SOUTHERN NEVADA WATER AUTHORITY™

2023 WATER RESOURCE PLAN

Colorado River, Nevada-Arizona

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.

Colorado River

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

Virgin River, Utah

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Glen Canyon Dam and 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 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 2023 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

The current planning environment includes uncertainty associated with the availability of future resources and long-term water demand forecasts. These considerations, as well as how they are addressed in the 2023 Plan, are detailed briefly in the following sections.

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.

Between 2000 and 2022, overall snowfall and runoff into the Basin were well below the historical average. Combined with warming temperatures, these factors resulted in the lowest 23-year runoff period on record. The persistence of decades-long drought conditions has resulted in significant water-level declines in major system reservoirs. As of late 2022, the combined water storage in the Colorado River's two primary reservoirs (Lake Mead and Lake Powell) was 26 percent of capacity.

The U.S. Bureau of Reclamation's 2012 Colorado River Basin Water Supply and Demand Study projects the Colorado River will experience a median imbalance of 3.2 million acre-feet per year (MAFY) between supply and demand by 2060 due to climate change and increased demands within the Basin. The supply and demand imbalance observed over the past decade strongly suggests that the structural deficit within the system will reach 3.2 MAFY well before 2060.

Recent studies show that warming temperatures in the Colorado River Basin have significantly impacted hydrologic conditions, including the timing and magnitude of inflows to the reservoir system. These conditions are not only expected to continue but worsen. 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 an overall reduction in runoff.

Hydrologic modeling indicates a high probability that water levels at Lake Mead and Lake Powell will continue to decline, which has water resource implications for the entire Colorado River Basin.

While Colorado River stakeholders have worked effectively since the onset of the drought to develop and implement shortage sharing, contingency and other plans to boost Lake Mead water levels, resource challenges reached a tipping point in 2022.

Modeling results by the U.S. Bureau of Reclamation in June of 2022 indicate urgent action is required. Without additional water savings, the elevations of Lake Powell and Lake Mead could drop below the minimum power pool within the next few years (3,490 feet and 950 feet, respectively), which will necessitate changes in power management for much of the western United States. With further water level declines, the reservoirs could reach dead pool, the point at which water can no longer be released to downstream users.

These results prompted additional action to preserve system operations. The federal government called upon the Seven Basin States to develop a plan by mid-August 2022 for further water use reductions ranging from 2.0 to 4.0 million acre-feet per year (AFY) through 2026. This reduction or "protection volume" is in addition to obligations and reductions under the 2019 Drought Contingency Plan and 2007 Interim Guidelines and represents the additional water savings amount needed to protect Lake Powell and Lake Mead from reaching critical elevations. The Colorado River Basin States failed to meet the August 2022 deadline and negotiations are ongoing. While municipalities throughout the basin have committed to water use reductions, these actions are not enough to satisfy the protection volume required.

The U.S. Bureau of Reclamation is also investigating engineering options to allow for the release of water below dead pool in Lake Powell, but actions could take several years to implement if feasible. At this time, it is unclear which specific actions the seven states and the federal government may take to further protect water levels at Lake Mead and Lake Powell. However, forthcoming actions could have a material effect on Lower Basin water supplies, including Nevada.

Nevada's maximum total reduction amount under existing agreements is 30,000 AFY through 2026. The maximum total obligation by all parties, including Mexico, is 1.375 million AFY through 2026. These totals will need to change if the states reach an agreement for achieving the required protection volume. A Tier 2 Shortage is currently in effect, reducing Nevada's available Colorado River supply by 25,000 AFY for 2023.

SUPPLY & DEMAND

Water resource planning is based on two key factors: supply and demand. Supply refers to the amount of water available or 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.

PLANNING FOR UNCERTAINTY

As in prior years, the SNWA used a scenario-based planning approach for its 2023 Plan. Key factors evaluated include reductions of Colorado River supplies, variation in future demands and the implications of conservation on water demand and water resource needs.

As part of its planning process, the SNWA considered the increasing likelihood of additional Colorado River supply reductions over the long-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 Drought Contingency Plan, 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 shortage reduction of 10,000 AFY in the event Lake Mead's elevation declines below 1,020 feet. In 2022, Lake Mead reached an elevation of 1,041 feet, the lowest point since the lake began filling in the mid-1930s. Chapter 3 provides

additional information about Colorado River water use reductions.

The SNWA also considered economic growth in Southern Nevada, and long-term projections indicate that the region will continue to grow. However, a high level of uncertainty remains regarding the magnitude and timing of population change and the 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 conservative approach 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 developing new facilities and implementing progressive water conservation initiatives to water banking and securing future resources, these efforts have reduced the potential for customer impacts.

The SNWA is not currently using its full Colorado River allocation, and near-term shortage declarations will not likely impact current customer use. By the end of 2021, Southern Nevada's consumptive Colorado River water use was 242,000 acre-feet. This amount is below any Colorado River water supply reduction under existing rules. However, Colorado River water use reductions associated with achieving the protection volume have yet to be defined and could result in significant additional limitations on local Colorado River water supplies.

A return to normal or near-normal hydrologic conditions is unlikely to occur during the long-term planning horizon, and the probability of shortage is forecast to remain high in future years. Meanwhile, local water demands are projected to increase. Meeting the community's long-term water resource needs will require the SNWA to make significant and sustained progress toward its conservation goal. As demonstrated in the planning scenarios, the level of conservation achieved is a critical factor that will impact the timing and need for temporary and future resources.

Ultimately, the community's conservation performance is critical in determining how much water is needed and when. The 2023 Plan reflects the SNWA's conservation goal of 86 gallons per capita per day and highlights strategies the SNWA has implemented or is pursuing to reduce demands and improve efficiency. Achieving the goal will require committed support from the SNWA member agencies and the public at large, particularly with upward pressures from climate change and system age.

Water conservation has far-reaching benefits for the community and the Colorado River system. Locally, water conservation increases water efficiency and reduces per capita demands. It also allows the SNWA to store or "bank" these conserved supplies. This, in turn, provides the SNWA with added flexibility in responding to drought conditions and meeting future demands. As of 2021, the SNWA has stored more than 2.2 million acre-feet of water, more than nine times Nevada's 2021 consumptive Colorado River water use.

On a larger scale, water conservation helped the SNWA 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, System Conservation and other initiatives that benefit the Colorado River system. Likewise, efforts by interstate and federal partners to develop and implement Drought Contingency Plans adopted in 2019 are helping to slow the decline of Lake Mead and Lake Powell water levels. To date, collaborations have bolstered Lake Mead's elevation by more than 86 feet.

These efforts have provided the SNWA with time to complete essential infrastructure, helped to forestall and reduce the impact of Colorado River shortage declarations, and provided water storage and recovery opportunities.

The SNWA completed construction of the Low Lake Level Pumping Station at Lake Mead in 2020. The pumping station works with SNWA's Lake Mead Intake No. 3 to preserve Southern Nevada's access to Colorado River water supplies to a Lake Mead 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.

CURRENT PRIORITIES

The 2023 Plan demonstrates the importance of conservation in extending the availability of Colorado River resources, minimizing the use of Temporary Resources, and delaying the timing and need for Future Resources. Continued progress towards the conservation goal will help ensure thoughtful and well-coordinated execution of operational and water-efficiency plans so that impacts to the community are reduced. With ongoing community support and through the adaptive use of its Water Resource Portfolio, the SNWA is prepared to meet the range of projected demands and water supply conditions presented in this plan.

Likewise, the SNWA and the community will continue to play a key role in helping to develop and implement Colorado River response efforts. While specific reduction amounts by state have yet to be determined, achieving the level of reduction needed will likely require participation from all Colorado River water users, including Nevada. To this end, Nevada may be required to take reductions beyond those already defined under existing agreements or take reductions sooner than currently required. The SNWA will update its Water Resource Plan to reflect the status of these discussions when the timing and magnitude of these changes are better understood.

While current Colorado River conditions are severe, Southern Nevada faces a much lower risk than the larger Colorado River community due to the planning, adaptation and extraordinary investments the community has made to secure Southern Nevada's water supplies. With community support, the SNWA has taken deliberate steps to bolster supplies, reduce demands and fortify facilities. Thoughtfully planned and executed over decades, these actions make Southern Nevada one of the most water-secure communities along the Colorado River.

There is still much work that lies ahead. As one of the fastest-warming and fastest-growing communities in the United States, Southern Nevada must continue to anticipate, mitigate and adapt to changing conditions.

Meeting the challenges that lie ahead will require significant and ongoing adaptive management efforts, which include:

- Working with SNWA member agencies to develop policies and programs to ensure new development has the smallest possible consumptive water use footprint;
- Collaborating with Colorado River stakeholders for conservation and flexible use of Colorado River supplies (for example, water banking), as well as taking steps to protect Lake Mead's elevation against future water level declines;
- Continuing to secure temporary resources to offset long-term impacts associated with shortage while working to bring other permanent resources online when needed;
- Working with Colorado River partners to explore collaborative future water resource projects;
- Addressing uncertainty by planning to a range of future supply and demand possibilities; and
- Collaborating with climate scientists and other agencies to understand and evaluate climate change, and its potential impacts on water supplies and facilities.

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Lake Mead, Nevada

PLAN INTRODUCTION

THIS CHAPTER PROVIDES AN OVERVIEW OF THE SNWA'S 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 THE 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.

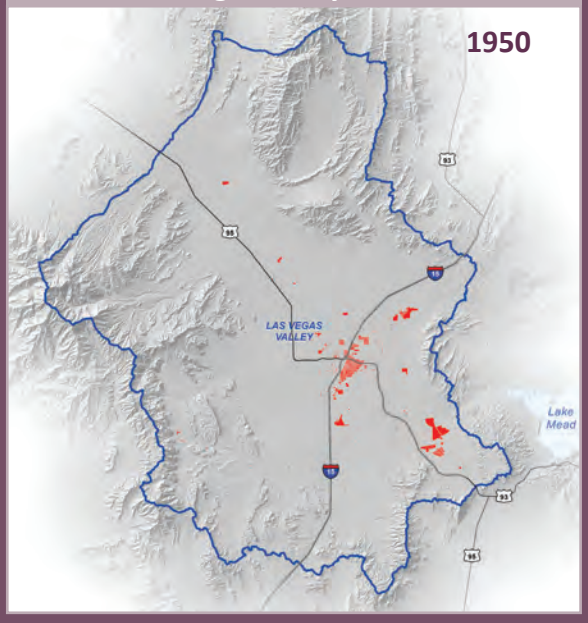
A Century of Change

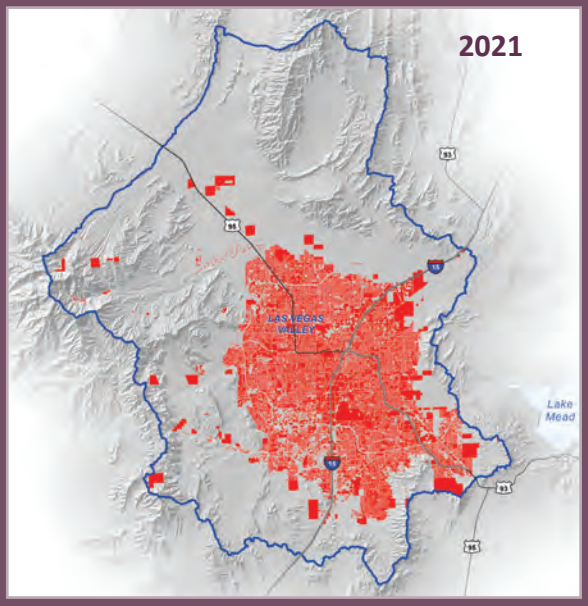
With the birth of Las Vegas in 1905 as a way station for the San Pedro, Los Angeles and Salt Lake Railroad, Southern Nevada began to attract a large number of residents and businesses.

From an estimated population of more than 40,000 in 1950 to more than 2.3 million in 2021, the Southern Nevada region has experienced change faster than almost any other region in the nation during this same time.

Today, Southern Nevada is home to 73 percent of Nevada's total population. The region uses less than 5 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

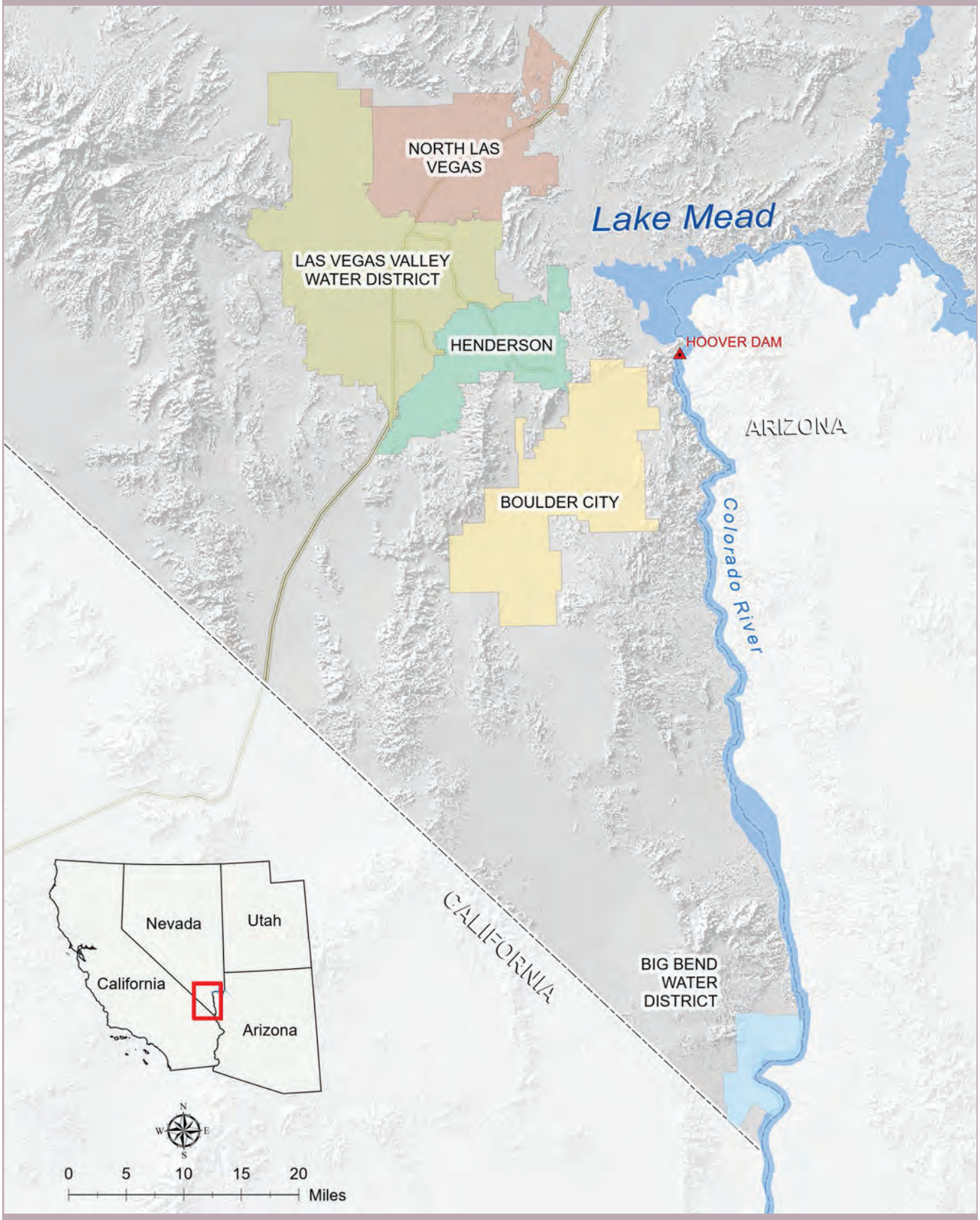
Since 1991, the SNWA has worked diligently to develop and manage a flexible portfolio of diverse water resource options resulting from years of in-state, interstate and international collaborations. These resources include groundwater and surface water rights in the state of Nevada, Colorado River water, 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 960 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.

As discussed in Chapter 2, the SNWA completed construction of a new raw water intake (Intake No. 3) and Low Lake Level Pumping Station (L3PS) at Lake Mead in response to changing hydrologic conditions in the Colorado River Basin. These facilities offset risk associated with future Lake Mead

FIGURE 1 **SNWA Purveyor Service Areas**



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

Planning for the Future

The SNWA's 2023 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.[6] The plan is reviewed annually and updated as needed to reflect changing developments in Southern Nevada's overall water resource picture.

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 2023 Plan is based on input from the Integrated Resource Planning Advisory Committee 2020 (IRPAC 2020). The committee 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).

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 SNWA adopted its first water conservation plan in 1995[4] and has updated the plan several times since.[5] During this timeframe, the community has consistently set and achieved aggressive water conservation goals.

Significant and sustained conservation progress remains of critical importance for our desert community, particularly as changing hydrologic, climate and economic conditions are anticipated to impact supply and demand. To this end and to help ensure supply and demand balance, the SNWA Board of Directors adopted a new conservation goal in 2021.

The 2023 Plan provides greater insight into changing conditions and details the water supply and demand implications of continued conservation over the SNWA's long-term planning horizon. It also details the planned trajectory of the community's new conservation goal and summarizes progress, including significant efforts planned or underway to increase conservation and efficiency gains.

As noted on left and described in Chapter 3, the SNWA has identified additional actions that will support conservation goal achievement. Some actions are based on recommendations from the Integrated Resource Planning Advisory Committee (IRPAC 2020) while others were identified by the SNWA as part of ongoing strategic planning efforts. If implemented, these actions will help the SNWA to achieve its current conservation goal while countering upward pressures associated with climate change and system age.

Conservation and efficiency improvements will require committed support from the SNWA's member agencies and from the community at large.

2023 Water Resource Plan

The SNWA's 2023 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 2023 Plan incorporates the recommendations from IRPAC 2020, which were approved by the SNWA Board of Directors in September 2020. (Appendix 3).

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 setting and achieving conservation goals. 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 changing hydrology, climate and economic conditions are anticipated to 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 "Memorandum of Understanding Regarding Southern Nevada Water Authority's Water Conservation/Efficiency Programs," January 26, 1995, amended March 18, 1999, SNWA.

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

6 "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, 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

Water supply and demand conditions have changed significantly in Southern Nevada over the past century. The community rose to these challenges time and again by developing new water resources and facilities and by significantly reducing water demands through progressive water conservation efforts.

Ingenuity and resolve are again required to address new challenges that emerged at the beginning of the 21st century. Continuing today, these challenges include changing hydrologic, climate and economic conditions. Individually or combined, these factors significantly influence local water demands and the resources and facilities needed to support those demands over time.

This chapter details the planning and response efforts taken by the SNWA, with community support, to minimize impacts. It also provides insight into current and future efforts required over the SNWA's 50-year planning horizon. As further described below, additional, significant and sustained efforts are needed to balance supply and demand, locally and within the Colorado River Basin. Ongoing adaptive management efforts are also required to address rapidly changing resource conditions.

The latter requires close monitoring and proactive planning. The 2023 Plan includes the latest information available at the time of publication. The SNWA will continue to monitor and address evolving conditions regularly as part of its water planning activities and annual resource planning process.

DROUGHT AND CLIMATE CHANGE

Southern Nevada depends on the Colorado River for approximately 90 percent of its overall water resource supply. These flows are derived primarily from snowmelt runoff originating in southwestern Wyoming, western Colorado, northeastern Utah and northwestern New Mexico.

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. During this timeframe, snowfall and runoff into the Basin were well below the historical average. Combined with warming temperatures, these factors resulted in the lowest 23-year runoff period on record (Figure 2.1). Since 2000, average inflows were about 12.2 million acre-feet per year (MAFY)—flows in about half of these years were at or below 11 MAFY.

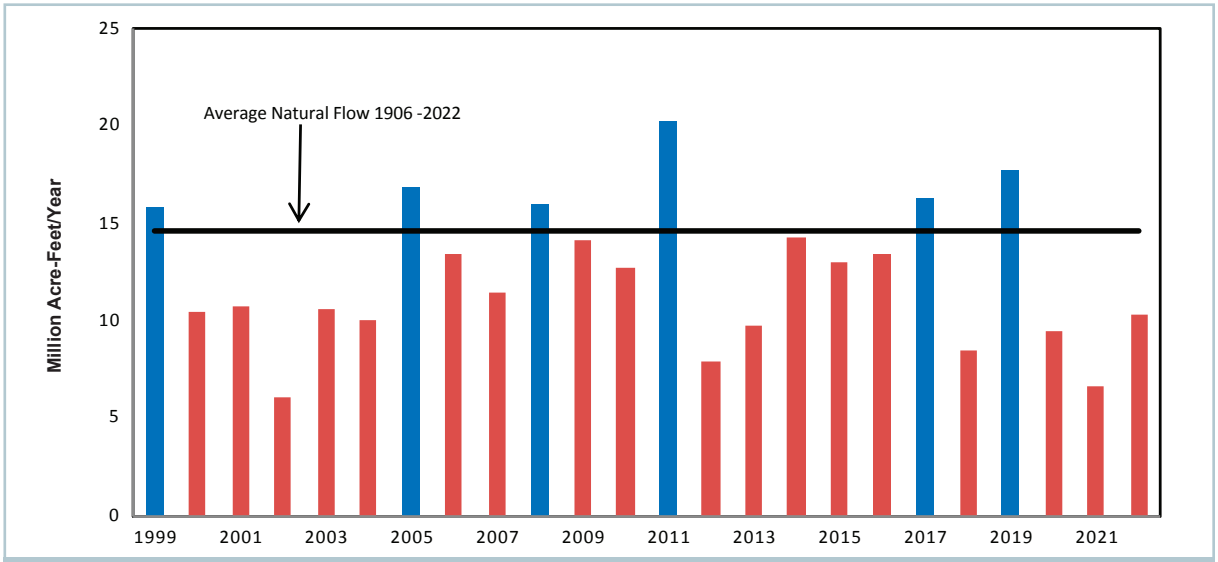


FIGURE 2.1 **Annual Colorado River Natural Flow 1999–2022**[1]

Average annual inflows since 2000 are lower than the amount of water allocated to the Colorado River Basin states and Mexico (16.5 MAFY) and substantially lower than the 1906 - 1921 historical average flow considered in determining compact allocations (about 18.0 MAFY).

The persistence of decades-long drought and changing climate conditions has resulted in significant water level declines at major system reservoirs. As of late 2022, the combined water storage in the Colorado River's two primary reservoirs (Lake Mead and Lake Powell) was at just 26 percent of capacity.[2] As described below and in Chapter 4, further water-level declines are expected.

Drought has become synonymous with the Colorado River over the last 23 years. This term can be misleading, implying a transient condition that will end. Today, the best scientific projections available suggest that current Colorado River conditions will not only continue but worsen. Leading climate scientists warn of a permanent shift to a drier future, something known as "aridification." In simple terms, aridification refers to drying conditions that result from warming. It is often measured by the reduction of average soil moisture content.[3] From a timescale perspective, aridification represents long-term change rather than seasonal variation or periodic droughts.

Recent studies show that warming temperatures within the Colorado River Basin are significantly contributing to current conditions, including reduced streamflows.[4] As demonstrated in recent years and when ground conditions are dry, near-normal precipitation does not equate to near-normal runoff. For example, Colorado River inflows were just 32 percent of average in 2021 despite near-normal snowpack (89 percent of normal). Record warm temperatures leading into the winter season significantly reduced soil moisture. As a result, the dry soil soaked up more water, and less water made its way to the river. These conditions persisted in 2022 with near-normal snowpack (90 percent of normal) and reduced inflows (63 percent of average).

Warming is primarily a result of increased concentrations of greenhouse gases in the Earth's atmosphere. Since the early 20th century, observations indicate that global mean annual air temperatures have warmed 1.8°F.[5] 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.[6] 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.

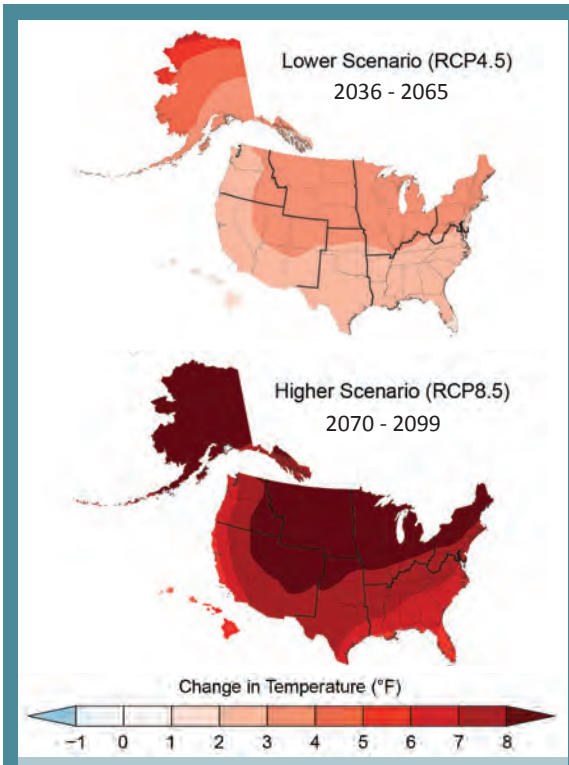


FIGURE 2.2 **Climate Change Range of Possible Future Warming in North America 2036 – 2099**
(2018) National Climate Assessment

Water resource managers must carefully consider climate change and climate change impacts as part of their planning processes. Direct climate change impacts will revolve around water quantity, particularly the form and distribution of precipitation and increasing water demands. In addition, rising temperatures will cause a greater percentage of precipitation to occur in the form of rain rather than snow. As previously noted, snowpack will melt earlier and be less efficient as runoff due to dry soil conditions and increasing temperatures. This may result in significant water supply reductions in some areas, while others experience greater frequency and severity

of flood events.[7] Other important considerations include changes to water quality from rising stream flow temperatures and changes in reservoir volumes.

Changing hydrology and climate conditions pose two interrelated challenges for Southern Nevada: reduced Colorado River resources and potental increases to local water demands.

Water Supply Impacts

Lake Mead water levels have declined approximately 170 feet since 2000 and further water-level declines are expected. While Colorado River stakeholders have worked effectively since the onset of drought to develop and implement shortage sharing, contingency and other plans to bolster Lake Mead water levels, resource challenges reached a tipping point in 2022.

Modeling by the U.S. Bureau of Reclamation in June 2022 determined that additional, urgent and extraordinary actions are needed to prevent water and power supply disruptions associated with operations at Lake Mead and Lake Powell, the Colorado River's two primary reservoirs. The following section outlines key policy initiatives currently being implemented and details the status of policy discussions currently underway to protect water and power operations in the Colorado River Basin.

Interim Guidelines. 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 (Interim Guidelines).[8] Among other things, the Interim Guidelines established rules for implementing shortages in the Lower Basin.

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; a shortage declaration will be made if Lake Mead is forecasted to be at or below 1,075 feet on January 1 of the following year.

Drought Contingency Plan. 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] The DCP was approved in 2019 to help mitigate drought impacts (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.

DCP contributions and shortage reductions are staged to increase as Lake Mead water levels decline. Nevada's obligation under these agreements ranges from 8,000 AFY to a combined maximum of 30,000 AFY. If at any time the U.S. Bureau of Reclamation's minimum probable forecast of Lake Mead elevation is projected to be at or 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 Lake Mead's elevation from declining below 1,020 feet.[10]

Nevada and Arizona began making DCP contributions in 2020 and have made contributions every year since. Mexico also made contributions under the Binational Water Scarcity Contingency Plan during the same time frame.[11] Combined contributions from Nevada, Arizona and Mexico between 2020 and 2021 totaled 442,000 AFY. Lake Mead water levels continued to decline, and the Secretary of the Interior made the first-ever first-tier shortage declaration in 2021 for 2022 operations. As a result, total Colorado River supplies available to Nevada, Arizona and Mexico were reduced by 613,000 AFY in 2022. Nevada's share of this amount was 21,000 AFY.

The U.S. Bureau of Reclamation's 2022 August 24-month study forecasts a Lake Mead elevation between 1,045 and 1,050 feet on January 1, 2023. Like the 2021 forecast, the agency also projects Lake Mead's minimum probable elevation will drop below elevation 1,030 feet. In accordance with the Interim Guidelines, the Secretary of the Interior declared a Tier 2 shortage in 2022 for 2023 operations. This declaration further reduces the amount of water available to Nevada and Arizona. Nevada's total obligation under the Interim Guidelines and DCP for 2023 is 25,000 AFY. The total obligations by all parties for 2023, including Mexico, are 721,000 AFY.

Emergency Actions. Consecutive years of poor hydrology between 2020 and 2022 exacerbated already challenging Colorado River water supply conditions. The Secretary of the Interior began meeting with Colorado River stakeholders in 2021 to establish additional plans and actions through 2026 to protect Lake Mead's elevation from declining below 1,020 feet. Lake Mead water levels have long been a focal point for action. However, discussions between the Seven Basin States and the federal government evolved in 2022 when low runoff conditions prompted growing concern about impacts on water and hydropower operations at Lake Powell.

The Colorado River experienced below-average inflows in 2020, and unregulated inflows to Lake Powell in 2021 and 2022 were the second lowest two-year period since 1964. These conditions resulted in significant water level declines at Lake Powell, putting water and power operations in jeopardy. With agreement from the Seven Basin States, the federal government updated its 2022 operating plan and reduced planned releases from Glen Canyon Dam by 480,000 acre-feet. This action further decreased the water level of Lake Mead but was neutral regarding future shortage determinations. Future water supply determinations will be based on the effective elevation, as though this water has been released to Lake Mead.[12]

Consistent with a 2019 Drought Response Operations Agreement between the federal government and the Upper Basin States, the U.S. Bureau of Reclamation also released 500,000 acre-feet from Flaming Gorge Dam to bolster the elevation of Lake Powell.[13] Collectively, these adjustments will add approximately 1 million additional acre-feet of storage (or 16 feet elevation) to Lake Powell by April 2023.

Modeling by the U.S. Bureau of Reclamation in June of 2022 prompted additional action, and the federal government called upon the Seven Basin States to come up with a plan by mid-August 2022 for further water use reductions ranging from 2.0 to 4.0 million AFY through 2026. This reduction or "protection volume" is the savings amount needed to protect Lake Powell and Lake Mead from reaching critical elevations.

The modeling effort that prompted this action considered potential water and power supply impacts associated with declining Lake Mead and Lake Powell elevations under current agreements and if recent conditions persist. As detailed below, the U.S. Bureau of Reclamation used two hydrology scenarios that vary in severity but generally bracket the range of hydrologic conditions experienced since the onset of drought (2000 – 2022).

Figures 2.4 and 2.5 show the projected Lake Powell and Lake Mead reservoir elevations without emergency actions under two different inflow scenarios (56 and 76 percent of average inflow, respectively). The green line on both figures assumes inflows between 2023 and 2026 are 56 percent of the 30-year average flow for 1991 to 2020. This is comparable to the hydrology experience between 2001 and 2004. The yellow line reflects a more optimistic inflow of 76 percent of average between 2023 and 2026, using the same historical timeframe.

The Colorado River Basin States failed to meet the August 2022 deadline and negotiations are ongoing. While municipalities throughout the basin have committed to water use reductions, these actions are not enough to satisfy the protection volume required.[16] Achieving the U.S. Bureau of Reclamation's target reduction is a challenge because it requires all water use sectors to participate.

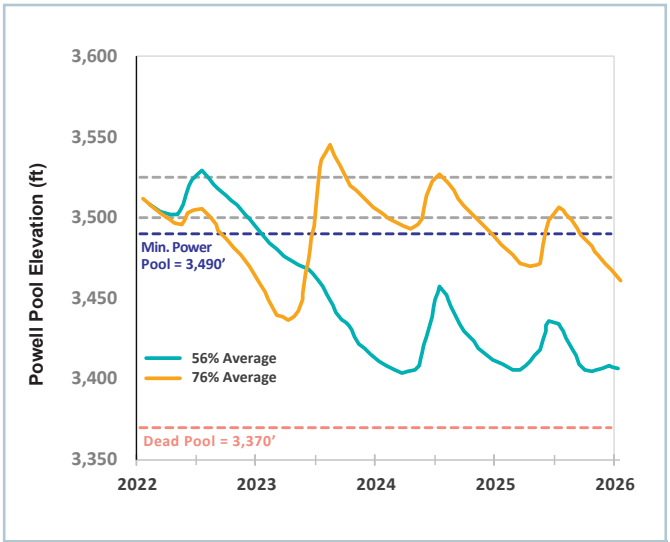


FIGURE 2.4 **Projected End-of-Year Lake Powell Elevation Without Emergency Actions (2023-2026)**[14]

Glen Canyon Dam's hydropower generating capacity below a Lake Powell elevation of 3,490 feet is unknown; the dam cannot release water to Lake Mead below 3,370 feet (dead pool).

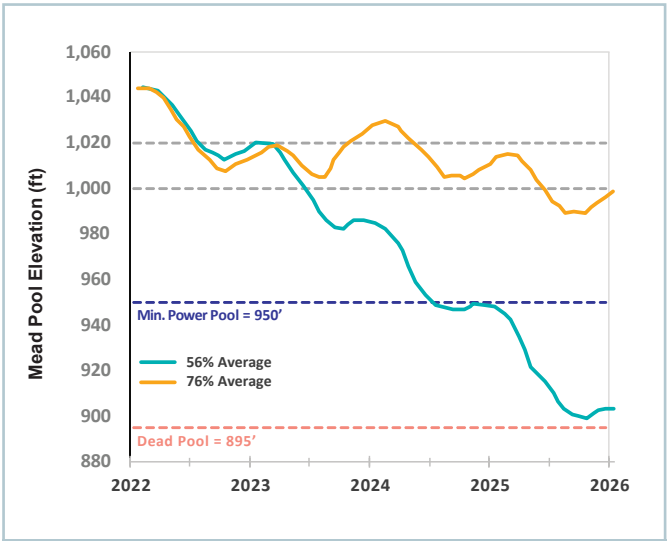


FIGURE 2.5 **Projected End-of-Year Lake Mead Elevation Without Emergency Actions (2023–2026)**[15]

Hoover Dam cannot generate hydropower below a Lake Mead elevation of 950 feet; the dam cannot release water downstream below 895 feet (dead pool).

Without urgent action, the elevations of Lake Powell and Lake Mead could drop below minimum power pool within the next few years (3,490 feet and 950 feet, respectively), which will necessitate changes in power management for much of the western United States. With further water level declines, the reservoirs could reach dead pool, the point at which water can no longer be released to downstream users.

The U.S. Bureau of Reclamation is investigating engineering options to allow for the release of water below dead pool at Lake Powell but actions could take several years to implement, if feasible. At this time, it is unclear what specific actions the seven states and federal government may take to protect water levels at Lake Mead and Lake Powell. However, significant reductions could have a material effect on Lower Basin water supplies, including Nevada.

As shown in Figure 2.6, Nevada's maximum total obligation under the Interim Guidelines and DCP is 30,000 AFY through 2026. The maximum total obligations by all parties, including Mexico, is 1.375 MAFY through 2026. These totals will likely change when agreement for achieving the protection volume has been reached. Appendix 4 includes a summary of shortage amounts and DCP contributions by state.

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 2.6 **Nevada Shortage/DCP Contribution**

The Interim Guidelines and DCP expire at the end of 2026. At the time of the 2023 Plan publication, discussions regarding post-2026 system operations were ongoing. Generally, the states are contemplating additional conservation and water use reductions.

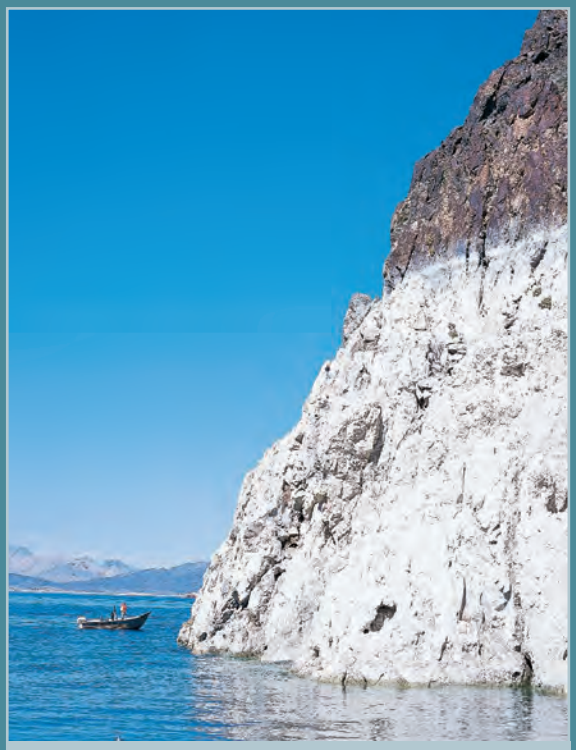
Exposed shoreline at Lake Mead, 2022

Bold Steps Needed to Safeguard the West's Most Critical Water Supply

The federal government has called upon Colorado River Basin States to implement conservation actions to significantly reduce demands. Ultimately, 2 to 4 million AFY is needed through 2026 (and likely beyond) to preserve system operations at Lake Mead and Lake Powell. This water savings target is in addition to DCP obligations and water use reductions established under the Interim Guidelines.

Achieving this level of demand reduction will require the full participation of all water users. Many municipal water providers in the Colorado River Basin are already implementing new rules. Actions range from restricting new turf installations and prohibiting non-functional turf irrigation to implementing mandatory watering restrictions and water budgets. Agricultural sectors are also taking actions, including fallowing fields, reducing irrigation through more efficient crop selection and upgrading irrigation systems for improved efficiency. Additional actions are necessary but still need to be defined.

See Chapters 3 and 4 for a detailed discussion on the SNWA's conservation priorities and progress.



Lake Mead Water Level Decline

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.[19]

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 while 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 forecasting 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.

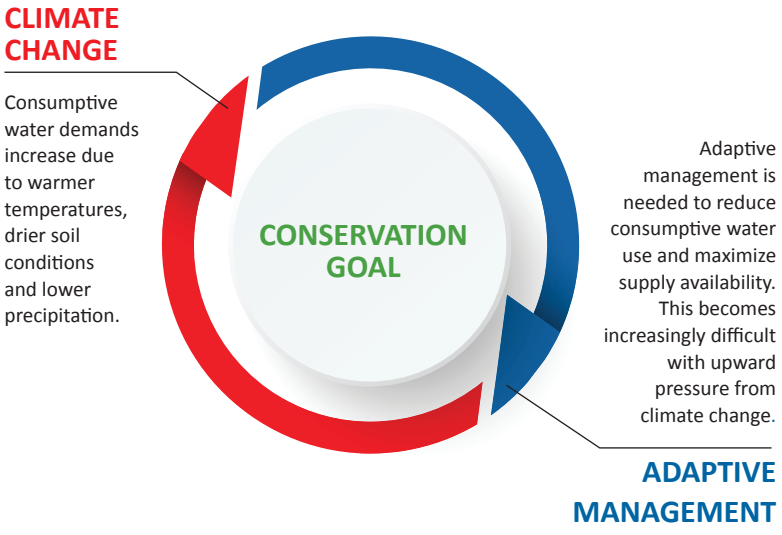
Demand Impacts

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 2060 due to climate change and increased demands within the Basin.[17] 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. This situation has been exacerbated by drought and climate change over the last two decades.

These studies recognize that climate change will also affect the amount of water available for use and overall demands. Water evaporation and evapotranspiration rates will increase as temperatures warm, resulting in higher water demands for agricultural irrigation and landscaping uses. Reductions in use among those who share the Colorado River are needed to ensure supply and demand are balanced and that the river is managed sustainably.

In Southern Nevada, the expected impacts of climate change are similar to that of drought. These include 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 will likely increase local water demands, particularly for landscape irrigation and evaporative cooling systems. As described in Chapter 3 and detailed below, upward pressure from climate change and system age could increase local water demands by 10 gallons per capita per day (GPCD) or more by 2035.[18] Among other actions, improving the efficiency of turf irrigation and cooling uses will reduce the upward pressure of climate change and help to keep local supply and demand in balance.



LOCAL ECONOMIC CONDITIONS

Southern Nevada's economic situation changed drastically in 2007 when the national economy began to experience its most significant decline since the 1930s. 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.[20] For a few years following the downturn, gaming and tourism revenues declined. This was followed by a historic 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.

Employment and economic activity began to recover as initial restrictions on the gaming industry eased in June 2020.[21] From a record high unemployment rate of 31.1 percent in 2020 to 5.7 percent in August 2022, the community's economic recovery is ongoing.[22] Home values also increased substantially during the same time frame, primarily due to low supply and growing demand.

As shown in Figure 2.7, municipal water providers experienced a significant increase in new service connections beginning in 2021.[23] An increase in interest rates toward the end of 2022 cooled the local housing market, resulting in increased inventory and stabilization of market prices. However, new service connections continue to outpace recent prior years.

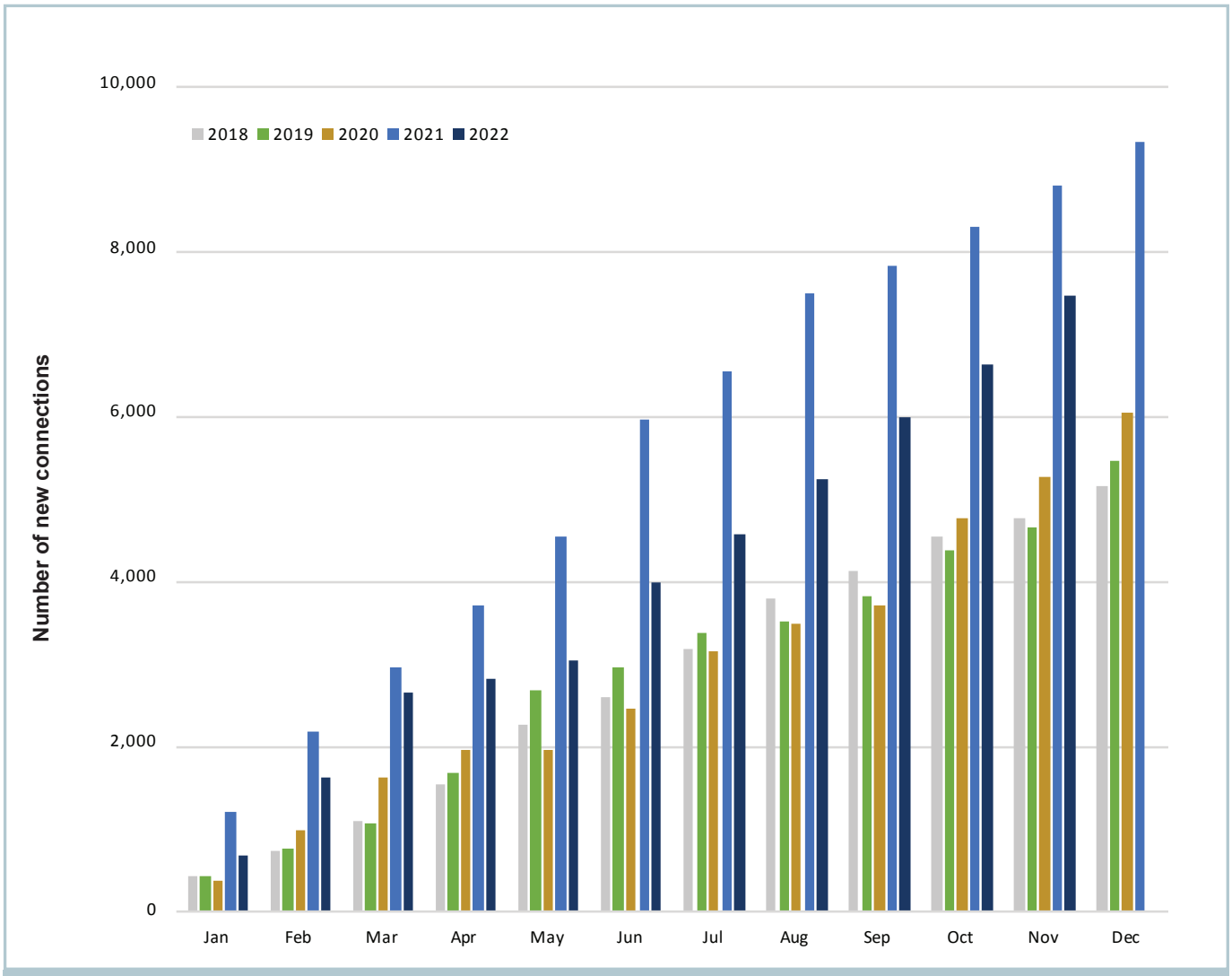


FIGURE 2.7 **Las Vegas Valley Water District New Service Connections**

Figure 2.8 shows historical Clark County population, including a reduction in population from 2020 to 2021. This reduction reflects adjustment for the 2020 U.S. Census demographic information over time rather than change from year to year. According to the Center for Business and Economic Research (CBER) at the University of Nevada, Las Vegas, growth will likely continue. The 2022 forecast estimates a population of 2.94 million by 2035 and 3.39 million by 2060.[24] This represents a moderate downward shift in the near term, mostly related to a census correction. The 2022 forecast is on par with the prior year's forecast in 2060.

As demonstrated by Southern Nevada's unpredictable past, population increases could occur faster or slower than forecasted. Significant shifts, such as those in the past, could affect local water demands and the resources available to meet those demands over time. As described in Chapter 3 and Chapter 4, the 2023 Plan details conservation actions needed to help balance supply and demand.

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 demand. In addition, Southern Nevada's local economy and its growth rate make predicting future water demands challenging, particularly given 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 changing hydrologic and climate conditions, other steps are considered long-term continuous efforts that will remain a priority for many years to come.

Lake Mead Facility Improvements

Lake Mead's surface elevation is down by approximately 170 feet since 2000. In 2022, Lake Mead reached 1,041 feet, the lowest point since the lake began filling in the 1930s.[25] Based on current and forecasted conditions, 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 several years. Protecting Lake Mead from continued water level decline is a priority for Colorado River stakeholders. As noted earlier in this chapter, below a Lake Mead elevation of 895 feet, Hoover Dam can no longer deliver Colorado River water to downstream users.

Until 2020, SNWA pumping facilities were limited in their operating range relative to the elevation of Lake Mead (Figure 2.9). To mitigate impacts associated with a potential Lake Mead water level decline below 1,000 feet and potential water quality concerns during low reservoir

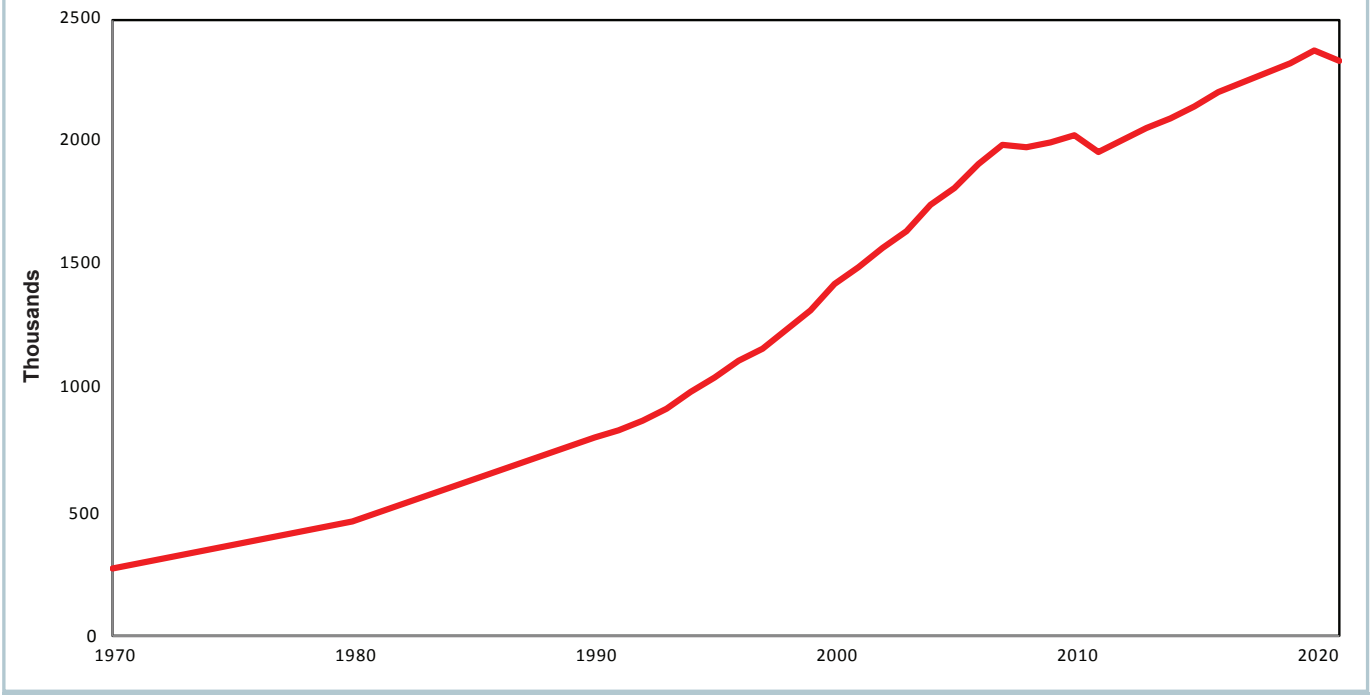


FIGURE 2.8 **Historical Clark County Population**

conditions, the SNWA constructed a new intake and pumping station at Lake Mead.

The SNWA put its new intake (Intake No. 3) into service in 2015 and began full-time operation of the Low Lake Level Pumping Station in 2022. Together, these facilities preserve existing capacity and allow the SNWA to pump from a Lake Mead elevation of 875 feet. This elevation 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. The Committee 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 for Southern Nevada, even during extremely low reservoir conditions, and provide new opportunities for the SNWA to explore water supply agreements with other downstream Colorado River users.

Water Conservation

The SNWA continues to implement one of the most progressive water conservation programs in the nation, which yielded significant water savings over the last 20 years, even as the community grew. By the end of 2021, Southern Nevada's consumptive use of Colorado River resources was 242,000 AFY. This amount is below any Colorado River water supply reduction that may occur under existing rules.

The SNWA does not anticipate near-term customer impacts associated with federal shortage declarations or implementation of the DCP due to community response efforts. However, Colorado River water use reductions associated with achieving the protection volume have not yet been defined and could result in significant additional limitations on local Colorado River water supplies. Continued water conservation will remain a critical priority in the years ahead. Meeting the community's long-term water resource needs will require significant and sustained contributions from all community sectors on an ongoing basis.

As further described in Chapter 3, the SNWA has enhanced education, outreach and incentive programs to support continued water savings. Meanwhile, additional conservation policies and programs are planned for future implementation as Southern Nevada continues to adapt to changing supply and demand conditions.

Interstate Collaboration

The Colorado River Basin States are working collaboratively with U.S. federal partners and Mexico to augment water supplies, improve system efficiency, and protect hydropower generation and access to water supplies. These efforts range from investing in infrastructure improvements in Mexico to system efficiency and water conservation efforts that have mutual benefit to Colorado River Basin water users. As shown in Figure 2.10, water banking and other collaborative efforts have reduced Lake Mead's water level decline by approximately 86 feet in 2022.

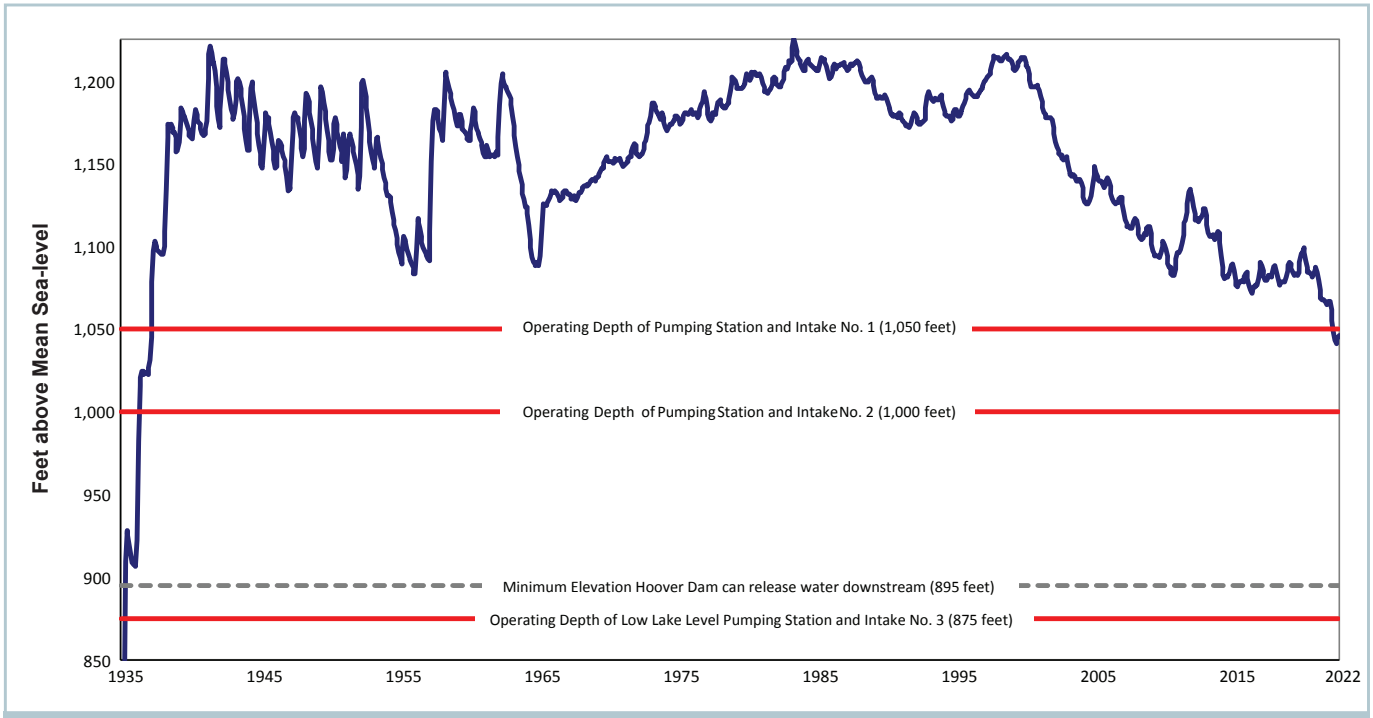


FIGURE 2.9 **Historical Lake Mead Elevations**

Drought Response Actions. Between 2014 and 2021, the SNWA entered into three agreements with federal, state, philanthropic organizations and other Colorado River water users to help mitigate the impacts of ongoing drought and bolster reservoir elevations.[26, 27, 28]

As further described below, these efforts were designed to protect against critical reservoir elevations that threaten hydropower generation at Glen Canyon and Hoover dams and preserve access to water supplies for millions of Lower Basin water users. However, as noted previously, additional action is required. Deliberations among the federal government and Colorado River Basin states are underway to identify additional response actions.

The SNWA and other Colorado River partners agreed to forgo off-stream banking efforts to leave water in Lake Mead as part of one agreement. Under other agreements, the U.S. Bureau of Reclamation partnered with municipal stakeholders to pay for conservation projects that benefit the Colorado River system as a whole. Projects included land fallowing, agricultural water efficiency, wastewater effluent recovery, turf removal and other water conservation efforts. Unlike water resources in the SNWA Water Resource Portfolio, water conserved as part of these agreements benefits 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, the plans recognize the increased potential for lakes Powell and Mead to reach critically low elevations and 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 DCP requires additional water contributions by the Lower Basin States, including Nevada, Arizona and—for the first time—California. Together, these 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 contributions are based on Lake Mead water levels. With implementation of the DCP and as part of its Water Scarcity Plan, Mexico joined the states' efforts to store additional water in Lake Mead.

Implementation of the DCP will help 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

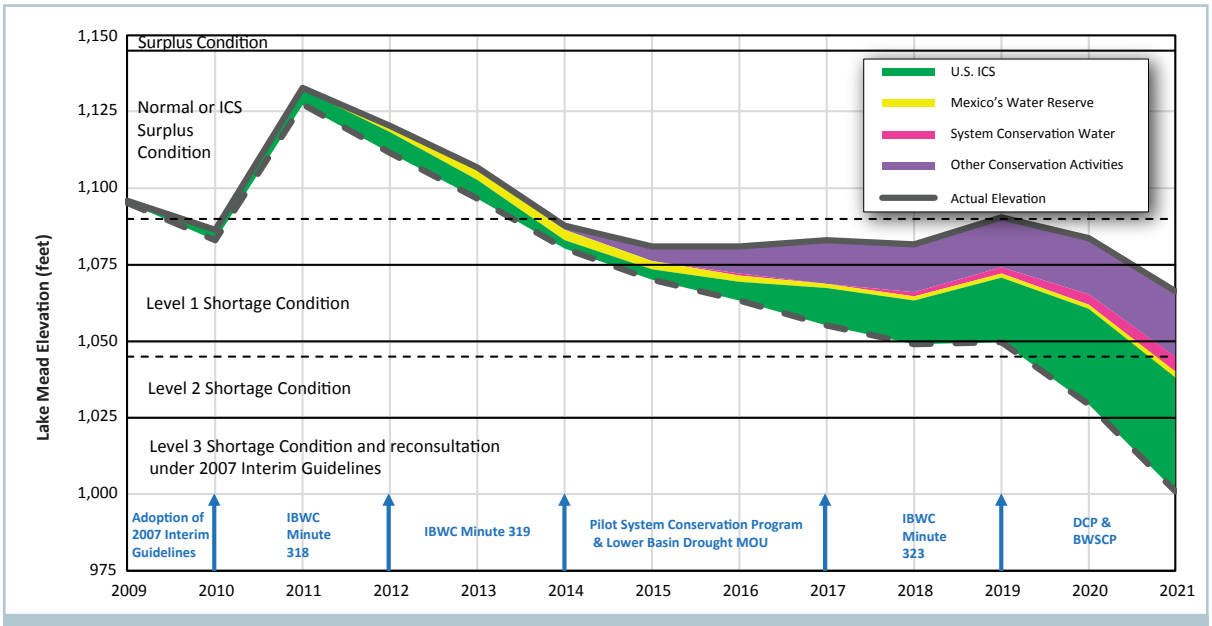


FIGURE 2.10 **Benefits to Lake Mead Storage**[30]

and DCP with conservation savings and temporary resources as described below and in Chapter 3.

500+ Plan. In 2021, the Lower Basin States and the U.S. Bureau of Reclamation entered into a Memorandum of Understanding commonly called the "500+ Plan."[29] This cooperative effort facilitates near-term actions to help maintain Lake Mead above elevation 1,020 and supports efforts to generate an additional 500,000 AF of voluntary conservation in each year between 2022 and 2023, relative to the U.S. Bureau of Reclamation's June 2021 operational projections. Voluntary conservation efforts include investments in conservation efficiency projects and are in addition to reductions under the Interim Guidelines and the DCP.

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 2022, the SNWA has banked resources in the Southern Nevada Water Bank, 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.

Conservation Memorandum of Understanding. In August 2022, the SNWA joined four municipal water providers in signing a Conservation Memorandum of Understanding (MOU) that commits the parties to actions to reduce Colorado River water use in their respective service areas. Specifically, MOU participants agreed to expand water efficiency programs, replace non-functional turf, increase water reuse and recycling programs where feasible and implement water efficiency strategies and best management practices. In November 2022, 28 additional municipal and public water agencies from across the Colorado River basin joined the MOU, significantly expanding the reach and impact of this effort.[31]

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.

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 84,000 AFY (approximately 27 billion gallons) between 2002 and 2021, even with the addition of more than 745,000 new residents.
- Stored more than nine times Nevada's 2021 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

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.[32] The Lake Mead study considered the potential impacts of low lake elevations and increasing air temperatures due to climate change on a suite of water quality measures. In 2022, the SNWA received additional funding to expand the model's forecasting functionality.

The SNWA is also a founding member of the Water Utility Climate Alliance (WUCA).[33] 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.

Supply and Demand Forecasting

As in prior years, the SNWA has taken a scenario-based planning approach with its 2023 Plan to address possible changes to water supply availability and demands. This conservative approach considers various water demand and supply conditions, including shortage and climate change impacts.

CHAPTER SUMMARY

The Colorado River community is facing a period of extreme uncertainty brought about by supply and demand imbalance resulting from overallocation and climate change. While stakeholders throughout the Basin have worked collaboratively for years to address and adapt to changing conditions, additional and urgent action is required to protect critical elevations at Lake Mead and Lake Powell.

The next steps will be hard and require participation from every water use sector in every community that relies on the river. Significant water use reductions are needed to protect systems operations, which include water and power supply delivery for approximately 40 million people. Meeting this moment requires unprecedented levels of cooperation and action. Response efforts will likely come at a steep cost for many communities, requiring major investments from stakeholders across the Basin.

The SNWA will continue to play a key role in helping to develop and implement Colorado River response efforts. However, Southern Nevada's risk profile is much lower due to the planning, adaptation and extraordinary investments made to secure Southern Nevada's water supply. With community support, the SNWA has taken deliberate steps to bolster supplies, reduce demands and fortify water delivery facilities. Thoughtfully planned and executed over decades, our actions make Southern Nevada one of the most water-secure communities in the Colorado River Basin.

There is still much work that lies ahead. As one of the fastest-warming and fastest-growing communities in the United States, Southern Nevada must continue to anticipate, mitigate and adapt to changing conditions. Conservation remains a critical priority for our desert community, and continued progress is required. Doing so will help to ensure our operational and water efficiency plans can be executed in a thoughtful, well-coordinated way that reduces impacts on our community.

Meeting the challenges ahead will require significant and ongoing adaptive management investments. Key efforts include:

- Continuing to set and achieve water conservation goals through aggressive water conservation efforts;
- Working with SNWA member agencies to develop policies and programs to ensure new development has the smallest possible consumptive water use footprint;
- Collaborating with Colorado River stakeholders to protect critical elevations at Lake Mead and Lake Powell;
- Working with Colorado River stakeholders for conservation and flexible use of Colorado River supplies (for example, water banking) and collaborative future water resource projects;
- Continuing to secure temporary resources to offset long-term impacts associated with shortage while working to bring other permanent resources online when needed;
- Addressing uncertainty by planning to a range of future supply and demand possibilities; and
- Collaborating 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 2020 are official, while estimates for the period 2020 and 2021 are provisional, September 2022, U.S. Bureau of Reclamation.

2 October 24-Month Study - most probable forecast, U.S. Bureau of Reclamation, October 2022.

3 "Climate Change and the Aridification of North America," Jonathan T. Overpeck, Bradley Udall. Proceedings of the National Academy of Sciences, June 20, 2020.

4 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.

5 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.

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

7 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.

8 "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.

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 Minute No. 323," between the International Boundary and Water Commission of the United States and Mexico for the extension of cooperative measures and adoption of a binational water scarcity contingency plan in the Colorado River Basin. September 21, 2017.

12 The operating determination for 2023 is based on the projected "effective" elevation in the U.S. Bureau of Reclamation's August 24-Month Study. The effective elevation is the elevation that would have occurred if the 480,000 acre-feet of water held in Lake Powell was released from Glen Canyon Dam and delivered to Lake Mead.

13 Between April 2022 and April 2023, the U.S. Bureau of Reclamation plans to release 500,000 acre-feet of water from upstream reservoirs to Lake Powell under Drought Response Operations associated with the Drought Contingency Plan.

14 In June 2022, the U.S. Bureau of Reclamation conducted an analysis of near-term risk associated with Lake Powell and Lake Mead declining below critical elevations and what measures are needed to reverse the declining trend. The analysis concluded that an additional 2.0 to 4.5 MAFY of mitigation water is needed to reduce the risk of falling below critical reservoir elevations.

15 Ibid.

16 Memorandum of Understanding by and among Colorado River Basin Municipal and Public Water Provider, November 16, 2022.

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

18 "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.

19 "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.

20 Clark County Population data 1970-1980 are decadal counts from the U.S. Census Bureau. Clark County Population data 1990-2021 are annual estimates prepared by the Clark County Comprehensive Planning Department.

21 "Local Area Unemployment Statistics," U.S. Bureau of Labor Statistics, 2021 - 2022

22 Ibid.

23 Las Vegas Valley Water District (LVVWD) New Service Connections, 2018 - 2022. LVVWD is the largest municipal water provider in Southern Nevada and data is used to illustrate increased demands for new service connections. Other providers also experienced increased demands.

24 "Population Forecasts: Long-term Projections Clark County Nevada Population Forecast 2021-2060," June 2022, Center for Business and Economic Research at the University of Nevada, Las Vegas.

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

26 "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.

27 "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.

28 Funding Agreement among the U.S. Bureau of Reclamation, Central Arizona Water Conservation District, Metropolitan Water District of Southern California", and the SNWA, 2021.

29 A Lower Basin Memorandum of Understanding established a cooperative effort commonly referred to as the "500 Plus Plan" to facilitate near term actions to maintain the water surface elevation of Lake Mead. The 500 Plus Plan aims to generate an additional 500,000 AF of voluntary conservation calendar year in 2022 and 2023.

30 End of calendar year 2022 balances of U.S. ICS and Mexico's Water Reserve, system conservation water, and other voluntary contributions to Lake Mead are based on projections from the September 2022 24-Month Study and are subject to change. U.S. Bureau of Reclamation, September 2022.

31 "Memorandum of Understanding by and among Colorado River Basin Municipal and Public Water Providers," November 15, 2022.

32 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.

33 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.

Marble Canyon, Arizona

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 make appropriate decisions regarding which resources to develop and use when needed. Key factors considered in determining acquisition, the priority of development, and resource use include availability, accessibility, cost and need.

The SNWA's water resource portfolio and associated facility planning and permitting efforts provide 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 conservation and resource strategies that have increased the efficiency of Colorado River water use, bolstering the elevation of Lake Mead and maximizing the availability of this critical water supply. The organization has also created new temporary resources that provide flexibility in meeting current and future demands. These efforts have helped delay the need to develop costly water projects.

Adaptive management has played an increasingly significant role in the SNWA's water resource and facility planning efforts, helping 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.

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. 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 is a critical component of the SNWA's water resource management strategy. Reducing per capita water use remains a top priority, particularly in light of current Colorado River conditions and required response measures. This chapter highlights new and ongoing strategies the SNWA is pursuing to balance supply and demand, building upon the community's conservation success over the last two decades.

PERMANENT RESOURCES

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. The section below describes these resources and provides details about their availability and use.

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.

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. While Colorado River Basin stakeholders have long recognized the potential for supply and demand imbalance. The federal government is working with the Colorado River Basin states to develop and implement measures to immediately and significantly reduce water use to protect critical elevations at Lake Mead and Lake Powell. Additional actions are under discussion and required to address long-term Colorado River operations.

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 volume includes 272,205 AFY for use by SNWA member agencies and 4,000 AFY that the SNWA delivers to Nellis Air Force Base. The SNWA also holds contracts for any surplus Colorado River water available to Nevada.

Nevada's remaining apportionment is contracted to other users.[2] 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 BCPA defines all Colorado River apportionments in terms of "consumptive use." Consumptive use is water diversions minus any Colorado River water returned to the Colorado River. These returns are also called "return-flow credits." With return-flow credits, Nevada can divert more than its full or reduced apportionment, as long as there are sufficient flows returned to the Colorado River to ensure consumptive use does not exceed the amount of water authorized for annual use.[4]

As described in Chapter 2, supply reductions under the Interim Guidelines and DCP will reduce the availability of Nevada's Colorado River supply by up to 30,000 AFY through 2026. The SNWA anticipates that any of Nevada's remaining available but unused allocation will be stored in Lake Mead or other banking programs.

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 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 designation 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 can consumptively use up to 400,000 AFY of Colorado River water when Lake Mead is above 1,145 feet. The 2023 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 located in Nevada, near the Colorado River. The SNWA may develop these rights as needed by conveying them to Lake Mead in exchange for Tributary Conservation ICS and Imported ICS credits.

The SNWA can use its Tributary Conservation and Imported ICS credits 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.

Water not used in the year it is created may be converted to Extraordinary Conservation ICS. As discussed in the "Temporary Resources" section on the following pages, the credits will be withdrawn as Colorado River water through SNWA facilities when needed 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 with 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, the SNWA has acquired approximately 16,700 AFY of permanent rights. In addition to these permanent rights, the SNWA also leases approximately 17,600 AFY of rights, with remaining terms through 2026. The SNWA anticipates developing 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 pumped sustainably. For the 2023 Plan, the SNWA assumes no use of this resource.

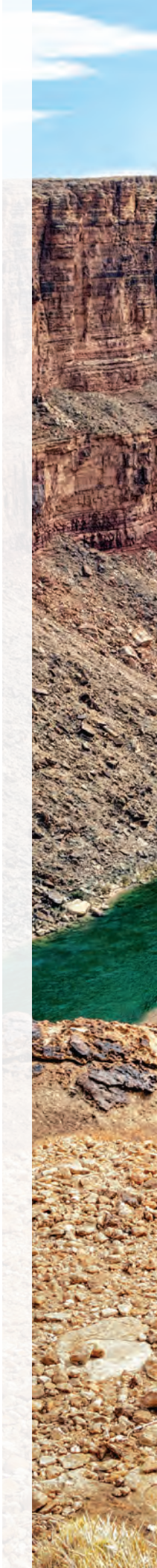
Las Vegas Valley Groundwater Rights

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. Las Vegas Valley groundwater rights remain 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 through treatment and releases 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.

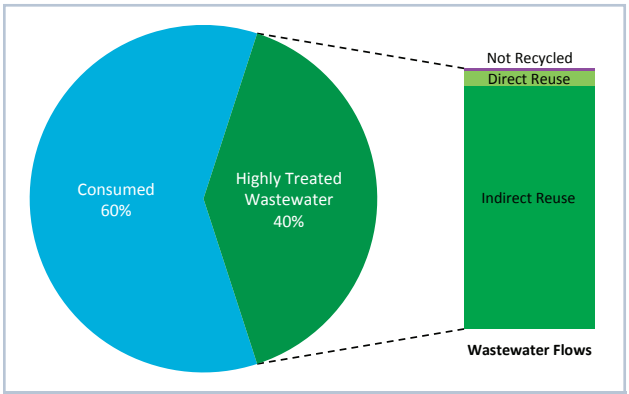


FIGURE 3.1 **SNWA Water Use and Recycling**

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.

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.[10] 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. The 2023 Plan assumes new non-consumptive water deliveries are treated and returned to the system for return-flow credits.

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 and to meet DCP contributions. The SNWA will carefully consider future resource availability and the lead time for future resource development when accessing temporary resources.

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

The SNWA has stored more than 345,000 acre-feet of water in the Southern Nevada Water Bank through 2021 for future use under 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 for the storage of Nevada's unused Colorado River water in California. As of 2021, Nevada has banked more than 330,000 acre-feet of water in California. This plan assumes a maximum recovery of 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] Through 2021, the SNWA stored approximately 614,000 acre-feet of Colorado River water underground in Arizona's aquifers for the SNWA's future use. The SNWA can bank additional water 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 a like amount of Colorado River water. The SNWA will then divert the water from facilities at Lake Mead. The SNWA can recover up to 40,000 AFY during any water supply condition and 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. Bi-National ICS is an additional form of ICS created in 2012 as part of an international pilot program. 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 repayment obligations 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 anticipated for use throughout the planning horizon and 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 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

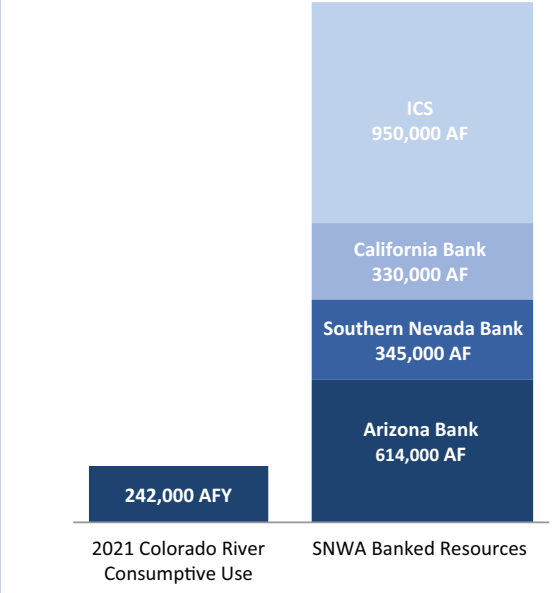
Recharge & Banking

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 32).

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 are 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 2021, the SNWA has accrued more than 2.2 million acre-feet of water. This amount is more than nine times Nevada's 2021 consumptive Colorado River water use.



SNWA Banked Supplies Through 2021

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.

Designed to help reduce the likelihood, magnitude and duration of shortages in the Lower Basin, ICS encourages the efficient use and management of Colorado River water to increase the water supply in Colorado River system reservoirs. Additional provisions for creating and recovering 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

operational viability for long-term use. In exchange for funding the pilot test, the states received System Efficiency ICS. The SNWA's share of 3,050 acre-feet is stored temporarily 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.[15] Using an established methodology to determine water savings, the SNWA will accrue Extraordinary Conservation ICS credits through 2026 when it stores these water savings in Lake Mead as ICS. Water conservation initiatives have reduced Nevada's Colorado River water use below the state's apportionment and created the opportunity for the SNWA to store conserved water in one of its off-stream water banks. Tributary Conservation and Imported ICS credits are also converted to Extraordinary Conservation ICS credits if 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 2021, the SNWA has stored approximately 475,000 acre-feet of Extraordinary Conservation ICS.

DCP Contributions and ICS. DCP 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.

Nevada has made DCP contributions since 2020 and will continue to do so through the term of the agreement when Lake Mead water levels are below elevation 1,090. Nevada's 2023 DCP contribution amount is 8,000 AFY (see Appendix 4). Subject to the DCP agreement and storage limitations, Nevada's DCP ICS account will be credited each time the state 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 is 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. Any unused DCP ICS credits will be reduced by 3 percent annually beginning in 2027 to benefit the Colorado River system. As of 2021, the SNWA has stored approximately 7,200 acre-feet of DCP ICS.

YEAR	ABOVE 1,110 FT.	1,110 TO ABOVE 1,075 FT.	1,075 TO ABOVE 1,025 FT.	1,025 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

*2023 Water Resource Plan assumes availability through 2072.

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 store water in the United States for later delivery to Mexico. The agreement will help maintain Lake Mead water levels, delay deeper level shortages and create additional certainty for all water users.

Like Minute 319, Minute 323 allows 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, 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 2021, the SNWA has accrued 32,842 acre-feet of Bi-National ICS credits.

The DCP and associated agreements limit the maximum amount of Extraordinary Conservation ICS, Binational ICS and DCP ICS each Lower Basin state can store. California is limited to 1.7 million acre-feet of storage, and Nevada and Arizona are each limited to 500,000 acre-feet of storage. As allowed by the DCP, Lower Basin stakeholders—including SNWA, Arizona Department of Water Resources, Colorado River Commission of Nevada and Metropolitan Water District of Southern California—entered into an Additional Sharing Agreement in 2021.[17] The agreement establishes a mechanism and framework that allows the parties to pool their ICS storage capacity for possible use among Lower Basin states, subject to storage availability

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.[16] 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 Hoover Dam operations and Lower Basin water deliveries.

The DCP was a significant collaboration milestone but additional actions are needed to offset the drastic water level declines associated with recent hydrology. In 2022, federal, state and municipal partners engaged in another round of difficult decision-making to identify next steps. Additional detail is provided in Chapter 2.

DCP Signing Ceremony at Hoover Dam, Lake Mead

Colorado River, Devil's Elbow, California

and ongoing coordination. The agreement provides enhanced flexibility for Lower Basin stakeholders, including Nevada.

FUTURE RESOURCES

Future resources are 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 require further research, analysis and agreement.

The development of most future resource options described in this Plan will require additional environmental permitting, as well as construction of water delivery infrastructure. Likewise, implementing 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 participation in other conservation and reuse initiatives. As part of Colorado River negotiations that began 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 Mexico to actively explore and investigate potential seawater and brackish water desalination projects in the state of California and the country of Mexico.

The Binational Projects Work Group is considering other projects such as 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.[18]

Colorado River Partnerships. The SNWA and other Lower Basin stakeholders are actively exploring future resource options that may involve financial participation in major capital projects under development in other states. For example, the SNWA, Central Arizona Project and the Arizona Department of Water Resources are exploring participation in a major reuse project by the Metropolitan Water District of Southern California (MWD).

MWD is planning for a full-scale regional recycled water program, also known as Pure Water Southern California, 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 development phase, the SNWA and MWD are collaborating to identify a path for the SNWA's participation and 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 has contributed funding to support environmental planning for the project and will continue to collaborate with MWD and other Colorado River water users to evaluate the potential for participation in this and other 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. As further described below, 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.

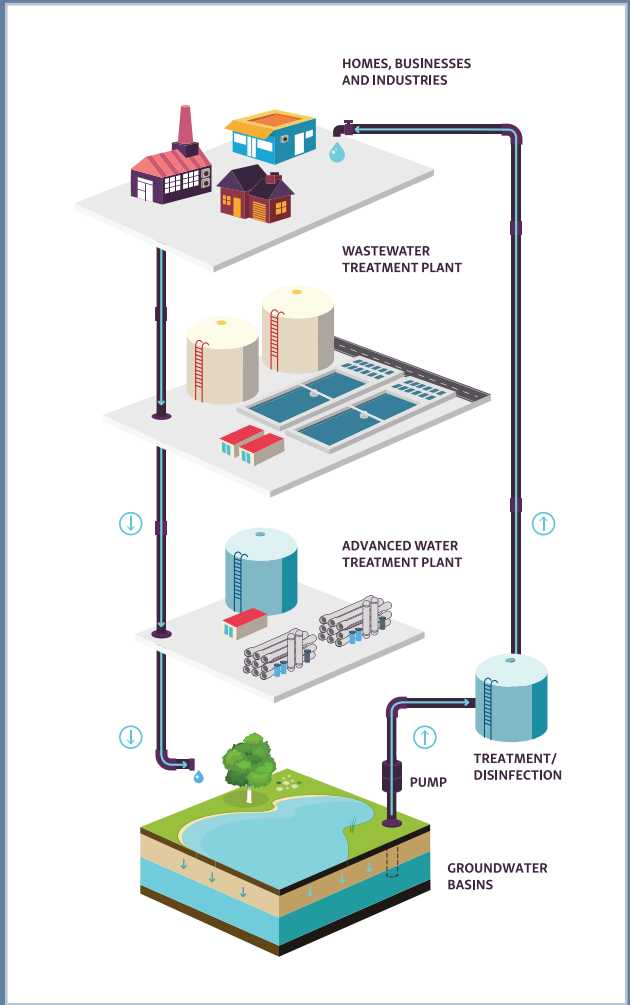
MWD Water Project

The Metropolitan Water District of Southern California is working with Sanitation Districts of Los Angeles County on the planned development of a Regional Recycled Water Advanced Purification Center. Planning efforts are currently underway, including the 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 MWD's 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 MWD for participation in this project. Any future agreement would likely involve a Colorado River water transfer/exchange in return for SNWA's financial involvement in the project.

The full-scale facility is expected to come online in 2032.



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 are leased to dry-cooled power plants located in Garnet Valley.[20] 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 planning 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. In 2020, the SNWA withdrew the remaining applications for groundwater not acted upon by the Nevada State Engineer.

WATER CONSERVATION

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

Gallons Per Capita Per Day (GPCD) is a metric used by many communities to measure water use. 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.

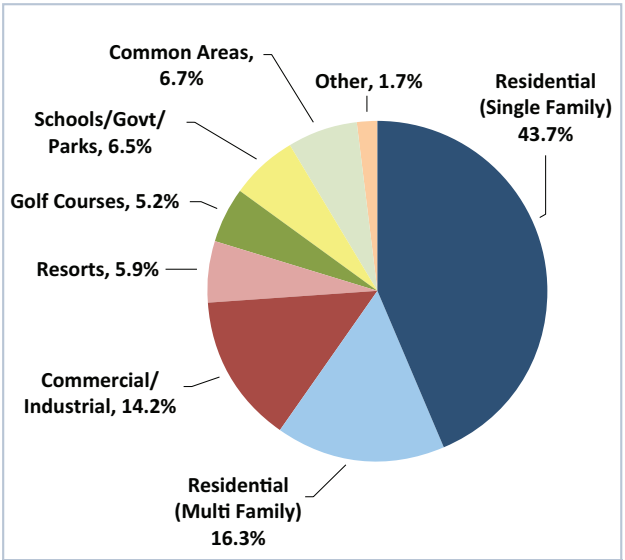


FIGURE 3.4 **Southern Nevada Municipal Metered Use (2021)**

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 as it cannot be treated and reused. As a result, consumptive water uses continue to be a primary focus area for future conservation gains.

Conservation Goals

As further described in Chapter 4, conservation progress underpins the community's long-term water resource planning efforts. Ultimately, the community's performance determines how much more or less water is needed and when.

Since its inception in 1991, the SNWA and its member agencies have worked collaboratively to set and achieve aggressive water conservation goals. Per capita water use in Southern Nevada decreased by 48 percent between 2002 and 2021, even as the population within the SNWA service area increased by approximately 49 percent during the same timeframe (Figure 3.5). However, the most significant conservation gains occurred between 2000 and 2010; until 2021, per capita water use was relatively flat. Stalled progress has significant implications for Southern Nevada, which faces two immediate and compounding challenges: upward pressure on water demands and water supply reductions.

Beyond projected population increases, which are expected to continue throughout the planning horizon, the SNWA anticipates that the upward pressures due to climate change and system age could increase demands by 10 GPCD or more by 2035.

Recognizing the paramount importance of the community's water supply security, the SNWA Board of Directors in 2021 established a new conservation goal of 86 GPCD by 2035. The new goal addresses changing conditions and recognizes that additional progress is needed to maximize available supplies. Achieving the goal

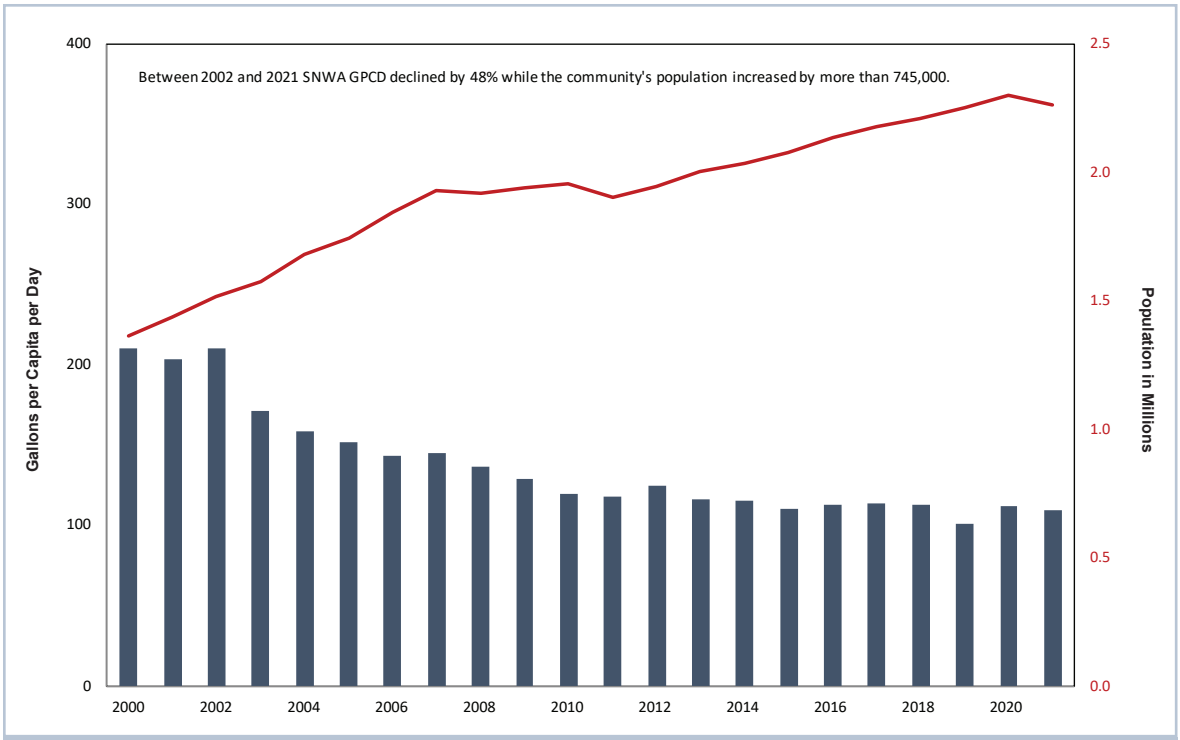


FIGURE 3.5 **Population & Per Capita Water Use**

will require significant and sustained conservation effort from all sectors of the community.

While the SNWA has expanded education, outreach and incentive programs to support water conservation and efficiency gains, meeting higher levels of efficiency will require the implementation of new strategies and tactics. The following sections detail conservation efforts currently underway and new initiatives that are now in planning to support continued water conservation and efficiency gains.

Key Focus Areas

Above and beyond the continued implementation of existing measures (see sidebar on Page 38), the SNWA has identified additional actions that will support conservation goal achievement. Some actions are based on recommendations from IRPAC 2020 (see Appendix 3), while the SNWA identified others as part of ongoing strategic planning efforts. Together, these actions will help the SNWA achieve its current conservation goal while countering upward pressures associated with climate change and system age. Implementation will require committed support from the SNWA's member agencies.

Prohibit New Golf Course Development. The LVVWD and the City of Henderson approved rule changes in 2021 that restrict the use of Colorado River water to irrigate new golf course developments. Other jurisdictions followed suit with rule and code changes in 2022, including Clark County and the City of North Las Vegas. Restricting new course development will help to reduce per capita consumptive water use.

Reduce Golf Course Water Budgets. The SNWA approved a resolution in 2022 supporting the reduction of golf course water budgets from 6.3 to 4.0 acre-feet of water annually per irrigated acre. The LVVWD and other local jurisdictions are coordinating efforts. Anticipated rule changes are expected to become effective in January 2024.

Not all golf courses will be affected. Many courses have participated in SNWA incentive programs to replace turf with water-efficient landscaping, and many are already using less water than allowed under the revised budget amount.

Convert Cool Season Turf. Limiting future installations of cool-season turf and expediting the conversions 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 its member agencies to identify conversion opportunities and provides support through its incentive programs. Future efforts

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 $288 million in incentive programs, reducing demand by more than 14.0 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 use of 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.

to limit new cool-season turf installations may include changes to service rules, codes and ordinances. The estimated annual water savings is 21 gallons per square foot of turf converted.

Implement Large Water User Policy. 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 has worked with its member agencies to embed the principles of the SNWA's Non-Functional Turf Resolution in municipal codes and service rules. Efforts include requiring out-of-valley development to return wastewater to Lake Mead for return-flow credits, and further limiting consumptive uses of water in out-of-valley areas.

Meanwhile, the SNWA continues to work with its member agencies to establish an efficiency review policy and process for new large water users that encourages efficient development and disincentivizes consumptive uses. In concept, the policy targets the largest water users and encourages them to take actions that will reduce consumptive water use by 10 percent per year over initial planned usage.

Implement AB356 (Non-Functional Turf Removal). The Nevada Legislature passed AB356 in 2021, restricting the use of Colorado River water to irrigate non-functional turf in non-single family residential applications by the end of 2026. The new law targets turf found in streetscapes, medians, parking lots, traffic circles and other areas not used for recreation and play.

The SNWA convened an advisory committee as required to define functional and non-functional turf. The committee advanced its recommendations to the SNWA Board of Directors in early 2022. The Board adopted definitions for functional and non-functional turf (see Appendix 5) and the SNWA Nonfunctional Turf Removal Plan. The SNWA has also positioned itself to accomodate increased demand under its Water Smart Landscapes program, which provides incentives for commercial and residential turf conversions.

Implement Pool Development Standards. Some private pools exceed 3,000 square feet and evaporate more than 145,000 gallons of water annually. The SNWA approved a resolution in July 2022 that supports a 600

Non single-family residential turf conversion

square foot surface area limit on new residential pools. The LVVWD and other local jurisdictions approved this change shortly thereafter with rule and code changes. This measure will help reduce consumptive water use associated with evaporative water loss, targeting savings from the largest 25 percent of new pools constructed.

Enhance Leak Resolution. Customers are responsible for repairing leaks occurring on their property and the customer side of the utility's water meter. Residential leaks are typically due to damaged irrigation systems, cracked supply lines or faulty fixtures (such as faucets, toilets, appliances and water heaters). Slow leaks are not always visible and can generate significant water loss.

As recommended by IRPAC 2020, SNWA member agencies, including the LVVWD, City of Henderson and City of North Las Vegas, are working to deploy advanced metering infrastructure (AMI). This technology will significantly enhance the ability of local water providers to notify their 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.

Implement Park Efficiency Improvements. Parks provide significant recreational value for our community's residents, offering active and programmed turf areas for a wide variety of uses. While turf is the predominant feature in most parks, other amenities may include playgrounds, sewer-connected splash pads, sports courts and group use facilities. Water use per irrigated acre varies markedly within this sector, and many parks appear to be using significantly more water than needed. High water use could be the result of unaddressed leaks, inefficient irrigation practices or other factors.

The SNWA offers incentives to public parks to convert cool-season turf, install sewer-connected splash pads and develop alternate amenities (such as basketball courts, tennis courts and other turfless play areas). Future efforts may include creating awareness and tools for parks to manage water use consistent with their property features.

Implement Cooling Efficiency Standards. Evaporative cooling is the second-largest consumptive water use in Southern Nevada, predominantly used to cool commercial and industrial buildings. Deployment of alternative cooling technology represents a significant opportunity for water savings. Water consumption primarily occurs through evaporation and drift loss, which comprise about 70 percent of total cooling water demand.

In December 2021, the SNWA approved a resolution supporting a moratorium on cooling and heating mechanisms that consumptively use water. This action is supported by the 2020 IRPAC, which recommended the SNWA evaluate changes necessary to reduce current and future

Cooling Tower

consumptive water losses associated with evaporative cooling technology.

The SNWA met with industry leaders to discuss implementation challenges and develop recommendations to advance this effort. The LVVWD approved Service Rule changes in 2022 that prohibit water service to new developments using evaporative cooling systems. The rule applies to new development applying for building permits submitted after September 1, 2023. LVVWD and SNWA are working with local jurisdictions on rule and code changes to help ensure uniform implementation across the Las Vegas Valley.

In the meantime, the SNWA continues to conduct research and pilot projects to inform best management practices, incentive programs and other policy changes. The SNWA also offers incentives to commercial and multifamily property owners who install water-efficient devices and technologies, including cooling system upgrades.

Enhance 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 rules 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. Likewise, the SNWA worked with some member agencies in 2022 to enhance water waste enforcement. The LVVWD, City of Henderson and City of North Las Vegas expanded enforcement staffing. They also coordinated joint enforcement efforts that included pooling and concentrating staff within specific geographic areas for high visibility and results.

Make Asset Management Investments. IRPAC 2020 recommended that water agencies continue making investments to maintain and improve the current 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 ongoing investment will be required as systems age. Other related efforts include deploying and testing innovative technologies that can improve leak detection and speed leak repairs, prioritizing system optimization and making proactive retrofits and repairs to system facilities.

The SNWA is currently working with its member agencies to establish water loss reduction goals and identify strategies to support goal achievement. These goals and strategies will be included in the 2024 update to the SNWA's Joint Conservation Plan.

Limit New Turf Installations. Southern Nevada has some of the most progressive development standards for new turf installation. In December 2021, the SNWA adopted a resolution supporting a prohibition on installing new irrigated turfgrass and installing and using spray irrigation systems in new development, excluding parks, schools and cemeteries. This measure includes prohibitions on turf in new single-family and multi-family development. The LVVWD and local jurisdictions, including Clark County and

the cities of Henderson, North Las Vegas, Boulder City and Las Vegas, considered and adopted rule and code changes to implement new turf restrictions in 2022.

Implement Pricing Changes. While the SNWA's member agencies set water rates independently, they use similar conservation rate principles to manage water demand. Over the years, SNWA water purveyors have compressed tier thresholds and significantly increased upper-tier water rates. To maintain a strong pricing signal, the SNWA adopted the recommendation of a citizens committee in 2015 to promote water rates that sustain and advance conservation achievements by ensuring rates keep pace with inflation. Future efforts may include changes that further incentivize conservation among top water users. Actions under consideration by some agencies include implementation of seasonal rates, excessive use surcharges, new tiers and tier compression.

The LVVWD approved rate changes in 2022 that went into effect on January 1, 2023. These changes include implementation of seasonal excessive use surcharges and tier compression. The City of Henderson also approved conservation-based rate changes.

Optimize Return-Flow Credit. There are approximately 14,500 commercial and residential septic systems in the greater Las Vegas Valley. Many of the associated properties rely on Colorado River water that is delivered by municipal water providers. Water discharged to septic systems is lost as it cannot be recovered. The SNWA developed a Septic Conversion Pilot Program in 2021 that offers grant funding for septic users to abandon their septic systems and connect to the municipal wastewater system. Water discharged to the municipal wastewater system is collected, treated and released to the Las Vegas Wash for return-flow credit. Future code changes may limit the development of new septic systems.

Figure 3.7 illustrates the estimated trajectory of conservation gains if all actions are implemented. Chapter 4 provides additional information by illustrating how conservation goal achievement affects the timing and need of temporary and future resources.

CHAPTER SUMMARY

Several 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 the SNWA can reliably meet community water demands.

The SNWA Water Resource Portfolio includes a mix of resources that will be used in tandem with continued conservation efforts to meet demands

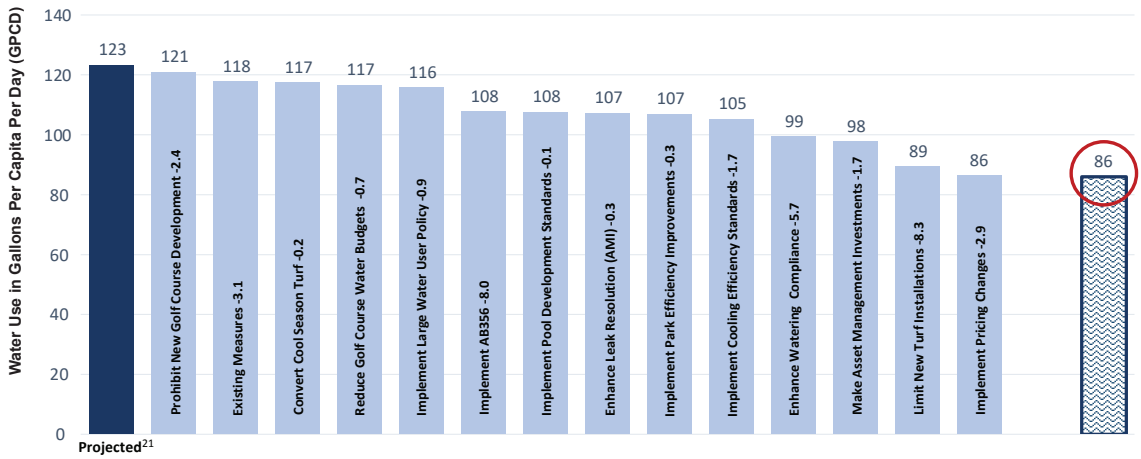


FIGURE 3.7 **Conservation Trajectory with Additional Measures**

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 86 GPCD conservation goal by 2035. The SNWA has taken several steps to increase conservation gains and is aggressively pursuing implementation of recommendations identified by the SNWA's 2020 Integrated Resource Planning Advisory Committee. The SNWA has identified additional actions that complement these efforts.

Implementation of these measures will put the community on a path to achieving its conservation goal. Moving from a projected 123 GPCD (which accounts for historical per capita water use and considered upward pressure due to climate change and system age) to 86 GPCD by 2035 will require significant and sustained investments from all community sectors.

From a supply perspective, the SNWA continues to work with other Colorado River water users to pursue flexible use of Colorado River supplies. Efforts include augmentation and storage projects designed to increase supplies and bolster Lake Mead water levels. The SNWA also continues to pursue 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 September 2022, U.S. Bureau of Reclamation, https://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 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.

16 "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.

17 "Agreement for Additional Interim Sharing of Intentionally Created Surplus Accumulation Limits," among Arizona Department of Water Resources, Metropolitan Water District of Southern California, U.S. Bureau of Reclamation, SNWA, and Colorado River Commission of Nevada, 2021. This agreement governs joint sharing of Lake Mead ICS storage of up to 2.7 million acre-feet and provides SNWA greater flexibility to store additional water in Lake Mead.

18 Black & Veatch, "Binational Study of Water Desalination Opportunities in the Sea of Cortez," 2000, prepared for Minute 323 Desalination Work Group, https://www.ibwc.gov/Files/TMs_All_Portfolio.pdf.

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 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.

21 Estimated per capita water use in 2035 based on a population served of 2.9 million. Based on a 2018 starting point of 113 GPCD and adjusted for climate change and system age.

Colorado River, Arizona

MEETING FUTURE DEMANDS

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

INTRODUCTION

Water resource planning is based on supply and demand. Supply refers to the amount of water available or expected to be available for use. Demand refers to the amount of water expected to be needed in a given year. As described in the preceding chapters, water supply and demand are influenced by several factors that can change in unpredictable ways. As the SNWA prepared its 2023 Plan, the organization carefully considered the following:

- 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 with prior plans, 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 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 planning scenarios presented in this chapter demonstrate the SNWA's ability to meet the community's long-term projected water needs with additional conservation and adaptive use of its Water Resource Portfolio.

SUPPLY AND DEMAND

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 change. 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 new regulations can also influence water resource availability over time.

The scenarios presented in this chapter consider a wide range of supply and demand possibilities. Rather than focusing on a single forecast, the scenarios bracket the range of reasonable conditions our community may face over the 50-year planning horizon. Key factors evaluated include possible reductions of Colorado River supplies and variations in future demands. As further detailed below, this conservative approach reflects uncertainties presented in the current planning environment.

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). Other resources are subject to future agreements or will require the development of facilities. Ultimately, the timing and need for resources depend significantly on how supply and demand conditions materialize over the long-term planning horizon.

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 and lower water demand projection that assumes expected conservation and an upper demand projection that assumes lower levels of conservation achievement. 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).

	SUPPLY	CONSUMPTIVE USE	AVAILABLE IN SHORTAGE
PERMANENT	Colorado River (SNWA and Nellis Air Force Base)	276,205 AFY	Yes. Subject to shortage reductions
	Nevada Unused Colorado River (Non-SNWA)	11,752 (2023) to 0 AFY in 2031	Yes. Subject to availability
	Tributary Conservation ICS	30,870-36,000 AFY	Yes
	Las Vegas Valley Groundwater Rights	46,961 AFY	Yes
TEMPORARY	Southern Nevada Groundwater Bank	344,524 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)	949,658 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**

The CBER 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 2022 CBER population forecast through 2060 and trending through 2072. The historical share of Clark County population attributable to the SNWA service area was multiplied by 2021 water-use levels and reduced over time to represent expected achievement of the community's water conservation goal of 86 GPCD by 2035.

YEAR	2023	2045	2072
LOWER DEMAND 86 GPCD IN 2035	277,000	297,000	328,000
UPPER DEMAND 86 GPCD IN 2035	281,000	347,000	410,000
UPPER DEMAND 98 GPCD IN 2035	286,000	383,000	439,000

FIGURE 4.2
SNWA Demand Projection, (AFY)

The upper demand projection was developed for planning purposes to reflect increased uncertainties related to possible changes in demands associated with the economy, climate, population and water use variability. It also reflects expected achievement of the community's water conservation goal of 86 GPCD by 2035.

The upper demand projection represents an approximate 15 percent increase over the lower projection at the midpoint of the planning horizon (2042), increasing to 25 percent in the latter part of the planning horizon (2072). The SNWA also considered one variant of the upper demand projection to illustrate how falling short of the current conservation goal will impact the anticipated timing and need for permanent, temporary and future resources. The projection assumes the community only reduces demands to 98 GPCD by 2035 and 92 GPCD by 2055.

Water Supply Conditions

The SNWA also made assumptions about future water supply conditions as part of its long-range planning efforts. The average natural inflow of the Colorado River for the period of record (1906 to 2022) was 14.6 MAFY. However, the region has experienced warmer and drier conditions since the turn of the century. These conditions will likely persist and intensify due to drought and climate change.

In response to changing hydrology and growing uncertainty about possible impacts on Colorado River water supplies, the SNWA assumes reduced inflow conditions will persist. The 2023 Plan evaluates two Colorado River water supply conditions with inflows at 13.7 and 11.0 MAFY (Figure 4.4).

This range considers better and worse hydrology than experienced in more recent years (the average inflow since 2000 is 12.2 MAFY). Incorporating a range of Colorado River conditions allows the SNWA to anticipate and prepare for factors that could impact the availability of Colorado River supplies over the long-term planning horizon. It also provides insight into the timing and volume of resources needed to meet future demands.

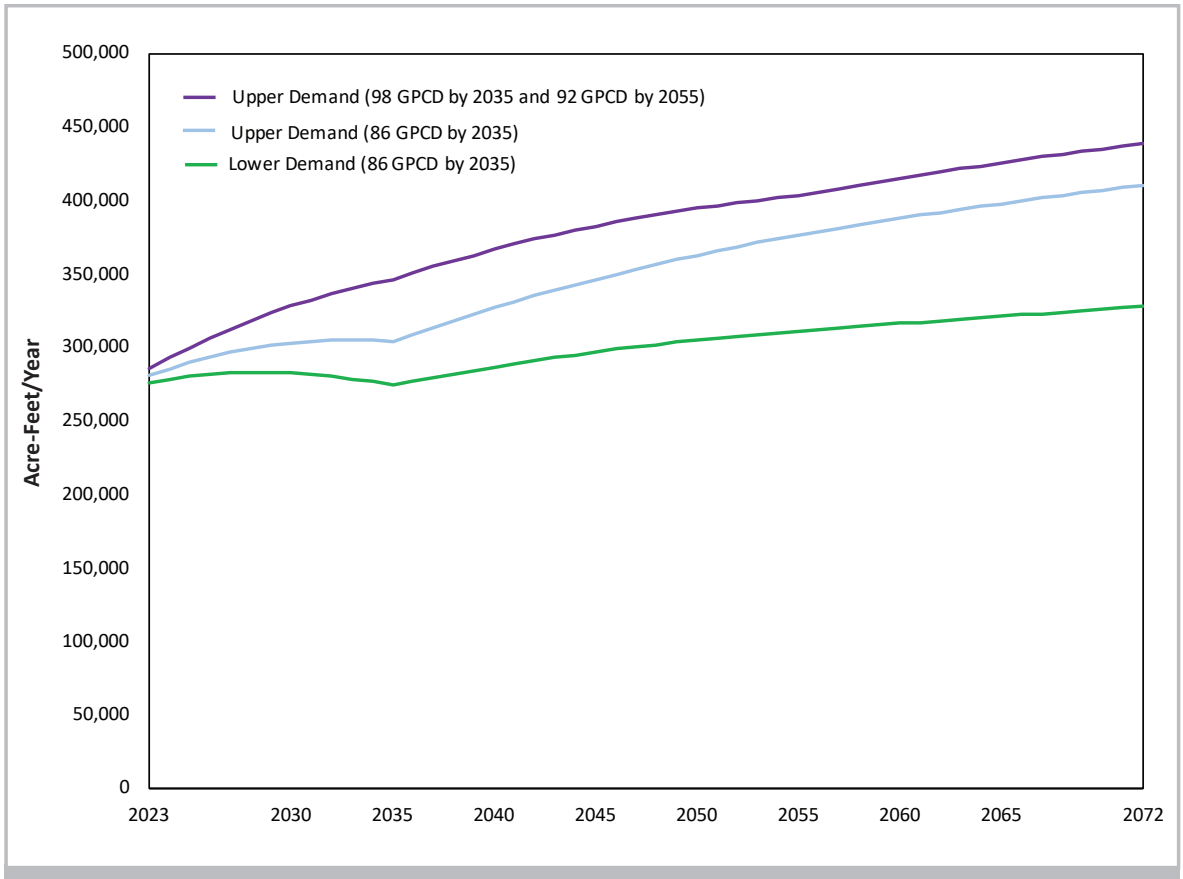


FIGURE 4.3 **SNWA Projected Water Demand**

Figure 4.5 details Colorado River inflows by year since 1906 (when record-keeping began) and highlights the period of hydrology used as a basis for the two water supply conditions used in SNWA planning (1995 to 2019). These hydrology inputs are important because they relate to Lake Mead water levels and, in turn, Colorado River supply availability. As detailed in Chapter 2, the DCP and Interim Guidelines reduce the availability of Colorado River resources to Nevada by between 8,000 and 30,000 AFY when Lake Mead is forecast to be at or below elevation 1,090 feet.

The U.S. Bureau of Reclamation's most recent August 24-Month Study forecasts the elevation of Lake Mead to be between 1,045 and 1,050 feet in January, resulting in a 25,000 AFY total supply reduction for Nevada in 2023. Continued Lake Mead water level declines are expected, and the risk of shortage remains high in future years. The DCP and Interim Guidelines expire in 2026. While some provisions extend further, operational certainty decreases with time.

The U.S. Secretary of the Interior and the Lower Basin States are consulting now to determine what additional measures are needed to protect against the potential Lake Mead water level decline below 1,020 feet. As described in Chapter 2, stakeholders throughout the basin are also focused on protecting critical elevations at Lake Powell. Given the rapid decline of Lake Mead and Lake Powell water levels and the potential for operational impacts, Nevada may be required to make shortage reductions and DCP contributions greater than 30,000 AFY or take reductions sooner. For planning purposes, the SNWA considered the potential for a combined shortage reductions and DCP contributions up to 40,000 AFY.

WATER SUPPLY CONDITION	SUMMARY
13.7 MAFY INFLOW	Based on average Colorado River inflow of 13.7 MAFY for the 25-year period from 1995 to 2019. The sequence was repeated twice to form the basis for the 50-year water supply condition. This hydrology is more optimistic than current conditions. Over the most recent 23-year period, Colorado River inflows averaged approximately 12.2 MAFY.
11.0 MAFY INFLOW	Based on Colorado River inflows for the period of 1995 to 2019 and adjusted to an average 25-year inflow of 11.0 MAFY. The adjusted sequence was repeated twice to form the basis for the 50-year supply condition. This hydrology is less optimistic than current conditions and reflects the recent downward trend in hydrology that is expected to continue in future years. Since 2000, there have been 11 years with inflow below 11.0 MAFY.

FIGURE 4.4 **Water Supply Conditions Summary**

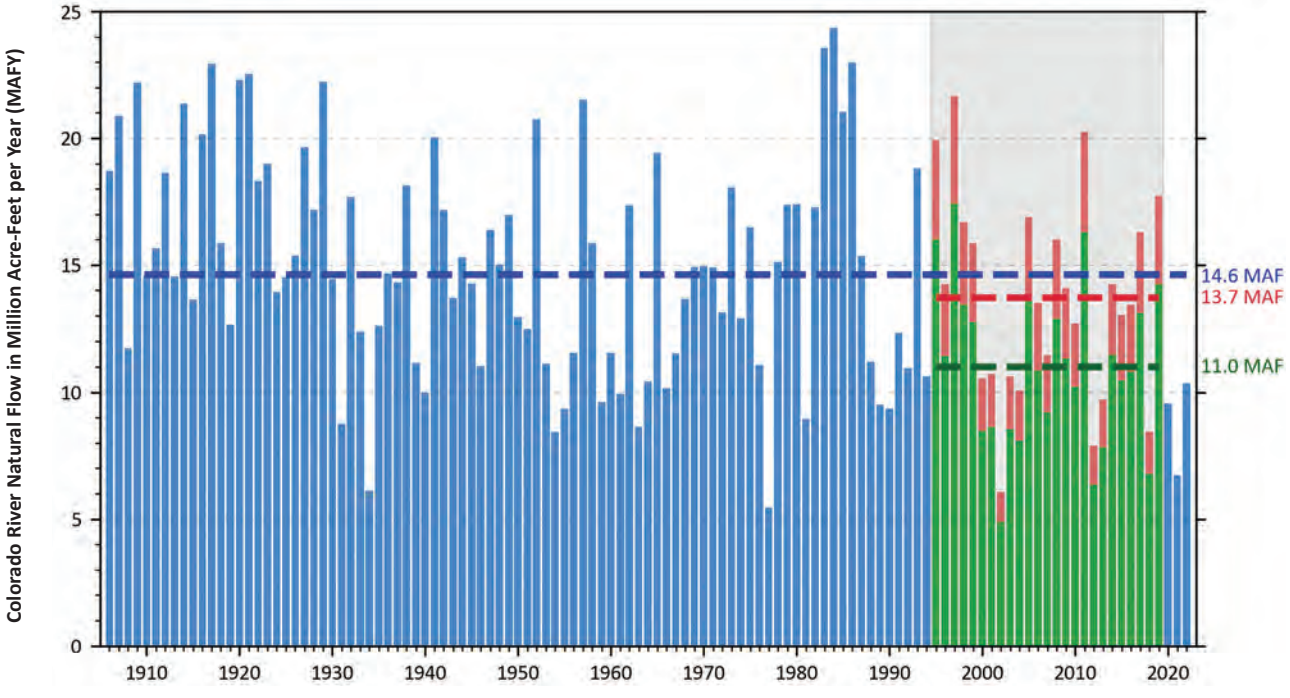


FIGURE 4.5 **Water Supply Conditions Evaluated in Planning Scenarios 1906 - 2022**

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.

SUPPLY AND DEMAND SCENARIOS

The SNWA used probabilistic modeling to develop planning scenarios that bracket the range of water supply and demand projections detailed on pages 47 and 48. The scenarios reflect the average volume and type of resources needed and available to meet projected demands throughout the planning horizon and are accompanied by detailed assumptions about Colorado River resource availability and use. This approach helps the SNWA to evaluate various possible outcomes related to Lake Mead water levels and associated supply reductions over the long-term planning horizon. It also helps to illustrate significant uncertainty within the current planning environment.

The SNWA used hydrology inputs for the two water supply conditions (13.7 and 11.0 MAFY) to project future Lake Mead water levels using the U.S. Bureau of Reclamation's Colorado River Simulation System (CRSS) model and index-sequential method (ISM). This approach preserves natural flow variability observed in the historical record by allowing the flow volume for any year in the 1995 to 2019 time sequence to occur at any point in the 50-year simulation period. In addition, the demand schedules for the Upper Basin States and the Lower Basin States of Arizona and California and Mexico, as provided in the U.S. Bureau of Reclamation's CRSS model, were used in the simulation of each planning scenario.

As shown in Figures 4.6 and 4.10, modeling results yield 50 corresponding outcomes or projections. These results are represented by individual gray lines for each year in the planning horizon. A shaded area bounds the upper and lower projections, representing the range of uncertainty associated with the possible outcomes. The dark blue line represents the average or most probable outcome and overlays DCP and shortage thresholds, providing insight into possible Colorado River water supply limitations for Nevada. These projections are paired with other supply assumptions and incorporated into the water supply and demand scenarios.[1]

All planning scenarios (Figure 4.6 through Figure 4.15) consider combinations of permanent, temporary and future resources as described in Chapter 3. Having a portfolio of resource options allows the SNWA to prioritize and adjust the use of some resources if the development of other resources is delayed or revised or changes in demand occur. If other options become available sooner, the priority and use of resources may change. Resource volumes may vary within scenario groupings based on assumptions for how the SNWA meets its DCP commitments. The SNWA can meet this obligation by reducing Colorado River water use, utilizing other resources, or converting eligible forms of ICS to meet DCP contributions.

The planning scenarios assume the Interim Guidelines and DCP continue through the planning horizon. It further assumes a combined shortage reduction and DCP contribution of up to 40,000 AFY are assumed when Lake Mead water levels are below 1,020 feet.

13.7 MAFY NATURAL FLOW PLANNING SCENARIOS

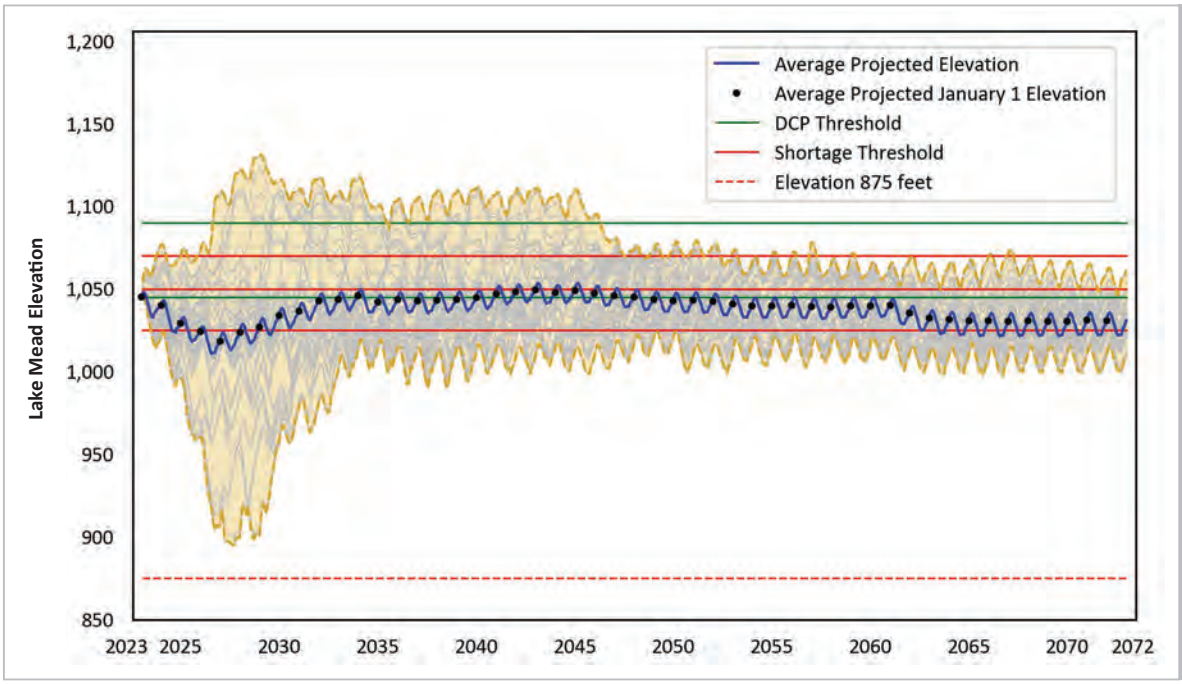


FIGURE 4.6 **Lake Mead Elevation, 13.7 MAFY Natural Flow**

Figure 4.6 depicts the projected range of Lake Mead elevations associated with the 13.7 MAFY water supply condition and variable inflow sequences.

On average, the elevation of Lake Mead is projected to remain below the Tier 2 shortage threshold, triggering shortage reductions and DCP contributions totaling 25,000 AFY. There is some improvement at the mid-point of the planning horizon. However, the elevation range consistently remains below the Tier 2 shortage threshold in later years.

Figures 4.7 - 4.9 reflect the average volume of water resources available to meet projected demands for this water supply condition.

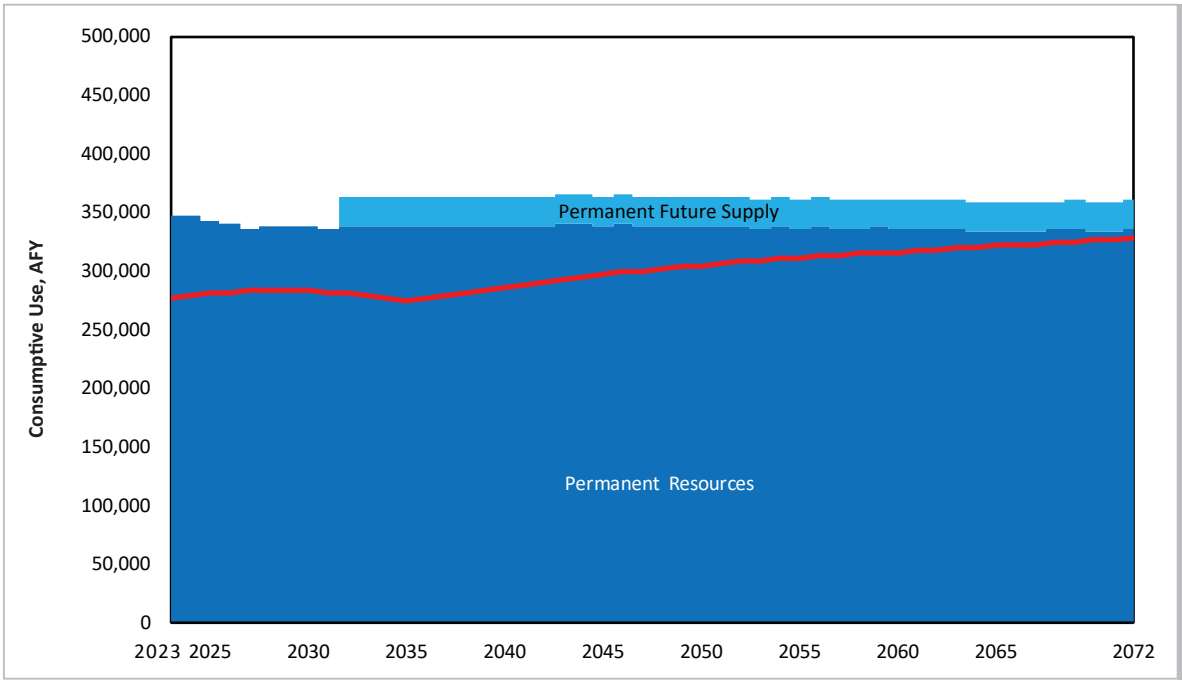


FIGURE 4.7 **13.7 MAFY Natural Flow, Lower Demand (86 GPCD)**

As shown in Figure 4.7, permanent resources are sufficient to meet demands through 2072. Permanent future supplies (25,000 AFY) are available in 2032 but are not needed under this scenario.

Temporary, permanent future supply and other future resources are not anticipated for use during the planning horizon.

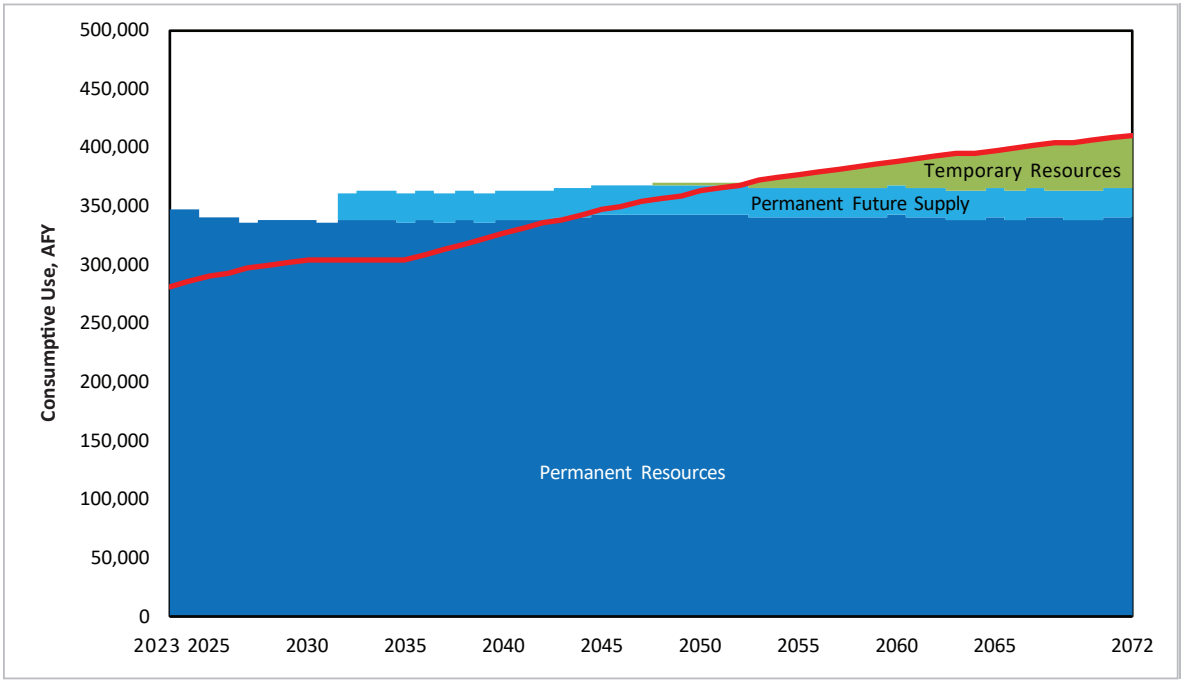


FIGURE 4.8 **13.7 MAFY Natural Flow, Upper Demand (86 GPCD)**

As shown in Figure 4.8, permanent, temporary and future resources are needed to meet demands through 2072. Permanent future supply (25,000 AFY) is available in 2032, with deliveries beginning in 2041. Temporary resources are needed in 2048 and through the remainder of the planning horizon.

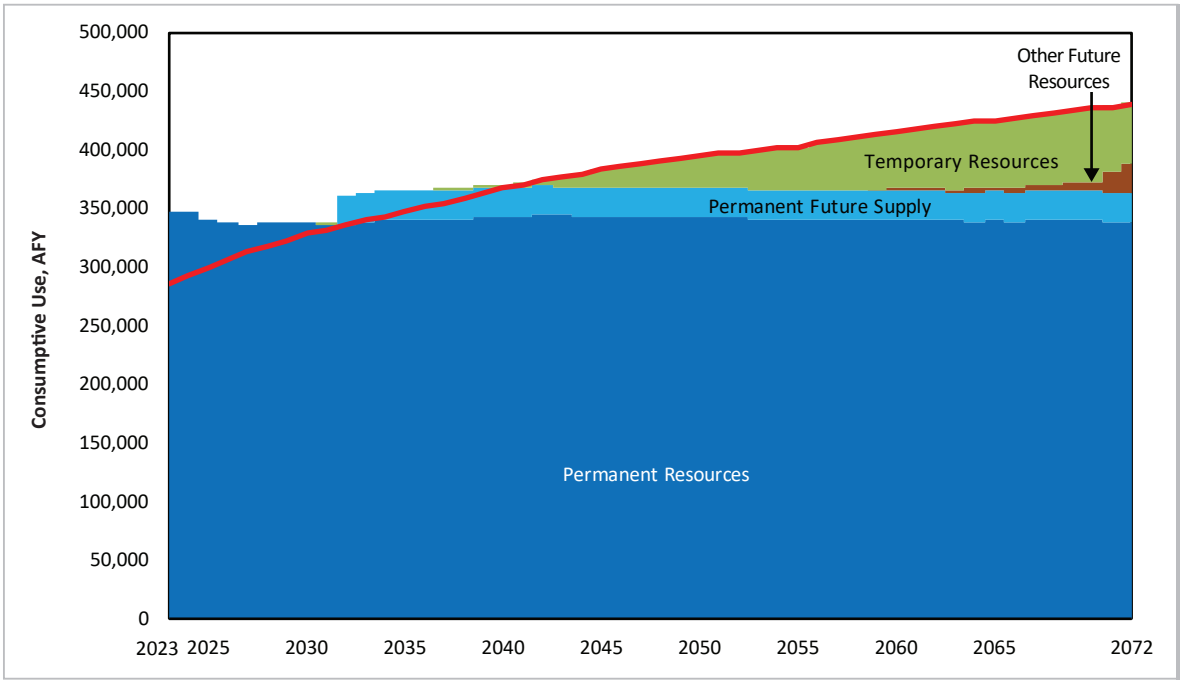


FIGURE 4.9 **13.7 MAFY Natural Flow, Upper Demand (98 GPCD by 2035 and 92 GPCD by 2055)**

Figure 4.9 illustrates water resource needs if the community falls short of its conservation goal. This scenario assumes future water use at 98 GPCD by 2035 and 92 GPCD by 2055. Permanent, temporary and future resources are needed to meet water demands through 2072. Temporary resources are needed in 2031. Permanent future supply is available and needed in 2032, and other future resources are needed by 2059 (25,000 AFY in 2072).

11.0 MAFY NATURAL FLOW PLANNING SCENARIOS

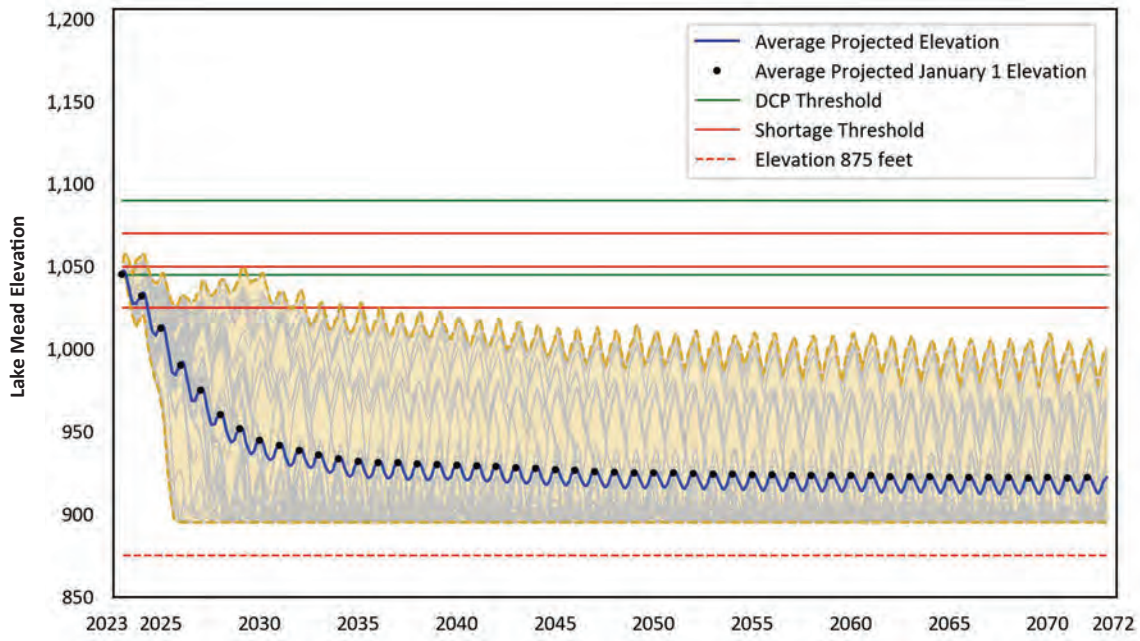


FIGURE 4.10 **Lake Mead Elevation, 11.0 MAFY Natural Flow**

Figure 4.10 depicts the projected range of Lake Mead elevations associated with the 11.0 MAFY water supply condition and variable inflow sequences.

Under this scenario, Lake Mead consistently falls below 1,050 feet (reaching a low elevation of 931 feet) with intermittent elevations above and below 1,025 feet. Shortage reductions and DCP contributions are assumed throughout the planning horizon. The combined shortage reduction and DCP contribution is 40,000 AFY when Lake Mead water levels are below 1,020 feet.

Figures 4.11 – 4.13 reflect the average volume of water resources available to meet projected demands for this water supply condition.

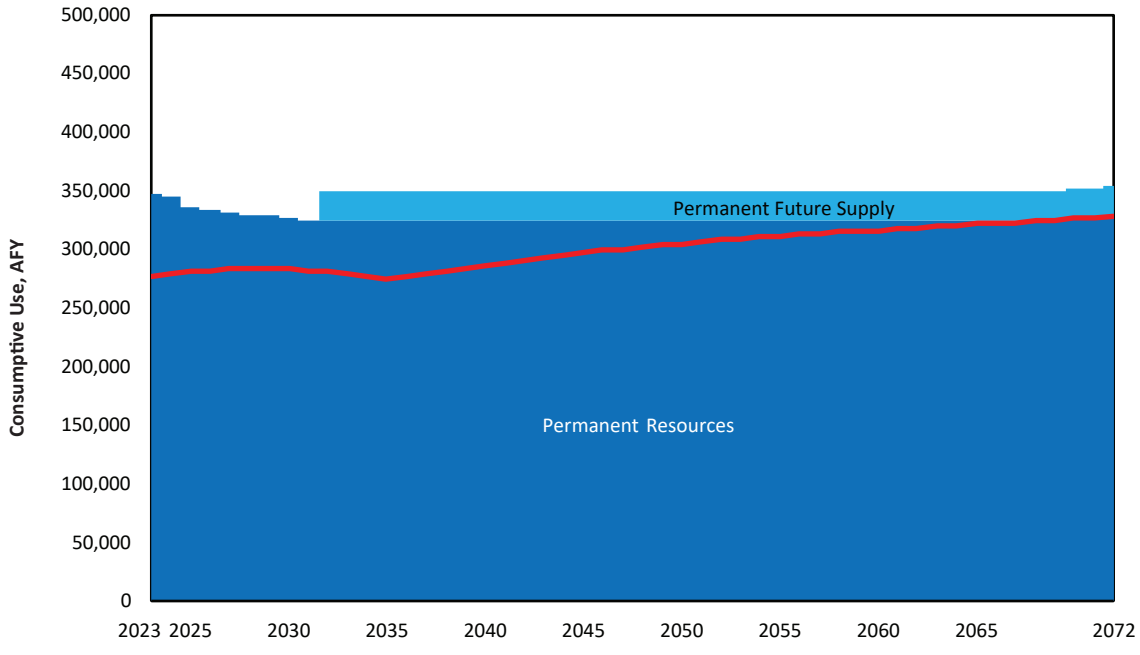


FIGURE 4.11 **11.0 MAFY Natural Flow, Lower Demand (86 GPCD)**

As shown in Figure 4.11, permanent resources are sufficient to meet demands through 2072. Permanent future supplies (25,000 AFY) are available in 2032 but are not needed under this scenario.

Temporary, permanent future supply and other future resources are not anticipated for use during the planning horizon.

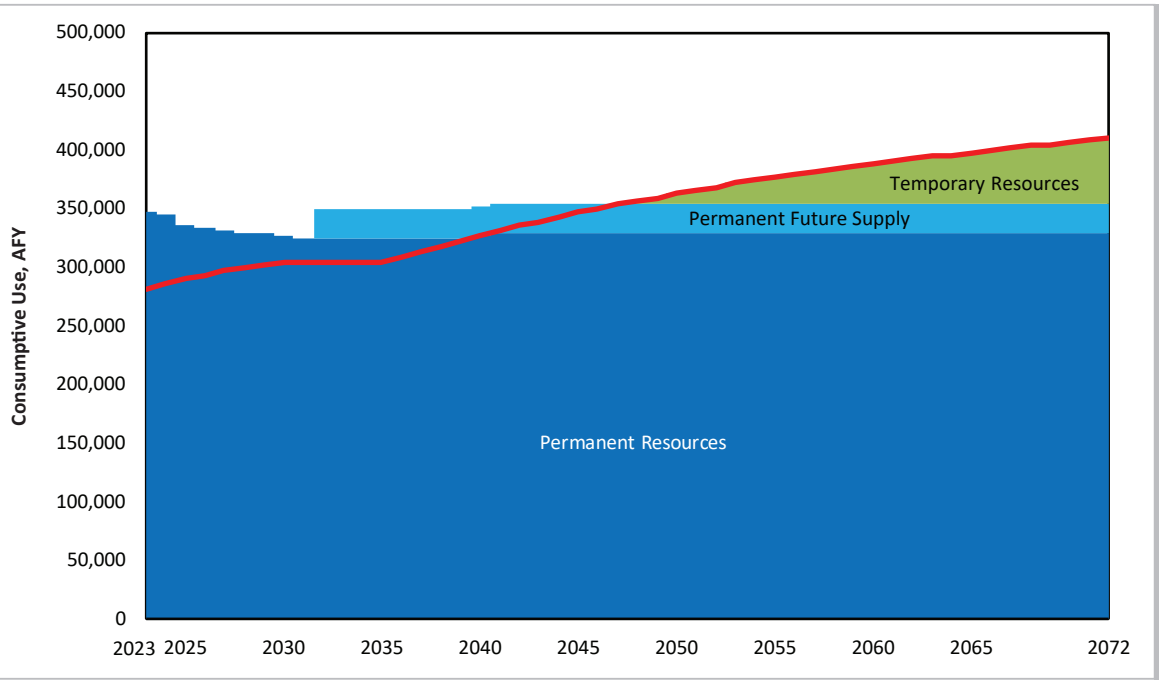


FIGURE 4.12 **11.0 MAFY Natural Flow, Upper Demand (86 GPCD)**

As shown in Figure 4.12, permanent, temporary and future resources are needed to meet demands through 2072. Permanent future supplies (25,000 AFY) are available in 2032 and needed in 2041.

Temporary resources are needed in 2048. Other future resources are not anticipated for use during the planning horizon.

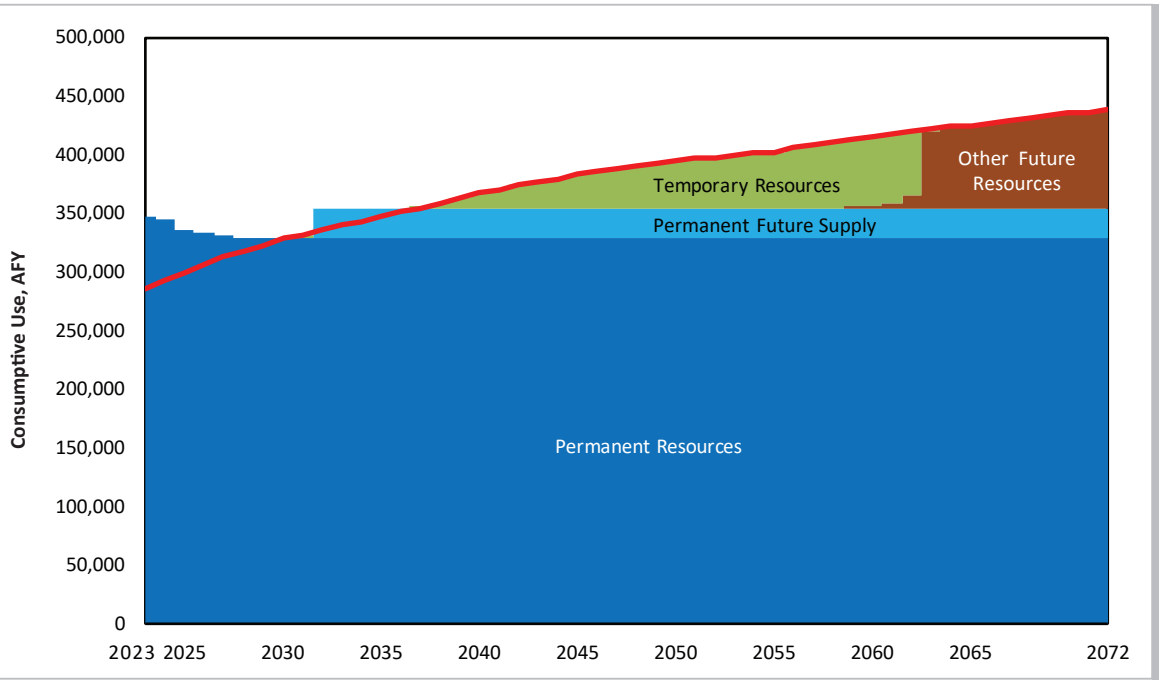


FIGURE 4.13 **11.0 MAFY Natural Flow, Upper Demand (98 GPCD by 2035 and 92 GPCD by 2055)**

Figure 4.13 illustrates water resource needs if the community falls short of its conservation goal. This scenario assumes future water use at 98 GPCD by 2035 and 92 GPCD by 2055. Permanent, temporary and future resources are needed to meet water demands through 2072.

Temporary resources are needed in 2031. Permanent future supply is available and needed in 2032, and other future resources are needed by 2059 (85,000 AFY in 2072).

Figures 4.14 and 4.15 illustrate the timing and need for temporary and other future resources under the 11.0 MAFY inflow scenario if permanent future supply is delayed until 2039.

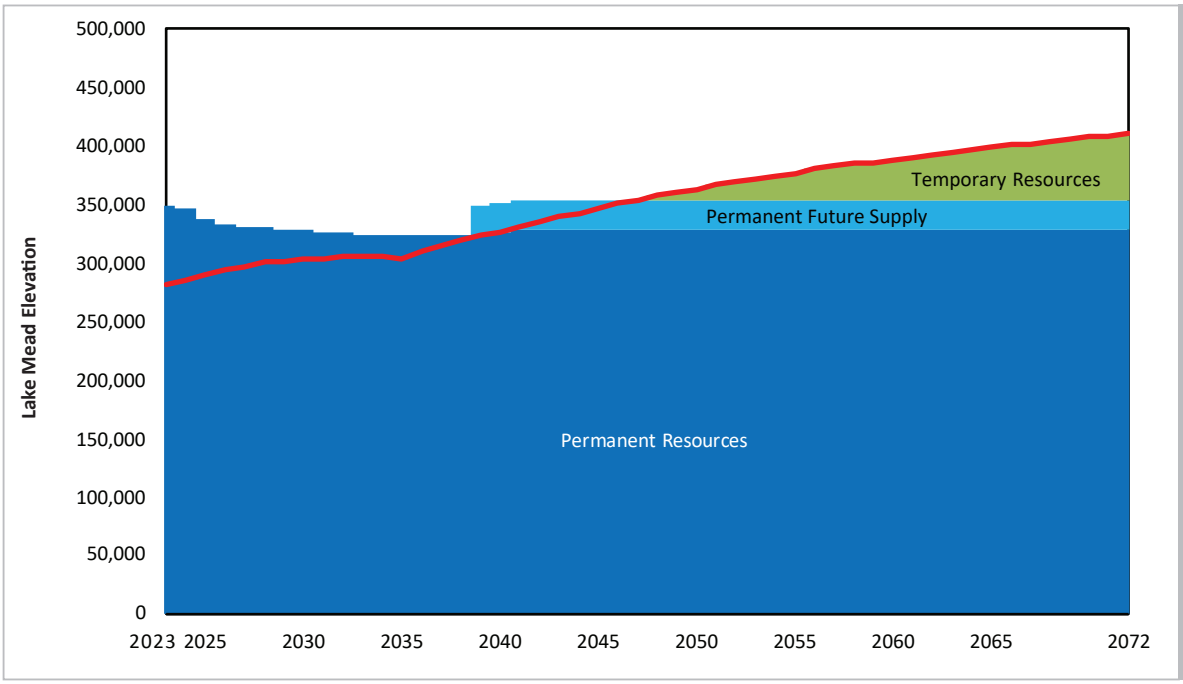


FIGURE 4.14 **11.0 MAFY Natural Flow, 2039 Upper Demand (86 GPCD by 2035)**

As shown in Figure 4.14, permanent and temporary resources are needed to meet demands through 2072. This planning scenario considers delaying timing for permanent future supply (25,000 AFY), which is available in 2039 and needed in 2041.

Temporary resources are needed in 2048, and other future resources are not anticipated for use in the planning horizon.

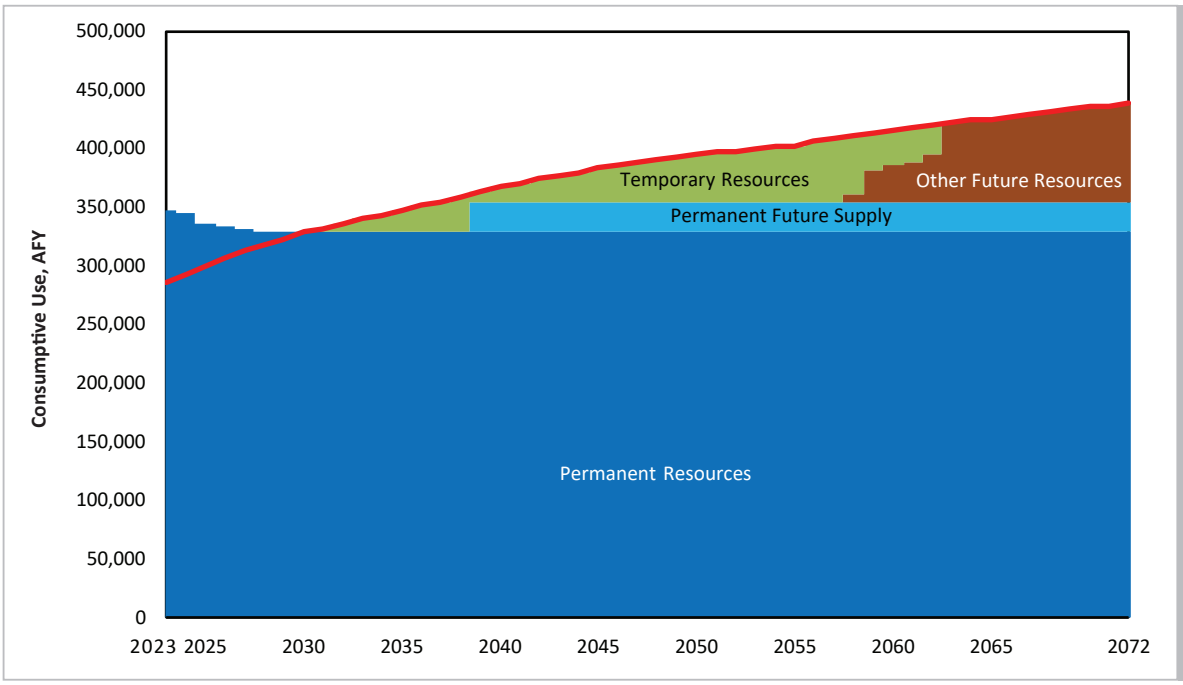


FIGURE 4.15 **11.0 MAFY Natural Flow, 2039 Upper Demand (98 GPCD by 2032 and 92 GPCD by 2055)**

As shown in Figure 4.15, permanent and temporary resources are needed to meet demands through 2072. This planning scenario considers delaying timing for permanent future supply (25,000 AFY), which is available and needed in 2039.

Temporary resources are needed in 2031, and other future resources are needed by 2058 (85,000 AFY).

CHAPTER SUMMARY

Several factors can influence water supply and demand, including changing economic conditions, water use patterns, conservation progress and climate variability. To account for these variables, the SNWA's 2023 Plan considers two water supply and demand scenarios that bracket a range of plausible conditions over the 50-year planning horizon.

The scenarios assume that Southern Nevada will continue to make progress towards its new water conservation goal of 86 GPCD. They also demonstrate how falling short of the goal could impact water resource timing and need over the planning horizon. Likewise, the scenarios assume that conserved Nevada Colorado River water will continue to be stored for future use when available and that temporary resources will be used to meet demands until future resources are needed and developed.

Significant uncertainty exists within the current planning environment. Colorado River modeling performed by the U.S. Bureau of Reclamation in 2022 projects that Lake Mead will reach an elevation between 1,045 and 1,050 feet in 2023, triggering a Tier 2 shortage declaration. The risk of shortage remains high in subsequent years. Under the Interim Guidelines and DCP, the maximum supply reduction prescribed to Nevada is 30,000 AFY; however, this amount could potentially increase.

The simulation results of Colorado River modeling also project Lake Mead's minimum probable elevation will decline below 1,030 feet in 2023. In accordance with the DCP, the Secretary of the Interior and the Lower Basin States are actively engaged in consultation to establish additional plans and actions to protect against lake level decline below elevation 1,020 in the next two years and through the remainder of the interim period. These efforts are described in Chapter 2.

The SNWA is not currently using its full Colorado River allocation, and near-term shortage declarations are not anticipated to impact current customer use. However, a return to normal or near-normal hydrology is unlikely to occur during the long-term planning horizon, and the probability of shortage is high. Meanwhile, local water demands are projected to increase.

Meeting long-term projected demands will require the SNWA to make significant and sustained progress toward its conservation goal. As demonstrated in the planning scenarios, lower levels of conservation achievement will impact the timing and need of temporary and future resources.

The 2023 Plan demonstrates the importance of conservation in extending the availability of Colorado River resources, minimizing the use of temporary resources, and delaying the timing and need for future resources. Subject to necessary authorizations and ongoing conservation progress, the amount of resources available for use as described in the SNWA Water Resource Portfolio is 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 evaluate conservation progress and take steps necessary to achieve conservation goals;
- 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;
- 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 when determining the priority of resources for use;
- Support ongoing efforts to increase the elevation of Lake Mead and preserve system operations; and
- Work proactively with other Colorado River water users to explore emerging future resource options of mutual benefit.

ENDNOTES

1 The December 31, 2022 reservoir and water supply conditions used to initialize the CRSS simulations correspond with the U.S. Bureau of Reclamation's Operation Plan for Colorado River System Reservoirs (24-Month Study) most-probable projection published on October 11, 2022.

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 (LCR MSCP).

Finalized in 2005, the LCR MSCP 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 LCR MSCP, which is being implemented by the U.S. 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, including native fishes, birds and other wildlife listed as threatened or endangered under the ESA.

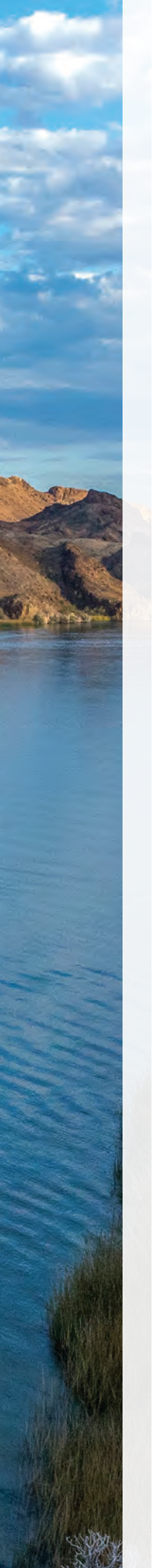
Some of the LCR MSCP projects being conducted in Nevada include razorback sucker studies in Lake Mead, southwestern willow flycatcher surveys and habitat protection at the Big Bend Conservation Area.

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 LCR MSCP 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.

Glen Canyon Dam Adaptive Management Work Group

The SNWA participates in the Glen Canyon Dam Adaptive Management Work Group (AMWG) Federal Advisory Committee. This multi-stakeholder group helps balance the needs and interests of the threatened 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 threatened 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 traillii extimus*), 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, including work at the Warm Springs Natural Area.

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 Land 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.

The SNWA and other resource management partners have supported fish and wildlife monitoring activities in the lower Virgin River for decades. This work has provided valuable information, such as understanding the long-term dynamics of the fish community and the success of fish stocking experiments.

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 (MSHCP) 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 MSHCP was approved in 2001, and provides ESA coverage for 78 species, including the threatened desert tortoise (*Gopherus agassizii*).[4] 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 2 percent of the flows into Lake Mead and consist of urban runoff, shallow groundwater, stormwater 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 more than 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 planned 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 565 acres with native plants
- Removed more than 600,000 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 2 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.

Activities on the upstream reach of the Las Vegas Wash are largely complete and the SNWA is working to implement a Long-Term Operating Plan. Current efforts focus on the Lower Las Vegas Wash, the reach between Lake Las Vegas and Lake Mead. Work efforts include the repair of existing erosion control structures and the installation of new structures.

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

Water Smart streetscape

resources. The SNWA's Water Smart Landscapes program has averted more than 42,000 metric tons of carbon dioxide equivalent discharge (more than 92 million pounds) through avoided water pumping, treatment and transmission activities. That is comparable to taking 9,050 cars off the road every year. On an annual basis, program participants reduce the SNWA's carbon dioxide footprint between 500-700 metric tons.

As one of the state's largest energy users, 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 modified renewable energy standards by the Nevada Legislature in 2019, the SNWA met the 2021 target of 24 percent renewables and is on track to meet the 50 percent target by 2030.

The SNWA's solar and small hydropower facilities generate more than 160 million kilowatt hours of clean energy, enough to power nearly 12,000 average Southern Nevada homes annually. The organization has also upgraded its fleet to include 86 percent alternative fuel vehicles or hybrids.

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.

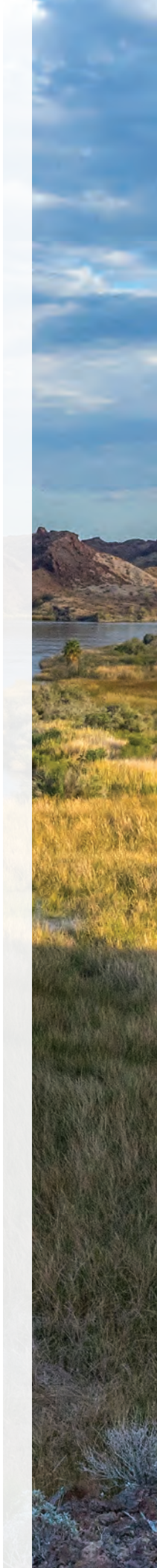
2 "Colorado River Basin Water Supply and Demand Study," December 2012, U.S. Bureau of Reclamation.

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 2023 WATER RESOURCE PLAN DEMAND PROJECTIONS

Year	Lower Demand Population[1]	Upper Demand Population[2]
2023	2,427,000	2,469,000
2025	2,540,000	2,625,000
2030	2,773,000	2,974,000
2035	2,940,000	3,256,000
2040	3,073,000	3,499,000
2045	3,181,000	3,709,000
2050	3,266,000	3,886,000
2055	3,334,000	4,034,000
2060	3,387,000	4,153,000
2065	3,440,000	4,261,000
2070	3,493,000	4,358,000
2072	3,514,000	4,393,000

Endnotes:

1 "Population Forecasts: Long-Term Projections for Clark County, Nevada 2022–2060," June 2022, Center for Business and Economic Research at the University of Nevada, Las Vegas (projected through 2072).

2 Adjusted "Population Forecasts: Long-Term Projections for Clark County, Nevada 2022–2060," June 2022, Center for Business and Economic Research at the University of Nevada, Las Vegas (projected through 2072 with a 15 percent increase by 2042 and a 25 percent increase by 2072).

APPENDIX 2

SNWA DEMAND PROJECTIONS USED IN 2023 WATER RESOURCE PLAN (in AFY)

Year	Lower Demand (86 GPCD Conservation goal)	Upper Demand (86 GPCD Conservation goal)	Upper Demand (98 GPCD Lower Conservation Scenario)
2023	277,000	281,000	286,000
2025	281,000	290,000	300,000
2030	283,000	303,000	328,000
2035	275,000	304,000	347,000
2040	287,000	327,000	367,000
2045	297,000	347,000	383,000
2050	305,000	363,000	395,000
2055	312,000	377,000	403,000
2060	316,000	388,000	415,000
2065	321,000	398,000	426,000
2070	326,000	407,000	436,000
2072	328,000	410,000	439,000

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

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**

APPENDIX 5

TURF DEFINITIONS

NON-FUNCTIONAL TURF

An irrigated grass area not providing functional use. Areas of nonfunctional turf include, but are not limited to:

Streetscape turf
Grass located along public or private streets, streetscape sidewalks, driveways and parking lots, including turf within a community, park and business streetscape frontage areas, medians, and roundabouts.

Frontage, courtyard, interior and building-adjacent turf
Grass in front of, between, behind or otherwise adjacent to a building or buildings located on a property not zoned exclusively for single-family residence, including maintenance and common areas.

Certain HOA-managed landscape areas
Turf managed by a homeowner association that does not provide a recreational benefit to the community or that otherwise does not qualify as functional turf, regardless of property zoning.

FUNCTIONAL TURF

An irrigated grass area that provides a recreational benefit to the community and is:

- Located at least 10 feet from a street, installed on slopes less than 25 percent and not installed within street medians, along streetscapes or at the front of entryways to parks, commercial sites, neighborhoods, or subdivisions.
- Active/programmed recreation turf, athletic fields, designated-use-area turf, golf course play areas, some pet relief turf, playground turf or resident area turf.

Active/programmed recreation turfs
Grass used for recreation that is 1,500 contiguous square feet or greater; co-located with facilities; and located at least 10 feet from a street or interior-facing parking lot unless the turf area is at least 30 feet in all dimensions or immediately adjacent to an athletic field.

Athletic field turf
Grass used for sports or physical education that is 1,500 contiguous square feet or greater; not less than 30 feet in any dimension; and located at a school, daycare, religious institution, recreation center, senior center, park or water park. Athletic field turf may be located less than 10 feet from a street or interior-facing parking lot if the contiguous turf area is at least 30 feet in all dimensions.

Designated use area
Grass designated for special use at cemeteries and mortuaries.

Golf course play area
Grass in driving ranges, chipping and putting greens, tee boxes, greens, fairways and rough.

Pet relief area
Grass at a property providing commercial and retail services for pets, such as veterinarian and boarding facilities. The area must not exceed 200 square feet.

Playground turf
Grass in designated play areas with playground amenities, including but not limited to slides, swings and climbing structures on homeowner association owned/managed property or at a public park, water park, school, daycare, recreation center, senior center or religious institution. Playground turf may be located less than 10 feet from a street if fenced.

Resident area turf
Grass up to 150 square feet per dwelling unit at multi-family residential properties, multi-family mixed use properties, or assisted living and rehabilitation centers used by tenants for recreation or leisure. May not be located in parking lots, streetscapes or other non-accessible areas.

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Las Vegas Wash, Nevada