ISSUE BRIEF

HYDROLOGIC DISCONNECT

ISSUE STATEMENT

The storage and recovery of water supplies in hydrologically disconnected areas within AMAs has the potential to create or worsen localized groundwater depletion. Similar issues may arise in the context of hydrologically disconnected pumping and replenishment to meet requirements of the Assured Water Supply Program.

BACKGROUND

Recharge and Recovery

The storage of renewable water supplies underground is one of Arizona's key long-term water management tools. Across the five Active Management Areas (AMA), Arizona water users have stored (or saved through in-lieu storage) over 11 million acre-feet of water through 2016.[1] The storage of water underground, *recharge*, and the eventual withdrawal of that water, *recovery,* are administered through the Arizona Department of Water Resources' (ADWR) Recharge Program.[2]

Recharge is accomplished through storage at either an underground storage facility for which ADWR has issued a permit pursuant to A.R.S. § 45-811.01 or through the delivery of *in-lieu water* to a groundwater savings facility for which ADWR has issued a permit pursuant to A.R.S. § 45-812.01. When qualified water supplies are stored underground within an AMA those supplies can be recovered within the same calendar year via annual storage and recovery (AS&R) or, with certain exceptions, they can generate a long-term storage credit (LTSC) for recovery in future years.[3] Stored water retains its initial legal classification and is accounted as such when it is recovered. For instance, recharged Central Arizona Project (CAP) water that earns a LTSC will still be classified as CAP water when it is recovered at a later date. Recharged water is subject to physical losses as well as a *cut to the aquifer* depending on the type of water and method of storage. Typically, with some exceptions, there is a 5% cut to the aquifer for water stored at a recharge facility, which is intended to provide a general benefit to the aquifer from the recharge activity.[4]

Arizona's Recharge Program requires that the recovery of stored water, whether through AS&R or LTSC recovery, take place within the same AMA or groundwater basin where the water was originally stored. Additionally, with respect to the recovery of a LTSC, there is no statutory time limitation on how soon the water would need to be recovered after it was stored. This programmatic flexibility has incentivized the use of renewable supplies earlier and more extensively than would have otherwise occurred, but also allows for water to be stored underground in one location, and recovered in a different location that is spatially and

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[1] ADWR, LTSC Summary Dashboard https://new.azwater.gov/recharge/accounting
[2] Broadly governed by regulations in statute (Title 45, Chapter 3.1) and ADWR policy.
[3] A.R.S. § 45-852.01
[4] https://new.azwater.gov/sites/default/files/media/Cut%20to%20the%20Aquifer%20Table_Revised_May_07_2019.pdf

hydrologically separate. The Phoenix AMA alone covers 5,646 square miles and contains seven distinct groundwater sub-basins.

Pumping and Replenishment

Arizona's Assured Water Supply (AWS) Program requires that new subdivision developments within AMAs have access to a water supply that is consistent with that AMA's statutory Management Goal. This requirement is satisfied by securing access to a renewable water supply or, if groundwater will be utilized, through membership in the Central Arizona Groundwater Replenishment District (CAGRD). Membership in the CAGRD allows those water users, including water providers or individual subdivisions, to utilize groundwater today, while the CAGRD finds renewable water supplies to *replenish* that volume of pumped groundwater through underground storage in the same AMA within three years of its use.[5]

Whereas recharging available renewable water supplies "up front" allows a water user to later recover that water under the legal classification in which it was stored, replenishment by the CAGRD serves to replace groundwater that has already been pumped by its members, so it is not intended for later recovery. However, similar to the recovery of a LTSC, replenishment may take place in a location hydrologically distinct from the area where groundwater was initially pumped.

THE HYDROLOGIC DISCONNECT

The ability to legally recover or replenish water that was respectively stored or pumped in a different location is referred to as the *hydrologic disconnect.* While artificial recharge of aquifers has led to a significant increase in water levels in certain areas, the hydrologic disconnect permits water users to pump water in areas that may not have benefited from recharge or replenishment tied to that pumping. For example, CAP water stored at a recharge facility in the Hassayampa sub-basin (located on the west end of the Phoenix AMA) can legally be recovered in the East Salt River Valley sub-basin, nearly 100 miles away. Similarly, CAGRD member lands that are served groundwater in the northern portion of the Tucson AMA currently have their pumping replenished at facilities located in hydrologically distinct regions in the west and southwest portions of the AMA.[6]

In some instances, pumping groundwater that has been legally stored or replenished elsewhere in an AMA may exacerbate localized groundwater declines. In general, subsidence, fissuring, aquifer compaction, storage capacity loss, and water quality impacts are all potential consequences of groundwater depletion.[7] Localized overdraft also threatens economic growth, diminishing the physical availability of groundwater in certain areas and reducing the likelihood that new development can secure an AWS determination. Stakeholders in the Arizona water community have also expressed concerns regarding the vulnerability of stored water to be diminished by groundwater withdrawals by other users. In other cases, recharge or replenishment sites must be managed to account for rising, rather than falling, groundwater levels. These conditions may present their own array of problems, from waterlogging to limiting the amount of water that can be stored at a recharge facility.[8]

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[5] A.R.S. § 48-3771

[6] See map of CAGRD member lands – Figure 2.3, 2015 CAGRD Plan of Operation; Overview of CAGRD replenishment location and capacity – http://www.cap-az.com/documents/meetings/2019-03-21/1741-032119-WEB-Final-Packet-CAGRD.pdf

[7] "Ground-Water Depletion Across the Nation." USGS, 2003. https://pubs.usgs.gov/fs/fs-103-03/JBartolinoFS(2.13.04).pdf

[8] For example, recharge at the Granite Reef Underground Storage Project is often curtailed as rising groundwater levels trigger regulatory alert levels designed to prevent encroachment on a nearby landfill.

Though conversations surrounding the hydrologic disconnect primarily focus on negative consequences, there are also situations in which net benefits to an area or aquifer could be gained. For instance, by recharging or replenishing in a location with declining groundwater levels, and pumping where shallow groundwater is problematic, the hydrologic disconnect can have a positive impact. It is also worth noting that the majority of groundwater pumping within AMAs is not related to recovery or replenishment, and problematic rises or declines in groundwater levels often occur from water use or management practices separate from the hydrologic disconnect.

There is a lack of comprehensive analysis or documentation as to the exact extent to which the hydrologic disconnect is will impact groundwater conditions; however, there is little question that a large and persistent disconnect between recharge and recovery could lead to localized issues. Existing empirical data and modeling related to other water management efforts suggest that in certain cases there is a significant benefit to aligning the withdrawals of groundwater to the location of recharge and replenishment.

One example includes the improvement of groundwater levels in recent years at the Tucson Water Central Wellfield area, located within the Upper Santa Cruz sub-basin. Groundwater pumping significantly increased at the Central Wellfield during the period between 1970 – 2000, peaking at over 73,000 AF/year. In the year 2000, Tucson Water initiated pumping in the Avra Valley area, where recharge of Central Arizona Project water was occurring. Over the following two decades, pumping in the Avra Valley has significantly increased, with a corresponding reduction in pumping at the Central Wellfield. During this same time period, water levels have increased throughout the Central Wellfield area as much as 50 feet, and land subsidence rates have decreased.[9]

In the Phoenix AMA, groundwater modeling conducted by ADWR in 2010 for AWS purposes also shed some light on the potential impacts of linking recharge with recovery. In the final modeling scenario, projections for future recovery and replenishment were shifted to locations closer to where water was originally stored or pumped.[10] These modeling assumptions had the effect of reducing the severity of projected groundwater declines in certain areas of the regional aquifer.[11] Although the assumptions improved model outcomes, actual implementation of those recovery and replenishment regimes could potentially be limited by permitting regulations and storage capacity constraints.

POLICIES & EFFORTS TO ADDRESS THE HYDROLOGIC DISCONNECT

Crafting policy to specifically address the hydrologic disconnect has been a long-running discussion in the Arizona water community and part of a broader set of initiatives to address localized groundwater declines. The need for sub-regional groundwater management strategies was identified as a priority for ADWR as early as 1999 in the Third Management plans.[12] The hydrologic disconnect relating to CAGRD's replenishment has been recognized as an issue by the Central Arizona Water Conservation District Board which has directed the CAGRD "to the extent feasible, replenish in areas of hydrologic impact of groundwater withdrawals by CAGRD members" in its last two Strategic Plans.[13] CAGRD has implemented that direction, but in some cases, as with water users, it is limited by recharge facility location and available storage capacity.

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[9] ADWR correspondence with Tucson Water. April 2, 2020. Also see Tucson 4MP, § 8.3.

[10] ADWR Modeling Report No. 22, § 8.0, pg 65. https://new.azwater.gov/sites/default/files/Modeling_Report_22_2.pdf

[11] Ibid., § 8.5, pg 74; § 9.0, pg 75. Pg. 21

[12] Phoenix 3MP - § 8.2; Tucson 3MP - § 8.7.2.3; Pinal 3MP - § 8.6; Prescott 3MP - §8.2

[13] CAWCD Board of Directors Strategic Plan, 2016. https://www.cap-az.com/documents/board/StrategicPlan-2016.pdf
2010 Strategic Plan, http://www.cap-az.com/documents/board/Strategic-Plan-2010.pdf

More recent attempts to address the hydrologic disconnect took place through stakeholder engagement led by ADWR in 2012 as part of initial efforts to develop the Fourth Management Plans. While concepts for adjusting the cut to the aquifer and designating certain sub-basins for targeted management were proposed, no policies were ultimately adopted due to lack of consensus on a path forward.

Several policy and regulatory requirements exist that govern the location of recovery and replenishment which may also so serve to mitigate some of the impacts stemming from the hydrologic disconnect:

1. ADWR's well spacing requirements prohibit recovery of stored water in some situations if, among other things, the recovery would lead to ≥ 10 feet of drawdown at another well within the first five years of recovery or would exacerbate existing subsidence issues.[14]
2. The AMA Management Plans prohibit recovery of water in an area experiencing ≥ 4.0 feet of average annual decline in groundwater levels.[15]
3. Recovery within the area of impact is considered physically available for assured water supply purposes.[16]
4. Statute requires the CAGRD to replenish groundwater in the East and West portions of the Phoenix AMA in proportion to the replenishment obligation generated in each portion of the AMA, to the extent reasonably feasible.[17]

While these policies do have bearing on the location of recovery and replenishment, they do not provide an overall framework for water management tailored for sub-AMA application and their effectiveness in specifically mitigating localized groundwater has not been well established.

The complexity and breadth of the issue must be taken into consideration when attempting to address problems that may stem from the hydrologic disconnect. As described previously, there are cases where storing water in areas with groundwater declines and recovering those credits in locations with shallow groundwater actually benefit aquifer conditions. In addition, the scale and distribution of the problem is extremely localized, differing between AMAs and even within the sub-basin level. Ultimately, proposals for solutions related to the hydrologic disconnect should remain flexible enough to account for the variability in local groundwater conditions and management practices in different areas.

[14] A.A.C. R12-15-1302.
[15] See 4MP *Storage and Recovery Siting Criteria* (Draft Phoenix AMA, Section 8-801; Tucson AMA, Section 8-901; Prescott AMA Section 8-901).
[16] A.A.C. R12-15-716
[17] A.R.S. § 48-3772(I)