Reconciling Urban Growth with Water Scarcity: Limits to Adaptation or Opportunity for Policy Innovation?

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Abstract

Water access and management in Arizona has long been a subject of competition and conflict, as well as institutional innovation. In the late 20th century, Arizona instituted progressive policies for groundwater management center on the 1980 Groundwater Management Act, and the state and many municipalities made significant investments in infrastructure to gain access to the Colorado River's water through the Central Arizona Project. These investments provided significant security for decades of rapid urban expansion. Today, however, these investments and institutional innovations are being challenged by environmental stress. The Colorado River, long perceived as the sustainable and renewable alternative to groundwater over-extraction, is experiencing a "mega-drought" and the impact of climate change. Its reduced flow is throwing into question the future reliability of this surface water source. In parallel, groundwater models now project future unmet demand in two groundwater basins underlying the rapidly expanding Phoenix metro area. In this difficult context, we document how stakeholders are positioned on "the horns of the dilemma": navigating a transition from a situation of compromise, which provided a perception of security stimulating rapid growth, through conflict, towards a potential for resolution of the ongoing tensions between urban growth and a sustainable water future. We draw from a review of news media reporting, policy documents, and interviews with 35 stakeholders in the Phoenix metro area to document the diverse stakeholder perspectives this pivotal moment. Our interviews illustrate how the dilemma for municipalities is particularly challenging. On the one hand, their economic dependence on urban growth and reluctance to constrain private investment challenges their willingness to let water define the parameters of growth. On the other hand, increasing pressures from citizens, and the physical and economic reality of water availability is forcing shifts in growth management. Specifically, the relationship between development interests and urban managers is evolving: our interviews reveal peripheral metro cities taking on increasing responsibility for assuring future water and demanding more from urban investors as a result. In addition, cities and developers both seem to recognize the need for greater coordination at a regional level to address perceived externalities and loopholes in existing institutional arrangements. While the water-growth "crisis" of Central Arizona is continuing, our research suggests that environmental stress is provoking shifts in responsibilities and roles in urban development, and reconsideration of the level and scope of needed governance arrangements.

Introduction

Central Arizona has long been a site of human innovation and adaptation to the constraints of the desert environment. The Hohokam -- with their elaborate irrigation works and desert-adapted settlements established hundreds of years ago -- laid the groundwork for the metropolitan region we have today (Hegmon et al., 2008). Arizona is now celebrated for the

achievements of its water legislation and institutional arrangements. The growth of the Phoenix metro area since the 1980s is often attributed to astute water resource management by both state and municipal authorities (Gammage et al., 2011). Nevertheless, tensions between urban growth and water have resurfaced onto the front pages of national and local newspapers.[1] In the last national census, the Phoenix Metro area was identified as one of the fastest growing metropolitan areas in the United States (United States Census Bureau, 2023). Like many areas, the Phoenix metro area is also facing constraints on housing availability and access. Concurrently, the long-term availability of two critical water resources on which the Central Arizona region depends -- namely, Colorado River water coming through the Central Arizona Project (CAP) canal system, and non-renewing groundwater extracted from aquifers beneath the metro area -- have been both subject to increased scrutiny and regulatory change. Reduced flows in the Colorado River watershed, as a result of long-term drought and changing climate conditions, have coincided with new projections of potential future shortfalls in groundwater availability, given current consumption patterns and projected demand scenarios.

The Phoenix metro area is not the only region of the country to experience the twin stressors of environmental resource constraints and urban growth, but it is perhaps one of the most well-known (e.g., Ross 2011). Central Arizona's long history in water resource management and urbanization provides a unique opportunity to explore how different actors view the changing landscape of urban development in relation to the specter of water constraints, and how they have begun to respond to challenges they perceive. This research asks: How is responsibility for managing the risk of water scarcity, and thus for water provisioning, changing among municipal, private developer and residential consumers because of the drought crisis? What are the mechanisms being employed by municipalities to shift these responsibilities and risks to non-state actors? What do the responses of cities and developers imply about what actors ultimately are being enrolled in, or protected from, water insecurity risk and responsibilities for adaptation? How do urban actors perceive the implications in relation to municipal legitimacy in service provisioning, and for the longer-term hydrological sustainability of the region?

We present a synthesis of the perspectives of diverse actors -- municipal representatives, urban land and housing developers, non-profit organizations and subject experts -- on the evolving water-urban development relationship. The insights and perspectives offered by the individuals we consulted collectively provide a snapshot of salient concerns, changing relationships, and ideas about pathways forward. While all metro regions are unique, we expect the issues that are raised by those we have consulted will be salient to other municipalities and to the urban development community in other locations, particularly those that are facing the "creeping" concern over the future of water.

Methods

We draw from publicly available reports and academic literature to provide a background to the water institutional and urban development history of Central Arizona. We then synthesize insights from interviews with 35 stakeholders (Table 1) with deep interests in urban

[1] For example, Childs, J., & James, I. (2023, 02 June). Shortfall in groundwater to slow growth in Arizona: Development in Phoenix area will be limited after state study finds supplies aren't sufficient to meet long-term water demands. *Los Angeles Times*; Flavelle, C., & Healy, J. (2023, 01 June). Arizona Limits Construction Around Phoenix as Its Water Supply Dwindles. *Arizona Republic*; Partlow, J., Wingett Sanchez, Y., & Stanley Becker, I. (2023, 02 June). Lack of water could dry up Phoenix area's growth. *The Washington Post*.

development, water resource management, and land change in the Phoenix metro region. Our sample of respondents should not be interpreted as representative, although we made an effort to consult with urban planning and water management representatives of cities in both the metro core as well as the periphery, individuals familiar with state-level policy-making, academics, thematic experts, and with actors involved in diverse dimensions of urban land and real estate development sectors.

Table 1: Interviewees by Sector and Domain of Expertise

Interviewee Sector	***Scope of Expertise***	***Number***
Developer/Investor	Metro-wide (Industry/Commercial, BTR, Single family home, Master planned community)	6
Development Sector Service Providers	Industry and sector advocacy, knowledge/information services	5
Environmental organization	State-wide	2
Municipal water resource and urban planning staff - East Valley	East Valley	4
Municipal water resource and urban planning staff - West Valley	West Valley	4
Municipal water resource and urban planning staff - Central	Central Valley	2
Water resource consultant	Sector, Metro area	3
State water administration	Sector, State	1
Private water supplier	Central Arizona	1
Water and/ or Development Experts	Sector	7

The individuals who graciously gave us their time remain anonymous in our reporting. All interviewees consented to the interviews on the basis of maintaining their names and affiliations confidential. The research was ruled exempt by the Internal Review Board of Arizona State University. We recruited participants through a review of commercial websites of area developers, city planning and water management directories, and through “snowball” sampling in which key informants suggested other experts with whom we should speak. Our aim was to present the diversity of perspectives while recognizing that the issue of water and urban development is highly political and often contentious, particularly as all actors involved attempt to negotiate a fair and sustainable pathway forward. We thus avoid any language that would identify the respondent’s organizational affiliation. We have left the names of some locations and entities in some of the quotes we present throughout the report where needed to ensure an accurate representation of meaning, as long as doing so does not identify the speaker.

The interviews were coded in MAXQDA qualitative data analysis software using a combined deductive and inductive coding scheme. Codes included interviewee attributes, perspectives on urban growth, investment decision-making (for developers), perspectives on mechanisms of water governance and institutions, responses to the Phoenix area growth moratorium, perspectives on affordable housing and water, attitudes and issues related to infrastructure

investments and proposed or desired solutions to the crisis. In addition, the interviews were coded for implicit or explicit indications of social contracts: imagined, practiced, or legal obligations between municipalities and developers, municipalities and residents, and among municipalities and between these actors and the state. A similar codebook was used for analyzing policy documents and news media articles, using NVIVO software.

Literature Review

Institutions of Water Management in Arizona

Groundwater overdraft emerged as a significant concern in Arizona in the mid-20th century, largely as a result of the heavy reliance of the state's agricultural sector on groundwater pumping. Arizona's growing cities were also increasingly reliant on groundwater as they expanded. The 1960s and 70s were marked by instances of land fraud, affecting individuals -- often from out of state -- who bought land planning to build a home but discovered their land lacked water access. In the 1970s the Arizona Legislature, intending to influence the "speed and location of urban growth" (Ferris and Porter, 2019, pg 5) and address the state's reliance on non-renewing groundwater extraction, started the process that led to the Groundwater Management Act (GMA) of 1980. The GMA was intended to limit growth to areas with a renewable water supply (Ferris and Porter 2019; 2021).

The GMA established Active Management Areas (AMAs) to regulate groundwater use by the State through the Arizona Department of Water Resources (ADWR). The Assured Water Supply rules were developed and finalized in 1995 to realize the GMA's objective of ensuring consumer protection by requiring subdivisions to prove a 100 year water supply. In accordance with Assured Water Supply rules, there are two paths to meeting the water supply requirements for a subdivision within an AMA: a designated assured water supply (DAWS) or a certificate of assured water supply (CAWS). ADWR grants DAWS, which then must be reviewed every 10 or 15 years, to municipal providers and private water companies who meet the requirements of an assured water supply. To develop a subdivision within the service area of a designated assured water supply provider, a developer must obtain a letter of commitment (a "will serve" letter) to service from the DAWS; the water demand of such developments are then part of the provider's water budget.

A CAWS is required for any subdivision of six or more lots for sale outside of a designated provider's service area within an AMA. CAWS are one-off permits: once approved, no renewals are required as long as the water footprint of the proposed development does not change. These processes de-risk the water future for property investment, thus enabling the desired growth on areas outside of the service area of a DAWS provider.

In parallel to the development of the GMA, Arizona was in discussion with the federal government to gain access to Colorado River water through the Central Arizona Project (CAP) canals. CAP canals were planned to run through Maricopa, Pinal and Pima countries. One of the final components of the negotiations was that Arizona would put in place regulations on groundwater pumping. Thus, with the passing of the GMA, Arizona was in position to receive Colorado River water once the CAP canals were finished (Gammage 2021; Ferris and Porter, 2019).

BOX 1 Rights to Water in Arizona
Underlying the complex development of water legislation in the 1980s were water rights, who has rights to what water and why. In Arizona, most in-state surface water is governed by the concept of priority: the first to use the water for 'beneficial use' gets priority rights to that water. Other users who come later have 'junior' rights, which means if there is scarcity, senior rights holders have precedence. Groundwater, however, is governed differently. Groundwater is only regulated within AMAs (Ferris et al., 2018). After the passing of the GMA, State regulation of groundwater was challenged in the courts. The Arizona Supreme Court ruled that the GMA was constitutional, determining that private property owners do not own the groundwater beneath their lands (Ferris and Porter, 2019; *Town of Chino Valley v. City of Prescott,* 1981).

After passing the GMA, some landowners and developers pushed back against the Assured Water Supply rules that made it impossible for them to develop subdivisions on land that was not easily serviced by a renewable water supply. The recently finished CAP canal system made it possible for ADWR to address the needs of this interest group by creating the Central Arizona Groundwater Replenishment District (CAGRD) and promulgating new Assured Water Supply rules (i.e., CAWS) that would permit subdivisions that were groundwater dependent to proceed as long as they became CAGRD members. At the time, there was no expectation that the CAWS mechanism would become as instrumental as it eventually did in enabling groundwater-dependent growth to continue.

Under the Assured Water Supply rules, to qualify for a CAWS, a new development's proposed use of groundwater must be consistent with the management goal of the AMA. Depleting groundwater supplies to serve a development is inconsistent with the AMAs' management goals. The CAGRD thus served as a work-around to enable a proposed groundwater-reliant subdivision's use of groundwater to meet AMA's management goal because the groundwater use will be replenished by the CAGRD. As new lands are enrolled, so grows the CAGRD's projected "replenishment obligation" – the quantity of groundwater used in a year that the CAGRD must replenish.

Every ten years, the CAGRD is required to submit a ten-year plan of operation for approval by ADWR's Director.[2] Among other things, the plan of operation must estimate the CAGRD's projected twenty-year replenishment obligation and describe the water resources that the CAGRD plans to use for replenishment purposes. If the Director does not approve the proposed plan, the CAGRD may no longer enroll new member lands. In addition, if the Director finds that there has been an unexpected increase in the CAGRD's projected replenishment obligation or an unexpected decrease in water supplies available for replenishment, the Director can require the CAGRD to submit a revised plan of operation, which the Director has the authority to review and approve. In addition, CAP's popularly elected Board of Directors must vote to approve a

[2] Ariz. Rev. Stat. § 45-576.02

proposed plan before it is submitted to ADWR. Required approval by both the CAP Board and ADWR's Director serve as two checks on the growth of the CAGRD's replenishment obligation.

Initially, the intent was that the CAGRD would purchase Colorado River water, wheeled through CAP, to replenish the groundwater that had been pumped by its members within the program. In the mid-1990s, Central Arizona had not built out demand for CAP supplies and was eager to find uses for it. The Underground Water Storage Act passed a year later, in 1994, enabled and encouraged underground storage of unused surface water supplies in an AMA, and the new Assured Water Supply rules adopted in 1995 made it possible for CAGRD to fully operate the replenishment program (HBACA, 2024).

In the 1990s, the most affordable land was on the periphery of the Phoenix metro area, making this real estate ideal for larger industrial facilities and master planned communities. Before growth picked up at the end of the 1990s, the communities in Phoenix's periphery were largely rural in character with little development pressure and thus had limited motivation or perceived need to seek a water supply designation. The availability of the CAGRD program, coupled with the CAWS and the availability of underground water storage allowed new developments reliant on local groundwater, eventually serving to fuel rapid growth and two decades of urban expansion on raw desert land.

Those who drafted the GMA wanted to steer urban growth to areas where renewable sources of water were already available. The designations and ADWR's periodical review of designations have pushed water providers to conserve water, treat and use reclaimed wastewater, and build technologically advanced treatment plants. The CAWS have required residential development outside of designated providers' service areas to examine water availability, prove 100 year assured water supply and guarantee a delivery and treatment system that works. Transitioning agricultural land-use to urban and technological advancements enabling enhanced urban water efficiency has meant that state-wide water demand is largely the same as it was in the late 1950s, and household water use has declined 30% in 30 years, giving rise to the prevalent narratives that water and development have been decoupled (Richter et al., 2023).

The political compromises that enabled continued growth in Phoenix's groundwater-dependent periphery were not, however, without controversy. In 2000, environmental organizations led an unsuccessful effort to force municipalities to set and plan within growth boundaries through Proposition 202: The Local Growth Management Plans Initiative. Some water professionals raised concerns about the extent of groundwater pumping still permitted under the GMA (Heim, 2001). These concerns were fueled in part because the pace of growth outstripped expectations. This growth has continued, even considering the temporary slow-down during the recession in 2008 (Ferris and Porter, 2019; 2021). By 2015, the CAGRD program was projecting a future replenishment obligation that could not be provided through readily available CAP supplies. The CAGRD's efforts to secure water through rights acquisition from on-River users failed in both 2017 and 2018, demonstrating that it is difficult to use water from one part of the state to support growth in a different part (Ferris and Porter, 2019). Despite an agreement with the Gila River Indian Community, these challenges have continued but are now overshadowed by the decades-long drought across the West.

Today, cities, residents, and investors in urban development are once again grappling with the challenging question of how to achieve the economic promises of urban growth while sustainably managing the region's limited, and variable, water resources. Greater Phoenix continues to be a magnet for new industry and population growth, stimulating continued pressure to expand the metro area's urban footprint, particularly eastward and westward where

raw desert land often provides the least-cost space for new growth. How to meet the water demands of this growth, however, is of growing concern. Not only is the flow of the Colorado River, and thus the CAP system, threatened by drought and longer-term climatic trends (Richter, 2023; Woodhouse et al., 2021; Ferris and Porter, 2025), but, as described below, the state has recently concluded that existing groundwater reserves will not be able to meet projected demands in the Phoenix AMA and imposed a moratorium on new CAWS (Arizona Department of Water Resources, 2023). The Groundwater Management Act represented an important institutional compromise for the dilemma of growth and water resource sustainability, serving, for decades, to create a stable environment favoring rapid urban development. Today, risk and uncertainty around both growth and water resource futures is increasing, raising questions about the appropriate mode of future growth.

The Urban Growth Machine and Urban Adaptation

What is the future of water and urban development in the Phoenix Metro Area? This perplexing, and persistent question underlies residents' queries in city council meetings, conversations among municipal staff, and debates in Arizona's legislature, and is coloring the investment decisions and negotiations of residential, industrial and retail investors. In research on adaptation to climate change, there is growing interest in how urban systems – as hotspots of climate vulnerability, as well as potential innovations in solutions – will adapt and potentially transform (Lobo et al., 2023). Towns, municipalities, and metro regions are not simple units of analysis in adaptation science: these units are composed of diverse actors with often conflicting agendas, disparate interests, with distinct rights to resources and with differential expectations of their own role in adaptation and the roles of others (Eakin et al., 2022; Eakin et al., 2024; Doshi & Garschagen, 2024).

The potential conflicts of interest embroiled in urban adaptation trajectories complicates understanding of urban adaptation (Eakin et al., 2022). The concept of the Urban Growth Machine (Logan & Molotoch, 2010; Molotch, 1976), which many scholars have found to be an apt heuristic for understanding the persistent and often uncritical pursuit of urban growth as an economic engine, is particularly interesting from an adaptation perspective (Eakin et al., 2022). The Urban Growth Machine posits that U.S. municipality growth policies are often generated and sustained through powerful local coalitions of "place entrepreneurs" (e.g., developers, real estate professionals, land investors and brokers), city managers and politicians, local media and educational institutions, that together push forward an uncritical ideology of normatively positive urban growth, serving to generate profits for land-based interests and urban elites (Farahani, 2017; Logan & Molotoch, 2010).

Adaptation scholars are increasingly concerned with the politics of adaptation: how political relations among prominent actors responsible for or influential in adaptation decisions may exert power in ways that could lead to maladaptive outcomes (Barnett & O'Neill, 2010; Dolsăk & Prakash, 2018; Eriksen et al., 2015; Shipper, 2010). The accumulation of environmental stressors in urban contexts potentially threaten the resources on which future of urban expansion depends. Such threats may, under some circumstances, make visible the contradictions and externalities arising from the Urban Growth Machine. The question remains whether municipal representatives and residents will choose to then divorce themselves from growth coalitions to exert greater controls over growth trajectories (Eakin et al., 2022).

A critical element in play is the extent to which urban adaptation is structured by implicit and explicit social contracts among urban residents, development interests, and city and state agencies. Doshi & Garschagen (2023, pg. 1) define social contracts in relation to climate

adaptation as “a collective arrangement between different actors of a society on the overall vision and goals as well as the mutual distribution of roles and responsibilities to achieve those goals. In other words, a social contract describes the collective arrangement of what a society wants and how it gets there.” Scholars of adaptation have posited that global environmental change is disrupting and forcing an evolution in social contracts (e.g., Adger et al., 2012; Hayward & O’Brien, 2010; O’Brien et al., 2009). Blackburn and Pelling (2018) argue that a social contract lens on adaptation allows for the illumination of tensions between obligations, needs and entitlements, and, specifically, how environmental stress challenges expectations of distributions of rights and responsibilities between citizens and the state.

As a means of exploring these differential and evolving expectations of roles, rights and responsibilities, we synthesize the diverse perspectives of 35 urban planners, water managers, development professionals and other stakeholders who are navigating emergent tensions in the development-water nexus in the Phoenix metro area. In the sections below, we explore with these actors how their perspectives on water and development have changed following recent events and how they have responded. We synthesize their perspectives on viable solutions, and what entities they feel need to take the lead in navigating Arizona’s future for water and appropriate modes of urban growth.

Collectively, the diverse perspectives of the individuals consulted for this report convey different positions in relation to the “horns of the dilemma” posed by current modes of urban growth on the one hand, and the recognition that water security is essential for urban prosperity on the other. In business innovation, the horns of the dilemma refers to the desire to obtain two values, which appear to be incompatible. Efforts to wrestle congruence between apparently divergent values can lead to distinct alternatives: compromise, in which neither value is adequately addressed and the dilemma is postponed or ignored; conflict, in which advocates for each value create contexts of polarization; and resolution, based on a recognition of the ways that the distinct values are seen to complement and reinforce each other, creating space for innovation (Hampden-Turner, 1990).[3]

Municipal water managers and planners, water suppliers, developers and residents face critical questions, fraught with uncertainty and potential risks. How abundant or scarce are the valley’s water resources? Will water ultimately prove to be a hard limit for urban growth? Or will technological innovations and the market economy overcome obstacles? Who ultimately should be responsible for securing Phoenix’s water future? The remaining sections of this report are based on the opinions and perspectives shared by the individuals interviewed, supplemented by an analysis of news media reporting (largely from *The Arizona Republic*) and salient policy documents and legislation. The actors interviewed reveal both divergent perspectives and beliefs about the way forward: Some continue to claim, despite the changes just described, that growth has been fully decoupled from water, while others claim that water is, or will become, a limiting factor for continued peripheral urban expansion. Nevertheless, the interviewees also shared values and concerns that may provide the basis for innovative pathways out of the decade’s old dilemma.

[3] see also H3Uni.org: https://www.h3uni.org/tutorial/dilemma-thinking/

Findings

Certainty from Compromise

Given Arizona's desert geography, relatively recent era of rapid urban growth, and complex water rules and regulations, it might be expected that water would be a central issue for urban development interests. Nevertheless, while today water has raised new concerns over appropriate modes for growth, interviewees representing the urban development sector argued that compared to cities such as Houston or Miami where flooding or sea level rise were growing issues, Phoenix has historically not been perceived as being of high climatic risk : "Phoenix is typically seen, at least in this development community, as lower risk than some other markets, because we don't really have that natural disaster risk." In other geographies, hazards are not just associated with loss, but also the cost of doing business: "...the big concern that I hear isn't just the economics, [it] is the issue of insurance costs associated with actually more hazardous parts of the country."

Until recently, water scarcity or water limits were not issues that were frequently raised among investors. As one interviewee from the development sector put it, "anybody that we talked to about Arizona, if they do have a question about water, you kind of explain that and that question kind of goes away." The focus for Arizona investors has been largely on other issues, e.g., the affordability of land and the demand and supply of home construction, conditions of the labor force, transport corridor planning, or municipal regulation and growth policy.

It was Arizona's institutional arrangements that essentially de-risked investment in the Phoenix metro area, allowing water resource availability to be largely taken for granted. Investors had confidence in the regulatory environment, namely the Groundwater Management Act, the Assured Water Supply regulations and the CAGRD. As a developer observed, "...for all the attention we get, I've had many water experts tell me that we have better regulations around our water usage than they do in other places that are perceived as having more water, but don't really have the rules around it." Another developer noted that "[the GMA] takes most of the risk and anxiety out of your life in our business" and that being able to rely on it allowed his business to have "virtually zero concerns about water scarcity." In general, water regulations were a perceived as transactional cost of doing business, an almost "perfunctory hurdle" as one expert put it: "it was an issue for people, but it was an issue you could solve by simply paying money right? …It cost more, took more time. …it was a known risk…was a manageable risk. It was one that you felt as though you could get through."

Developers interviewed explained that working within the boundaries of a Designated Assured Water Supply provider (DAWS) was particularly straightforward because the designated provider -- the city, or a private utility with designation -- bore the responsibility of ensuring the 100-year supply across all water users in its service area. A representative of a designated water supplier explained that the DAWS serves as a budget, or a bank account, so that any new water demand could be confidently accounted for, and accurate revisions to the provider's water budget could be made year on year as estimations of use were confirmed with actual water demand. An expert in municipal water management explained that the DAWS mechanism was a key motivator for cities that were experiencing rapid growth in the 1980s and early 1990s to invest in water treatment facilities and shared infrastructure in order to offset or recharge groundwater extraction with effluent or renewable sources. One state water manager called the DAWS "a jewel in the crown," signaling to developers and investors that the provider has "done the planning for the growth that they're experiencing." As a city manager explained, DAWS

water budgets can't be inflated and thus give investors confidence in investment. Investing within a designated city also saves investors a lot of hassle in finding water to meet growth needs: "either the city leads that effort with their funding, or they [developers] figure it out for themselves, figuring out for themselves is very challenging. And they know that."

From the developer's perspective, the DAWS have historically served to shift any responsibility or concerns about water budgeting and availability to the designated provider. As a developer put it, "We pay them some money. They give us a chunk of the water. We move on." A commercial developer concurred: "Within the city boundaries, all we need to get our facility moving forward is a quote-unquote 'will-serve letter' from the city. The city says, 'we will provide water to this, you know, facility,' whatever that is, and that's what we need to get over the hurdle." Developers then contribute with impact fees to cover the financial implications of their development for the provider's infrastructure.

While interviewees from the development sector all agreed that investing in property that was within the service of a Designated Assured Water Supply (DAWS) provider was procedurally simpler, until recently, investments requiring a Certificate of Assured Water Supply (CAWS) were not considered unduly problematic, and provided a similar assurance of water security:

> *"You hired a hydrologist who did a study to determine if there was 100 year's worth of water underneath your development that you could pull up, and with very few exceptions, they would reach that conclusion. … and you would then file that hydrological report with the Department of Water Resources. They take a look at it and they issue a certificate, saying, OK, you've got 100 year's worth of water. But to use it, you must join the CAGRD. So, then you join the CAGRD. You filled out an application form, you filed the application fee and from the developer standpoint, what happened then is the cost is all borne directly by the homeowners and it hasn't been a huge cost. It's not cheap, it's a couple $1000 a year that the homeowner will pay. It looks like a property tax from the homeowner standpoint."*

The first step in seeking a CAWS was to get a water analysis completed and approved by the Arizona Department of Water Resources, which would then, according to one water consultant interviewed, allow the developer to "essentially hold that water…say, you could lock it up for 20 years by doing this analysis [and] use that as an account to essentially pull out for your Certificate." The CAWS allowed city councils to approve platting a new development outside the service area of a DAWS.

Reflecting back to the early 2000s, some interviewees recalled that there was always a background concern over water ("it's always been a huge issue"), but it was not considered a critical threat. An expert in commercial and retail development noted that water was always considered a distant future issue, nothing that would fit within a typical investment horizon of 5-7 years. For industrial developers, water scarcity "was sort of pending in the future, and hopefully we can get this figured out before the time comes… An issue that would be something that folks who are invested for the long term really needed to pay attention to." As a distant concern, the expert added, "it's super hard in any context like this to make tough decisions and sacrifices when what you're dealing with is kind of this hypothetical future…Everybody quietly acknowledged that, but it was not top of mind, it wasn't in conversations as to why we should do something."

Water Risks Depend on Where You Are

The water portfolios of cities and water providers across the valley vary considerably in terms of the degree to which the city or water provider is reliant on CAP, groundwater, local surface water and effluent. Respondents emphasized that the heterogeneity of water portfolios of cities and water providers across the Phoenix AMA translate into distinct perspectives and concerns about the future of water in relation to urban growth. As one respondent underscored, "depending on literally where your plot of land that your house is on, like it, your context could be completely different."

The ten cities that are members of the Arizona Municipal Water User Association (AMWUA) have access to local surface water resources through the Salt River Project, in addition to CAP and groundwater. Their relatively diversified water portfolios are strengthened by their decades of collaboration in water infrastructure investments, including treatment plants that enable them to make use of effluent. In contrast, many of the more peripheral cities that have only recently embraced rapid growth, such as Buckeye, Surprise and Queen Creek, are groundwater dependent with limited infrastructural access to CAP or alternative water supplies. Municipalities considering incorporating State land into their planning areas face additional challenges. State trust land must be managed to generate the "highest and best use" to maximize returns to the State trust; while urban development or industrial use may be considered of high economic value, state land does not typically have existing water infrastructure to support such development. What water rights and physical water infrastructure would be necessary to enable development on State land, and at whose cost, in most cases is highly uncertain. As one urban water manager commented, "…budgeting water for state land is a near impossibility."

As detailed in the interviewees' perspectives in the next section, the distinct water portfolios and geographic constraints and opportunities of each city in the Phoenix metropolitan area has meant that the hydrological concerns of recent years, and the institutional responses, have affected each provider differently.

Drought, Unmet Demand, and Emergent Conflict Over Water and Growth

Three key events coincided to create the current context of uncertainty and risk for urban growth and water in the Phoenix metropolitan area: the Pinal AMA moratorium on new groundwater-dependent development, the deepening of the Colorado River drought and associated inter-state negotiations, and the Phoenix AMA groundwater-dependent development moratorium. These events followed several decades of institutional development that had effectively shielded development interests from having to worry about water-related risk. Each event had uneven implications for municipalities and the development community but collectively have served as a wake-up call in relation to the water-growth dilemma.

Unmet demand in the Pinal AMA

In 2019, ADWR released the *2019 Pinal Model and 100-year Assured Water Supply Projection Technical Memorandum,* which several interviewees highlighted as the first sign of a significant shift in the institutional context for urban development. The memorandum contained an assessment of 8.1 MAF of unmet demand, equal to just over 10% of the cumulative total demand projected for the 100-year time frame (ADWR, 2019). A moratorium on groundwater extraction for new subdivisions was put in place, although developments that already had approved CAWS or that did not require a CAWS (e.g., industry or commercial investments) were allowed to proceed. The moratorium, however, did not make national news, although it

began to raise alarm among home builders and actors holding land in Pinal County for development outside of DAWS service areas.

The Colorado River Drought

Concern over Pinal's groundwater was amplified by the simultaneous recognition of the precarity of Colorado River supplies, as the state negotiated the significant cuts to that supply that were needed to address the Colorado Basin decadal drought conditions. For area cities that were dependent on CAP water, and ironically for those who had intentionally fostered that dependence to alleviate groundwater pumping, cuts to the Colorado River supply was a wakeup call. An urban planner commented, "we're relying a lot on CAP water…just the idea of the whole drought was probably what spurred that conversation [about water constraining growth] going back several years."

A water expert with long experience working with area cities observed that the abrupt change in thinking about the longer-term reliability of the Colorado has been challenging: "we're having to deal with a major shift in how we look at the Colorado River. It was supposed to be the renewable supply that we would always be able to utilize and now we know there's going to be less of it. So, we're having to adjust accordingly." A water consultant put it bluntly: "What we've learned over the last decade is that being 100% dependent on CAP isn't exactly the best place to be."

In face of pending CAP shortages, developers who had invested in areas with designations trusted that their suppliers -- e.g., cities, or private water suppliers -- would have a back-up plan, i.e., groundwater extraction. As a development sector representative stated, "We are paying attention to it, but it's not a critical issue because the designated providers have groundwater rights that they can pump groundwater. So, if the Colorado River supplies are cut, and they will be cut, they can just turn the pumps on." As described below, other initiatives are underway to expand options for CAP-dependent communities, although these may take some time to bring to fruition.

Phoenix AMA model release and unmet demand

In January 2023, Arizona's new governor, Katie Hobbs, publicly released a report detailing the results of the Lower Hassayampa Sub-Basin Groundwater Model, which indicated that given existing demand and new demand from planned developments in the groundwater-dependent basin west of Phoenix projected over the next 100 years, the sub-basin would face groundwater shortages of 15% (ADWR, 2023). The report had been prepared during the previous governor, Doug Ducey's administration, but had not been released. In her January 9 address to the state, Governor Hobbs declared "This report unequivocally shows that we have to act now, or this will only be the first new area that faces this kind of shortage" (Hobbs, Jan 9, 2023). The report triggered an immediate halt to the state issuing new certificates for developments that would be groundwater reliant.

In the same month, citing concerns over the reliability of its CAP water allocation, Scottsdale stopped allowing an unincorporated community of several hundred residents, Rio Verde Foothills, to haul water from the city's turn-out. The "wildcat" development had emerged as a result of land sales that had skirted the state's subdivision laws, and thus had not applied for Assured Water Supply certification. While Scottsdale had allowed the community to haul water for years, the drought had triggered the enforcement of its drought response plan, curtailing the arrangement. Then, in July 2023, the state released the Phoenix AMA groundwater model

output (ADWR, 2023), with a finding of a 4% unmet demand over 100 years across the AMA, equivalent to 4.86 MAF, triggering the moratorium on new certifications of assured water supply in any area of the AMA solely reliant on groundwater.

The combination of these events attracted the attention of local and national news outlets, with headlines such as “Taps running dry for Arizona suburb: Growth, shrinking water supply has residents fretting” (*The Chicago Tribune,* Jan 19, 2023), “As drought saps Colorado River, an Arizona town is cut off” (*The Washington Post,* Jan 17, 2023), and “Arizona limits construction around Phoenix as its water supply dwindles” (*The New York Times*, Jun 1, 2023). Many of the representatives of the development and construction industry expressed deep frustration over what they perceived to be an over-hyped and inaccurate portrayal of the water situation in the Valley.

The conflation of the Rio Verde Foothills situation to the whole metro area was particularly frustrating to many in the development community: “The media … take a case and ascribe it to the whole, especially if it's dramatic. Like this situation in North Scottsdale, right? Ohh Phoenix is out of water! No, 2000 people who bought land in a pretty iffy way don't have water. Now, that doesn't apply to the rest of the place.” They were frustrated by the lack of nuance in how the stories were conveyed in the media in terms of what areas of the city were affected by the moratorium, and the fact that the moratorium did not signal an immediate present-day shortage of water, but rather a potential overdraft of groundwater over a projected, highly uncertain growth trajectory. Further, they were frustrated that many clients did not understand that the moratorium did not apply to commercial or industrial developments that did not require a Certificate of Assured Water Supply, or to any developments that already had their CAWS in place.

Developers reported fielding panicked clients calling from Europe, and CEOs of investment groups phoning in after seeing articles in *The Atlantic*, *Time,* or *Newsweek* about their prospects for investment. “Holy Hell broke loose. You know, that day you would have thought that it was the apocalypse. I am not kidding!” A local service provider to industrial investors explained, “there's brokers [who] get these calls of, ‘Hey, I just read this really alarming article or I heard on the radio or the TV or whatever that Phoenix is out of water or there's no more new houses!’ Like, ‘How is this going to affect what I'm considering? Do I need to pull, you know, remove Phoenix from my short list of places I may locate?’” Others described investors “pulling the plug” and leaving the development projects “dead in the water, so to speak!,” particularly when the financing was international or national, and the investors lacked sophisticated understanding of the complexity of the local water institutions. A local real estate expert characterized investors’ thinking this way: “Some of these land deals are falling out frankly because people have realized ‘Wait a minute: It has now become way too uncertain. I don't know that I can buy my way out of this, which means it's a known risk that I don't have a necessity I can't quantify, and I don't have a solution for it… I don't want to spend the money.”

New uncertainty and risks in urban development

The tension between perceptions of *physical risk* and *transition risk* were clearly evident in the interviewee’s comments (Box 2). Rather than see the groundwater model release as a forewarning of future physical water scarcity, some respondents saw the issue more as risk induced by policy action. Several interviewees from the development community were highly critical of the state for the way the groundwater modeling had been conducted, as well as for not involving them in crafting the messaging around the reports and helping prepare legislative

solutions prior to the reports' release. They questioned the conclusions of unmet demand, rising concerns about many assumptions in the model pertaining to the placement of wells, accounting for effluent and urban efforts at groundwater recharge, and the reliance on projected demand that would likely be an overestimate of actual use.[4]

BOX 2: *What is Risk and What is Uncertainty?*

Risk and uncertainty are closely related: risk refers to the potential or probability of a specific consequence, while uncertainty relates to the inherent challenges in accurately calculating what that probability is, given limitations of knowledge and understanding. The Urban Land Institute (Haggerty, 2023) distinguishes between physical risk and transitional risk, as real estate and urban development sector actors face the challenges posed by environmental change. They define physical risk as "the risk of damage to assets due to climate-related factors" while transition risk refers to "a broad grouping of business risks associated with climate change and the transition to a low-carbon economy", such as changes in the regulatory backdrop, reduced resource availability, increased costs, higher taxes, reputational risks, etc. While water scarcity has not been a focus of ULI work, drought risk has been recently highlighted as a concern for the real estate industry (Eppig et al., 2022).

Nevertheless, while regretting the bad press that followed the reports' release, others interviewed (including some in the development community) felt that ultimately the model outputs and moratorium were signs that the water regulations of the state were working, "the state was being responsible" by triggering precautionary action. As one respondent commented, "I think when that first came out, the headline was wrong…It made it look like we were running out of water when in fact it's like, no, we're actually instituting consumer protection to protect people that are coming in." Another expert in water policy observed, "The declaration by ADWR is not based on a development-by-development conclusion, but they stepped back and looked at the big picture and said, wait a minute, we are incrementally over allocating what exists and we can't do this anymore." The moratorium had made people in the sector realize that water "is no longer an existential threat. It's an actual inhibitor."

Essentially, many developers interviewed felt that the CAWS process, as a mechanism they had come to take for granted to enable suburban growth on groundwater, had been upended, introducing new uncertainty into the investment environment. A water manager in a groundwater dependent city captured the frustration of developers in their municipal area: "...[it is the] growth that has not received certificates that is kind of in limbo and it's a difficult position to be in. You know, you're a developer, you bought a lot of land at the right time. You're ready to develop and here the state comes in and says timeout." A member of the development community underscored the affront the moratorium posed to property owners and land investors: "it's been very eye opening what a moratorium can do, because if you have land with water rights, that you paid for and own, and the policy doesn't allow you to use them -- or moratorium, more importantly -- that's pretty shocking. And that will affect the institutional capital availability for development for the long term in Arizona." Another commented, "Money flows to certainty. Arizona has a lot of uncertainty."

[4] Subsequent to the initial release of the Phoenix AMA report, ADWR did re-run the model with some revisions to the assumptions, but this did not result in any substantive change to the projected unmet demand. Nevertheless, ADWR was sued in 2025 by the Goldwater Institute on behalf of the Home Builders Association in part over concerns about the model.

While the Pinal County moratorium had given some communities a warning that development could be halted, the moratorium in the Phoenix AMA had caught some developers of proposed groundwater-reliant subdivisions and their champions off guard and less prepared than they would have liked. A city planner in an affected area noted, “We could see the writing on the wall that it was coming -- So this wasn't a shock. We were just hoping it was going to happen in 2026, not 2023.” A water consultant observed that “these are areas that weren't imagined back in 1985 when they did the Groundwater Management Act. So it's a big deal to people and it’s mostly confusion” adding, “the cities got a real wakeup call… .”

Affordable housing gets caught up in the dilemma…

In the months following the moratorium, the potential linkages between housing affordability and the moratorium on new groundwater-dependent development has surfaced as a prominent narrative in the news media, and in political discourse. Nevertheless, the interviewees had distinct perspectives on the issue, raising doubts about the extent to which the specific water constraints will add to the existing housing shortage in the valley.

Some of the representatives of the development sector argued that in face of an existing housing shortage, the moratorium would only increase pressure on the housing stock, pushing prices higher, and moving housing development to other states with less regulation: “we have sent the message: you're going to get a quicker return on your money in any of those other states than you are in Arizona because we can't grow homes in the most affordable markets…the areas where we have land and quite honestly in areas where we have groundwater.” These respondents argued that any additional costs entailed in water acquisition would be passed onto consumers to the detriment of the housing market and affordability.

Nevertheless, other respondents, including experts on the housing market and urbanization trends, had more muted responses regarding the linkages between housing and water. Several experts noted that the housing crisis was long in development and largely driven by non-local factors such as COVID, large injections of capital into the economy in response to the COVID shut-down, unfavorable mortgage rates and supply chain issues that had little to do with water resources (see also Rounds Consulting, 2023). A developer acknowledged, “Affordable housing and such is a complex issue. Just like water is a complex issue. And the contributing factors to lack of affordable housing has been going on well before the groundwater management or the groundwater model came out.” While land for housing has been historically cheap at the fringe of the metropolitan area, until 2023 the existence of the CAWS mechanism and the CAGRD helped keep costs low, enabling relatively unfettered growth. Many noted that affordable housing, particularly subsidized multifamily construction, was more likely to be associated with in-fill development near urban cores, public transport and job opportunities. Water would also likely be cheaper and more efficiently used in multifamily construction in urban cores. While these respondents emphasized that the water constraints certainly were not the cause of the current housing crisis, they did acknowledge that any change in the price and availability of water, as an essential requirement for urban growth in the Phoenix area, would undoubtedly have some effect on home prices. How water would affect housing prices would be a function of whether the housing was being built within the service areas of designated providers, whether a CAWS was required for construction (given that rental properties are exempted from assured water supply certification), and whether the water provider or the developer would need to be

investing in acquiring new water rights and the associated infrastructure to bring water to the development.[5]

Others noted that the publicly subsidized housing for low-income families had little to do with the type of housing stock offered in new developments at the metropolitan periphery outside of designated provider areas. Much of the housing in peripheral areas were targeted at middle-income and higher income markets; they opined that any rise in costs associated with water fees was unlikely to make a significant difference to the home buyer. A water provider representative commented that if a new development outside a designated provider had to spend more to acquire and secure the wet water needed, the ultimate cost for the homeowner would be equivalent to "a granite countertop" or maybe "10 Pumpkin Spice lattes a month" concluding that "idea that people can't pay for this water is ridiculous." A water manager in a peripheral city concurred, arguing that relative to the average $500-600 thousand price tag of homes being built on the periphery, any increase in home prices as a result of rising water stress would likely be the equivalent of an "appliance upgrade." Others suggested that ultimately it would be the city, or the water provider -- particularly in designated areas -- that would have to absorb the brunt of the cost for new water rights acquisitions and new infrastructure for addition homes, ideally recouped by the city through impact fees, and the water ratepayer: "Who's bearing the brunt of the cost? From my perspective, it's probably mostly the cities. And so then how do they pass that on? It's after your house has been built and you just have a higher water bill."

Most of the interviewees suggested that the solution to the housing crisis was not a relaxation of water regulations on the urban fringe, but rather policies that would support densification of urban cores and address public resistance to multifamily construction within designated water supply districts. The recent Arizona policy change that eliminated property taxes on rental properties was, ironically, seen as a deterrent for cities to build more multifamily properties because they no longer would receive any tax revenue from its construction. "Per acre it costs the city every year -- I want to say $40,000 an acre -- to put in a multifamily project. Well, from a city perspective that makes us want to build more commercial, more retail, to offset that because we get a return on investment." Ultimately, as one city water planner observed, the real solution to both the housing and water crises was to build homes where there was a reliable long-term water supply and associated services: "The only way we ever get out of that is if we start saying we're only going to allow residential development in places that have that have water."

Exploiting loopholes to return to prior compromises?

Not knowing how the water and development issue was going to be resolved, and who would resolve it, was articulated as the primary concern in the development community: "the issue is until it's done it's not done and the uncertainty which remains. I think it's bad for everybody, it's bad for the politicians, it's bad for the economics, the state." Several interviewees suggested that ultimately the market would figure it out: the value of remaining land and the opportunities in housing would eventually create the impetus for the necessary technological or infrastructure investments from the private sector to "unlock" the land for continued development. In the immediate term, as both water providers and developers sought new supplies, water costs

[5] See also Kyl Center for Water Policy (2023) "Untangling housing affordability & groundwater regulation. https://morisoninstitute.asu.edu/publication/untangling-housing-affordability-groundwater-regulation

would rise, something they had already observed. They posited that investors would shift their priorities towards moving development forward in areas supplied by designated providers.

Nevertheless, some interviewees suggested that one pathway forward was for developers to exploit what some have called a loophole in the GWA: moving forward with commercial, industrial and rental developments instead of single-family home projects. These alternative land uses do not require a CAWS to be approved in groundwater dependent areas as long as land is not being subdivided into six or more lots. An urban water manager in a West Valley city commented, “I don't know if it's a matter of a loophole or a matter of look, this is what those folks are in business to do, and their business must move on. And yeah, the rules change fast, and the rules changed seemingly overnight for a lot of these folks that aren't tracking the water world, and they've had to adapt their business model, so I don't know that I'd call it a loophole other than just the general adaptation of “development will find a way.”

An increase in construction of “build-to-rent” (BTR) properties was also raised as a possible pathway forward for areas where single family home subdivisions have been halted under the moratorium. Because BTR properties are not subdivided for sale, they are not subject to the CAWS requirement. Some media reports have suggested that BTR property development may rise as a result of the water restrictions in groundwater dependent areas (e.g., Hardle, 2023, 22 Dec). Even prior to the moratorium, beginning around 2017-18, Phoenix was on the map as a prime growth region for BTR development (Northmarq, 2023). BTR properties represent a relatively low cost of entry for residents who are aspiring to eventually purchase a single-family home. A BTR developer confirmed growth in cities such as Phoenix, Glendale, Peoria, Avondale, Goodyear, Queen Creek and Buckeye. Indeed, an urban planner did note an increase in applications for zoning changes to accommodate BTR following the moratorium: “We're seeing a lot of more medium density build for rent communities, which change sort of the land use landscape of some of our areas, and so we're adapting and reacting to that, making sure that they don't occupy prime retail areas, but also they become a bridge between retail and traditional single family areas.” They were careful to explain that water is still a significant consideration for these land use changes: “our water team is still very much involved in those decisions.” The BTR developer also noted that because BTR investors typically hold onto the rental property for 5-10 years, they assume more risk and responsibility for the properties than home builders of for-sale properties. A broader concern is the fact that by not having CAWS in place, BTR developments may be using groundwater supplies that another water provider is counting on to meet its service demands.

Nevertheless, experts and BTR developers interviewed were somewhat skeptical that BTR would necessarily become an easy “out” for growth planning in peripheral groundwater dependent areas. They characterized the BTR market, compared to other rental markets, as generally “high-end” catering to middle-class families and professionals, and that typically these developments were built in suburban areas with established access to urban services and amenities. As one BTR investor explained, “Is water really an issue for us where we're building? Absolutely not, and I wouldn't even entertain a community that wasn't available with water, sewer, wet and dry utilities.” They would not be likely to be built at the fringe of a metropolitan area on raw desert land: “They want to be within close proximity to a freeway. You know, restaurants and healthcare and all that, it's got to be right there. They don't drive till they qualify to rent a home.” Several experts, however, made exceptions for BTR investments that were done by national BTR builders such as Invitation Homes, or American Homes. They speculated that national BTR brands might partner with traditional master planned community developers and find economic advantage to building template rental homes as an alternative to traditional

high-end single-family homes, particularly if mortgage rates are high. “Has that happened yet? No. Will it? Maybe.”

Moving towards a resolution of the growth-water dilemma

As developers, cities, water providers and the state regulators and legislature responded to the immediate fallout of the moratorium and the ensuing tensions, they also began to consider distinct pathways forward. The options and strategies they brought up encompassed pursuing ‘the next bucket’ of water, a phrase that covered a range of concepts/topics, including acquisition of both wet and paper water; efficiency and conservation gains that enabled more growth, collaboration on both water acquisition and infrastructure for wheeling water; and water treatment and reuse (including direct potable reuse). Water infrastructure is a key component of solutions, whether for physical water access and transfer (wheeling water), water treatment and storage, conservation & efficiency or rights and ownership. Similarly, most strategies they mentioned involved some form of water acquisition, ranging from gaining priority rights on a river, paper transfer rights in a groundwater replenishment facility, access to water storage in a dam or outright buying water from a private water broker.

In the sections below, we summarize the diversity of solution pathways described by the interviewees, ranging from conservation and demand-side management, state regulation and legislative reform, municipal and local-level policy, as well as reconfiguring water governance and mobilizing collaboration across cities and sectors to identify and invest in water solutions.

Conservation

Water conservation has long been a core component of municipal water planning and is what many attribute to the fact that per capita water consumption today is largely what it was in the mid 1950s, despite the dramatic population increase in the Phoenix metropolitan area. Both municipal and developer representatives interviewed brought up voluntary conservation measures and municipal programs as ways in which conservation would continue to be a part of water solutions moving forward, taking advantage of improvements in appliance and irrigation efficiencies, and changing residents’ attitudes in favor of more xeric landscaping. Nevertheless, one respondent noted that “we're reaching the limits of what we can do technically.” Relying on residents’ voluntary actions, such as the use of community pools or removing grass, was also difficult: “once you start really tightening the belt on the water conservation, those demands, the actual demands you're left with are much harder.” While there is some contrary evidence from municipal experience,[6] some respondents were concerned that conservation can run up against the fixed costs of water utilities, eventually forcing utilities to raise rates, which can be difficult to communicate to ratepayers.

Interviewees had a variety of suggestions for how conservation could be incentivized, including stronger support from the Arizona Corporation Commission, the establishment of a regional water conservation authority or state-wide conservation code, pricing water appropriately, and more consistent use of municipal ordinances, zoning, and regulations of master planned communities.

[6] Research from the Alliance for Water Efficiency has found that lower water use results in less wear and tear of infrastructure, resulting in lower maintenance and repair costs over the longer-term.

State Action and Legislation

In the course of our interviews, interviewees often obliquely referred to ongoing negotiations of legislative proposals in which they were involved. In some cases, they referred to proposals they felt were bolstering the existing institutional framework for water management, in others, they indicated their interests were in altering the framework they saw as being an impediment to growth. Several respondents expressed alarm over legislative proposals that appeared to weaken the existing assured water supply rules; others suggested that the only way forward for the state was to "stop the bleeding" by expanding groundwater management regulations to currently unregulated basins, from which cities and developers would potentially be seeking new supplies. Other areas they signaled that needed attention were in relation to perceived or actual loopholes in existing rules, for example, mitigating the risk that "wildcat" housing developments could be built without securing water supplies, or requiring Build to Rent and industrial properties to acquire CAWS. Others noted that reform was needed in the assured water supply program such that CAWS would better reflect actual demand (rather than, for example, projected needs at the full build out of a development). While some were advocating for legislation, others noted that rulemaking was procedurally easier and more flexible, consistency in regulation across the state is important, and incentives for collaboration on water were preferred over additional constraints.

In recognition that designations allowed water providers to reduce the uncertainty in water demand and better allocate available resources, many interviewees expressed hope that the legislature would develop an alternative pathway towards designation. Indeed, the Alternative Designation of Assured Water Supply or ADAWS that was proposed by ADWR in November 2023, was finalized in November 2024. ADAWS is designed "to address challenges that some water providers face in pursuing a new Designation of 100-year Assured Water Supply (DAWS) under the current rules."[7] The ADAWS recognizes the value of the Designations of Assured Water Supply for water management, while acknowledging the time, expense, infrastructure investment and administrative procedures required for an undesignated provider to acquire the necessary renewable supplies to qualify for a DAWS. Water providers seeking designations would have to assume the responsibility to satisfy the water demand associated with residential developments with CAWS or that were developed before the Assured Water Supply rules were implemented, and for other groundwater users within the DAWS provider's service area. The effort to meet this demand is particularly challenging as new renewable water sources become more expensive and in face of increasing competition for access. As one city water manager commented, "If you look at where water pricing is to backfill some of these water supplies, it could be anywhere from $10,000 to $20,000 an acre foot. So, if you just throw out round numbers, that's $50 million to $100 million [just] to go out and finance to bring an alternative water supply for current customers. And then the question is how do you recover that through rates?" The ADAWS rulemaking gave cities and undesignated providers a "longer runway" to get around and ahead of water demand by providing a groundwater allocation, and a graduated schedule for incorporating new renewable supplies into the supplier's portfolio.

Overall, the Second Regular Session of the 56th Legislature considered proposals of 95 water-related bills, several put forward in response to the 2023 Phoenix AMA Groundwater Model and subsequent consequences and discussions (AMWUA, 2024). This volume of legislative action around water was unusual, reflecting both efforts to strengthen Arizona's water regulations, as well as efforts to skirt what some actors perceived as unwarranted constraints on growth. At the

[7] See ADWR's description of the ADAWS rule here: https://www.azwater.gov/how-do-I/find-info/alternative-path-assured-water-supply-public-comments

end of the session, three pieces of water legislation were signed into law. SB 1242 paved the way for increased water access by allowing private and public utilities, in addition to municipalities, to transport groundwater pumped from the Harquahala Basin northwest of Phoenix. Two bills, SB 1081 and SB 1181, provided water access and accounting mechanisms that would potentially facilitate non-designated municipalities and water providers to move towards an Alternative Designation (ADAWS). An additional complex proposal, designed to facilitate agriculture to urban water transfers, was ultimately defeated (SB 1172).

Local-Level Policy Action

Institutional change and regulatory tools at the municipal level was also a noted focus of solutions by interviewees. Among these tools are municipal development fees and investment policies that municipalities use to ensure current residents' and ratepayers are not burdened by service and infrastructure demands of new growth. Our interviews revealed that many cities are continuing to lean into the norm of "ensuring development pays for itself" through impact fees and development agreements. But in some cases, they are also working with investors to explore ways in which developments can "bring water to the table" or can contribute to infrastructure development that takes into account uncertainty in future water supplies for all actors involved, and help share the burden of mitigating risk. Some municipalities were also considering zoning waivers to accommodate shifts in land use to enable development to proceed if forestalled by the moratorium.

Infrastructure

Aside from demand management options, almost all the solutions discussed by interviewees entailed substantive infrastructure investments. For municipalities threatened by reductions in CAP water, investments in well infrastructure would allow them to reclaim stored groundwater credits. Many respondents also emphasized the recognition that more infrastructure -- not only replenishment or infiltration facilities, but also water treatment -- would be needed to ensure that groundwater replenishment was occurring in the same vicinity as extraction. The increasing value of effluent as a water resource for indirect or direct use also meant collaboration in advanced treatment facilities, such as the 91st Ave treatment facility in Phoenix. For entities struggling to find new sources of water, creating new water wheeling infrastructure, or wheeling agreements that would provide access to existing infrastructure, would be essential. Several interviewees described declining CAP water volumes in CAP infrastructure as an opportunity to move new sources of water, if water quality issues and institutional constraints could be resolved. Many respondents were putting their hopes in investments in the expansion of the Bartlett Dam, and, in the even longer term, in the possibility of imported water from desalination facilities in Mexico. Given the expense and urgency of infrastructure investments, the state was expected to take leadership. While individual developers and private capital were expected to take more initiative in solving infrastructure bottlenecks, one respondent underscored that coordination from municipalities would be needed to ensure that development projects “work together” to achieve public infrastructure aims.

Collaboration

The interviewees recognized that some of the solutions they discussed for conservation, water acquisition, and infrastructure would have to occur at a regional or national scale between public and private entities. Given the need for collaboration, some respondents also argued that current regulatory agencies might need different legal powers, or perhaps new coordinating agencies would need to be created. Issues such as desalination, water wheeling, and achieving economies of scale through investments in shared infrastructure (e.g., treatment facilities,

Bartlett Dam) were demanding, or would demand, collaboration across disparate levels of government and private entities. Several respondents called for new regional or state-level entities to coordinate such collaboration, such as a water tzar, or state level institutional arrangements (as described above). Watershed-level interventions, or creating a wetland corridor (as mentioned by one respondent) would require such regional leadership. Inter-municipal collaboration was already noted as a historical asset in the metro area, exemplified by AMWUA's efforts, and the resulting shared infrastructure that enabled cities to provide "backup" to each other in managing dynamic resource availability. Many respondents described the evolution of development agreements as a means for enhancing public-private partnerships to achieve both immediate private development and longer-term water public infrastructure needs. Within municipalities, respondents noted the importance of increased collaboration between water resource and water conservation departments, and between water managers and urban planners and city council members (see "Building Political Will" below).

Managing Uncertainty

Uncertainty, more than perhaps any other issue, was what connected the perspectives of all the stakeholders consulted, and their interest in finding solutions to the water crisis, fast. The interviews with Phoenix stakeholders revealed that in the current moment, it was the institutional dimensions of "transition risk" (Haggerty, 2023) that was causing the most significant consternation, underpinned by inherent uncertainty in predicting evolving water resource supply and demand dynamics, raising the specter of an actual physical risk of future water scarcity (see Box 2, above).

Improved scientific climate and hydrological modeling -- greater *scientific certainty* about the trajectory of environmental change -- had led to better understanding and projections of the declining flows in the Colorado River, and improved modeling of the unmet groundwater demand in the Phoenix AMA. It was these improvements in knowledge that had triggered the institutional response of the moratorium, and the growing concerns over future CAP water availability. Despite legal challenges[8] to the hydrological and modeling science that led to the moratorium, almost all respondents viewed the scientific work of ADWR and the models as solid and credible. While respondents understood the economic motivations that had led some stakeholders to challenge the science, most understood that scientific understanding changes over time, and that new knowledge would entail institutional revisions. Further, even with the current improvements in modeling, a water consultant acknowledged there were significant uncertainties in terms of how one city's groundwater withdrawals might affect a neighboring city's replenishment investments or how commercial and industrial water extraction, given the lack of certification needed for such developments, might be affecting a city's water budget and longer-term water supply.

Ensuring that the assured water supply program was supported politically, and that all water providers were eventually designated and working within a clear water budget, was the only viable way some respondents considered would enhance institutional confidence. While many respondents were confident that the CAGRD would continue as a reliable mechanism for enabling sustainable urban development into the future, others expressed concern that it was

[8] In 2025, ADWR faced two lawsuits over its rulemaking in relation to the Assured Water Supply program and moratorium on new groundwater dependent development. The Goldwater Institute is a plaintiff in both lawsuits.

increasingly fragile given its dependence on CAP water availability, was an overused institutional mechanism, and that alternatives would be needed.[9]

As municipal providers considered how to address current and potential future water constraints, they acknowledged that anticipating water needs and infrastructure investment expenses is critical, yet increasingly complex. Accurate projections of future water supply and demand was necessary to calculate development fees, rate increases and infrastructure investment expenses. Cities lacking designations and hoping to pursue the route of an alternative designation in the future, face the significant challenge of trying to "get ahead" of and backfilling existing and evolving groundwater demand from developments with approved CAWS. These calculations were made more challenging by the lack of requirement for industry and commercial investments to acquire a CAWS. Several respondents commented that given the pace of technological development, it was possible that they were over-estimating future water demand, particularly from industrial users who were constantly innovating in water resource conservation. Cities with designations, but seeking to diversify their sources, faced the tricky question of how much investment, into how many alternative sources of future water, would be necessary and ultimately financially and politically feasible for voters and ratepayers. Requesting that both commercial/ industrial and residential developers "bring water to the table" -- even within the service area of designated suppliers -- was one-way cities could assuage some of the risk and uncertainty entailed in approving new growth.

A need for innovation in water governance?

Ultimately, the range of solutions being debated in municipalities, the state legislature, environmental groups, among water providers and development interests may require re-thinking the complex institutional arrangements that have served urban development interests well for the last several decades. Key issues in play relate to what actors need to be included in any revisions to water and urban growth policies, and over what geographic scope and at what organizational scale governance arrangements are most likely to be needed and effective.

Coordination is needed

It was widely noted that enhanced coordination is needed to ensure that the actions taken by private and public water providers, state and municipal governments and developers do not result in a "wild west" of individuals pursuing the next bucket of water through independent projects with potential negative consequences. A water consultant observed that lack of coordination across the AMA results in inconsistent policies, fragmentation and confusion among consumers who are unclear where different providers' service areas end and what rules are in place governing water supplies, conservation programs, and consumer protection: "You've got 7 different grants ordered to seven different cities to remove turf and some of it's residential and some of its commercial, and some of it you have to replace it with this or that, and some of it 'No, you don't have to do that.' And here's how much per square foot, and there's seven different numbers. You can't advertise it regionally, you can't achieve any economies of scale, and there aren't enough conservation professionals to handle the workload."

The possibility of increased inter-city competition for investment as water issues surfaced in the news was also a concern for some municipal respondents. One noted that the lack of an assured water supply designation or certificate could put a city at a potential disadvantage for attracting new development investment: "We are concerned it would put us at a competitive

[9] See Ferris, Porter, and Sorensen (2025) for an analysis of the CAGRD's challenges.

disadvantage where we could have a very similar water portfolio to another community, but since they have a certificate they can move forward even though they may be in worse shape than we are." As an urban planner noted, "We all want the wins to be in our community. And so there is a level of competitiveness and knowing that that water, new water resources are limited, there'll be, I'm sure, some competitiveness in regards to acquiring water supplies."

The need to find the "next bucket of water" was the primary concern, as municipal and private water suppliers would be increasingly competing with each other and with large scale developers over remaining water rights and water allocations. A developer noted that their industry was already in competition with water suppliers and with the CAGRD, with negative effects for all: "Designated providers and home builders are now going to compete directly for these hundred years, and what is my industry going to do? They're going to go and gobble up a lot of water that they don't need today. That's the other factor in this water market. You need to create a system where people are buying it down over time because they need it today. You don't want to create a system that creates hoarding. And we've created a system of hoarding." An urban water manager in the West Valley commented, "If we start to advertise, all of the cities are advertising: 'Hey we need this amount of water!' All the assets are going to get gobbled up by several entities, maybe some of the big hedge funds, which are also in this business, and you know, and then we're really at the mercy of the private side of things."

Municipalities as key actors

Municipalities, as entities at the intersection of water allocation and urban development, and who ultimately needed to ensure water was available long into the future for their citizens, were seen as key actors in any governance arrangement designed to address the future of growth in the Valley. An advocate for city water managers argued that developers, despite their political influence with cities and the state, were not the ones who ultimately would be left responsible if water scarcity became a significant threat. Rather, it was water providers with direct responsibility to water consumers that had the most at stake. Respondents acknowledged that the different water users and development investors had distinct investment and thus decision-making horizons. While homeowners might be concerned about the timeframe of their home mortgage, some investors in master planned communities took decades to bring their projects to fruition, industries often sited their manufacturing headquarters with decadal vision of investment, and homebuilders were characterized as "in-and-out" interests, hoping to achieve a return in a few years. Water providers -- particularly those associated with municipalities -- were there for the long duration, needing to anticipate evolving demands and infrastructure needs far into the future. Municipalities must be politically responsive to their current residents, who interviewees acknowledged had become increasingly vocal about their concerns of future water availability. Being able to stand up and explain the rationale behind specific economic development projects and the implications for the city's water future was thus important for city councils, water managers and urban planners.

The fact that the region's municipalities were at different stages of development and sophistication in their water infrastructure investments was a clear challenge, creating, as one water supplier representative stated "haves and have nots" in relation to the politics of water access. But there was a recognition that even the 10 cities that were part of the long-standing Arizona Municipal Water User Association (AMWUA), who were all designated providers, faced challenges when it came to the reliability of CAP water into the future, and were not unaffected by the moratorium. As one expert knowledgeable of municipal interests in the metropolitan core noted, "Somehow we've got to get development going again out in Buckeye and Queen Creek and other of far areas of the valley and that then raises concerns of, wait, how do we do that in

a way that doesn't hurt us, …making sure that we still have access to the groundwater that we have planned on having for insurance for a dry day, such as when we have less Colorado River water and we're trying to develop a new supply and some other new supply to replace it." A West Valley water manager concurred, commenting, "We recognize that we're all in this together and some of the some of the cities that are fairly well healed they know it … but for them, the Colorado is a big deal and they're not quite sure where they're going to go. And, so, you know, we've got to work together. So it is certainly changing, [but] there's still competition." Cities were already collaborating on raising the Bartlett Dam to increase its storage capacity, and many cities referred to the long history of AMWUA municipal collaboration around infrastructure investment as exemplary of what could be accomplished in light of shared interests in Arizona's water future.

Calls for state and regional leadership

While inter-municipal coordination was perceived as critical, leadership at the state or regional level, with *everyone* at the governance table, was also seen as important, given the long temporal horizon necessary for sustainable water management compared to the relatively short horizon for investors, the diverse stakeholders involved with potential conflicts of interest, and the need for a broader spatial scale for coordination. The possibility that new, large investments in water infrastructure were needed -- for example, investments that would enable inter-state or even international transport of water -- also implied greater degrees of cross-scale coordination and consolidation. A water resource manager in the West Valley commented that from their perspective, the need for larger-scale infrastructure investment required more consolidation of effort: "... ultimately, I think every little municipal water business would probably be formed into a really large water district that has the buying power in the capital to develop a big project … You know small buckets first and then take the leap and go after the big buck. It's not unheard of. People have been moving water for hundreds of miles, going back to the Romans." State or even federal investment was considered critical for such efforts: "We have not traditionally had the support from the state in providing investments into water, and that's something that needs to be recognized that if we don't, if we're not investing in water, then we're not investing in our future."

Governance at a regional, if not state, spatial scale was also considered important to address issues of equity and potential tradeoffs between urban and rural areas, and to address inter-city competition. For example, as urban water suppliers sought water from agriculture districts and rural areas with Colorado River rights, some respondents raised concerns about future undesirable social or environmental externalities resulting from, for example, connectivity between ground and surface water and unregulated groundwater pumping. The fact that because so many urban residents had second homes in rural counties also indicated a need for more regional planning. An expert in water and development commented, "those of us who live part of our lives in the high forests of Arizona are competing with ourselves for water."

A water consultant underscored that while regional leadership was needed, it wasn't clear what type of entity could play the role, given the difficult and delicate politics involved: "We need an umbrella organization for water in the state and it ain't SRP [Salt Water Project, a utility]. It ain't CAP. It ain't DWR. Nobody wants to step into that role. Nobody would be accepted in that role." Another real estate expert observed: "We need policy from the top down. You can't leave it to individual cities and towns. All you're doing is asking for that kind of inter-metropolitan area competition."

Building political will

One of the prominent outcomes of the current debates around the future of development and water in Phoenix AMA was a new acknowledgement of the need for broader and new engagement in issues of water by residents, urban planners, and developers. Interviewees indicated that in many cities water resource management and urban planning were relatively siloed. A planning professional acknowledged the water resource constraints and management are not typically part of the professional disciplinary training of urban planners, perhaps because the discipline had its roots in the Eastern U.S. where water resources were not a primary concern. Several urban planners interviewed indicated that they considered water issues as highly technical, and difficult to understand: “It's very complicated in the how it's regulated, how it's supplied, who gets what and there's so many different rules and requirements in place that it that just would turn my head into a spinning top!” Another agreed: “...water stuff is so complicated. I mean, most people, their eyes glaze over.” Smaller municipalities, and development investors, often relied on water consultants and university resources for information and advice. Interviewees indicated that the current crisis underscored the value of that expertise, particularly that of Arizona State University's Kyl Center for Water Policy, the Lincoln Institute of Land Policy, and the Babbitt Center for Land and Water Policy: “there's a couple of really wise policy folks out there that are easy to get to. And again, it’s our most precious resource and there's a cottage industry around understanding it, managing it, changing it, fixing it, whatever, and so we have just great access to great data and great expertise.” The current constraints also made many in the development community realize they, and their financial backers, needed to gain more personal understanding of water issues moving forward.

To effectively manage growth, interviewees underscored the importance of having not only close communication and coordination among water and economic development staff, but also an informed and responsible City Council. As a result of the water crisis, one consultant observed that he had “seen a sea change in the relationship between the heads of the water departments and the head planners.” A city planner noted that in order to say no to any specific development proposal on the basis of water constraints, “you have to have internal teams that work really, really well together and trust each other and understand the why behind why certain things are needed.” Successful municipal growth planning meant that “management understands how no matter how shiny and new that development looks, you've really have to factor in the water. So it's not just asking about the water, it's really factoring it in.” He continued, “… the cities are much more aware of that and having that type of dialogue. And so I think it's that dialogue, that discussion, that openness, avoiding silos is what determines success or not.”

Providing clear and consistent updates to Council members, backed by accurate data, was seen as essential to empower municipal staff to steer development in directions that would ultimately be sustainable in relation to water resources. A Central Valley water expert argued, “You have to have very clear evidence and data to show that, you know, we're just, we can't accommodate you. And if you had that evidence, that's kind of the first step into maybe creating a picture of where your community stands and where it can or cannot accommodate growth…” Water strategy documents and accompanying scenario analyses allowed staff to help elected officials make more informed decisions, and to communicate their decisions effectively to residents. A few cities had recently adopted specific economic development policies that clearly stipulated that any development projects associated with high water use would need additional economic justification in order to be approved; having such policies had proved critical for a city to be able to decline an investment opportunity, or to request that developers bring additional water rights to the city. A West Valley planner explained, “we can point to this policy to say, hey, look, that's not what we were expecting. You need to bring more water to the table. And that

prompts further conversations." Having water strategies and policies in place enabled cities to assure their residents that they were taking a long view, and, as one respondent said, "getting the bang for the buck for their water."

Discussion

Our interviews and document analysis illustrate the ways in which legal social contracts (Blackburn & Pelling, 2018) – e.g., the institutional arrangements between the state of Arizona, municipalities, the CAGRD and developers – provided the secure context for urban growth and a consistent, if implicit, distribution of responsibility for urban water futures from developers and future residents to municipalities and the state. In exchange, development interests helped expand the Phoenix metro area's urban footprint, making construction and urban expansion an economic growth engine, fueling sales tax and property tax revenue for the suburban and peripheral municipalities, and converting agricultural water rights into watering urban communities. Consistent with Urban Growth Machine propositions (Farahani, 2017), these institutional arrangements evolved, through explicit pressure from a strong urban development coalition, to enable unsustainable growth on raw desert land, creating loopholes that have now required municipalities and the development community to confront their assumptions about the availability of future water resources as a potential constraint on growth.

Blackburn and Pelling (2018) argue that tensions emergent from the divergence of legal, practiced and imagined social contracts in a particular setting can create circumstances ripe for institutional transformation. In this case, developers reported relatively little, if any, concerns about water as a limit to their growth plans and rights to land development prior to the current moratorium on new groundwater-dependent growth. The practice of easy access to Certificates of Assured Water Supply, and the confidence of those water providers that were Designated (DAWS), appeared to have led to *practiced* social contracts in which developers perceived an entitlement to water for their investments. This sense of entitlement was particularly prominent amongst the "home builders" in development community – the actors that had the shortest time horizons for investment returns. Because the home builders were not those who made the initial land investments, and because they only held onto their property investments for the time it took to build homes and sell them, they were least vested in the longer term water security of the region, and had the most to gain from being able to rapidly advance their construction projects so they could move on to the next viable investment. The case of the Rio Verde Foothills—the "wildcat" development at the border of Scottsdale – also underscored this practiced social contract: whether the legal backing was there, the state, municipalities and other water providers would ultimately make water available for the needed development.

The growth moratorium and shortages anticipated in the CAP canal system, however, have thrown the sense of security emerging from practiced social contracts in question. The moratorium – while contested – was the intended outcome of a legal contract between residents/water consumers, the state and development interests, triggered by the Groundwater Management Act. On the one hand, the interviews revealed how the water constraints in the Phoenix area were bringing into sharper relief the relative importance of differential social contracts from the perspective of municipalities. For municipal actors, pushing back on development interests was in part a recognition of their primary obligation to their current residents and voters, and the uncomfortable politics of having to justify growth benefits to rate payers who were increasingly concerned about their city's water future. Obligations to future residents were increasingly being called into question. On the other hand, the rush of legislation following the moratorium in 2024, and the lawsuits that have been pursued by development

interests (the Goldwater Institute, on behalf of the Home Builder Association among others) against the State of Arizona's Department of Water Resources, demonstrates the conflict and institutional dilemmas that can emerge when imagined and practiced social contracts – here, the entitlements some developers felt they had in relation to their development investments in a water-scarce state -- come into conflict with enforcement of legal contracts – in this case, the enactment of restrictions based on best available science backed by legislation.

Does this disjuncture and tension point towards more transformative, and potentially more sustainable water resource management for the Phoenix metro area? At this point the jury is still out. Nevertheless, our interviews revealed that the specter of future water scarcity – something relatively new for consideration in the urban development sector compared to other hazards – does seem to be introducing new fractures in what has historically been a strong elite coalition of urban growth entrepreneurs, politicians, and water resource managers (Heim, 2015; Stanley & Stanley, 2017). The declining influence of the Urban Growth Machine coalition in the metro area is evident in the ways in which municipal actors – particularly those in the peripheral cities subject to the growth moratorium – talked about finding ways to push back on the assumption that they would assume the risk of future water demand for new growth. Through water acquisition fees, modified development agreements, negotiations over the use of private land to serve as recharge basins, interviewees suggested that they were willing to ask private actors to take on more of the responsibility for mitigating future water risk for the city, beyond the footprints of individual developments. Several respondents – from the metro core, where urban land use was largely "built out" (and thus in a relatively privileged position relative to development pressures) -- described taking the politically risky action of turning away development projects that were assessed to be too costly in terms of water demand. Peripheral cities, with municipal planning areas still undeveloped, faced greater challenges in reigning in the growth machine. Yet, even in these areas, both developers and municipal managers reported being forced to think more strategically about water resource availability, with cautious efforts towards (re-)distributing risk and responsibility for sourcing "the next bucket of water" from public to private actors.

These subtle and not-so-subtle shifts in expectations, roles and responsibilities between urban actors have significant implications for urban governance and urban adaptive capacity (Eakin et al., 2022; Eakin et al. 2023). The interviews also illustrated how deeply all actors – with perhaps the exception of the home builders – valued a consistent and clear regulatory context for development investment, one in which they had confidence that public sector actors were responsibly managing risks on their behalf. For municipal actors, it was clear that their ability to assume this responsibility depended on specific capacities: capacity for synthesizing and mobilizing scientific knowledge, for sharing that knowledge and understanding within their administrations and with political leaders, and ultimately with the public. Other scholars have underscored the critical role played by knowledge synthesis and communication in urban adaptation capacity (Wolfram, 2016; Wolfram et al., 2019; Ziervogel, 2019; Ziervogel & Morgan, 2023), and this case reinforces that finding. Ironically, it was this scientific knowledge that the home builders – the most vocal constituents of the growth machine coalition – were challenging in the news media and in the courts to avoid water restrictions and return to relatively unconstrained growth. The fact that many of our interviewees advocated for a greater role for more regional, if not state, management of security for future water resources in the metro area suggested that the current crisis has underscored the value of more systemic perspectives and understanding. The tensions that have emerged – and indeed the conflicts that have come to the fore – have also served to illustrate the interdependencies across metro-area municipalities, the relations of municipal demand to rural interests and water assets, and the complex interplay of water security from groundwater and surface water sources. This recognition, if appropriately

leveraged, may pave the way for novel institutional innovations at a more regional scale to steer Central Arizona towards a more sustainable future.

Conclusion: Seeking new narratives on growth and water

Rising concern over Central Arizona's dependence on Colorado River flows and the longer-term sustainability of groundwater use in the Phoenix AMA has, once again, positioned Phoenix on the horns of the dilemma. On the one hand, the process of urban growth and expansion has been itself an economic engine for the region, providing employment in construction, while also bringing in new industries, and creating a dynamic and thriving economy and metropolitan region. Continued urban expansion in this perspective is a necessity and inherent good:

> *"So what is growth? I mean growth is bringing people, growth is bringing jobs, growth is bringing amenities and services. And so it's like, you know all these things, I mean growth in terms of people like you hear about sales, you know people, people coming in, you know, they're paying money, sales taxes, you know, they're buying homes, there's all sorts of, like, ways that you can extract money from people when they come in and move into a place and move around a place, work in a place."*

On the other hand, the issue of the water needed to sustain that growth out into the next 100 years is once again surfacing, as the different interest groups debate the science, the continued viability of the institutions that have enabled the last decades of expansion, where the "next bucket of water" is and who has the capacity and responsibility to obtain and allocate it. Our interviews suggest that the compromise that enabled the significant urban expansion over the last 30 years is now being re-negotiated.

While some of the respondents were pushing to return as quickly as possible to the status quo, others recognized that things were changing. As one respondent articulated, "…[there] is a recognition that water is shifting from building a pipeline and delivering water …towards recognition that it's a bigger topic." And it was not only the development industry and water providers that were part of this shift; residents also were increasingly calling for more attention and clarity about the region's water future. Whereas previously water was something "people use every day, but they don't see…", a Central Valley planner noted that it was now in the news all the time: "more and more people are seeing about it, hearing about it, understanding that it is a component of growth that needs to be considered." Conflict has emerged, but there is also a concerted interest among all actors to create conditions of stability and certainty that will enable appropriate and sustainable development investments that both serve the interests of existing residents and ratepayers, while enabling communities to continue to welcome new inhabitants and industries.

In this moment of flux, one respondent suggested that there was a need for a new narrative, a new metaphor that would reframe the growth-water tension that would not cast urban sprawl as inevitable, or the current trajectory as inevitably good: "It's just hard for people to come up with any other metaphor for what the end should be for us, or what we should be working towards …People are at a loss for words… We need other metaphors that could be salient for us here, that could help us see another path."

We are grateful that the many individuals who spoke with us on this controversial and challenging topic were not at a loss for words. The depth of perspective, experience, and the diversity of interests at stake are indicative of a potential fruitful moment for re-thinking the

growth-water relationship into the future in ways that continue to ensure Phoenix supports the creative and thriving economies and lifestyles of current and future desert residents, while ensuring the continued sustainable management of its most precious resource.

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