Kyl Center for Water Policy at Morrison Institute
Arizona State University

Groundwater Protection

in the Valley of the Sun

Past, Present & Future

March 2024

Groundwater Protection in the Valley of the Sun

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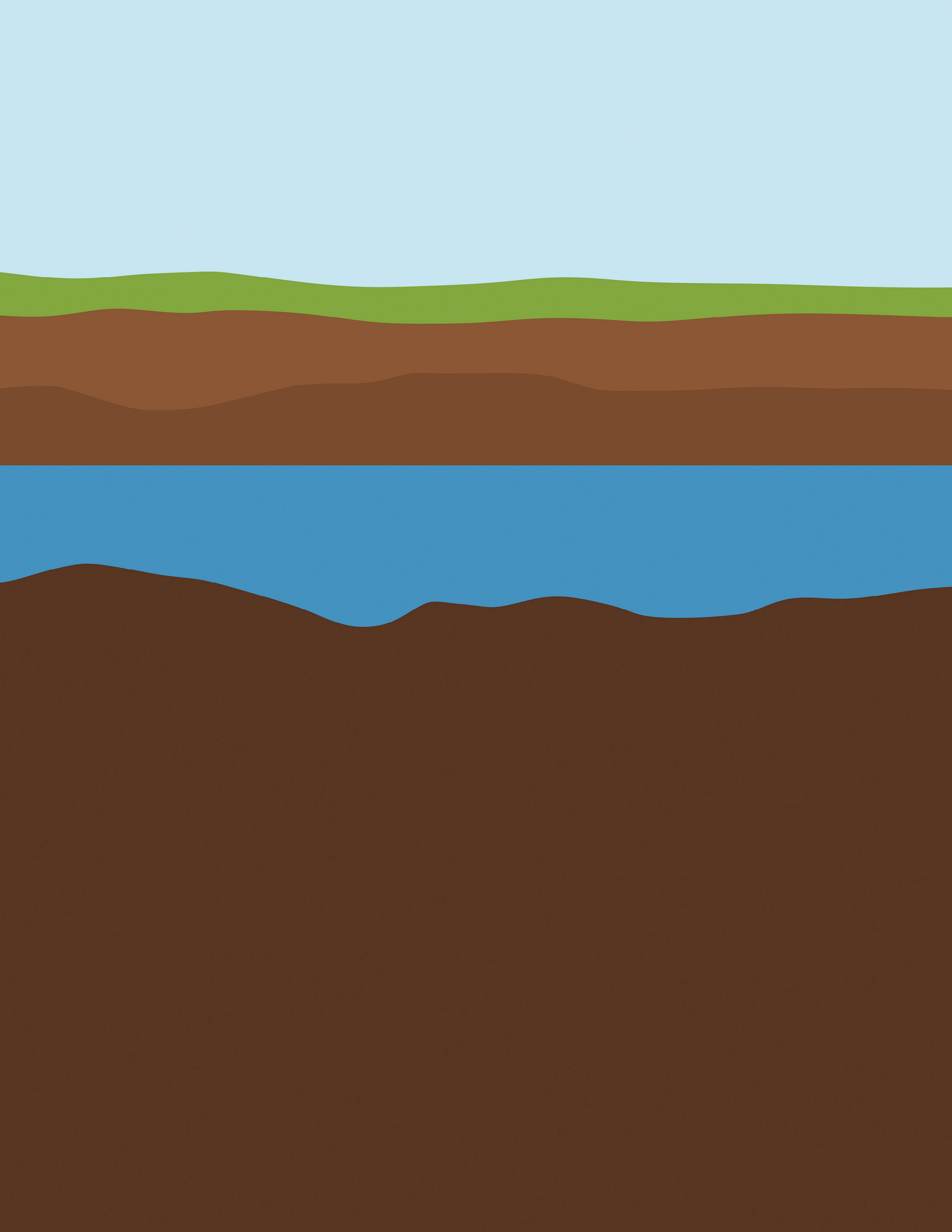
The Kyl Center for Water Policy at ASU's Morrison Institute

Contents



Highlights

- **Arizona's rules allowing development on groundwater have disincentivized investments needed for long-term water resilience in the Phoenix Active Management Area.**
- **Unless aquifer recharge and replenishment occur closer to areas of groundwater decline, the aquifer in these areas will likely be lost – meaning that aquifer layers will subside and compact.**
- **Colorado River supply cuts will exacerbate these problems.**
- **Remarkable investments in aquifer protection in the Valley of the Sun were made in the past: it is possible to uphold and improve these protections.**

Sustainable water management is essential in the Valley of the Sun, underpinning public health, economic vitality and quality of life in our desert cities. The Valley enjoys access to three different renewable water supply sources: Salt and Verde River water, reclaimed water and Colorado River water imported from Western Arizona. Yet there is an unseen water source that is also indispensable to Phoenix-area communities. Underneath the Valley sits an enormous aquifer containing enough groundwater to fuel many generations of families and economic enterprises.

However, nearly all of this groundwater is fossil, meaning that it has been in the aquifers for thousands of years,[1] and is not annually renewed by natural precipitation at any significant rate. Once it is pumped out and used, it is no longer available for future generations. In the Valley's desert environment, the aquifer can be viewed as a savings account for times when surface water supplies run short.

Because of the 1980 Arizona Groundwater Management Act, the Valley is one of the few highly populated arid or semi-arid areas in the world where groundwater stocks are not currently in steep decline.[2]

The future for the Valley's groundwater is less bright. In June 2023, the Arizona Department of Water Resources' (ADWR) released projections from its updated groundwater model for the Phoenix area[3] and concluded that the area has "reached the anticipated limits of growth on groundwater supplies."[4] Moreover, as Colorado River water supplies diminish, municipal water providers will turn to groundwater as a back-up supply and less Colorado River water will be available for aquifer recharge and replenishment.[5]

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1 Marissa Grunes et al., Ancient groundwater: *Why the water you're drinking may be thousands of years old*, The Conversation, October 7, 2021, https://theconversation.com/ancient-groundwater-why-the-water-youre-drinking-may-be-thousands-of-years-old-167982.

2 See Scott Jasechko et al., *Rapid groundwater decline and some cases of recovery in aquifers globally*, Nature, January 24, 2024, https://www.nature.com/articles/s41586-023-06879-8 (detailing groundwater decline and recovery worldwide). Arizona's 1980 Groundwater Management Act is codified in Ariz. Rev. Stat. Title 45, Chapter 2.

3 Arizona Department of Water Resources Groundwater Modeling Section Hydrology Division, *Technical Memorandum Phoenix AMA 100-Year Assured Water Supply Projection*, June 2023, https://infoshare.azwater.gov/docushare/dsweb/Get/Document-76432/2023_Technical_Memorandum_Phx_AMA_100_Yr_Projection.pdf at ES-1.

4 Governor's Water Policy Council Assured Water Supply Committee, *Assured Water Supply Committee*, June 27, 2023, https://www.azwater.gov/sites/default/files/adwr_meetings_docs/20230627_AWS_Comm_Meeting.pdf at 12.

5 Kyl Center for Water Policy, *Impacts of Colorado River Shortage to Tap Water Deliveries in Central Arizona*, ASU Morrison Institute, June 2023, https://morrisoninstitute.asu.edu/sites/default/files/impacts_of_colorado_river_shortage_to_tap_water_deliveries_in_central_arizona.pdf.

The good news is that solutions are known. They involve developing the alternative water supplies and infrastructure necessary to transition away from reliance on groundwater pumping and/or recharging the alternative supplies into areas of the regional aquifer that are experiencing groundwater decline.

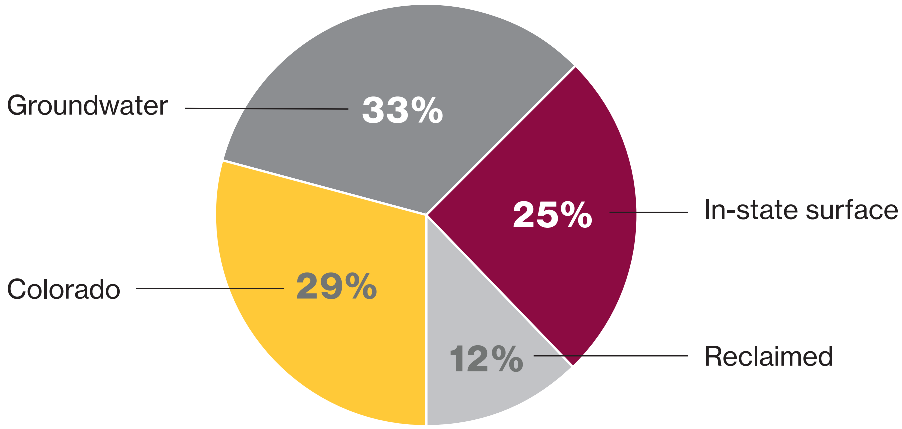
Groundwater regulation in Central Arizona was politically difficult to achieve.[6] Building the political will to enact the Groundwater Code required the intentional use of carrots and sticks to both incentivize and force investment in the expensive infrastructure necessary to develop and use renewable water supplies in lieu of groundwater dependency. The degree to which the protections of the Groundwater Code can be upheld – or even improved – in an era of declining access to Colorado River water and a declining groundwater basin is unclear.

Yet, the groundwater protections afforded in the 1980 Arizona Groundwater Management Act function as the signal of water security that enables confident investment in the Valley. Reducing these protections potentially jeopardizes this resilience and may have ramifications on the local economy. The tradeoffs should be carefully considered.

Water supplies and associated infrastructure in the Valley of the Sun

The Valley of the Sun has access to significant sources of water, including water from the Salt and Verde Rivers, local groundwater, Colorado River water imported from Western Arizona via the Central Arizona Project (CAP) canal and reclaimed wastewater. Portions of the West Valley enjoy access to water from the Agua Fria and Gila Rivers, as well.

Greater Phoenix Water Sources



Source: ADWR AMA Data (2022).

6 See, e.g., Arizona Groundwater Management Study Commission, *Draft Report of Tentative Recommendations*, July 1979, https://azmemory.azlibrary.gov/nodes/view/255569.

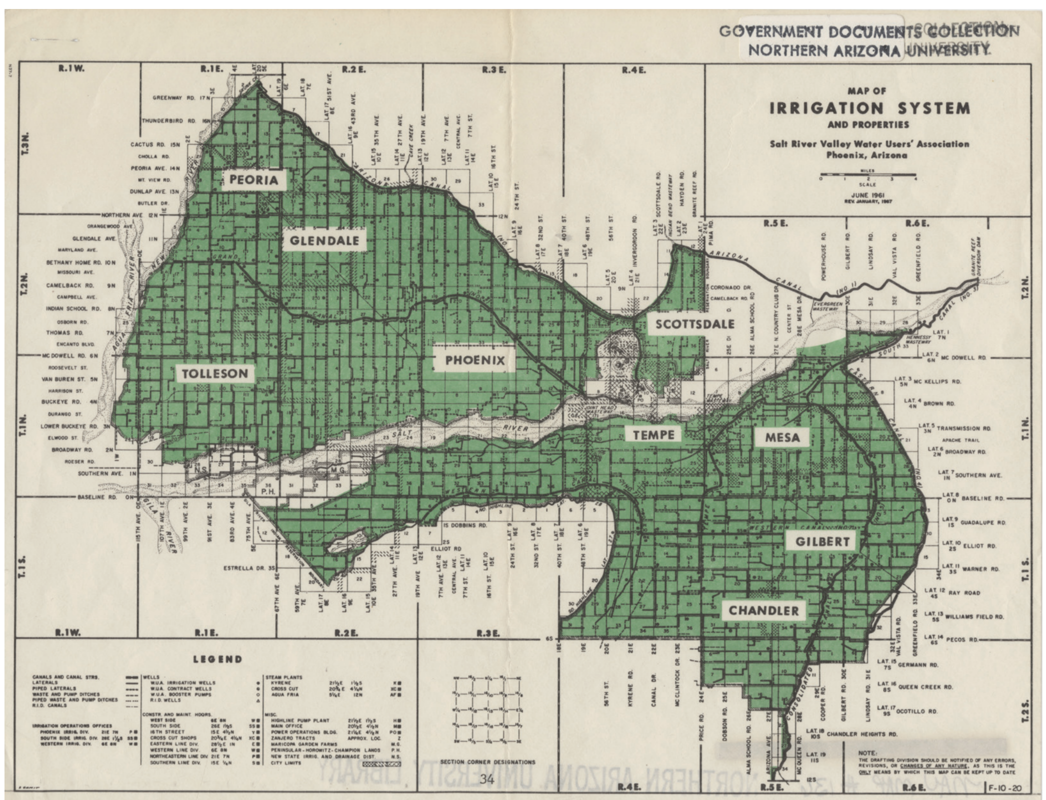
The use of renewable surface water supplies

It is likely because of the flows of the Salt, Verde, Agua Fria and Gila Rivers that early Native Americans settled in the region and developed large agricultural civilizations. They channeled river water into hand-dug canals and used gravity to spread water far across the Valley floor to vast fields of crops. This ancient canal system forms the basis of the modern system managed by the Salt River Project (SRP) and used to deliver Salt and Verde River water for municipal, industrial and agricultural purposes.

Because the water in the SRP canals flows gradually downhill, no power is necessary to deliver the water from the system. When used for non-potable purposes that do not require treatment, no cheaper water is available in the Valley of the Sun. Salt and Verde River water delivered in this manner has been used since time immemorial for local agriculture and is still used to this day for irrigation of crops, parks, school yards, cemeteries, sports fields, golf courses and other non-potable uses. The right to water from the Salt and Verde Rivers, delivered through this canal infrastructure, runs with the lands originally pledged as collateral to finance Roosevelt Dam and, with some exceptions, cannot be used outside the boundaries of those SRP lands.

Map of Irrigation System and Properties

Salt River Valley Water Users' Association Phoenix, AZ.
June 1961, Rev. January 1967.



Source: NAU.MAP.136. Colorado Plateau Archives. Special Collections and Archives, Cline Library, Northern Arizona University.

From the turn of the 20th century and through the 1980s, population growth and economic enterprise was concentrated on the lands served by SRP in part because of the availability of this inexpensive, reliable surface water supply. In 1947 Phoenix completed the state's first surface-water treatment plant on the banks of the Verde River. In 1952 Phoenix built a surface-water treatment plant on the banks of SRP's Arizona canal, and Tempe followed with completion of another on SRP's South Canal in 1967. In 1973 Phoenix partnered with Mesa to build a water treatment plant on SRP's South canal. Ultimately, Chandler, Gilbert, Glendale, Peoria, Scottsdale and Goodyear would also build surface-water treatment plants on SRP canal banks. In total, 13 Salt and Verde surface-water treatment plants were constructed to meet the potable water needs of a growing population.

Development of Surface Water Treatment Plants

Dependent on Salt and Verde River Water

1947	Verde Water Treatment Plant – Phoenix
1952	24th Street Water Treatment Plant – Phoenix
1963	Deer Valley Water Treatment Plant – Phoenix
1967	Johnny G. Martinez Water Treatment Plant – Tempe
1973	Val Vista Water Treatment Plant – Phoenix
1979	Cholla Water Treatment Plant – Glendale
1980	Price Road Water Treatment Plant – Tempe
1988	Pecos Water Treatment Plant – Chandler
1995	North Water Treatment Plant – Gilbert
2002	Greenway Water Treatment Plant – Peoria
2006	Chaparral Water Treatment Plant – Scottsdale
2007	Oasis Water Treatment Plant – Glendale
2021	Goodyear Water Treatment Plant – Goodyear

River water supplies are considered to be renewable because snowpack, rain and springs in their watersheds continually feed them. The development of dams and reservoirs on river systems mitigates the impact of droughts and floods. By bearing the cost of the dams, reservoirs and canal delivery systems collectively, the owners of land served by SRP achieved benefits in public safety and economic development.

The transition to pumping groundwater

While neighborhoods and businesses were initially concentrated within the boundaries of SRP lands, over time both spilled onto desert lands that had never been cultivated and did not have rights to Salt and Verde River water. In the vast alluvial plain that underlies the Valley of the Sun, wells can be developed very close to where the demand for water exists, and they can be developed to supply treated water in smaller increments at lower up-front costs than via surface water treatment plants. Not surprisingly, towns, farms and other enterprises located outside of the boundaries of SRP lands drilled wells into local aquifers to tap groundwater.

A surface water treatment plant typically is built to provide a minimum of 8 million gallons per day of treatment and delivery capacity and can cost tens of millions of dollars to construct. A well, on the other hand, can be developed to provide as little as 20,000 gallons per day at a cost of less than a million dollars. Wells thus allow increased water demands to be more flexibly met with smaller, less expensive units of treatment and delivery.

While use of groundwater today provides economic benefits, current use comes at the cost of future economic benefit to the extent that:

- groundwater is depleted and unavailable for future use,
- groundwater pumping compacts aquifer soils and causes subsidence of the land surface, diminishing its ability to soak up water and be naturally or artificially recharged,
- contaminants move as groundwater is pumped and water quality in the aquifer diminishes, and
- the cost to drill a well and pump water increases because groundwater levels in the aquifer fall.

Some of these detrimental impacts of groundwater depletion can be fixed or overcome at a price. However, loss of aquifer elasticity, and the resulting compaction of aquifer soils, is predominantly irreversible.[7] In these cases, after compaction of aquifer soils, the aquifer can no longer be recharged or replenished, and its water storage capacity is lost forever – imagine filling an underground reservoir with concrete. In many places, aquifer depletion causes the ground to sink.

ADWR maps and monitors subsidence areas throughout Arizona.[8] According to ADWR, areas in Maricopa County have subsided more than eighteen feet since the early 20th Century.

> *Land subsidence in the basins of Arizona is generally due to compaction of alluvium caused by lowering of the water table. As the water table declines, pores in the alluvium once held open by water pressure are no longer supported and collapse… This subsidence is generally not recoverable.*[9]

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7 United States Geological Society, *Aquifer Compaction Due to Groundwater Pumping*, October 18, 2018, https://www.usgs.gov/centers/land-subsidence-in-california/science/aquifer-compaction-due-groundwater-pumping.

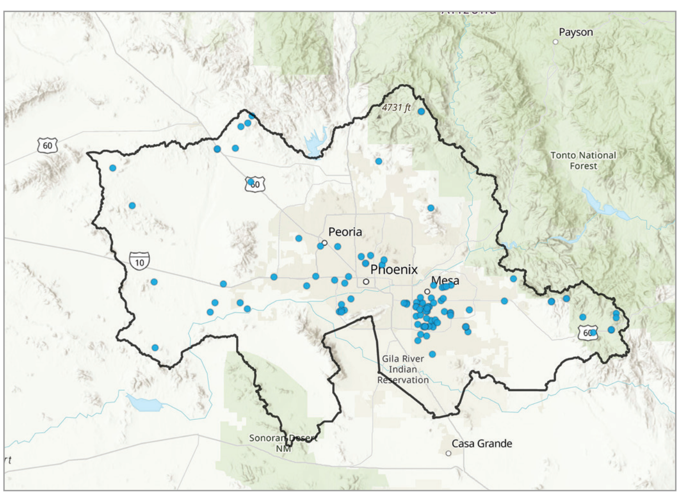
8 For more information, see https://www.azwater.gov/hydrology/field-services/land-subsidence-arizona.

9 Arizona Department of Water Resources, *Land Subsidence in Arizona*, https://www.azwater.gov/hydrology/field-services/land-subsidence-arizona.

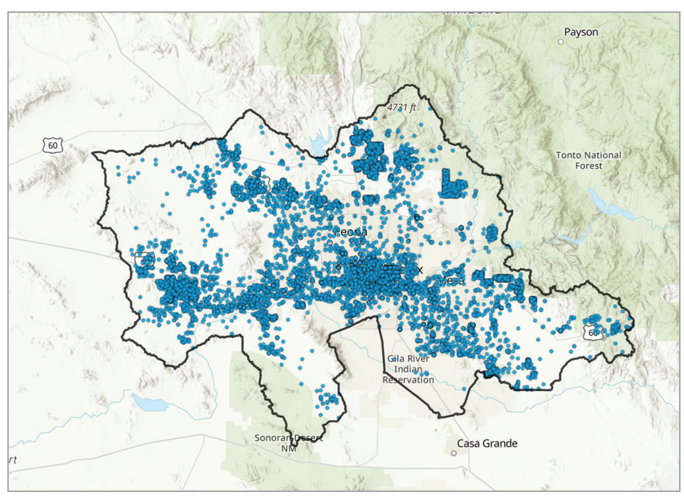
It was not until the emergence of vertical turbine pumps that groundwater began to be used in the Phoenix area at a significant scale. Due to the expansion of thirsty cotton acreage beginning in the 1930's, the cost advantage of meeting new municipal demands with wells rather than surface-water treatment plants and the lack of access to Salt and Verde River water outside of SRP lands, demand for pumped groundwater soon outpaced the rate at which the aquifers were naturally replenished. Severe groundwater overdraft was the result.[10]

Land subsidence Eloy-Picacho, Pinal County. Signs on the pole show approximate altitude of land surface in 1952 and 2018. Source: ADWR.

Phoenix AMA Wells Before 1920 and After 1990



☐ Phoenix AMA
● Wells before 1920



☐ Phoenix AMA
● Wells after 1990

10 Milman, Bonnell, Maguire, Sorensen and Blomquist, Groundwater Recharge for Water Security: The Arizona Water Bank, Arizona, Case Studies in the Environment, 2021, https://online.ucpress.edu/cse/article/5/1/1113999/116771/Groundwater-Recharge-for-Water-SecurityThe-Arizona.

A shift to renewable water supplies

The importation of Colorado River water into central Arizona was viewed as the "rescue plan" for farms and communities relying on rapidly depleting aquifers.[11] In 1968 Arizona secured the federal loan necessary to build the Central Arizona Project (CAP) canal, through which Colorado River water from western Arizona is delivered into Maricopa, Pinal and Pima Counties. Because that water must be pumped up an elevation of more than 2,000 feet over more than three hundred miles, and because the loan from the federal government to construct the project must be repaid, the cost of the water delivered through the CAP has basically always been much higher than the cost of continuing to rely on wells and pump local groundwater.[12]

Recognizing the economic threat associated with continued depletion of groundwater supplies, and threatened by the Secretary of the Interior that the CAP would not be completed unless Arizona enacted meaningful groundwater reform, in 1980 the Arizona Legislature adopted laws to manage groundwater in Central Arizona. The Groundwater Management Act also established the Arizona Department of Water Resources (ADWR) to administer the groundwater regulations. The highest level of management is applied to Active Management Areas (AMAs), including the Phoenix AMA, which spans roughly the entire Valley of the Sun.

In the Phoenix AMA the management goal is to attempt to achieve and maintain "safe yield," defined as a long-term balance between the annual amount of groundwater withdrawn in the AMA and the annual amount of natural and artificial recharge.

Active Management Areas

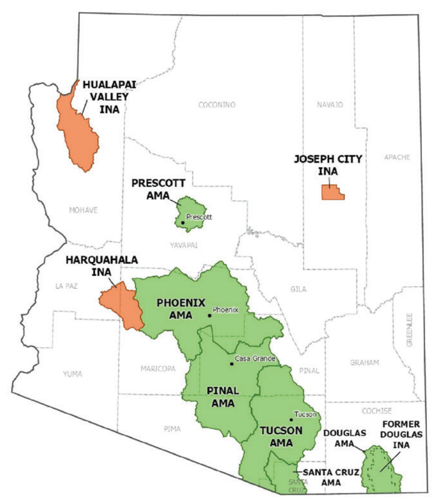
Developers must demonstrate an Assured Water Supply before subdivided land may be sold.

An Assured Water Supply is a determination by ADWR that:

- sufficient water of adequate quality will be physically, continuously and legally available to satisfy water needs of the subdivision for at least 100 years,
- any projected groundwater use is consistent with the AMA's management goal, and
- financial capability has been demonstrated to construct the necessary facilities to treat and distribute water to customers

In the Phoenix AMA the management goal is safe-yield

Safe-yield is accomplished when no more groundwater is being withdrawn than is replaced annually.



Active Management Areas

Irrigation Non-Expansion Areas

Former Non-Expansion Areas

Source: ADWR, January 2023.

11 Arizona Water Commission, *Inventory of Resource and Uses; Phase 1-Arizona State Water Plan, Summary*, July 1975, https://azmemory.azlibrary.gov/nodes/view/269564 at 28. According to a 1975 report by the Arizona Water Commission, "In the three central Arizona counties of Maricopa, Pinal and Pima, the estimated annual overdraft is 1.8 million acre feet. The estimated long-term water supply that will be imported to central Arizona via the Central Arizona Project is 1.2-million acre feet per year or two-thirds of the current rate of overdraft.

12 Michael Hanemann, *Department of Agricultural & Resource Economics, UCB*, University of California Berkeley and Giannini Foundation, 2002, http://large.stanford.edu/courses/2020/ph240/bhatt1/docs/hanemann.pdf.

The Groundwater Management Act was crafted to employ both carrots and sticks to lessen dependence on pumping inexpensive groundwater supplies. It did not outlaw all groundwater pumping; nor did it prevent new industrial uses of groundwater. For example, it gave grandfathered rights to water users that were pumping groundwater as of 1980 authorizing that groundwater use to continue. But it required ADWR to set conservation requirements for all uses of groundwater, including uses pursuant to grandfathered rights, and authorized the agency to impose withdrawal fees on the groundwater pumped. Fees collected are to be used for groundwater management purposes.

One of the key requirements of the 1980 Groundwater Management Act is that a person proposing to sell subdivided land (the division of land into six or more lots) in an AMA must demonstrate an Assured Water Supply before a subdivided lot may be sold. An Assured Water Supply is a determination by ADWR that: 1) sufficient water of adequate quality will be physically, continuously and legally available to satisfy water needs of the subdivision for at least 100 years, 2) any projected groundwater use is consistent with the AMA's management goal and 3) financial capability has been demonstrated to construct the necessary facilities to treat and distribute water to customers. The Assured Water Supply program is intended[13] to protect consumers and signal certainty in the long-term provision of water supplies to families and economic enterprises.

Under the Assured Water Supply program, municipal water providers, such as cities, may apply to ADWR for a Designation of Assured Water Supply. A Designation covers all uses of water served by the water provider, including subdivisions.

Phoenix AMA Designated Providers

Cities: Avondale, Chandler, El Mirage, Gilbert, Glendale, Goodyear, Mesa, Peoria, Phoenix, Scottsdale, Surprise, Tempe and the Apache Junction Water District

Private water companies: EPCOR Chaparral City and EPCOR San Tan

Generally, obtaining a Designation entails large, up-front acquisitions of renewable surface water and reclaimed water supplies as well as construction of associated infrastructure in capacities large enough to prove to ADWR that enough water is physically available for all current, committed and future uses of water served by the municipal provider over 100 years. ADWR reviews each Designation at least every 15 years to determine whether it should be modified or revoked, making the 100-year mark a rolling time-frame.

To incentivize the transition to more expensive renewable surface water supplies and reclaimed water, in the early years of the Assured Water Supply program ADWR's rules gave Designated municipal water providers in the Phoenix AMA a one-time amount of groundwater equal to 7.5 times their total municipal water deliveries in 1994 (called a groundwater allowance). Pumping groundwater allowance was considered to be consistent with the goal of safe yield, but the amount of the groundwater allowance given was not enough to secure a Designation. Investments in renewable supplies were also necessary. The groundwater allowance was valuable to municipal water providers as they sought to transition to renewable surface and reclaimed water supplies. However, because of the rolling time-frame on Designation reviews, depleting these stocks entails the need to replace them with an alternative supply of water to avoid falling short of sufficient water supplies at the next Designation review.

13 ADWR is required to follow the definition of subdivision contained in A.R.S. § 32-2101. That has allowed land to be divided into fewer than 6 parcels and sold without an assured water supply, resulting in so-called "wildcat" subdivisions, such as the now infamous Rio Verde Foothills area north of Scottsdale.

The rolling time-frame on Designations and the resulting continual, periodic review of the sufficiency of water supplies is a powerful policy tool. Cities that wish to enable and encourage growth and economic enterprise through the subdivision of land can never allow their renewable surface and reclaimed water supplies, nor their stocks of allowable groundwater pumping to fall below the Assured Water Supply threshold over 100 years for current demands and ten-year projected growth.

In effect, the 1980 Groundwater Management Act and its Assured Water Supply requirements forced and enticed Valley cities that wanted to grow their populations and serve new businesses and industries to accept higher priced Colorado River water and reclaimed wastewater over less expensive reliance on wells and groundwater. In 1985, Phoenix built the first surface-water treatment plant fed with imported Colorado River from the CAP canal at Deer Valley Road. Mesa, Scottsdale and Glendale quickly followed. All told, Designated providers in the Valley built eleven plants for treating Colorado River supplies.

Development of Surface Water Treatment Plants

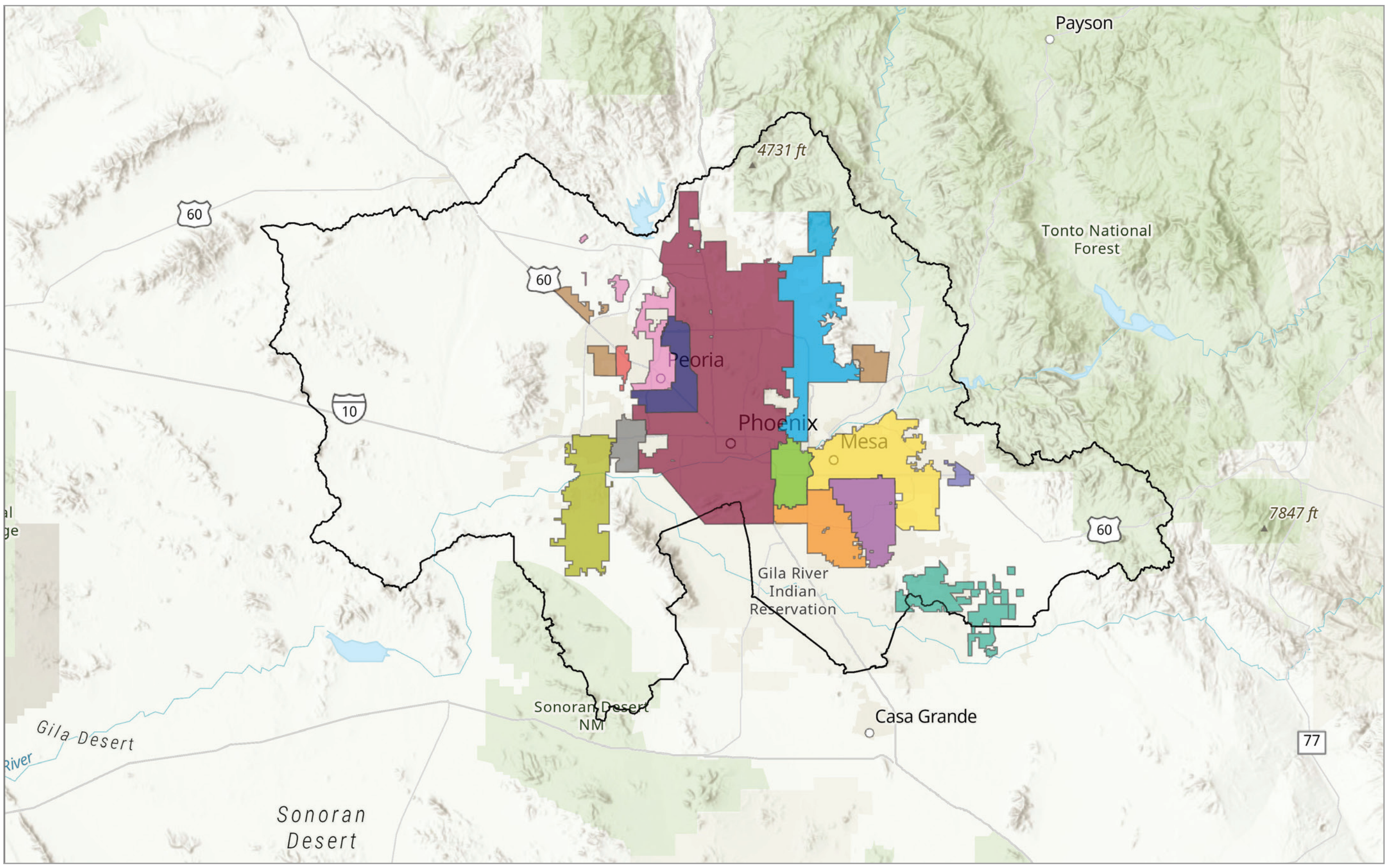
Colorado River Dependent

1985	Union Hills Water Treatment Plant – Phoenix
1986	Pyramid Peak Water Treatment Plant – Glendale
1986	Brown Road Water Treatment Plant – Mesa
1987	Scottsdale CAP Water Treatment Plant 1
1998	Scottsdale CAP Water Treatment Plant 2
1999	Anthem Water Treatment Plant – EPCOR Anthem
2007	Lake Pleasant Water Treatment Plant – Phoenix
2009	San Tan Vista Water Treatment Plant – Gilbert
2009	White Tanks Water Treatment Plant – EPCOR Agua Fria
2010	Scottsdale CAP Water Treatment Plant 3
2018	Signal Butte Water Treatment Plant – Mesa

At the same time, many providers also upgraded their wastewater treatment plants to provide a reclaimed water quality high enough for beneficial reuse. Parks, schools, industries and golf courses began to use reclaimed water rather than groundwater.

The $4 billion-dollar Central Arizona Project canal is often celebrated as an engineering achievement and a storied investment for the State of Arizona.[14] But acquiring the renewable water supplies and building the physical infrastructure necessary to obtain an Assured Water Supply Designation is similarly complex and collectively more expensive. Valley cities' transition away from pumping groundwater supplies for municipal purposes has entailed billions of dollars of investments in surface water treatment plants, wastewater reclamation facilities, new water supply development and conservation.[15]

Water Providers Designated with a 100-Year Assured Water Supply in the Phoenix Area, 2022



- City of Phoenix
- City of Glendale
- City of Scottsdale
- Town of Gilbert
- City of Chandler
- City of Mesa
- City of Peoria
- EPCOR - Chaparral City
- EPCOR - San Tan
- Apache Junction Water Facilities District
- City of Goodyear
- City of Avondale
- City of El Mirage
- City of Tempe
- Surprise - Mountain Vista
- Active Management Area

14 See, e.g., Central Arizona Project, *Colorado River Water & Arizona's Economy*, August 14, 2014, https://youtu.be/kNGle23fvco?si=OGN65s5VTB8bnPZa; Jake Green, *CAP has $1 Trillion Impact on Arizona Economy*, AZ Big Media, April 30, 2014, https://azbigmedia.com/business/environment/cap-1-trillion-impact-arizona-economy/; Central Arizona Project, *Economic Impact of Colorado River Water Delivered by CAP to Arizona: Fact Sheet*, February 2019, https://library.cap-az.com/documents/departments/finance/2019-Economic-Impact-Fact-Sheet.pdf.

15 AMWUA Staff, *Maintaining and upgrading infrastructure is critical to the reliability of water systems*, AMWUA, May 16, 2023, https://www.amwua.org/blog/maintaining-and-upgrading-infrastructure-critical-to-the-reliability-of-water-systems.

The push to continue reliance on wells

The municipal transition away from wells and groundwater dependency to renewable Colorado River and reclaimed water supplies stalled for a number of reasons, but at bottom it was all about cost.

The CAP canal enters the Valley of the Sun northwest of Sun City near the city of Surprise. It travels eastward through Peoria, Phoenix, Scottsdale, the Salt River Pima-Maricopa Indian Community, Mesa, Apache Junction and finally Queen Creek before it exits the Valley to the southeast. Avondale and Goodyear receive Colorado River water via a lateral SRP canal.[16] For communities and developers located a greater distance from the canal, accessing water from the CAP canal entails construction of large and expensive transmission mains and associated pump stations. The only Colorado River dependent surface water treatments plants located any significant distance from the CAP canal serve the relatively affluent communities of Anthem,[17] Chandler and Gilbert.

In 1993, in response to pressure from the development community, Arizona enacted laws that offer an easier way to meet the requirement that new growth be served by renewable water supplies.[18] This alternative scheme permits communities and developers to rely on wells to serve new subdivisions if the groundwater served to these subdivisions is later replenished. The replenishment obligation is met by the Central Arizona Water Conservation District (CAWCD), the political subdivision of the state that operates the CAP. Through a responsibility colloquially known as the Central Arizona Groundwater Replenishment District (CAGRD or GRD), the CAWCD acquires renewable water supplies to replenish through artificial aquifer recharge the groundwater pumped to serve CAGRD member subdivisions and by member service areas.[19]

The push for continued well dependency didn't come solely from development interests. In 2004 the Arizona legislature enacted the Underground Water Storage Act, which allowed municipal water providers, through "annual storage and recovery," to "store" water underground and then pump wells to recover water within the same calendar year.[20] The wells from which the water is withdrawn can be very distant from the location in which the water was stored.

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16 Goodyear's Colorado River water is delivered via the CAP canal, to the interconnect between the CAP and SRP canals, and then through a lateral ditch off of the SRP Grand canal. Physically, the water delivered to Goodyear in this method is a blend of Salt & Verde River water and a small amount of groundwater and Colorado River water. Avondale sends its Colorado River water to Phoenix, which treats it and then sends it to Avondale through a shared connection in their potable distribution systems.

17 Anthem is located in the far north portion of the Valley of the Sun where the aquifer is shallow relatively little groundwater is available, so construction of a surface water treatment plant was the only viable option for development.

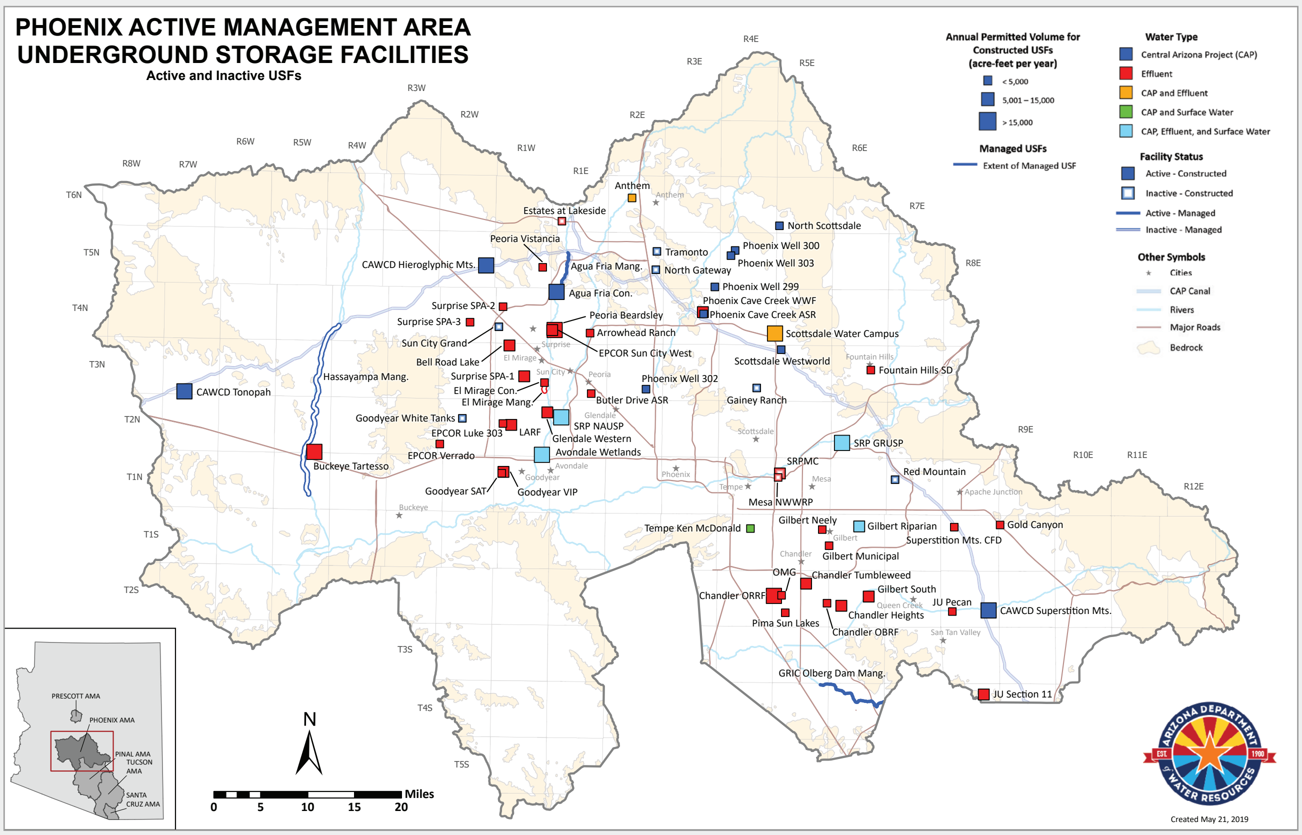
18 See Kathleen Ferris & Sarah Porter, *The Elusive Concept of an Assured Water Supply Requirement: The Role of CAGRD and Replenishment*, Kyl Center for Water Policy at ASU Morrison Institute, Fall 2019, https://morrisoninstitute.asu.edu/sites/default/files/kyl_center_elusive_concept_101619.docx.pdf.

19 Id.

20 Water can be "stored" in two ways, either through a USF or a Groundwater Savings Facility (GSF). A GSF is an entity (usually an irrigation district or farm) with rights to pump groundwater in an Active Management Area or Irrigation Non-expansion Area that has established a permit with the state that demonstrates that operation of the facility will cause the direct reduction of groundwater withdrawals by means of delivery of water other than groundwater pumped that the recipient will use in lieu of groundwater. Operators of the GSF use this water rather than pumping groundwater.

What is Aquifer Recharge?

Artificial aquifer recharge entails putting water back into an aquifer that wouldn't otherwise have gone there naturally – typically by spreading water in a constructed basin designed to let the water percolate back underground. There are different techniques for artificial aquifer recharge, but two are commonly used in the Valley of the Sun. The first involves the construction of large basins, called underground storage facilities, where water can be artificially directed and then pooled for infiltration through loose soils into the aquifer below. Examples of this technique include the Granite Reef Underground Storage Facility, the New River-Agua Fria Underground Storage Facility and the Hieroglyphic Mountains Underground Storage Facility. Large facilities are built near the CAP and SRP canals because short distances make it is easy and inexpensive to deliver surface water supplies to the facility. Other, smaller facilities are built near wastewater reclamation plants where the reclaimed water can be easily directed. There are limits to the development of large water-infiltration basins because of the land area that is necessary, and because they must be located where the soils underneath the land are loose and porous so that infiltration can occur. Since large underground storage facilities can't be built just anywhere, they do not exist everywhere groundwater is being withdrawn.

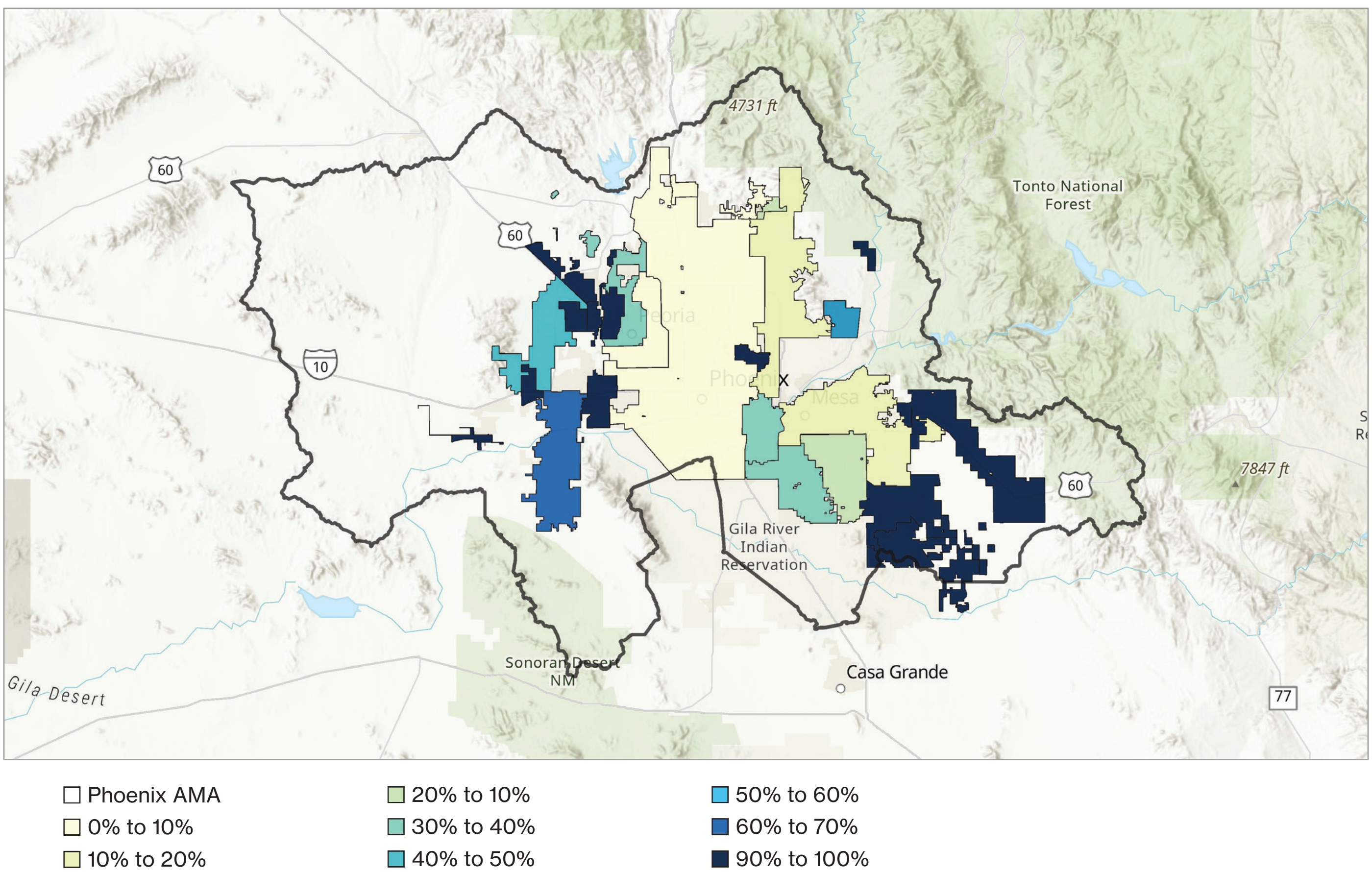


The other common technique for artificial aquifer recharge involves essentially operating a well in reverse and forcing water back into the aquifer. Wells constructed for this purpose must be specially designed. Typically, the amount of water that can be recharged into the aquifer by operating a well in reverse is orders of magnitude less on an annual basis than the amount that can be recharged using the large underground storage facilities. Annual storage and recovery wells are more expensive than recharge basins. Still, they can be developed exactly where impacts of pumping occur and are therefore valuable for aquifer management.

Developers of master-planned subdivisions, private water companies serving extensive territories, as well as entire cities recognized that the expense of building surface-water treatment plants could be avoided by continuing to pump wells and then artificially recharging aquifers to meet annual storage or replenishment requirements. Development of aquifer recharge facilities entails purchasing land, building berms to contain water, building a short canal lateral or pipeline for water delivery and enduring the permitting process. The costs of a recharge facility are typically orders of magnitude lower than the costs of building a surface-water treatment plant: Consider that, in 2023 dollars, Mesa's Signal Butte Surface Water Treatment Plant was built for approximately $153,000,000 while Goodyear's Full-Scale Underground Storage Facility was built for around $150,000. Operating an underground storage facility involves maintaining berms and the water conveyance channel or pipe, scraping and moving the ground periodically to remove sediment and allow for continued infiltration and monitoring water levels. Operating a surface-water treatment plant involves dozens of operators, electricians, mechanics, IT specialists and chemists, not to mention maintenance of the concrete reservoirs, filters, pumps, valves, lab equipment and chemical storage and handling facilities associated with the facility.

So strong is the preference for pumping and recharging over treating and delivering surface water, that in the Phoenix AMA more Colorado River water is delivered for recharge and replenishment than to taps. In many high-growth areas of the Valley, more than half of the water delivered to taps is groundwater.

Percent of Tap Water that is Groundwater by Provider in the Phoenix AMA[21]



21 Selected municipal water providers, 2020 data except for Goodyear, which brought a surface water treatment plant on-line in 2022.

Phoenix AMA Colorado River Water Use Before Shortage*

In acre-feet. *2020 data, not including turf, industrial, and exchange uses.

The developer of land in the Phoenix AMA that will not be served by a Designated provider must apply to ADWR for a Certificate of Assured Water Supply. To obtain a Certificate, the developer must show that there is 100 years of groundwater physically available to a depth of not more than 1,000 feet beneath the development as a one-time effort. The CAGRD is required to replenish the groundwater that is withdrawn within three years but the replenishment can occur anywhere in the Phoenix AMA. There is no review of the Certificate to make sure that there is still sufficient groundwater to meet the water users' long-term needs. This alternative path for development proved more popular than anticipated because it is the cheapest and least burdensome means of meeting the assured water supply requirements.[22]

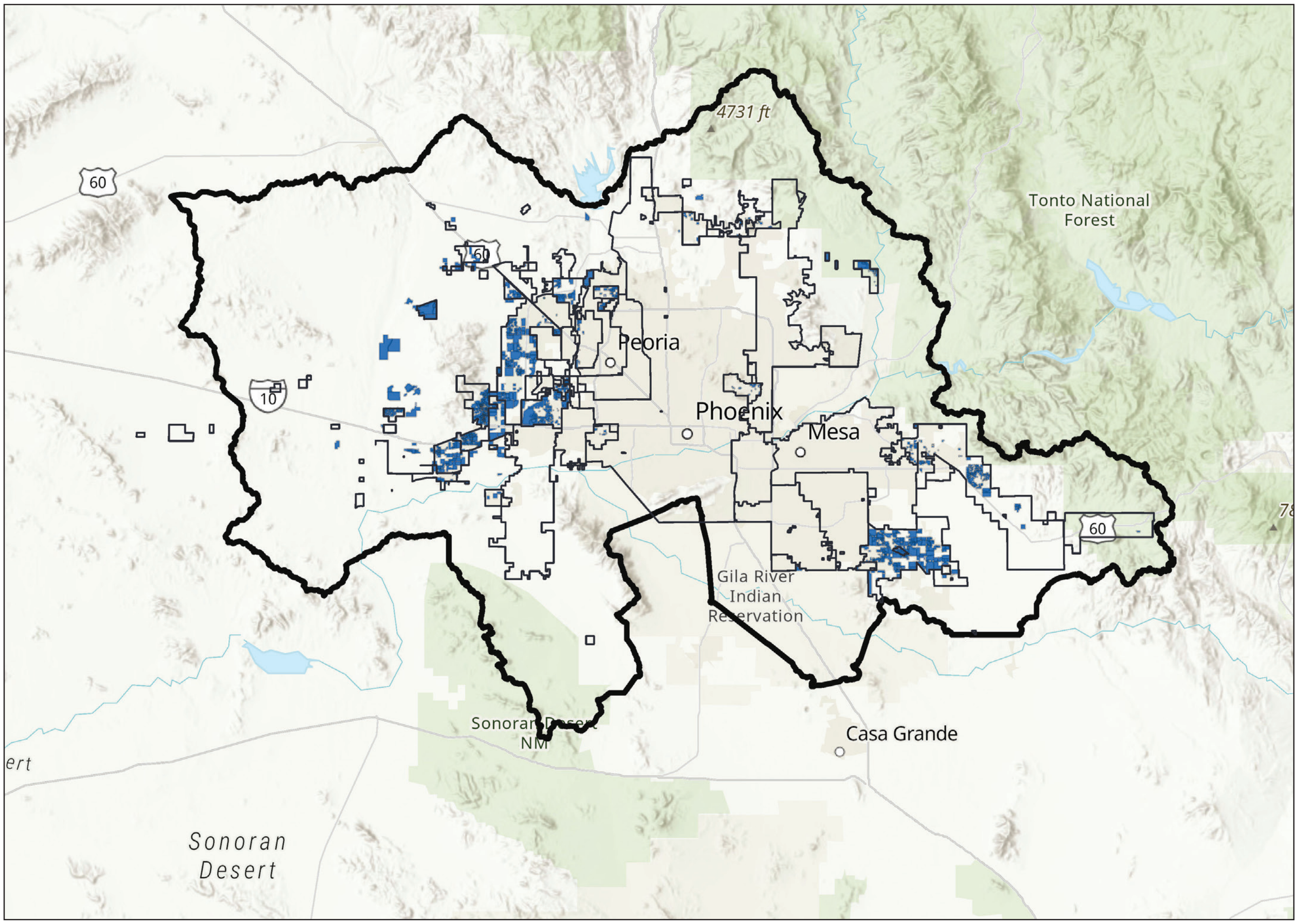
Development via CAGRD is less expensive at least in part because the ultimate owner of the subdivided land – the homeowner – pays most of the cost of CAGRD replenishment through charges levied on the homeowner's property tax bill.

Reliance on groundwater pumping and subsequent replenishment through membership in CAGRD allows the subdivision of land and resulting population growth to occur before the renewable water supplies necessary to support that growth over the long term have been acquired.[23] CAGRD has also facilitated development of lands on the fringes of the valley outside of the service areas of water providers with Designations. In the future, these leapfrog, groundwater dependent developments will have to acquire new supplies of water.

22 Central Ariz. Water Conserv. Dist., *2004 Plan of Operation*, 2004; see also Ferris & Porter, *Elusive Concept*, supra note 19, for a discussion of the unanticipated growth of the CAGRD's replenishment obligation.

23 Ferris & Porter, *Elusive Concept*, supra note 19, at 12; CAGRD must develop a Plan of Operation every ten years. "Each Plan of Operation must identify the water supplies CAGRD plans to use for replenishment during the 20 years following submission of the Plan and the water supplies potentially available to CAGRD for replenishment during the subsequent 80 years. While the word 'plans' connotes that CAGRD intends to use certain water supplies, the words 'potentially available' would seem to mean that there is only a possibility that these supplies would be used or be available."

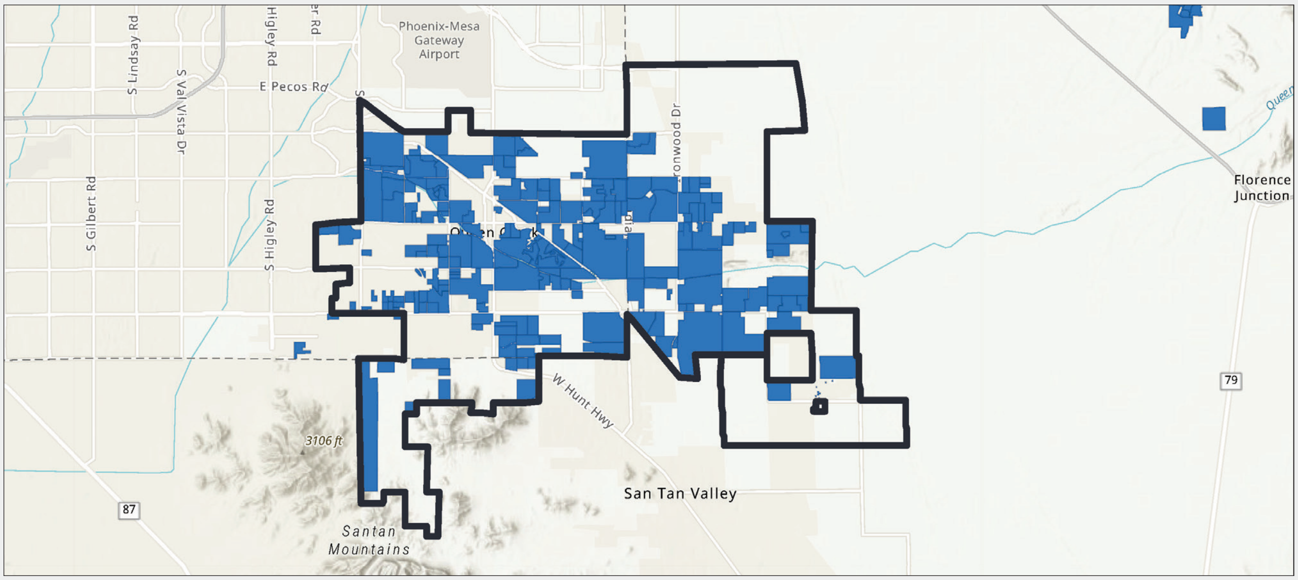
CAGRD Member Lands in the Phoenix AMA



☐ Community Water System Service Area
■ CAGRD Member Lands 2022
☐ Phoenix AMA

The Certificate Trap

Consider the map of CAGRD Member Lands in the Phoenix AMA, and zoom in on the fast-growing town of Queen Creek as an example. The lands appear as a patchwork of discontinuous developments.



☐ Queen Creek Community Water System Service Area

■ CAGRD Member Lands 2022

On these lands, developers proved to ADWR that there was 100 years of groundwater beneath the future subdivision "physically" available to serve the needs of the subdivision and obtained a Certificate of Assured Water Supply. The Town of Queen Creek pumps and provides groundwater to customers in the subdivision. The home owners pay both a replenishment fee to CAGRD via their property tax and a water bill from the town for tap water deliveries. Families within these developments may perceive that they are "all set" for 100 years (though without replenishment in the area of groundwater pumping, eventually the groundwater beneath these lands will likely be depleted).

Because the path of growth via Certificates is now closed, the only option for additional subdivision of land for a town like Queen Creek entails acquiring new water supplies and developing the infrastructure necessary to deliver it – all at great cost, just as Designated water providers historically paid enormous sums for their renewable water supplies and related infrastructure. Mustering the political support necessary to invest in alternative water supplies and the infrastructure needed to avoid ultimate groundwater depletion is always difficult because it entails significant water rate increases. However, in the case of a town dependent on Certificates it may prove even tougher over time because a significant subset of the town's population is already paying for groundwater replenishment via their property tax. Every Certificate-dependent development potentially erodes political support for collective investment in alternative water supplies – and may thus create a "trap" from which municipal water providers find it difficult to achieve Designation status and protect local groundwater.

Safe-yield on paper isn't safe for the aquifer—or future generations

The goal of safe yield is managed at the regional level, across an active management area that spans the entire Valley of the Sun, over 5,600 square miles and seven distinct groundwater sub-basins. So long as the amount of groundwater withdrawn equals the amount of water recharged in the AMA *on paper*, safe yield is theoretically met, regardless of whether the groundwater pumping and recharge are hydrologically connected.

"Hydrologic disconnect" occurs when water is stored or replenished (recharged) in one area and pumped from an area that did not benefit hydrologically.[24] When aquifer recharge does not occur in the same "area of impact" as the point of withdrawal, the aquifer may be depleted risking potentially irreversible impacts of subsidence and aquifer compaction. In 2021, the Governor's Water Augmentation, Innovation and Conservation Council outlined the concern for the areas in which groundwater pumping occurs, writing, "there is little question that a large and persistent disconnect between recharge and recovery could lead to localized issues."[25]

The potential for severe, localized aquifer drawdown is of concern in the areas of the AMA where developers have chosen to rely on pumped groundwater and replenishment through membership in CAGRD.[26] While, according to its 2015 Plan of Operation, CAGRD "attempts to replenish in the same subbasin in which obligations are incurred whenever possible"[27] there is no requirement to do so, and the locations of CAGRD storage facilities simply do not allow for replenishment in all of the locations where its members are located.[28] Moreover, CAGRD's job is to replenish groundwater: It is not responsible for providing water supplies to meet water demand on its member lands.[29] There is no legal assurance that there will be water physically available for member lands once the local groundwater stocks are depleted. On this trajectory and without intervention the aquifers in these areas may be lost, becoming compacted to the point that they cannot be re-filled via recharge.

> *"...compaction of the aquifer system, sight unseen, may permanently decrease its capacity to store water; subsidence occurring today is a legacy for all tomorrows."*[30]

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24 Governor's Water Augmentation, Innovation and Conservation Council Post-2025 AMAs Committee, *Issue Brief #1 Hydrologic Disconnect*, ADWR, March 5, 2021, https://www.azwater.gov/sites/default/files/2022-08/Post-2025_ActiveManagementAreas_IssueBrief_UpdatedVersion_March52021.pdf.

25 Id.

26 It is also a concern in other areas of the AMA. See Kathleen Ferris & Sarah Porter, *The Myth of Safe-Yield: Pursuing the Goal of Safe-Yield Isn't Saving our Groundwater*, ASU Kyl Center for Water Policy at Morrison Institute, May 2021, https://morrisoninstitute.asu.edu/sites/default/files/the_myth_of_safe-yield_0.pdf at 33-34.

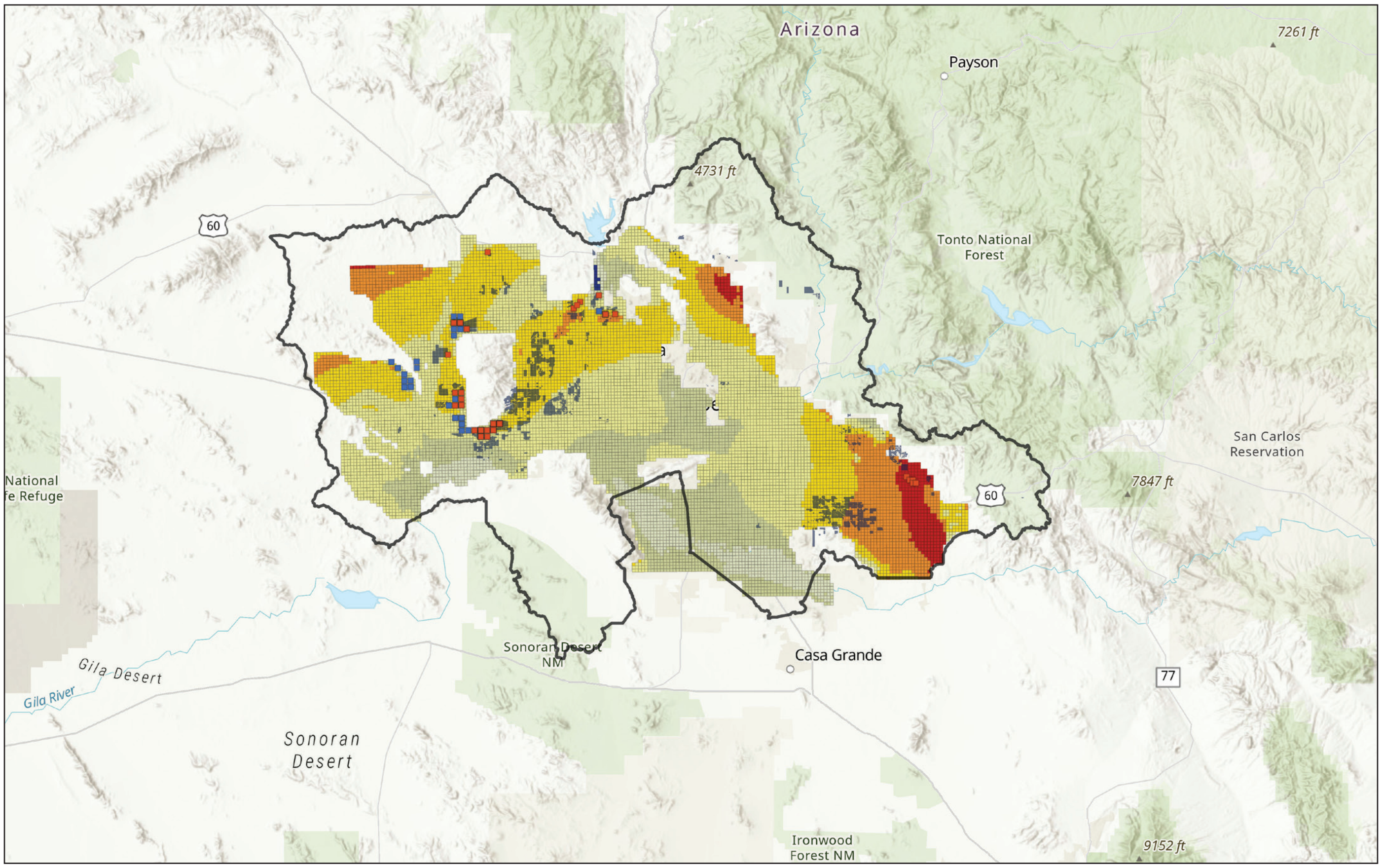
27 Central Arizona Water Conservation District, *Central Arizona Groundwater Replenishment District 2015 Plan of Operation*, December 29, 2014, https://library.cap-az.com/cagrd/documents/2015-CAGRD-Plan-of-Operation.pdf at 6-1.

28 Kathleen Ferris & Sarah Porter, *The Elusive Concept of an Assured Water Supply Requirement*, Supra note 19.

29 Id.

30 United States Geological Society, *Aquifer Compaction Due to Groundwater Pumping*, October 18, 2018, https://www.usgs.gov/centers/land-subsidence-in-california/science/aquifer-compaction-due-groundwater-pumping.

100-Year Projection of Depth to Water



Unmet Demand

- certificate
- analysis
- Phoenix AMA
- CAGRD Member Lands

100 Year Projection of Depth to Water (Ft)

- 0
- >1 - 100
- >100 - 250
- >250 - 500
- >500 - 750
- >750 - 1,000
- >1,000

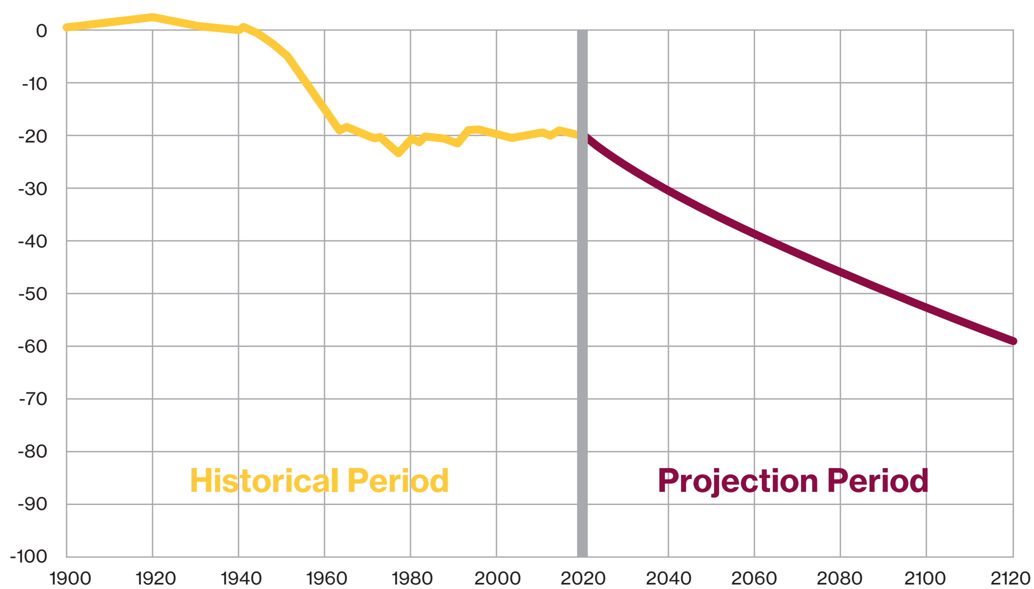
Only the construction of the infrastructure necessary to deliver alternative water supplies into these areas can fix this looming problem. If these investments are pushed off too long, and the aquifer in these vulnerable areas loses its elasticity and ability to store water, future generations will not be able to rely on the relatively inexpensive paradigm of pumping and subsequent recharge. Instead, they will need to deliver alternative water supplies into these areas and potentially build surface-water treatment plants for their use. This transition is likely to be extraordinarily costly. The longer these infrastructure investments are delayed the bigger the problem for future generations.

A new hydrological model reveals new challenges

As part of its Assured Water Supply Program, ADWR released a new groundwater model for the Phoenix AMA in June of 2023 along with a Technical Memorandum summarizing the results of a 100-year projection that includes the demands of existing groundwater users (those currently pumping groundwater) and the demands of assured water supply determinations. The model projection indicates that insufficient groundwater is physically available to satisfy all of the projected pumping demand in the AMA over 100 years and estimates an overdraft of nearly 387,000 acre-feet per year during that period. ADWR concluded that the area has "reached the anticipated limits of growth on groundwater supplies."[31]

Cumulative Modeled Storage Change in Phoenix AMA

in million acre-feet by year



As a result of these findings, the state will not issue Certificates of Assured Water Supply based on local groundwater for new subdivisions in the Phoenix AMA.[32] This closed off the least-cost path of subdivision development – reliance on wells and subsequent aquifer replenishment via CAGRD.

Growth can and will continue, but the pattern and rate of growth in the AMA may change. Planned subdivisions that have already received a Certificate can proceed. Going forward, however, the choice is between developing on more expensive land within the boundaries of a water provider with a Designation[33] or securing expensive water supplies other than local groundwater to develop outside of those boundaries.

31 Governor's Water Policy Council Assured Water Supply Committee, supra note 4.

32 Kyl Center for Water Policy, *New Phoenix AMA Model*, supra note 2.

33 The Arizona Municipal Water Users Association estimates that there more than 185,000 acres of developable land in the Phoenix AMA within the boundaries of its member municipalities. Warren Tenney, *Don't Mortgage Our Future by Weakening Assured Water Supply Requirements*, AMWUA Blog, November 21, 2023, https://www.amwua.org/blog/dont-mortgage-our-future-by-weakening-assured-water-supply-requirements.

The release of the new model and the ensuing consequences related to subdivision developments sparked controversy. Some developers and homebuilders accustomed to relying on inexpensive local groundwater and CAGRD replenishment expressed concern that this path was closed off in the Phoenix area[34] and supported legislation to push back.[35] The push to grow on wells continues,[36] but the Phoenix AMA model indicates that allowing additional groundwater reliance for a new use may entail less groundwater availability for an existing one.

Continued reliance on groundwater is problematic

There are two fundamental problems with reliance on groundwater. One is depletion of groundwater stocks and the resulting loss of aquifer elasticity and storage capacity where recharge doesn't occur within the area of hydrologic impact. The other is depletion of the region's water savings account. To the extent regional groundwater stocks are depleted for everyday needs, there will be less available during times of surface water shortage.

That's unfortunate, because surface water shortage is already here and it has significant implications for the health of regional aquifers.

The diminishing flows of the Colorado River exacerbate the problem

The Colorado River is in decline. It is also over-allocated, meaning that the total annual volume of Colorado River water users are entitled to on paper nearly always exceeds the physical amount of water the system produces annually. More than two decades of drought have compounded the problem, and many experts believe that climate change will cause even greater long-term reductions in Colorado Rivers flows. The first-ever shortage on the Colorado River was declared in 2022 and central Arizona's access to Colorado River has been cut by between 30 to 37 percent since that time. Cuts will likely continue and may increase. The Lower Colorado River Basin states of Arizona, California and Nevada aim to address the "structural deficit," a long-term gap of nearly 1.25 million acre-feet per year between the amount of water the river supplies to Lake Mead in a year and the amount used annually in the Lower Basin.[37] While reducing uses by 1.25 million acre-feet is significant, most scientists believe even further cuts will be needed to address the greater reduction of river flows resulting from climate change.[38] Looking forward it is reasonable to assume that significantly less Colorado River water will be available for aquifer recharge in the Valley.

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34 Howard Fischer, *Homebuilders want changes to ease water law restrictions*, Arizona Capitol Times, December 21, 2023, https://azcapitoltimes.com/news/2023/12/21/homebuilders-want-changes-to-ease-water-law-restrictions/.

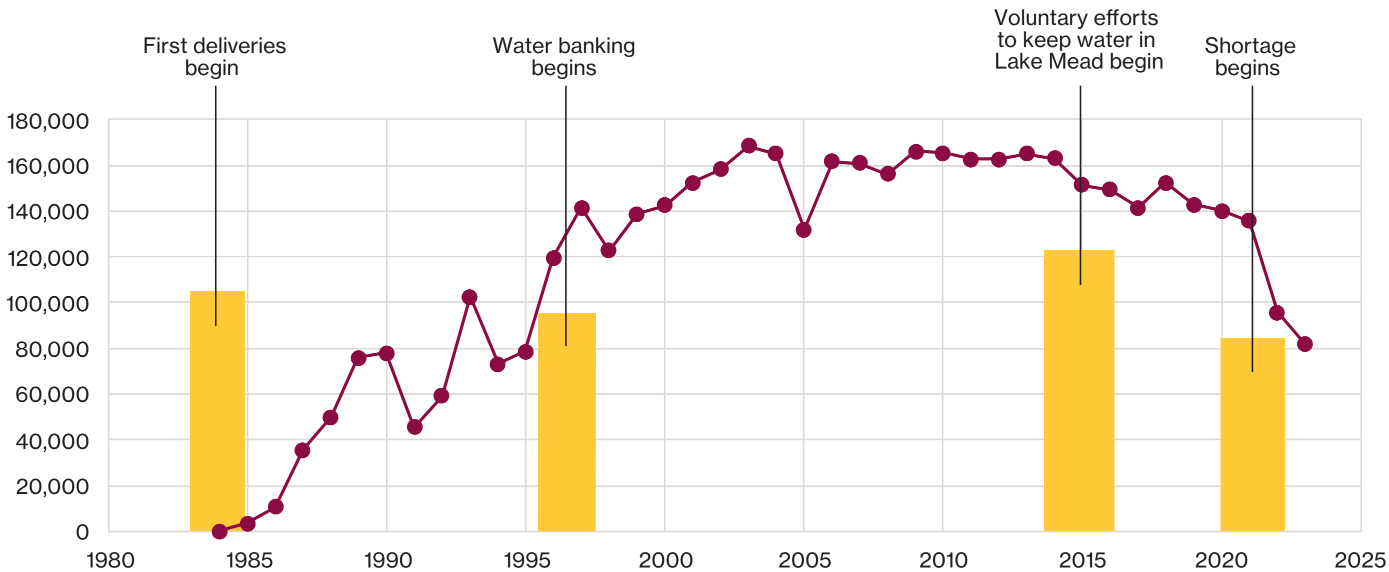
35 See, e.g., HB 2029, https://www.azleg.gov/legtext/56leg/2R/bills/HB2029P.pdf & https://www.azleg.gov/legtext/56leg/2R/bills/HB2366P.htm.

36 Howard Fischer, *Homebuilders want changes to ease water law restrictions*, supra note 34.

37 John Fleck, *Closing in on a post-2026 Colorado River management deal (some terms and conditions may apply)*, December 20, 2023, https://www.inkstain.net/2023/12/closing-in-on-a-post-2026-colorado-river-management-deal-some-terms-and-conditions-may-apply/.

38 Bradley Udall and Jonathan Overpeck, *The twenty-first century Colorado River hot drought and implications for the future*, Water Resources Research 53, 2404–2418, 2017, https://doi.org/10.1002/2016WR019638.

Colorado River Water Delivered through the Central Arizona Project Canal



In acre-feet. Data source: U.S. Bureau of Reclamation *Colorado River Accounting and Water Use Report*.

The health of the Valley's aquifer is highly dependent on Colorado River water. Because it is less expensive than developing and maintaining surface-water treatment plants, many cities and municipal water providers in central Arizona have chosen to pump wells and rely on CAGRD replenishment or use their Colorado River water supplies to artificially recharge aquifers. Colorado River supplies comprise nearly 80% of the water supplies that CAGRD plans to use to meet its future replenishment obligations.[39]

The loss of Colorado River water in central Arizona since 2022 has significantly diminished artificial recharge in the Phoenix AMA. In 2020, over 146,000 acre-feet of Colorado River water was artificially recharged into aquifers in the Valley of the Sun. In 2023, the second year of Colorado River shortage, that number fell to approximately 37,000 acre-feet, a loss of over 100,000 acre-feet.[40]

Since the amount of Colorado River water that will be available in the Valley of the Sun in the future is highly uncertain, it seems unlikely that amounts as large as have been available historically will be available for artificial recharge and replenishment except in relatively rare instances.

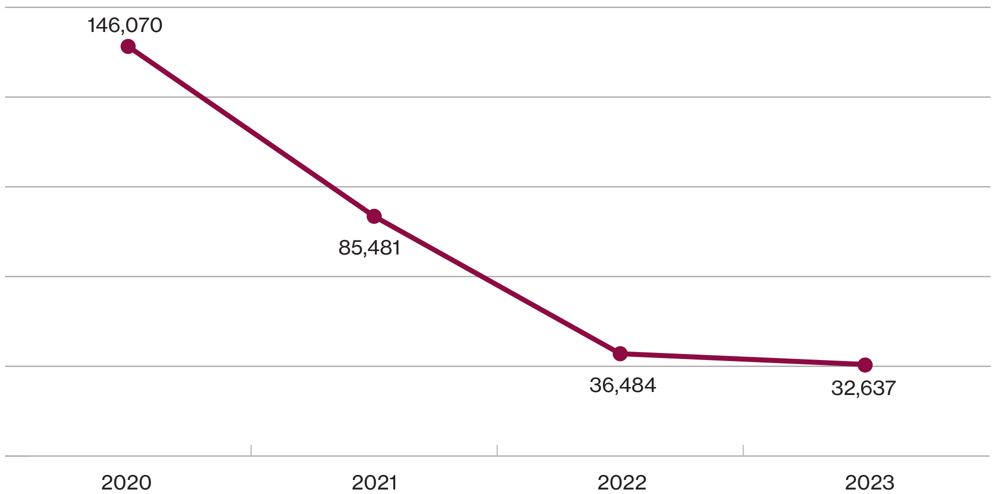
39 Central Arizona Project CAGRD and Underground Storage Committee, 2024 CAGRD Plan of Operation, CAP, February 2024, https://capaz.portal.civicclerk.com/event/385/files/agenda/7689.

40 Central Arizona Water Conservation District, Deliveries by Recharge Facilities 2020 & 2023, 2024, https://www.cap-az.com/water/cap-system/water-operations/deliveries/.

Colorado River Water Aquifer Recharge in the Phoenix AMA Before and After Storage

in acre-feet by year

Data source: Central Arizona Water Conservation District, Deliveries by Recharge Facilities.



Some developers and homebuilders complained that the Phoenix AMA Model includes assumptions that may overstate the actual pumping that occurs over time, and therefore underestimate the physical availability of groundwater.[41] However, the model does not factor in the loss of Colorado River water due to shortages, and therefore may significantly overestimate physical availability of groundwater over time.[42]

Tradeoffs and considerations

If land use patterns in the Valley continue on the current trend, the avoidance of aquifer compaction and eventual loss of piped water in areas of groundwater depletion may well depend on importation of alternative water supplies either for use directly through a potable water treatment plant or for artificial recharge in the area of groundwater depletion. Given that the likely cost of delaying such investments is the permanent loss of aquifer storage capacity through aquifer compaction, consideration should be given to requiring or further incentivizing the development of alternative supplies and associated infrastructure in these areas.

These investments are expensive and the transition to reliance on alternative, renewable water supplies is difficult. Decades ago, significant transitions were achieved by using both carrots and sticks. Cities seeking a Designation were given a valuable groundwater allowance to facilitate the transition to renewable supplies, but in exchange were required to demonstrate periodically the continuing sufficiency of their water supply portfolio. Importantly, ADWR's regular review of Designations and associated rolling time-frame create a powerful incentive to avoid immediate depletion of groundwater allowances at significant rates. Designations have proven far more beneficial for groundwater management than piecemeal Certificates based on replenishment.[43]

41 See Concepts Submitted to the Governor's Water Policy Council Assured Water Supply Subcommittee by the Home Builders Association of Central Arizona, https://www.azwater.gov/sites/default/files/2023-11/20231128_AWS_Committee_Proposals_Comments.pdf at 26 ("Identify Critical Problems Through Appropriate Modelling").

42 Governor's Water Policy Council Assured Water Supply Committee, supra note 4; Arizona Department of Water Resources Groundwater Modeling Section Hydrology Division, *Technical Memorandum: Phoenix AMA 100-Year Assured Water Supply Projection*, ADWR, June 2023, https://infoshare.azwater.gov/docushare/dsweb/Get/Document-76432/2023_Technical_Memorandum_Phx_AMA_100_Yr_Projection.pdf.

43 Kathleen Ferris & Sarah Porter, *The Elusive Concept of an Assured Water Supply Requirement*, supra note 19.

When it comes to water management, the Phoenix area is always under a national microscope.[44] There is a need to signal certainty of water supplies in a desert city so that new economic enterprises feel comfortable investing in the region. Pushing needed infrastructure investments off into the future creates uncertainty.

Looking forward, it may be possible to develop a new carrot-and-stick paradigm through Arizona's Water Infrastructure and Finance Authority, WIFA. WIFA could finance the water supply acquisition and infrastructure projects necessary to bring alternative water supplies into areas of groundwater decline for either direct use or aquifer recharge and replenishment. Developers of subdivisions and industries looking to build outside of the boundaries of Designated water providers could contract with WIFA and pay into a fund designed for repayment. Some portion of the obligation to repay could carry with the land, in a manner similar to CAGRD's current financial structure. Such an arrangement could provide ADWR with the assurances of financial, legal, and physical availability of water necessary for a Designation of an Assured Water Supply.

In 2000, then Governor Hull asked for a review of the 1980 Groundwater Management Act. From her Water Management Commission's final report:

> *" ...The Commission has completed its work and has found that the goals and legal framework contained in the Groundwater Code are sound and should continue to guide water management decisions and investments in the State's five AMAs. However, the Commission also has identified areas that could be improved to address changing water management needs in the AMAs as well as areas that the original Act did not address."*

The Commission made many proposals that are worth revisiting,[45] as did former directors of the Arizona Department of Water Resources, Rita Maguire and Kathleen Ferris.[46] Some are re-phrased here. Other proposals mentioned here have been or are under current consideration, and still others are new:

- In areas of groundwater depletion, **increase the groundwater withdrawal fee** for groundwater pumpers without a replenishment obligation or Designation. This would create a strong disincentive to pump groundwater and the money could be used to develop supplies and infrastructure for areas of groundwater decline.

- **Require artificial recharge and replenishment** to occur within the hydrogeologic area impacted by groundwater pumping.

- **Provide better protection to municipal water provider service area rights** so that industries cannot pump groundwater within or near existing service territories. This will become especially important as more and more cities become fully built-out. Once subdivision of land is no longer required, many Assured Water Supply requirements no longer apply. Municipal water providers will need tools to prevent depletion of groundwater within and near their service territories.

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44 *See,* e.g., Christopher Flavelle and Jack Healy, *Arizona Limits Construction Around Phoenix as Its Water Supply Dwindles*, New York Times, June 1, 2023, https://www.nytimes.com/2023/06/01/climate/arizona-phoenix-permits-housing-water.html; Jeremy Childs and Ian James, *Water concerns prompt new limits on growth in Arizona*, Los Angeles Times, June 1, 2023, https://www.latimes.com/environment/story/2023-06-01/phoenix-arizona-water-crisis; Jim Carlton and Eliza Collins, *Arizona's Dry Future Begins as Colorado River Shrinks*, Wall Street Journal, April 2022, https://www.wsj.com/articles/arizonas-dry-future-begins-as-colorado-river-shrinks-11650718801.

45 Governor's Water Management Commission, Final Report, December 2001, https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/attachment/Governors-Water-Management-Commission-Recommendations.pdf.

46 Rita Pearson Maguire, Esq, *Patching The Holes In The Bucket: Safe Yield And The Future Of Water Management In Arizona*, 2007, https://arizonalawreview.org/pdf/49-2/49arizlrev361.pdf; see also Kathleen Ferris & Sarah Porter, *The Myth of Safe-Yield: Pursuing the Goal of Safe-Yield Isn't Saving our Groundwater*, supra note 26; Kathleen Ferris & Sarah Porter, *The Elusive Concept of an Assured Water Supply Requirement: The Role of CAGRD and Replenishment*, supra note 19.

- **Cease issuing new groundwater pumping permits** for industrial users that can instead rely on a municipal water provider.
- **Use groundwater withdrawal fees to pay municipal water providers** to serve tap water in place of groundwater pumped via grandfathered rights to turf facilities located within or near their service boundaries at a cost equivalent to what the turf facility would have paid for the pumped groundwater.
- **Allow CAGRD to deliver alternative water supplies** for direct use. Delivering water for a direct use better protects the aquifer than pumping groundwater and then using the alternative supply to replenish the pumping.
- In areas of aquifer decline, **require wells to be developed** as annual storage and recovery wells that can pump alternative supplies back into the aquifer. CAGRD can wheel alternative water supplies to municipal water providers in these areas, who can then improve aquifer health by pumping those supplies directly into the aquifer.
- In areas of groundwater depletion, **consider a new tax** requiring those with grandfathered rights or industrial permits to pay into a fund to develop alternative water supplies and associated infrastructure.
- **Facilitate discussions among developers and municipal water providers** across the Phoenix, Pinal and Tucson AMAs that need to develop alternative water supplies and the infrastructure necessary to deliver them to create ways to share costs across a larger group of rate-payers.
- **Require that future updates to the Phoenix AMA model reflect changes** in aquifer recharge, storage and replenishment due to decreases in available Colorado River supplies.

Conversion of Agricultural Pump Rights to Municipal

Agricultural water uses in the Valley are typically much higher than urban ones.[47] Crops can use as much as 6 acre-feet per acre while urban water uses in the Valley average somewhere around 1.3 acre-feet per acre.

The retirement of agricultural land irrigated with groundwater in the Phoenix AMA has long been seen as necessary to reach sustainable water management goals. in 1977, the Arizona Water Commission – the predecessor of ADWR – projected that in Maricopa County:

> "*A balance of supply and demand can be maintained through the importation of Central Arizona Project supplies and a reduction in harvested acreage in the county of approximately 300,000 acres by year 2020. Without the retirement of agricultural lands sizable overdrafts would continue under all alternatives investigated.*"[48]

It is often suggested that retirement of agricultural land is a logical way to free up groundwater for non-agricultural uses, such as subdivisions. However, creation of a new, permanent, groundwater pump right for municipal uses is potentially more harmful for long-term aquifer management.

Consider an example where a farmer is using 6 acre-feet per acre on 1,000 acres of land that would urbanize in 20 years. In 20 years, he would pump 120,000 acre-feet of groundwater, but a portion of this water would return to the aquifer as incidental recharge after it is applied to his fields. Some are proposing a conversion of 3 acre-feet per acre to a permanent municipal pump right as a net savings.[49] Certainly, 3 is less than 6. However, in just 40 years the same amount of groundwater would theoretically be pumped under this conversion, there would be very little incidental recharge and the aquifer would experience a net loss of groundwater thereafter because the municipal groundwater use would likely continue into perpetuity.

A better approach may be to allow entities to pay farmers and other holders of grandfathered rights not to pump groundwater. The groundwater saved could be converted in some proportion, say 50%, to a Long-term Storage Credit, similar to ADWR's existing program for creation of Long-term Storage Credits through Groundwater Savings Facilities.[50]

Alternatively, ADWR could assign the physical availability of groundwater projected for use by these grandfathered rights to the entity that retires the agricultural land and require that entity to replenish any groundwater used in the area of hydrologic impact.

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47 See Arizona Department of Water Resources Staff, *Fourth Management Plan: Phoenix Active Management Area*, March 2020, ADWR, https://www.azwater.gov/sites/default/files/media/FULL%20FINAL%20PHX%204MP_1.pdf; see also Kyl Center for Water Policy, *Water and Land Use in Central Arizona: How land use choices drive water use intensity in Arizona's Sun Corridor*, ASU Morrison Institute, February 2024, https://storymaps.arcgis.com/stories/eb51183c1305428187c699d004cbf77b.

48 Arizona Water Commission, *Phase II Arizona State Water Plan Alternative Futures*, February 1977, at 5.

49 See, e.g., S.B. 1172, 2024, https://www.azleg.gov/legtext/56leg/2R/bills/SB1172P.pdf.

50 Kyl Center for Water Policy, *Long-term Storage Credits in Central Arizona*, ASU Morrison Institute, July 2023, https://storymaps.arcgis.com/stories/61c95c2245e549fbb51fb94e7e0070bb.

Conclusion

Some value the Valley's aquifer for easy and inexpensive access to groundwater and short-term economic gain. Others value it as a long-term savings account to be used during shortages on the Colorado River and to ensure and signal the stability of local water supplies without which economic investment is uncertain. There is a natural tension between these perspectives.

Yet, ADWR concluded that the area has "reached the anticipated limits of growth on groundwater supplies."[51] Allowing additional groundwater use today may well entail less groundwater availability for others. Colorado River shortages exacerbate this problem and threaten the long-term health of the Valley's aquifer.

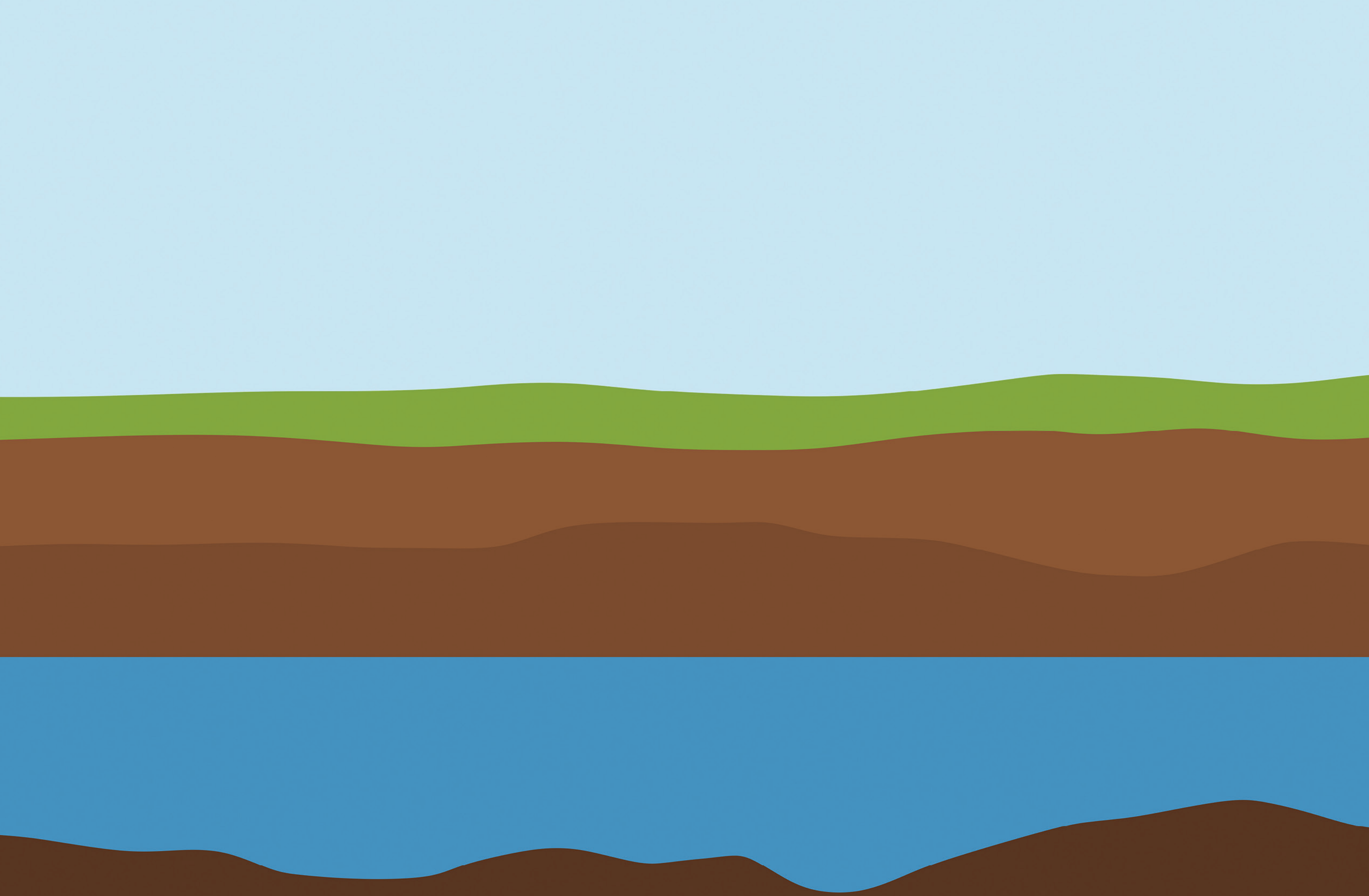
The Valley of the Sun has benefitted immensely from historic investments in infrastructure that enabled the use of renewable surface water supplies in lieu of groundwater depletion. These investments were economically large and burdensome, but their advantages for growth and economic prosperity are undeniable. Re-opening reliance on local groundwater for Certificates, or otherwise weakening the protections in the 1980 Groundwater Management Act would allow some to avoid the investment necessary to secure and deliver renewable water supplies. While subdivision development on the fringes of the Valley could continue at a low cost, the ultimate price to others – loss of groundwater stocks and, perhaps more importantly, aquifer elasticity – is high.

The 1980 Groundwater Management Act and the resulting Assured Water Supply rules act as the region's brand for signaling certainty in the long-term provision of reliable water supplies upon which additional economic investment largely depends. Undermining the value of the brand has real consequences.

Ross D. Franklin, Associated Press, from https://www.deseret.com/2011/11/21/20232586/arizona-museum-displays-bolo-ties-symbol-of-west.

Though politically difficult, it is possible for current generations to make the sacrifices necessary to further protect groundwater stocks. The huge steps taken in the past indicate that further progress – or at least maintenance of current protections – is achievable. With the political willingness to employ both requirements and inducements, investments in the infrastructure necessary to secure and deliver alternative water supplies can proceed apace and the Valley's aquifer can be better protected for current and future generations.

51 Governor's Water Policy Council Assured Water Supply Committee, supra note 4.



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