ARIZONA DEPARTMENT of WATER RESOURCES
EST. 1980

SUPPLY & DEMAND

2025

HUALAPAI VALLEY

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2025 SUPPLY AND DEMAND ASSESSMENT
HUALAPAI VALLEY BASIN

1 INTRODUCTION

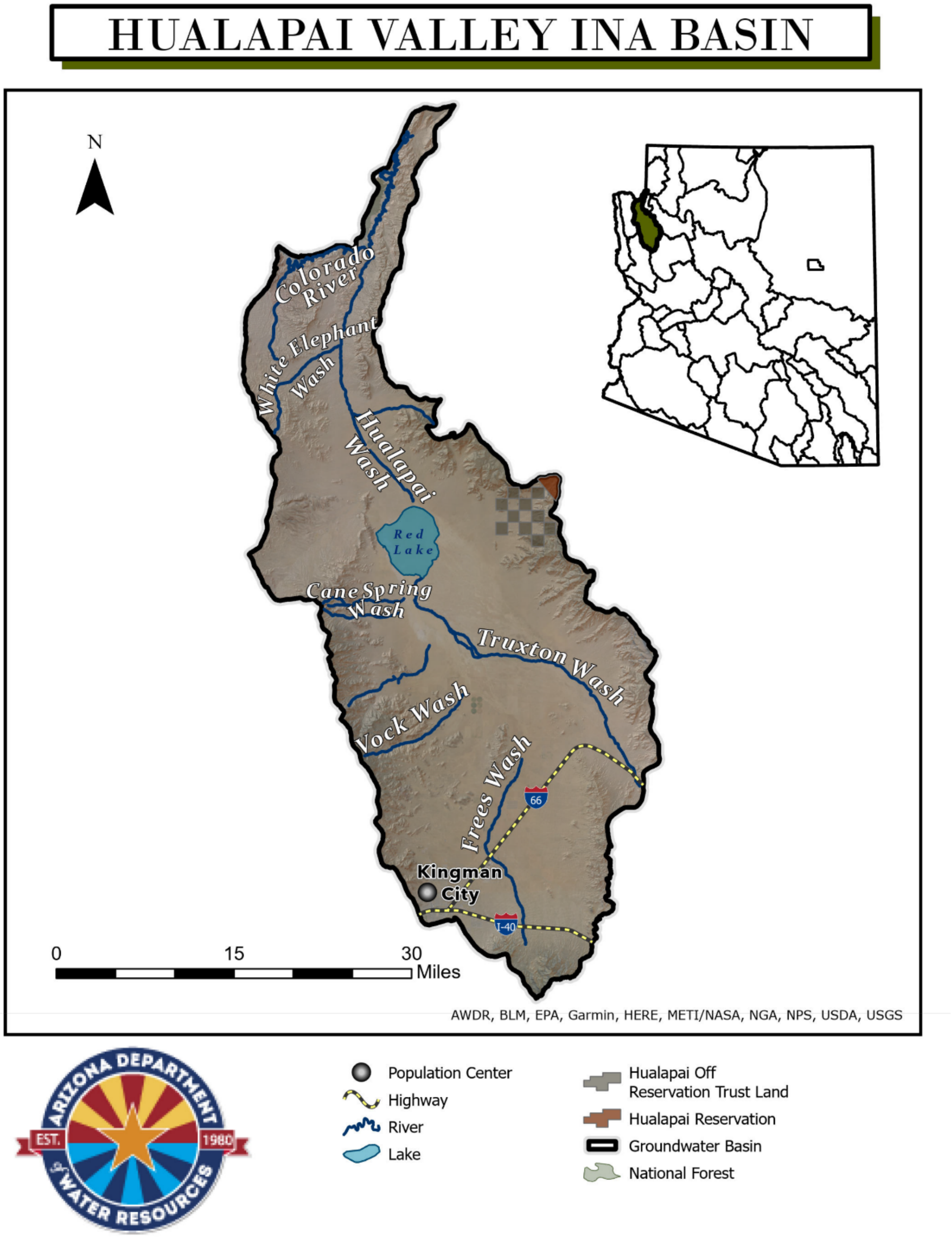

Figure 1. Map of the Hualapai Valley Basin.

1.1 REPORT BACKGROUND AND PURPOSE

Preparing the Supply and Demand Reports (SDRs) is a duty of the Director of the Arizona Department of Water Resources (ADWR) required by statute, as stated in Arizona Revised Statutes (A.R.S.) § 45-105(B)(14).[1] Beginning in 2023, the Director must ensure that a water supply and demand assessment for at least six of Arizona's fifty-one groundwater basins are prepared and issued by December 1st of each year.

Although similar assessments have been completed periodically, 2023 was the first time ADWR allocated dedicated funding and staff to conduct assessments of all of Arizona's groundwater basins on a recurring cycle. By the end of 2027, ADWR will complete assessments for all 51 groundwater basins throughout the state, and each basin will be reassessed at least every five years. The SDRs may be used to inform the Water Infrastructure Finance Authority on funding decisions in the future (see A.R.S. § 49-1304(A)(14)[2]). The SDRs may also be used as a planning tool for water resource management by ADWR, policymakers, community members, and other interested stakeholders.

The basins and subbasins assessed in 2025 include Aravaipa Canyon, Bill Williams (Alamo Reservoir, Burro Creek, Clara Peak, Santa Maria, and Skull Valley Subbasins), Bonita Creek, Coconino Plateau, Dripping Springs Wash, Duncan Valley, Hualapai Valley, Little Colorado River Plateau, Morenci, Sacramento Valley, Safford (San Carlos Valley, Gila Valley, and San Simon Valley Subbasins), Salt River (Black River, White River, Salt River Canyon, and Salt River Lakes Subbasins), and San Simon Wash.

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[1] Arizona Revised Statutes § 45-105(B)(14). https://www.azleg.gov/ars/45/00105.htm

[2] Arizona Revised Statutes § 49-1304(A)(14). https://www.azleg.gov/ars/49/01304.htm

1.2 PROCEDURE AND SCOPE

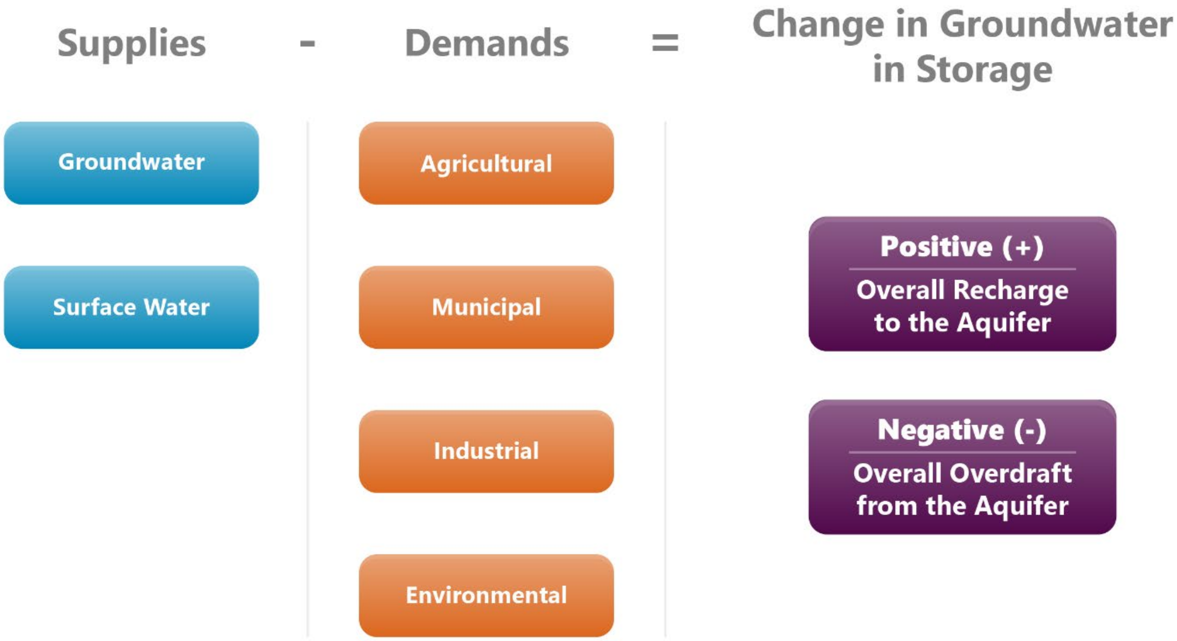

Figure 2. Depiction of the Hualapai Valley basin water budget, including all available supplies and demands and how they contribute to changes in groundwater in storage.

The SDRs are structured as water budgets, focusing on total inflows and outflows at the basin scale. The SDRs estimate the volumes of water demands from all uses (categorized into sectors of Agricultural, Industrial, Municipal, and Other) and the volumes of water supplies (Surface Water, Groundwater, Effluent, Incidental Recharge, Transportation Water, and Moved Water) available to meet those demands. The reports also include projected demands and supplies under various influences of future scenarios.

The SDRs are not groundwater flow models with finer geographic results. The development of regional groundwater flow models for each basin is an extensive technical process and is not feasible within the time constraints of this project. Outside of Arizona's regulated Active Management Areas (AMAs) and Irrigation Non-Expansion Areas (INAs), data is much more limited. In instances where data does exist, the data may be outdated or lack reliability. ADWR has endeavored to acquire local and specific data to generate the SDRs. However, when such information was not obtainable, staff utilized scientific literature estimates, averages, or assumptions to formulate water usage estimates.

The SDRs attempt to answer the following questions:

1. What is the estimated annual volume of water demand?
2. What is the estimated annual volume of available water supply?
3. Is there sufficient available water supply to balance water demand annually?

The water budget was calculated by subtracting the estimated annual demand from the estimated annual available supply. If demand exceeds supply in a year, the difference is subtracted from the estimated aquifer storage. If supply exceeds demand, the difference is added to estimated aquifer storage. In this manner, the process is like balancing a checkbook, totaling the credits and debits made to the account through the year to understand how much estimated groundwater is available in storage.

The SDRs are designed to be understandable to the general public. The Methods Appendix includes specific technical information and additional details regarding data and methods: [Methods Appendix]. Additional SDRs and an interactive dashboard are available for further information: [Dashboards].

1.3 METHODOLOGY AND LIMITATIONS

This study reviewed and compiled data for two primary purposes:

1. Estimate supply and demand volumes in the basin.
2. Project changes in supply and demand from possible future scenarios.

ADWR developed and compiled baseline data for the period from 1990 to 2024. Staff then developed scenarios based on the most likely impacts on water demands and supplies over 51 years (from 2025 to 2075), and then projections were generated from the baseline data. The results from these scenarios and the combined baseline data were used to estimate whether supply could meet demand each year from 1990 to 2075. ADWR independently developed both the supply and demand estimates.

Due to the limited reported water data available outside Arizona's AMAs and INAs, the supplies and demands outlined in the SDRs are estimates only. When available, ADWR used high-quality data from credible sources. Due to the need to focus staff bandwidth on developing initial methods for analysis of all 51 groundwater basins by the December 1, 2027, statutory deadline, outreach was limited to major water users in the basin. When data could not be obtained, research into existing literature and the use of representative data were necessary to develop estimates.

Please see the Methods Appendix for an in-depth discussion of the methodologies and assumptions ADWR applied to create each estimate: [Methods Appendix].

2 RESULTS

2.1 BASIN SUMMARY

The Hualapai Valley Basin encompasses 1,212 square miles in the northwestern portion of the state and is characterized by the Cerbat Mountains along the southwestern basin boundary, the Hualapai Valley running through the center of the basin, the Grand Wash Cliffs along the eastern basin boundary, the White Hills along the northwest basin boundary, and Mt. Tipton on the western basin boundary. The basin is comprised of U.S. Bureau of Land Management (BLM) land (39.1%), National Park Service (NPS) land (9.0%), State Trust Land (7.5%), and the federally recognized Hualapai Indian Reservation (1.0%). The Hualapai Valley INA was established in 2022. The basin has an estimated population of 46,492, and 43.3% of the basin is privately owned. The major aquifers in the Hualapai Valley Basin consist of basin fill, sedimentary rock, and volcanic rock. Previous storage estimates have been from 3,000,000 to 21,000,000 acre-feet (AF) to a depth of 1,200 feet.[3] The basin includes the Red Lake and the Truxton Wash running from the southeast.

2.2 SUPPLIES

2.2.1 Surface Water

ADWR examined all water sources defined as surface water in each basin. Surface water includes all water flowing in streams, canyons, ravines, or other natural channels, or in definite underground channels, whether perennial or intermittent, floodwater, wastewater, or surplus water, and of lakes, ponds, and springs discharging to the surface (A.R.S. § 45-141).4 After examining these sources and deducting any existing surface water diversions (stockponds, reservoirs, and agricultural diversions) from the resulting volumes, ADWR generated a final estimate of the remaining water available for diversion or use. When possible, streamgage data were used to estimate surface water volumes. Where active streamgages were absent, which often applies to areas with intermittent and ephemeral streamflow, the Drainage-Area Ratio (DAR) method (see the Methods Appendix) was used to estimate surface water volume.

While Colorado River water is subject to a different legal framework, the term "surface water" necessarily encompasses Colorado River water, including Central Arizona Project ("CAP") water. Therefore, Colorado River water, including CAP water, is incorporated in the estimates of available surface water supplies. The availability of Colorado River water in Arizona will be subject to operations to be determined by the Secretary of the Interior in an ongoing federal process. While significant uncertainty surrounds the reliability of Colorado River water supplies, particularly on the mainstem of the Colorado River in the Lower Basin, this report assumes that Non-Indian Agricultural (NIA) Priority CAP water will generally not be available during the projection period, but that all other Colorado River water and CAP water will be available.

2.2.2 Groundwater

This report refers to the "inflow to" and "outflow from" the aquifer each year as groundwater. This volume is distinct from the volume of groundwater considered to be available in storage. "Inflow to" represents the annual recharge or replenishment of groundwater through processes such as the percolation of precipitation or surface water into the subsurface, which is observed through processes such as streamflow infiltration, groundwater inflow, and mountain-front recharge. "Outflow from," the movement of water leaving the system, is represented by such processes as baseflow and groundwater outflow. See the Methods Appendix for more information on how

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[3] ADWR (2009). Arizona Water Atlas, Volume 4, Section 4.4, pg. 192, Table 4.4-4. https://infoshare.azwater.gov/docushare/dsweb/Get/Document-10429/Volume_4_final_web.pdf

[4] Arizona Revised Statutes § 45-141. https://www.azleg.gov/ars/45/00141.htm

streamflow, baseflow, groundwater inflow/outflow, and mountain-front recharge estimates were obtained.

The total groundwater storage volume provided in this report reflects the volume of groundwater reasonably accessible at the average depth of the wells in the basin, rather than at the 1,200 feet groundwater storage depth used in previous ADWR reports. The water level falling below the basin's average well depth suggests that wells will have begun to go dry. Using this approach to estimate groundwater storage effectively illustrates the impact of declining water levels on the current existing infrastructure of property owners, residents, and other water users in each basin. Please note that this report does not address potential subsidence or permanent loss of aquifer storage that could occur if the estimated water volume in storage were to be removed from the basin. See the Methods Appendix for more information on how groundwater storage was estimated.

2.2.3 Effluent

Effluent is defined as "water that has been collected in a sanitary sewer for subsequent treatment in a facility that is regulated pursuant to Title 49, Chapter 2."[5] ADWR used effluent data provided by the Arizona Department of Environmental Quality (ADEQ) to estimate the amounts of effluent available for reuse. These effluent estimates are based on effluent volumes produced from wastewater treatment plants designated for reuse. These volumes do not include wastewater discharged from the treatment plants. Effluent volumes also do not include septic tanks or other wastewater collection systems. Recharge from septic tanks is included in the Incidental Recharge estimation.

2.2.4 Incidental Recharge

Incidental recharge is defined as water from human use that replenishes groundwater supplies. Incidental recharge is associated with agricultural, industrial, and municipal water demands. ADWR used data derived from demand analyses to estimate incidental recharge volumes.

2.2.5 Transportation Water

Certain basins have been identified in A.R.S. Title 45, Chapter 2, Article 8.1[6] as basins from which groundwater may be withdrawn for transportation to an AMA. Where such transportation has been authorized, that groundwater is referred to as "Transportation Water" in this report.

2.2.6 Moved Water

Any water that crosses basin boundaries through artificial means and that does not fall under the Transportation Water definition is referred to as "Moved Water" in this report. Moved Water

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[5] Arizona Revised Statutes § 45-101(4). https://www.azleg.gov/ars/45/00101.htm

[6] Arizona Revised Statutes Title 45, Chapter 2, Article 8.1. https://www.azleg.gov/arsDetail/?title=45

includes groundwater that is transported between basins that are not AMAs, pursuant to A.R.S. Title 45, Chapter 2, Article 8.[7]

2.3 SUPPLY RESULTS

This subsection contains ADWR's estimates of annual supplies available to the Hualapai Valley Basin.

2.3.1 Surface Water

In the Hualapai Valley Basin, ADWR identified the following surface water conveyances (USGS streamgages in parentheses):

- Cane Spring Wash
- Colorado River
- Frees Wash
- Hualapai Wash
- Spencer Creek (09404222)
- Truxton Wash (09404343)
- Vock Wash
- White Elephant Wash

Flows on Spencer Creek and Truxton Wash are measured with two streamgages (09404222, 09404343). For streams without streamgage data, the DAR method was applied to estimate streamflow volumes. The streamflow volume estimates provided in the table above are composites of the streamgage and DAR estimation methods.

Table 1. Estimated Surface Water Volumes in the Hualapai Valley Basin for 1990-2024. (SDR 2025)

Basin	Streamflow Minimum	Streamflow Maximum	Average Streamflow (Streamgage Method)	Average Streamflow (DAR Method)	Total Average Streamflow	Median Streamflow
Hualapai Valley	2,168(2019)	57,119(2004)	5,201	6,008	11,209	7,794

All values are shown in AF. Parentheses indicate the year streamflow volume was recorded.

Surface water is estimated to contribute 7,794 AF to the supplies in the basin in a typical year. However, there are years with extremely high or low surface water inflows. Due to the extremely high flow years associated with floods, the average surface water supply in the basin is higher than the median of 7,794 AF per year.

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[7] Arizona Revised Statutes Title 45, Chapter 2, Article 8. https://www.azleg.gov/arsDetail/?title=45

Table 2. Estimated Surface Water Volumes Diverted for Use in the Hualapai Valley Basin for 1990-2024. (SDR 2025)

Year	Diverted Streamflow
1990	2,038,878
2007	2,038,878
2024	2,038,878
Average Annual Diverted Streamflow from 1990-2024	2,038,878

All values are shown in AF.

The estimated surface water volumes were diverted for storage in reservoirs in the Hualapai Valley Basin.

2.3.2 Groundwater

The following groundwater volumes were estimated in the Hualapai Valley Basin:

Table 3. Estimated Streamflow Infiltration Volumes in the Hualapai Valley Basin for 1990-2024. (SDR 2025)

Basin	Average Annual Streamflow Infiltration (Perennial)	Average Annual Streamflow Infiltration (Intermittent & Ephemeral)	Total Average Annual Streamflow Infiltration
Hualapai Valley	442	4,824	5,266

All values are shown in AF.

- Streamflow Infiltration: Infiltration for perennial streams was estimated using the fixed percentage listed in the Methods Appendix. Infiltration for intermittent and ephemeral streams, was estimated using infiltration rates from the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) Soil Quality Indicators.[8] The predominant soil type was fine-silty.[9] The standard storm duration utilized was 1.5 hours.[10] Total streamflow infiltration peaked in 2005 at approximately 19,748 AF and was lowest in 2024 at 568 AF.

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[8] USDA NRCS. (2008). Soil Quality Indicators. United States Department of Agriculture Natural Resource Conservation Service. https://www.nrcs.usda.gov/sites/default/files/2022-10/Infiltration.pdf

[9] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture (NRCS, USDA). (2016). Web Soil Survey (STATSGO2). http://websoilsurvey.nrcs.usda.gov/

[10] Food and Agriculture Organization of the United Nations (FAO). (2024). Annex 2 Infiltration Rate and Infiltration Test. https://www.fao.org/4/s8684e/s8684e0a.htm

Table 4. Estimated Groundwater Volumes
in the Hualapai Valley Basin for 1990-2024. (SDR 2025)

Basin	Average Annual Baseflow	Average Annual Groundwater Inflow	Average Annual Groundwater Outflow	Average Annual Mountain-Front Recharge	Calculated Initial Groundwater Storage
Hualapai Valley	-347	0	-2,337	1,668	2,473,916(2006)

All values are shown in AF. Negative numbers indicate demands or water flows leaving the basin. Parentheses indicate the representative year chosen to calculate initial storage.

- Baseflow: ADWR estimated baseflow using the USGS Hydrologic Toolbox in ArcGIS.[11] Streamgage data were utilized when available. Any gaps in the data were filled using precipitation data from PRISM[12] and the USGS StreamStats website.[13]
- Groundwater Inflow/Outflow: Inter-basin underflow volumes were based on USGS predevelopment maps and scientific literature estimates.[14]
- Mountain-Front Recharge: The mountain-front recharge estimates were calculated using precipitation data, model data, scientific literature estimates for groundwater inflows/outflows,[15] and a water budget accounting for the inflows/outflows that affected the mountain-front recharge volume.
- Groundwater Storage: Storage was calculated using either a model data plus water budget method, if model data were available for the basin, or a GIS-based geological data non-model method, if model data were unavailable for the basin (Section 2.5.4, Methods Appendix). Initial groundwater storage was calculated using wells located within alluvial aquifer boundaries in the basin. A representative year was selected containing the most

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[11] Barlow, P.M. et al. (2022). U.S. Geological Survey Hydrologic Toolbox — A graphical and mapping interface for analysis of hydrologic data: U.S. Geological Survey Techniques and Methods, book 4, chap. D3, 23 p.https://doi.org/10.3133/tm4D3

[12] PRISM Climate Group. (2024). 30-Year Normals [dataset] https://prism.oregonstate.edu/explorer/

[13] USGS. (n.d.-b). StreamStats [dataset]. https://www.usgs.gov/streamstats

[14] Tillman, F. et al. (2011). Water Availability and Use Pilot: Methods Development for a Regional Assessment of Groundwater Availability, Southwest Alluvial Basins, Arizona (Scientific Investigations Report 2011–5071). United States Geological Survey.

https://media.kjzz.org/s3fs-public/field/docs/2011/09/21/sir2011-5071_text.pdf

[15] Tillman, F. et al. (2011). Water Availability and Use Pilot: Methods Development for a Regional Assessment of Groundwater Availability, Southwest Alluvial Basins, Arizona (Scientific Investigations Report 2011–5071). United States Geological Survey. https://media.kjzz.org/s3fs-public/field/docs/2011/09/21/sir2011-5071_text.pdf

water level measurements at those wells. The estimated storage volume was calculated to the basin's average well depth, 540 feet.

2.3.3 Effluent

None of the effluent produced in the Hualapai Valley Basin has been allocated for reuse, so no effluent is categorized as a water supply.

2.3.4 Incidental Recharge

Sources of incidental recharge in the Hualapai Valley Basin are agricultural, municipal, and industrial.

Table 6. Estimated Incidental Recharge Volumes in the Hualapai Valley Basin for 1990-2024. (SDR 2025)

Sector	1990	2007	2024
Agricultural	0	0	7,545
Municipal	404	827	808
Industrial	169	186	166

All values are shown in AF.

- Agricultural Incidental Recharge: Agricultural incidental recharge depends on the total irrigation withdrawals and irrigation efficiency within a basin. The first year of recorded agricultural water use in the Hualapai Valley Basin was 2014. Therefore, agricultural incidental recharge only occurred beginning in 2014.
- Municipal Incidental Recharge: Municipal incidental recharge is a byproduct of lost and unaccounted for (L&U) water from water providers and seepage from septic tanks. The estimated volume of municipal incidental recharge has increased by 423 AF from 1990 to 2007. After 2007, incidental recharge declined to 808 AF in 2024.
- Industrial Incidental Recharge: Industrial incidental recharge occurs from the irrigation of turf facilities and is influenced by irrigation systems' total withdrawals and efficiency. The estimated volume of industrial incidental recharge increased from 1990 to 2007, when industrial incidental recharge peaked at 186 AF. Industrial incidental recharge has fallen since 2007 and was estimated to be 166 AF in 2024.

2.3.5 Transportation Water

Certain basins have been identified in A.R.S. Title 45, Chapter 2, Article 8.1 as basins from which groundwater may be withdrawn for transportation to an AMA. Where such transportation has been authorized, that groundwater is referred to as "Transportation Water" in this report.

The Hualapai Valley Basin was not identified as a transportation water basin.

2.3.6 Moved Water

Any water that crosses basin boundaries through artificial means and that does not fall under the Transportation Water definition is referred to as "Moved Water" in this report. Moved Water includes groundwater that is transported between basins that are not AMAs, pursuant to A.R.S. Title 45, Chapter 2, Article 8.

The Hualapai Valley Basin was not identified as a basin with moved water.

2.4 DEMAND RESULTS

The Demand subsection contains ADWR's estimates of annual demands in the Hualapai Valley Basin.

Table 9. Estimated Demand Volumes for the Hualapai Valley Basin by Sector for 1990-2024. (SDR 2025)

Sector	Subsector/Water Type	Year		
		1990	2007	2024
Agricultural	Agriculture	0	0	-41,746
Municipal	Residential Provider	-2,109	-4,068	-3,653
	Residential Non-Provider	-32	-61	-55
	Non-Residential	-742	-1,766	-2,057
	L&U	-399	-817	-799
Industrial	Dairies	0	0	0
	Feedlots	0	0	0
	Grazing	-35	-35	-35
	Mining	0	0	0
	Power	0	0	-24
	Sand and Gravel	-13	-124	-151
	Turf	-1,376	-1,588	-1,501
	Other	0	0	0
Environmental	Riparian	-1,404	-1,404	-1,404

Negative numbers indicate demands or water flows leaving the basin—all values in AF.

2.4.1 Agricultural

Agricultural demand is water applied to two or more acres of land to produce plants or parts of plants for sale for human consumption or use as feed for livestock, range livestock, or poultry.

The first year of recorded agricultural water use in the Hualapai Valley Basin was 2014. Total irrigation withdrawals have quickly increased to over 40,000 AF between 2022-2024. Currently, there are an estimated 17,024 acres of cultivated land in the basin, with 92% of this land used for orchards. Other crops grown in the basin include grass, winter vegetables, and vineyards. 90% of cropland in the basin is drip irrigated, resulting in a high overall irrigation efficiency of approximately 89%.

2.4.2 Municipal

Municipal demand is defined as the non-agricultural and non-industrial uses of water supplied by a city, town, private water company, irrigation district, domestic water improvement district, water cooperative, or private domestic well.

The Hualapai Valley Basin has an estimated 46,492 residents, with the largest population center being the City of Kingman. A small portion of the residents live on the federally recognized Hualapai Indian Reservation. Water demand is influenced by the Kingman Airport and transitory water use along major transportation routes, including Route 66 and Interstate I-40, which serve as vital corridors for regional travel.

- Residential Provider: Residential provider use is supplied by a municipal provider, or a Community Water System (CWS) as defined in A.R.S. § 45-341[16]. The Hualapai Valley Basin has approximately 45,802 residents served by a CWS. Between 1990 and 2007, residential provider water demand increased approximately 93%, with the highest average annual growth of 115 AF. After 2007, the demand decreased by 10 AF annually, reaching 10% by 2024.
- Residential Non-Provider: Residential non-provider use is any residential water use that is not supplied by a municipal provider but rather by a non-public water system or domestic well. An estimated 690 residents in the basin rely on self-supplied water resources. From 1990 to 2007, residential water demand among non-provider users increased by 91%. The highest annual growth rate of approximately 2 AF occurred from 1990 to 2007. After 2007, the average yearly demand began to decrease by 0.4 AF, which gave an overall decrease of 10% by 2024.
- Non-Residential: Non-residential use is defined as municipal water not used for residential purposes but instead used for commercial, institutional, recreational, or transitory uses. Between 1990 and 2024, non-residential water demand nearly tripled, with the highest annual increase of 60 AF occurring between 1990 and 2007. After 2007, the average annual demand continued to increase, but at a slower rate of 17 AF per year, reaching 17% by 2024.
- Lost and Unaccounted for Water: Lost and Unaccounted for water is defined as the total quantity of water from any source that enters a water distribution system minus the total amount of authorized deliveries from the distribution system during the calendar year. L&U does not account for water loss from a non-public water system or domestic well. During the baseline period, the volume of L&U water doubled, with the highest annual increase of 25 AF occurring from 1990 to 2007. After 2007, L&U began to decline at 1 AF annually, reflecting a two percent decrease by 2024.

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[16] Arizona Revised Statutes § 45-341. https://www.azleg.gov/ars/45/00341.htm

2.4.3 Industrial

Industrial demand is water used by an industrial facility, such as a golf course, dairy, feedlot, power plant, mine, or paper mill.

The current industrial water demands in the Hualapai Valley Basin come from grazing, power production, sand and gravel operations, and the irrigation of turf facilities.

- Grazing: Grazing demand is defined as the water used to maintain stock ponds for the sole purpose of watering livestock. An estimated 2,097 animals graze in the Hualapai Valley Basin, the majority of which are cattle. The estimated annual water consumption of the animals is 35 AF.
- Power: Power demand is defined as the water use for the generation of power at thermal or renewable power plants. There are three solar power plants in the basin that became operational in 2011, 2017, and 2018. Total annual water use in 2024 was estimated to be 24 AF.
- Sand and Gravel: Sand and gravel demand accounts for the water use of any facility or establishment that produces aggregates or quarried materials. An increase in the number of operating sand and gravel facilities in the basin has resulted in an increase in water use over the baseline period. In 1990, water use was estimated to be 13 AF. This volume grew until 2016, when water use peaked at 165 AF. The volume of water used for sand and gravel production in 2024 was estimated to be 151 AF.
- Turf: Turf demand is defined as the irrigation or maintenance of any area of landscaping that is not part of a private residence. From 1990 to 2024, the acreage of irrigated turf increased in the Hualapai Valley Basin, resulting in an increase in water use of nine percent.

2.4.4 Environmental

Environmental demand is quantified within this report as evapotranspiration along streams, rivers, lakes, and drainage ways. Most riparian habitat in the Hualapai Valley Basin is along reaches of the Colorado River upstream of Lake Mead in the far northern corner of the basin. The riparian demand values in the SDRs represent a high-end estimate of the potential water needs of riparian plants within a basin. In the absence of site-specific data, these estimates assume an average value for riparian plants' water needs, which does not consider local environmental conditions. Please see the Methods Appendix for an in-depth explanation of the methodologies.

- Annual net water requirements for the riparian plants are estimated to be 1,404 AF.

3 COMBINING SUPPLY AND DEMAND

The water budget in the Hualapai Valley Basin shows a consistently negative trend over the baseline period due to demand outweighing supply. Demand steadily increased from 6,110 AF in 1990 to 10,283 AF in 2012 before rapidly climbing to a maximum of 52,100 AF in 2022. Supply peaked in 2005 at an estimated 15,681 AF but largely fluctuated, resulting in an average contribution of 5,521 AF per year over the entire baseline period. Overall, groundwater storage has decreased throughout the baseline period due to this imbalance of demand consistently exceeding supply in the basin.

Table 10. Summary of Total Estimated Demand and Supply Values from 1990-2024 in the Hualapai Valley Basin. (SDR 2025)

	1990	2007	2024
Supply	2,164	7,867	9,433
Demand	-6,110	-9,863	-51,426
Balance	-3,946	-1,996	-41,992
Resulting Water Available in Storage	2,511,698	2,471,920	2,104,738

Negative numbers indicate demands or water flows leaving the basin—all values in AF.

4 RESULTS OF PROJECTION SCENARIOS

Staff developed scenarios based on the most likely impacts on water demands and supplies over 51 years (from 2025 to 2075). Projections were then generated from the baseline data.

The projection scenarios developed are:

1. Status Quo: baseline volumes were carried forward through the projection period.
2. Growth: volumes were assumed to increase within specific parameters throughout the projection period.
3. Conservation: volumes were assumed to be influenced by specific conservation practices through the projection period.
4. Technology: volumes were assumed to be influenced by technological advancements through the projection period.
5. Climate: volumes were adjusted for three different climate scenarios, using a 1-degree Fahrenheit temperature increase in the mean annual temperature for the projection period, following a lower emissions pathway for Arizona; a 5-degree Fahrenheit temperature increase, following a medium emissions pathway; and a 10-degree Fahrenheit temperature increase, following a high emissions pathway.

While Colorado River water is subject to a different legal framework, the term “surface water” necessarily encompasses Colorado River water, including Central Arizona Project (“CAP”) water. Therefore, Colorado River water, including CAP water, is incorporated in the estimates of available surface water supplies. The availability of Colorado River water in Arizona will be subject to operations to be determined by the Secretary of the Interior in an ongoing federal process. While significant uncertainty surrounds the reliability of Colorado River water supplies, particularly on the mainstem of the Colorado River in the Lower Basin, this report assumes that Non-Indian Agricultural (NIA) Priority CAP water will generally not be available during the projection period, but that all other Colorado River water and CAP water will be available.

4.1 SUPPLY PROJECTION RESULTS

4.1.1 Surface Water

For the Status Quo scenario, the estimated projected volume of surface water will remain constant until 2075.

Table 11. Estimated Surface Water Status Quo Projection Volumes for the Hualapai Valley Basin for 2025-2075. (SDR 2025)

Basin	Volume
Hualapai Valley	9,939

All values are shown in AF.

Due to ongoing projection scenario improvements, no other projection scenarios were applied to surface water for this report.

4.1.2 Groundwater Storage

For the Status Quo scenario, the estimated projected balance between Supply and Demand will remain constant at -35,939 AF through 2075.

Table 12. Estimated Groundwater Storage Status Quo Projection Volumes for the Hualapai Valley Basin for 2025-2075. (SDR 2025)

Scenario	2025	2050	2075
Status Quo	2,068,799	1,170,316	271,833

All values are shown in AF.

Due to ongoing projection scenario improvements, no other projection scenarios were applied to groundwater storage for this report.

4.1.3 Effluent

In the Hualapai Valley Basin, no effluent produced has been allocated for reuse. Therefore, no effluent is used as a water supply, and no supply projections were applied to the data.

4.1.4 Incidental Recharge

Table 13. Estimated Agricultural Incidental Recharge Projection Volumes for the Hualapai Valley Basin for 2025-2075. (SDR 2025)

Sector	Scenario	2025	2050	2075
Agricultural	Status Quo	6,237	6,237	6,237
	Climate – Low	6,237	6,280	6,322
	Climate – Medium	6,237	6,446	6,655
	Climate - High	6,237	6,650	7,062
	Conservation	6,237	6,235	6,235
	Growth	6,237	6,237	6,237
	Technology	6,237	6,178	6,111

All values are shown in AF.

- Status Quo: The Status Quo scenario estimated projected volume will remain constant through 2075.
- Climate: The Climate scenario is expected to result in rising temperatures and increased evapotranspiration, leading to increased irrigation withdrawals. Incidental recharge would be expected to increase with irrigation withdrawals. The projected increase in incidental recharge is about one percent for a 1° F rise in average temperature, seven percent for a 5° F rise, and 13% for a 10° F rise.
- Conservation: The Conservation scenario implements requirements similar to those in the initial AMAs' 5th Management Plan. The projected impact in the Hualapai Valley Basin is minimal because most agriculture in the basin already uses highly efficient drip irrigation.
- Growth: Agriculture has quickly grown in the Hualapai Valley Basin since 2014. However, future irrigation withdrawals are projected as constant due to the basin's status as an INA.
- Technology: Irrigation systems are assumed to be upgraded with available technology to reduce overall water use. As with the Conservation scenario, projected impact is minimal because highly efficient irrigation systems are already used for the vast majority of cropland in the basin.

Table 14. Estimated Municipal Incidental Recharge Projection Volumes for the Hualapai Valley Basin for 2025-2075. (SDR 2025)

Sector	Scenario	2025	2050	2075
Municipal	Status Quo	62	62	62
	Climate – Low	64	64	64
	Climate – Medium	64	65	65
	Climate - High	64	65	67
	Conservation	63	54	44
	Growth	65	80	95
	Technology	64	56	49

All values are shown in AF.

- Status Quo: The Status Quo scenario estimated projected volume will remain constant through 2075.
- Climate: Under the Climate scenario, rising temperatures and increased evaporation rates are expected to increase water demands. Projected incidental recharge volumes by 2075 are estimated to show no increase under the low emissions scenario, an increase of two percent under the medium scenario, and a five percent under the high emissions scenario.
- Conservation: Under the Conservation scenario, additional water-saving measures and requirements similar to those in the initial AMAs' 5th Management Plan are implemented. Under the scenario, the projected demand is expected to decrease 30% by 2075.
- Growth: Under the Growth scenario, population projections produced by the Arizona Commerce Authority Office of Economic Opportunity (ACA OEO)[17] were used to estimate the growth in the basin. The incidental recharge is projected to increase 46% by 2075 due to an increase in service area population.
- Technology: The Technology scenario assumes widespread adoption of water monitoring technologies, such as advanced metering infrastructure (AMI) or home-based devices, with active leak detection and customer response. Estimated savings of 14,000 gallons per household per year reflect reductions from leaks and improved water use efficiency. This reduction is projected to result in a decrease in incidental recharge of 23% by 2075.

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[17] Arizona Commerce Authority (ACA). (2022a). Population Estimates. Arizona Commerce Authority. https://www.azcommerce.com/oeo/population/population-estimates/

Table 15. Estimated Industrial Incidental Recharge Projection Volumes for the Hualapai Valley Basin for 2025-2075. (SDR 2025)

Sector	Scenario	2025	2050	2075
Industrial	Status Quo	164	164	164
	Climate – Low	166	168	169
	Climate – Medium	166	173	179
	Climate - High	167	180	193
	Conservation	163	159	159
	Growth	164	164	164
	Technology	164	162	161

All values are shown in AF.

- Status Quo: The Status Quo scenario estimated projected volume will remain constant through 2075.
- Climate
    - Turf: Increased temperatures and evapotranspiration are expected to raise overall turf irrigation requirements in the Climate scenarios. In the low emissions scenario, incidental recharge is projected to increase by 3 AF. In the medium and high emissions scenarios, incidental recharge is projected to increase by 13 AF and 26 AF, respectively.
- Conservation
    - Turf: The Conservation scenario assumes that turf facilities will increase irrigation efficiency over time. As irrigation efficiency increases, total irrigation is expected to drop, resulting in a reduction in incidental recharge. By 2075, the volume of incidental recharge is estimated to decrease by 4 AF, or two percent.
- Growth: Status Quo projection volumes were applied in the absence of a defined Growth scenario.
- Technology
    - Turf: The Technology scenario assumes that eligible acres of natural turf will be replaced with synthetic turf. Synthetic turf requires less water to maintain than natural grass and reduces groundwater recharge. The conversion of natural turf to synthetic turf is projected to decrease industrial incidental recharge volumes by 3 AF, or less than two percent, by 2075.

4.2 DEMAND PROJECTION RESULTS

4.2.1 Agricultural

Table 16. Estimated Projected Demand Volumes for the Agricultural Sector for the Hualapai Valley Basin for 2025-2075. (SDR 2025)

Scenarios	Year		
	2025	2050	2075
Status Quo	-34,420	-34,420	-34,420
Climate - Low	-34,420	-34,691	-34,962
Climate – Medium	-34,420	-35,774	-37,128
Climate - High	-34,420	-37,128	-39,836
Conservation	-34,420	-34,418	-34,418
Growth	-34,420	-34,420	-34,420
Technology	-34,420	-34,357	-34,294

Negative numbers indicate demands or water flows leaving the basin—all values in AF.

- Status Quo: The Status Quo scenario estimated projected volume will remain constant through 2075.
- Climate: The Climate scenario is expected to result in rising temperatures and increased evapotranspiration, leading to increased irrigation withdrawals. Irrigation needs in the Hualapai Valley Basin are estimated to increase by 1.6% for a 1° F rise in average temperature, 7.9% for a 5° F rise, and 15.7% for a 10° F rise.
- Conservation: The Conservation scenario implements requirements similar to those in the initial AMAs' 5th Management Plan. The projected impact in the Hualapai Valley Basin is minimal because most agriculture in the basin already uses highly efficient drip irrigation.
- Growth: Agriculture has quickly grown in the Hualapai Valley Basin since 2014. However, future irrigation withdrawals are projected as constant due to the basin's status as an INA.
- Technology: Irrigation systems are assumed to be upgraded with available technology to reduce overall water use. As with the Conservation scenario, projected impact is minimal because highly efficient irrigation systems are already used for the vast majority of cropland in the basin.

4.2.2 Municipal

Table 17. Estimated Projected Demand Volumes for the Municipal Sector for Hualapai Valley Basin for 2025-2075. (SDR 2025)

	Residential Provider			Residential Non-Provider		
	2025	2050	2075	2025	2050	2075
Status Quo	-3,546	-3,546	-3,546	-53	-53	-53
Climate – Low	-3,654	-3,662	-3,669	-55	-55	-55
Climate – Medium	-3,655	-3,694	-3,732	-55	-56	-56
Climate - High	-3,657	-3,734	-3,811	-55	-56	-57
Conservation	-3,631	-3,067	-2,503	-55	-46	-38
Growth	-3,724	-4,575	-5,416	-56	-69	-82
Technology	-3,637	-3,225	-2,813	-55	-49	-42

Negative numbers indicate demands or water flows leaving the basin—all values in AF.

	Non-Residential			L&U		
	2025	2050	2075	2025	2050	2075
Status Quo	-1,939	-1,939	-1,939	-768	-768	-768
Climate – Low	-2,057	-2,057	-2,057	-2,568	-2,569	-2,570
Climate – Medium	-2,057	-2,057	-2,057	-2,568	-2,574	-2,579
Climate - High	-2,057	-2,057	-2,057	-2,569	-2,579	-2,590
Conservation	-2,057	-2,057	-2,057	-796	-512	-456
Growth	-2,097	-2,576	-3,050	-815	-1,001	-1,185
Technology	-2,057	-2,057	-2,057	-797	-739	-682

Negative numbers indicate demands or water flows leaving the basin—all values in AF.

- Status Quo: The Status Quo scenario estimated projected volume will remain constant through 2075.
- Climate: Under the Climate scenario, rising temperatures and increased evaporation rates are expected to increase water demands. By 2075, residential provider demands are projected to show minimal increase under the low emissions scenario, two percent under the medium, and a four percent under the high scenario. Residential non-provider demand is projected to show no change under the low emissions scenario, a two percent increase under the medium scenario, and four percent rise in the high scenario. Non-residential demand is expected to remain constant across all scenarios. Lost and Unaccounted for (L&U) water is anticipated to show minimal change under the low and medium emissions scenario, while the high emissions scenario is expected to see a one percent increase.
- Conservation: Under the Conservation scenario, additional water-saving measures and requirements similar to those in the initial AMAs' 5th Management Plan are implemented.

By 2075, residential provider and non-provider demand is projected to decline by 31%. Non-residential demand is expected to remain constant throughout the projection period. The total volume of L&U water is projected to decrease 43%.

- Growth: Under the Growth scenario, population projections produced by the Arizona Commerce Authority Office of Economic Opportunity (ACA OEO)[17] were used to estimate the growth in the basin. Projected demand for residential providers is expected to increase 45% by 2075. Residential non-provider demand is projected to rise 46%. Non-residential demand and L&U are expected to rise 45% by 2075.
- Technology: The Technology scenario assumes widespread adoption of water monitoring technologies, such as AMI or home-based devices, with active leak detection and customer response. Estimated savings of 14,000 gallons per household per year reflect reductions from leaks and improved water use efficiency. By 2075, residential provider demand is anticipated to decline by 23%. Residential non-provider water demand is expected to decrease 24%. Non-residential demand is expected to remain constant with no change. The total volume of L&U water is projected to reach a decrease of 14% by 2075.

4.2.3 Industrial

Table 18. Estimated Projected Demand Volumes for the Industrial Sector for Hualapai Valley Basin for 2025-2075. (SDR 2025)

	Grazing	Sand and Gravel
Status Quo	-35	-157

Status Quo projections were the only projection scenarios that were applied to the grazing and sand and gravel subsectors. Negative numbers indicate demands or water flows leaving the basin—all values in AF.

Due to ongoing projection scenario improvements, no other projection scenarios were applied to the grazing and sand and gravel subsectors for this report.

	Power			Turf		
	2025	2050	2075	2025	2050	2075
Status Quo	-23	-23	-23	-1,486	-1,486	-1,486
Climate – Low	-24	-24	-25	-1,502	-1,514	-1,525
Climate – Medium	-24	-25	-25	-1,504	-1,561	-1,619
Climate - High	-24	-25	-27	-1,506	-1,621	-1,737
Conservation				-1,501	-1,439	-1,439
Growth	-24	-24	-24			
Technology	-23	-17	-11	-1,484	-1,469	-1,453

Status Quo projection values were applied in the absence of a defined scenario for a subsector. This is indicated by a gray cell. Negative numbers indicate demands or water flows leaving the basin—all values in AF.

- Status Quo: The Status Quo scenario estimated projected volume will remain constant through 2075.
- Climate
    - Power: The Climate scenario considers changes in consumer electrical demand and changes in power plant operations resulting from higher temperatures. In the low emissions and medium emissions scenarios, water used for power production is estimated to increase to 25 AF per year. In the high emissions scenario, water use is projected to increase to 27 AF per year.
    - Turf: Increased temperatures and evapotranspiration are expected to raise overall turf irrigation requirements in the Climate scenarios. Water use for turf facilities is estimated to increase by two percent in the low emissions scenario, eight percent in the medium emissions scenario, and 15% in the high emissions scenario.
- Conservation
    - Turf: Under the Conservation scenario, increased irrigation efficiency requirements are expected to decrease water use by 62 AF, or four percent.
- Growth
    - Power: The Growth scenario considers the impact that population growth, planned decommissions of existing power plants, and additions of permitted power plants will have on water demand for power production. The Growth scenario is not projected to have an impact on water use for power production in the Hualapai Valley Basin.
- Technology
    - Power: The implementation of consumer-side and utility-side technologies is projected to reduce demand by 12 AF by 2075.
    - Turf: In the Technology scenario, it is assumed that eligible acres of natural turf will be converted to synthetic turf. The conversion of natural turf to synthetic turf is projected to have a modest impact on irrigation water use, with the annual water demands estimated to decrease by two percent.

4.2.4 Environmental

Table 19. Estimated Projected Environmental Demand Volumes for Hualapai Valley Basin for 2025-2075. (SDR 2025)

	Environmental		
	2025	2050	2075
Status Quo	-1,404	-1,404	-1,404
Climate – Low	-1,404	-1,411	-1,418
Climate – Medium	-1,404	-1,428	-1,450
Climate - High	-1,404	-1,451	-1,490

Negative numbers indicate demands or water flows leaving the basin—all values in AF.

- Status Quo: The Status Quo scenario estimated projected volume will remain constant through 2075.
- Climate: The Climate scenarios for riparian use consider the impact of increased temperatures, increased evapotranspiration, and habitat transition. Under the set parameters of these scenarios, riparian use is expected to increase in the Hualapai Valley Basin as the higher temperatures increase evapotranspiration from riparian plants. Riparian water use is estimated to increase by one percent in the low emissions scenario, three percent in the medium emissions scenario, and six percent in the high emissions scenario.

5 CONCLUSION

A long-term imbalance between water supplies and demand in the Hualapai Valley Basin has led to a decline in groundwater storage. Demand values outweighed supply through a majority of the baseline period, which resulted in groundwater storage decreasing by approximately 400,000 AF from 1990 to 2024. If groundwater levels were to drop below the basin's average well depth of 540 feet, approximately 54% of existing wells would become dry. The average recorded water level of wells in Hualapai Valley Basin is 314 feet.

Water supplies showed great variance throughout the baseline period. Supply averaged 5,521 AF per year but covered a wide range, from a minimum of 1,578 AF in 1998 to a maximum of 15,681 AF in 2005. Streamflow infiltration was the greatest component of supply during the baseline period, with intermittent and ephemeral streams contributing 4,824 AF per year. Agricultural incidental recharge became a major component of supply once agricultural water use started, averaging 5,552 AF per year from 2014 to 2024.

Demand steadily increased from 6,110 AF in 1990 to 9,000 AF in 2013. Demand values then rapidly increased, starting at 16,866 AF in 2014 before ending at 51,426 AF in 2024. This rapid increase is largely attributed to Agricultural demand starting in 2014, with an initial value of 8,000 AF before ending the baseline period with 41,746 AF in 2024. Municipal non-provider saw the second highest increase over the baseline period, increasing almost threefold to 2,057 AF in 2024.

Hualapai Valley Basin carried a negative water balance during the baseline period.

5.1 ATTACHMENTS

- **Acronyms and Definitions**
- **References (Sources) – general**