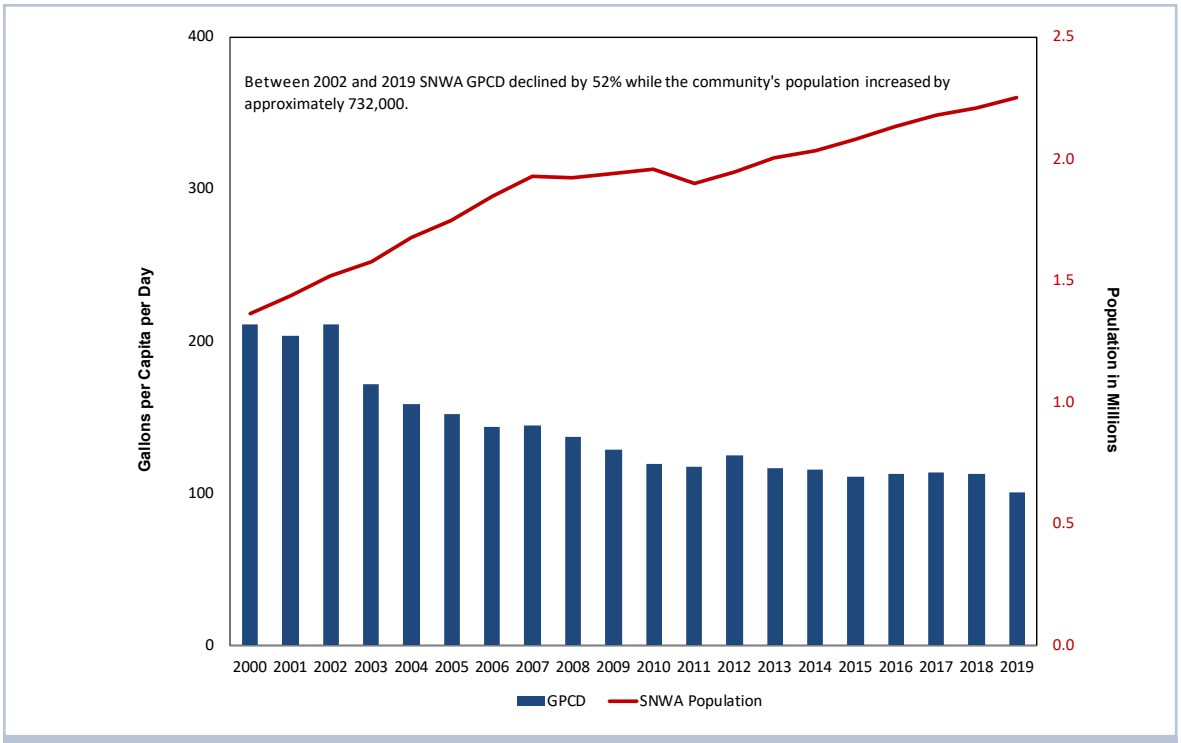


FIGURE 3.5 **Population & Per Capita Water Use**

While the SNWA has expanded education, outreach and incentive programs to support water conservation and efficiency gains, meeting our current conservation goal (and even higher levels of efficiency thereafter) will require the implementation of new strategies and tactics. IRPAC 2020 considered this and other supply and demand challenges as part of its review process. The committee also considered impact of upward pressure on water use due to climate change and system age.

Key Focus Areas

Above and beyond the continued implementation of existing conservation tools (see sidebar on page 34), IRPAC 2020 recommended specific actions, that if implemented, will help the SNWA to achieve its current conservation goal and support the achievement of additional conservation gains thereafter. Among other things, these recommendations specifically address major consumptive uses of water in Southern Nevada (see Appendix 3). Key focus areas are described in the balance of this chapter.

Non-Functional Turf. As of 2019, approximately 5,000 acres of non-functional turf remain in the SNWA member agency service area, predominantly located in streetscapes, common areas and commercial frontage (Figure 3.6). As recommended by IRPAC 2020, the SNWA is working to reduce existing non-functional turf acreage by 50 percent by 2035. The SNWA assumes that achieving this target could save up to 365 million gallons of water annually. The SNWA is currently working with its member agencies to update service rules, codes and ordinances to consistently implement the SNWA's 2019 non-functional turf resolution, which prohibits new non-functional turf installations. Other efforts will include outreach and collaboration with developers and master planned communities, and other potential changes to municipal codes.

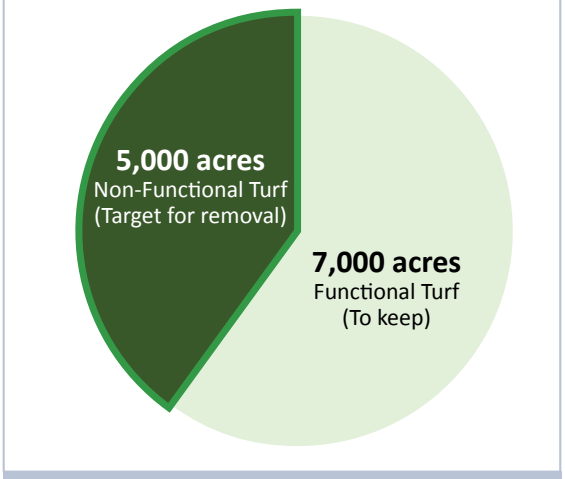


FIGURE 3.6 **Remaining Turf Acreage**

Conservation Tools

The SNWA uses several demand management tools to promote conservation and reduce overall water use, including water pricing, incentives, regulation and education. As described below, these measures are designed to work in conjunction with one another to promote efficient water use. Likewise, the SNWA has deployed new strategies to promote continued conservation and efficiency gains. These include increased water management measures, targeted education and outreach initiatives and increases to financial incentive programs. New incentives and offerings have also been introduced.

- Education: Education is an integral element of the SNWA's water conservation strategy. It includes both formal and informal education, from tips and tutorials to improve efficiency, to class offerings on water-smart landscaping practices for both residents and landscape professionals.
- Incentives: The SNWA operates one of the largest incentive programs in the nation. Since 2000, SNWA has invested more than $230 million in incentive programs, reducing demand by more than 12.6 billion gallons annually.
- Regulation: Through collaboration, SNWA member agencies and Clark County have adopted a suite of land use codes, ordinances and water use policies to ensure more efficient use of water in Southern Nevada. These include time-of-day and day-of-week watering restrictions, water waste restrictions and limitations on the installation of new turf in residential and commercial development.
- Water Pricing: SNWA member agencies implement conservation rate structures that charge higher rates for water as use increases. These rate structures encourage efficiency, without jeopardizing water affordability for essential uses.

Cool Season Turf. Limiting future installations of cool-season turf in public spaces and expediting the conversion of cool-season turf to warm-season turf at existing public facilities will help reduce consumptive use associated with turf irrigation while preserving functional turf in recreational spaces. The SNWA is working with the its member agencies to identify conversion opportunities and is providing support through its incentive programs. Future efforts to limit new cool-season turf installations may include changes to service rules, codes and ordinances. The estimated water savings is 21 gallons per square foot of turf converted.

Landscape Watering Compliance. Improving compliance with landscape watering restrictions and preventing water waste is a high priority for reducing consumptive water use in Southern Nevada. Current restrictions allow customers to water on three assigned days per week in spring and fall, one assigned day per week in winter and six assigned days per week in summer. Sunday watering is prohibited year-round. The SNWA maintains an active information and outreach campaign to promote landscape watering compliance and SNWA's member agencies conduct water waste enforcement. The SNWA is currently working to develop a pilot program to examine water savings associated with smart controllers, which can automatically adjust for seasonal watering schedule changes and weather factors. Other strategies to improve compliance include enhanced water waste investigations and more direct-outreach to violators.

Water Efficient Development. While Southern Nevada has some of the nation's most progressive water efficiency standards, the implementation of additional policies, products and practices can significantly reduce consumptive water use in new development. Meaningful opportunities for efficiency gains exist within the commercial and industrial sectors, particularly for new development. As recommended by IRPAC 2020, the SNWA is working to embed the principals of the SNWA's Non-Functional Turf Resolution in municipal codes and service rules; require out-of-valley development to return wastewater to Lake Mead for return-flow credits and further limit consumptive uses of water in out-of-valley areas; and establish an efficiency review policy and process for new large water users that encourages efficient development and disincentivize consumptive uses.

Leak Resolution. Customers are responsible for repairing leaks that occur on their property and downstream of the utility's water meter. Residential leaks are typically the result of damaged irrigation systems, cracked supply lines or faulty fixtures (such as faucets, toilets, appliances

Cooling Tower

and water heaters). Slow leaks aren't always visible and can generate significant water loss. As recommended by IRPAC 2020, SNWA member agencies, including the Las Vegas Valley Water District, City of Henderson and City of North Las Vegas, are working to deploy advanced metering infrastructure (AMI) that will significantly enhance their ability to notice customers of suspected leaks for faster leak resolution. The Big Bend Water District is currently using this technology. AMI provides high-resolution data in near real-time. Other efforts may include the development of new programs and services, as well as the deployment of other new technologies that can help customers to identify and resolve leaks faster.

Cooling Efficiency. Evaporative cooling is the second-largest consumptive use of water in Southern Nevada and deployment of alternative cooling technology represents a significant opportunity for water savings. In Southern Nevada, evaporative cooling is predominantly used to cool commercial and industrial buildings. Water consumption primarily occurs through evaporation and drift loss which comprise about 70 percent of total cooling water demand. As recommended by IRPAC 2020, the SNWA is evaluating changes necessary to reduce current and future consumptive water losses associated with evaporative cooling technology. Near-term efforts include research and pilot projects to inform best management practices, incentive programs and other policy changes.

Infrastructure investments. IRPAC 2020 recommended making continued investments to maintain and improve the existing water loss rate among wholesale and retail water purveyors. Non-revenue water losses are typically associated with leaks in transmission or distribution pipelines, variations in meter accuracy and water theft. The SNWA and its member agencies implement several strategies to minimize water loss within their water distribution systems, but investments will be required as systems age. Other related efforts include deploying and testing innovative technologies that can improve leak detection and speed leak repairs, as well as prioritizing system optimization and making proactive retrofits and repairs to system facilities.

CHAPTER SUMMARY

A number of factors can influence the timing, use and availability of water resources. Having a diverse portfolio of resources allows the SNWA to assess its overall water resource options and make appropriate decisions regarding which resources to bring online when necessary. This approach provides flexibility in adapting to changing supply and demand conditions, and helps ensure that community water demands can be met reliably.

The SNWA Water Resource Portfolio includes a mix of resources that will be used in tandem with continued conservation efforts to meet demands over the 50-year planning horizon. Some of these resources can be used under any Colorado River operating condition, while others are subject to limitations.

The SNWA continues to make water conservation a priority and the community is currently working to achieve its 105 GPCD conservation goal by 2035. Additional targets will be evaluated once the current goal is achieved. The SNWA has taken a number of steps to increase conservation gains and is aggressively pursuing opportunities and recommendations identified by the SNWA's 2020 Integrated Resource Planning Advisory Committee. Priority areas include:

- Targeting the reduction of non-functional turf and limiting turf installation in new development.
- Limiting cool-season turf installation in public spaces and expediting conversions in public facilities.
- Enhancing landscape watering compliance through implementation of smart controller technology.
- Speeding customer leak repairs through implementation of advanced metering infrastructure.
- Reducing consumptive water losses associated with evaporative cooling by promoting advanced technology.
- Encouraging efficient development and discouraging consumptive water use for new large water users.
- Continuing to achieve reductions in water loss through infrastructure investments.

With ongoing support from the community, conservation will maximize the use and availability of existing supplies, help protect Lake Mead water levels from continued decline, offset potential climate change supply and demand impacts, delay the need for new resources and facilities, and provide opportunities to increase temporary storage reserves.

Likewise, the SNWA continues to work with other Colorado River water users to pursue flexible use of Colorado River supplies, including augmentation and storage projects that are designed to increase supplies and bolster Lake Mead water levels, as well as other water resource initiatives that could provide permanent supply benefits to Southern Nevada.

ENDNOTES

1 "Contract with the Southern Nevada Water Authority, Nevada for the Delivery of Colorado River Water," effective March 2, 1992; between Secretary of Interior, Colorado River Commission and Southern Nevada Water Authority." The contract was amended in 1994: "Amended and Restated Contract with the Southern Nevada Water Authority, Nevada for the Delivery of Colorado River Water," effective November 17, 1994.

2 Nevada Colorado River consumptive use entitlement available for SNWA and the SNWA purveyor members is estimated to be 272,205 AFY plus 4,000 AFY for Nellis Air Force Base with 23,795 AFY allocated for use by Nevada non-SNWA contractors. "Listing of Individual Water Entitlements in the State of Nevada," listing as of May 2020, U.S. Bureau of Reclamation, http://www. usbr. gov/lc/region/g4000/contracts/entitlements/NVentitlements.pdf.

3 The 1944 United States-Mexico Treaty for Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande. The treaty guarantees Mexico the delivery of 1.5 million AFY of Colorado River water plus 200,000 AFY of any surplus Colorado River water. In 1974, an international agreement interpreting the 1944 Treaty guaranteed Mexico water of the same quality as that being used in the United States.

4 Nevada receives credits for Colorado River return flows from the Las Vegas Wash based upon a procedure originally agreed to by the U.S. Bureau of Reclamation (BOR) and the Colorado River Commission of Nevada in 1984. This procedure has been updated periodically through consultation with the BOR, SNWA and Colorado River Commission of Nevada; the most recent update in 2007 allows full consumptive use of water imported to the Las Vegas Valley.

5 The 1964 Supreme Court Decree in Arizona v. California defines "surplus" as follows: "If sufficient mainstream water is available for release as determined by the Secretary, to satisfy annual consumptive use [in the Lower Division states of Arizona, California and Nevada] in excess of 7,500,000 acre-feet, such excess consumptive use is surplus."

6 Under the Interim Guidelines, Extraordinary Conservation ICS credits accumulated in ICS accounts will be reduced by the amount of the Flood Control Surplus on an acre-foot for acre-foot basis until no Extraordinary Conservation ICS remains. The reductions to the ICS accounts will be shared on a pro-rata basis among all contractors that have accumulated Extraordinary Conservation ICS credits.

7 According to the Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations of Lake Powell and Lake Mead (Interim Guidelines), Lower Basin States of Arizona, California and Nevada can create credits for Colorado River or non-Colorado River water that has been conserved by users in the Lower Basin (known as intentionally created surplus or ICS). ICS credits can be used in the year they are created or be stored in Lake Mead and made available for release from Lake Mead at a later time, subject to Operating (Shortage) conditions at the time of release.

8 "Developed Shortage Supply ("DSS")" shall mean water available for use by a contractor under the terms and conditions of a Delivery Agreement and Section 4 of Interim Guidelines in a Shortage Condition, under Article III(B)(3) of the Consolidated Decree. During a year when the Secretary has determined a shortage condition, the Secretary shall deliver DSS available in a contractor's DSS Account at the request of the contractor, subject to the provisions of Interim Guidelines' Section 4.C.

9 Nevada Revised Statutes, Chapters 532, 533, and 534.

10 "Policy Regarding Out-of-Valley Water Reuse," 2017, SNWA.

11 "Cooperative Agreement for the Banking of Water in the Las Vegas Valley Groundwater Basin between the Southern Nevada Water Authority and the Las Vegas Valley Water District," effective February 21, 2006. The artificial recharge program in the Las Vegas Valley was initiated in 1987 by the Las Vegas Valley Water District.

12 "Third Amended Operational Agreement among the Metropolitan Water District of Southern California (Metropolitan), Colorado River Commission of Nevada and the Southern Nevada Water Authority (SNWA)," effective October 19, 2015 and "Storage and Interstate Release Agreement among the United States of America, the Metropolitan Water District of Southern California, the Southern Nevada Water Authority, and the Colorado River Commission of Nevada," effective October 27, 2004. The amount of developed and released water stored in Metropolitan's SNWA Interstate Account to SNWA depends on timing of SNWA's request and Colorado River operating conditions at the time of such request.

13 "Third Amended and Restated Agreement for Interstate Water Banking among the Arizona Water Banking Authority and the Southern Nevada Water Authority and the Colorado River Commission of Nevada," effective May 20, 2013 and "Storage and Interstate Release Agreement among the United States of America, the Arizona Water Banking Authority, the Southern Nevada Water Authority, and the Colorado River Commission of Nevada," effective December 18, 2002.

14 "In-Lieu Recharge Order," Order No. 1176, December 10, 2004,State of Nevada, Office of the Nevada State Engineer.

15 "Lower Colorado River Basin Drought Contingency Plan Agreement" among the U.S., State of Arizona, Metropolitan Water District of Southern California, Coachella Valley Water District, Palo Verde Irrigation District, City of Needles, Colorado River Commission of Nevada and SNWA. May 20, 2019.

16 "Lower Basin Drought Contingency Operations, ICS Exhibit W - Southern Nevada Water Authority – Extraordinary Conservation Intentionally Created Surplus using Municipal Conservation and Offstream Storage for implementation under the Lower Basin Drought Contingency Plan," May 20, 2019.

17 Black & Veach, "Binational Study of Water Desalination Opportunities in the Sea of Cortez," 2000, prepared for Minute 323 Desalination Work Group (ibwc.gov/Files/TMs_All_Portfolio.pdf).

18 SNWA has 2,200 AFY of groundwater permits in Garnet and-Hidden valleys as a combined duty. SNWA is currently leasing a maximum of 1,450 AFY, not to exceed 13,000 acre-feet over any ten year rolling period, for power generation in Garnet Valley. The leases therefore commit 1,300 AFY over a ten year rolling period. In addition, the City of North Las Vegas is permitted to divert 300 AFY from their wells in Garnet Valley, and the remaining 600 AFY is available for future uses.

19 "Agreement Concerning Colorado River Management and Operations," effective April 23, 2007; between Arizona Department of Water Resources, Colorado River Board of California, Colorado Water Conservation Board, Governor's Representative for the State of Colorado, Colorado River Commission of Nevada, Southern Nevada Water Authority, New Mexico Interstate Stream Commission, Utah Division of Water Resources, Utah Interstate Streams Commissioner, and Wyoming State Engineer.

20 Southern Nevada Water Authority Joint Water Conservation Plan," November 2019, SNWA.

21 J. Kiefer, J. Clayton, B. Dziegielewski and J. Henderson, "Changes in Water Use Under Regional Climate Change Scenarios," 2013, Water Research Foundation (Project #4263).

Colorado River, Nevada

MEETING FUTURE DEMANDS

THIS CHAPTER ADDRESSES HOW SNWA PLANS TO RELIABLY MEET PROJECTED WATER DEMANDS UNDER A RANGE OF SUPPLY AND DEMAND CONDITIONS.

INTRODUCTION

As described in the preceding chapters, water supply conditions and demands can be influenced by several factors that can change in unpredictable ways, including changes associated with economic conditions, water conservation progress and climate variability. As the SNWA prepared its 2020 Plan, the organization considered two overriding issues related to water supply and demands:

- The potential impact of continued drought and climate change on water resource availability, particularly for Colorado River supplies; and
- The potential impact of economic conditions, climate change and water use patterns on long-term water demands.

To address these uncertainties, the SNWA developed a series of planning scenarios that represent Southern Nevada's future water resource needs under variable supply and demand conditions. This approach helps inform water resource planning and water resource development efforts and demonstrates how the SNWA plans to meet future needs, even if conditions change significantly over time.

Water demands and resource volumes are presented in consumptive use terms, consistent with the water resource descriptions in Chapter 3 and illustrating the supply related impacts of SNWA shortage reductions and DCP contributions. As described in the following sections, all of the planning scenarios presented in this chapter demonstrate the SNWA's ability to meet the community's long-term projected water needs through adaptive use of its Water Resource Portfolio.

SUPPLY AND DEMAND

Water resource planning is based on two key factors: supply and demand. Supply refers to the amount of water that is available or that is expected to be available for use. Demand refers to the amount of water expected to be needed in a given year.

Water demand projections are based on population forecasts and include assumptions about future water use, such as expected achievements toward water conservation goals. Precise accuracy from year to year rarely occurs in projecting demands, particularly during periods of significant social and economic changes. While making assumptions is a necessary part of the planning process, assumptions are unlikely to materialize exactly as projected. Likewise, climate variations, policy changes and/or the implementation of new regulations can also influence water resource availability over time.

The scenarios presented in this chapter address these uncertainties by considering a wide range of supply and demand possibilities. Rather than considering a single forecast, the scenarios bracket the range of reasonable conditions that may be experienced over the 50-year planning horizon. Key factors evaluated include possible reductions of Colorado River supplies, as well as variation in future demands. This is a conservative approach that reflects the uncertainties presented in the current planning environment.

The following describes the water supply conditions and demand projections that were considered as part of scenario development.

Water Supply

Figure 4.1 summarizes the water resources planned for development and use as part of the SNWA's Water Resource Portfolio. As previously described, some permanent and temporary resources are subject to restrictions for use based on Lake Mead water levels (when Lake Mead is at an elevation of 1,090 feet or lower), while other resources will require the development of facilities for use.

Ultimately, the timing and need for resources will depend significantly on how supply and demand conditions materialize over the long-term planning horizon.

	SUPPLY	CONSUMPTIVE USE	AVAILABLE IN SHORTAGE
PERMANENT	Colorado River (SNWA and Nellis Air Force Base) [1]	276, 205 AFY	Yes. Subject to shortage reductions
	Nevada Unused Colorado River (Non-SNWA)	13,132 (2020) to 0 AFY in 2031	Yes. Subject to availability
	Tributary Conservation ICS	28,700-36,000 AFY	Yes
	Las Vegas Valley Groundwater Rights	46,961 AFY	Yes
TEMPORARY	Southern Nevada Groundwater Bank	345,777 AF (20,000 AFY max.)	Yes
	Interstate Bank (Arizona)	613,846 AF (40,000 AFY max.)	Yes
	Interstate Bank (California)	330,225 AF (30,000 AFY max.)	Yes
	Intentionally Created Surplus (storage in Lake Mead)	785,913 AF (300,000 AFY max.)	Yes. Varies by Lake Mead elevation
FUTURE	Colorado River Transfers/Exchanges Permanent Future Supply (Desalination and Colorado River Partnerships)	20,000-40,000 AFY	Yes
	Colorado River Transfers/Exchanges Virgin River/Colorado River Augmentation	Up to 108,000 AFY	To be determined
	Garnet and Hidden Valleys Groundwater	2,200 AFY	Yes
	Tikaboo and Three Lakes Valley North and South Groundwater	10,605 AFY	Yes

FIGURE 4.1 **SNWA Water Resource Portfolio**

Water Demand Projections

The planning scenarios developed as part of this Plan include three water demand projections (Figure 4.2 and Figure 4.3). These include: an upper water demand projection, a lower water demand projection and an additional conservation demand projection. The lower water demand projection was derived from a population forecast and expected conservation achievements. The Clark County population forecast was obtained from the University of Nevada Las Vegas Center for Business and Economic Research (CBER).

YEAR	2020	2045	2071
LOWER DEMAND	281,000	334,000	353,000
UPPER DEMAND	283,000	393,000	441,000
ADDITIONAL CONSERVATION	282,000	365,000	406,000

FIGURE 4.2
SNWA Demand Projection, (AFY)

This forecast is also used in local planning, including transportation planning by the Regional Transportation Commission. The forecast is based on CBER's working knowledge of the economy and the nationally recognized Regional Economic Model Incorporated (REMI).

The lower water demand projection was derived using the 2020 CBER population forecast through 2060 and trending through the year 2071. The historical share of Clark County population attributable to the SNWA service area was multiplied by 2019 water-use levels and reduced over time to represent expected achievement of the community's water conservation goal of 105 GPCD by 2035. The projection assumes a further reduction in total demand (100 GPCD) by 2055 to reflect the potential for additional conservation once the current goal has been met.

The upper demand projection was developed for planning purposes to reflect increased uncertainties related to possible changes in demands that are associated with the economy, climate, population and water use variability.

The upper demand projection represents a 15 percent increase over the lower projection at the midpoint of the planning horizon (2040), increasing to 25 percent in the latter part of the planning horizon (2071). The SNWA also considered one variant of the upper demand projection that includes assumptions about additional levels of conservation.

The additional conservation demand projection was developed for planning purposes to illustrate how additional conservation might reduce water demands, extend permanent and temporary resources and delay the need for future resources. The projection assumes the community meets its conservation goal of 105 GPCD and further reduces water use to 98 GPCD by 2035 and 92 GPCD by 2055.

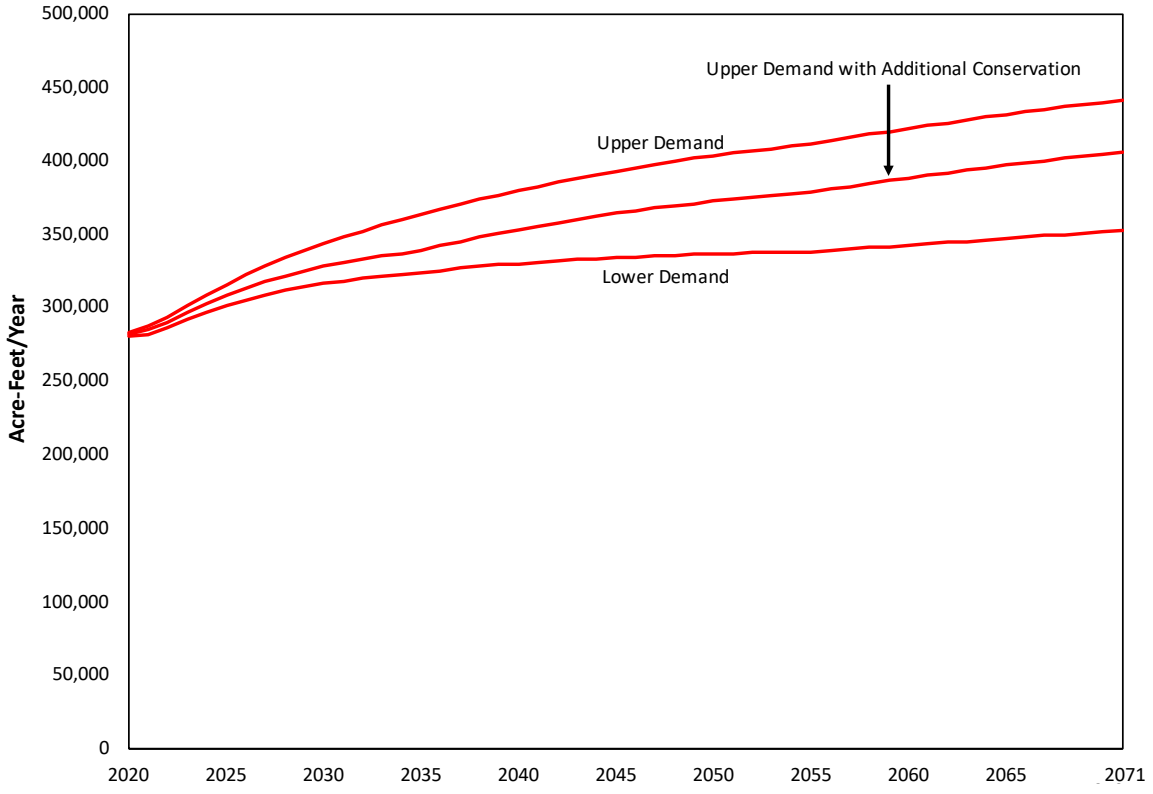


FIGURE 4.3 **SNWA Historical and Projected Water Demand**

Water Supply Conditions

The SNWA also made assumptions about future water supply conditions as part of its long-range planning efforts. As detailed in Figure 4.4 and Figure 4.5, the SNWA evaluated four water supply conditions that are based on historic Colorado River inflows since 1906 (when record-keeping began) to 2020. While several planning scenarios presented in this Plan consider historical average flows for Colorado River supplies, drier hydrology is expected based on current trends and forecast conditions (see Chapter 2). As a result, the Dry, Extremely Dry and Climate Change water supply conditions as shown on right provide a more likely range for planning purposes.

As noted earlier in this Plan, Colorado River inflows are highly variable with occasional and extended periods of extremely wet and extremely dry inflows. By incorporating historical water supply conditions into long-term planning efforts, the SNWA can make better-informed decisions about future Lake Mead water levels and associated restrictions on Colorado River supplies, as well as the timing and volume of resources needed to meet future demands.

Under the Interim Guidelines, shortage volumes are defined for Lake Mead elevations between 1,075 and 1,025 feet. Likewise, the DCP defines Lower Basin contributions when Lake Mead is at or below

WATER SUPPLY CONDITION	SUMMARY
AVERAGE	Repeats Colorado River inflows over the combined 50-year period from 1915 to 1964; assumes an average annual Colorado River inflow of 14.8 million AFY. This is representative of the river's historic long-term average inflow of 14.7 million AFY.
DRY	Repeats Colorado River inflows over the 50-year period from 1924 to 1973; assumes an average annual Colorado River inflow of 14.1 million AFY.
EXTREMELY DRY	Repeats Colorado River inflows over the 50-year period from 1929 to 1978; assumes an average annual Colorado River inflow of 13.7 million AFY.
CLIMATE CHANGE	To simulate the effects of drier and hotter conditions represented in climate change projections, the Colorado River inflows over a 25-year period from 1953 to 1977 are repeated to form an average annual inflow of 12.9 million AFY. Projections of inflows under the Colorado River Basin study for climate change ranged from roughly 10 to 17 million AFY. While this does not represent the driest scenario, it is drier than approximately 70 percent of the climate scenarios (see Appendix 4).

FIGURE 4.4 **Water Supply Conditions Summary**

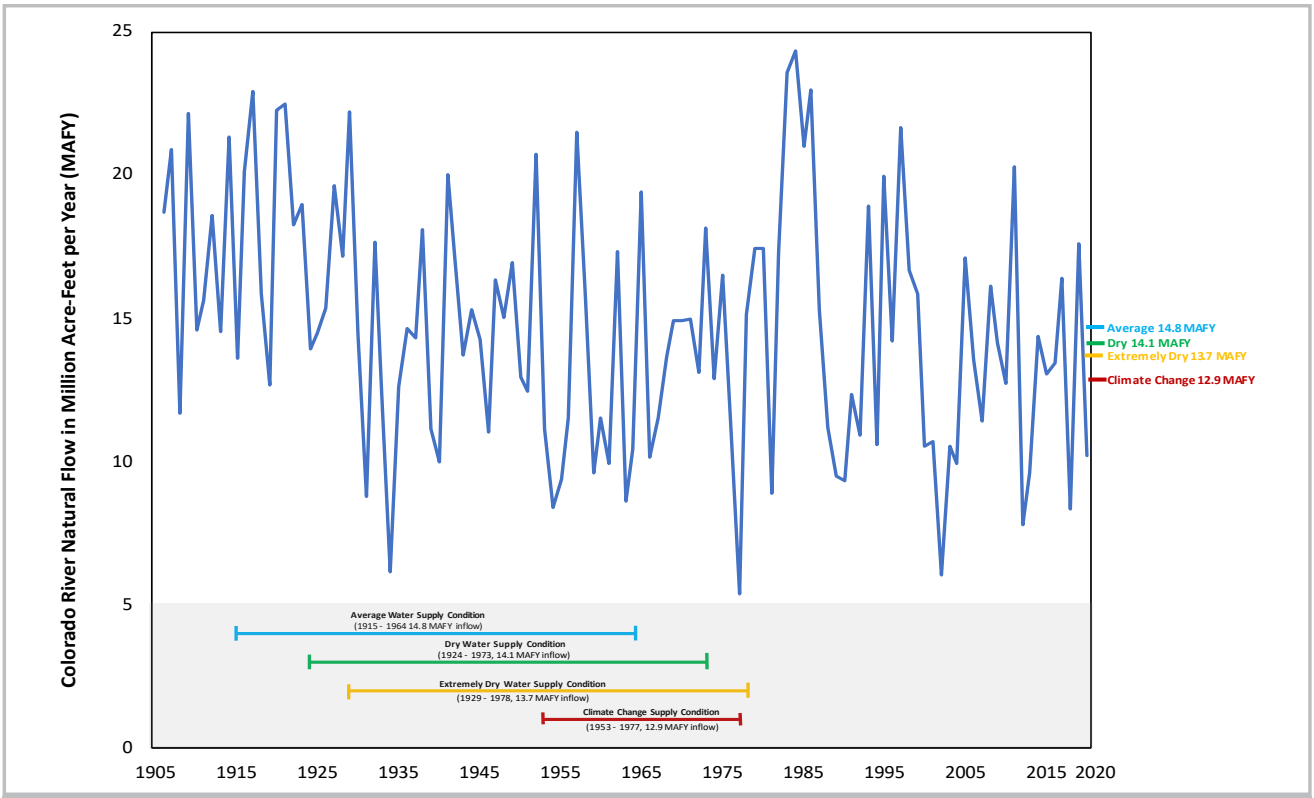


FIGURE 4.5 **Water Supply Conditions Evaluated in Planning Scenarios 1906 - 2020**

Hoover Dam

The Interim Guidelines and Lower Basin DCP work to reduce the decline of Lake Mead water levels and protect Colorado River operations. If modeling projects Lake Mead to be at or below 1,030 feet, the U.S. Secretary of the Interior will work with Lower Basin states to determine what additional actions may be needed to avoid and protect against the potential for Lake Mead to decline below 1,020 feet.

1,090 feet. Both agreements expire in 2026. While some provisions extend further, operational certainty decreases with time.

If Lake Mead is projected to be at or below 1,030 feet, the U.S. Secretary of the Interior will consult with the Colorado River Basin States to determine what additional measures are needed to avoid and protect against the potential for Lake Mead to decline to below 1,020 feet. If this were to occur, future negotiations and consultation with the U.S. Secretary of the Interior may establish additional shortage volumes and/or DCP contribution amounts. As a result, Nevada may be required to assume reductions greater than 30,000 AFY (Nevada's combined maximum shortage and contribution volume under the Interim Guidelines and DCP). This Plan assumes a maximum reduction of 40,000 AFY as described later in this chapter.

Colorado River modeling performed by the Bureau of Reclamation in 2020 projects an approximate 23 to 53 percent probability that Lake Mead will reach an elevation of 1,075 feet or lower in the years 2022 to 2025, triggering a federal shortage declaration. The probability of shortage ranges between approximately 50 to 64 percent in the years following.

SUPPLY AND DEMAND SCENARIOS

The water supply conditions and demand projections on pages 39 and 40 have been combined into a series of planning scenarios (Figure 4.6 through Figure 4.23) that depict the volume and type of resources planned for use to meet the range of possible future supply and demand conditions discussed in this chapter. Each set of planning scenarios is accompanied by a more detailed description of water supply conditions, as well as assumptions about resource availability and use.

The 2020 Plan assumes the Interim Guidelines and DCP continue through the planning horizon. Resource volumes may vary within scenario groupings based on assumptions for how SNWA DCP commitments are met. The SNWA can meet this obligation by reducing the use of Colorado River supplies, by utilizing other resources, or converting eligible forms of ICS to meet DCP contributions.

All planning scenarios consider combinations of permanent, temporary and future resources as described in Chapter 3. Having a portfolio of resource options provides the SNWA with the flexibility to adjust the use of some resources if the development of other resources is delayed or revised, or if changes in demands occur. If other options become available sooner, the priority and use of resources may change.

AVERAGE HYDROLOGY SCENARIOS
(14.8 Million AFY Natural Flow)

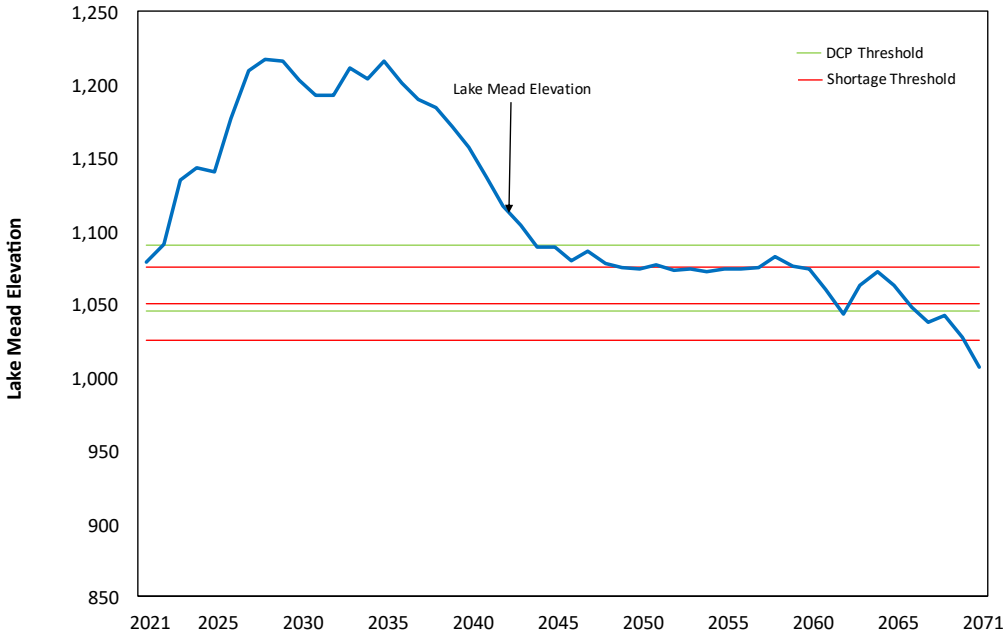


FIGURE 4.6 **Lake Mead Elevation, Average Hydrology**

Figure 4.6 depicts the projected Lake Mead elevation if Colorado River hydrology over the combined 50-year period from 1915 to 1964 repeats through 2071.

This forecast assumes Lake Mead will decline intermittently over the long-term planning horizon, triggering DCP contributions in 2021 and 2022 . This is followed by intermittent DCP contributions and shortage conditions between 2045 and 2071. Increased reductions up to 40,000 AFY are assumed in later years based on demand and when Lake Mead falls below 1,020 feet.

Figure 4.7 - Figure 4.9 reflect SNWA planning adjustments and water resources available to meet average hydrology demand projections.

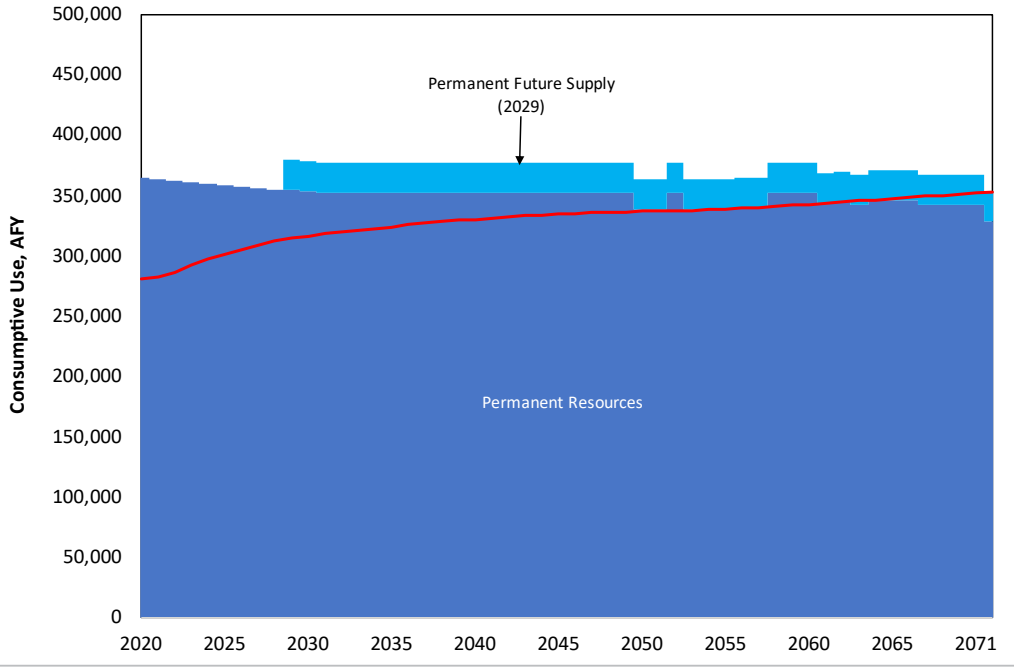


FIGURE 4.7 **Average Hydrology, Lower Demand**

As shown in Figure 4.7, permanent and future resources are sufficient to meet demands through 2071 Permanent future supplies (25,000 AFY) are available in 2029 with deliveries beginning in 2063.

Under this scenario, temporary and other future resources are not anticipated for use during the planning horizon.

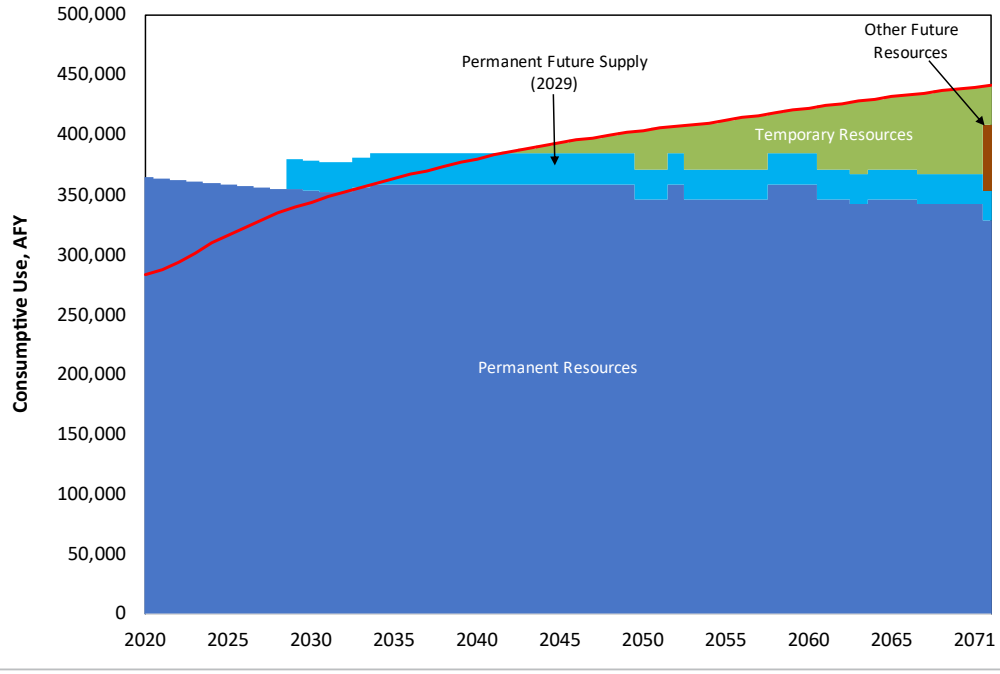


FIGURE 4.8 **Average Hydrology, Upper Demand**

As shown in Figure 4.8, permanent, temporary and future resources are needed to meet demands through the 50-year planing horizon. Under this scenario, permanent future supply (25,000 AFY) is available in 2029 with deliveries beginning in 2034. Temporary resources are needed in 2042 and other future resources are needed in 2071. The volume of other future resources needed at the end of the planning horizon is estimated at 54,000 AFY.

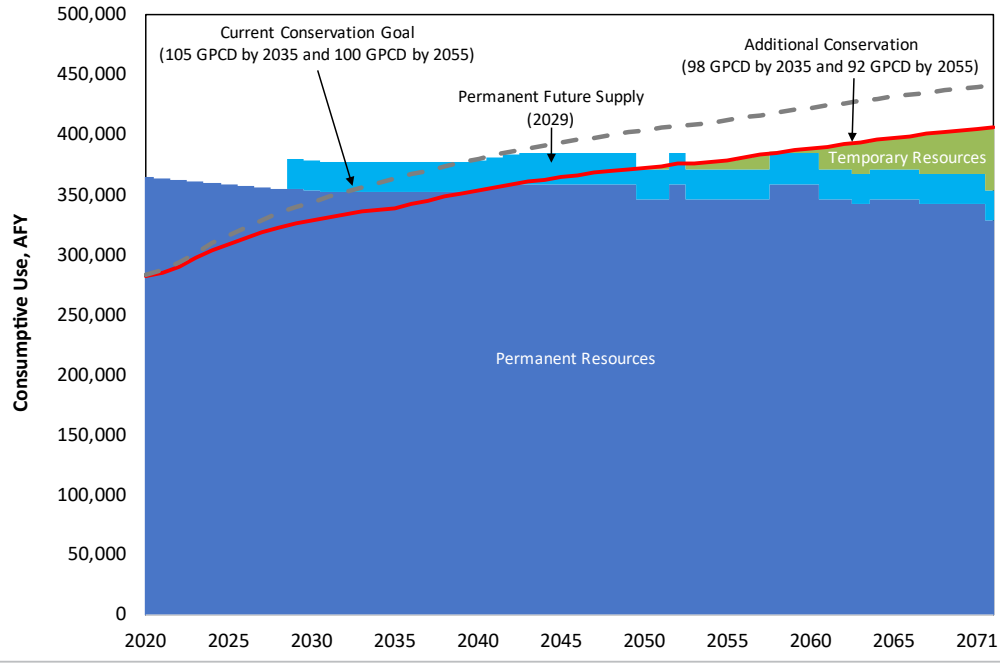


FIGURE 4.9 **Average Hydrology, Additional Conservation**

Figure 4.9 illustrates the impact of additional conservation on the timing and need of temporary and future resources. This scenario assumes future water use at 98 GPCD by 2035 and 92 GPCD by 2055. Under this scenario permanent, temporary and future resources resources are sufficient to meet water demands through 2071. Permanent future supply (25,000 AFY) is available in 2029 with deliveries beginning in 2043 and temporary resources are needed in 2050. Other future resources are not anticipated for use during the planning horizon.

DRY HYDROLOGY SCENARIOS
(14.1 Million AFY Natural Flow)

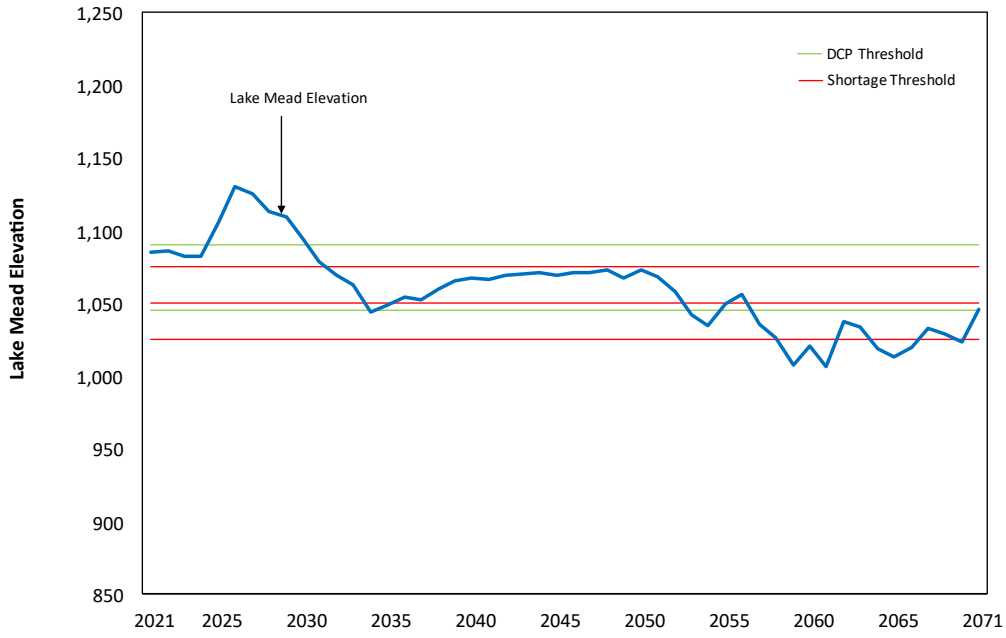


FIGURE 4.10 **Lake Mead Elevation, Dry Hydrology**

Figure 4.10 illustrates the projected elevation of Lake Mead if Colorado River hydrology experienced between 1924 and 1973 repeats through 2071.

This forecast assumes Lake Mead will decline between 2021 and 2025, triggering DCP contributions. A period of sustained decline follows after 2031, triggering defined shortage reductions and DCP contributions for the balance of the planning horizon. A maximum annual reduction of 40,000 AFY is assumed in later years based on demand and when Lake Mead water levels are below 1,020 feet.

Figures 4.11 – 4.13 reflect SNWA planning adjustments and water resources available to meet dry hydrology demand projections.

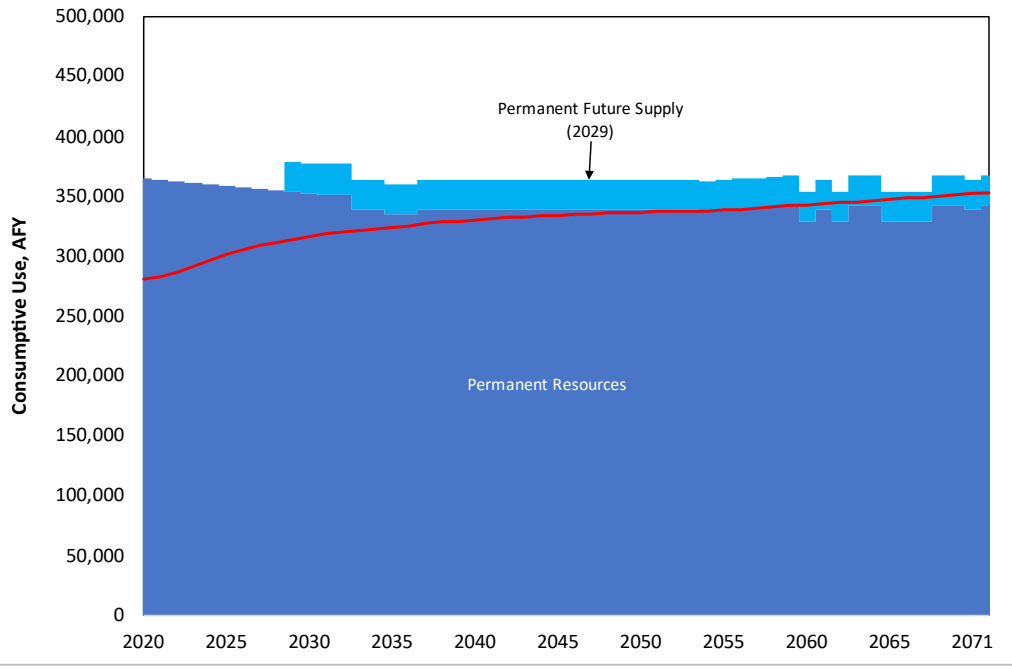


FIGURE 4.11 **Dry Hydrology, Lower Demand**

As shown in Figure 4.11, permanent and future resources are sufficient to meet demands through 2071. Permanent future supplies (25,000 AFY) are available in 2029 with deliveries beginning in 2060.

Under this scenario, temporary and other future resources are not anticipated for use during the planning horizon.

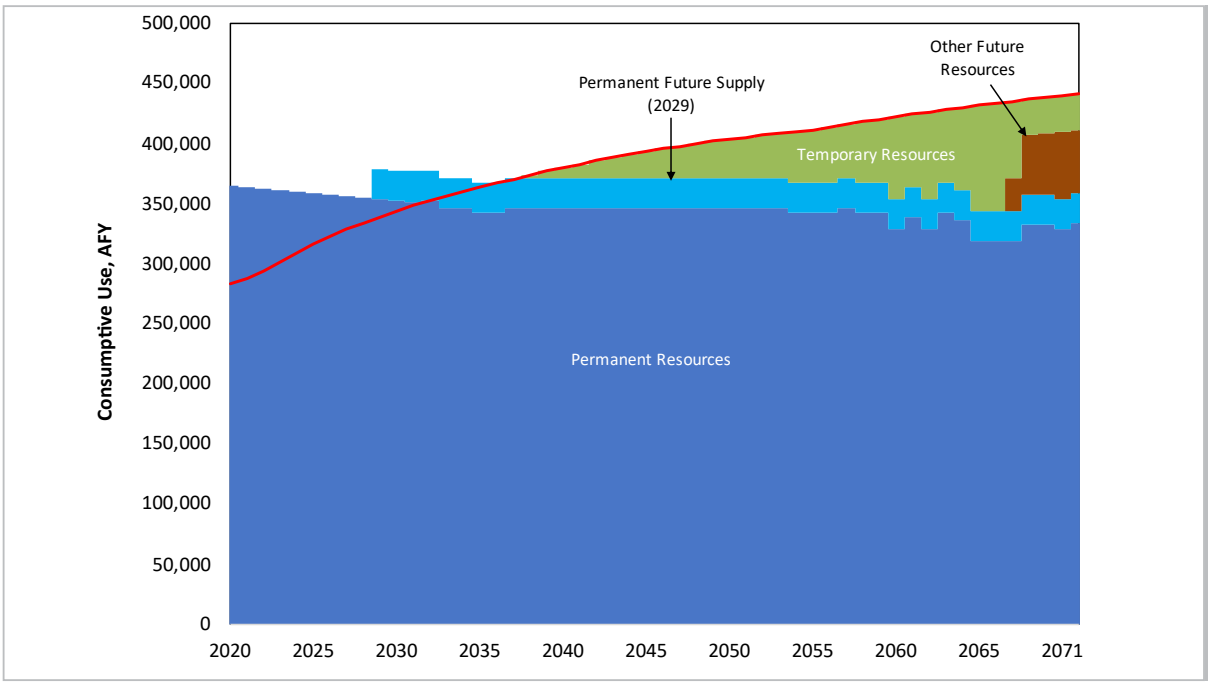


FIGURE 4.12 **Dry Hydrology, Upper Demand**

As shown in Figure 4.12, permanent, temporary and future resources are needed to meet demands through the 50-year planing horizon. Under this scenario, permanent future supply (25,000 AFY) is available in 2029 with deliveries beginning in 2033. Temporary resources are needed in 2038 and other future resources are needed in 2067. The volume of other future resources needed at the end of the planning horizon is estimated at 52,000 AFY.

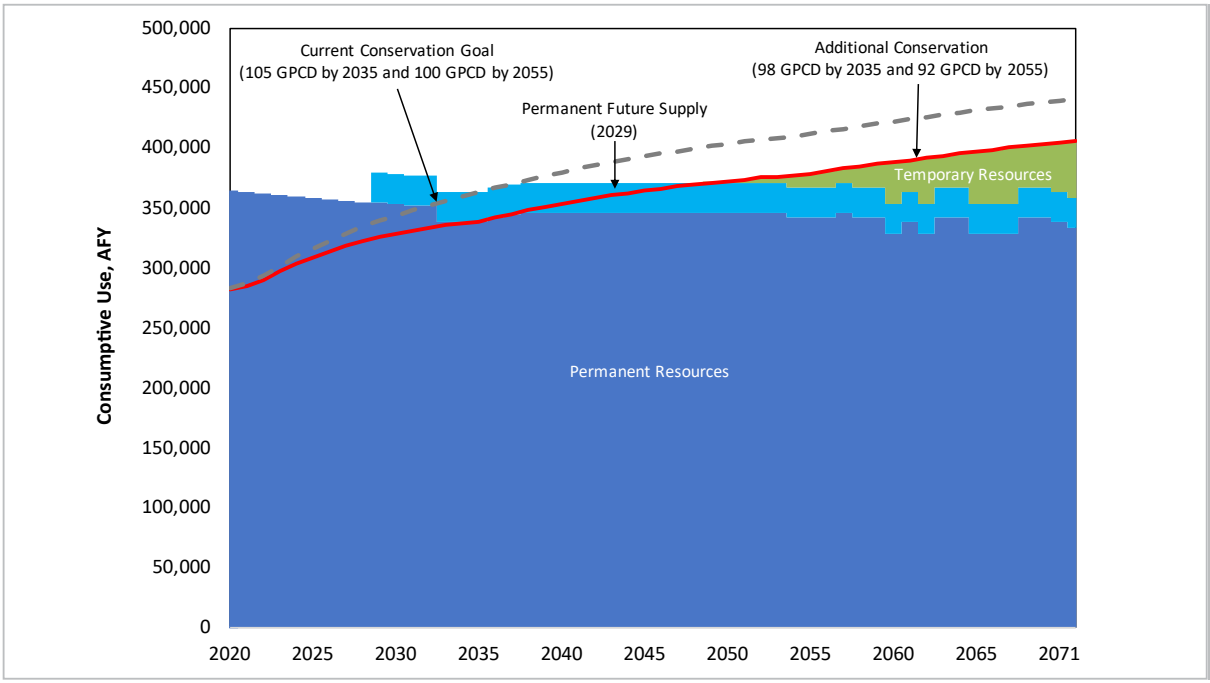


FIGURE 4.13 **Dry Hydrology, Additional Conservation**

Figure 4.13 illustrates the impact of additional conservation on the timing and need for temporary and future resources. This scenario assumes future water use at 98 GPCD by 2035 and 92 GPCD by 2055. Under this scenario permanent, temporary and future resources resources are sufficient to meet water demands through 2071. Permanent future supply (25,000 AFY) is available in 2029 with deliveries beginning in 2038 and temporary resources are needed in 2049. Other future resources are not anticipated for use during the planning horizon.

EXTREMELY DRY HYDROLOGY SCENARIOS
(13.7 Million AFY Natural Flow)

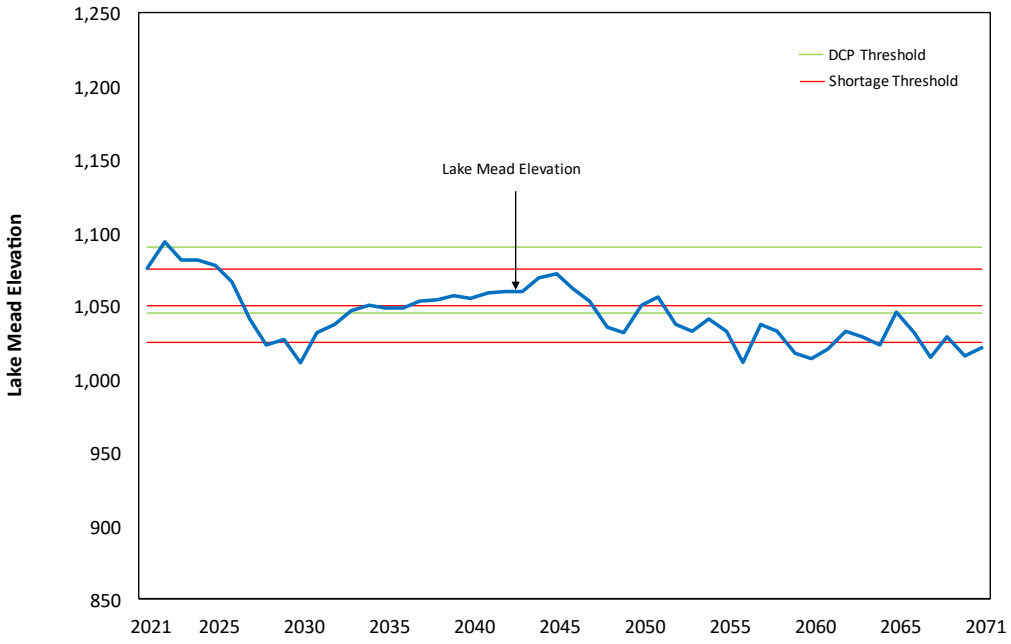


FIGURE 4.14 **Lake Mead Elevation, Extremely Dry Hydrology**

Figure 4.14 illustrates the projected elevation of Lake Mead if Colorado River hydrology experienced between 1929 and 1978 repeats through 2071.

This forecast assumes Lake Mead will decline between 2021 and 2026, triggering DCP contributions. A period of sustained decline follows in years thereafter, triggering defined shortage reductions and DCP contributions.

Increased reductions up to 40,000 AFY are assumed in later years based on demands and when Lake Mead is below 1,020 feet.

Figures 4.15 – 4.17 reflect SNWA planning adjustments and water resources available to meet the three water demand projections with extremely dry hydrology.

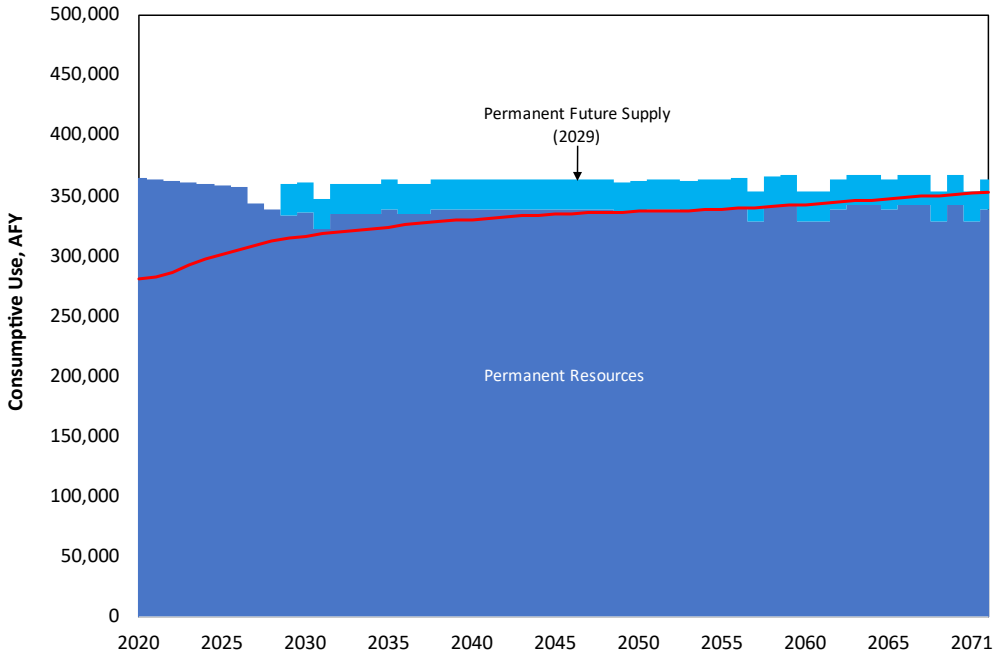


FIGURE 4.15 **Extremely Dry Hydrology, Lower Demand**

As shown in Figure 4.15, permanent and future resources are sufficient to meet demands through 2071. Permanent future supplies (25,000 AFY) are available in 2029 with deliveries beginning in 2057.

Under this scenario, temporary and other future resources are not anticipated for use during the planning horizon.

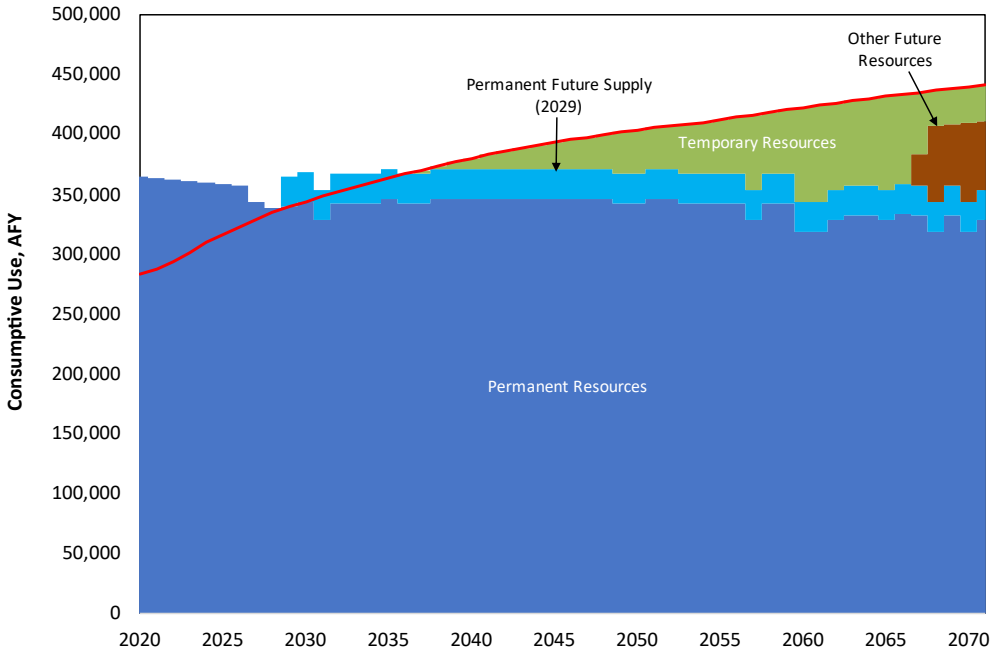


FIGURE 4.16 **Extremely Dry Hydrology, Upper Demand**

As shown in Figure 4.16, permanent, temporary and future resources are needed to meet demands through the 50-year planing horizon. Under this scenario, permanent future supply (25,000 AFY) is available in 2029 with deliveries beginning in 2030. Temporary resources are needed in 2037 and other future resources are needed in 2067. The volume of other future resources needed at the end of the planning horizon is estimated at 57,000 AFY.

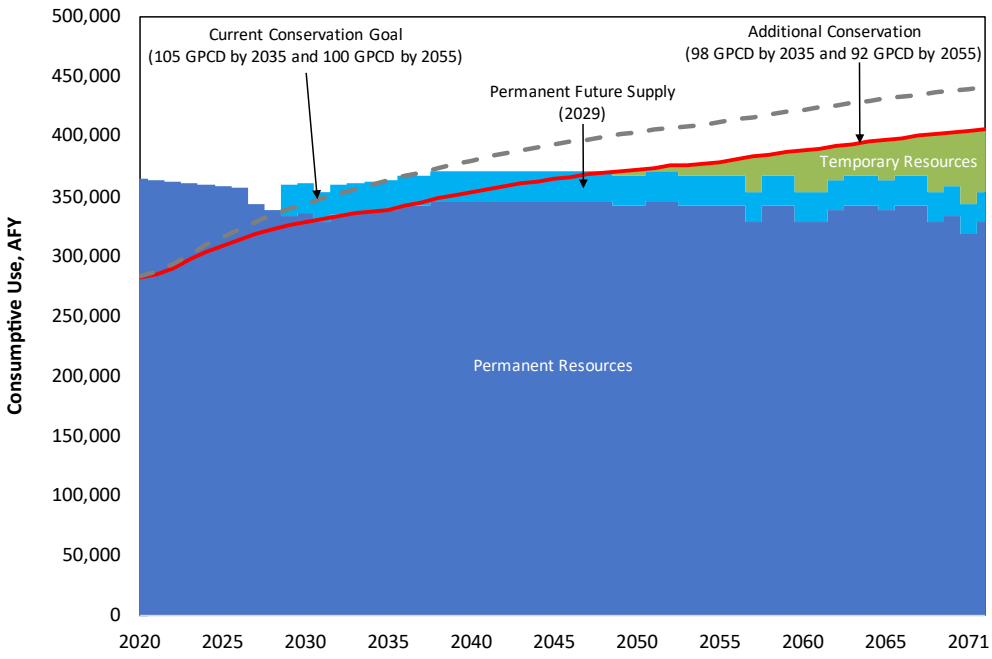


FIGURE 4.17 **Extremely Dry Hydrology, Additional Conservation**

Figure 4.17 illustrates the impact of additional conservation on the timing and need for temporary and future resources. This scenario assumes future water use at 98 GPCD by 2035 and 92 GPCD by 2055. Under this scenario permanent, temporary and future resources resources are sufficient to meet water demands through 2071. Permanent future supply (25,000 AFY) is available in 2029 with deliveries beginning in 2031 and temporary resources are needed in 2049. Other future resources are not anticipated for use during the planning horizon.

CLIMATE CHANGE SCENARIOS
(12.9 Million AFY Natural Flow)

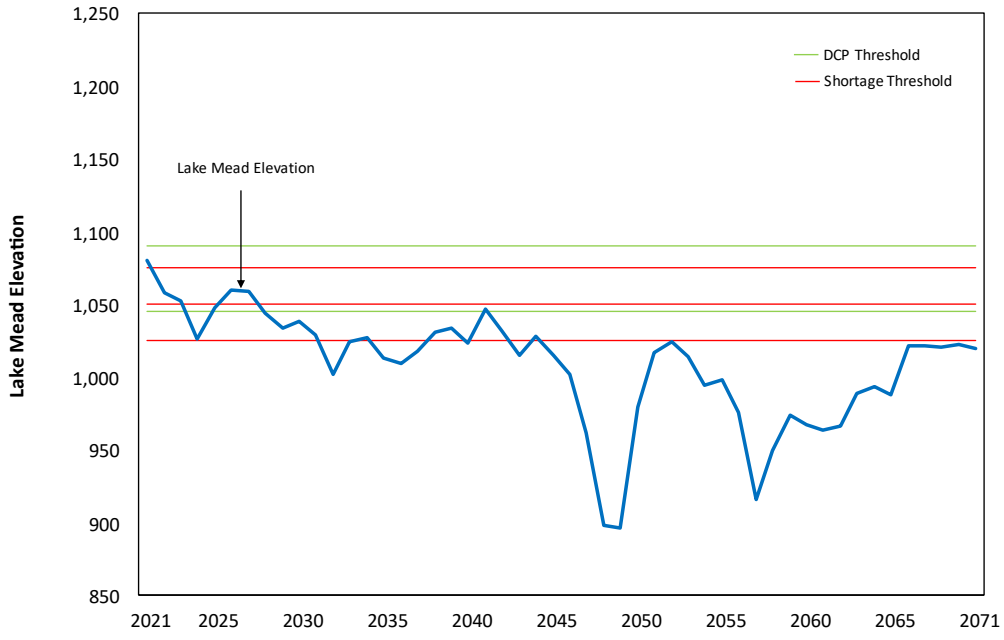


FIGURE 4.18 **Lake Mead Elevation, Climate Change Hydrology**

Figure 4.18 illustrates the projected elevation of Lake Mead if Colorado River hydrology experienced between 1953 and 1977 repeats through 2071. Under this scenario, Lake Mead falls below 1,090 feet and declines between 895 and 1,000 feet in 2048.

Shortage reductions and DCP contributions are assumed throughout the planning horizon. Increased reductions up to 40,000 AFY are assumed based on demands and when Lake Mead water levels are below 1,020 feet.

Figures 4.19 – 4.23 reflect SNWA planning adjustments and water resources available to meet the climate change hydrology water demand projections.

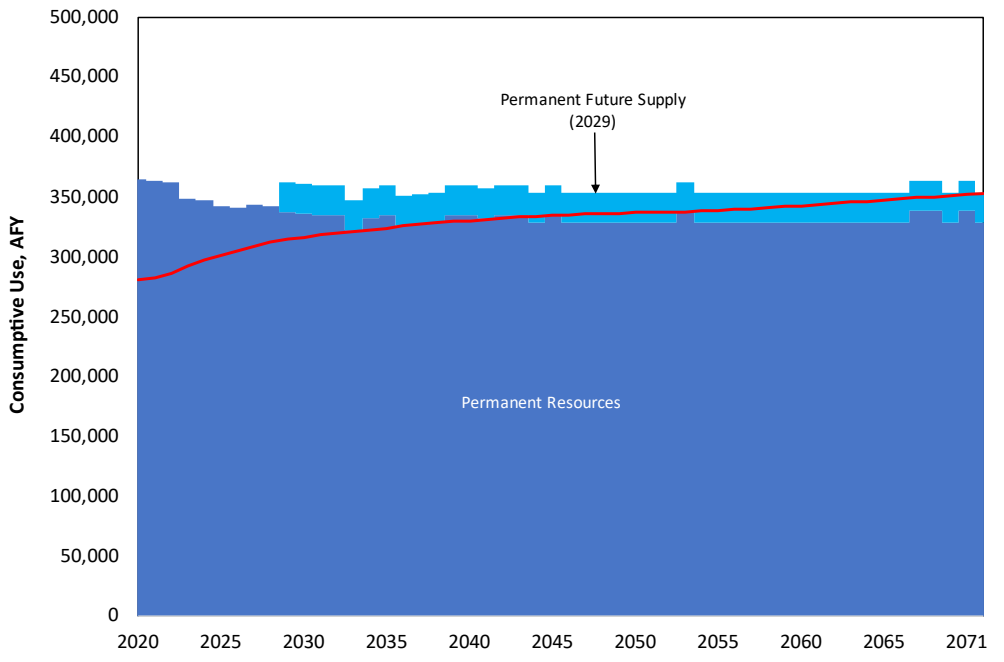


FIGURE 4.19 **Climate Change Hydrology, Lower Demand**

As shown in Figure 4.19, permanent and future resources are sufficient to meet demands through 2071. Permanent future supplies (25,000 AFY) are available in 2029 with deliveries beginning in 2044. Under this scenario, temporary and other future resources are not anticipated for use during the planning horizon.

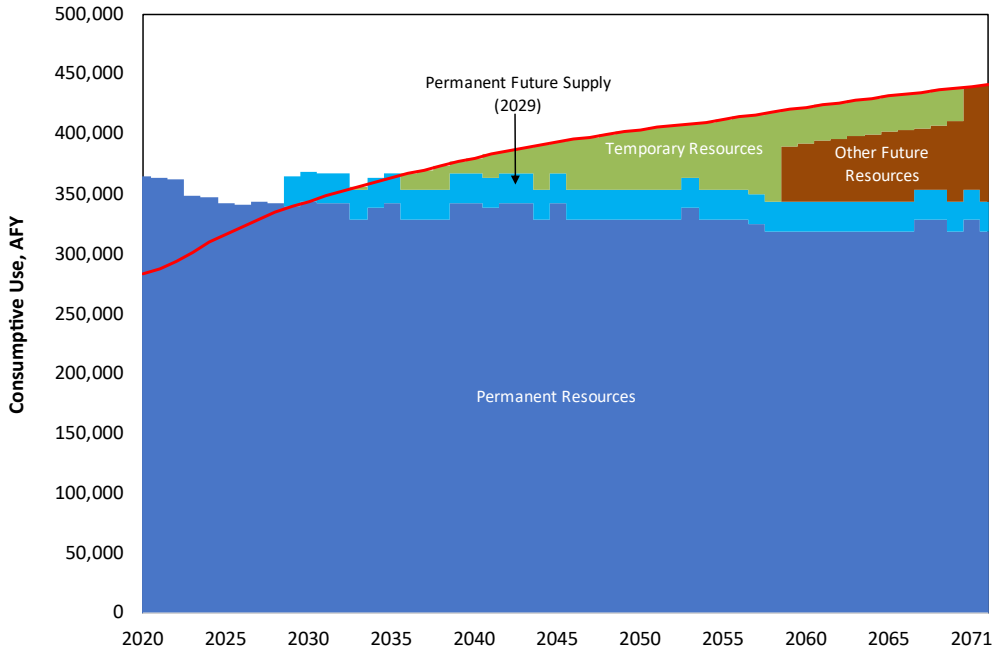


FIGURE 4.20 **Climate Change Hydrology, Upper Demand (2029)**

As shown in Figure 4.20, permanent, temporary and future resources are needed to meet demands through the 50-year planing horizon. Under this scenario, permanent future supply (25,000 AFY) is available in 2029 with deliveries beginning in 2030.

Temporary resources are needed in 2033 and other future resources are needed in 2059. The volume of other future resources needed at the end of the planning horizon is estimated at 97,000 AFY.

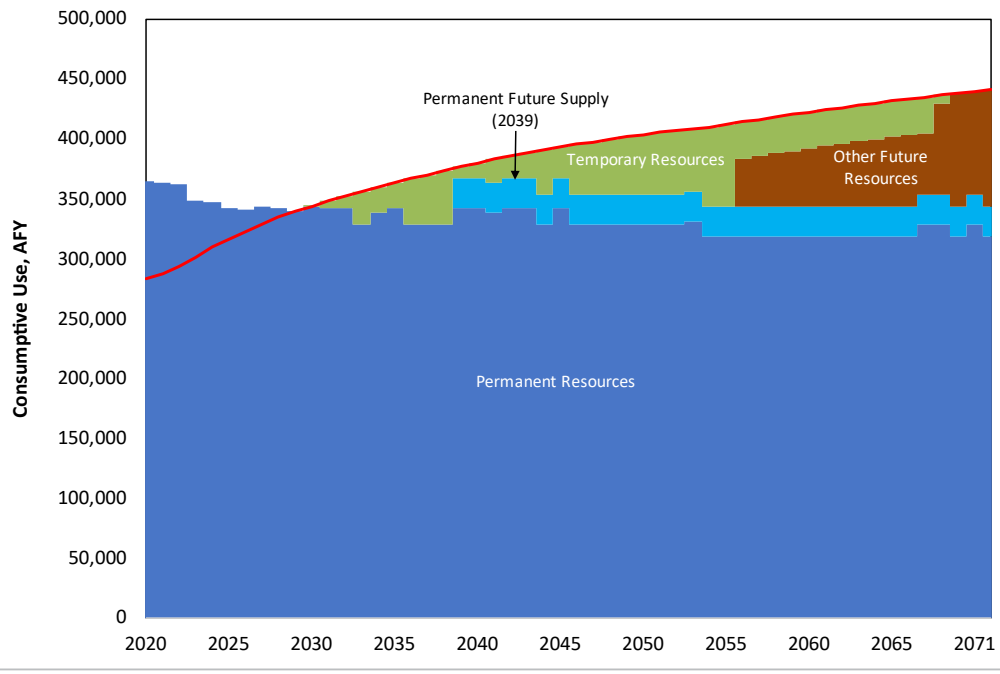


FIGURE 4.21 **Climate Change Hydrology, Upper Demand (2039)**

As shown in Figure 4.21, permanent, temporary and future resources are needed to meet demands through 2071. Under this scenario, permanent future supply (25,000 AFY) is available and needed in 2039.

Temporary resources are needed in 2030 and other future resources are needed in 2056. The volume of other future resources needed at the end of the planning horizon is estimated at 97,000 AFY.

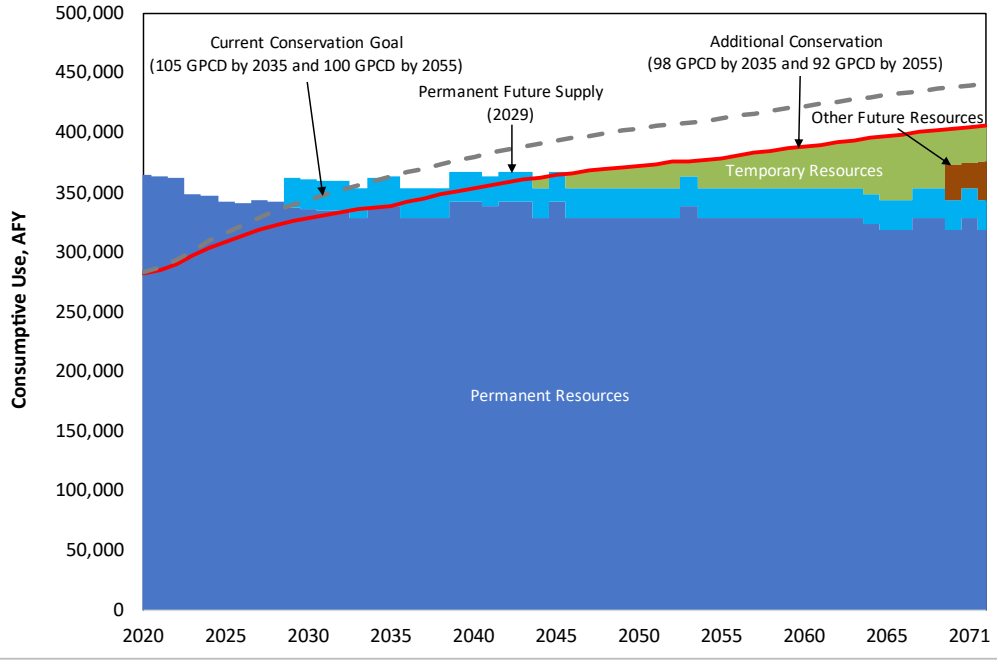


FIGURE 4.22 **Climate Change Hydrology, Additional Conservation (2029)**

Figure 4.22 illustrates the impact of additional conservation on the timing and need for temporary and future resources. This scenario assumes future water use at 98 GPCD by 2035 and 92 GPCD by 2055. Under this scenario permanent, temporary and future resources resources are sufficient to meet water demands through 2071. Permanent future supply (25,000 AFY) is available in 2029 with deliveries beginning in 2033. Temporary resources are needed in 2044 and other future resources are needed in 2069. The volume of other future resources needed at the end of the planning horizon is estimated at 32,000 AFY.

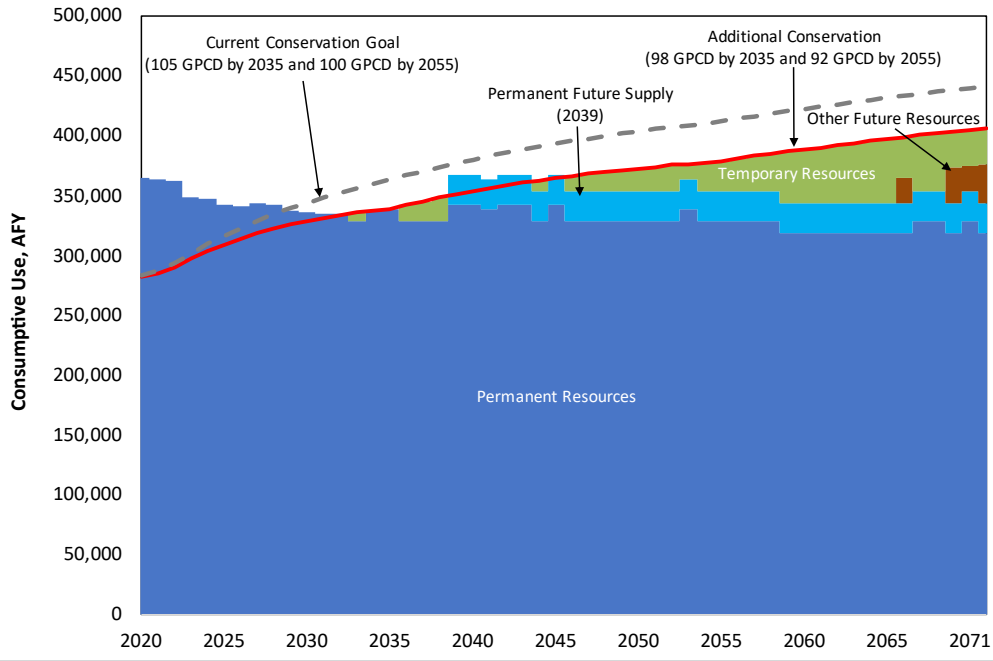


FIGURE 4.23 **Climate Change Hydrology, Additional Conservation (2039)**

As shown in Figure 4.23, permanent, temporary and future resources are needed to meet demands through 2071. Under this scenario, permanent future supply (25,000 AFY) is available and needed in 2039. Temporary resources are needed in 2033 and other future resources are needed in 2066. The volume of other future resources needed at the end of the planning horizon is estimated at 32,000 AFY.

CHAPTER SUMMARY

Water supply and demand conditions are influenced by a number of factors, including economic conditions, water use patterns, conservation progress and climate variability. To account for these variables, the SNWA's 2020 Plan considers several water supply and demand scenarios that bracket the range of plausible conditions to be experienced over the 50-year planning horizon.

The scenarios assume that Southern Nevada will continue to make progress towards its current water conservation goal, as well as achieve increased levels of efficiency over the long-term planning horizon. Likewise, the scenarios assume that unused Nevada Colorado River water will continue to be stored for future use and that this and other temporary resources will be used to meet demands until future resources are needed and developed. Meanwhile, the SNWA will continue to work with its Colorado River partners to explore emerging resource development opportunities, including participation in desalination projects in the U.S. and Mexico, and/or conservation and reuse projects in the state of California.

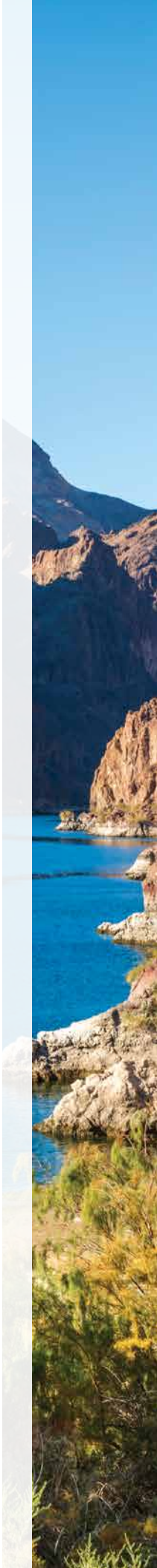
Colorado River modeling performed by the U.S. Bureau of Reclamation in 2020 projects an approximate 23 to 64 percent probability that Lake Mead will reach an elevation of 1,075 or lower over the 50-year planning horizon. This would trigger a federal shortage declaration. Under the Interim Guidelines and DCP, the maximum supply reduction prescribed to Nevada is 30,000 AFY; however, this amount could potentially increase. If modeling projects Lake Mead to be at or below 1,030 feet, the Secretary of the Interior will work with Lower Basin states to determine what additional actions may be needed to avoid and protect against the potential for Lake Mead to decline below 1,020 feet.

The SNWA is not currently using its full Colorado River allocation and near-term shortage declarations are not anticipated to impact current customer use. Additionally, and as illustrated in the planning scenarios, the SNWA is prepared to meet long-term demands and future Colorado River supply limitations by adaptively managing its resource portfolio and by bringing future resources online when needed.

Subject to necessary authorizations, the amount of resources available for use as described in the SNWA Water Resource Portfolio is more than sufficient to meet the range of projected demands through the planning horizon. Maintaining this portfolio provides flexibility and enables the SNWA to use an appropriate mix of resources as needed to meet demands. Through this and other adaptive management strategies, the SNWA is better prepared to address factors that can influence resource availability over time such as permitting, policy changes, climate variability and/or new regulations.

As part of its long-term water planning efforts, the SNWA will:

- Continue to assess factors influencing water demands and the outlook for future demands;
- Continue to assess its overall water resource options and make informed decisions on which resources to use when needed;
- Consider the factors of availability, accessibility, cost and need a when determining priority of resources for use;
- Maintain a diverse water resource portfolio to ensure future resources are available to meet projected long-term demands and to replace temporary supplies such as banked resources; and
- Work proactively with other Colorado River water users to explore emerging future resource options of mutual benefit, and support ongoing efforts to increase the elevation of Lake Mead to preserve system operations.



ENDNOTES

1 The U.S. Bureau of Reclamation developed the Colorado River Simulation System (CRSS), a long-term planning and operations model. The probabilities of shortage correspond with August 2019 CRSS results, applying historical Colorado River flows, provided by U.S. Bureau of Reclamation to Southern Nevada Water Authority, August, 2019.

Colorado River, Arizona

PROTECTING THE ENVIRONMENT

THE SNWA'S ENVIRONMENTAL STEWARDSHIP EFFORTS HELP CONSERVE AND PRESERVE NATURAL RESOURCES FOR FUTURE GENERATIONS WHILE MINIMIZING CONFLICTS WITH WATER RESOURCE MANAGEMENT.

The SNWA works cooperatively with federal, state and local agencies as part of its long-term water resource management and planning efforts. This work helps to ensure avoidance, mitigation or minimization of impacts during development and delivery of water resources, including the construction, operation and maintenance of regional water facilities. In addition to the organization's proactive efforts, the SNWA adheres to strict environmental laws and regulations that govern its use and development of resources and facilities. These include the Endangered Species Act (ESA), National Environmental Policy Act (NEPA) and Clean Water Act.

By complying with environmental laws and regulations, working cooperatively with others, and by implementing the latest best management practices, the SNWA minimizes its footprint and protects valuable environmental resources for generations to come.

The SNWA participates in several environmental programs that contribute to species recovery and habitat conservation and protection in areas where its facilities or resources are located. The following summarizes specific activities that are currently planned or underway:

COLORADO RIVER

Human alterations on the Colorado River, including changes to riparian, wetland and aquatic habitats, have affected the river's ecosystem, both in the United States and in Mexico. Today, there are several native fish, birds and other wildlife species listed as threatened or endangered under the ESA.

Lower Colorado River Multi-Species Conservation Program

Environmental issues are being addressed cooperatively by Colorado River water users, primarily through the Lower Colorado River Multi-Species Conservation Program (LCRMSCP).

Finalized in 2005, the LCRMSCP provides ESA coverage for federal and non-federal operations in the Lower Colorado River under a Biological Opinion and a Habitat Conservation Plan.[1]

The SNWA is a non-federal partner in the LCRMSCP, which is being implemented by the Bureau of Reclamation over a 50-year period. The program area extends more than 400 miles along the lower Colorado River, from Lake Mead to the southernmost point of the U.S./Mexico border. Lakes Mead, Mohave and Havasu, as well as the historical 100-year floodplain along the main stem of the lower Colorado River, are all included. The program area also supports implementation of conservation activities in the lower Muddy, Virgin, Bill Williams and Gila rivers. The plan will benefit at least 26 species, most of which are state or federally listed endangered, threatened or sensitive species.

Some of the LCRMSCP projects being conducted in Nevada include razorback sucker studies in Lake Mead, southwestern willow flycatcher surveys and habitat protection at the Big Bend Conservation Area.

In 2005, the SNWA purchased the 15-acre Big Bend Conservation Area site along the Colorado River to protect backwater habitat for native fish. In 2008, the LCRMSCP and the U.S. Fish and Wildlife Service (USFWS) funded wildlife habitat improvements on the property. The SNWA continues to maintain the property and habitat.

By taking a proactive role in the health of the river and its native species, the SNWA and other Colorado River users are working to help ensure the long-term sustainability of this critical resource.

Colorado River Basin Water Supply and Demand Study

An Environmental and Recreational Flows Workgroup was one of three workgroups established following completion of the Colorado River Basin Water Supply

and Demand Study.[2] The SNWA is a member of this workgroup, which identified opportunities that would provide multiple benefits to improve flow and water-dependent ecological systems, power generation and recreation.

Binational Collaboration

Through interpretive minutes to the 1944 Treaty for the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, the United States and Mexico have established a framework for cooperation on environmental issues in Mexico. This includes studies related to the riparian and estuarine ecology of the Colorado River limitrophe and Delta.

The SNWA is a member of the Environmental Work Group that was established in 2010. The work group provides a forum where the two countries can explore and evaluate potential areas of cooperation. The SNWA continues to collaborate with the work group to consider opportunities for environmental improvements such as those identified in minutes 319 and 323 regarding environmental flow deliveries in the limitrophe and Delta.

Adaptive Management Work Group

The SNWA participates in the Adaptive Management Work Group (AMWG) for the operations of Glen Canyon Dam. This multi-agency work group helps balance the needs and interests of the endangered humpback chub, recreational interests, Native American perspectives, hydropower generation, water deliveries and downstream water quality. Active participation in the AMWG and its subcommittees helps ensure the SNWA's interests in protecting water deliveries, downstream water quality and the endangered humpback chub are adequately addressed.

MUDDY RIVER

The Muddy River and its tributaries and springs provide habitat for a unique array of rare species, including the federally endangered Moapa dace (*Moapa coriacea*), southwestern willow flycatcher (*Empidonax trailii extimus*), and Yuma Ridgway's rail (*Rallus obsoletus yumanensis*) (formerly Yuma clapper rail), and the federally threatened western yellow-billed cuckoo (*Coccyzus americanus occidentalis*). It is also habitat for the Virgin River chub (*Gila seminuda*), which although not listed on the Muddy River is listed as endangered on the Virgin River.

The SNWA has conducted and supported environmental studies on the Muddy River since 2004, including population and habitat surveys for these and other native, sensitive species. The SNWA is also working with federal and state agencies, environmental organizations and local stakeholders to implement conservation and recovery actions.

Warm Springs Natural Area

Located approximately 7 miles northwest of the town of Moapa, the Warm Springs Natural Area contains more than two dozen warm water springs that form the headwaters of the Muddy River. The springs and river provide habitat for the federally endangered Moapa dace, a small fish that is endemic to the area. The river and surrounding riparian areas also provide habitat for 27 other listed and sensitive species, including fish, birds, bats, invertebrates and amphibians.

In 2007, the SNWA purchased the former 1,220-acre "Warm Springs Ranch," using funding secured under the Southern Nevada Public Lands Management Act. Working with federal, state and local stakeholders, the SNWA completed a Stewardship Plan for the Warm Springs Natural Area in 2011.[3] The Stewardship Plan provides a framework for use and management of the property that preserves the integrity of natural resources and allows for management of water resources.

Since acquisition of the property, the SNWA has focused on restoration of aquatic fish habitat, control and eradication of invasive species, fire prevention and general property maintenance. A public use trail system with interpretive signage also was developed to allow for low-impact public use of the property. These conservation actions help to provide mitigation benefits for water development. For more information, including hours of operation for public exploration, visit warmspringsnv.org.

VIRGIN RIVER

The Virgin River is one of the largest riparian corridors in the desert southwest; within Nevada, the lower Virgin River is home to the federally endangered woundfin, Virgin River chub,

southwestern willow flycatcher, and Ridgway's rail and the federally threatened western yellow-billed cuckoo.

CLARK COUNTY

The SNWA participates in a number of environmental initiatives in Clark County to help protect and restore the environment, including the Clark County Multiple Species Habitat Conservation Plan and Las Vegas Wash Comprehensive Adaptive Management Plan. These efforts directly affect the SNWA's ability to operate facilities in Clark County and deliver high quality water to the community.

Clark County Multiple Species Habitat Conservation Plan

The Clark County Multiple Species Habitat Conservation Plan (MSHCP)[4] was approved in 2001, and provides ESA coverage for 78 species, including the threatened desert tortoise (*Gopherus agassizii*). The key purpose of the MSHCP is to achieve a balance between the conservation and recovery of listed and sensitive species in Clark County and the orderly beneficial use of land to meet the needs of the growing population in Clark County. The SNWA actively participates in the MSHCP, which provides ESA coverage for its projects and facilities located on non-federal lands within the county.

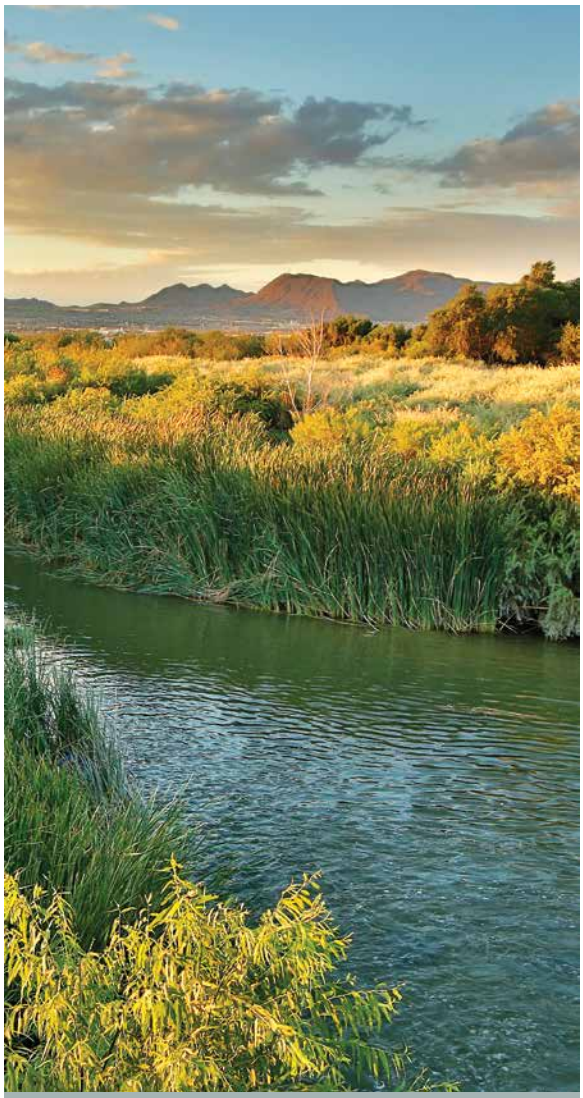
Las Vegas Wash

The Las Vegas Wash is the primary channel through which the SNWA member agencies return water to Lake Mead for return-flow credits. These flows account for less than two percent of the water in Lake Mead and consist of urban runoff, shallow groundwater, storm-water and highly treated wastewater from the valley's four water reclamation facilities. Decades ago, the flows of the Wash created more than 2,000 acres of wetlands, but by the 1990s, only about 200 acres of wetlands remained. The dramatic loss of vegetation reduced both the Wash's ability to support wildlife and serve as a natural water filter.

In 1998 at the request of its citizen's advisory committee, the SNWA reached out to the community in an effort to develop solutions to the problems affecting the Wash. This led to the formation of the Las Vegas Wash Coordination Committee (LVWCC), a panel representing more than two dozen local, state and federal agencies, businesses, an environmental group, the University of Nevada Las Vegas and private citizens. The committee quickly developed a Comprehensive Adaptive Management Plan for the Wash.[5]

Over nearly 20 years of working together, the LVWCC and its member agencies have taken significant strides toward improving the Las Vegas Wash. Early efforts focused on reducing the channelization of the Wash, reducing erosion and increasing the number of wetlands. Accomplishments to date include:

- Completed construction of 21 identified erosion control structures or weirs.
- Stabilized more than 13 miles of the Wash's banks
- Removed more than 565 acres of non-native tamarisk



Mature Vegetation Along the Wash

Dace on the Rise

The Moapa dace is endemic to the Muddy River.

The Moapa dace only occurs in the warm springs, tributaries and upper main stem of the Muddy River, and was listed as an endangered species in 1967. The USFWS recovery plan for the Moapa dace set a goal to delist the fish when the adult population reaches 6,000 in five spring systems for five consecutive years.[6]

The SNWA has worked with its partners to implement a number of activities to benefit the Moapa dace. Efforts include improving connectivity between springs and streams, eradicating invasive fish species, and restoring natural streamflow dynamics and riparian vegetation.

These actions have helped the overall Moapa dace population to increase substantially. The population increased from a low of 459 individuals in 2008 to more than 2,340 in 2020.

- Revegetated more than 515 acres with native plants
- Removed more than 550,000 pounds of trash from adjacent areas
- Organized more than 16,000 volunteers
- Completed extensive wildlife and water quality monitoring programs
- Identified more than 933 species of wildlife
- Identified more than 270 species of vegetation
- Built or improved more than two miles of trails
- Implemented an invasive species management program

Today, the Wash carries about 200 million gallons of water a day to Lake Mead. The efforts to stabilize the Wash have resulted in a greater than 60 percent reduction in the amount of total suspended solids in the water, and the removal of the Wash from Nevada Division of Environmental Protection's list of impaired waters.

SUSTAINABILITY

Sustainability transcends resource boundaries, but it is inseparably linked to the conservation of vital resources such as water and energy. This concept forms the framework for SNWA's sustainability initiatives, which focus on four main areas:

- Water
- Energy
- Environment
- Personal responsibility

As a water provider and educator in one of the region's driest communities, living a conservation ethic is an essential part the organization's work practices. The SNWA strives to provide sufficient water to the community while promoting conservation, utilizing reliable, renewable water resources and maintaining water quality with minimal impact on the environment.

The SNWA has undertaken a broad range of initiatives to help ensure conservation and preservation of water resources. The SNWA's Water Smart Landscape program has averted nearly 41,000 metric tons of carbon dioxide discharge (more than 90 million pounds) through avoided water pumping, treatment and transmission activities. That is equivalent to taking 8,900 cars off the road every year. On an annual basis, program participants reduce our carbon dioxide footprint by 900 metric tons.

Water Smart streetscape

As the state's largest energy user, the SNWA strives to reduce energy consumption and reduce environmental pollution through efficient energy use and incorporating use of renewable resources such as solar energy and hydropower. Following the passage of new renewable energy standards by the Nevada Legislature in 2019, the SNWA is working to achieve 20 percent renewable energy by 2019 and 50 percent by 2030. The SNWA's current energy portfolio consists of approximately 18 percent derived from renewable resources.

The SNWA's solar and small hydropower facilities generate more than 44 million kilowatt hours of clean energy, enough to power nearly 3,500 average Southern Nevada homes annually. The SNWA's fleet is nearing its goal of becoming 100 percent alternative fueled, replacing standard-fueled vehicles with alternative-fueled models when appropriate.

The SNWA continues to identify ways to minimize the environmental impacts of operations and create a greener way of working. Reducing, reusing and recycling are key components of waste reduction efforts. SNWA facilities are designed to be environmentally conscious, including certification under U.S. Leadership in Energy and Environmental Design green building program.

CHAPTER SUMMARY

The SNWA adheres to strict environmental laws and regulations that govern its use and development of resources and facilities. In addition, the SNWA proactively integrates environmental stewardship into facility operations and resource management. To support its long-term water resource planning and development efforts, the SNWA will:

- Continue its environmental planning, monitoring and mitigation efforts to minimize its footprint and protect community water supplies;
- Participate in environmental programs to enhance regulatory certainty for the flexible and adaptive use of resources;
- Work with partners to conserve habitat and work towards the recovery of threatened and endangered species, as well as reducing the likelihood of additional species listings; and
- Meet the community's current and long-term water resource needs while promoting conservation, utilizing reliable, renewable water resources and maintaining water quality with minimal impact on the environment.

ENDNOTES

1 Lower Colorado River Multi-Species Conservation Program, 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan. December 17, 2004.

2 "Colorado River Basin Water Supply and Demand Study," December 2012, U.S. Bureau of Reclamation.

3 SNWA, 2011. "Warm Springs Natural Area Stewardship Plan," June 2011, SNWA.

4 Clark County Multiple Species Habitat Conservation Plan and Environmental Impact Statement for Issuance of a Permit to Allow Incidental Take of 79 Species in Clark County, Nevada, September, 2000, Clark County Department of Comprehensive Planning and U.S. Fish and Wildlife Service.

5 "Las Vegas Wash Comprehensive Adaptive Management Plan," December 1999, Las Vegas Wash Coordination Committee.

6 "Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem," May 16, 1996, U.S. Fish and Wildlife Service Region 1, Portland, Oregon.

APPENDIX 1

CLARK COUNTY POPULATION FORECAST AND ASSUMPTIONS USED IN 2020 WATER RESOURCE PLAN DEMAND PROJECTIONS

Year	Lower Demand Population	Upper Demand Population
2020	2,341,000	2,361,000
2025	2,555,000	2,682,000
2030	2,731,000	2,968,000
2035	2,847,000	3,189,000
2040	2,936,000	3,376,000
2045	3,008,000	3,537,000
2050	3,067,000	3,675,000
2055	3,119,000	3,795,000
2060	3,161,000	3,893,000
2065	3,203,000	3,980,000
2070	3,245,000	4,056,000
2071	3,253,000	4,070,000

Endnotes:

1 "Population Forecasts: Long-Term Projections for Clark County, Nevada 2020–2060," June 2020, Center for Business and Economic Research at the University of Nevada, Las Vegas (projected through 2071).

2 Adjusted "Population Forecasts: Long-Term Projections for Clark County, Nevada 2020–2060," June 2020, Center for Business and Economic Research at the University of Nevada, Las Vegas (projected through 2070 with a 15 percent increase by 2040 and a 25 percent increase by 2071).

APPENDIX 2

Year	Lower Demand (105 GPCD Conservation goal)	Upper Demand (105 GPCD Conservation goal)	Upper Demand (Add'l Conservation Scenario)
2020	281,000	283,000	282,000
2025	301,000	316,000	309,000
2030	317,000	344,000	329,000
2035	324,000	363,000	339,000
2040	330,000	380,000	353,000
2045	334,000	393,000	365,000
2050	337,000	404,000	373,000
2055	338,000	412,000	379,000
2060	343,000	422,000	389,000
2065	347,000	432,000	397,000
2070	352,000	440,000	405,000
2071	353,000	441,000	406,000

APPENDIX 3

IRPAC 2020 RECOMMENDATIONS

The SNWA Board of Directors established the 11-member Integrated Resource Planning Advisory Committee (IRPAC 2020) in 2019 to evaluate and develop recommendations on various issues critical to the SNWA's mission. As detailed below, the committee's deliberations resulted in 22 recommendations that were accepted by the SNWA Board of Directors in September 2020. Major topics include water resources, water conservation, facilities and rates.

GENERAL RECOMMENDATIONS

1. Work with community stakeholders to implement IRPAC recommendations.

MCCP AND FACILITIES

2. Maintain current asset management funding levels and practices to ensure reliable water treatment and transmission in Southern Nevada.

3. Pursue projects to meet Nevada's Renewable Portfolio Standard.

4. Include the candidate projects presented to IRPAC 2020, totaling $3.166 billion, in the SNWA's Major Construction and Capital Plan (MCCP).

WATER RESOURCES

5. Pursue emerging water resource opportunities with Colorado River partners to increase Nevada's water supplies, as presented to IRPAC on December 18, 2019.

6. Require out-of-valley development to return wastewater to Lake Mead and embed the principles of the SNWA's Out-of-Valley Water Use Policy within municipal codes and Las Vegas Valley Water District (LVVWD) Service Rules.

CONSERVATION

7. Pursue changes necessary to achieve the SNWA's current water conservation goal of a minimum of 105 GPCD by 2035 and further efforts to achieve additional conservation thereafter.

8. Reduce existing non-functional turf acreage by 50 percent by 2035.

9. Embed the principles of the SNWA's Non-Functional Turf Resolution in municipal codes and LVVWD Service Rules.

10. Limit future installations of cool-season turf in public spaces and expedite the conversion of cool season turf to warm-season turf at existing public facilities.

11. Implement smart controller technology to automate landscape watering compliance and increase outreach and enforcement efforts.

12. Pursue implementation of advanced metering infrastructure and develop partnerships and programs to improve the speed of customer leak repairs.

13. Evaluate changes necessary to reduce current and future consumptive water losses associated with evaporative cooling technology.

14. Establish an efficiency review policy and process for new large water users to encourage efficient development and disincentivize consumptive use.

15. Continue to make investments that will maintain or improve the existing water loss rates among wholesale and retail water purveyors.

16. Continue outreach efforts to engage the public and effectuate the changes needed to meet the community's regional conservation goal.

FUNDING

17. Fund the MCCP with a combination of debt capital and pay-go to manage unrestricted reserve balances at adequate levels consistent with the Reserve Policy.

18. Implement a six-year annual increase to SNWA charges effective January 2022 to: 1) Phase-in an inflationary catch up, and 2) Adjust for subsequent annual inflation within the six-year period: – Increase the Connection Charge by 9.5% annually for six years effective Mar. 2022 – Increase the Infrastructure Charge by 4.6% annually for six years effective Jan. 2022 – Increase the Commodity Charge by 4.8% annually for six years effective Jan. 2022.

19. Implement an indexed rate component to the SNWA Infrastructure and Commodity charges annually, effective January 2028, and limit future increases to a floor of 1.5% and a ceiling of 4.5% each year. – Infrastructure Charge in accordance with Engineering News Record (ENR) index – Commodity Charge in accordance with the Consumer Price Index (CPI) Do not implement inflationary increases in a year in which the five-year forecast unrestricted reserve balance is projected to be greater than 150% of targeted reserve balances.

20. Implement an indexed rate component to the SNWA Connection Charge annually in accordance with the ENR index, effective March 2028.

21. Eliminate the $16.1 million Connection Charge threshold, require SNWA Connection Charge revenues to fund the pay-go portion of capital expenditures and related debt service, and exclude from funding recurring operating expenses.

22. Provide IRPAC 2020 with an annual update of the funding model and convene the committee as necessary.

APPENDIX 4

SCENARIO DETAIL

Figure A-1 from the Colorado River Basin Study illustrates the range of Colorado River inflows considered under observed hydrology and climate change projections, providing useful detail to compare the water supply conditions presented in Chapter 4.2 The graph on the left was developed using observed resampled average annual Colorado River natural flow at Lees Ferry. It shows the variability of future hydrology based on observed records, with a range of Colorado River inflow between approximately 13.7 MAFY and 16.3 MAFY. Mean inflow is approximately 15 MAFY.

The graph on the right considers how climate change might impact Colorado River inflows and flow variability. It was developed using Downscaled General Circulation Model (Downscaled GCM) projections and simulated hydrology, which project the climate will continue to warm in the future. The range of inflow for the Downscaled GCM projection is between approximately 10 MAFY and 17 MAFY. The mean inflow is approximately 13.7 MAFY.

The water supply conditions presented in Chapter 4 are within range of the average and below average observed natural flow, and within mid-range of the Downscaled GCM projections.

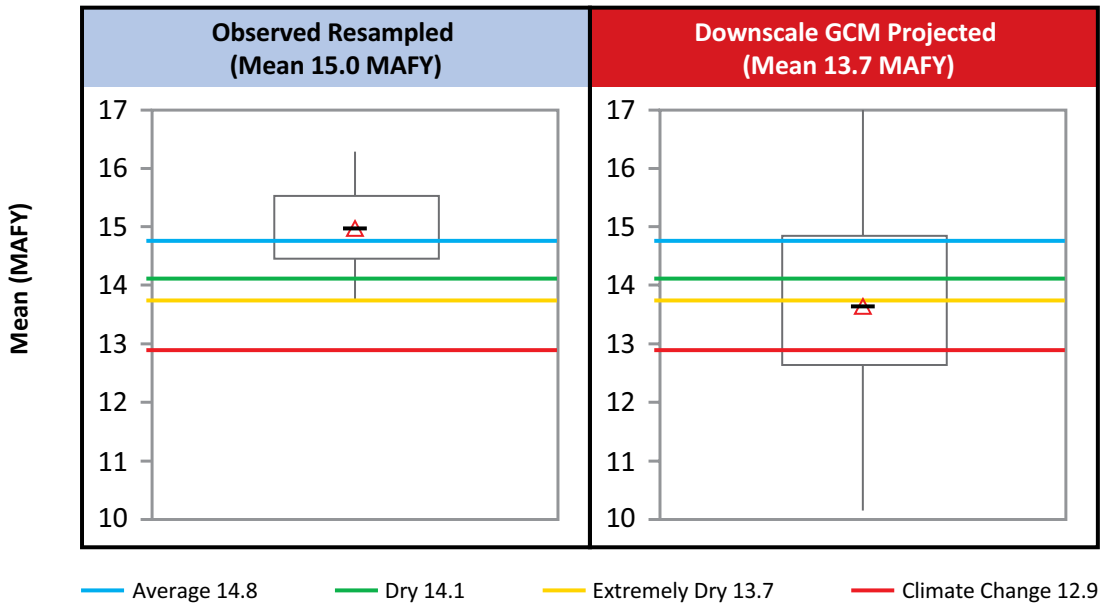


FIGURE A-1 **Average Annual Colorado River Natural Flows at Lees Ferry in Million Acre-Feet per Year (MAFY)**

ENDNOTES

1 "Colorado River Basin Water Supply and Demand Study Technical Report B – Water Supply Assessment," December 2012, U.S. Bureau of Reclamation.

2 The lower and upper borders of each box in the graph represent the 25th and 75th percentile values (lower quartile Q1 and upper quartile Q3). The band within each box denotes the median (dash) and the mean (triangle) values. The value Q3-Q1 is the interquartile range or IQR. Thus, 50 percent of the values reside within the box and the IQR is the height of the box. The upper and lower vertical lines, or whiskers, cover the points outside of the box. Each of the whiskers covers 25 percent of the values. The colored lines in the graphs represent average annual flow for the water supply conditions used in Chapter 4.

APPENDIX 5

VOLUME BY STATE AND COUNTRY

The following table summarizes shortages, delivery reductions, DCP contributions and other water savings by volume under the 2007 Interim Guidelines, Minute 323, Lower Basin DCP and the Binational Water Scarcity Contingency Plan. Participants include Arizona (AZ), Nevada (NV), California (CA) and Mexico (MX). Volumes are represented in thousands of acre-feet (kaf).

Lake Mead Elevation (ft. above mean sea level)	**2007 Interim Guidelines Shortages**		**Minute 323 Delivery Reductions**	**Total Combined Reductions**	**DCP Water Savings Contributions**			**Binational Water Scarcity Contingency Plan Savings**	**Combined Volumes by States and Country**					
	AZ	NV	MX	**Lower Basin & Mexico Total**	AZ	NV	CA	MX	AZ Total	NV Total	CA Total	Lower Basin Total	MX Total	**Lower Basin & Mexico Total**
1,090-1,075	0	0	0	**0**	192	8	0	41	192	8	0	200	41	**241**
1,075-1,050	320	13	50	**383**	192	8	0	30	512	21	0	533	80	**613**
1,050-1,045	400	17	70	**487**	192	8	0	34	592	25	0	617	104	**721**
1,045-1,040	400	17	70	**487**	240	10	200	76	640	27	200	867	146	**1,013**
1,040-1,035	400	17	70	**487**	240	10	250	84	640	27	250	917	154	**1,071**
1,035-1,030	400	17	70	**487**	240	10	300	92	640	27	300	967	162	**1,129**
1,030-1,025	400	17	70	**487**	240	10	350	101	640	27	350	1,017	171	**1,188**
<1,025	480	20	125	**625**	240	10	350	150	720	30	350	1,100	275	**1,375**

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Horseshoe Bend, Arizona

Lake Mead National Recreation Area