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Water Rights, Water Quality & Water Solutions in the West

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TRIBAL MAR PROJECT

THE GILA RIVER INDIAN COMMUNITY'S MANAGED AQUIFER RECHARGE PROGRAM

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& Peter Mock, Peter Mock Groundwater Consulting Inc. (Paradise Valley, AZ)

Introduction

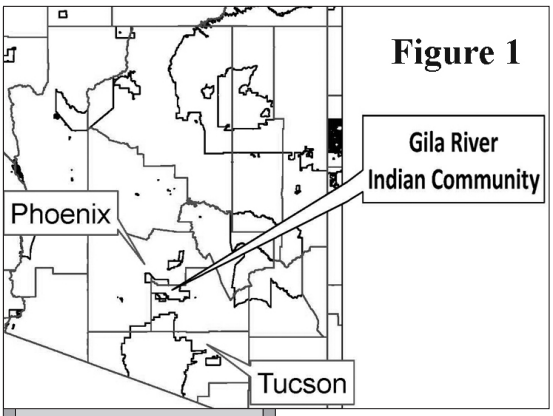
The Gila River Indian Community (Community), located in central Arizona, has developed a large-scale **m**anaged **a**quifer **r**echarge (MAR) program as part of a larger project to implement the Community's water settlement that was approved under the Arizona Water Settlements Act of 2004. This article provides background on the Community and its water rights settlement before discussing the regional recharge assessment and development of the Community's two large-scale MAR projects.

Background of Gila River Indian Community

The Pima, or Akimel O'otham ("River People"), and the Maricopa, or Piipaash ("People"), are the two tribes that form the Community. The Akimel O'otham trace their roots to the HuHuGam, a civilization that began large-scale irrigated agriculture in central Arizona around 2,000 years ago. It is estimated that by A.D. 1450 the HuHuGam civilization was in decline. The Akimel O'otham continued practicing irrigated agriculture in central Arizona after the HuHuGam civilization was gone. The Piipaash were originally from the confluence of the Colorado and Gila rivers but began migrating up the Gila River by at least the 17th Century due to warfare with other Colorado River tribes. Eventually the Akimel O'otham offered refuge to the Piipaash and the two tribes formed an alliance.

The discovery of gold in California in the mid-1800s brought a steady stream of travelers through central Arizona on their way to California to strike it rich. The Community became an area of respite for these travelers where one could rest and restock supplies. By 1860, the Akimel O'otham and Piipaash produced more than two million pounds of grain annually, and grew 30,000 acres of produce. This thriving agrarian economy assured there was plenty to go around for all. These days of prosperity changed soon after the end of the Civil War when non-Indian settlers began illegally diverting Gila River and Salt River water upstream from Community lands. The United States failed to prevent the theft of water, which lead to the decline of the Community's agricultural production to subsistence levels and eventually resulted in widespread famine by the turn of the century.

As a result of the theft of its water the Community had strong legal claims. These claims were partially addressed through: the establishment of the San Carlos Irrigation Project (1924); the construction of the Coolidge Dam (1927) for stored Gila River Water; and the United States negotiating on behalf of the Community to quantify Gila River water rights under the Globe Equity Decree (1935). However, these efforts ultimately fell short of addressing the Community's claims. The Community continued to struggle for its water rights throughout the rest of the 20th Century until it began to finalize a water settlement with the US, the State of Arizona and other non-Indian parties. On December 10, 2004, the Arizona Water Settlements Act of 2004 was signed into law, which approved the Community's water settlement. *See* Water Briefs, *TWR* #10.



The Settlement authorizes a total annual water entitlement of 653,500 acre-feet from multiple sources with the combined costs to use these multiple sources of water intended to be equal to the cost of pumped water on the Community's Reservation. The Settlement also provided funding to rehabilitate and extend the irrigation infrastructure on the Community's Reservation.

The Community's settlement made it the single largest entitlement holder of Colorado River water that is delivered through the Central Arizona Project (CAP). The Community has a 311,800 acre-feet annual entitlement to CAP water. The Community can use its CAP water off and on the Reservation. This flexibility made CAP water the prime source for water marketing efforts. The challenge in using CAP water is its cost. Because CAP water has to be pumped out of the Colorado River, and travel through a 300 plus mile aqueduct with lift stations, the annual energy and operating costs are high.

In an effort to subsidize the cost of CAP water deliveries, the Community developed a water marketing plan to monetize some of its CAP water through leases, exchanges, and through the creation of long-term storage credits. These long-term storage credits are transferable water rights that entitle the owner of the credit to recover an acre-foot of water for each credit, provided that the recovering party is permitted to do so by the Arizona Department of Water Resources. As part of this effort the Community formed the Gila River Water Storage LLC, with the Salt River Project, to create long-term storage credits and market these credits. A key part of the marketing plan was to store water on the Reservation to create long-term storage credits.

Water Market

Storage Credits

Riparian Restoration

Underground Storage

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Water Management Perspective for Developing MAR

The Gila River crosses through the Community's Reservation. One key Community goal was to restore parts of the Gila River under its care. Except for infrequent flood events, upstream diversions for irrigation eliminates natural flow of the Gila River through the Community and the river bed is dry for most of the year. The Community wanted to deliver some of its CAP water to restore portions of the dry Gila River bed within the Reservation, as well as other potential riparian areas within the Community. Given the cost of CAP water deliveries, the Community wanted these riparian restoration projects to be permitted under Arizona law as Underground Storage Facilities (USFs) to create long-term storage credits that could later be marketed to pay for the operation of these projects.

Given the intended dual functions of the projects, the Community decided to develop MARs rather than develop constructed aquifer recharge facilities. This is due to the fact that constructed aquifer recharge facilities would not have the riparian restoration component that was so important to the Community. A MAR could be both an USF and a riparian restoration area.

There was an additional cost benefit that made the development of MARs feasible. The primary goal of the Settlement was to ensure long-term agricultural development. The Community anticipates relying more and more on pumped underground water for irrigation — rather than expensive CAP water — in an effort to keep overall irrigation costs down. In order to avoid over-pumping, the Community would need additional recharge to supplement the natural recharge. By using its CAP water at its MAR facilities the Community not only restores riparian habitat, but also recharges underground water supplies. In this way the Community efficiently uses its CAP water to serve two purposes — riparian restoration and irrigation — rather than just irrigation. This effort is part of a larger water use plan to meet agricultural development demands in an affordable and sustainable way.

Community-Wide Recharge-Riparian Projects Assessment – 2010

The United States Geological Survey (USGS) estimates of recharge from flood events of the Gila River going through the Community in just the 1980s and 1990s totaled nearly one million acre-feet. This indicated a high capacity of infiltration in and near the Gila River bed.

The Community collected and summarized locations for potential recharge and riparian redevelopment projects in a regional recharge assessment in 2010. The assessment identified 12 delivery points as potential "MAR Sites." Initially, this assessment formed the basis for identification and implementation of site investigations.

The MAR Site 3 was selected for initial investigations as the infrastructure was already in place there to deliver CAP water. MAR Site 3 was on a tributary of the Gila River. The site investigation revealed lower infiltration rates than expected, but the ease of delivery was attractive. Backhoe trenching revealed a heavily cemented silt unit to at least ten feet, so this site was not followed through for recharge development. It remains a possibility for a future small riparian restoration project.

Tribal MAR

Infiltration Testing

MAR Site 5, located just west of the Olberg Dam and Bridge that traverse the Gila River, was selected next for potential project development. The modern Gila River deposits, from the Olberg Dam and Bridge in the middle of the Community downstream for just over six miles, was selected for testing. Backhoe trenching at several locations in the potential site revealed a uniform medium sand with minor dispersed gravels to at least 10-15 feet. Three monitoring wells were installed to a depth of 120 feet and pre-recharge water level changes were identified. Next, a test was conducted in December 2013 by releasing 100 cubic feet per second for a few days. The natural flow infiltrated over six to eight miles as expected and the monitoring wells showed a clear response to the infiltration of the water. Representatives of the Arizona Department of Water Resources (ADWR) were invited to observe this initial test and discuss the potential for permitting the site as an Underground Storage Facility for the creation of long-term storage credits.

Underground Storage Facilities

A Novel Intergovernmental Agreement and Permitting

The Community is a sovereign nation and therefore not subject to state laws. In order to accrue long-term storage credits under Arizona's permitting regime, a novel Intergovernmental Agreement was negotiated and entered into between the Community and ADWR. This Agreement enables the Community to develop permitted Underground Storage Facilities on its Reservation. There are currently two fully permitted Underground Storage Facilities on the Community's Reservation. Water deliveries to these sites accrue long-term storage credits equal to the water delivered to the site, minus a five percent cut for the health of the aquifer and a small reduction due to evaporation and transpiration losses.

Pilot-Scale Permits

With a legal document addressing the relationship for recharge permitting, the Community applied for Pilot-Scale Permits for the MAR 5 Site, which was renamed the Olberg Dam Underground Storage Facility (ODUSF) consistent with ADWR permit terminology. The approved Pilot-Scale Permits provided for operations of the ODUSF for two years and storage of 7,500 acre-feet of CAP water. Community staff became proficient at the operations and monitoring of the ODUSF during the Pilot-Scale Permit program. Riparian growth sprang up along the wetted areas without any artificial planting.

USF Storage Permits

Based on the success of the Pilot-Scale Project, the Community prepared the necessary computer simulations to quantify the potential rises from expanded operations. Based on these simulations, and an assessment of any possible negative consequences of raising water levels around the Facility, a Full-Scale Underground Storage Facility and associated storage permits were granted by ADWR. The ODUSF has operated under these since April of 2018. The current annual limit of storage under the permit is 20,000 acre-feet per year. A second delivery point is being evaluated. Current plans call for requesting a permit modification to start using the second delivery point, but not increasing the total annual storage allowed under the permit. Then, based on that experience and updated model situations, the Community would apply for an increase in the total volume allowed under the Permit.

Second Delivery Point?

Access

A Dedicated Interpretive Center for the Community at the ODUSF

The Gila River is culturally important to the Community and the return of riparian vegetation and animals has been a great benefit to the members of the Community. Some Community members use the site to gather indigenous plants for basket making, traditional remedies, and other purposes. An Interpretive Center and trail was constructed in 2017 to improve access to the site for Community members and enhance the experience of visiting the ODUSF.

This Interpretive Center and trail has been a great success among the Community's membership. In addition, the Center and trail showcases the Community's success in implementing its water Settlement. The Center has restored riparian areas and adopted sustainable water use practices that enables the Community to affordably expand agricultural development on its lands. These projects have also freed up some of the Community's CAP water to be used for other purposes including conservation efforts to help the drought-stricken Colorado River Basin.

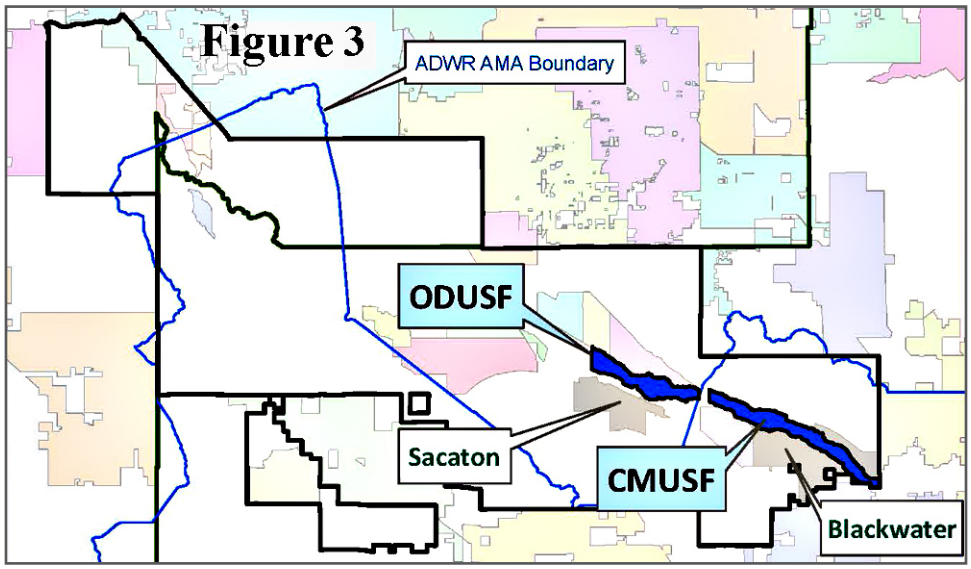
Tribal MAR

Second Facility

The Cholla Mountain Underground Storage Facility

Based on its success at the ODUSF, the Community recently built, permitted, and is now operating a second Underground Storage Facility, the Cholla Mountain Underground Storage Facility (CMUSF), using the MAR 1B Site for delivery of CAP water to the far upstream end of the Community. The lateral limits of the modern Gila River deposits again define the lateral limits of the CMUSF as they do for the ODSUF, but the CMUSF is longer at 10 miles. (*See* Figure 3). This site is currently permitted for 10,000 acre-feet per year. Despite the COVID-19 pandemic, the first year of operations proceeded with great success.

There are currently no plans to develop an interpretive trail at this site, but that may change as new riparian growth continues to expand and the Community decides it wants to allow better access to the site for its members.



Sustainable Development

Conclusion

The Community has developed and is running two large-scale managed aquifer recharge projects with significant riparian restoration benefits as part of a larger water use plan to meet agricultural development demands in an affordable and sustainable way. These sites are key components to achieve the water Settlement goals of the Community to restore the Gila River on its lands and ensure that the Community's agrarian roots will be preserved for future generations.

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Demand Management

Homestead

1922 Interstate Compact

"Law of the River"

Lake Mead

Flow Change

Snowpack Change

Change Accommodation

Demand Management

SAVING THE COLORADO RIVER

HOW DEMAND MANAGEMENT CAN SAVE THE COLORADO RIVER

by James Eklund, Eklund Hanlon, LLC (Denver, CO)

Introduction

THE CHALLENGE & THE OPPORTUNITY

In 1887, after a week at sea, my great-great grandmother Mary Gunderson led her blind husband, Ole, down the gangplank into New York City. Ole was the victim of a mining accident only days before their scheduled departure for America. The economy in Norway had collapsed and the couple sought a brighter future for their two young sons. The family made its way to the new (then twelve-years-old) state of Colorado to homestead on a tributary to the Grand River. The federal government had recently removed the indigenous Ute peoples from the land and opened it to homesteading. The river that dominated this landscape has carried many names, among them Rio del Tizon, the Grand River, and the Colorado River. For eleven years, 1873-1883, the river's performance was below what once was considered average (*i.e.* the average flow of the river 1906-1995). (Woodhouse, 2006). When the Gundersons arrived, the flows had returned to average and were about to enter a wet period that would form the backdrop for the consequential first round of modern management negotiations. (Woodhouse, 2006).

The river that carved the Grand Canyon now shaped new economies — economies that quickly grew too big to fail. Westerners sought ways to control and harness the river while confronting legal and hydrologic uncertainty. In 1922, the seven sovereign Basin States achieved a form of legal certainty through an interstate compact expressly consented to by Congress. The Colorado River Compact (Compact) was the first interstate compact apportioning water use in the nation's history. The Compact divided the river basin in two, apportioning Colorado River system water use between the Upper Basin and the Lower Basin. (The Upper Basin includes: Colorado, New Mexico, Utah and Wyoming; while the Lower Basin includes: Arizona, California and Nevada) The basin states and the federal government adopted agreements, laws, policies, and practices based on their understanding of the river's historic performance. Taken together, these instruments constitute what is now known as the "Law of the River." In 1935, a measure of hydrologic certainty was achieved, for the Lower Basin, with the filling of Lake Mead behind Hoover Dam. If the compact negotiators had been correct in their assumption that Colorado River flows would remain stationary, this article would end here. You, dear reader, are not so fortunate.

Anthropomorphic climate change has fundamentally shifted Colorado River hydrology and the foundation upon which the Law of the River was built. The once average annual river inflows of 18 million acre-feet were experienced and assumed by interstate negotiators — while we now only see 12.5 million acre-feet. In addition, more carbon in our atmosphere is producing warmer temperatures. Consequently, not only are we receiving less precipitation, but more of what we do receive falls in the form of rain instead of snow.

Moreover, snowpack behavior, once considered somewhat predictable and reliable, is now dramatically underperforming. In the 2020 water year, the Upper Basin saw above average snowpack (114%) misbehave to such an extent that it produced a mere 55% of average runoff. (Milly, 2020). These trends can be expected to continue. (Plucinski, 2019). Reasons for this are, firstly, the "aridification" of the Colorado River Basin, where temperature has risen and is rising such that sublimation occurs at higher rates and liquid water fails to occur. The second reason is the "spongeification" of the Colorado River Plateau whereby dry soils and depleted groundwater aquifers soak up the runoff that does materialize.

Nevertheless, the demands placed and the economies reliant on the Colorado River are still too big to fail. Our challenge, therefore, is to shift the Law of the River to accommodate the change in hydrology and encourage practices that can help save the river. Too small a shift risks failing to adequately address the challenge. A larger — perhaps necessary — response may upset the carefully crafted agreements that sovereigns and stakeholders throughout the basin have labored to reach. Unfortunately, the latest data and analysis shows we must prepare for river flows reduced by climate change.

Readying the Colorado River system and the 40 million people reliant on the river in seven states, two countries, and numerous American Indian Tribes requires a rethinking of the fundamental terms of the Law of the River. The picture can seem bleak and depressing — but take heart! These challenges also represent excellent opportunities to develop more reliable and sustainable Colorado River management. We *can* manage our way out of this problem while addressing climate change, thus saving the Colorado River for future generations. Demand management is a necessary management tool that we should be wielding with greater urgency.

Demand Management

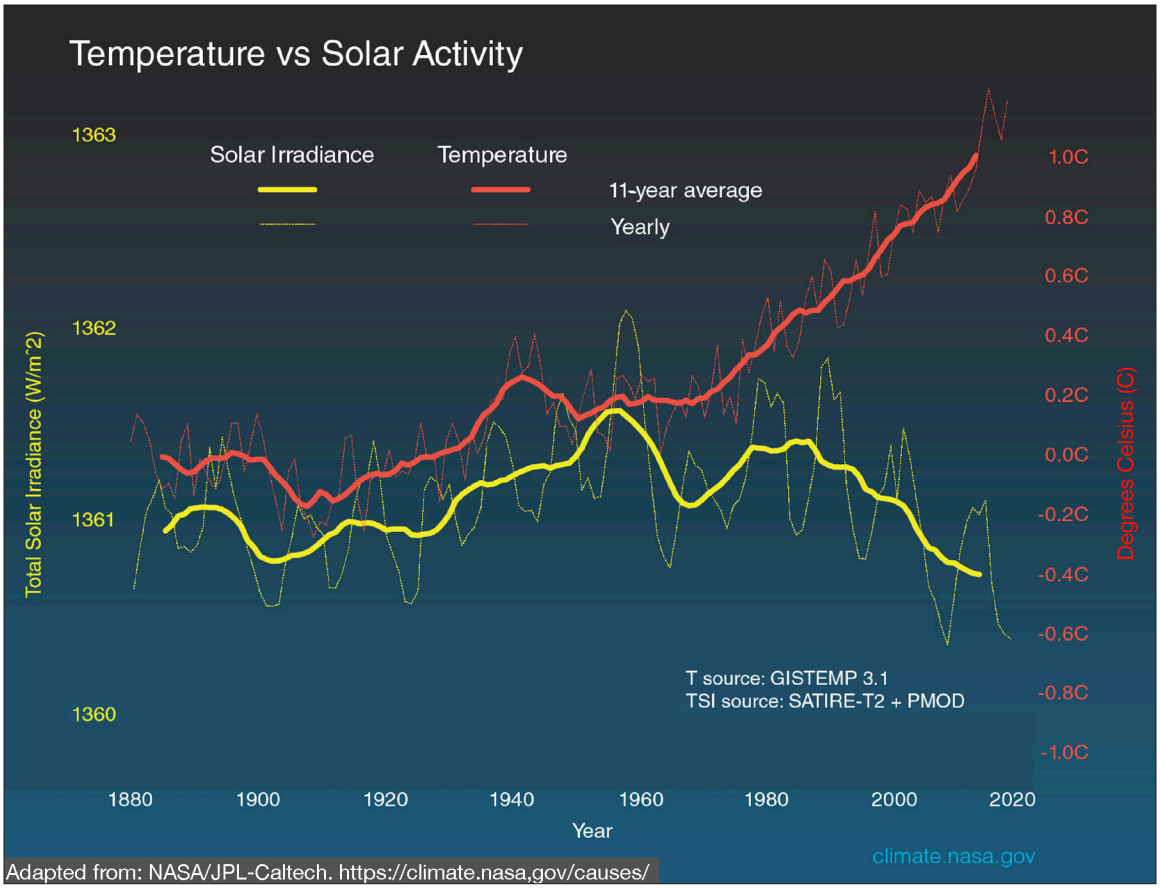
Warming Temperatures

Precipitation Change

Climate Change, Declining Agriculture, and the Law of the River

The Effects of Climate Change on the Colorado River

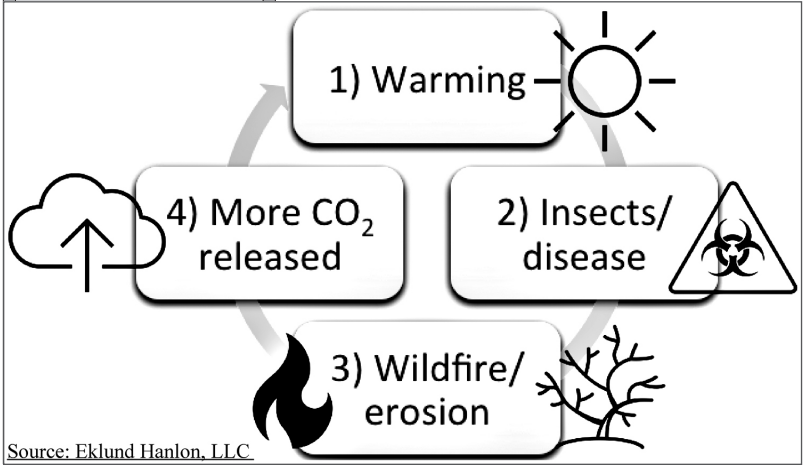
Anthropomorphic climate change is consequential for Colorado River management and presents an existential threat to communities, economies, and environments in the basin. More carbon in our atmosphere produces warmer temperatures. (NASA, 2011). Since the Gundersons homesteaded, average global temperatures have risen 1.4 degrees Fahrenheit. (NASA, 2011).



The above graph compares global surface temperature changes (red line) and the Sun's energy that Earth receives (yellow line) in watts per square meter since 1880. The amount of solar energy that Earth receives has followed the Sun's natural 11-year cycle of small ups and downs with no net increase since the 1950s. Over the same period, global temperature has risen markedly.

Not only are we receiving less precipitation, but more of what we do receive falls in the form of rain instead of snow.

In our integrated environmental systems, the problem is self-perpetuating:



Source: Eklund Hanlon, LLC

1) WARMING: more carbon dioxide in our atmosphere traps solar radiation and results in warmer temperatures
2) INSECTS/DISEASE: warmer temperatures provide a more favorable climate for forest insects and diseases
3) FOREST LOSS: the loss of entire forests in the Rocky Mountains to insects or disease contributes to increasingly destructive wildfire, desertification, and erosion of soils
4) CO_2 RELEASE: wildfire and soil erosion and degradation causes the release of carbon that was once sequestered into the atmosphere
5) DOWNWARD SPIRAL: the cycle continues and conditions worsen.

Demand Management

Soil Degradation

"Buy-and-Dry"

Less Water Spurs Adaptation

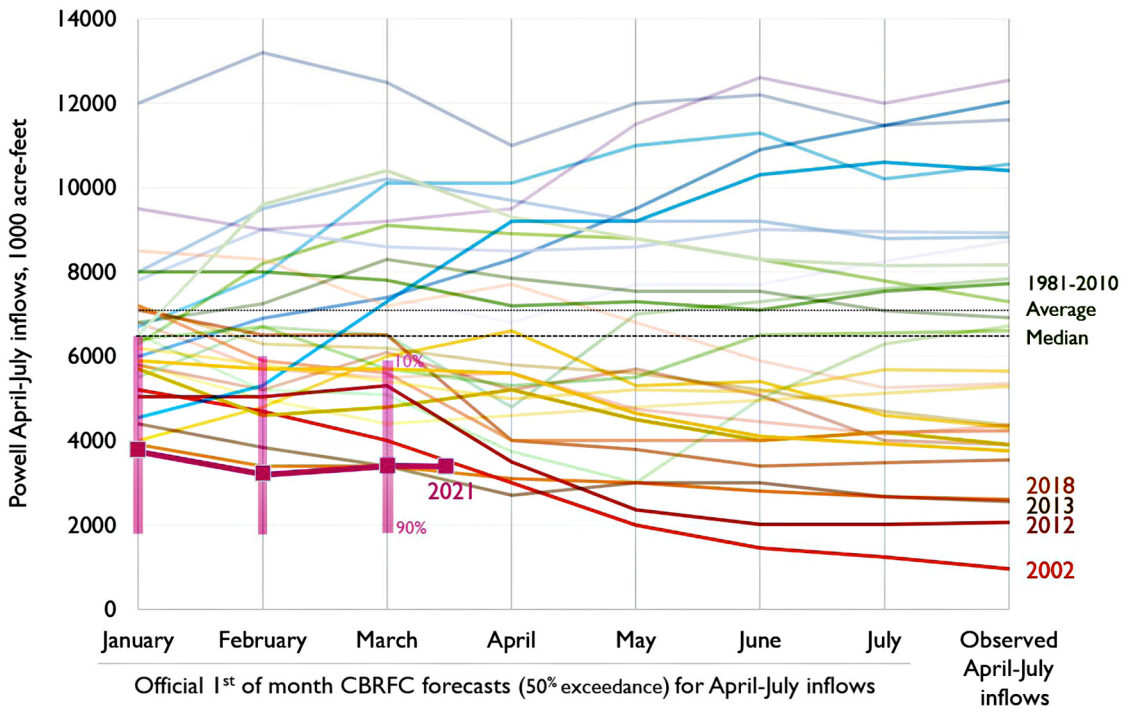
The most current scientific analysis and review of Colorado River data supports this unfortunate dynamic: "Our results underscore that greenhouse gas emissions reduction and moderating or decreasing atmospheric greenhouse gas concentrations may be critical to maintaining sufficient streamflow volumes to satisfy current and future water use while also complying with interstate and international water allocation agreements." (Wheeler, 2021; Miller, 2021).

Agriculture in the Colorado River Basin

Agriculture in the Western US has declined and so have our soils. Just as soil degradation has contributed to our condition, so too can soil regeneration be our salvation. The latest Agriculture Census, released in 2019, shows the amount of US agricultural land continued to decline as did the overall number of farming and ranching operations. The 2.04 million farms and ranches marked a three percent decline from 2012. Simply put, land use practices and climate change are resulting in erosion of our soils. (Borrelli, 2020).

Another principal threat to irrigated agriculture in the Western US is the practice of permanently transferring water from irrigated land (aka "buy-and-dry"). (Colorado's Water Plan, 2015). "Buy-and-dry" is generally disfavored under state water policy due to its potential to negatively impact agricultural communities and economies. (*Id*.). Colorado's Water Plan calls for measurable shifts from buy-and-dry to alternative transfer methods such as lease-fallowing arrangements.

If necessity is the mother of invention, some good news in all the dismaying water data may be that less water becomes the crucible in which new practices and collaborations take shape to: regenerate soils; increase sustainable food production; sequester carbon; and conserve water. Regenerative cropping and grazing management practices can increase water percolation and retention in soils. (Elevitch, 2018; Teague, 2018). A Demand Management program could encourage wider adoption of these practices while freeing up irrigation water that could help with water levels at Lake Powell. The science seems clear that even more strategic farming and ranching practices will be necessary to grow more with less water in a Colorado River Basin impacted by climate change while avoiding buy-and-dry. (Wheeler, 2021; Miller, 2021). A Demand Management program appears critical to provide agricultural producers with additional options moving forward.



Source: Jeff Lukas, @LukasClimate; data courtesy of NOAA CBRFC; https://www.cbrfc.noaa.gov/ Additional data and plots for Lake Powell inflow forecasts: https://www.cbrfc.noaa.gov/wsup/graph/front/espplot_dg.html?year=2021&id=GLDA3

Demand Management

Compact Provisions

Upper Basin Burden

Too Little, Too Late

Purchasable Water Rights

Lake Powell & Lake Mead

Storage Abundance

"System Water"

Aridification

The Law of the River

The agreements, laws, policies, and practices that govern the use of Colorado River water constitute the "Law of the River." Complete and thorough descriptions of this canon exist elsewhere. For our purposes, it is sufficient to note the foundation of the Law of the River: *i.e.*, the Colorado River Compact of 1922. The Compact divided the river basin at Lee Ferry, Arizona, and apportioned 7.5 million acre-feet of consumptive use to the Upper Basin and 7.5 million acre-feet to the Lower Basin. Importantly, the Compact also prohibited the Upper Basin States from "caus[ing] the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of 10 consecutive years…" (Compact, 1922). The intent of this provision was to guard against the Upper Basin exceeding its apportionment from a river that experienced annual flows of 18 million acre-feet on average. When, however, climate change has reduced average flows to 12.5 million acre-feet, the non-depletion provision effectively places the entire burden of climate change on the Upper Basin. The negotiators and signatories to the Compact did not anticipate climate change and, therefore, did not intend one basin to bear the brunt of reduced river flows. For this reason, the non-depletion provision has become the chief obstacle to the equitable apportionment it was originally crafted to enforce.

This fact also suggests that minor surgery on the Law of the River provides too little medicine, too late. A recent study of reservoir elevations and inflows warns, "…the current management approach that allows only incremental changes to the Law of the River may be insufficient to adapt to the future conditions of the basin." (Wheeler, 2021). Instead, the perfect storm of climate change, aridification, and a structural deficit calls for major, evasive (and probably invasive) action.

Demand Management: Friend or Foe?

For nearly two years, the Upper Basin has engaged in lively debate about Colorado River Demand Management. Unfortunately, the hydrology has not slowed its descent to accommodate these discussions. The positive view of Demand Management holds that a program paying users to temporarily and voluntarily leave water in the river is a key tool to address a falling system in a manner that recognizes the American West's system of purchasable and transferable water rights. The negative position fears such a program would accelerate the decline of irrigated agriculture or the environment in the Upper Basin. Ironically, in a desperate attempt to cling to water that is no longer available, this position would limit agricultural water users' access to the very capital that could keep them in production. Importantly, the negative view offers no alternative solution to address a climate-change-impacted river system. Far from being a foe, read on to learn why Demand Management should be embraced like an old friend.

Pre-Continency Plan Disincentive

re: lake powell & lake mead

Incentives matter, especially in a system of free enterprise with purchasable and transferable water rights. Prior to the signing of the Colorado River Drought Contingency Plan in 2019, sovereigns and water users in the Upper Basin of the Colorado River actually faced a structural *disincentive* to conserve water. Firmly in the grips of aridification where demand outstrips supply, how could this be? In addition to Mark Felt's (aka Deep Throat) advice to "follow the money" in the US West, it also pays to "follow the water." Following the water here brings us to the two largest reservoirs in the United States: the Upper Basin's insurance policy, Lake Powell, and the Lower Basin's bank account, Lake Mead.

Lake Mead and Lake Powell are the two largest human-made reservoirs in the United States. Lake Mead's capacity is 28,229,730 acre-feet and Lake Powell can hold 26,215,000 acre-feet of water, with a combined capacity of 54,444,730 acre-feet. At the current average inflow to the river (12,500,000 acre-feet), these two reservoirs could hold four years, four months' worth of the river's flow. As such, we have an abundance of water storage infrastructure, which means our Colorado River challenge is a water management challenge.

Any water in the Upper Basin conserved prior to 2019 was deemed "system water" the moment it hit Lake Powell. Colorado River system water is the water used to determine releases from Lake Powell, through the Grand Canyon, to Lake Mead. Because water conserved in the Upper Basin had no special designation, any water that made it to Lake Powell was used to calculate the releases and, therefore, could actually trigger a *larger* release of water from Lake Powell.

Negotiations

Faced with the threat of increasing aridification, the seven basin states and the federal government commenced emergency river management talks in 2017. Projections for Lake Powell and Lake Mead were alarming and showed that mere reliance on the operations policies then in place could bankrupt both reservoirs well in advance of the 2026 deadline for replacement criteria. (Interim Guidelines, 2007).

Demand Management

Lower Basin Releases

Lower Basin Situation

The Upper Basin had long criticized the Lower Basin's water use that withdrew more water than flows into the system on an annual basis. The Upper Basin referred to this imbalance as "the structural deficit." Furthermore, for reasons too involved to review in detail here, the Lower Basin states were facing their own disincentives to bank water in Lake Mead. California, the largest user in the Lower Basin, wanted assurances that Arizona would refrain from ordering the release of water the Golden Bear had banked in Lake Mead. Arizona, on the other hand, felt compelled to order the release of its entire legal apportionment from Lake Mead because of its junior priority on the river (the junior priority was the sacrifice Arizona was required to make to gain congressional approval of the Central Arizona Project). The stage was set for negotiations that would determine whether terms could be reached. The Lower Basin's saga deserves its own article and I will not test your patience with it here.

Upper Basin Situation

The Upper Basin sovereigns sought more control over their shared destiny, especially given the entrenched nature and size of the structural deficit in the Lower Basin. Indeed, one of the reasons the system had not dropped even more quickly was because actual consumptive use in the Upper Basin failed, annually, to keep up with projections of greater water use. (Wheeler, 2021). Therefore, more water was showing up at Lake Powell, for subsequent release to Lake Mead, than the models predicted. This "extra" water in the system masked the real impact and rate of climate change. The true disruptive potential, however, of climate change would not remain hidden. The Lower Basin's structural deficit was so great that, even with the Upper Basin already on a physically imposed water diet, the reservoirs continued to fall. Something had to be done.

"Extra" Water Confusion

Due to political, practical, and temporal realities, any immediate solution would need to work within the existing Law of the River. For one thing, the need to act quickly was incompatible with the lengthy environmental review processes typically required when making fundamental changes to existing management policy. In an attempt to avoid legal and practical crises on the river, Upper Basin interests began discussing two concepts: 1) operation of the initial units of the Colorado River Storage Project (Flaming Gorge, Aspinall, and Navajo reservoirs) to allow releases of water to address critical Lake Powell levels; and 2) creation of a safe harbor that would allow water users to voluntarily manage their demands and send conserved water to Lake Powell, free from the threat that the volume of conserved water would trigger larger releases of water to Lake Mead.

Upper Basin Concepts

Colorado River Drought Contingency Plan

Over the course of 2018, the Upper Basin and Lower Basin concepts were discussed, debated, and eventually agreed to by the seven states and federal agency representatives. After much intrastate and interstate wrangling, the most recent addition to the Law of the River was settled on in a suite of agreements collectively known as the Colorado River Drought Contingency Plan (Contingency Plan or DCP). *See* Article, *TWR* #182 & Bovee, *TWR* #201. The states further agreed to pursue federal legislation directing the Secretary of the Interior to sign and implement the Contingency Plan agreements upon execution by the parties. On March 19, 2019, the Basin States wrote a letter to the US Congress requesting this legislation. In transmitting suggested legislative language, the Basin States noted that, much like the Contingency Plan itself, the language was "the product of collaboration and compromise" and that the Contingency Plan "will enhance existing water management tools in order to address a looming water crisis in the Colorado River Basin." (Contingency Plan, Attachment C). The states also stressed the urgency of the situation, "[i]t is the position of the Basin States, and water contractors within those states, that immediately enacting the proposed federal legislation and implementing the [Contingency Plan] reduces the probability that Lakes Powell and Mead will decline to critically low elevations — which could occur as early as 2021 — and promotes both domestic and binational participation in drought contingency planning." (Contingency Plan, Attachment C).

Contingency Plan (DCP)

Looming Crisis

When asked what the Law of the River means, many Colorado River negotiators quip, "whatever the seven states say it means." The retort proved true when, in an exceptionally polarized Congress, passage of the requested legislation occurred on April 8, 2019, a mere twenty days after the states submitted their request.

Quick Passage

The Contingency Plan consists of an umbrella "Companion Agreement" (officially titled "Agreement Concerning Colorado River Drought Contingency Management and Operations") and the following appended agreements:

- "Agreement for Drought Response Operations at the Initial Units of the Colorado River Storage Project Act"
- "Agreement regarding Storage at Colorado River Storage Project Act Reservoirs under an Upper Basin Demand Management Program"

Contingency Plan Specifics

Demand Management

- "Lower Basin Drought Contingency Plan Agreement"
  - Exhibit 1: "Lower Basin Drought Contingency Operations"
  - Appendix 1: "Table of Extraordinary Conservation (EC) ICS available as of the Effective Date, in accordance with Section IV.A.1 of the LBOps"
- "Proposed Legislation" (Contingency Plan, 2019).

Responsive Operations of Reservoirs above Lake Powell

Lake Powell Target

The first agreement directs and authorizes the Secretary of the Interior to operate the Colorado River Storage Project Act reservoirs (Flaming Gorge, Aspinall, Navajo) to protect the Lake Powell "Target Elevation" of 3,525 feet above mean sea level. This includes the authority to take emergency action at these reservoirs. Unless the parties agree otherwise, this agreement terminates on December 31, 2025. (Contingency Plan, Attachment A1).

Demand Management

Demand Management Program

The second agreement authorizes the Secretary of the Interior to create an account "available for use by the Upper Division States" not subject to release or used to "cause a different release from Lake Powell than would have otherwise occurred under" the 2007 [Guidelines] or post 2026 operational rules." (Contingency Plan, Attachment A2). The agreement describes the four steps for approval of the Upper Basin Demand Management Program:

- First, the Upper Colorado River Commission makes findings that Demand Management is necessary.
- Second, the Upper Basin States and the Secretary of the Interior agree on the methodology, process and documentation for verification and accounting for Demand Management water.
- Third, the Upper Colorado River Commission approves of the Program.
- Finally, each Upper Basin State representative on the Upper Colorado River Commission approves the Program. (Contingency Plan, Attachment A2).

Surviving Termination (2057)

Whether or not the Law of the River is fundamentally altered under some alternative management paradigm, Demand Management is critical to the future of the Colorado River. The Contingency Plan recognizes this importance by allowing the concept of Demand Management to survive termination of the Contingency Plan through 2057. (Contingency Plan, Attachment A2).

Account Holders in Lake Powell: Sovereigns and Sovereigns Only

Sovereigns' Account

In describing the Demand Management account, the obvious is clear: sovereigns and only sovereigns are capable of holding water accounts in Lake Powell. At no point in the Basin States' contingency plan negotiations did Colorado or any other state voice support for any entity other than a sovereign holding water in the Demand Management account in Lake Powell. The signatories to the Colorado River Contingency Plan Demand Management Agreement were all signing on behalf of sovereigns and sovereigns only. (Contingency Plan, Attachment A2). Moreover, not only would private accounts held by non-sovereigns be inconsistent with the Demand Management agreement and approvals described above, but such accounts could also undermine the benefit of the bargain Colorado and the other Upper Basin States negotiated in 1922. This is because the mere existence of those accounts would move substantially closer to Upper Basin to Lower Basin transfers of water. Such transfers would fly in the face of the benefit of the bargain the Upper Basin States negotiated to use water at their own pace (as opposed to engaging in a race to develop prior appropriation rights that the Lower Basin had already won). Sovereigns and only sovereigns are or should be capable of holding water in Lake Powell. The role of a sovereign here is to design a program that encourages the participation of its non-sovereign water users (e.g. private individuals and businesses, special water districts, municipal water providers).

Holding Water in Powell

Post-Contingency Plan

PROGRAMS RESERVED TO THE STATES

Program Design

Belying the pending crisis, the Upper Basin has yet to take even the first of the four steps required for Demand Management program approval. While the signatory states created the Demand Management account upon approval by Congress and execution by the Upper Basin States, the negotiators intentionally reserved the design and detail of programs that would populate the account to the individual sovereign states.

Empty Account

While the Demand Management account now exists, it sits empty heading into yet another year of aridification. As of this writing, no state has approved a program to populate the account with water. Colorado, the state with both the largest contribution of water to the Colorado River, the largest Upper Basin apportionment, and the state where the discussion has been most involved to date, has yet to determine whether any program is feasible, achievable, worthwhile, or advisable. (CWCB, 2020).

The analogy of skydiving is apt. Thanks to the Contingency Plan, we now have a two-parachute rig strapped to our collective back. One parachute represents our ability to release water from reservoirs above Lake Powell to slow our descent. (Contingency Plan, Attachment A1). The second is Demand

Demand Management

Approvals Needed

Banking in Powell

Conserved Water Payments

Streamflow Restoration

Water Temperature Impacts

Equitable Demand Reductions

Linkage

Management. (Contingency Plan, Attachment A2). The ground is quickly approaching. We can argue about the color of the second chute until it is too late, or we can pull the ripcord and start focusing on landing as safely as possible.

Our pace on achieving the four approvals must accelerate considerably in order for the second parachute to deploy in time. In the words of NASA Flight Director Gene Kranz, failure is not an option. Demand Management, alone, may prove insufficient to keep Lake Powell above the Target Elevation but we simply must deploy it to help arrest our descent. Making the decision to "go" requires leadership. Director Kranz speaks to this as well: "Leadership is fragile. It is more a matter of mind and heart than resources." (Kranz, 2000). Without courageous leadership, a perfectly good parachute will remain, useless, in our pack and our hard-won Demand Management account will continue to sit empty.

Demand Management Benefits

Colorado River Demand Management has the potential to benefit all water users, the environment, and regional economies. With the creation of the Demand Management account, the Upper Basin States have, for the first time, an incentive to encourage water users to conserve water for banking in Lake Powell. Moreover, because the account exists until at least 2057, this incentive does not depend on any facet of the Law of the River changing or remaining static.

The Demand Management Storage Agreement provides a path to compensated, voluntary, temporary payments for conserved water. Should Upper Basin uses have to be reduced for any reason, Demand Management is a way to effectuate that reduction in a manner that best avoids "buy-and-dry." (Colorado's Water Plan, 2015). Demand Management can help facilitate alternatives to buy-and-dry that keep water rights permanently tied to production agriculture, thereby helping increase food security.

Demand Management can also assist with streamflow restoration. Conserved water flowing to Lake Powell might be timed to maximize the benefit to endangered fish species and critical habitat in the Upper Basin. Fortunately, the decline of the Colorado River is coinciding with evolving environmental science that helps quantify the benefits when water is left in a river. (Szeptycki, 2018). These benefits can be quantified and monetized to benefit water users trying to decide whether to consume their water or to leave it in the river in a given year.

Downstream of Lake Powell, scientific analysis shows environmental benefits and detriments to both native and non-native fish species below Lake Powell depending on its contents. (Rosenberg, 2021). Cooler water temperatures result when reservoir contents are higher while warmer water is the product of lower water levels in reservoirs. While native fish may prefer warmer water temperatures from a drawn down Lake Powell, "they may also face invasion by warm water non-natives from Lake Mead." (Rosenberg, 2021). The "best strategy is an intermediate strategy, where you have water that's not too hot and not too cold…where you can still provide thermal conditions that are conducive to growth of native fish." (Dibble, 2021). Demand Management water in the Colorado River System can make it easier to hit this "Goldilocks Zone" where reservoir releases are neither too hot nor too cold.

An Urgent Call to Action

While you have been reading this article, our continued, collective skydive has brought us that much closer to an unacceptable, and unpleasant, reunion with the ground. Simple physics demands we act. Two recent studies underscore the fact that managing Upper Basin demands is critical to addressing the decline of the Colorado River. (Wheeler, 2021; Miller, 2021). One argues that "[e]quitable demand reductions will be an important part of water management in the Colorado River basin in the era of climate change." (Wheeler, 2021). A Demand Management program appears to be the most equitable and beneficial method for reducing demands without accelerating the buy-and-dry of irrigated agriculture.

Livelihoods, cultures, economies, food production, and environments are inextricably linked to the Colorado River. As such, sovereigns should involve both public and private sectors in making the next round of macro and micro water management decisions. The science seems clear that Colorado River management moving forward also requires more than a mere tweak here or there to the 2007 Guidelines for river operations. The fundamental tenants of interstate water management are overdue for a serious reevaluation. One part of the basin bearing the vast majority of climate change risk and reality is neither equitable nor sustainable. Moreover, to use a basketball analogy, the clock is not our friend. We are playing from behind and do not have the luxury of waiting until 2026 to adopt new water management policy.

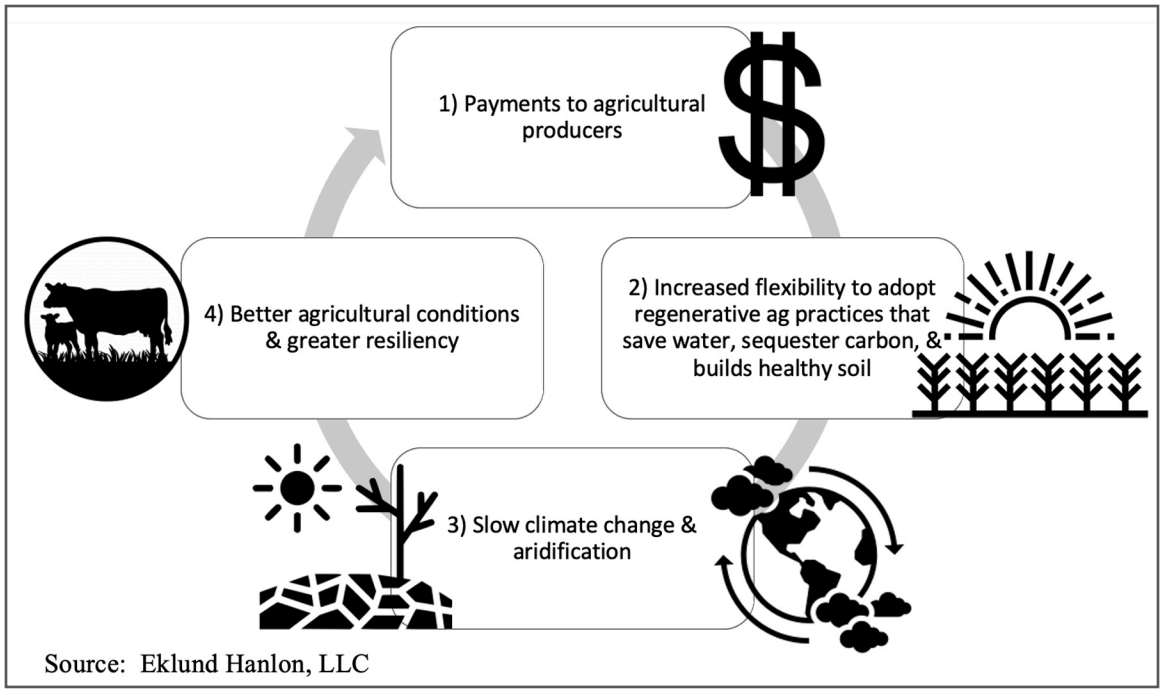
Each stakeholder on the Colorado River has an important role to play and Demand Management can facilitate their involvement. By now, you probably have a sense of the roles that federal, tribal, interstate, state, and local governments play on the Colorado River. Less often discussed is the role of the private

Demand Management

For-Profit Interests

sector. Importantly, private, for-profit interests include farmers and ranchers, rafting guides and flyfishing outfitters, main street businesses, and professional services industries. Given the scope and urgency of the challenge, excluding or vilifying stakeholders wastes precious time — time better spent cultivating and encouraging new water management ideas, innovation, and expertise from stakeholders from all sectors for the benefit of the Colorado River basin. (Ryder Howe, 2021). Providing agricultural producers access to capital in ways that avoid buy-and-dry and de-risk production is also important.

Demand Management Cycle



Source: Eklund Hanlon, LLC

Conclusion

The sovereigns in the Colorado River basin should move quickly to make effective, efficient, equitable, and holistic management decisions in response to climate change. Demand Management has the potential to encourage conservation, innovation, and collaboration. Allowing agricultural producers greater flexibility and options encourages regenerative agricultural practices that could help address climate change. Compensating Upper Basin water users for leaving water in the river is a critical tool currently available to us by virtue of the Contingency Plan and can help us control the system's descent. Upper Basin ranches like Mary and Ole Gunderson's and those on Ute Tribal lands, stand a chance of not only still being in active production but thriving and contributing to the solutions that save the Colorado River. In summary, effective and efficient Demand Management could jumpstart a different cycle: 1) money is paid to agricultural water users for temporarily leaving their water in the river; 2) the increased flexibility this capital provides producers increases their ability to adopt regenerative agricultural practices that save water, sequester carbon, and regenerates healthy soil; 3) regenerative practices help slow climate change and aridification; 4) slowing climate change and aridification results in better agricultural conditions and greater resiliency; and 5) a stronger agricultural sector increases yields and nutrient content that results in more money for producers.

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Demand Management

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WATER SCARCITY & PRIOR APPROPRIATION

POLICY SOLUTIONS FOR WATER SCARCITY IN PRIOR APPROPRIATION STATES

by Robert Sappington (Sammamish, WA)

Water Policy Needs

Economic Externalities

Prior Appropriation

Scarcity Solution

Increasing Conflict

Market Demand

Solution Aspects

Optimization Goals

The prior appropriation legal framework for water use encouraged development of the western US without regard for optimal use or economic externalities, *i.e.* an economic activity's effects on third parties not reflected in the cost of that activity. Supply shortages exacerbated by climate change have forced society to shift from development to optimal management of a scarce resource as the primary goal of water use. Optimization requires accounting for externalities, which must be accomplished through policy changes.

Twenty western states, however, remain tethered to either prior appropriation or hybrid prior appropriation/riparian regimes. Decades of legal reform have adapted these prior appropriation frameworks to reduce waste, enable sales to higher value users, and incorporate externalities, such as environmental impacts and infringement of Native American rights. These reforms, however, have left gaps and frictions that inhibit water resource optimization. For example, inefficient farms fighting the transfer of water use rights to domestic or efficient agricultural use.

Prior appropriation regimes must evolve in a manner that offers a comprehensive solution to water scarcity. This article presents a solution that adapts prior appropriation governance to optimize scarce water resources. The State of Washington is used as the primary example, but the concepts apply to other jurisdictions.

Water law in Washington must manage increasing conflicts between uses of a scarce resource. Substantial progress has been achieved through judicial, administrative, and legislative reform to support historically neglected uses, such as instream flows. However, the current legal framework has failed to protect sufficient water flows to meet minimum instream flow rules, which may not allow for the recovery of endangered fish populations or Puget Sound orcas and certainly do not support fish populations able to sustain traditional harvests under Native American treaties, e.g. the *Treaty of Point Elliott, 1855, Article 5*. Permit exempt wells continue to proliferate and deplete groundwater reserves, impacting surface flows. Industrial agriculture, businesses, developers, municipalities, and investors demand increasing shares of over-allocated water resources dwindling from climate change while rural communities and small-scale farmers face existential threats from dehydration.

The lack of a durable solution means that it's simply a matter of time before future generations decide any water use beyond out-of-stream human use is not worth the cost. Further, future conflicts won't be limited to people versus the environment. Domestic use will compete against agriculture and poor communities will lose to wealthy ones. As these conflicts evolve, technological innovation and market demand will drive significant changes in land use, such as the impact of cultured meat products on ranching and animal feed production or the impact of vehicle electrification on the ethanol market for corn and sugar cane producers.

A forward-looking, system-wide approach can solve current and future challenges. Defining the solution's characteristics is the first step.

A durable solution:

- incorporates a goal to optimize resource use;
- measures and forecasts supply and demand for all uses;
- creates an optimized plan;
- reallocates resource use to optimize public benefit;
- scales over time with increasing resource demand;
- adapts to change and resource availability, and
- integrates with other systemic changes.

The remainder of this article explores these solution factors in greater detail.

Optimizing for Public Benefit

Scarcity necessitates choices. These choices become intractable without actionable goals, a common basis for making decisions, and a plan to achieve the goals. Early prior appropriation laws lacked goals to optimize scarce water resources because their original goal was settlement not optimization. Threats to environmental values were unrecognized. Revisions over time introduced terms, such as "public interest" and "maximum net benefit" to direct usage; however, these amorphous concepts lack actionable objectives. A truly optimized result begins with a clear view of the optimization goals.

Water Policy Needs

Public Benefit

A stable solution requires all societal values be met. The failure to fully address all values in water's public benefit creates dislocation and conflict. For example, over-allocation for domestic use to the detriment of agriculture generates supply/demand imbalances and higher food prices. Ignoring environmental values compromises ecosystem services, spurring costly and disruptive litigation. Thus, the public benefit of water is the current and future portfolio of uses that society values, including: agricultural; industrial; domestic; cultural; and environmental. Cultural values include not only Native American cultural heritage preservation, as embodied in treaties, but also a broader notion of social justice supporting indigenous, marginalized, or minority groups. Environmental values include complementary economic and non-economic uses, such as recreation, aesthetics, and endangered species preservation. Public benefit transcends the aggregate private benefit to a group of individuals in various use categories by including non-economic benefits and, by extension, economic benefits accruing to the general public.

Water Allocation

Quantity allocation based upon need of a scarce resource creates a stable solution paradox. How can we fully satisfy the public benefit in perpetuity when we don't have enough water? Understanding what the public benefit is *not* will help us resolve the paradox. Water's public benefit is not a guarantee that water may be used by any individual, in any location, for any purpose. Additionally, public benefit emerges from use, not investment speculation. This distinction will become increasingly important with the growth of water securities trading, which began last year in California (Michael Hiltzik, "Wall Street can now bet on the price of California water. Watch out," Los Angeles Times, January 3, 2021). Solving the water allocation paradox requires us to shift paradigms from legacy-controlled free resource use to scarce resource optimization.

Current Ambiguities

Washington water law provides a good example of both ambiguous public benefit concepts and the array of laws defining those concepts. The state uses a number of different terms as goals, including: beneficial use (*RCW 90.03.040*), public benefit (*RCW 90.03.040*), public interest (*RCW 90.03.290*), public welfare (*RCW 90.03.290*), and maximum net benefit (*RCW 90.03.005*). Individuals may obtain private benefits from use of the public's water because "beneficial use of water is...declared to be a public use." *See RCW 90.03.040*.

Actionable Goals

The determination of actionable goal(s), however, doesn't end here because the complexity of water law and inextricably linked land use law creates a solution space that includes: "common goals...in the conservation and the wise use of our lands...environment, sustainable economic development, and the health, safety, and high quality of life" (*RCW 36.70A.010*); environmental, agricultural, commercial, industrial, and domestic uses (*RCW 90.54.005*); cultural and socioeconomic factors (*RCW 90.54.010*); and "presently unmet needs and emerging needs" (*RCW 90.42.010*). For convenience, I will use the term "public benefit" to encompass this solution space. Shifting the paradigm to resource optimization for public benefit is mandated throughout Washington's water law. *See, e.g*., the exercise of eminent domain (*RCW 90.03.040*), the issuance of new water rights (*RCW 90.03.290*), and the establishment of minimum flow levels (*RCW 90.22.010*).

Allocation Plan

Counting the Molecules and Forecasting Use

Resource optimization begins by counting water molecules and forecasting use (Mark T. Anderson and Lloyd H. Woosley, Jr., *Water Availability for the Western United States—Key Scientific Challenges*, U.S. Geological Survey, Circular 1261, 2005, pp. 2, 4). Quantifying the water volumes needed to satisfy each of the public benefit values enables development of an integrated allocation plan. Unfortunately, even carefully constructed regional municipal water plans — accounting for long-term population growth and minimum instream flows — fail to consider necessary values, such as flows for optimal fish populations and the geographic scope needed for resource optimization.

Data Availability

The missing information extends beyond unmeasured molecules. Optimization requires not only complete inventory and use measurement of the existing resource but also hydrological models to accurately assess impacts from current and prospective uses and forecasts for use and demand changes at all jurisdictional levels, including interstate. Border states must consider international implications. Timely data availability is required for both planning and permitting. Delayed or missing information enables one societal value to impose externalities on another, increases correction costs, and hinders resource optimization.

Quantified Volumes

The lack of quantified volumes and a long-term plan to use them causes a number of problems. Consider delayed or missing information on Washington fish populations. Minimum instream flow rules have not enabled the recovery of a single endangered salmon run, much less Puget Sound orcas dependent upon salmon. Whether these failures result from unmet minimum flows or levels that are set too low is yet to be determined. Thus, even the lowest environmental threshold, recovery of endangered and threatened species, lacks a verified instream flow volume. Further, historical harvest levels required under Native American treaties will require fish populations supported by optimal river flows unburdened by consumptive uses. These flow levels have not yet been quantified.

Water Policy Needs

Agricultural Production

Growth Limits

Shifting Uses

Allocation Constraints

Storage Priorities

Storage Development

Capacity Planning

Current Constraints

Agricultural production plans, and consequent water use, rarely exceed crop rotation cycles measured in a handful of years and are near-term demand driven without regard to optimal use for societal values. Barring emigration or an economic or catastrophic displacement, domestic use is a permanent water sink. Transfer of water from agricultural to domestic use using market prices without regard to feeding current and future populations risks supply and demand imbalances.

Municipalities plan for water use within a watershed assuming a perpetual and growing population. Ghost towns littering western states argue for a broader geographic perspective. Resource optimization mandates population centers located and sized appropriately for the available water given other values in the public benefit calculus. This means that communities unwilling or unable to reduce their consumptive use and develop off-stream capacity will dry up. Washington State has historically been reluctant to curtail domestic use; but unbridled growth has consequences. For example, the *Hirst* decision required counties to consider water availability for residential development. *See Whatcom County. v. Hirst*, 381 P.3d 1, 186 Wash. 2d 648 (2016).

Water is currently over-allocated in Washington and disproportionately allocated to agricultural, commercial, industrial, and domestic uses. Resource optimization will shift water use. The intent of Washington's Growth Management Act supports such optimization. *See RCW 36.70A.010*. This shift must be planned and managed, or people and values will suffer, spurring conflict.

Plan for Optimizing a Scarce Resource

Once the water resource inventory and uses are quantified and forecasted and use impacts understood, an integrated plan must be developed that considers all the jurisdictional levels from municipalities and counties to bordering states and nations. The plan will not allocate water based on existing seasonal resource limits or unfettered growth but rather on the total amount of water available throughout the year. This total water constraint is a near and intermediate one and subject to alleviation in the long-term (*see* scaling section below). A complete discussion of optimization planning exceeds the scope of this article; however, two aspects (capacity planning and trade-off decision-making) with significant gaps in current water resource management will be discussed.

Capacity Planning

Humans have stored water for millennia. The construction of dams, reservoirs, tanks, and other water storage capacity, however, has served a narrow set of societal values, *e.g.* domestic or agricultural, and limited hydrologic areas and jurisdictions. The failure to address all societal values in capacity planning has resulted in compulsory post-implementation changes in water management. Numerous examples across prior appropriation jurisdictions exist, including: the addition of fish ladders and mandatory release schedules for dams, multi-decade adjudication of use right volumes (*e.g.* Washington's Yakima basin rights), and the series of disputes embodied in litigation between Arizona and California, arising from the Colorado River Compact and spanning nine decades resulting in eleven Supreme Court cases (see *e.g. Arizona v. California*, 140 S.Ct. 684 (2020)).

The societal value dislocations that force these changes arise from, and produce, both economic and non-economic costs. Climate change will increase these costs through decreased total precipitation and shifting winter precipitation from snow to rain, magnifying water scarcity issues. Storage of wet-season rain for dry-season use offers a solution to dwindling snowpacks, but the infrastructure must be developed in a manner that satisfies all social values. For example, storage capacity created by dams causes environmental and cultural harms. Off-stream capacity must be strictly limited to storage solutions with no flow impairment. Proper capacity integration into optimization planning will reduce overall costs by avoiding expensive post-implementation changes and by maximizing storage efficiency across hydrologic and jurisdictional scales. Projects (including production, storage, reclamation, hydrology modeling, and water resource research and development) should be sited to meet efficiency and mitigation requirements, avoid moral hazard (*i.e.* the incentive to increase risk exposure because costs are born by others), and reflect cost, stream flow, and feasibility constraints.

The scale of capacity management throughout prior appropriation states must change significantly. Neither the status quo nor a half measure deemed feasible provide an adequate measure of needs. Capacity must be planned to meet all societal values. Thus, underserved values require a greater allotment of the capacity while over-allocated values receive reductions. Trade-offs must be made.

Trade-Off Decision-Making

Expense, political will, and technology constrain water resources to current supply levels. Resource optimization expands supply management to total annual precipitation, which exceeds current supply, for the near and intermediate planning horizon. Utilizing total precipitation, however, will not eliminate water scarcity, mandating trade-offs between societal values. Decision-makers attempting to appease competing special interests frequently struggle to allocate a scarce resource between economic and non-economic values. Their choices often reflect political clout or decision-making expediency rather than optimality.

Water Policy Needs

Mathematical Optimization

All Societal Values

Agency Discretion

Conflict Impacts

Impact Avoidance

Incremental Reallocation

Transfers

Instream Flows

Informed Trade-Offs

Many mathematical optimization tools enable better decisions. Techniques exist to incorporate qualitative factors into a quantitative model. These optimization models yield a number, which is useful in allocating water. However, the major benefits of these approaches are the journeys required to produce the result. The models enhance buy-in promoting transparency, consider a wider range of factors, including externalities, than one person can mentally juggle, and enable auditing for biases and errors. An optimal solution will utilize these mathematical tools.

The Center for Environmental Law & Policy v. State of Washington, Department of Ecology (No. 97684-8, (Wash., 08/06/2020) (*Spokane River*) offers an insightful study in decision-making. The case addressed whether the Department of Ecology (Ecology) adequately considered recreational values in setting Spokane River minimum flow levels. Ecology argued *RCW (90.54.020)* did not require them to set instream flows to account for all societal values. They gathered information about flows needed to support recreational and navigational river usage (including public comments, opinion surveys, and photographs), considered the information; but then adopted minimum flow levels supporting a fish population without considering other needs. The Center for Environmental Law & Policy (CELP) argued Ecology merely gathered information and failed to consider *all* instream values; therefore, Ecology's decision was arbitrary and capricious. The Washington Supreme Court deferred to Ecology's agency discretion in interpreting the statute.

The only decision-making paradigm used in *Spokane River* was Ecology's narrowly focused black box process. A mathematical optimization approach would have provided a rigorous means of incorporating all uses and values through an auditable decision process. The Court's ruling in favor of an opaque decision process and continued dislocation of recreational values ensures future societal value disruptions and added costs.

The Great (Incremental) Reallocation

Change can occur suddenly in large shifts or gradually in incremental steps. In the context of water reallocation, lawsuits under the federal Endangered Species Act could force sudden change, resulting in a development ban and radically curtailed domestic, agricultural, commercial, and industrial water use. The economic impacts and disruption to society would be significant. Note, for example, the significant reduction of timber harvest on public lands to save the spotted owl. Further, social injustices and cultural oppression persist in long-standing violations of Native American treaties. These costs and disruptions can be avoided and injustices corrected with a proactive, systematic approach that incrementally reallocates water. If the incremental change occurs fast enough to prevent further harm to threatened and endangered species and assure other stakeholders that their values will be met, lawsuits and major dislocations may be avoided.

A reallocation paradigm can be crafted by drawing from municipal development codes that require recreation space; tree retention; critical area protection; surface water management; and transportation, sewer, and school infrastructure and impact fees — to name a few concessions developers make in order to develop land. The implementation of a reallocation protocol will vary by state to account for differences in prior appropriation frameworks. There are common characteristics, however, that span all jurisdictions. Every societal value will receive an allotment of water. Transfers within an allocation will occur freely, but transfers between value allocations, e.g. from agricultural to domestic use, will be restricted after reaching an optimal mix, with one exception. The percentage of water dedicated to instream flows would vary through the year, increasing in dry seasons and decreasing in wet seasons. The objective is to move toward optimal year-round flows while enabling wet season off-stream storage for consumptive use during the dry season. Seniority should be preserved across the reallocated water use right to prevent junior rights from usurping instream flow reallocations and increases from stored water use.

States must ward against abusive implementation of water reallocation. Development codes contain provisions to grant variances that exempt developers from requirements. These variances have been used too frequently in some jurisdictions.

Informed trade-offs of a scarce resource are key to increasing instream flows while meeting other needs in prior appropriation states. Geographic optimization, in addition to use optimization, provides another opportunity to correct imbalances by promoting water use in the locations best suited to increasing supply through subterranean storage and other capacity efforts that benefit from economies of scale, such as off-stream storage, sourcing, and reclamation. Thus, cities with the geologic features for water storage should be allowed to grow more than locations lacking this capability. Likewise, coastal cities will ultimately meet dry season water needs through desalination. *See* "Policy Effects on Innovation Adoption" below. Moving toward optimal water use and river flow restoration means shifting the water source for dry season consumptive uses to off-stream supply.

Water Policy Needs

Change Reallocation

Water Trusts

Donation Offset

Water Exchange

Transaction Transparency

Rights Change

Permanent Reallocation

Domestic Use

Ecotourism

Continuing with Washington as an example, the state could require, as a condition to changing a water use right or through eminent domain action, reallocation of portions of that use right to instream flows and other uses to match a long-term optimized resource plan and collect fees to improve stream habitat and build off-stream storage. This would require a change in Washington law. *RCW 90.03.380(6)* states, "No applicant for a change, transfer, or amendment of a water right may be required to give up any part of the applicant's valid water right or claim to a state agency, the trust water rights program, or to other persons as a condition of processing the application."

Variants of water reallocation protocols can utilize water trust programs, such as those operating in Colorado, Montana, Oregon, and Washington (collectively "the Trust"), to encourage earlier instream flow preservation. For example, a portion of a water use right parked in the Trust could revert to a permanent instream flow donation each year. This donation will offset the percentage of flow reserved for instream use when a future use right change is made. The longer a use right remains in the Trust the greater the offset to the future instream use required with a rights change. This offset strategy works best when instream flow reallocation percentages increase as off-stream storage becomes available. Off-stream capacity expansion must offset existing and future consumptive uses in order to correct the current over-utilized and disproportionately economic allocation scheme. To ease the reallocation transition, the percentage of flow reserved for instream use with a rights change may start at a lower proportion and increase as off-stream capacity increases until optimal flow levels occur.

Markets may play a role allocating water through a water exchange within the regulatory optimization framework, e.g. the market decides allocation within the agricultural water allotment. A water exchange (the Exchange), as opposed to a utility, could facilitate reallocation and optimization by making transfer easier and more transparent (Peter W. Culp, Robert Glennon, and Gary Libecap, *Shopping for Water: How the Market Can Mitigate Water Shortages in the American West*, The Hamilton Project Discussion Paper 2014-05, October 2014, pp. 17-18). The water exchange contemplated here differs from current water markets in states such as California, Colorado, Kansas, Nebraska, Texas, and Washington. First, the Exchange would be a statewide non-governmental organization that captures economies of scale in information systems and trade processing. Second, the governing board would consist of representatives from all water uses, including environmentalists, farmers, municipalities, and industrialists. Finally, the exchange would operate independently of local use pressures and political influence.

Water use rights must detach from property ownership and trade solely through the Exchange to increase transaction transparency and aid the reallocation process. The Exchange focuses on transparency and transaction efficiency in a fiduciary role. The state regulator will implement water policy, *e.g.* reallocation, through qualifying rights available to trade. Ideally, the rights should be adjudicated so that extent and validity are known with certainty to prevent rehydration. This structure separates rights verification, policy implementation, and market structure to simplify regulation and aid adoption. A utility model, in contrast, merges policy and market structure and delegates policy implementation to the local water bank with attendant bias risks.

An optimized portfolio of water resource use enables informed trade-offs to free water for instream flows while protecting other vulnerable uses with social justice implications. The Methow Valley in Washington offers a good case study. With each water use right change, trade-offs can be made to enhance stream flows. Redeploying water from less efficient, lower value agricultural uses to more efficient, higher value agricultural uses (either downstream or on site) enables the reduction of water dedicated to agriculture necessary for population support. Water resource optimization is consistent with the planning goals expressed in Washington's Growth Management Act. *See RCW 36.70A.020*. The highest environmental value arises from permanent reallocation to instream flows. Merely sending the water downstream for a consumptive use risks bottlenecks that breach either flow, temperature, or salinity thresholds below the downstream extraction point, which is problematic for anadromous species that depend upon the entire watershed. More efficient water use enables reallocation with less economic impact. Reserving a portion of these water use rights for instream flows apportions part of the efficiency gain to the environment. Small towns, such as Methow, Twisp, and Winthrop, can be preserved by reserving a portion of the rights for upstream domestic use. Community growth will be capped, but these smaller communities won't have to compete with larger, well-funded downstream domestic users for use rights. Population growth will be limited to domestic use supported by local off-stream storage, e.g. domestic cisterns, and future technological advances in capacity development. Domestic use may be further refined to foster the development of eco-tourism by creating seasonal domestic use capacity during the wet season and curtailing that capacity, e.g. restricting rentals and hotel rooms, during the dry season. Ecotourism is critical for fostering in future generations the appreciation of and a desire to support the environment. Further, variable recreational domestic use serves more people and supports a larger local recreation economy at the expense of second-home domestic use.

Water Policy Needs

Expand Volume

Quick Response Needed

Tiered Pricing

Speculation

Resource Value

Water Price

Scaling the Resource

All prior appropriation states must expand water supply volume to correct current allocation imbalances and provide for sustainable population growth. Scaling the resource to achieve these goals requires significant investment in production, conservation, reclamation, and off-stream storage and distribution infrastructure. The solution mix will vary by jurisdiction; however, funding for water resources may be generalized to three possible options: cost recovery, private investment, and a price for water.

Cost Recovery

The traditional model of voter-approved bonds paid for by water utility base rates plus progressively priced consumption tiers has three limitations. First, the water utility rate setting process lacks the responsiveness required for adapting to uncertainty. Current climate models lack the completeness and resolution to assess local impacts (Matthew Green, "Scientists warn over misuse of climate models in financial markets," Reuters, February 8, 2021). Infrastructure development and funding must respond more quickly to resource changes than the traditional funding model allows. Second, federal subsidies and cost recovery pricing fails to manage the public resource value in water use rights, allowing a significant wealth transfer from the public to a small number of people. Third, tiered water taxes, such as those proposed by Sabo and Glennon offer a viable revenue source from domestic use (John Sabo and Robert Glennon, *Financing Water Reform in the Western United States*, The Solutions Journal, February 22, 2016); however, tiered pricing for holders of water use rights risks manipulation by subdividing a right across legal entities controlling a single physical use.

Tiered pricing with revenue decoupled from water utility sales volumes, to avoid conservation disincentives, offers a viable pricing approach for domestic use (Newsha K. Ajami, Barton H. Thompson Jr., David G. Victor, *The Path to Water Innovation*, The Hamilton Project, Discussion Paper 2014-06, October 2014, pp. 26-28) if price is indexed to resource availability changes. Revenue decoupling occurs by adjusting rates to match actual revenue to a sustainable target. Decoupling mitigates financial harm to utilities from conservation while indexing price to resource availability mitigates harm to other societal values.

Private Investment

For private investment to scale water resources, prices for water use rights must offer a financial return high enough to incent investment. Investors will fund the most profitable water uses. Non-economic values will be ignored unless jurisprudence mandates consideration. Prior appropriation states use this system today, but private investment has not scaled water resources. Australia employed a free market approach that resulted in a market dominated by water speculators (Ben Ryder Howe, "Wall Street Eyes Billions in the Colorado's Water," New York Times, January 3, 2021). It's worth noting that the highest investment return for water may be speculation not use. Further, private investment appropriates the financial value in a public resource, transferring wealth to the private sector, forcing the public to pay twice — once to repurchase water and again to build infrastructure.

A Price for Water

A water price distinguishes the resource value from the use priority value and allows a private cost, *i.e.* the water price, to provide a public good, *i.e.* resource development. Aside from air, water is the only public resource given away. Both state and federal governments charge for timber, minerals, and grazing rights. Further, the majority of value in a water use right is the molecule itself, not the priority right. Consider the value differential between senior and junior rights or the value of any right when no water exists.

The water price must be set to fund generation, storage, conservation, and reclamation sufficient to support all public values optimally. Timing is important. Charging for water now may preempt disruptive litigation and resulting higher lump-sum remedial costs. A water price will spur efficiency and conservation, as well as dampen speculation. Subsidies can be granted to low income areas to promote social justice.

Charging public and private use rights holders for the volume of water withdrawn, combined with decoupled, tiered, and indexed water utility prices, offers a viable approach to scaling the water resource for fully satisfying all societal values.

Adapting to Change and Resource Availability

Changes in water resources, technology, and policy generate consequences that must be considered in managing water. Two scenarios will be discussed here: technological impacts on water availability and policy effects on innovation adoption.

Technology Impacts on Water Availability

As mentioned previously, market penetration of plant-based meat substitutes will affect water use. How and when? Impossible Foods plans to undercut ground beef prices. The meat substitute company

Water Policy Needs

Adaptation

Desalination

Conservation v. Desalination

is scaling production to capture economies of scale and cut prices to grocery stores by 20% in February (Reuters, February 2, 2021), the third price cut in a year. The full effects of plant-based meat market share gains will materialize over several years because of the time required to reduce beef supply to lower demand. The impact, however, starts this year. In 2018, farmers in prior appropriation states irrigated hay, haylage, and alfalfa with 13.5 million acre-feet of water. Arizona, California, Idaho, and Utah used over half the water (USDA 2018 Irrigation and Water Management Survey). Shifts from livestock production and forage crop land use will impact water consumption. An integrated water optimization plan must include forecasts of these impacts and other land use changes.

Policy Effects on Innovation Adoption

Policy decisions will affect innovation adoption in some circumstances. Desalination offers an example. The process is currently expensive, energy intensive, and environmentally harmful because of brine discharge and toxic anti-fouling chemicals. Technological innovation, renewable energy production, and increasing costs of competing sources are changing this calculus (Carlos Cosín, *The evolution of rates in desalination (Part I)*, Smart Water Magazine, January 15, 2019).

The choice to desalinate requires more than an isolated financial analysis. Szinai et al. studied the impacts of climate change on the nexus of water and electricity in California and concluded conservation should be preferred to desalination because the latter will exacerbate climate impacts on California's electricity supply (Julia K Szinai et al., *Evaluating Cross-Sectoral Impacts of Climate Change and Adaptations on the Energy-Water Nexus: a Framework and California Case Study*, Environ. Res. Lett. 2020 15 124065). These cross-sectoral effects should be evaluated in the context of unmet societal values and expanded geographic scope. Desalination offers both a supply expansion and a sourcing change, which enables California to draw less water from the Colorado River basin, preserving more water for instream flows and use by other basin states — analogous to the aquifer recharge cooperation between Nevada and Arizona (Culp et al., p. 19). The magnitude of water required to meet all societal values necessitates use of all strategies, including conservation and new supply generation from desalination at scale.

Conclusion

Attempting to solve water scarcity issues may appear too forward-looking and ambitious to be of practical use for near-term legislative change. Time, however, is running out for solutions that serve all needs. The extinction of orcas and salmon isn't the only issue. Delayed action forces a catastrophically disruptive and costly response that may be so imposing that courts or legislatures strike the environmental laws requiring the response (*e.g. RCW 90.94.020* and *RCW 90.94.030*, reversing *Hirst's* requirement to consider water supply in designating areas for rural residential construction). Neither outcome is acceptable. Prior appropriation states must solve their water issues now.

The views expressed here are solely the author's.

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WATER BRIEFS

WATER RIGHTS & CLIMATE CHANGE RESPONSE CA

In February, the California State Water Board received the staff report "*Recommendations for an Effective Water Rights Response to Climate Change*" outlining water rights permitting reform options.
The following are excerpts from that 34-page document:

California is already experiencing the impacts of climate change, which will continue and increase over the coming decades. Current and future impacts include increasing frequency and intensity of extreme weather events, prolonged fire seasons with larger fires, increased tree mortality, heat waves, rising sea level, and storm surges. Among changes in hydrology are declining snowpack, with more precipitation falling as rain than snow, earlier snow melt, changes in the timing and volume of peak runoff, more frequent and more severe flooding, more frequent and longer droughts, and consequent impacts on water quality and water availability (Moser et al 2012, Pierce et al. 2018).

Recognizing that the implications to California's water resources due to climate change are significant, the State Water Board adopted Resolution No. 2017-0012 "Comprehensive Response to Climate Change" (State Water Board 2017b). The resolution provides direction to staff to embed climate change consideration into all programs and activities, including the need to evaluate and make recommendations on regulatory and policy changes regarding the use of models to account for projected impacts of climate change when conducting water rights water availability analyses.

This report embraces and complements the vision of a resilient water system in the face of changing climate, and presents staff recommendations to make permitting water availability analysis more robust, and actions that could support an effective response to climate change within the existing water rights framework in California. The report provides an overview of California's system of water rights, and general principles of water availability analysis for water right permitting. The report then summarizes existing information on projected climate change impacts on California's water resources, and discusses potential challenges and opportunities that climate change poses for administering the water rights system. Finally, the report identifies a range of approaches to respond, individually or in combination, to climate change, including how existing information and available data can inform water rights permitting processes, and aid applicants in selecting appropriate season, rate, and quantity of proposed diversions.

Regarding changes projected for California, the uncertainty lies only in the magnitude of warming, but not in whether warming will occur. Models indicate that due to warming alone, California will see less of its precipitation fall as snow, which will result in diminished mountain snow pack, less snow in lower and intermediate elevations, and less "natural water storage" in the form of snow. The wet season is projected to become wetter, and the dry season will become longer and drier.

Anyone planning to take water from a lake, river, stream, or creek for a beneficial use requires a water right of some type. California law requires that every application to appropriate surface water demonstrate a reasonable likelihood that unappropriated water is available to supply the applicant. Hence, parties interested in obtaining an appropriative water right must conduct a permitting water availability analysis as part of the permitting process. Generally, water availability for permitting is calculated by estimating the amount of unimpaired flow in a stream during the diversion season, and subtracting the demand of all senior diversions and the demand for instream needs.

Permitting water availability analyses are typically based on historical data sets. However, historical precipitation and streamflow records for the majority of the watersheds in California may not be sufficiently long to capture the full range of hydrologic variability needed to evaluate future available water supply. In addition, rising temperatures and changing precipitation patterns will affect hydrology, making future water availability increasingly difficult to reliably estimate.

Staff recommendations in this report offer a menu of options to make water rights permitting analysis more robust, and to support applicants in developing projects that will remain feasible in the future. The report concludes with a set of recommendations, which include actions to:

- Leverage existing climate change data in permitting water availability analyses
- Develop adaptive permit terms in new permits
- Implement tiered requirements for climate change analysis in permitting, with complexity based on categories such as size, location and/or project type
- Develop a fact sheet for water right applicants to incorporate climate change
- Strengthen the minimum period of record requirement for streamflow data
- Require more rigorous analytical methods to estimate supply when gage data are not available
- Expand existing network of stream and precipitation gages
- Reevaluate the existing instream flow metrics and criteria
- Revise the Fully Appropriated Stream list
- Prepare for and capitalize on capturing flood flows and storing them underground
- Plan for droughts
- Coordinate with other agencies and partners

For info: Report at: www.waterboards.ca.gov/waterrights/water_issues/programs/climate_change/ (*see* Staff Report / Feb 21)

WATER BRIEFS

FLORIDA V. GEORGIA US SUPREME COURT DECISION

Justice Barrett issued a unanimous decision by the US Supreme Court (Court) in *Florida v. Georgia*, No. 142, Orig (April 1, 2021) in a case involving a dispute between Florida and Georgia concerning the proper apportionment of interstate waters. The Court's decision was made on exceptions filed by the states to the Second Report of the Special Master. The Special Master produced an 81-page (second) report recommending that the Court deny Florida's requested relief, concluding that Florida failed to prove by clear and convincing evidence that Georgia's alleged overconsumption of water caused serious harm either to Florida's oyster fisheries or to its river wildlife and plant life. The Court held that Florida's exceptions to the Special Master's Report were overruled and the case was dismissed.

Florida brought an original action against Georgia, before the Supreme Court, alleging that its upstream neighbor consumes more than its fair share of water from interstate rivers in the Apalachicola-Chattahoochee-Flint River Basin. Florida claimed that Georgia's overconsumption of Basin waters caused low flows in the Apalachicola River which seriously harmed Florida's oyster fisheries and river ecosystem.

The Court has original jurisdiction to equitably apportion interstate waters between States. To obtain an equitable apportionment of water, Florida was faced with the burden of proving by clear and convincing evidence a serious injury caused by Georgia. The Court found that Florida did not prove by clear and convincing evidence that the collapse of its oyster fisheries was caused by Georgia's overconsumption. Florida failed to establish that Georgia's overconsumption was a substantial factor contributing to its injury, much less the sole cause.

The Court also found that Florida did not prove by clear and convincing evidence that Georgia's overconsumption has harmed river wildlife and plant life by disconnecting tributaries, swamps, and sloughs from the Apalachicola River, thereby drying out important habitats for river species. The Special Master found "a complete lack of evidence" that any river species has suffered or will suffer serious injury from Georgia's alleged overconsumption (Second Report of Special Master 22), and the Court agreed with the Special Master's conclusions. *See* Court *Syllabus*, pages 1-2.

Justice Barrett summed up the Court's short, unanimous decision. "In short, Florida has not met the exacting standard necessary to warrant the exercise of this Court's extraordinary authority to control the conduct of a coequal sovereign. We emphasize that Georgia has an obligation to make reasonable use of Basin waters in order to help conserve that increasingly scarce resource. But in light of the record before us, we must overrule Florida's exceptions to the Special Master's Report and dismiss the case." *Slip Op*. at 10.

The Water Report plans to publish a detailed article about the history of the case and the Court's opinion in *Florida v. Georgia* in next month's issue.

For info: Full decision of *Florida v. Georgia* at: https://www.supremecourt.gov/opinions/20pdf/22o142_m648.pdf

KLAMATH ADJUDICATION OR TRIBAL CLAIMS REGULATION

On February 24, 2021, the Klamath County Circuit Court (Court) issued an opinion letter that addresses legal issues pending in the Klamath Basin Adjudication regarding the quantification of the Klamath Tribes' determined claims for hunting, fishing, and gathering as provided in the Amended and Corrected Findings of Fact and Order of Determination (ACFFOD). The Court's opinion letter must be reduced to an order before it may take effect.

The Oregon Water Resources Department (Department or OWRD) anticipates that an order may provide clarification regarding the status of the Tribes' determined claims and the status of water regulation pending final actions on the remaining matters before the Court. Unless or until the Court orders otherwise, the Department is required to regulate water in accordance with the determinations made in the ACFFOD.

OWRD expects this year to be a difficult year for water users due to dry conditions throughout the basin. In Oregon, senior water right holders may call for the watermaster to regulate junior users off when there is not enough water to fully satisfy a senior user's right to water.

On March 1, the Klamath Tribes made a call for water to satisfy their instream determined claims which, as provided in the ACFFOD, are the most senior rights in the Klamath Basin. The watermaster has investigated and confirmed that the Tribes' instream determined claims for streamflow values in the Williamson and Sprague River basins are not being met. Accordingly, the watermaster expects to begin issuing regulation orders next week requiring the shut off of junior water users in the Upper Klamath Basin on the Williamson and Sprague river systems. The instream determined claims for the Wood River system are currently satisfied.

Under Oregon statutes, while the Department's determination of claims in a general stream adjudication is before the Circuit Court, the agency is required to regulate in accordance with the Department's determination. For the Klamath Basin Adjudication, the findings of fact and order of determination (FFOD) was submitted to the Klamath County Circuit Court in 2013, and the amended and corrected findings of fact and order of determination (ACFFOD) was submitted in 2014. Regulation of water consistent with the priority date of determined claims as provided in the FFOD and the ACFFOD has been occurring since 2013.

The Oregon Water Resources Department is the state agency charged with allocating and distributing water in Oregon. The Klamath Basin Watermaster office can be reached at 541/ 883-4182.

For info: Klamath Basin Status of Regulation at: www.oregon.gov/owrd/programs/regulation/KlamathRegulation/Pages/default.aspx

SPECULATION CONCERN WA AREA-WIDE PERMIT

The Center for Environmental Law & Policy (CELP) on March 17, 2021, wrote a letter to the Washington Department of Ecology (Ecology) expressing concerns over the unprecedented application for a

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water right (No. S4-33625) by Crown Columbia Water Resources, LLC (Crown) that appears to be intended to allow new diversions of water almost anywhere in the Columbia Basin. An area-wide permit of this type has, to CELP's knowledge, never been approved or implemented in Washington. CELP asserted that such a permit would allow for an entirely new type of water appropriation, which raises serious legal and policy questions. CELP stated that it believes that approving such a permit would be unlawful, and also raised grave concerns about the process Ecology is following. (*See Letter,* March 17, 2021).

CELP raises the issue of speculation in water, asserting that "there is no basis in the Water Code for even *processing an application* for a water right whose quantity and rate of withdrawal, place of withdrawal, and place of use are all unspecified, let alone *granting* such a right." The source of the application is also questioned: "We believe that 'the Columbia River Watershed, a Tributary to the Pacific Ocean' is a wholly inadequate description of a water source and have no doubt that the courts would agree." CELP goes on to state that "the 'nature and amount' of the proposed new water use(s) are also unspecified and indeed are completely unknown." A footnote to this last statement, refers to the application as "rank speculation." *Letter*, p. 2.

CELP's level of concern is evident by its assertion that "…Ecology appears to be actively working to support this water right application." CELP entitled another section of the letter, "The area-wide permit approach appears to be an attempt to minimize review of new water diversions." *Letter* at 4.

CELP's Executive Director Trish Rolfe closes the letter with a strong admonition regarding Ecology's approach. "For the reasons stated here, CELP urges Ecology and OCR to cease consideration of any such area-wide water permit. If such a sweeping change in water management is to be made, that is the province of the Legislature. Ecology has no authority to overturn our state's water management framework in this manner." *Letter* at 5.
For info: CELP letter at: https://celp.org/wp-content/uploads/CELP-letter-re-Crown-Columbia-application.pdf

WATER RELIABILITY US RECLAMATION GRANTS

The US Bureau of Reclamation (Reclamation) is awarding $42.4 million in grants to 55 projects in 13 states. These projects will improve the water reliability for these communities by using water more efficiently and power efficiency improvements that generate more hydropower. The projects are anticipated to conserve more than 98,000 acre-feet of water per year.

These grants support President Biden's January 27, 2021 *Executive Order on Tackling the Climate Crisis at Home and Abroad* (*see* www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/). The grants will help increase resilience to the impacts of climate change and conserve water. "Improving water and energy efficiencies is one way Reclamation is using its resources to provide communities in the West the ability to be resilient to climate change, because conserving water is also saving energy," said Reclamation Deputy Commissioner Camille Calimlim Touton.

The selected projects are in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming. Projects include canal lining and piping to reduce seepage losses; installation of advanced metering; automated gates; Supervisory Control and Data Acquisition systems to improve water management; and programs in urban areas to install residential water meters.

The Confederated Tribes and Bands of the Yakama Nation in central Washington will receive $570,965 to convert more than 15,000 feet of earthen canals to PVC pipe. The project will improve water use efficiency and reliability through optimal flow rates, reduced leakages, and operational losses. The project is expected to result in an annual water savings of 1,504 acre-feet remaining in the system supporting other needs within the irrigation project.

The Greenfields Irrigation District in Teton County, Montana, will receive $1.9 million to replace a concrete drop structure with an 11-foot diameter penstock and turbine with a planned capacity of 2,400 kilowatts. The project is also expected to save 1,190 acre-feet of water currently lost to seepage. The water saved will remain in the Sun River, improving flows for fish and recreation.

In California, near the Arizona border, the Bard Water District will receive $1.1 million to complete a canal lining and piping project. The project is expected to result in annual water savings of 701 acre-feet, which will remain in the Colorado River system for other uses. Once completed, the project will also better position farmers to work with Natural Resources Conservation Service's Environmental Quality Incentives Program to improve on-farm irrigation systems.

Some projects complement on-farm irrigation improvements that can be carried out with the assistance of the US Department of Agriculture's Natural Resources Conservation Service (NRCS) to accomplish coordinated water conservation improvements. "Infrastructure modernization is critical to enable agricultural producers to make additional improvements on their land," said Astor Boozer, Regional Conservationist for NRCS's western operations. "Using EQIP-WaterSMART Initiative assistance to reduce water losses and use irrigation water efficiently allows farmers to complement WEEG funded projects and to conserve additional water for prolonged droughts."
For info: WaterSMART website at: www.usbr.gov/watersmart

DROUGHT RESOURCE AZ
US DROUGHT PORTAL

The National Oceanic and Atmospheric Administration's National Integrated Drought Information System (NIDIS) has been providing resources, maps, and tools for drought decision makers through the US Drought Portal, or Drought.gov, since 2008. In January, NIDIS launched a major redesign of Drought.gov.

The new website features updated content and new interactive architecture designed to provide actionable, shareable information and easy-to-understand graphics. That new website describes current drought conditions and forecasts by city, county, state, and at watershed to global scales. Drought.

WATER BRIEFS

gov also presents drought impact data for economic sectors such as agriculture, water utilities, and wildfire management using interactive maps and data that don't exist anywhere else.

The website's "Data and Maps" section provides up-to-date drought-status reports, including: national drought conditions, impacts, and outlooks; as well as drought-related maps for temperature and precipitation, water supply, snow drought, wildfires, and more.

The new US Drought Portal has four key new features:

- Drought conditions down to the city and county level, including current conditions, key indicators of drought, outlooks and forecasts, water supply impacts, historical drought conditions, and more. Curated lists show drought early warning resources for the entire Intermountain West.
- Historical data and maps, including an interactive map where you can compare three historical drought datasets side by side down to the county level: US Drought Monitor data going back to 2000; Standardized Precipitation Index (SPI) data going back to 1895; and paleoclimate data (*e.g.*, from tree-ring analysis) going back to the year 0 for some regions of the US.
- By Sector section, which shows drought impacts on different economic sectors, such as agriculture, energy, water utilities, and tourism and recreation.
- Research and Learn section where you can "go back to the basics" on drought with definitions, overviews of different types of drought such as flash drought and snow drought, and learn about initiatives like the National Coordinated Soil Moisture Monitoring Network.

For info: Email to: drought.portal@noaa.gov; Website at: drought.gov

DRINKING WATER LOAN OR WATER INFRASTRUCTURE

On March 4, with Oregon Governor Kate Brown, Senator Jeff Merkley (OR), Portland Mayor Ted Wheeler, and other dignitaries, the US EPA announced its largest Water Infrastructure Finance and Innovation Act (WIFIA) loan to date — a $727 million loan to the Portland Water Bureau in Portland, Oregon. The loan will help finance the Bull Run Treatment Program to improve drinking water quality and reliability for nearly one million people by better controlling contaminants and lead while bolstering the system's climate resiliency. Bull Run was established as a water source more than a century ago.

Through WIFIA, EPA will play a key role in improving and upgrading the nation's water and wastewater infrastructure across the country. With this loan closing, EPA has announced 45 WIFIA loans totaling more than $9 billion in credit assistance to help finance over $19 billion for water infrastructure projects while creating almost 47,000 jobs.

The City of Portland's Bull Run Treatment Program will construct a new filtration water treatment plant, to remove the microorganism Cryptosporidium and other potential contaminants, and water pipelines to connect the filtration facility to existing conduits. In addition, the program will implement improved corrosion control treatment to further adjust the chemistry of Portland's water and reduce potential levels of lead at the tap. The program is designed to comply with two federal regulations, the Long Term 2 Enhanced Surface Water Treatment Rule and the Lead and Copper Rule. The project will also improve the system's resiliency to fire, landslides, major storms, and earthquakes.

"Using WIFIA financing for most of the construction costs of the Bull Run Treatment Projects captures significant money-saving benefits for our ratepayers," said Portland Water Bureau Director Gabriel Solmer. "Not only does WIFIA's low interest rate guarantee savings, but its long-term repayment schedule doesn't begin until the projects are built and ratepayers are getting the benefits of the projects as they share in the costs."

EPA's WIFIA loan will finance nearly half the project costs. The remaining project funds will come from a combination of revenue bonds and Portland Water Bureau's system funds. The WIFIA loan will save Portland Water Bureau an estimated $247.5 million compared to typical market financing. Project construction and operation are expected to create at least 4,700 jobs.

Project Benefits:

- Protects drinking water by reducing lead leaching from household plumbing
- Improves drinking water quality and removes microorganisms from source water
- Increases system resiliency to fire, landslides, major storms, and earthquakes
- Ensures the system meets the terms of two compliance agreements with the Oregon Health Authority
- Saves the Portland Water Bureau an estimated $247.5 million from financing with a WIFIA loan

For info: WIFIA website at: www.epa.gov/wifia; Project Factsheet at: www.epa.gov/wifia/portland-bull-run-treatment-program

WIFIA 2020 REPORT US PROGRAM ACCOMPLISHMENTS

WIFIA's most recent Annual Report highlights program accomplishments through 2020, including closing 27 new WIFIA loans totaling over $4 billion to finance more than $8 billion in water infrastructure jobs and create over 38,000 jobs. Established by the Water Infrastructure Finance and Innovation Act of 2014, the WIFIA program is a federal loan and guarantee program administered by EPA. WIFIA's aim is to accelerate investment in the nation's water infrastructure by providing long-term, low-cost supplemental credit assistance for regionally and nationally significant projects. The WIFIA program has an active pipeline of pending applications for projects that will result in billions of dollars in water infrastructure investment and thousands of jobs. Learn more about the WIFIA program at: www.epa.gov/wifia.

For info: WIFIA 2020 Annual Report at: www.epa.gov/wifia/wifia-annual-report

HAZARDOUS SPILLS US DRINKING WATER SITES

EPA recently released a detailed report of the incidents, location, and characteristics of chemical and toxic spills into US drinking water sources. The report found that for the years between 2010 and 2019, there were 3,931 unique incidents of toxic spills into groundwater, rivers, or lakes used for drinking water in the US (incident

WATER BRIEFS

refers to a specific event that resulted in the release of at least one material). *Occurrence of Releases with the Potential to Impact Sources of Drinking Water,* EPA 817-R-21-001 (Feb. 2021), page 22.

"The objective of the study described in this report was to characterize the occurrence of releases into sources of drinking water used by community water systems in the U.S. Specifically, the study evaluated:

- Temporal occurrence of releases between 2010 and 2019 (full calendar years)
- Geographic occurrence of releases
- Type and amount of material released
- Responsible party and cause of releases
- Distribution of the numbers of releases impacting individual community water systems

"There were 840 different materials released over the study period, but the most commonly released materials by a significant margin were Refined Oil products, which were involved in 56.8% (2,402) of releases. However, the material categories responsible for the largest total volume released were: Wastewater with 14,014 kgal (36%), Coal Combustion By-products with 10,769 kgal (27.7%), Drilling Fluid with 3,503 kgal (9%), and Mine Waste with 3,000 kgal (7.7%)." *Report* at 45.

The Report concludes with a section on Recommendations. "The findings from this study demonstrate there is a significant risk of releases into sources of drinking water at a national scale. However, the risk to a community water system will depend on their unique circumstances. To understand the relative risk of source water contamination to a community water system, it is recommended that releases into source water be considered in an all-hazards risk assessment, such as that required under America's Water Infrastructure Act (U.S. EPA, 2019a)."

The detailed assessment contains a plethora of information and data on the spill incidents that is highly recommended.

For info: *Report*: www.epa.gov/sites/production/files/2021-02/documents/occurrence_of_releases_to_sources_of_drinking_water.pdf; Steve Algeier, EPA, 513/ 569-7131 or Allgeier.Steve@epa.gov

CANNABIS WATER USE CA

USE INCREASING

New Frontier Data, the premier data, analytics and technology firm specializing in the global cannabis industry, in partnership with Portland, Oregon-based Resource Innovation Institute (RII) and the Berkeley Cannabis Research Center, has released "*Cannabis H2O: Water Use and Sustainability in Cultivation*." The report provides an in-depth look at water usage in the regulated cannabis cultivation market and how its use compares to the illicit market and traditional agricultural sectors. The report also includes strategic recommendations for policy makers, industry leaders, and other key stakeholders.

The report found that the cannabis industry uses significantly less water than other major agricultural crops in California. However, there are significant opportunities to drive even greater efficiency in the industry. "It is interesting to note how the conventional wisdom about water use in the legal industry does not appear to be accurate, which further validates why the findings in this report are so important. Understanding water use is the first step to learning how we can create a more sustainable cannabis agriculture industry," said Derek Smith, Executive Director of RII.

Key Findings:

- By 2025, total water use of the legal cannabis market is expected to increase by 86%.
- Combined legal and illicit cannabis crops used nearly 2.8 billion gallons in 2020, with usage forecast to reach 3.6 billion gallons by 2025 fueled by demand-driven growth.
- The illicit market will remain the primary driver of water use over the next five years, accounting for 83% of water use in 2020, and declining to 69% in 2025.
- Water use practices are highly diverse in the new regulated cannabis industry, underscoring the need for well-tailored regulatory policies that are responsive to this diversity.

For info: Report at: https://info.newfrontierdata.com/cannabis-h2o

CLEANUP RULING CA

WETLANDS PROTECTIONS UPHELD

In a ruling that could strengthen vital wetlands protections throughout California, the First District Court of Appeal has upheld a cleanup and abatement order and a $2.8 million fine issued by the San Francisco Bay Regional Water Quality Control Board (San Francisco Bay Water Board) for unauthorized levee construction and other activities in the Suisun Marsh. The San Francisco Water Board is a California state agency responsible for the preservation and enhancement of water quality.

Located in Solano County, Suisun Marsh is the largest contiguous, brackish marsh on the west coast of North America and a critical part of the Bay-Delta estuary.

The case centers around activity dating to 2014 and 2015, when John Sweeney and Point Buckler Club constructed nearly a mile of levee around Point Buckler Island without obtaining permits or approvals from the San Francisco Bay Water Board and other agencies. The levee blocked off all tidal channels, killing the tidal marshland vegetation and preventing salmon and other sensitive fish species from entering the channels to forage for food.

Point Buckler Club advertises itself as an exclusive kiteboarding club and is a 15-minute helicopter flight from Silicon Valley. It is historically a managed wetland used for duck hunting. In 2016, the board issued a cleanup and abatement order requiring Sweeney and the club to restore the tidal circulation and marsh habitat at the island and imposed a $2.8 million fine.

The large fine reflected the brazen nature of the dischargers' activities and the extent of the ecological harm. The Bay Conservation Development Commission (BCDC) also issued a $752,000 penalty in 2016 and required restoration, mitigation, and monitoring requirements.

Sweeney and Point Buckler Club challenged the board's and BCDC's orders in court and received a favorable decision by the Solano County Superior Court. The board and BCDC petitioned to the Court of Appeal, which sided with the board and BCDC. The court's decision affirms longstanding precedent

WATER BRIEFS

under the Porter-Cologne Water Quality Control Act and ensures that the board can continue to regulate dredge and fill activities, and protect critical wetland habitat throughout the San Francisco Bay.

The court ruling declares that state law protects waters of the state from fill activities. This is especially important given the numerous creeks, ponds, and wetlands that are no longer Waters of the U.S. under the new Clean Water Rule.

The court's opinion is consistent with a decision issued last fall by the U.S. District Court for the Eastern District of California. That decision found that Sweeney and the Point Buckler Club had violated the Clean Water Act when they built the levee.
For info: Blair Robertson, San Francisco Bay Water Board, Blair.Robertson@waterboards.ca.gov

NO DISCHARGE ZONE WA
PUGET SOUND PROTECTION

EPA has completed their economic analysis of the No Discharge Zone (NDZ) and concluded that the cost of preventing vessels from dumping sewage in Puget Sound is well worth the benefits gained in protecting and restoring Puget Sound.

EPA did this economic analysis because of a lawsuit filed in 2018 by the American Waterways Operators (AWO), challenging EPA's determination that there are adequate pumpout facilities in Puget Sound to support a No Discharge Zone. The lawsuit is still active.

The Washington State Department of Ecology (Ecology) established the NDZ in 2018 to stop the discharge of both treated and untreated sewage from boats into state waters. Ecology states that: "Puget Sound is a regional treasure of great economic importance, and preventing vessel sewage from being released throughout Puget Sound is a common-sense decision. The NDZ is an important part of protecting and restoring the sound."

Vessel sewage can contain bacteria and viruses that are harmful to people and the environment. These contaminants are harmful to water quality, beaches, and shellfish beds. Eating shellfish that've been exposed to pollution can make people sick. The presence of one type of bacteria, fecal coliform, has closed shellfish beds throughout Puget Sound

Boaters will continue to use the more than 100 recreational and commercial pumpouts to safely dispose of vessel sewage on Puget Sound. Ecology is working with Washington State Parks and other partners to establish more pumpouts in convenient locations. Ecology is providing technical assistance to help industry on their extended compliance timeframe. Vessel operators have begun investing in retrofits and all vessels will be fully retrofitted to hold sewage by 2023.
For info: Colleen Keltz, Ecology, 360/791-3177 or colleen.keltz@ecy.wa.gov

SNOWMELT WEST
CU BOLDER STUDY

More snow is melting during winter across the West, a concerning trend that could impact everything from ski conditions to fire danger and agriculture, according to a new University of Colorado Boulder analysis of 40 years of data. Researchers found that since the late 1970s, winter's boundary with spring has been slowly disappearing, with one-third of 1,065 snow measurement stations from the Mexican border to the Alaskan Arctic recording increasing winter snowmelt. While stations with significant melt increases have recorded them mostly in November and March, the researchers found that melt is increasing in all cold season months — from October to March.

The new research found that snowmelt before April 1 has increased at almost half of more than 600 stations in western North America, by an average of 3.5% per decade.

"Historically, water managers use the date of April 1 to distinguish winter and spring, but this distinction is becoming increasingly blurred as melt increases during the winter," said Noah Molotch, co-author on the study, associate professor of geography and fellow at INSTAAR.

Snow is the primary source of water and streamflow in western North America and provides water to 1 billion people globally. In the West, snowy mountains act like water towers, reserving water up high until it melts, making it available to lower elevations that need it during the summer, like a natural drip irrigation system.

More winter snowmelt is effectively shifting the timing of water entering the system, turning that natural drip irrigation system on more frequently in the winter, shifting it away from the summer. This is a big concern for water resource management and drought prediction in the West, which depends heavily on late winter snowpack levels in March and April. This shift in water delivery timing could also affect wildfire seasons and agricultural irrigation needs.

Wetter soils in the winter also have ecological implications. One, the wet soils have no more capacity to soak up additional water during spring melt or rainstorms, which can increase flash flooding. Wetter winter soils also keep microbes awake and unfrozen during a time they might otherwise lay dormant. This affects the timing of nutrient availability, water quality, and can increase carbon dioxide emissions.

Across the western US, hundreds of thin, fluid-filled metal pillows are carefully tucked away on the ground and out of sight from outdoor enthusiasts. These sensors are part of an extensive network of long-running manual and automated snow observation stations, which you may have even used data from when looking up how much snow is on your favorite snowshoeing or Nordic skiing trail. This new study is the first to compile data from all 1,065 automated stations in western North America, providing valuable statistical insight into how mountain snow is changing. By using automated, continuously recording snowpack stations instead of manual, monthly observations, the new research shows that winter melt trends are very widespread — at three-times the number of stations with snowpack declines.

Snowpack is typically measured by calculating how much water will be produced when it melts, known as **s**now-**w**ater **e**quivalent (SWE), which is affected by how much snow falls from the sky in a given season. But because winter snowpack melt is influenced more by temperature than by precipitation, it is a better indicator of climate warming over time.
For info: Full Report at Nature Climate Change website: www.nature.com/articles/s41558-021-01014-9

CALENDAR

April 15 WEB
Finding and Retaining Good Leaders and Staff Webinar, 4:00 pm to 6:00 pm Eastern Time. Presented by EPA to Provide Insight Into Utility Operation & Maintenance. For info: www.epa.gov/small-and-rural-wastewater-systems/operating-and-managing-small-wastewater-and-water-utilities

April 15-16 WEB
Washington DC Roundtable: Interstate Council on Water Policy, Western States Water Council & National Water Supply Alliance Event, 4/15: Noon - 3:30 pm Central Time; 4/16: 9 am - 12:30 pm CT. Program will include Updates from the US Geological Survey, NOAA-National Weather Service, US Army Corps of Engineers, National Integrated Drought Information System, Key Congressional Committee Staff, and More. FREE / Registration Needed. For info: ICWP webpage (www.icwp.org) or WSWC webpage (https://westernstateswater.org); Sue Lowry, ICWP, 307/ 630-5804 or Sue@icwp.org

April 16 WEB
Berkeley Law's 2021 Environmental Awards Banquet, 4:00 pm to 6:00 pm Pacific Time. Presented by Center for Law, Energy, & the Environment. For info: https://na.eventscloud.com/ereg/index.php?eventid=608903&

April 16 WEB
Drought Planning Methodologies & Tools: Supply/Demand Visualization Tool & Water Demand Data Assessment Webinar, 10:00 am - Noon and 1:00 pm - 3:00 pm Pacific Time. Presented by the State Water Resources Control Board; Meeting ID: 946 4054 8166 | Passcode: 248201. For info: https://waterboards.zoom.us/j/94640548166?pwd=VDdzZWVhUWZrTzZjRGdmbjBNOEcrZz09

April 19 WEB
12th National Water Quality Monitoring Conference - "Working Together for Clean Water," National Water Quality Monitoring Council Event. For info: www.nalms.org/2021nmc/

April 19-22 CA
2021 AEP California State Conference: Planting the Seeds of Knowledge, Yosemite. Presented by Assoc. of Environmental Professionals. For info: www.califaep.org/programs.php

April 19-23 WEB
12th National Monitoring Conference: Working Together for Clean Water, Virtual Event. Presented by the National Water Quality Monitoring Council. For info: https://acwi.gov/monitoring/ or https://www.nalms.org/2021nmc/

April 21 WEB
WaterSmart Innovations Webinar, RE: Water as Hidden Resource; Marketing Native Plants; Technology & Collaborative Conservation. For info: https://watersmartinnovations.com/spring2021webinar/

April 22 WEB
Contaminated Sites Liability & Litigation Risk Webinar, 8:30 am - 5:30 pm Eastern Daylight Time. Canadian Institute Virtual Conference. For info: www.canadianinstitute.com/

April 22 WEB
Asset Management - Planning for the Future Webinar, 4:00 pm to 6:00 pm Eastern Time. Presented by EPA to Provide Insight Into Utility Operation & Maintenance. For info: www.epa.gov/small-and-rural-wastewater-systems/operating-and-managing-small-wastewater-and-water-utilities

April 22-23 WEB
Law of the Rio Grande - 20th Annual Virtual Conference, Hot Topics in Water Management & Conservation. For info: CLE International, 800/ 873-7130 or www.cle.com

April 22-23 WEB
Water Education Foundation (WEF) California Water 101 Workshop, RE: California Water History; Laws; Geography; & Politics. For info: www.watereducation.org/event-calendar

April 25-May 1 DC
Water Week 2021, Washington. TBA. Presented by National Assoc. of Clean Water Agencies. For info: www.nacwa.org/conferences-events/events-at-a-glance

April 26-28 WEB
2021 AWRA/CGWA Annual Symposium, Virtual Event. Presented by the Colorado Chapter of the American Water Resources Association & the Colorado Groundwater Association. For info: https://awracolorado.org/meetinginfo.php

April 26-29 TX
Texas Watershed Planning Short Course, Bandera. Mayan Dude Ranch. Sustainable Proactive Approaches to Managing Water Quality. For info: https://twri.tamu.edu/our-work/engaging-educating/texas-watershed-planning/workshop-schedule/2021/april/texas-watershed-planning-short-course/

April 27-28 DC
National Water Policy Fly-In, Washington. Hilton Washington DC National Mall. Presented by National Assoc. of Clean Water Agencies. For info: www.nacwa.org/conferences-events/event-at-a-glance/2021/04/27/nacwa-events/national-water-policy-fly-in

April 28 WEB
WaterSmart Innovations Webinar, RE: Reaching the Hard to Reach; Water Waste Technology; Water Efficiency Audits. For info: https://watersmartinnovations.com/spring2021webinar/

April 28 WEB
Lead and Copper Rule Revisions, EPA Roundtable, RE: Public Engagement to Obtain Further Input on EPA's Lead and Copper Rule Revisions (LCRR). For info: www.epa.gov/safewater

April 28-30 FL
PFAS Summit: Regulatory and Legal Issues; Monitoring; Treatment; Cleanup and Disposal Technologies; Tampa. Renaissance Tampa International Plaza Hotel. Attend In-Person or Virtually. For info: https://pfasforum.org

April 29 WEB
Emergency Response and Cyber Security Webinar, 4:00 pm to 6:00 pm Eastern Time. Presented by EPA to Provide Insight Into Utility Operation & Maintenance. For info: www.epa.gov/small-and-rural-wastewater-systems/operating-and-managing-small-wastewater-and-water-utilities

May 5 WEB
Lead and Copper Rule Revisions, EPA Roundtable, RE: Public Engagement to Obtain Further Input on EPA's Lead and Copper Rule Revisions (LCRR). For info: www.epa.gov/safewater

May 11-12 WEB
Emerging Water Technology Symposium, Meet Well-Known Experts from Across the Globe. For info: https://ewts.org

May 12-13 WEB
Association of California Water Agencies (ACWA) Spring Virtual Conference & Exhibition, RE: Critical Issues Affecting California's Water Industry. For info: www.watereducation.org/event-calendar

May 13 WEB
Immerse 2021 - A Virtual Benefit for the Freshwater Trust, 7pm - 8pm Pacific Time. Immerse in TFT's Analytical Approach & Data-Driven Work. For info: www.eventbrite.com/e/immerse-2021-a-virtual-benefit-for-the-freshwater-trust-tickets-138348840105

The Water Report
Water Rights, Water Quality & Water Solutions in the West
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CALENDAR

(continued from previous page)

May 18-21 TN
National Pretreatment Workshop & Training, Nashville. Nashville Marriott at Vanderbilt University. Presented by National Assoc. of Clean Water Agencies. For info: www.nacwa.org/conferences-events/event-at-a-glance/2021/05/18/nacwa-events/national-pretreatment-workshop-training

May 19-20 WEB
Water & Wastewater Investor Forum, RE: New Investments; Growth Strategies; Financing Sources & Creative Deal Structures. For info: www.euci.com/events/ or 303/ 770-8800

May 25-27 VA
11th Annual Choose Clean Water Conference: A Changing Chesapeake, Richmond. TBA. For info: Drew Robinson, 443/927-8049, RobinsonAQ@nwf.org or www.choosecleanwater.org/choose-clean-water-conference/2021

May 26-27 CA
Smart Water Utilities USA 2021: Reducing Water Leakage Across the Network - Exhibition & Conference, Long Beach. Presented by the Choose Clean Water Coalition. For info: www.usa.smart-water-utilities.com/?join=VR

June 2-4 CA
20th Institute for Natural Resources Law Teachers, Monterey. TBA. Presented by Rocky Mountain Mineral Law Foundation. For info: www.rmmlf.org/conferences

June 10-11 WEB/WA
Water Law in Washington Seminar, For info: Law Seminars International, 206/ 567-4490, registrar@lawseminars.com or www.lawseminars.com

June 14-15 WI
Strategic Communications: H2O Workshop, Milwaukee. Saint Kate - The Arts Hotel. Presented by National Assoc. of Clean Water Agencies. For info: www.nacwa.org/conferences-events/event-at-a-glance/2021/06/14/nacwa-events/strategic-communications-h2o-workshop

June 18 CO
SEER Climate Change Conference, Denver. TBA. Presented by the American Bar Association - Section of Environment, Energy & Resources Law. For info: https://www.americanbar.org/groups/environment_energy_resources/events_cle/section_calendar_archive/

June 23 MT & WEB
Real Estate Development Conference, Bozeman. TBD. For info: The Seminar Group, 800/574-4852, info@theseminargroup.net or www.theseminargroup.net

June 23-24 TX
Hydraulic Fracturing & Production Chemicals 2021, Houston. Hotel Derek. For info: https://www.hydraulic-fracturing-chemicals.com/?join=VR

June 30-July 1 TX
Annual Texas Groundwater Conference, Austin. Omni Austin Hoel Southpark. Presented by the American Groundwater Trust. For info: https://agwt.org/civicrm/event/info?id=323&reset=1

June 30-July 1 WEB
Western Governors' Association 2021 Annual Meeting, TBA. For info: https://westgov.org/