WATER RESOURCE PLAN 2015

SOUTHERN NEVADA WATER AUTHORITY®

Little Colorado River, 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.

Las Vegas Wash , Nevada

SOUTHERN NEVADA WATER AUTHORITY

MISSION

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

GOALS

Assure quality water through reliable and highly efficient systems.

Deliver an outstanding customer service experience.

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

Develop innovative and sustainable solutions through research and technology.

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

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

Colorado River, Grand Canyon National Park

TABLE OF CONTENTS

E EXECUTIVE SUMMARY 1

1 PLAN INTRODUCTION 5

2 CURRENT PLANNING ENVIRONMENT 11

3 SNWA WATER RESOURCE PORTFOLIO 21

4 MEETING FUTURE DEMANDS 35

5 PROTECTING THE ENVIRONMENT 45

A APPENDICES 54

Colorado River, Utah

EXECUTIVE SUMMARY

SINCE ITS INCEPTION IN 1991, THE SNWA HAS WORKED TO SEEK NEW WATER RESOURCES FOR SOUTHERN NEVADA, MANAGE EXISTING AND FUTURE WATER SUPPLIES, CONSTRUCT AND MANAGE 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 more than 2 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 development of a water resource plan to be reviewed and adopted annually by the Board of Directors. The 2015 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 SNWA to meet those demands over time.

THE CURRENT PLANNING ENVIRONMENT

Beginning in 2000 and continuing today, a number of 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. By far, the most significant change affecting Southern Nevada has been the onset and persistence of drought conditions in the Colorado River Basin.

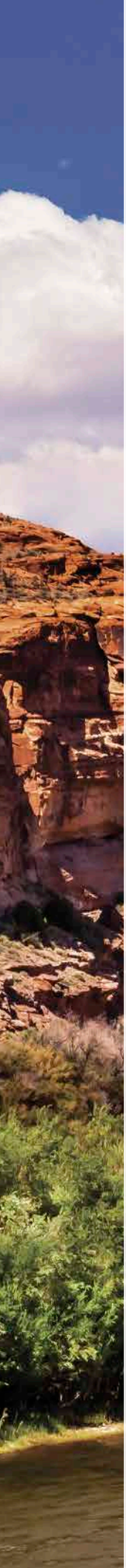
Between 2000 and 2014, snowfall and runoff into the basin were well below normal, representing the lowest 15-year average on record. As a result, the combined water storage in the Colorado River's two primary reservoirs (Lake Mead and Lake Powell) decreased to just 44 percent at the end of 2014.

Beyond the current impacts presented by drought, climate change is another unpredictable variable associated with the long-term availability of water supplies. According to the U.S. Bureau of Reclamation's 2012 Colorado River Basin Water Supply and Demand Study, the Colorado River is projected to experience a median imbalance of 3.2 million acre-feet per year (AFY) between supply and demand by the year 2060 as a result of climate change and increased demands within the basin.

In the near term, hydrologic modeling indicates a high probability that Lake Mead water levels will continue to decline. This creates two distinct challenges for Southern Nevada, which depends on the Colorado River for approximately 90 percent of its overall resource supply. Among other things, lowering Lake Mead water levels has the potential to reduce the availability of community water supplies during declared shortages and put SNWA's current Lake Mead intake pumping facilities at risk.

The current planning environment also includes uncertainty associated with long-term water demand forecasts. In 2007, the United States began to experience a severe economic disruption that lasted for several years. Southern Nevada was among the hardest hit regions in the country. While these conditions temporarily suppressed near-term population growth in Southern Nevada, long-term projections indicate the community will continue to grow in the future.

As experienced in Southern Nevada's recent past, population growth can occur much faster than predicted, or it can be drastically affected by



economic disruptions such as those experienced in the years following the downturn. As the community continues its recovery from these events, it is difficult to predict how long this recovery will take, and what impact this will have on long-term water demands.

These supply and demand considerations, as well as how they are addressed in the 2015 Water Resource Plan, are discussed further below.

SUPPLY & DEMAND

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

To meet current and future water demands, the SNWA has worked for nearly 25 years to develop and manage a flexible portfolio of water resource options that include permanent, temporary and future resources. Some of these resources are available for immediate use, such as Nevada's Colorado River allocation, Las Vegas Valley groundwater and banked resources, while others may require the construction of additional infrastructure or are pending state and/or federal review processes. The portfolio approach allows SNWA to assess its overall water resources and make appropriate decisions regarding what resources to bring online when necessary.

To reduce community water demands and improve overall efficiency, the SNWA has also developed and implements one of the most aggressive water conservation programs in the nation. Over the last decade (2002 – 2014), the region has reduced its net gallons per capita per day or net GPCD water use by 43 percent. Nevada's use of Colorado River water declined by approximately 100,000 AFY during the same timeframe, despite the addition of more than 500,000 new residents. Conservation continues to be an essential and effective demand management tool, and remains a top priority for the organization over the long-term planning horizon.

PLANNING FOR UNCERTAINTY

In 2012, the SNWA Board of Directors initiated an integrated resource planning process that included the formation of the Integrated Resource Planning Advisory Committee, comprised of diverse stakeholder groups throughout the Southern Nevada community. The 21-member committee was formed to provide recommendations on key organizational initiatives, including funding, resources, facilities, conservation and water quality. The committee met between 2012 and 2014, and presented its resources and facility recommendations to the SNWA Board in December 2014 (Appendix 2). These recommendations were adopted by the Board and have been integrated in the 2015 Water Resource Plan.

While preparing the 2015 Water Resource Plan, SNWA also considered a number of other factors related to water supply and demand conditions, including:

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

To help address these factors, the SNWA has used a scenario-based planning approach for its 2015 Water Resource Plan. Scenarios considered as part of this plan address the relative highs and lows of future water demands, as well as supply restrictions that could occur over the long-term planning horizon. The scenarios represent Southern Nevada's future water resource needs under variable supply and demand conditions. The SNWA expects water demands to fall somewhere within this range. As discussed in the chapters that follow, SNWA has sufficient permanent, temporary and future resources to meet all future planning scenarios.

The SNWA has also undertaken a number of important initiatives to help mitigate the impacts of drought and climate change in Southern Nevada.

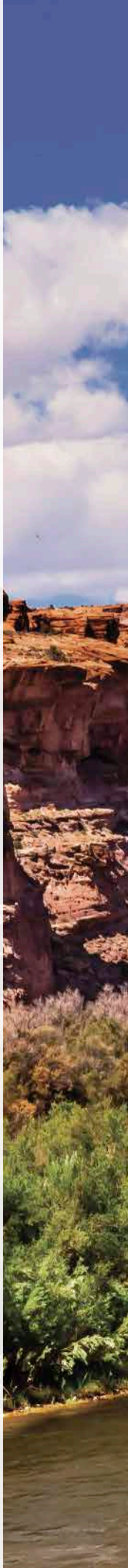
Collectively, these efforts have proved increasingly valuable as SNWA continues to work to address unprecedented drought conditions in the Colorado River Basin, as well as evolving demand forecasting uncertainties.

Among the organization's top priorities are to preserve access to Colorado River supplies through the development of new intake and pumping facilities, and to continue to identify and acquire permanent and temporary supplies that can be used to offset potential supply reductions. Other efforts include progress on water rights and environmental permitting for the development of future resources.

As of 2015, SNWA has completed the tunneling portion of its new Intake No. 3 and has started work on a new Low Lake Level Pumping Station. Together, these facilities will allow for continued access to Colorado River supplies if Lake Mead reaches levels where Intakes 1 and 2, and their associated pumping stations, become inoperable.

Meanwhile, SNWA continues to collaborate with other Colorado River Basin states to maximize the use and availability of Colorado River supplies. These collaborations have led to new temporary water supplies for Southern Nevada that can be stored in Lake Mead for future use, helping maintain Lake Mead water levels and delay shortage declarations.

The 2015 Water Resource Plan discusses these efforts in detail, and provides a comprehensive summary of SNWA's demand and supply outlook through the year 2065. As with previous plans, the SNWA will review its plan annually and make adjustments as needed.



Lake Powell, Arizona

PLAN INTRODUCTION

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

INTRODUCTION

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

In 1922, the Colorado River Compact defined the geographic areas of the upper and lower basins of the Colorado River, apportioning 7.5 million acre-feet 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, LVVWD entered into agreements with what is now known as Basic Management Inc. (BMI) for expansion of BMI'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 BMI pipeline, LVVWD initiated formal engineering studies for new facilities to import additional Colorado River water into the Las Vegas Valley from Lake Mead. This effort ultimately resulted in the construction of the Alfred Merritt Smith Water Treatment Facility and associated intake, pumping and transmission facilities (collectively referred to as the Southern Nevada Water System or SNWS), which became operational in 1971. The SNWS was first expanded in 1982 (and again in the years to follow) in response to increasing demands.

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

CREATION OF SNWA

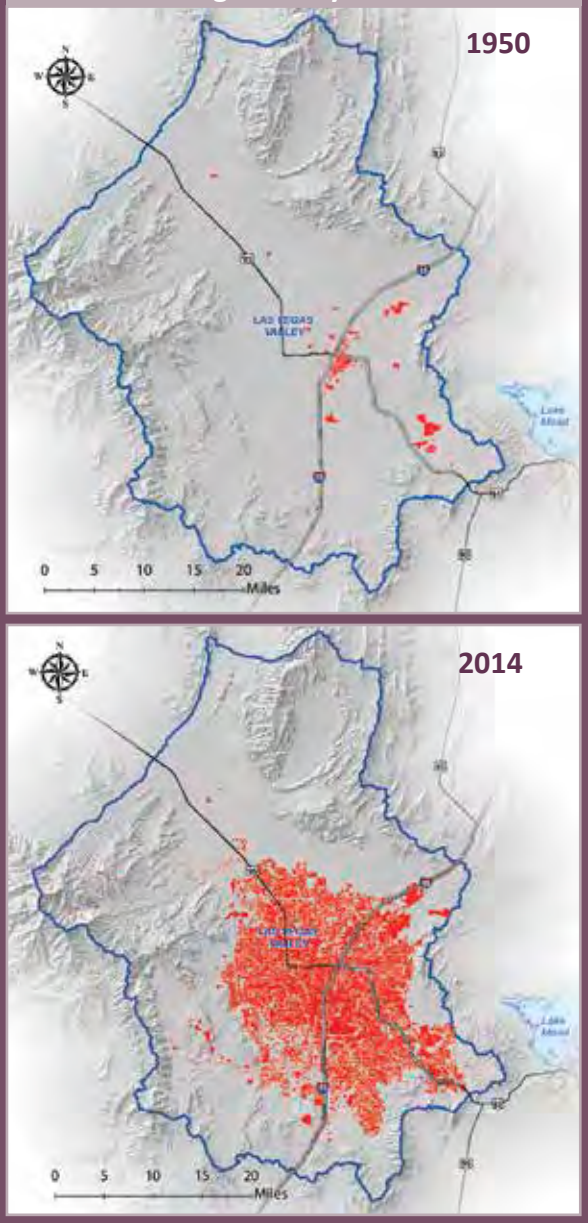
By the end of the 1980s, resource challenges had reached a critical point; with the new decade, local leaders began to aggressively explore different options for extending and managing water resources, while meeting the ongoing demands of the community.

A Century of Change

With the birth of Las Vegas in 1905 as a way station for the San Pedro, Los Angeles and Salt Lake Railroad, Southern Nevada began to attract a large number of residents and businesses. Over the next century, a series of social and economic developments—including legalized gaming, the construction of Hoover Dam, industrial production for the Second World War, development of a military air base, atomic testing, tourism and trade shows, and ongoing evolution of mega-resorts with world class retail and entertainment—steadily increased local population and associated demands for water.

From an estimated population of more than 40,000 in 1950 to more than 2 million by 2014, the Southern Nevada region has experienced change faster than almost any other region in the nation during this time period. Population density in Southern Nevada is the highest in the interior western U.S.[4]

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 more than 2 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, 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, 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, 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 a number of improvements and expansions to these facilities over the years to increase capacity to 900 Million Gallons per Day (MGD). Pumping facilities and state-of-the-art treatment and laboratory facilities were also constructed and updated to ensure the availability of high-quality reliable water supplies. These efforts were phased, coming online just in time to meet demands.

FIGURE 1 **SNWA Purveyor Service Areas**

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

Planning for the Future

The SNWA's 2015 Water Resource Plan is based on an Integrated Resource Planning Process that involved public stakeholders.

In 1996, the SNWA Cooperative Agreement was amended to require adoption of a Water Resource Plan. The SNWA's first Water Resource Plan was adopted in 1996;[6] the SNWA has reviewed its plan annually since then, adopting revisions as needed.

The plan reflects changing developments in Southern Nevada's overall water resource picture. Since the plan's inception, those developments have come principally from water demand changes as well as from landmark changes in rules, agreements or other factors affecting the region's water supplies.

In 2014, SNWA's 21-member Integrated Resource Planning Advisory Committee was asked to address issues related to the Colorado River drought, the effects of climate change, and the effects of declining water reservoir levels on the reliability of Southern Nevada's municipal water system. The committee was formed in 2012 to assist SNWA with its long-term planning efforts and was comprised of citizens representing diverse areas of the community. Phase 1 and 2 committee recommendations were presented to the SNWA Board of Directors in September 2013 and December 2014, respectively.

As discussed in Chapter 2, SNWA recently completed construction of a new raw water intake (Intake No. 3) and is working to construct associated pumping facilities at Lake Mead to preserve access to existing supplies in response to low Lake Mead water levels due to extraordinary drought conditions in the Colorado River Basin.

Water Conservation

The SNWA and its member agencies have worked diligently over the years to maximize the availability of existing water supplies and reduce overall water demands. The community's first water conservation plan was adopted in 1995;[5] since then, the community has consistently set and achieved aggressive water conservation goals. As of 2015, the community remains on target to achieve its current goal.

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

2015 Water Resource Plan

The SNWA's 2015 Water Resource 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 Water Budget
- 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

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 2015 SNWA Water Resource Plan incorporates the recommendations from SNWA's most recent Integrated Resource Planning Advisory Committee, which were approved by the SNWA Board of Directors in December 2014 (see Appendix 1 and 2).

CHAPTER SUMMARY

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

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

These efforts will continue to be of paramount importance in the years to come, particularly as climate change and drought are anticipated to reduce the availability of supplies, and as the Southern Nevada region rebounds from the effects of economic downturn. These challenges, as well as 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 SNWA plans to meet current and future demands (Chapter 4); and a discussion on SNWA environmental initiatives underway to support water resource development and management efforts (Chapter 5).

ENDNOTES

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

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

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

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

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

Lake Mead, Nevada

CURRENT PLANNING ENVIRONMENT

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

INTRODUCTION

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

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

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

The SNWA is well prepared to respond to evolving conditions as they arise through close monitoring, proactive planning and adaptive management. As discussed in the latter portion of this chapter, shortages and declining lake levels associated with drought in the Colorado River Basin are being addressed to avoid impacts to current customers.

DROUGHT

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

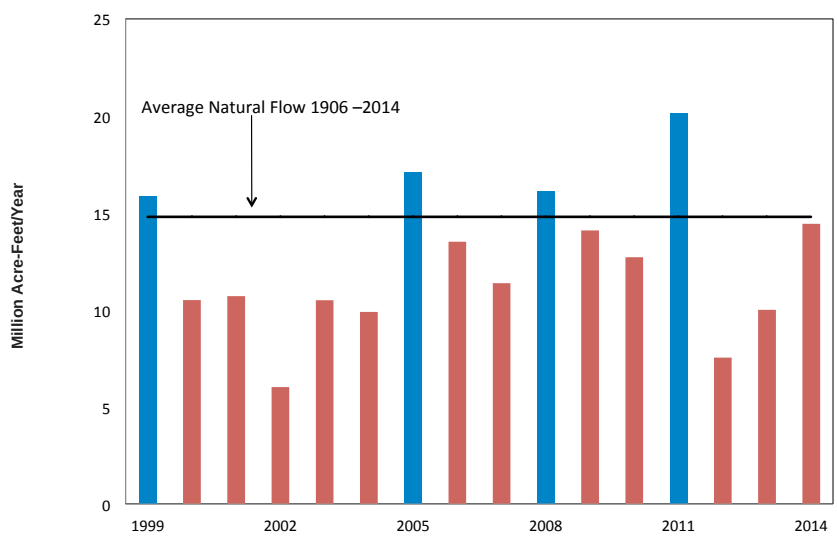


FIGURE 2.1 **Annual Colorado River Natural Flow 1999–2014**

Between 2000 and 2014, snowfall and runoff into the basin were well below normal, representing the lowest 15-year average on record (Figure 2.1).[1] As a result, combined water storage in the Colorado River's two primary reservoirs (Lake Mead and Lake Powell) decreased to just 44 percent at the end of 2014.[2]

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

Potential Supply Impacts

In 2007, the Secretary of the Interior issued a Record of Decision for the Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, also referred to as "Interim Guidelines."[3] Among other things, the Interim Guidelines established how shortages in the lower basin will be implemented, based upon Lake Mead's elevation.

According to the Interim Guidelines, the Secretary of the Interior will make a shortage declaration based on a projection of Lake Mead water levels as determined by the U.S. Bureau of Reclamation's Colorado River modeling efforts. The forecast is reviewed annually in August; if Lake Mead is forecasted to be at or below 1,075 feet on January 1 of the following year, a shortage declaration will be made.

Under a shortage declaration, the amount of Colorado River water available for use to the states of Nevada and Arizona will be reduced as shown in Figure 2.2. A shortage declaration will also restrict the use of other temporary supplies as identified in SNWA's Water Resource Portfolio (Chapter 3).

LAKE MEAD WATER LEVEL	NEVADA SHORTAGE	ARIZONA SHORTAGE
1,075 - 1,050 FT.	13,000 AFY	320,000 AFY
1,050 - 1,025 FT.	17,000 AFY	400,000 AFY
BELOW 1,025 FT.	20,000 AFY	480,000 AFY
	RECONSULTATION	

FIGURE 2.2 **Interim Guidelines Shortage**

Modeling efforts conducted by the U.S. Bureau of Reclamation in August 2015 indicate an approximate 20–60 percent probability of shortage in years 2017–2020. There is a high probability (ranging from 60 to 70 percent) in the years thereafter.[4] The model applies historical flows to simulate future conditions, representing both wet and dry years on the Colorado River.

Potential Facility Impacts

Lake Mead's surface elevation declined by more than 130 feet between 2000 and the end of 2014,[5] reaching its lowest level to date since the lake began filling in the 1930s (Figure 2.3). Based on current and forecasted conditions, there is a high probability that Lake Mead water levels will continue to decline, potentially reaching an elevation of 1,000 feet or lower within the next decade.

Currently, SNWA's intake and pumping facilities have a combined water supply and treatment capacity of 900 MGD, consisting of two water treatment facilities, three

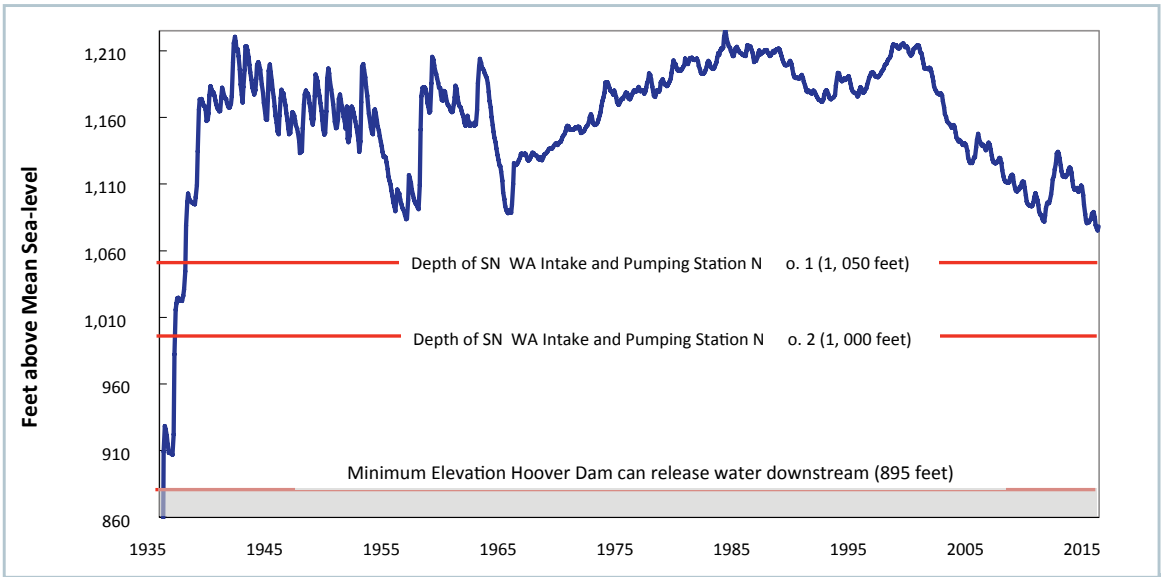


FIGURE 2.3 **Historical Lake Mead Elevations**

raw water intakes and associated pumping facilities. These facilities are limited in their operating range relative to Lake Mead elevation. As Lake Mead approaches an elevation of 1,050 feet, Intake No. 1 and Pumping Station No. 1 will become inoperable. If this happens, Intakes Nos 2 and 3 and Pumping Station No. 2 will be used to meet Southern Nevada's water needs down to a Lake Mead elevation of 1,000 feet.

A new Low Lake Level Pumping Station is being constructed to preserve Southern Nevada's access to Colorado River resources below 1,000 feet.

CLIMATE CHANGE

In addition to droughts, which are temporary and cyclical events, climate change is expected to have lasting effects on the availability of future water supplies. Mounting scientific evidence indicates that climate conditions are changing due to global warming, primarily a result of increased concentrations of greenhouse gases (GHGs) in the Earth's atmosphere. Since the late 19th century, observations indicate that global mean annual air temperatures have warmed 1.5 degrees Fahrenheit.[6]

Consistent with global trends, warming has also occurred in the southwestern United States. While climate change models predict that warming trends will continue, the magnitude of change at a given location will depend in part on global mitigation efforts to reduce GHG emissions (Figure 2.4).

Compared to relatively uniform projected temperature increases in the southwest, precipitation patterns are highly variable and show substantial shifts in where and how the precipitation falls. In addition, rising temperatures will cause a greater percentage of precipitation to occur in the form of rain rather than snow, and snowpack will melt earlier and more rapidly due to increasing temperatures. In some areas, this may result in significant reductions in supply, while other areas experience greater frequency and severity of flood events.[7]

From a resource planning perspective, the most direct climate change impact will revolve around water quantity, particularly the form and distribution of precipitation. Rising air temperatures can also have an effect on soil moisture, and ultimately reduce the volume and timing of snowmelt runoff. In addition, changes to water quality from rising stream flow temperatures and changes in reservoir volumes are also important considerations.

Climate Change Assessments

In 2014, two important climate change studies were released: The U.S. Global Change Research Program's National Climate Assessment and the Intergovernmental Panel on Climate Change's (IPCC) Climate Change 2014 Impacts, Adaptation, and Vulnerability report.[8] Each of these studies concludes that climate change is occurring and is expected to significantly affect water resources.

According to the National Climate Change Assessment, "future droughts in the Colorado River basin are projected to be substantially hotter, more frequent and longer lasting than in the instrumental record."

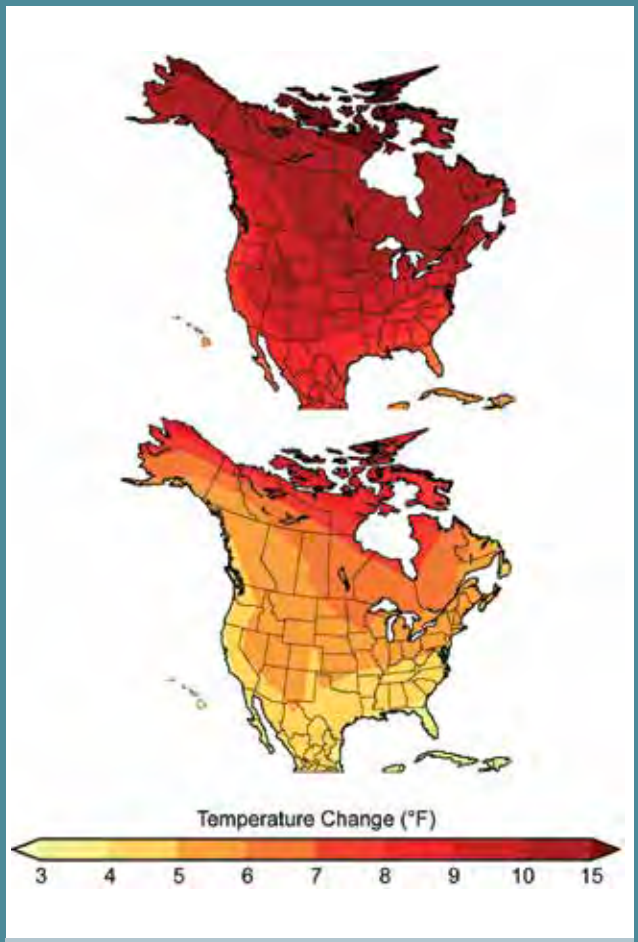


FIGURE 2.4 **CLIMATE CHANGE**
Range of possible future warming in North America 1999 – 2100 under high and low GHG emission scenarios. [9]
(2014) National Climate Assessment.

To help inform future decision-making efforts in the Colorado River Basin, the Bureau of Reclamation, in partnership with the seven states and numerous other stakeholders, initiated a comprehensive water supply and demand analysis. The process represented a concerted effort by Colorado River stakeholders to better understand possible future water supply and demand imbalances.

This effort resulted in the Colorado River Basin Water Supply & Demand Study (Colorado River Basin Study),[10] released in 2012. The study considered a range of supply and demand projections using the best available climate change science and global models to evaluate projected increases in temperature by 2060, and changes in precipitation over the same period. The combined impact of projected changes in air temperature and precipitation translated into diminished stream flows in the Colorado River watershed over the mid- to long-term, worsening over time. The study recognizes that climate change will not only affect the amount of water available for use, but is also likely to affect overall water demands. As temperatures warm, water evaporation and evapotranspiration rates will increase, resulting in higher water demands for agricultural irrigation and landscaping uses.

Potential Supply and Demand Impacts

The Colorado River Basin Study projects a median imbalance of 3.2 million AFY in Colorado River supply and demand by the year 2060 through a combination of climate change and increased demand.[11] In Southern Nevada, the impacts of climate change are expected to be similar to that of drought. This includes extended durations of low Lake Mead elevations, water quality changes, possible reductions of Colorado River resources, and potential increases in water use to compensate for warmer and drier conditions.[12]

ECONOMIC DECLINE AND RECOVERY

Southern Nevada's economic situation changed drastically in 2007, when the national economy began to experience its most significant decline since the 1930s. Southern Nevada was hit harder than almost any other region in the nation. This period of recession marked the first time in decades that the Las Vegas area experienced a sustained period of little or no growth (Figure 2.5).[13] For years following the downturn, gaming and tourism revenues declined followed by a record spike in unemployment. Most new residential and commercial development projects came to a halt and home foreclosures flooded the real estate market.

Between 2002 and 2014, per capita water use dropped significantly, mostly due to the community's early drought response efforts. In contrast to voluntary drought response efforts, drying pools and landscapes at foreclosed properties provided strong visual cues that water use patterns had also changed as a result of economic pressures.

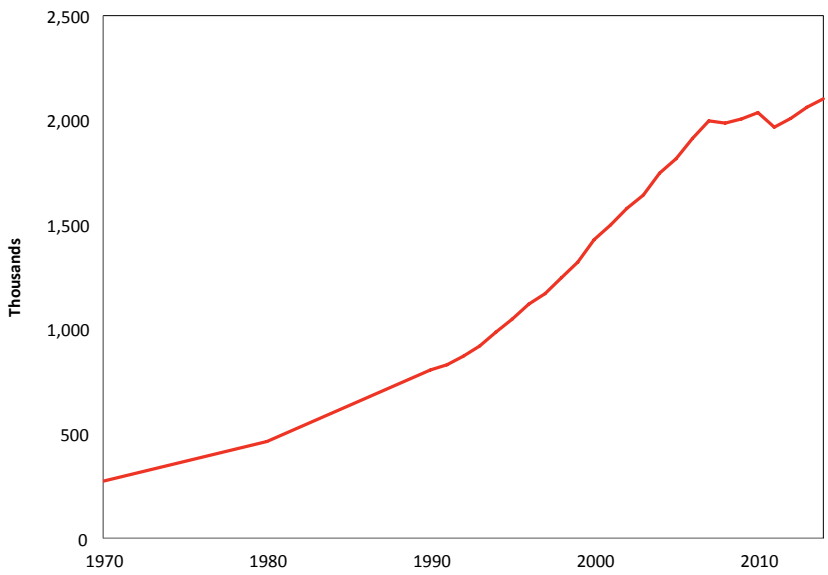


FIGURE 2.5 **Historical Clark County Population**

However, economic conditions have improved steadily in the region over the past three years. According to the U.S. Bureau of Economic Analysis, the Las Vegas metropolitan area's economic output rose 2 percent per year between 2011 and 2013.[14] As of 2014, building permits were also on the rise. According to the Clark County Development Services Department, the number of permits issued that are likely to generate new water demands increased by 22.2% year-over-year between 2012 and 2013.[15]

Potential Supply and Demand Impacts

The University of Nevada Las Vegas Center for Business and Economic Research (CBER) forecasts that Southern Nevada population growth will continue, although actual growth rates will occur faster or slower than forecasted as demonstrated by Southern Nevada's unpredictable past.[16] While the region's economy appears to be rebounding, it is difficult to predict future population changes and how these changes will translate into water demands over the long-term planning horizon.

ADAPTIVE MANAGEMENT

Adaptive management relies on continuous assessment, flexible planning and action. As the region's wholesale water provider, 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 the potential to impact water facilities, water supply availability, water quality and—to some extent—long-term water demands. In addition, factors associated with Southern Nevada's local economy and its rate of recovery make predicting future water demands challenging, particularly in light of the region's previous growth history.

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

Adaptive Management in Action

The SNWA took a number of adaptive management steps to reduce impacts to water supplies and facilities in response to persistent drought conditions. These include:

- Reduced consumptive use of Colorado River supplies between 2002 and 2014 by nearly 100,000 AFY (32 billion gallons), despite the addition of 500,000 new residents.
- Significantly increased water banking, storage and recharge efforts, resulting in nearly the 6-year storage equivalent of Nevada's Colorado River allocation.
- Retrofitted existing and added new intake and pumping facilities in response to declining Lake Mead water levels and constructed new facilities.
- Initiated legal and environmental permitting associated with the development of in-state groundwater resources.
- Acquired and developed approximately 40,000 AFY of permanent and temporary water resources in Clark County through resource lease and purchases on the Virgin River, Muddy River and in Coyote Spring Valley.

Intake No. 3 Construction

Lake Mead Facility Improvements

To mitigate impacts associated with a potential Lake Mead water level decline below 1,000 feet and potential water quality concerns during low reservoir conditions, the SNWA constructed a new intake and initiated construction of pumping facilities that will ensure continued access to Colorado River resources. These facilities are being developed to address current and future projected drought conditions, as well as the potential effects of long-term climate change.

In 2005, the SNWA authorized construction of a new Intake No. 3. The new intake is at an elevation of 860 feet, approximately 35 feet below the minimum elevation that Hoover Dam can release water downstream. In May 2015, the SNWA awarded a pre-construction services contract to a construction contractor for the Low Lake Level Pumping Station, which will work in tandem with Intake No. 3. These efforts are based in part on the recommendation of SNWA's Integrated Resource Planning Advisory Committee (IRPAC), which determined that the risk of Lake Mead's elevation falling below 1,000 feet is not acceptable for Southern Nevada due to the potential impacts on water delivery and resource availability.

New intake and pumping facilities will preserve existing capacity and will allow SNWA to pump from a Lake Mead elevation of 875 feet. Work on Intake No. 3 will be complete in 2015; the new pumping station is expected to be complete and operational by 2020.

Water Conservation

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

While there is a high potential for shortages to be declared over the next several years, SNWA does not anticipate any near-term customer impacts. This is due in large part to the success of local conservation efforts. The Southern Nevada community took both serious and sustained action as the drought took hold in the early 2000s. These efforts have provided a significant buffer against water supply impacts over the near-term planning horizon. As of 2015, Southern Nevada's use of Colorado River resources is well below any restrictions that could be imposed under the current Interim Guidelines.

Interstate Collaboration

The Colorado River Basin states are also working collaboratively with federal partners to protect water supply and facility access for lower basin users. These efforts range in nature from contributing funds for cloud seeding designed to increase the potential yield of snowfall in the Colorado River Basin, to system conservation efforts that benefit the system as a whole.

In 2014, the SNWA entered into two agreements (discussed below) to help bolster reservoir elevations. These efforts are intended to forestall the declaration of and reduce the severity of shortage, and will help stabilize Lake Mead water levels. This will provide the SNWA with a buffer of time as the organization works to complete development of its Low Lake Level Pumping Station.

Pilot System Conservation Agreement. The SNWA, Department of the Interior and other Colorado River water users have initially committed to fund up to $14 million in 2015 and 2016 for conservation projects that benefit the Colorado River system.[17] In accordance with a 2014 agreement, project partners evaluate and select projects, compensating users for voluntary water use reductions. Projects being considered include land fallowing, water efficiency, desalination, reuse and other conservation projects.

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

Drought Response Actions. The SNWA, Department of the Interior and other lower basin water users and states set a goal of developing 1.5 to 3 million acre-feet of water in Lake Mead before 2020 to serve as a "protection volume." This water is intended to help stabilize water levels.

As part of a 2014 memorandum of understanding the parties will use their best efforts to create a total of 750,000 acre-feet between 2014 and 2017.[18] The SNWA's commitment to the program is 45,000 acre-feet. Southern Nevada's current water

use is well below the state's 300,000 AFY Colorado River allocation and SNWA plans to meet its commitment by foregoing offstream banking of its unused apportionment. During this period, SNWA does not anticipate water demands to exceed SNWA's remaining Colorado River allocation.

Moving Forward Process. To support continued work associated with the 2012 Colorado River Basin Study, the Bureau of Reclamation initiated the "Moving Forward" effort. This is a process designed to inform future Colorado River management efforts. As part of the process, three workgroups were formed to investigate various aspects of: municipal and industrial conservation and water reuse; agricultural conservation, productivity and water transfers; and environmental and recreational flows. A Phase I report was released in May 2015.[19] Phase II will further expand upon these efforts by implementing pilot projects.

Water Banking Efforts. Over the last several years, the Seven States have worked collaboratively to store or "bank" available Colorado River water and other unused supplies through various storage efforts. As of 2015, SNWA has banked resources in the Southern Nevada Water Bank, in the Arizona and California water banks, and in Lake Mead (in the form of Intentionally Created Surplus). As discussed in Chapter 3 and to the extent possible, SNWA will continue water banking efforts to help offset potential supply shortages associated with drought and climate change, to help meet future demands and to help stabilize Lake Mead water levels.

Applying Best Available Climate Science

To better understand and adapt to climate change effects on water-related infrastructure and water resources, SNWA initiated collaborative efforts with both climate scientists and other water agencies. The SNWA was recently awarded a WaterSMART grant from the Bureau of Reclamation to evaluate potential changes in Lake Mead water quality using SNWA's advanced Lake Mead model. The Lake Mead study considers potential impacts of low lake elevations and increasing air temperatures due to climate change.[20]

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

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

Supply and Demand Forecasting

The SNWA has taken a scenario-based planning approach with its 2015 Water Resource Plan to address possible changes to water supply availability and demands. As detailed in Chapter 4, SNWA has developed a range of demands that brackets what is likely to be experienced during the planning horizon.

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

Lake Mead Water Level Decline

CHAPTER CONCLUSION

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

While the water supply challenges presented in this chapter need to be taken seriously, SNWA has worked diligently to ensure both resources and facilities are available to meet the community's short- and long-term water resource needs.

By applying adaptive management—evaluating, planning and action—SNWA is well prepared to meet whatever challenges lie ahead, including efforts to:

- Continue setting and achieving water conservation goals through aggressive water conservation efforts;
- Develop new intake and pumping facilities at Lake Mead to preserve Colorado River supply access in the event that existing facilities become inoperable;
- Collaborate with Colorado River stakeholders for conservation and flexible use of Colorado River supplies (for example, water banking), as well as protect Lake Mead's elevation against future water level declines;
- Continue to secure temporary resources to offset long-term impacts associated with shortage while working to bring other permanent resources online when needed;
- Address uncertainty by planning to a range of future supply and demand possibilities; and
- Collaborate with climate scientists and other agencies to understand and evaluate climate change, and its potential impacts to water supplies and facilities.

Hoover Dam Spillway, 2013

ENDNOTES

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4 The U.S. Bureau of Reclamation developed the Colorado River Simulation System (CRSS), a long-term planning and operations model. The probabilities of shortage correspond with August 2015 CRSS results, applying historical Colorado River flows, provided by U.S. Bureau of Reclamation to Southern Nevada Water Authority August, 2015.

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

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

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

Colorado River, Utah

SNWA WATER RESOURCE PORTFOLIO

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

INTRODUCTION

Since 1991, SNWA has worked to establish and manage a flexible portfolio of water resources, an approach commonly used in resource planning. Having a portfolio of resources allows SNWA to assess its overall water resource options and to make appropriate decisions regarding which resources to develop and use when necessary. Key factors considered in determining acquisition, priority of development, and use include the availability, accessibility, cost and need of the resource. Water supply diversification is also an important consideration. Having a portfolio of resource options helps to offset risks typically associated with dependence on any single resource.

The SNWA's water resource portfolio, along with associated facility planning and permitting efforts, provides SNWA flexibility in adapting to changing supply and demand conditions, and helps ensure that community water demands can be met. Resources in the portfolio are described in consumptive net use volumes and are organized into three categories:

- Permanent Resources
- Temporary Resources
- Future Resources

PERMANENT RESOURCES

For the purpose of this plan, "Permanent Resources" are resources 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 (including return-flow credits); Tributary Conservation Intentionally Created Surplus (ICS) and Imported ICS; permitted groundwater rights in the Las Vegas Valley; and reclaimed water. Descriptions of these resources and details regarding their availability are discussed in the following section.

Colorado River—Nevada Basic Apportionment

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

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

With the creation of the SNWA in 1991, these agencies agreed to collaboratively manage Southern Nevada's current and future water resources, representing a significant shift in the overall management of the region's water supply. In the years that followed, 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] SNWA's total estimated Colorado River entitlement is 272,205 AFY of Nevada's 300,000 AFY allocation. Nevada's remaining apportionment is contracted to other users.[2] SNWA also holds contracts for any surplus Colorado River water available to Nevada.

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

SNWA may also choose to leave a portion of Nevada's unused allocation in Lake Mead to help alleviate the impacts of drought conditions and avoid critical Lake Mead elevations.

Return-Flow Credits. The BCPA defines all Colorado River apportionments in terms of "consumptive use." Consumptive use is defined as water diversions minus any water that is returned to the Colorado River. These returns are also referred to as "return-flow credits." With return-flow credits, Nevada can divert more than its 300,000 AFY apportionment, as long as there are sufficient flows returned to the Colorado River to ensure the consumptive or "net use" is no greater than 300,000 AFY.[3]

Return-flow credits constitute a significant portion of Southern Nevada's permanent Colorado River resource, expanding SNWA's Colorado River supply allocation by approximately 75 percent. Nevada's Colorado River return-flows consist mostly of highly-treated wastewater that is returned to Lake Mead via the Las Vegas Wash.

Flood Control Surplus. If Lake Mead is full or nearly full, the Secretary of the Interior can declare a flood control surplus, which allows the 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.[4]

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

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," SNWA is allowed to consumptively use up to 400,000 AFY of Colorado River water when Lake Mead is above 1,145 feet. The 2015 Water Resource Plan does not assume availability or use of domestic surplus water during the planning horizon. However, SNWA will utilize this resource as a priority, when it is available.

Intentionally Created Surplus

In 2007, as part of the Interim Guidelines, SNWA entered into a series of agreements that ensure the availability and delivery of water resources developed under provisions for Intentionally Created Surplus (ICS).[5] As discussed below, Tributary Conservation ICS and Imported ICS enable SNWA to develop some of its surface and groundwater rights that are located in Nevada, near the Colorado River. The SNWA may develop these rights as needed by allowing them to flow into Lake Mead in exchange for Tributary Conservation ICS and Imported ICS credits.

Tributary Conservation and Imported ICS credits can be used during the year created and under any operating condition, including shortage (taken as Developed Shortage Supply or "DSS" during a declared shortage).[6] As required by the Interim Guidelines, these resources are subject to a one-time deduction of five percent for the benefit of Lake Mead system storage. As discussed in the "Temporary Resources" section on the following pages, water that is not used in the year it is created is converted to Extraordinary Conservation ICS. When needed, the credits will be withdrawn as Colorado River water through SNWA facilities at Lake Mead. Resources that are diverted can be returned to the system for return-flow credits.

Tributary Conservation ICS. The SNWA is allowed to develop the portion of its Muddy and Virgin River surface water rights that have a priority date that precedes the BCPA (pre-1929 rights) as Tributary Conservation ICS. The SNWA can develop up to 50,000 AFY of Tributary Conservation ICS credits. To date, approximately 14,200 AFY of permanent rights have been acquired. In addition to its permanent rights, SNWA has acquired approximately 13,000 AFY of leased rights, with terms of use ranging from two to 20 years. The SNWA anticipates 30,000 AFY of Tributary Conservation ICS will be developed for use over the planning horizon.

Imported ICS. The SNWA may develop its Coyote Spring Valley groundwater rights as Imported ICS. These resources will be pumped from the aquifer and conveyed to Moapa Valley Water District and Muddy Valley Irrigation Company facilities via SNWA's 15-mile pipeline. Under various agreements, these entities will convey the water to the Muddy River, which flows into Lake Mead, for ICS credit.

Up to 15,000 AFY of water can be developed as Imported ICS. The SNWA has acquired 9,000 AFY of permitted groundwater rights in Coyote Spring Valley. The SNWA anticipates 9,000 AFY of Imported ICS will be developed as needed over the planning horizon.

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.[7]

Of the seven SNWA member agencies, the LVVWD and North Las Vegas have permanent groundwater rights totaling 40,629 and 6,201 AFY, respectively. These two entities operate about 100 permitted municipal wells in the Las Vegas Valley.

The municipal groundwater rights of the SNWA member agencies are among the most senior groundwater rights in the Las Vegas Valley. As such, these rights are protected even though new rights were granted to other users. Groundwater resources remain a critical component of the SNWA Resource Plan.

Water Reuse

The term water reuse generally means to recycle wastewater to support a secondary use. In Southern Nevada, 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 or park irrigation. Indirect reuse consists of recycling water by way of treatment and release to the Colorado River for return-flow credits.

The City of 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 indirect reuse.

Approximately 22,000 AFY of water is directly reused in Southern Nevada for golf course irrigation, power plant cooling, sand and gravel operations, and municipally operated common area landscape irrigation. Indirect reuse accounts for return-flow credits associated with all SNWA Colorado River water resources.

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. 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.

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 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.[8]

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

Intentionally Created Surplus

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

ICS was instituted to encourage the efficient use and management of Colorado River water and to increase the water supply in Colorado River system reservoirs. The creation of ICS helps to reduce the likelihood, magnitude and duration of shortages in the Lower Basin.

Efforts to help stabilize Lake Mead water levels are of key importance to the SNWA—a new intake has been constructed and new pumping facilities are planned to allow for deeper water access in the event that SNWA's upper intakes become inoperable.

Map of Virgin/Muddy Rivers & Coyote Spring

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.

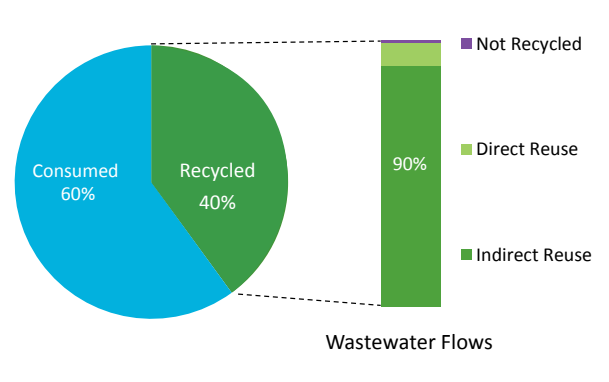

FIGURE 3.1 **SNWA Water Use and Recycling**

Reuse of In-State Groundwater Resources

The water resources described in this chapter have generally been quantified and discussed based on consumptive use volumes. Water accounting for return-flow credits, which extends SNWA's diversions of Colorado River water, includes provisions for the reuse of imported in-state groundwater resources. Under these provisions, in-state groundwater resources are similarly extended by approximately 75 percent.

TEMPORARY RESOURCES

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

For the purpose of this plan, "Temporary Resources" are defined as banked resources. As part of its overall water resource strategy, SNWA reserves water in years when Nevada's Colorado River allocation exceeds the community's demands. 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, SNWA stores banked resources locally, as well as through banking agreements with other states.

Southern Nevada Water Bank

As of 2014, SNWA has accumulated approximately 337,000 acre-feet of water stored in the Las Vegas Valley aquifer for future use through an agreement with LVVWD. SNWA may recover water banked under this agreement in any water supply condition, including shortage. This plan assumes a maximum recovery rate of 20,000 AFY.[9]

California Water Bank

Between 2004 and 2012, SNWA entered into various agreements that allow it to store Nevada's unused Colorado River water in California. As of 2014, Nevada has banked more than 205,000 acre-feet of water in California. This plan assumes a recovery up to 30,000 AFY during normal and shortage conditions, subject to agreement terms.[10]

Arizona Water Bank

In 2013, SNWA approved an amendment to the 2001 water banking agreement with the Arizona Water Banking Authority.[11] Based on the amended agreement, SNWA stored approximately 601,000 acre-feet of Colorado River water underground in Arizona's aquifers for SNWA's future use. Additional water can be banked on a pay-as-you-go basis up to 1.25 million acre-feet.

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

Intentionally Created Surplus

The SNWA has participated in a number of efforts to expand its portfolio of temporary resources under provisions specified in the Interim Guidelines for Intentionally Created Surplus.

As discussed earlier in this chapter, the Interim Guidelines created several forms of Intentionally Created Surplus: Tributary Conservation ICS and Imported ICS (discussed under "Permanent Resources"), as well as System Efficiency ICS and Extraordinary Conservation ICS. In 2012, an additional form of ICS was created as part of an international pilot program, referenced here as Bi-National ICS.

System Efficiency ICS. In 2007, SNWA collaborated with the 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, helping to bolster Lake Mead water levels. System Efficiency ICS can not be used under a Colorado River shortage condition.

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

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

Extraordinary Conservation ICS. Tributary Conservation and Imported ICS credits are converted to Extraordinary Conservation ICS credits if they are not used in the year they are created. Under the Interim Guidelines, the SNWA can accumulate up to 300,000 acre-feet of credits. These ICS credits are banked in Lake Mead and are reduced by 3 percent each year to account for evaporation losses.

Unlike Tributary Conservation and Imported ICS, Extraordinary Conservation ICS is not available during declared shortages. As of 2014, SNWA has stored approximately 162,000 acre-feet of Extraordinary Conservation ICS credits. Due to restrictions during shortage, SNWA does not assume use of this resource during the planning horizon. However, the SNWA will utilize this resource as needed if and when it is available.

Recharge & Banking

Artificial Recharge Well

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.[12] Artificial recharge involves the 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.

The LVVWD recharge/recovery wells have a total injection capacity of over 100 million gallons per day making it the largest recharge program of its kind in the world. The SNWA administers the Las Vegas Valley Groundwater Management Program, which includes a program to purchase artificial recharge credits and ensure the associated volume remains in the aquifer to protect against unreasonable water level declines.[13]

Bi-National ICS. In 2012, the United States and Mexico established Minute 319 to the 1944 U.S./Mexico water treaty. The historic Minute 319 and related agreements define Colorado River deliveries to Mexico under both high- and low-reservoir conditions. It also allows Mexico to defer its Colorado River water deliveries and to store water in Lake Mead. The agreement helps to maintain Lake Mead water levels, delay potential shortages, and creates additional certainty for all water users particularly during shortages.

Minute 319 also allows the SNWA to invest in Mexico's infrastructure improvements in exchange for Bi-national ICS credits. This accord is part of a pilot program that also created a "pulse flow" to the Colorado River Delta in 2014. Before the expiration of the Minute, SNWA will obtain 23,750 acre-feet of Bi-National ICS; these credits cannot be used during shortage conditions.

FUTURE RESOURCES

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

Water resource conditions have changed significantly over the years for many of the western states, including Nevada. During that time, SNWA has worked to implement water resource strategies that maximize use of permanent and temporary resources, delaying the development of costly facilities that may not be needed in the future.

Development of the Future Resources discussed below will require additional environmental permitting as well as project design and construction of water delivery infrastructure. In some cases, litigation will be necessary. For planning purposes, SNWA estimates a 10-year lead time is needed from project authorization by its Board of Directors to first water delivery.

Desalination

The SNWA is engaged with other Colorado River Basin states and water users, the Bureau of Reclamation and the country of Mexico to actively explore and investigate potential seawater and brackish water desalination projects in the state of California and in the country of Mexico. One example includes ongoing exploration for operation of the Yuma Desalting Plant to treat brackish water. Another project being actively evaluated is a seawater desalination plant at Rosarito Beach in Mexico.

The latter was included as a potential Bi-national project under Minute 319 with Mexico.

In-State Groundwater

The SNWA has a number of groundwater permits and applications in southern and eastern Nevada based on applications filed by the LVVWD in 1989. Many of these applications have been permitted by the Nevada State Engineer in accordance with Nevada Water Law, while others require further review and analysis. Figure 3.2. depicts the hydrographic areas associated with these permits/applications. Below is a summary of each resource and its current standing.

Garnet and Hidden Valleys. The SNWA has permitted rights to 2,200 AFY of groundwater in Garnet and Hidden valleys. The majority of these rights have been leased to dry-cooled power plants located in Garnet Valley. The remaining resources are anticipated to be developed as needed within these valleys.[14]

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 SNWA rights to 10,605 AFY of groundwater in these basins. The SNWA is working to develop options for delivery of 8,018 AFY of the groundwater rights from Three Lakes Valley North and South and Tikaboo Valley South into the northwest portion of the Las Vegas Valley.

Indian Springs. The SNWA holds applications filed in 2004 for 16,000 AFY of groundwater in Indian Springs. The SNWA intends to pursue the development of these resources when needed to help meet long-term demands.

Delamar, Dry Lake, Cave and Spring Valleys. In 2012, the Nevada State Engineer issued a ruling on SNWA's 1989 groundwater applications in Spring, Delamar, Dry Lake and Cave valleys. The ruling granted SNWA 61,127 AFY from Spring Valley and 22,861 AFY from Delamar, Dry Lake and Cave valleys.

The 2012 ruling requires the 1989 groundwater permits in Spring Valley to be developed in three stages, limited to 38,000 AFY for the first eight years, 50,000 AFY for the next eight years, and 61,127 AFY in the years thereafter. In addition, SNWA committed to the U.S. Bureau of Land Management that groundwater development in Cave Valley would occur in three stages, limited to 2,600 AFY for the first five years, 3,900 AFY for the next five years,

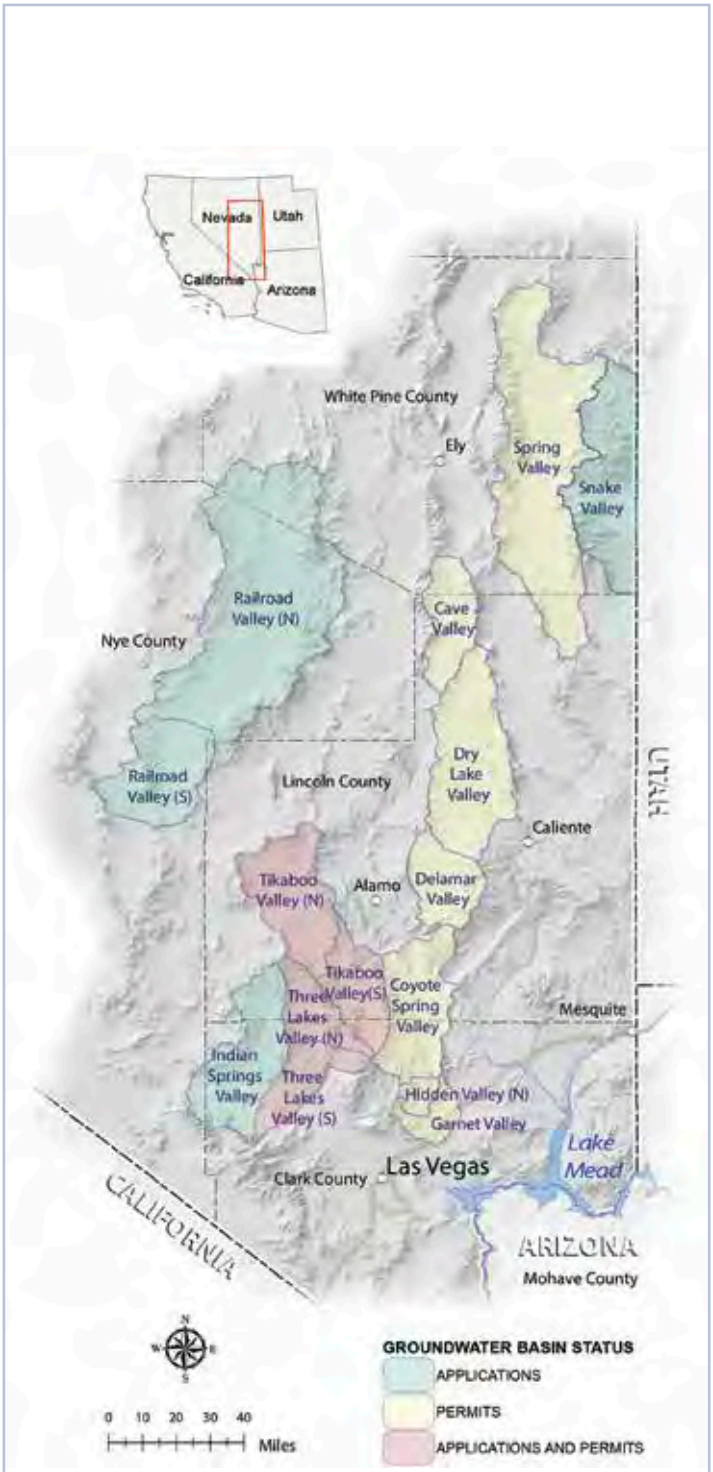

FIGURE 3.2 **In-State Groundwater Resources**

Nevada Water Law

Nevada water law is considered one of the most comprehensive water laws in the west.[15]

Unlike Colorado River water, which is managed by the U.S. Bureau of Reclamation, groundwater and surface water in Nevada (excluding the Colorado River) is administered and managed by the state. Nevada's first water law was passed in 1866 and has been amended many times since then.

The Nevada Division of Water Resources, also known as the Office of the State Engineer, regulates these supplies. The Office was created in 1903 to protect existing water rights and to bring about a better method for utilizing the state's water resources.

Today, Nevada water law serves the people of the state by providing the rules for acquiring and maintaining a water right, as well as guidelines for the State Engineer in managing the state's valuable water resources. Nevada water law follows the doctrine of prior appropriation, or "first in time, first in right"—meaning the first person to file on a water resource for beneficial use is typically considered first for a permanent right to water, subject to the Nevada State Engineer's determination of available appropriated water.

and 5,235 AFY in the years thereafter. Although the permits are subject to ongoing litigation, the SNWA continues to maintain its permitted rights and performs hydrologic and biologic monitoring to satisfy reporting requirements as set forth in State Engineer approved monitoring plans.

Additionally, SNWA also holds groundwater rights to more than 8,000 AFY in Spring Valley that were acquired through the acquisition of its Great Basin Ranch holdings (see Chapter 5).The SNWA intends to pursue development of these resources when needed to supply future demands.

Snake Valley. The SNWA currently holds applications for approximately 50,678 AFY in Snake Valley. The Lincoln County Conservation, Recreation, and Development Act of 2004 require the states of Nevada and Utah to reach an agreement regarding the division of water resources in Snake Valley, which is located in portions of both states. To date, an agreement has not been signed by Utah and SNWA's applications remain pending before the Nevada State Engineer. The SNWA intends to pursue development of these resources when needed to supply future demands.

Railroad Valley Groundwater. The SNWA holds applications filed in 1989 for 111,496 AFY of groundwater in Railroad Valley North and South. The SNWA intends to pursue development of these resources when needed to supply future demands.

Virgin River/Colorado River Augmentation

The SNWA was permitted 113,000 AFY of Virgin River water rights in 1994. Under an agreement, 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.[16]

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 users could involve transfers/exchanges associated with participation in desalination or agricultural fallowing projects. While Colorado River transfers and exchanges

are an important future resource for Southern Nevada, they will require considerable discussion, agreements and potential regulations to implement. The SNWA continues to collaborate with other Colorado River users to evaluate the potential for future transfer and exchange projects.

WATER CONSERVATION

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

The SNWA's comprehensive five-year water conservation plan details the community's water conservation goals and progress towards those goals over time.[17] It also includes a complete description of water conservation programs and projected water savings. The following provides a brief overview of how conservation is measured and implemented in Southern Nevada.

Measuring Water Conservation and Use

Gallons Per Capita Per Day (GPCD) is a metric used by many communities to measure water uses. It is also an effective tool to measure efficiency over time. GPCD varies across communities due to a number of factors, including differences in climate, demographics, water-use accounting practices and economic conditions. For planning purposes and to monitor conservation progress, GPCD is weather-normalized to account for weather variations that differ from the region's 30-year average. As shown in Figure 3.4 and at the recommendation of the SNWA's Integrated Resource Planning Advisory Committee, the SNWA calculates two variants of GPCD: Total System GPCD and Net GPCD.[18]

Total System GPCD: is calculated by dividing total water "delivered" (all sources) by total resident population served per day (water delivered/resident population/365 days = Total System GPCD). The SNWA uses Total System GPCD as a benchmark for setting conservation goals and measuring achievements.

Net GPCD: is calculated by dividing total water "consumed" (all sources) by total residential population served per day (water consumed/resident population/365 = Net GPCD). Net GPCD recognizes that not all delivered water is consumed; this is because SNWA recycles nearly all indoor water use, either through return-flow credits or direct reuse. Net GPCD more accurately reflects the community's use of water resources and provides a more comparable comparison to other communities.

Consumptive vs. Non-Consumptive Uses

Approximately 60 percent of all water delivered by SNWA is consumed, primarily for landscape irrigation and cooling. Unlike water used indoors, water used outdoors and for cooling is lost to the system as it cannot be treated and reused. As a result, outdoor uses continue to be a primary focus area for future conservation gains. Since 66 percent of all metered uses are by residential and common area use (Figure 3.3), this is the principal water use sector that is targeted for conservation actions.

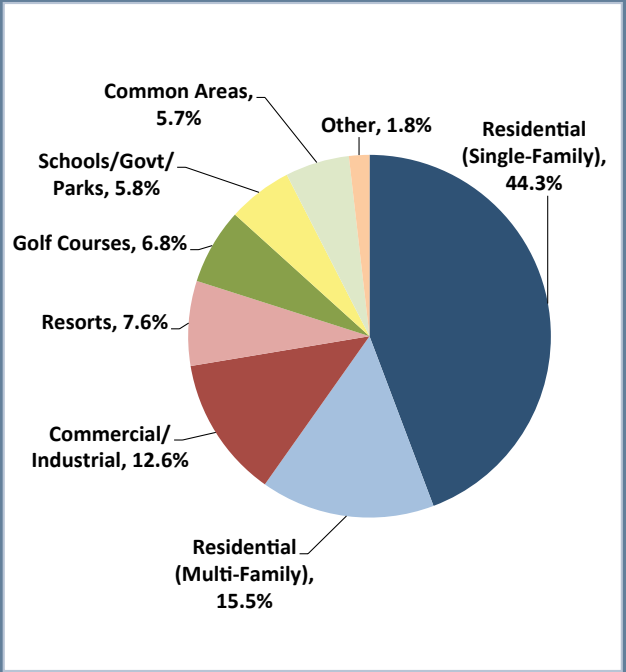

FIGURE 3.3 **Municipal Metered Use (2014)**

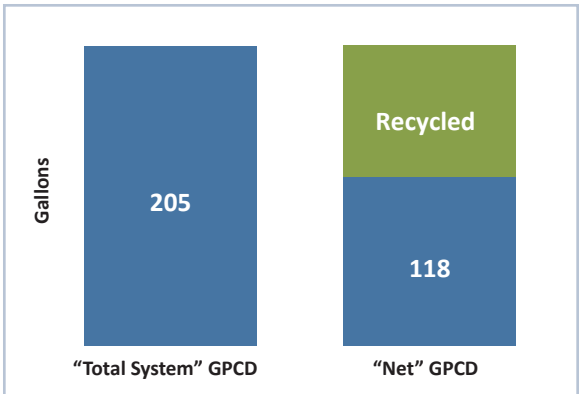

FIGURE 3.4 **SNWA 2014 GPCD**

Conservation Goals

Since its inception in 1991, SNWA and its member agencies have worked collaboratively to set and achieve aggressive water conservation goals. These efforts produced significant decreases in per person water use as shown in Figure 3.5. The community is currently ahead of schedule to achieve its water conservation goal of 199 Total System GPCD by 2035. As recommended by SNWA's 2014 Integrated Resource Planning Advisory Committee, a new conservation target will be evaluated after the current goal has been achieved.

While future conservation gains are expected to occur over the planning horizon, these gains are likely to be realized more slowly than in previous years as higher levels of efficiency—over and above what has already occurred—become more difficult to achieve. In the long-term there is also anticipated to be upward pressure on water use as a result of warming due to climate change.

Conservation Tools

The SNWA operates one of the largest and most aggressive water conservation programs in the nation. This program includes a combination of education, incentives, regulation and water pricing. Because the biggest potential for water savings comes from reductions in consumptive water demands, primarily in the form of outdoor water uses such as landscape irrigation, the majority of conservation tools are designed to achieve results in these areas.

- Education: Education is an integral element of 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 resident and landscape professionals.

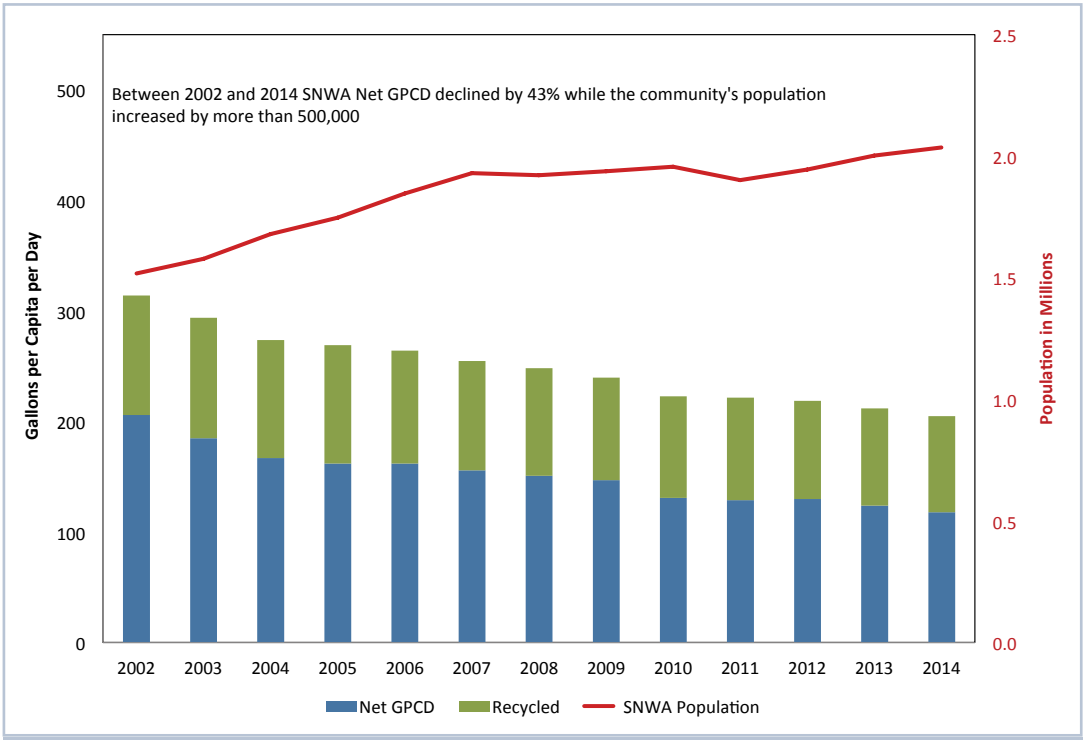

FIGURE 3.5 **Population & Per Capita Water Use**

- Incentives: The SNWA operates one of the largest incentive programs in the nation. Since 2000, SNWA has invested more than $200 million in incentive programs, reducing demand by more than 10 billion gallons annually.
- Regulation: Through collaboration, SNWA member agencies and Clark County have adopted a suite of land use codes, ordinances and water use policies to ensure more efficient use of water in Southern Nevada. These include time-of-day and day-of-week watering restrictions, water waste restrictions and limitations on the installation of new turf in residential and commercial development.
- Water Pricing: SNWA member agencies implement conservation rate structures that charge higher rates for water as use increases. These rate structures encourage efficiency, without jeopardizing water affordability for essential uses.

CHAPTER SUMMARY

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

The SNWA Water Resource Portfolio includes a mix of Permanent, Temporary and Future resources that will be used in tandem with continued conservation efforts to meet demands over the 50-year planning horizon. Some of these resources can be used under any Colorado River operating condition, while others are subject to limitations (such as staged pumping or restrictions during shortage).

To maximize the use and availability of existing supplies, SNWA continues to make water conservation a priority. The community is currently ahead of schedule to achieve its 199 Total System GPCD conservation goal by 2035 and will evaluate additional targets once the current goal is realized. In the meantime, SNWA continues to work with other Colorado River water users to pursue flexible use of Colorado River supplies, including augmentation and storage projects that are designed to increase supplies and bolster Lake Mead water levels. Together, these efforts will provide flexibility in meeting demands as described in Chapter 4.

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 acre-feet/year with 27,795 acre-feet/year estimated to be allocated to Nevada non-SNWA contractors. "Listing of Individual Water Entitlements in the State of Nevada," listing as of January 2015, U.S. Bureau of Reclamation, http://www.usbr.gov/lc/region/g4000/contracts/entitlements/Nevada.pdf.

3 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 groundwater imported to the Las Vegas Valley.

4 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."

5 According to 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.

6 "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 Developed Shortage Supply (DDS) available in a contractor's DSS Account at the request of the contractor, subject to the provisions of Interim Guidelines' Section 4.C.

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

8 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.

9 "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.

10 "Second 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 24, 2012 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.

11 "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.

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

13 Las Vegas Valley Groundwater Management Program information is available at http://www.lasvegasgmp.com/html/.

14 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. The remaining 900 AFY has been made available to the City of North Las Vegas for use in Garnet Valley.

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

16 "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.

17 "Southern Nevada Water Authority Water Conservation Plan, 2014-2018," 2014, SNWA.

18 "Integrated Resource Planning Advisory Committee Recommendations Report, Phase II Resources and Facilities," November 2014. IRPAC recommended presenting water use information to the SNWA Board of Directors and community in both gross [referred to in this Plan as Total System GPCD] and net terms for the purpose of: 1) more accurately communicating the water resource implications associated with various conservation measures; and 2) improving comparability of the community's water consumption with others (Recommendation No. 2).

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Lake Mead Aerial

MEETING FUTURE DEMANDS

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

INTRODUCTION

As described in the preceding chapters, water supply conditions and demands can be influenced by a number of factors that can change in unpredictable ways, including changes associated with economic conditions, water conservation progress and climate variability. As SNWA prepared its 2015 Water Resource Plan, the organization considered two overriding issues related to water supply and demands:

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

To address these uncertainties, 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 to inform water resource planning and water resource development efforts, and demonstrates how the SNWA plans to meet future needs, even if conditions change significantly over time.

As described in the sections below, all of the planning scenarios presented in this chapter demonstrate SNWA's ability to meet the community's long-term projected water needs through adaptive use of its Water Resource Portfolio.

SUPPLY AND DEMAND

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

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

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

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

Water Demand Projections

The planning scenarios developed as part of this plan include two water demand projections: an upper water demand projection or a lower water demand projection. The lower water demand projection (Figures 4.1 and 4.3) 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). This forecast is also used in local transportation planning by the Regional Transportation Commission and is accepted by the Southern Nevada Regional Planning Coalition for use in regional planning. The forecast is based upon 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 2015 CBER population forecast through 2050 and trending through the year 2065. The historical share of

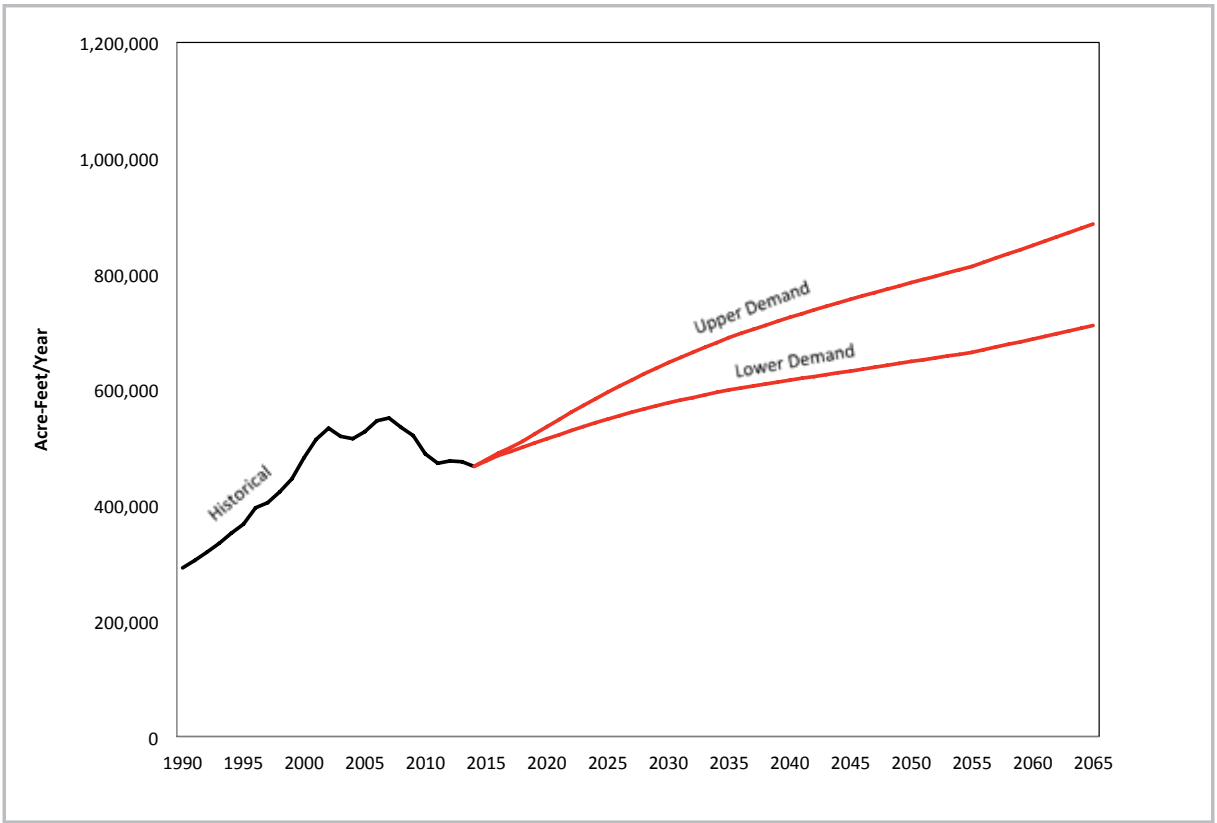

FIGURE 4.1 **SNWA Historical and Projected SNWA Water Demand**

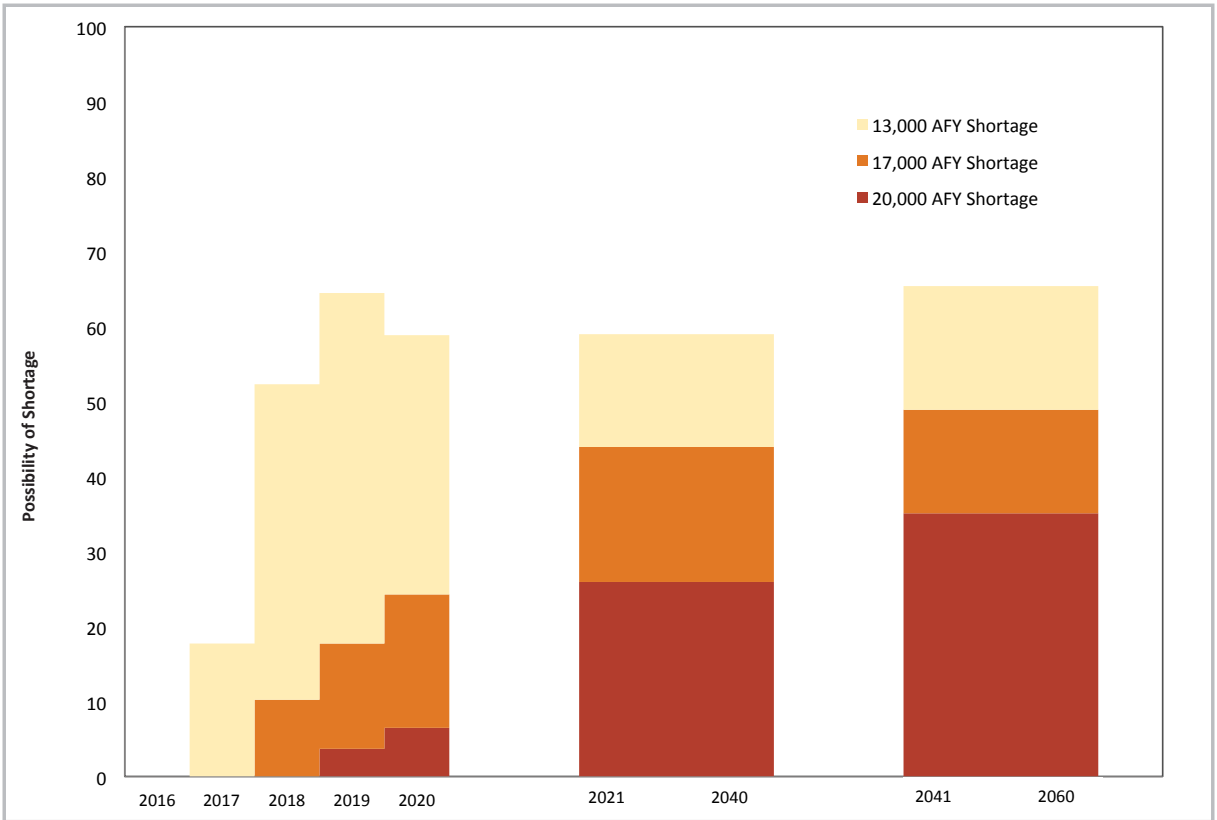

FIGURE 4.2 **Probability of Colorado River Shortage Declarations**[1]

Clark County population attributable to the SNWA service area was multiplied by 2014 water-use levels (Total System GPCD) and reduced over time to represent expected achievement of the community's water conservation goal of 199 Total System GPCD by 2035. The projection assumes a further reduction in total demand (190 Total System GPCD) by 2055 to reflect the potential for additional conservation once the current goal has been met.

The upper demand projection was developed for planning purposes to reflect increased uncertainties related to possible changes in demands that are associated with climate variability, economic recovery, increased population and water use patterns. The upper demand projection represents an approximate 15 percent increase over the lower projection at the midpoint of the planning horizon (2035), increasing to 25 percent in the latter part of the planning horizon (2065). The SNWA also considered one variant of the upper demand projection that includes additional assumptions about possible future conservation goals, using the 2015 CBER forecast as a baseline.

YEAR	2015	2035	2065
LOWER DEMAND	477	599	711
UPPER DEMAND	479	690	886

FIGURE 4.3
SNWA Demand Projection, in thousands (AFY)

Water Supply Conditions

The water supply conditions considered in the planning scenarios represent three Colorado River water-supply conditions: Normal Supply, Shortage and Increased Shortage (Figure 4.4). These supply conditions were developed to reflect current and likely conditions in the Colorado River Basin, as well as the potential for more significant water resource shortages than are currently prescribed by the Interim Guidelines.

NORMAL SUPPLY	Nevada receives its full apportionment of 300,000 AFY
SHORTAGE	Nevada apportionment is incrementally reduced to a maximum shortage of 20,000 AFY according to the Interim Guidelines
INCREASED SHORTAGE	Nevada apportionment is reduced by 40,000 AFY, double the maximum shortage level established in the Interim Guidelines

FIGURE 4.4 **Water Supply Conditions**

Under the Interim Guidelines, shortage volumes are defined for Lake Mead elevations between 1,075 and 1,025 feet. The Secretary of the Interior will consult with Colorado River Basin States to determine what additional measures are needed if Lake Mead drops below elevation 1,025 feet. If this were to occur, future negotiations and consultation with the Secretary of the Interior may establish additional shortage volumes. As a result, Nevada may be required to bear shortages greater than 20,000 AFY (currently Nevada's maximum shortage volume under the Interim Guidelines).

Colorado River modeling performed by the Bureau of Reclamation in 2015 projects an approximate 20–60 percent probability of a Colorado River shortage in the years 2017 to 2020. The probability of shortage ranges between 60–70 percent in the years following. (Figure 4.2)[1]

SUPPLY AND DEMAND SCENARIOS

Figure 4.5 summarizes the water resources planned for development and use as part of the SNWA's water resource portfolio. These resources were combined with the Supply and Demand Scenarios (Figures 4.6 – 4.10) to depict the volume and type of resources planned for use to meet the range of possible future demand projections under the three supply conditions. All planning scenarios use combinations of permanent, temporary and future resources as described in Chapter 3. Having a portfolio of resource options provides flexibility to adjust the use of some resources if development of other resources is delayed or revised, or if changes to demands occur. Likewise, if other options become a reality sooner rather than later, priority and use of resources may change.

As previously described, some Permanent and Temporary resources are subject to restrictions for use during declared shortage, while other resources will require the development of facilities for use. Ultimately, the timing and need for resources will depend significantly on how supply and demand conditions materialize over the long-term planning horizon. For planning purposes, it is important to note that an estimated 10-year lead time is needed to secure remaining state and federal permits, and to design and construct facilities associated with in-state groundwater resources. Other future resources are likely to require lead time as well for the development of facilities and/or agreements for use.

FIGURE 4.5 **SNWA Water Resource Portfolio**

	SUPPLY	CONSUMPTIVE USE	DIVERSION EQUIVALENT	AVAILABLE IN SHORTAGE?
PERMANENT	Colorado River (SNWA)	272,205 AFY	476,359 AFY	Yes. Subject to shortage reductions
	Nevada Unused Colorado River (Non-SNWA)	20,947 (2014) to 0 AFY in 2031	36,658 (2014) to 0 AFY in 2031	Yes. Subject to availability
	Tributary Conservation/Imported ICS	39,000 AFY	68,250 AFY	Yes
	Las Vegas Valley Groundwater Rights	46,830 AFY	Not applicable	Yes
	Direct Reuse	21,800 AFY	Not applicable	Yes
TEMPORARY	Southern Nevada Groundwater Bank	336,787 AF	Up to 589,377 AF	Yes
	Interstate Banks (Arizona and California)	806,266 AF	1,410,966 AF	Yes
	Intentionally Created Surplus (storage in Lake Mead)	564,765 AF	988,339 AF	No
FUTURE	Desalination	To be determined	To be determined	To be determined
	Garnet and Hidden Valleys Permitted	2,200 AFY	Not applicable	Yes
	Delamar, Dry Lake, Cave and Spring Valleys Permitted	91,988 AFY	160,979 AFY	Yes
	Tikaboo and Three Lakes Valley North and South Permitted	10,605 AFY	18,559 AFY	Yes
	Snake Valley Applications	50,678 AFY	88,687 AFY	Yes
	Virgin River/Colorado River Augmentation	Up to 108,000 AFY	Up to 189,000 AFY	To be determined
	Indian Springs Valley Applications	16,000 AFY	28,000 AFY	Yes
	Railroad Valley Applications	111,496 AFY	195,118 AFY	Yes
	Transfers/Exchanges	To be determined	To be determined	To be determined

Water Supplies are described in Chapter 3.[2]

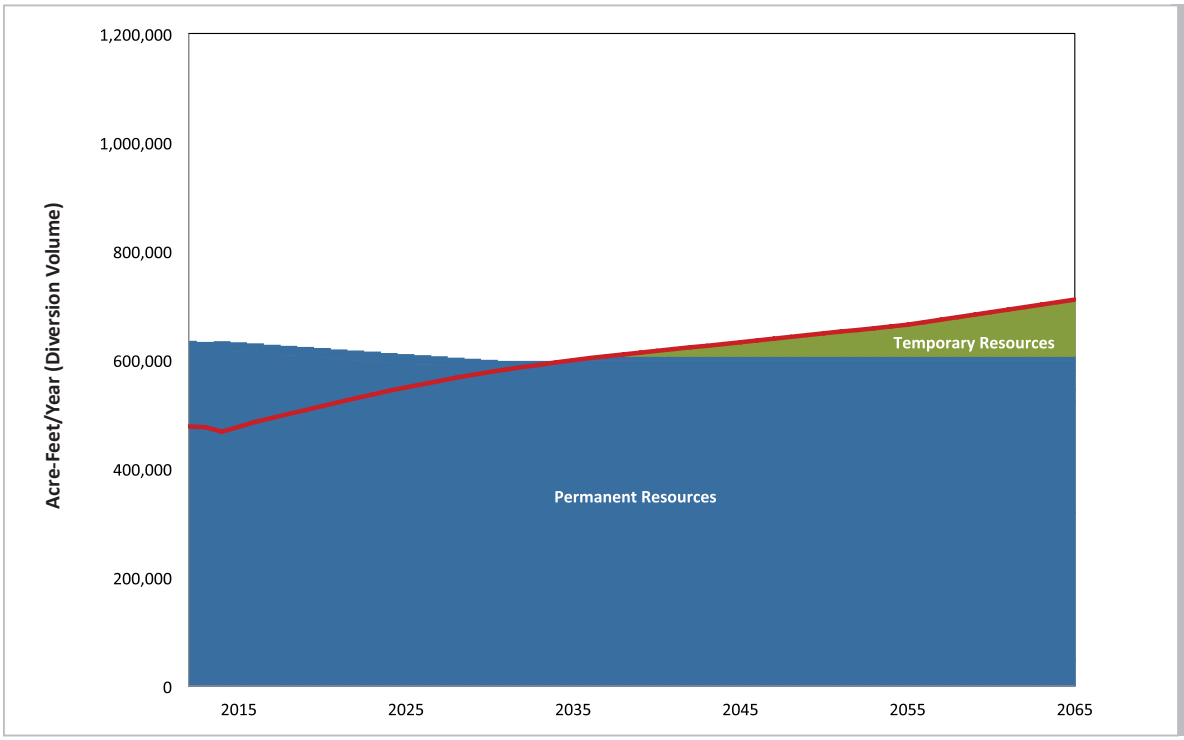

FIGURE 4.6 **Normal Supply (Lower Demand)**

Normal Supply Scenario (Lower Demand)

Figure 4.6 assumes full availability of Southern Nevada's 300,000 AFY Colorado River allocation. Under this scenario, permanent and temporary water resources are sufficient to meet water demands through the 50-year planning horizon.

This scenario also assumes continued banking of unused Colorado River supplies to the extent these resources are available. Given the high probability of Colorado River shortages, this scenario is unlikely to represent actual future supply conditions.

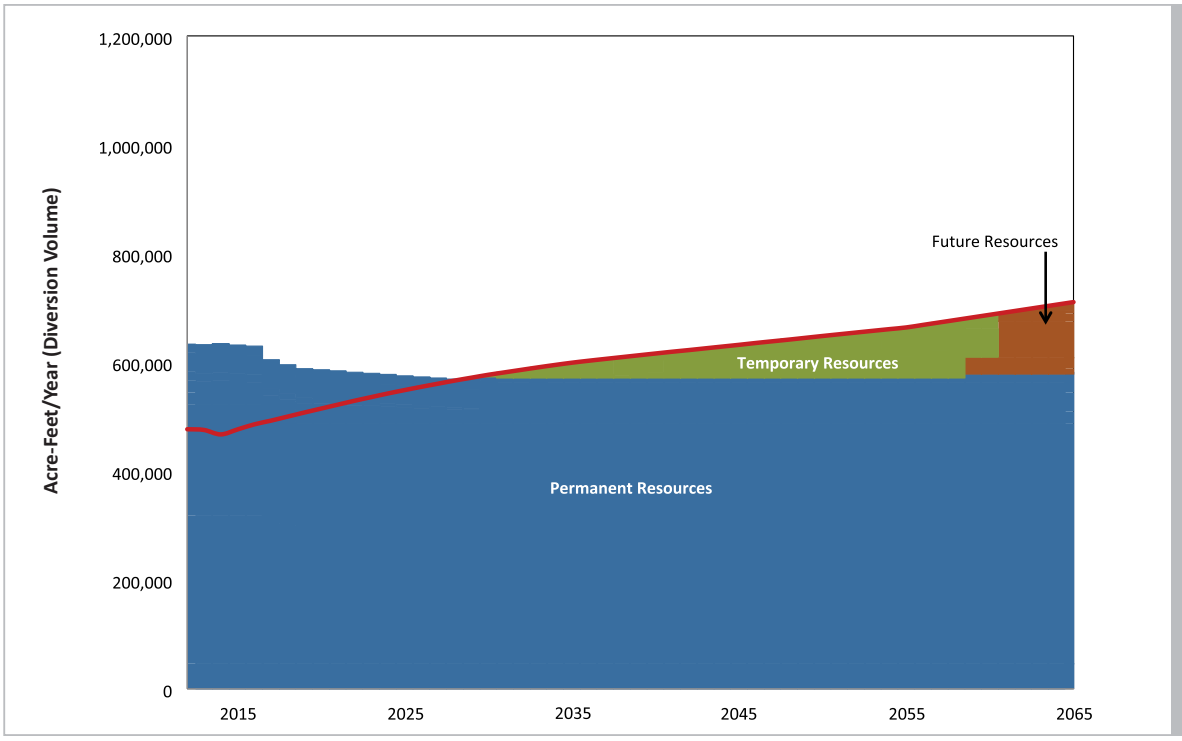

FIGURE 4.7 **Shortage (Lower Demand)**

Shortage Scenarios (Lower Demand)

Figures 4.7 assumes a staged reduction of Colorado River water up to 20,000 AFY based on a shortage declaration (reduction of 13,000 AFY in 2017, 17,000 AFY in 2018 and 20,000 AFY thereafter). Under this scenario, permanent and temporary water resources are sufficient to meet water demands through 2058 before future resources are needed. In 2065, the need for future resources is estimated at 76,000 AFY (consumptive use volume).

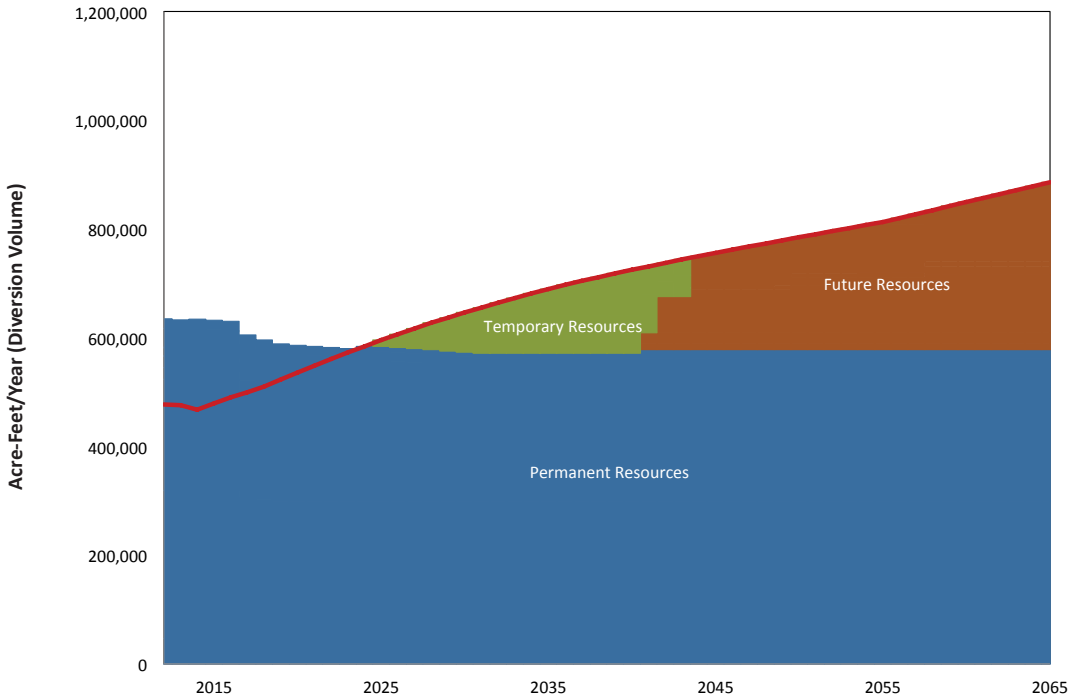

FIGURE 4.8 **Shortage (Upper Demand)**

Shortage Scenario (Upper Demand)

Figure 4.8 assumes a staged reduction of Colorado River water up to 20,000 AFY based on a shortage declaration (reduction of 13,000 AFY in 2017, 17,000 in 2018 and 20,000 AFY thereafter). Under this scenario, permanent and temporary water resources are sufficient to meet water demands through 2040 before future resources are needed. In 2065, the need for future resources is estimated at 176,000 AFY (consumptive use volume).

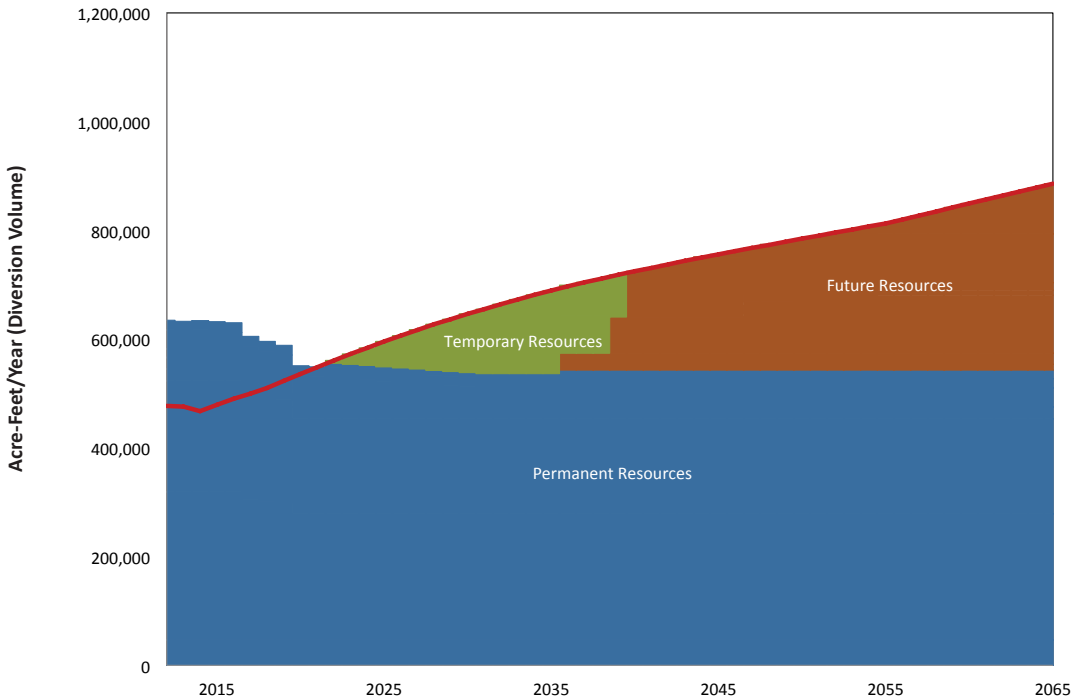

FIGURE 4.9 **Increased Shortage (Upper Demand)**

Increased Shortage Scenario (Upper Demand)

Figure 4.9 assumes a staged Colorado River shortage in years 2017–2019 and an increased shortage of 40,000 AFY thereafter. Under this scenario, SNWA's permanent and temporary water resources are sufficient to meet water demands through 2035 before future resources are needed. In 2065, the need for future resources is estimated at 196,000 AFY (consumptive use volume), demonstrating the need for a combination of future resources to meet projected demands.

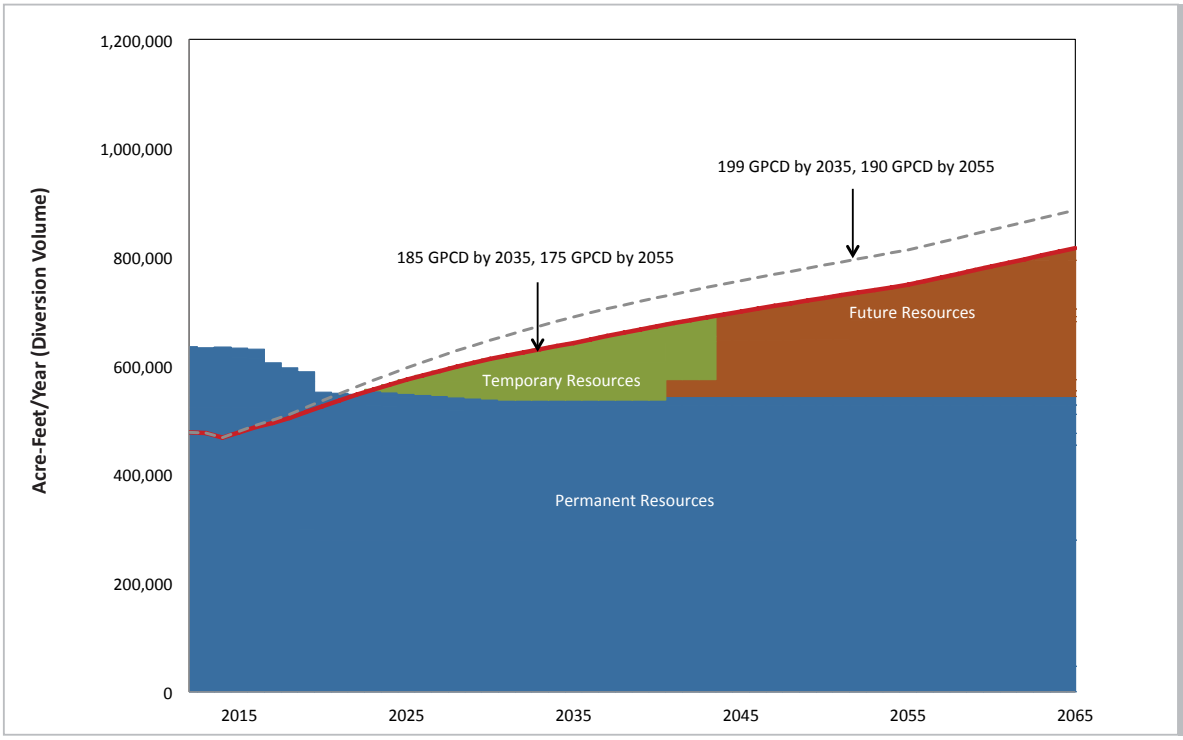

FIGURE 4.10 **Increased Shortage (Upper Demand)**

Additional Conservation Scenario

Figure 4.10 illustrates the timing and need for additional resources with the implementation of additional conservation. This scenario assumes future water use at 185 GPCD by 2035 and 175 GPCD by 2055. The scenario also assumes a staged Colorado River shortage in years 2017–2018 and an increased shortage of 40,000 AFY thereafter. Under this scenario, permanent and temporary water resources are sufficient to meet water demands through 2040 before future resources are needed. In 2065, the need for future resources is estimated at 156,000 AFY (consumptive use volume).

CONCLUSION

Water supply and demand conditions are influenced by a number of factors, including economic conditions, water use patterns, conservation progress and climate variability. To account for these variables, SNWA's 2015 Water Resource Plan considers a number of water supply and demand scenarios that bracket the range of plausible conditions to be experienced over the 50-year planning horizon.

The scenarios assume that Southern Nevada will continue to make progress towards its current water conservation goal, as well as achieve increased levels of efficiency over the long-term planning horizon. Likewise, the scenarios assume that unused Nevada Colorado River water will continue to be stored for future use and that this and other temporary resources will be used to meet demands until future resources are needed and developed.

Modeling efforts performed by the U.S. Bureau of Reclamation indicate a high probability of future shortage associated with Colorado River supplies (approximately 60–70 percent, beginning in 2019). The current maximum level of shortage prescribed to Nevada is 20,000 AFY; however, this level could potentially increase if Lake Mead water levels fall below an elevation of 1,025 feet.

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

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

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

- Continue to assess factors influencing water demands and the outlook for future demands;
- Continue to assess its overall water resource options and make informed decisions on which resources to use when needed;
- Consider the factors of availability, accessibility, cost, need and supply diversification when determining priority of resources for use;
- Maintain a diverse water resource portfolio to ensure future resources are available to meet projected long-term demands and to replace temporary supplies such as banked resources; and
- Work proactively with other Colorado River water users on efforts that increase Lake Mead's elevation in order to reduce the likelihood and severity of shortages.

ENDNOTES

1 The U.S. Bureau of Reclamation developed the Colorado River Simulation System (CRSS), a long-term planning and operations model. The probabilities of shortage correspond with August 2015 CRSS results, applying historical Colorado River flows, provided by U.S. Bureau of Reclamation to Southern Nevada Water Authority August, 2015.

2 Water supplies are described in Chapter 3. For this plan, SNWA estimates diversion volumes by multiplying the corresponding consumptive use volume by a factor of 1.75, which incorporates the estimated return-flow credit ratio, where applicable. This factor is also applied in this plan to estimate full consumptive use of future in-state water resources.

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Muddy River inflow to Lake Mead

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, 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, 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 section details 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.

These environmental issues are being addressed cooperatively by Colorado River water users, primarily through the Lower Colorado River Multi-Species Conservation Program. The SNWA has a key interest in the success of this program, and other similar initiatives, because it provides regulatory certainty for flexible and adaptive resource management solutions like the Arizona and California water banks.

Lower Colorado River Multi-Species Conservation Program

The Lower Colorado River Multi-Species Conservation Program (LCRMSCP) is a coordinated, multi-agency effort to protect the species and habitat of the Lower Colorado River region. The LCRMSCP, finalized in 2005, provides ESA coverage for federal and non-federal operations in the Lower Colorado River under a Biological Opinion and a Habitat Conservation Plan (HCP).[1]

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

The HCP and Biological Opinion call for the creation of 8,132 acres of habitat for fish and wildlife species, and the production of 1.28 million native fish to augment existing populations. The plan will benefit at least 26 species, most of which are state or federally listed endangered, threatened or sensitive species.

The overall goal of the LCRMSCP is to develop and implement a plan that will:

- Conserve habitat and work toward the recovery of threatened and endangered species, as well as reducing the likelihood of additional species being listed;
- Accommodate present water diversions and power production, and optimize opportunities for future water and power development, to the extent consistent with the law; and
- Provide the basis for incidental take authorization.

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

In 2005, SNWA purchased the 15-acre Big Bend Conservation Area site along the Colorado River to support backwater habitat for native fish. In 2008, the LCRMSCP and the U.S. Fish and Wildlife Service (USFWS) funded wildlife habitat improvements on the property, which provides mitigation credit under the program. The SNWA continues to maintain the property and habitat, and conducts annual vegetation monitoring.

By taking a proactive role in the health of the river and its native species, 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 study recognized that additional efforts were needed to better understand and quantify the needs of flow-dependent ecological systems and recreation on the river. The SNWA is a member of this workgroup, which was tasked with identifying opportunities that would provide multiple benefits to improve flow and water-dependent ecological systems, power generation and recreation. In their Phase I report, the workgroup identified future opportunities and potential actions to advance those opportunities.

Colorado River Delta

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 by Minute 317 in 2010. The work group provides a forum where the two countries can explore and evaluate potential areas of cooperation. Subsequently, and as part of the later Minute 319, the Environmental Work Group began gathering scientific information on the effectiveness of environmental flows delivered to the Delta as part of the 2014 pulse flow.

Adaptive Management Work Group The SNWA participates in the Adaptive Management Work Group (AMWG) for the operations of Glen Canyon Dam. This multi-agency work group helps to balance the needs and interests of various stakeholders. These interests include the endangered humpback chub, recreational interests, Native American perspectives, hydropower generation, water deliveries and downstream water quality. Nevada and other Colorado River Basin states are active participants on the AMWG and Technical Work Group, a subcommittee responsible for translating AMWG policy and goals into resource management objectives, and establishing criteria and standards for long-term monitoring and research. Active participation in the AMWG and its subcommittees helps to ensure SNWA's interests in protecting water deliveries, downstream water quality and the endangered humpback chub are adequately addressed.

MUDDY RIVER

The Muddy River and its tributaries and springs provide habitat for a unique array of rare species, including the federally endangered Moapa dace (Moapa coriacea), southwestern willow flycatcher (Empidonax trailii extimus), and Yuma Ridgway's rail (Rallus obsoletus yumanensis) (formerly Yuma clapper rail), and the federally threatened western yellow-billed cuckoo (Coccyzus americanus occidentalis). It is also habitat for the Virgin River chub (Gila seminuda), which although not listed on the Muddy River is listed as endangered on the Virgin River. The SNWA has conducted and supported environmental studies on the Muddy River since 2004, including population and habitat surveys for these and other native, sensitive species. The SNWA is also working with federal and state agencies, environmental organizations and local stakeholders to implement conservation and recovery actions.

As noted in Chapter 3, SNWA has surface water rights on the Muddy River and groundwater

rights in adjacent Coyote Spring Valley. In accordance with the Interim Guidelines, SNWA can convey these rights through the natural channel of the Muddy River to Lake Mead and receive ICS credit. To support its water planning efforts, SNWA participates in the Muddy River Recovery Implementation Program. The program is a coordinated, multi-agency effort to protect the species and habitat of the Muddy River, while ensuring the responsible management of water resources. In accordance with a 2006 Memorandum of Agreement with the USFWS, the SNWA provided $300,000 in funding for preparation of the program, which is currently in draft form.[3] The SNWA continues to coordinate with other agencies, as part of a Biological Advisory Committee, to implement monitoring and conservation actions on the Muddy River.

In addition to activities conducted on the Warm Springs Natural Area, described below, ongoing environmental activities on the Muddy River include:

- Native fish surveys
- Non-native fish surveys and invasive fish removal
- Non-native fish barrier installation
- Habitat creation and restoration

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. The upper Muddy River area, also home to the Moapa Valley National Wildlife Refuge, has long been recognized for its environmental value and as an important site for conservation and protection.

In 2007, SNWA purchased the former 1,220-acre "Warm Springs Ranch," using funding secured under the Southern Nevada Public Lands Management Act. As part of the acquisition, SNWA committed to protecting and preserving the property as a natural area and to use this resource to:

- Support management of SNWA's water resources in the Muddy River and Coyote Spring Valley
- Protect the habitat of the endangered Moapa dace
- Protect the headwaters of the Muddy River where SNWA owns and leases water rights
- Advance SNWA's goal of fostering responsible environmental stewardship

Working with federal, state and local stakeholders, SNWA completed a Stewardship Plan for the Warm Springs Natural Area in 2011.[4] 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, 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 is also being constructed, to enable low-impact public use of the property. These conservation actions help to provide mitigation benefits for water development.

Warm Springs Natural Area

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.[5]

The SNWA has worked with its partners to implement a number of activities to benefit the Moapa dace, including installation of non-native fish barriers, eradication of invasive fish species, restoring natural stream flow dynamics and riparian vegetation, and improving connectivity between springs and streams. These actions have helped the overall Moapa dace population to increase substantially, going from a low of 459 individuals in 2008 to over 1,900 in 2015.

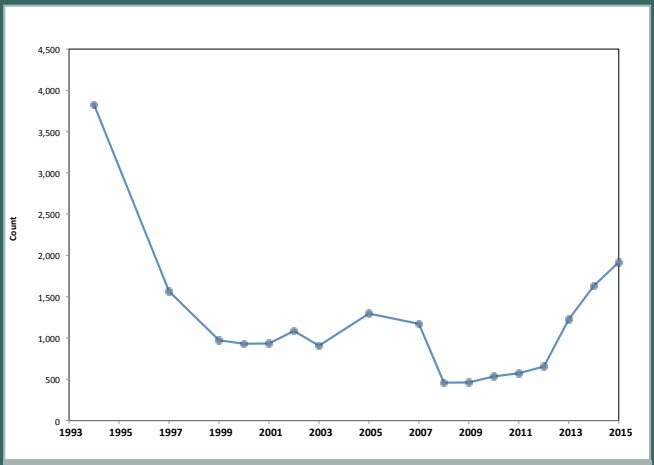

FIGURE 5.1 **Moapa Dace Count Through 2015**

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 (Plagopterus argetissimus), Virgin River chub, southwestern willow flycatcher, and Ridgway's rail and the federally threatened western yellow-billed cuckoo. Since 1993, SNWA has conducted and supported environmental studies on the Virgin River, including population and habitat surveys for these species.

To support its water planning efforts associated with Virgin River rights and leases, SNWA also participates in environmental stakeholder forums on the lower Virgin River, including the Virgin River Habitat Conservation Plan, which is being prepared by the City of Mesquite. In addition, the SNWA participates on the Lower Virgin River Recovery Implementation Team, which is working to develop a conservation action plan for the woundfin and Virgin River chub.

CLARK COUNTY

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

Clark County Multiple Species Habitat Conservation Plan

After the ESA listing of the desert tortoise (Gopherus agassizii) in 1989, local agencies in Clark County recognized the need to address concerns about listed or sensitive species that could affect development in the county. While projects on federal lands continue to receive project-specific ESA coverage from the USFWS, projects on private lands within the County receive ESA coverage under habitat conservation plans. Initially, the Clark County Desert Conservation Plan was approved in 1995. However, this plan only covered the desert tortoise. The county and local governments began discussing preparation of another habitat conservation plan that would also proactively conserve other sensitive species through an ecosystem approach.

The Clark County Multiple Species Habitat Conservation Plan (MSHCP)[6] was approved in 2001, and provides ESA coverage for 78 species, including the desert tortoise. The MSHCP serves as an insurance policy to cover future

federal listings of species in areas where urban development is taking place. The key purpose of the MSHCP is to achieve a balance between the conservation and recovery of listed and sensitive species in Clark County and the orderly beneficial use of land to meet the needs of the growing population in Clark County. The SNWA actively participates in the MSHCP, which provides ESA coverage for its projects and facilities located on non-federal lands within the county.

Las Vegas Wash

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

Mature Vegetation Along the Wash

In 1998 at the request of its citizen's advisory committee, 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,[7] which identified 44 action items to help meet the goals of stabilization and enhancement of the Wash.

Over more than 15 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:

- Constructed 18 of 21 identified erosion control structures or weirs
- Stabilized more than 12 miles of the Wash's banks
- Removed more than 500 acres of non-native tamarisk
- Revegetated more than 400 acres with native plants
- Removed more than 500,000 pounds of trash from adjacent areas
- Organized more than 10,000 volunteers
- Completed extensive wildlife and water quality monitoring programs
- Built or improved more than two miles of trails
- Implemented an invasive species management program

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

NORTHERN NEVADA GROUNDWATER RESOURCES

As described in Chapter 3, SNWA holds groundwater rights in Spring, Delamar, Dry Lake and Cave valleys, in central Nevada. The SNWA is working to complete the environmental compliance and permitting that will allow these rights to be developed and conveyed to Southern Nevada when they are needed.

In 2006 and 2008, SNWA and U.S. Department of the Interior agencies, including the Bureau of Indian Affairs, Bureau of Land Management (BLM), USFWS and the National Park Service, entered into stipulations for withdrawal of protests for water right applications in Spring, Delamar, Dry Lake and Cave valleys.

Technical teams representing the agencies developed biological and hydrological monitoring plans pursuant to the obligations of the stipulated agreements. These monitoring plans were approved by the Nevada State Engineer under the 2012 water rights rulings and include the requirement for monitoring baseline conditions prior to groundwater withdrawals. Hydrologic monitoring is ongoing, in accordance with the Hydrologic Monitoring and Mitigation Plan for Spring Valley[8] and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake and Cave valleys.[9] These efforts meet permit conditions of the water right rulings and conditions of the stipulated agreements.

In accordance with the Biological Monitoring Plan for Spring Valley, SNWA conducted two years of baseline biologic monitoring in 2009 and 2010.[10] The biological technical team has been evaluating those monitoring efforts and is preparing recommendations for revision to the Spring Valley plan, which would be implemented during the remaining baseline monitoring. These recommendations may also be implemented in the Biological Monitoring Plan for Delamar, Dry Lake and Cave valleys.[11] In the interim, biological activities are focused on specific species monitoring efforts and small studies to further understand the ecosystems and biota.

Groundwater Development Project

In 2012 after more than eight years of research, analysis, review and public comment, the BLM completed an Environmental Impact Statement[12] and Record of Decision[13] in accordance with NEPA for the primary water and power conveyance facilities associated with SNWA's Clark, Lincoln and White Pine Counties Groundwater Development Project. The BLM also consulted with the USFWS, as required under ESA, to assess potential effects on federally listed species. The right-of-way across federal land was issued to SNWA in 2013, and contains over 600 measures for environmental protection and mitigation.

The right-of-way and associated environmental compliance measures are for the first phase of the Groundwater Development Project; additional tiered compliance will be necessary when specific well sites and collector pipeline routes are identified. The SNWA continues working on some of the over 40 individual environmental plans that will be required for the project, so that it will be ready for design and construction when the water resource is needed.

The SNWA also holds groundwater applications in Snake Valley that would ultimately be part of the Groundwater Development Project. As discussed in Chapter 3, Utah has not yet signed an agreement regarding the division of groundwater supplies in Snake Valley. When an agreement is signed and the water is incorporated into the Groundwater Development Project, additional environmental compliance will be needed prior to receiving a right-of-way from federal land managing agencies.

Great Basin Ranch

Beginning in 2006, SNWA began acquiring ranch properties in Spring Valley from landowners who approached SNWA desiring to sell their properties. Since then, the SNWA has continued to operate the properties, collectively named the Great Basin Ranch, to ensure water rights associated with the properties are maintained in good standing through beneficial use and to ensure land resources remain productive. The land and water rights associated with Great Basin Ranch provide SNWA with an opportunity to integrate adaptive management with environmental mitigation during future development activities.

The seven properties acquired by the SNWA include the El Tejon, Robison, Huntsman, Harbecke, Wahoo, Phillips and Bransford ranches. As part of its ranch purchases, the SNWA has:

- More than 23,500 acres of private land
- More than 34,000 acre-feet of surface water rights
- More than 8,000 acre-feet of groundwater rights
- More than 23,000 acre-feet of supplemental water rights
- On average, 3,700 head of livestock (depending upon time of year and season)

The SNWA also holds roughly 933,500 acres in grazing allotment permits from the BLM and the U.S. Forest Service. There are a total of 15 grazing allotments that span Spring, Dry Lake, Cave, Lake, Tippett, Hamlin, Pahroc, Steptoe and Patterson valleys. SNWA-owned cattle and sheep graze these allotments under a program designed to maintain rangeland health standards.

The Great Basin Ranch provides opportunities for SNWA to better understand and manage hydrologic and biological resources of Spring Valley while continuing the historic agricultural and livestock operations. The SNWA accomplishes this by employing best management practices, such as adaptive grazing, water- and energy-efficient agricultural technologies, GPS tracking of livestock and invasive weed-control treatments. Technical staff and contractors perform range monitoring and rangeland-condition analyses, among a variety of monitoring and reporting programs. The SNWA is also investigating use of surface-water rights acquired with the land holdings to support aquifer recharge. Through these management efforts, the SNWA is making significant progress toward creating a sustainable ranch operation.

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.

Great Basin Ranch

The SNWA has undertaken a broad range of initiatives to help ensure conservation and preservation of water resources. For example, SNWA's chemical reduction program has increased non-chemical water treatment methods and reduced our carbon footprint by 309 metric tons of carbon equivalent.

As the state's largest energy user, the SNWA strives to reduce energy consumption and reduce environmental pollution through efficient energy use and incorporating use of renewable resources such as solar, wind, hydro, biomass and geothermal energy. The SNWA has voluntarily committed to meeting 25 percent of its energy needs through renewable resources by 2025, which parallels Nevada's Renewable Energy Portfolio Standards. The SNWA's current energy portfolio consists of approximately 13 percent derived from renewable resources, with that amount increasing to approximately 18 percent by 2016.

The SNWA's solar facilities generate more than 920,000 kilowatt hours of clean energy, enough to power nearly 60 average Southern Nevada homes annually. The SNWA's fleet is nearing its goal of becoming 100 percent alternative fueled, replacing standard-fueled vehicles with alternative-fueled models when appropriate.

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

CONCLUSION:

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 "Memorandum of Agreement," April 20, 2006, SNWA.

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

5 "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.

6 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.

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

8 "Hydrologic Monitoring and Mitigation Plan for Spring Valley (Hydrographic Area 184)," 2011 SNWA (Doc. No. WRD-ED-0012).

9 "Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys," 2011, SNWA (Doc. No. WRD-ED-0011).

10 Biological Monitoring Plan for the Spring Valley Stipulation, 2011 Biological Working Group.

11 Biological Monitoring Plan for Delamar, Dry Lake, and Cave Valley Stipulation, January, 2011, Biological Resource Team.

12 "Clark, Lincoln, and White Pine Counties Groundwater Development Project Final Environmental Impact Statement," August 2012, U.S. Bureau of Land Management.

13 "Clark, Lincoln, and White Pine Counties Groundwater Development Project Record of Decision," 2012, U.S. Bureau of Land Management.

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APPENDIX 1

SOUTHERN NEVADA WATER AUTHORITY

SEPTEMBER 2013—INTEGRATED RESOURCE PLANNING ADVISORY COMMITTEE

FUNDING RECOMMENDATIONS

1. Develop rates through a transparent and inclusive community process.

2. Retain the existing rates and charges previously adopted by the SNWA Board and its purveyor members, formalizing the fire line meter charge at 17.5 percent of the current Infrastructure Charge.

3. Cap the Infrastructure Charge on fire line meters at the 2013 dollar amounts.

4. Increase the Commodity Charge $.18 per 1,000 gallons (from $.30 to $.48) to meet 50 percent of annual revenue requirements in the target year 2017 and increase the Infrastructure Charge to meet the other half of annual revenue requirements.

5. Temporarily reduce the maximum rate in 2014, 2015 and 2016 to provide the community time to adjust to the new rates.

6. Separate money added to the New Expansion Debt Service fund and related interest attributed to the 2014 and 2015 phased-in rates from the remainder of the fund balance and use it to only offset forecasted operating deficits in 2016 to 2021 and not for any other purposes.

7. Allocate Connection Charge revenues in excess of the 2014 base year ($16.1 million) exclusively to pay the following, in order of priority:

    - Early payment or pre-refunding of existing debt or one-time capital expenditures, whichever is most financially efficient, and

    - Water rate reductions.

8. If funds in excess of the target fund balance remain in the New Expansion Debt Service fund (not including phased-in rate revenue), use the excess fund balance only for any of the following purposes:

    - To redeem outstanding bonds (thereby reducing outstanding debt and future debt service requirements) or to acquire capital assets that would otherwise need to be funded with borrowed money (thus avoiding additional debt and debt service), whichever is most financially efficient;

    - To moderate further the impact of future rate increase; or

    - To reduce water rates.

9. Encourage the Las Vegas Valley Water District and the cities of Henderson and North Las Vegas to assess the rates and charges approved by the SNWA Board.

APPENDIX 2

SOUTHERN NEVADA WATER AUTHORITY

DECEMBER 2014—INTEGRATED RESOURCE PLANNING ADVISORY COMMITTEE

RESOURCE AND FACILITY RECOMMENDATIONS

1. Evaluate an increased water conservation target upon achieving the currently established goal of reducing gross water usage to 199 Gallons Per Capita Per Day (GPCD) by 2035.

2. Present water usage information to the Board of Directors and the community in both "gross" and "net" terms for the purpose of 1) more accurately communicating the water resource implications associated with various conservation measures, and 2) improving comparability of our community's water consumption with that of others.

3. Continue to partner with other Colorado River Basin States to undertake system conservation projects designed to protect critical elevations in Lake Powell and Lake Mead, conditional upon the identification of mutually agreeable projects and shared funding responsibilities.

4. Classify expenditures associated with Colorado River system conservation projects as one-time capital expenditures, thereby making funds available for these costs from Connection Charge revenues as identified in Recommendation Nos 7 and 8 from the September 2013 Integrated Resource Planning Advisory Committee Recommendations Report.

5. Begin design and construction of a new low lake level pumping station within the swiftest feasible timeframe.

6. Generate needed revenue for the construction of a new low lake level water pumping station exclusively through fixed charges based upon meter size.

7. Phase in the increase to fixed monthly charges over a three-year period.

8. Continue to include the Groundwater Development Project within the SNWA's Water Resource Portfolio with future resource options.

APPENDIX 3

CLARK COUNTY POPULATION FORECAST AND PROJECTION USED BY SNWA IN PREPARATION OF WATER RESOURCE DEMAND PROJECTION IN SNWA 2015 WATER RESOURCE PLAN

Year	Lower Demand Population	Upper Demand Population
2015	2,146,000	2,156,932
2016	2,191,000	2,210,313
2017	2,225,000	2,254,618
2018	2,262,000	2,307,035
2019	2,299,000	2,368,806
2020	2,335,000	2,429,801
2021	2,371,000	2,489,966
2022	2,407,000	2,550,331
2023	2,441,000	2,607,658
2024	2,475,000	2,664,006
2025	2,507,000	2,719,403
2026	2,538,000	2,772,666
2027	2,568,000	2,823,745
2028	2,598,000	2,875,981
2029	2,626,000	2,924,870
2030	2,654,000	2,973,748
2031	2,679,000	3,018,073
2032	2,704,000	3,063,504
2033	2,729,000	3,108,888
2034	2,753,000	3,151,906
2035	2,776,000	3,194,886
2036	2,799,000	3,236,620
2037	2,821,000	3,277,121
2038	2,843,000	3,316,359
2039	2,865,000	3,356,702
2040	2,887,000	3,395,784
2041	2,909,000	3,433,604
2042	2,930,000	3,471,352
2043	2,952,000	3,509,022

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APPENDIX 3

Year	Lower Demand Population	Upper Demand Population
2044	2,974,000	3,545,435
2045	2,996,000	3,581,780
2046	3,019,000	3,619,259
2047	3,041,000	3,655,480
2048	3,063,000	3,690,454
2049	3,086,000	3,726,578
2050	3,109,000	3,762,652
2051	3,131,600	3,798,665
2052	3,154,200	3,834,627
2053	3,176,800	3,870,541
2054	3,199,400	3,906,407
2055	3,222,000	3,942,228
2056	3,244,600	3,978,004
2057	3,267,200	4,013,737
2058	3,289,800	4,049,428
2059	3,312,400	4,085,078
2060	3,335,000	4,120,688
2061	3,357,600	4,156,260
2062	3,380,200	4,191,794
2063	3,402,800	4,227,292
2064	3,425,400	4,262,754
2065	3,448,000	4,298,182

Source: Lower Demand Population, "Clark County Nevada Population Forecast 2015–2050," June 2015, CBER at the University of Nevada Las Vegas, which was then projected through 2065.
Upper Demand Population corresponds with the Upper Demands by assuming a 199 Total System GPCD in 2035 and 190 GPCD in 2055.

APPENDIX 4

Year	Lower Demand (199 GPCD BY 2035)	Upper Demand (199 GPCD BY 2035)	Upper Demand (185 GPCD BY 2035)
2015	477,000	479,000	477,000
2020	515,000	536,000	525,000
2025	549,000	596,000	574,000
2030	577,000	647,000	612,000
2035	599,000	690,000	641,000
2040	616,000	725,000	672,000
2045	632,000	756,000	699,000
2050	648,000	785,000	725,000
2055	664,000	813,000	748,000
2060	687,000	849,000	782,000
2065	711,000	886,000	816,000

GPCF Figures are shown here as “Total System GPCD”.

Colorado River, Grand Canyon National Park

Colorado River, Horseshoe Bend, Arizona