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WATER RESOURCE INFRASTRUCTURE

HISTORY, PRESENT ISSUES, & FUTURE NEEDS

by Eric Buer, RIDOLFI, Inc. (Seattle, WA)

INTRODUCTION

In preparation for the upcoming American Water Resources Washington Section State Conference (Seattle, October 23 — see Agenda, page 10), this article reviews the historical context of construction, environmental costs, and present day issues surrounding water resource infrastructure. While the focus is primarily on infrastructure related to water supply and flood control, in many cases the issues identified for these types of infrastructure are shared with other classes as well.

Water resource infrastructure — including dams, levees, drinking and wastewater facilities, inland waterways, ports, and other investments — constitutes one of the most critical classes of infrastructure in our modern society. This dense network of human achievement includes: more than 80,000 dams; an estimated 100,000 miles of levees (NCLS, 2014); 12,000-plus miles of inland and intracoastal waterways equipped with more than 200 lock chambers; over 180 large commercial ports (US Army Corps, 2013); and over one million miles of water supply piping (Galloway, 2014). High profile dams such as Shasta, Grand Coulee, and Glen Canyon aside, much of our essential water resource infrastructure is unobtrusive, blending with the landscape as dredged navigation channels, flood control levees, agricultural water supply aqueducts, or buried stormwater and wastewater conveyance pipes. It is, therefore, a class of infrastructure that is comparatively easy to overlook — though it clearly functions as one of the essential pillars supporting modern society.

American water resource infrastructure was expanded rapidly in the early 20th century by the federal government as part of an effort to develop the national economy and settle the West. However, increasing environmental and financial costs have ultimately caught up with the building boom, and the rate of infrastructure investment has slowed considerably since the 1970s. Because funding for water resources infrastructure has primarily been provided through federal appropriations — a process that remains geared towards new construction rather than operations, maintenance, and rehabilitation — much of the nation's existing infrastructure is now facing age-related deterioration. These deficiencies have been further taxed by increasing population pressure, climate change, and environmental concerns.

As is examined below, there are no simple solutions to the present dilemma. However, examples of successful projects today feature coordination and compromise between stakeholders and take advantage of new technology to develop integrated, multiple benefit approaches to infrastructure.

Infrastructure

Federal Legislative Foundation

"Go-Go Years"

Controlling Nature

Expansion

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HISTORICAL CONTEXT

Historical Context: Past Construction

In the United States, the foundation for water resource infrastructure development was laid in 1824 when the first Rivers and Harbors Act was passed by Congress. The act funded the United States Army Corps of Engineers (Army Corps) to improve navigation on the Ohio and Mississippi Rivers (Samet, 2009; Furry, 2011). Additional legislation, including the General Survey Act (also in 1824), the Reclamation Act (1902), and the first Flood Control Act (1917), expanded the national water resource infrastructure framework and affirmed the role of the federal government as the primary entity in the identification, design, and construction of large-scale infrastructure projects. New versions of both the Rivers and Harbors Act and the Flood Control Act continued to be passed on a regular basis up through 1970. These later acts, similar to their namesakes, provided federal authorization and funding for infrastructure and water resource management projects across the country.

The arrival of the Great Depression following World War I, and election of Franklin Roosevelt in 1932, brought about a surge in public works spending that far exceeded the previous rate of investment. In *Cadillac Desert*, Marc Reisner's exhaustive work on the search for and development of water resources in the American West, the period from 1928 through the 1970s is identified as the "go-go years" during which the New Deal, World War II, the development of electrolytic smelting of aluminum (requiring vast hydroelectric generating facilities), the rise of industrial agriculture in the western US, and the Baby Boom all occurred. During this same time period, the US Bureau of Reclamation (Reclamation) and the Army Corps expanded significantly both in terms of size and authority.

The period was unique in many ways. Engineering the control of nature became more tangible than ever before and swept forward in what Robert Kelley (1989) described as a "renaissance of faith" in an expanded and considerably strengthened federal government. The concept of "total use" and full development of nature's commercial potential through increased management and investment in infrastructure was widely promulgated. Expansion of national commerce was pursued through the construction of government infrastructure that provided water, power, flood control, and commercial transportation across the nation (Kelly, 1989; White, 1991; Reisner, 1993; Mount, 1995; Harden, 2012).

Detailing the rapid expansion of water resources infrastructure during this time period falls beyond this article's scope, but a few examples of the speed and breadth of development are warranted. For example, the mainstem Columbia River went from being undammed in 1933 to having 11 large dams in the US by 1974. In 1936 alone, construction was underway for Hoover, Shasta, Bonneville, and Grand Coulee dams. By 1956, Reclamation had received 110 specific funding authorizations for new dam and irrigation projects in the western US while the Army Corps had built hundreds of new flood control and navigation projects on both coasts (White, 1991; Reisner, 1993; Mount, 1995; Harden, 2012).

Expansion of the nation's water resource infrastructure began to wane starting in the 1950s with the Eisenhower Administration's "no-new starts" policy for dams (Dzombak et al., 2013). Presidents following Eisenhower would continue this trend with further reductions and eventually elimination of authorizations for many proposed projects. This did not mean a wholesale stop in the authorization and construction of new projects in general, however. Widespread flooding in California during the winter of 1955 spurred on the Feather River Project which in turn led to the State Water Project in 1960 (Mount, 1995); and the Colorado River Basin Project Act was passed in 1968, which included authorization for the Central Arizona Project (Dzombak et al., 2013). However, the pace of investment was greatly reduced from previous decades. Beginning in the late 1960s, passage of several environmental protection acts would further slow major infrastructure construction.

By 1973 the National Water Commission noted that "it seems virtually certain that in the future the United States will need relatively few major navigation, flood control, or water projects" (NWC, 1973). Irrigation storage and distribution systems such as Reclamation's Columbia Basin Project were placed under greater economic scrutiny starting in the 1980s. State governments were increasingly asked to bear the cost of proposed expansions to existing projects (Harden, 2012). During the Reagan Presidency there was talk in Congress of forcing states to pay a large share of the costs, in the range of 33 percent, for new flood-control dams. Suggested local and state funding for downstream flood control projects, such as levee expansions, were in the range of 10 to 30 percent (Reisner, 1993). As local cost sharing obligations increased, enthusiasm for many projects waned considerably.

When the Water Resources Development Act (WRDA) of 1986 was passed, it required local government to pay between 35 and 50 percent of federal flood protection project costs, 100 percent of hydroelectric and municipal water supply project costs, 35 percent of agricultural project costs, and 50 percent of recreational and navigation project costs (WRDA, 1986). The passage of this act not only further reduced the overall rate of infrastructure development, but also marked a distinctive shift towards specific, locally-focused appropriations for individual projects in response to requests from community, local, and state governments who would share in the financial burden.

Infrastructure

Externalized Costs

Environmental Legislation

Historical Context: Environmental and Social Costs

It is probably fair to conclude that the environmental and social impacts incurred by such intense development and industrialization of US water resources during the mid-twentieth century were among the driving forces (in addition to the mounting ecologic cost associated with 20 years of DDT application) behind the rise of the environmental movement.

Many, if not all, of the projects pursued in the early century had significant, far-reaching, environmental and social consequences. Hydrographs of some of the nation's largest rivers including the Columbia, Sacramento, San Joaquin, Missouri, and of course the Colorado saw seasonal flows considerably reduced or leveled off. Migratory waterfowl and other birds arrived at historical overwintering grounds to find them drained of water and food resources submerged under 100 feet of standing water. As navigable inland waterways and flood control projects expanded, so too did a complex system of levees, dikes, and floodwalls that restricted channel movement, altered sediment transport regimes, reduced biodiversity, and increased both the hydrograph amplitude and the downstream damage of seasonal floods. First Nations experienced devastating loss of traditional cultural and subsistence food resources such as the salmon runs in California and the Pacific Northwest (Reisner, 1993; Barber, 2005; Harden, 2012) and in some cases wholesale displacement such as in the bottomlands along the Missouri River (White, 1991). In short, the externalized costs of many projects were immense, and they remained largely unconsidered, or at least externalized until the late 1960s.

The Wild and Scenic Rivers Act was passed into law in 1968. The National Environmental Policy Act was passed in 1969. The Clean Water Act, Endangered Species Act, and Safe Drinking Water Act were all passed between 1970 and 1975. Many of these laws in some way began to internalize the cost of what amounted to the social and ecological collateral damage that would be incurred as a result of new project construction or changes in operations at existing facilities. The Endangered Species Act prohibited "taking" of endangered species, which included the broad impacts of harming, harassment, pursuit, wounding, capture, collection, or killing (16 USC 1531 §3 (19)). The Clean Water Act set standards to maintain water quality in public waterways and instituted the National Pollutant Discharge Elimination System. The NEPA process literally required accounting for project impacts through the drafting of an Environmental Impact Statement. From an infrastructure perspective, these legislative acts meant the regulatory requirements applied to new projects would reduce the speed of development and considerably increase the cost. For existing facilities, the new legislation brought with it a new burden to account for the environmental cost of operation. Collectively, these actions resulted in a significant shift from the earlier decades that focused on expansion and construction to tame and manage natural resources across much of the contiguous US.

Ballard Locks: A tugboat maneuvers into the Ballard Locks in Seattle, Washington with a completed bridge pontoon. Funds for the Locks were authorized in Rivers and Harbors Act of 1911 and the dam and locks were completed in 1916 (it was another year before they were officially opened to boat traffic). Thus, the Locks are one of many structures across the US approaching their centennial birthday.
Photo by Eric Buer

Ballard Locks Presentation

Marian Valentine, Locks Operations Project Manager for the US Army Corps Seattle District, will be presenting on the Ballard Locks for the ***"Adapting Existing Infrastructure"*** session at AWRA-WA's upcoming ***Water Resources Infrastructure Conference***.

October 23
Seattle

See Agenda Page 10

Infrastructure

Current Concerns

Aging Systems

Investment Needs

Funding Mechanisms

Maintenance & Repair Needs

Funding Obstacles

User-Based Funding

State Programs

PRESENT ISSUES

The boom of construction from the 1930s to the 1970s left the US with a considerable endowment of water infrastructure. There are, however, a number of issues now facing this network that include age-related deterioration, ongoing operations and maintenance funding shortfalls, environmental concerns, and new system stresses from climate change.

Age Related Deterioration

There is growing concern that the Nation's water resources infrastructure is deteriorating as it continues to age. A cursory search for examples to this end turned up a variety of alarming statistics. Approximately half of the dams operated by the Army Corps have reached or exceeded their 50-year design lives (Army Corps, 2012). Necessary wastewater capital investments to maintain and upgrade existing facilities are estimated at $122 billion over the next 20 years (USEPA, 2009). Nationally the current condition and performance of flood control levees remains poorly documented (NCLS, 2014), but widely publicized examples such as the levee failures in New Orleans (2005), Midwest states including Indiana, Illinois, Iowa, Michigan, Minnesota and Wisconsin (2008), and along the Mississippi River in Louisiana (2011), suggests that levee failure remains a serious threat to many people.

On July 25, 2013, Dr. Gerald Galloway (University of Maryland) testified to the US Senate that while the United States once hosted a world-class system of water infrastructure, the picture today was one of aging and fragile facilities in need of repair or replacement. Given the services provided by many of these facilities, allowing them to fail in place does not appear to be a realistic alternative. Galloway noted in his testimony that in 2013 the American Society of Civil Engineers estimated that at least $257 billion will need to be invested in water resource infrastructure by the year 2020 in order to meet current system demands. However, what remains elusive is where such funding will come from.

Funding for Operations and Maintenance

Principal funding for water resources infrastructure during the past century has primarily been provided through roughly annual or biannual passage of both Rivers and Harbors Acts and Flood Control Acts by Congress. This process was superseded in 1974 with the passage of the first Water Resources Development Act, which became the new principal funding source for water resources infrastructure. As was the case with both the Rivers and Harbors Act and the Flood Control Act, new versions of the Water Resources Development Act were passed on roughly a biannual basis through 2007. As part of a study into the current state of Army Corps water resources infrastructure, the National Research Council noted in some detail that the process of authorizing and funding individual projects through Water Resources Development Acts has continued to emphasize the construction of new water projects, making it very effective at expanding national infrastructure. The Council went on, however, to point out that the need for continued expansion of such infrastructure is limited, and that what the WRDA process does not provide is regular or ongoing support for operations, maintenance, and repair of infrastructure once it is built (Dzombak et al., 2013). Furthermore, there is no federal policy or criteria for prioritizing such funding among existing non-federal projects even though demand is likely to increase (Lane, 2013).

For example, in 2013 a $13 billion urban flood control system was completed by the Army Corps to protect New Orleans from future hurricane damage similar to what was observed in 2005. Ownership of the infrastructure, and responsibility for operation of the system was transferred in segments to local flood authorities. Operations and maintenance costs for the system as a whole are estimated to run approximately $38 million annually. Despite passage of a new local levee tax, long-term funding to maintain and operate the system as a whole is not assured. This is due in part to the initially small tax bases in many of the flood control districts being further reduced after the widespread damage caused by Hurricane Katrina (Burdeau, 2012; Schleifstein, 2013). As the national infrastructure network continues to age, it is reasonable to expect that the need to fund increased maintenance, repair, and rehabilitation will likewise increase at many locations.

One alternative is to transfer the cost of operating and maintaining these systems to the user base who benefits from them. Examples of such cost sharing include rates charged for federally-delivered irrigation water, fuel surcharges associated with barge traffic on inland waterways, and development fees to support improvements in flood control infrastructure. However, as Galloway noted in his testimony, user-based funding mechanisms tend to be unpopular when proposed; and even when in place and tied to a service — such as municipal water supply — they frequently do not keep up with the cost of providing said service.

Another alternative is to increase local government funding to operate and maintain projects. For example, the Congressional Research Service identified nine states — Arizona, Massachusetts, Maryland, New Jersey, New York, Ohio, Pennsylvania, Utah, and Wyoming — that have developed loan or grant programs to address rehabilitation of nonfederal dams (Lane, 2008). But these and other similar state revolving fund programs remain fairly limited. For now at least, the Nation's water resource infrastructure appears to be caught in the center of a shrinking pool of government funding with no way to turn the tap back on.

Infrastructure

Environmental Damage

Regulatory Constraints

Slow Permitting

Drought Impacts

Environmental Concerns

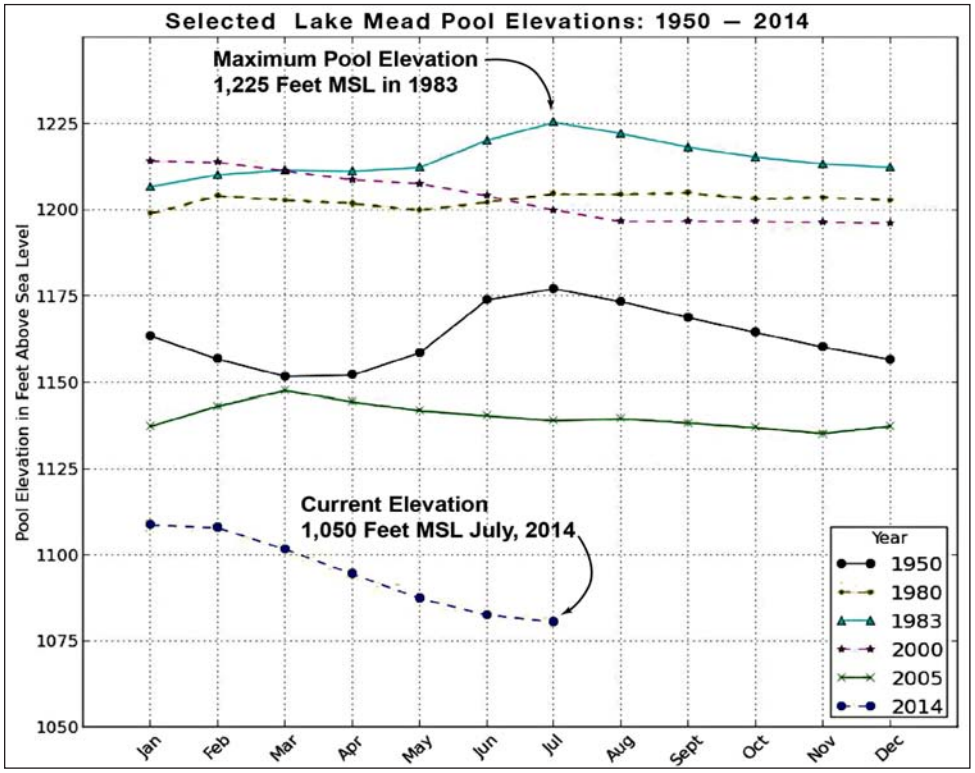
The rise of the environmental movement following the early to mid-20th century construction boom has meant that from at least one perspective there are a great deal of amends that need to be made for the damage that has already been done. While detailed accounting is beyond the scope of this article, it is sufficient to say that the adverse environmental impacts associated with the development of national water resources infrastructure were very significant at the time of construction, and they remain very significant where infrastructure remains in place today.

One result of this history is that water resource infrastructure today must navigate among many complex and frequently competing environmental requirements from construction (or rehabilitation) through operation. Ironically, were they not already in place, many existing facilities faced with today's environmental and regulatory requirements would probably not be built. This makes compliance with (comparatively) newer environmental requirements difficult as the impacts that are generated by, for example, an irrigation supply dam, cannot be easily mitigated or reduced without impairing the dam's original function of storing and diverting water.

While the detailed environmental permitting requirements for infrastructure vary by specific project, it is reasonable to say that the permitting process is generally slow (estimated to range from 10 to 15 years when working with the Army Corps (HTIC, 2014), expensive, and can frequently be contentious. Passage of the Water Resources Reform and Development Act (WRRDA) in 2014 may address some of these challenges by streamlining federal permitting performed by the Army Corps. However, without coordination, cooperation, and compromise between those who rely on water resources infrastructure, and those who rely on or advocate for natural ecosystems, the tension between the two will remain unresolved.

Climate Change

Finally, providing a backdrop to current problems facing many facilities is the threat of climate change and the increasing prospect of longer and hotter droughts, more intense flooding, and rising sea levels. Examples of how climate change is currently impacting our existing water resources and the infrastructure built to manage them are abundant. As of this writing, drought conditions in California are on track to generate the driest water year ever recorded in the state (NASA, 2014a). The Colorado River Basin is experiencing the driest 14-year period to occur in the past century (NASA, 2014b). Water surface elevations in Lake Mead are currently around 1,080 feet above mean sea level (note: Reclamation reports elevations in reference to a local "Power House Datum." This datum is approximately 0.55 feet above National Geodetic Vertical Datum 1929 (NGVD 1929). Water shortages are declared at 1,075 feet, which triggers federal rationing of water allocations to Utah, New Mexico, Colorado, Wyoming, Arizona, Nevada, and California. Reclamation has estimated that the 1,075-foot pool elevation may be reached as soon as 2015 (Wines, 2014). Should the pool elevation drop to 1,000 feet, municipalities including Las Vegas will be unable to pump water from the lake using existing intakes (Postel, 2014; Holthaus, 2014; Wines, 2014).



Monthly Pool Elevation Measurements for Lake Mead on the Colorado River using USBR local "Power House Datum." Maximum pool elevation was reached in 1983 following one of the strongest El Nino events ever recorded in U.S. history. Comparison of the 2000, 2005, and 2014 lines shows effects of the 14-year drought currently affecting the Colorado Basin.

Editors' Note: See Water Brief on improving Lake Powell Releases to Lake Mead. Page 28

Infrastructure

Extreme Weather Risks

During his 2013 testimony to Congress, Dr. Galloway noted that potential flooding risks were increasing across the nation and that existing structures designed to protect against flooding and coastal erosion may not be capable of withstanding future storm events. Increasing global temperatures have resulted in longer hurricane seasons and more intense storms. Hurricane Sandy in 2012 recorded the lowest central pressure ever observed in an Atlantic storm to make landfall north of Cape Hatteras (CNN, 2013). Less than a year later, Michael Bloomberg proposed a $20 billion plan to protect New York City from future storm damage which could include a storm surge five feet higher than what was observed in 2012 (CBS News, 2013). While such investments provide a model of pragmatic preparation for future changes, the national cost of similar upgrades remains high, and frequently implementation is politically difficult.

EMERGING TRENDS

New Infrastructure Trends

The ongoing process of operating, maintaining, and replacing national water resources infrastructure provides ongoing opportunities to introduce new ideas and amend operations. The nexus of scarce funding combined with other stresses has resulted in some new trends in water resource infrastructure. Projects are now frequently designed to meet the needs of many stakeholders, and to provide multiple benefits that range across both the human and ecological spectrums. Infrastructure development and operation are also increasingly occurring under integrated plans that work to balance the societal, economic, and ecologic benefits incurred with each investment. Infrastructure systems that formerly relied on engineered muscle now frequently seek to emulate natural processes and wherever possible to minimize long-term maintenance, reducing ecological impacts and operational costs while providing desired services.

Integrated Planning Efforts

Broader Interests

Watershed-scale planning was practiced during the go-go years to ensure that new infrastructure projects did not hinder each other's functionality. For example, failure to coordinate between upstream storage and downstream navigation projects could leave a waterway with flows too low for barge and boat traffic. However, integrated planning today reaches across a broader spectrum of interest groups and disciplines than in the past to coordinate between ecological, agricultural, industrial, and municipal needs.

Yakima Basin Example

The Yakima Basin Integrated Plan is one such example. The 30-year, $3.8 billion plan is a basin-wide systematic approach to improving water supplies, water quality, and ecological function through a series of land acquisitions and wilderness designations, infrastructure modifications and improvements, conservation measures, and changes to existing system operations (Reclamation and Ecology, 2012). Infrastructure improvements funded through the plan include modifications to six existing dams to aid fish passage and increase surface storage by as much as 450,000 acre-feet, improvements to irrigation delivery systems to reduce seepage and consumptive use losses by as much as 170,000 acre-feet, and aquifer storage systems. *See* Malloch & Garrity, *TWR* #106 (Dec. 15, 2012).

Ecological Compromise

Many of the project's hard infrastructure elements, such as the improvements to irrigation delivery systems, added surface storage, and aquifer storage, will also provide additional ecological benefit in the form of increased baseflows where water is appropriated. Other elements such as the Keechelus-to-Kachess pipeline were devised to provide added flexibility to the water supply system with consideration for both ichthyologic and agricultural needs. It is an impressive compromise, and two years into its implementation, the plan continues to be held up as a model of what can be accomplished when water users work together on an integrated approach that addresses everyone's needs (Garrity et al., 2013).

Central Valley Plan

A similar integrated approach was applied to the 2012 Central Valley Flood Protection Plan (Swanson et al., 2012). The Plan is a long-term program that aims to address the Central Valley's flood risk through system-wide infrastructure evaluation and investment such as widening floodways and bypass structures, and improvement of 120 miles of local levees, in addition to coordinated reservoir release schedules. The Plan goes a step further by giving preference to project alternatives that promote natural fluvial processes and support native species within the management system that has been developed.

Folsom Dam Integration

Finally, present upgrades to California's Folsom Dam provide another example of an integrated approach that literally combines two projects into one to meet both party's needs. The Folsom Joint Federal Project will address dam safety requirements (overseen by Reclamation) and downstream flood control requirements (overseen by the Army Corps) through the construction of a new spillway and improvements to the existing dam structure that include new concrete anchors and raising the dam structure up 3.5 feet. Construction of the auxiliary spillway will include a 1,000 foot approach channel to the spillway, and a 3,000 foot long downstream spillway chute to direct floodwaters during large release events (Reclamation et al., 2014).

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Natural Systems

Imitating Nature and Sustainable Design

Design and operation of infrastructure to imitate nature provides a number of benefits that can range from reduced maintenance to greater social value. Frequently, engineered systems that imitate nature result in reduced ecological disruption and enjoy greater support among the environmental community. Much of the rebuilding effort following Hurricane Sandy has been designed to imitate natural systems, such as the Living Breakwaters Project in New York. While the system's primary purpose remains protection of coastal infrastructure and the reduction of damage associated with erosion and wave energy, the new breakwater will also create functional habitat zones for fish and shellfish while also providing new recreational opportunities along the shoreline. A similar project called the New Meadowlands is also planned for New Jersey that will incorporate a mix of flood protection measures with wetland restoration to buffer storm surges and high tide events (Cardno, 2014).

Floodplain Design

The Central Valley Flood Protection Plan incorporated emulation of natural systems as part of its preferred alternative with the expansion of floodplain bypasses in four locations as well as setting back levees along three rivers. The modified system will result in an annual reduction in flood damages of approximately 80 percent while simultaneously allowing flows to access historical floodplains, improving ecological function and providing habitat benefits throughout the system. The naturalized bypasses will also ultimately result in reduced long-term maintenance costs by allowing natural sediment transport to occur within levee setback areas, reducing the need for repairs in areas of scour and deposition. This approach of creating managed floodplain bypasses or floodplain storage areas fits with a national movement of "Floodplains by Design" to restore floodplain ecologic and flood control functionality in concert with infrastructure investment (Nature Conservancy, 2014).

Aquifer Storage

Aquifer storage, such as what is proposed as part of the Yakima Basin Integrated Plan restores another small link between the Yakima River and its historical floodplains, where floods formerly infiltrated into the porous alluvial units in the subsurface. While the Integrated Plan relies on artificial recharge using pumping and infiltration systems, this planned element will imitate the natural recharge process in shallow aquifers, adding to the total water storage in the basin while also improving base flows in adjacent streams and reducing evaporative loss.

New Technology and Data Applications

Technology Controls

Advances in available technology and data collection have provided a wealth of additional flexibility in the management and improvement of water resource infrastructure. For example, improved electrical grid and instream monitoring have allowed for greater flexibility in balancing electrical generation and instream flows to support the outmigration of native salmonids as part of the Yakima Basin Integrated Plan. New technology has allowed for other smaller successes such as in the Verde Valley of Arizona where an automated system of flow-control gates that monitor water levels in the river channel have replaced a traditional gravity-fed irrigation diversion that required damming the Verde River. The modular systems include solar panels to power each gate as well as cellular modems that allow the units to be checked remotely. Installation of the system put flows of up to five cubic feet per second back into the channel (significant for this waterway), just above its Wild and Scenic reach, supporting healthier aquatic and riparian ecosystems downstream (Postel, 2013).

Remote Sensing

Similarly, the introduction of remote sensing has allowed for system-wide evaluation of the Green River flood control system that will be upgraded through the System-Wide Improvement Framework developed between the Army Corps and the King County (Washington) Flood Control Districts. Application of Geographical Information Systems, remote sensing, and other tools have allowed existing flood risks and infrastructure vulnerabilities to be evaluated in conjunction with ecologic, geomorphic, geotechnical, and hydraulic assessments over a 59-mile stretch of the Green River. These assessments in turn will be used in concert to produce a prioritized set of capital improvement projects and programmatic recommendations to meet flood control objectives that also support ecologic, economic, and social goals (King County, 2014a, 2014b).

Satellite Data

On a larger scale still, this year NASA released data from the Gravity Recovery and Climate Experiment satellite which combined with other remote sensing data allowed the agency to measure the mass of water stored in underground aquifers across the continental U.S. (NASA, 2014c). The data are part of a project between NASA, California Department of Water Resources, University of California researchers, and other resource management agencies to better assess water resources and drought impacts (Castle et al., 2014; NASA and U.C. Irvine, 2014).

Groundwater Loss

The study compared data from July 2014 against average values from 1948 and 2009, and was able to estimate the volume of groundwater loss in the Colorado Basin since 2004, which made up more than 75-percent of the total water loss in the basin. This conclusion has significant implications since low rates of aquifer recharge make groundwater in this area essentially non-renewable, while also providing a

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Multiple Benefit Approach

Author **Eric Buer** will be moderating a session on "*New Infrastructure Projects and Processes*" at AWRA-WA's Water Resources Infrastructure conference. **October 23 Seattle, WA**

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strategic reserve during times of scarcity (such as a 14-year drought). Such a comprehensive view of water consumption, and particularly of groundwater, would not be possible without advances in computing and satellite technology.

CONCLUSIONS

Water resource infrastructure in the US will face many challenges in the coming decades. Following the building boom in the first half of the 20th century, environmental and fiscal costs have reduced the rate of expansion while operations, maintenance, and rehabilitation needs have grown. The passage of the WRRDA in 2014 included $12 billion worth of infrastructure projects and new provisions to streamline the environmental permitting process for water resource infrastructure work. The Act also included a pilot loan-based funding program to be jointly administered through the Army Corps and the US Environmental Protection Agency to qualified water and wastewater rehabilitation or expansion projects. However, long-term funding of operations, maintenance, and rehabilitation for many existing facilities will require additional action in the future.

Successful infrastructure projects today frequently apply an integrated, multiple benefit approach to meeting the needs of many stakeholders. New approaches to infrastructure that imitate or work with natural processes have in many cases helped to build consensus among former rival interest groups and accelerated project implementation. With improved data collection and analytical tools, management of America's national water resource infrastructure operations can be fine-tuned, and strategic capital investments can be made to provide the greatest benefit possible now and in the future.

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REFERENCES

American Rivers. 2014. "*Yakima River Restoration*" Fact Sheet. Available online at: http://www.americanrivers.org/assets/pdfs/water-supply/yakima-river-restoration-fact.pdf?422fcb

American Society of Civil Engineers. 2013. "*2013 Report Card of American Infrastructure*" March. Available online: http://www.infrastructurereportcard.org.

Barber, K. 2005. "*The Death of Celilo Falls*" University of Washington Press. 258 pages.

Bourne, J.K. 2010. "*California's Pipe Dream*" National Geographic Magazine. Volume 217, Number 4. April.

Burdeau, C. 2012. "*Levees Protect New Orleans, But Annual Bill is Crushing*" NBC News online. Available at: http://usnews.nbcnews.com/_news/2012/11/27/15482726-levees-protect-new-orleans-but-annual-bill-is-crushing?lite. Accessed: July 29, 2014.

Castle, S.L., B.F. Thomas, J.T. Reager, M. Rodell, S.C. Swenson, and J.S. Famiglietti. 2014. "*Groundwater Depletion During Drought Threatens Future Water Security of the Colorado River Basin*" Geophysical Research Letters.

Cardno, C.A. 2014. "*Rebuilding by Design*" Civil Engineering July/August.

CBS News. 2013. "*Levees, Removable Walls, Part of $20 Billion Plan to Protect NYC from Storms, Climate Chang*e" June 11. Online resource available at: www.cbsnews.com/news/levees-removable-walls-part-of-20-billion-plan-to-protect-nyc-from-storms-climate-change/. Accessed August 1, 2014.

CNN Library. 2013. "*Hurricane Sandy Fast Facts*" July 13. Online resource available at: www.cnn.com/2013/07/13/world/americas/hurricane-sandy-fast-facts/. Accessed August 1, 2014.

DeVaney, J. 2014. "*Yakima Valley Agriculture: Growing Crops and the Economy*" Presentation to the Washington State Employment Security Department.

Dzombak, D.A., P.A. Atkins, G.B. Baecher, L.K. Blum, R.A. Dalrymple, M. Demissie, T.J. Fulp, L.A. Larson, D.M. McKnight, J.W. Milon, A.D. Tarlock, P.R. Wilcock. 2013. "*Corps of Engineers Water Resources Infrastructure: Deterioration, Investment, or Divestment?*" Water Science and Technology Board of the National Research Council

Endangered Species Act. 16 U.S.C. §1531-1544.

Furry, J.C. 2011. "*A History of Water Resources Policies and Guidance*" Overview Briefing for Planning Associates Class of 2011. March 3.

Galloway, G. 2013. "*Aging U.S. Water Infrastructure: A Badly Neglected National Problem*" July 25 testimony to the Subcommittee on Water and Power, U.S. Senate Committee on Energy and Natural Resources.

Galloway, G.E., P.L. Brockett, S.L. Cutter, D.T. Ford, C.Q. Goodwin, K.M. Jacoby, D.I. Maurstad, M.W. McCann, A.D. McDonald, E.A. Nance, K.W. Potter, J.D. Rogers. 2013. "*Levees and the National Flood Insurance Program: Improving Policies and Practices*" National Research Council of the National Academies. Washington D.C. 275 pages.

Garrity, M., M. Leita, P. Jewell, P. Rigdon, R.VanGundy, S. Malloch, T. Ring, U. Eberhart, D.Sandison. 2013. "*Building a Future for Water Wildlife and Working Lands*" May.

Harden, B. 2012. "A *River Lost: The Life and Death of the Columbia*" W.W. Norton and Company. 288 pages.

Infrastructure

Holthaus, E. 2014. "*Lake Mead Before and After the Epic Drought*" Slate Magazine online resource available at: www.slate.com/articles/technology/future_tense/2014/07/lake_mead_before_and_after_colorado_river_basin_losing_water_at_shocking.html. Accessed July 29, 2014.

House Transportation and Infrastructure Committee (HTIC). 2014. "*The Water Resources Reform and Development Act of 2014.*"

Kelley, R. 1989. "*Battling the Inland Sea: Floods, Public Policy, and the Sacramento Valley, 1850-1986*" University of California Press Ltd. London, England.

King County. 2014a. "*Green River System-Wide Improvement Framework (SWIF) Current Conditions Report*" Presentation to the Green River System Wide Improvement Framework Symposium April 16, 2014.

----------. 2014b. "*Green River System-Wide Improvement Framework (SWIF)*" Online Resource available at: www.kingcounty.gov/environment/wlr/sections-programs/river-floodplain-section/capital-projects/green-river-system-wide-improvement-framework.aspx Accessed August 5, 2014.

Lane, N. 2008. "*CRS Report for Congress: Aging Infrastructure: Dam Safety*" Congressional Research Service, March.

Mount, J. 1995. "*California Rivers and Streams: Conflict Between Fluvial Processes and Land Use*" University of California Press. 359 pages.

National Committee on Levee Safety (NLCS). 2014. "*About Levees*" Online Resource available at: http://www.leveesafety.org/levee.cfm. Accessed: July 24, 2014.

National Aeronautical and Space Administration (NASA). 2014a. "*All Dry on the Western Front*" NASA Earth Observatory online resource. Available at: http://earthobservatory.nasa.gov/IOTD/view.php?id=82910 Accessed July 31, 2014.

NASA. 2014b. "*Groundwater Deficit Out West*" NASA Earth Observatory online resource. Available at: http://earthobservatory.nasa.gov/IOTD/view.php?id=84065&src=eoa-iotd. Accessed July 31, 2014.

NASA. 2014c. "*NASA responds to California's Evolving Drought*" Online press release available at: www.nasa.gov/press/2014/february/nasa-responds-to-californias-evolving-drought/. Accessed July 31, 2014.

NASA and University of California Irvine. 2014 *"Parched West is Using Up Underground Water*" Online press release available at: www.jpl.nasa.gov/news/news.php?release=2014-242. Accessed July 31, 2014.

National Water Commission (NWC). 1973. "*Water Policies for the Future: Final Report to the President and to the Congress of the United States*" Washington, DC: U.S. Government Printing Office.

Nature Conservancy. 2014. "*Floodplains by Design: Nuts and Bolts*" Online Resource available at: www.nature.org/ourinitiatives/habitats/riverslakes/floodplains-by-design-feature.xml. Accessed July 31, 2014.

Postel, S. 2013. "*Arizona Irrigators Share Water with Desert River*" National Geographic Water Currents. September. Available online at: http://newswatch.nationalgeographic.com/2013/09/03/arizona-irrigators-share-water-with-desert-river/. Accessed July 30, 2014.

Postel, S. 2014. "*An Innovative Conservation Fund for the Colorado River*" National Geographic Water Currents. May. Available online at: http://newswatch.nationalgeographic.com/2014/05/06/an-innovative-conservation-fund-proposed-for-colorado-river/. Accessed July 30, 2014.

Reisner, M. 1993. "*Cadillac Desert: The American West and its Disappearing Water*" Penguin Books. 582 pages.

Samet, M. 2009. "A Citizen's Guide to the Corps of Engineers." Published by American Rivers and the National Wildlife Federation.

Schleifstein, M. 2013. "With New Orleans' new levee system complete local officials worry about paying for its upkeep." Times-Picayune. Online publication available at: www.nola.com/hurricane/index.ssf/2013/08/with_new_orleans_new_levee_sys.html. Accessed: August 3, 2014.

Swanson K.E., Marshall, P.A., Arrich, J.M., Rice M.P., Koch, E.S., Lerner, N.M., Hinojosa, A., and M. Sabbighian. 2012. "*2012 Central Valley Flood Protection Plan*" Prepared for the Central Valley Flood Protection Board. June.

US Army Corps. 2012. "*U.S. Port and Inland Waterways Modernization: Preparing for Post-Panamax Vessels*" Alexandria, VA: U.S. Army Corps of Engineers Institute for Water Resources.

US Army Corps Navigation and Civil Works Decision Support Center. 2013. "*The U.S. Waterway System Transportation Facts and Information*" November.

US Bureau of Reclamation (US Reclamation), US Army Corps, California Department of Water Resources, and Sacramento Area Flood Control Agency. 2014. "*Folsom Dam Improvements: Promoting Public Safety for the Sacramento Region*" Fact Sheet.

US Reclamation and State of Washington Department of Ecology. 2012. "*Yakima River Basin Integrated Plan Final Programmatic Environmental Impact Statement Benton, Kittitas, Klickitat, and Yakima Counties*" March.

US Environmental Protection Agency. 2009. "*Drinking Water Infrastructure Needs Survey and Assessment*" Fourth Report to Congress by the U.S. Environmental Protection Agency Office of Groundwater and Drinking Water. Washington D.C.

USA Hops. 2014 Online Resource available at: www.usahops.org/index.cfm?fuseaction=hop_farming&pageID=13. Accessed July 25, 2014.

Water Resources Development Act. 1986. 33 U.S.C. §2201.

Wines, M. 2014. "*Colorado River Drought Forces Painful Reckoning for States*" New York Times, January 1.

White, R. 1991. "*It's Your Misfortune and None of My Own: A New History of the American West*" University of Oklahoma Press. 644 pages.

Infrastructure Conference

Conference Agenda

Keynote Speech: State Policy for New Infrastructure *Jay Manning, Cascadia Law Group*

Session 1: Multiple Objectives - History and New Concepts
Moderator: Felix Kristanovich, ENVIRON
Existing Infrastructure, New Objectives
Bob Freitag, Director, University of Washington Institute for Hazards Mitigation Planning and Research
Principles for Sustainable Infrastructure Innovation
Rhys Roth, Director, Center for Sustainable Infrastructure at The Evergreen State College
Floodplains by Design
Bob Carey, Director of Strategic Partnerships, The Nature Conservancy

Session 2: Adapting Existing Infrastructure - Retrofitting, Relicensing, and Replacement
Moderator: John Chandler, Puget Sound Energy
Tacoma's Cushman Dam
Steve Fischer, Assistant Generation Manager, Tacoma Power
Culvert Replacement Program
Paul Wagner, Environmental Services Biology Branch Manager, Washington State Department of Transportation
Dike, Floodplain, and Infrastructure Work in Yakima County
Joel Freudenthal, Senior Natural Resource Specialist, Yakima County Public Services
Ballard Locks
Marian Valentine, Locks Operations Project Manager, Seattle District, US Army Corps of Engineers

Session 3: New Infrastructure Projects and Processes
Moderator: Eric Buer, RIDOLFI, Inc.
Sunset Falls Fish Passage and Energy Project
Scott Sphar, Manager, Generation Engineering, Snohomish County PUD
Green River System-Wide Improvement Framework
Lorin Reinelt, Managing Engineer, River and Floodplain Management Section, King County DNRP/WLRD
Yakima Basin Integrated Water Resource Management Plan
Derek Sandison, Director, Office of Columbia River, Washington Department of Ecology

Session 4: Panel Discussion - Lessons Learned and Paths Forward

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Aquifer Recharge

MANAGED AQUIFER RECHARGE

AN OVERVIEW OF LAWS AFFECTING AQUIFER RECHARGE IN SEVERAL WESTERN STATES

by Evan Mortimer, University of Idaho College of Law (Moscow, ID)

Editors' Note: Groundwater v. Ground Water
While there is, as yet, no uniformity in usage within or among the states "groundwater" is expressed as a single word throughout this article, except within quoted text where it originally appeared as "ground water."

INTRODUCTION

Given the ever-increasing demand for finite water resources in the western United States, the effective functioning of our aquifers continues to be of the utmost importance. Numerous western aquifers currently suffer from moderate to severe overdraft, with groundwater withdrawal outpacing replenishment, while many other aquifers are on their way towards one-hundred percent depletion. This unsustainable situation will continue unless something is done to stop the overdraft of groundwater. As aquifer depletion becomes more problematic, a continued effort to stabilize aquifers and promote the managed recharge of aquifers will be crucial to the economic and social health of the western United States.

Some efforts are already underway. In a number of western states, both public and private entities are working to stabilize aquifers through various methods, including managed aquifer recharge. One recent example comes from Idaho, where earlier this year the Idaho Legislature passed House Bill 547, which dedicates $5 million annually in state Cigarette Tax revenue to be used by the Idaho Water Resource Board for statewide aquifer stabilization. In California, the Legislature recently voted to place a $7.545 billion bond before the voters to, among other things, promote aquifer recharge. In addition,as this issue of *The Water Report* goes to press, a three-bill legislative package addressing groundwater sustainability is awaiting Governor Brown's signature.

This article briefly summarizes of the technical aspects of aquifer recharge and then lays out background information on laws affecting groundwater management approaches in California, Colorado, Arizona, and Idaho to illustrate some of the similarities and differences amongst these western states.

TECHNICAL ASPECTS

Hydrogeology

Aquifer Diversity

A geologic formation from which groundwater can be pumped for domestic, municipal, or agricultural uses is known as an aquifer. Oftentimes, aquifers are separated from one another by a geological formation that permits little or no water to flow between them. These geological formations can be either less permeable than the aquifer (an "aquitard") or entirely impermeable (an "aquiclude"). Describing the diversity of aquifers, the United States Geological Survey (USGS) states that, "an aquifer may be only a few or tens of feet thick to hundreds of feet thick. It may lie a few feet below the land surface to thousands of feet below…[and] may underlie thousands of square miles to just a few acres." *Ground Water,* USGS (1999) at: http://pubs.usgs.gov/gip/gw/how_b.html.

Confined & Unconfined

There are two major types of aquifers: unconfined and confined. An unconfined aquifer has no overlying aquitard or aquiclude, the absence of which allows water to percolate directly into the aquifer from the surface. A confined aquifer, on the other hand, is sandwiched between an aquitard above and an aquiclude or aquitard (e.g., bedrock) below. Oftentimes, a confined aquifer is pressurized such that drilling a borehole into it will cause the water in the aquifer to rise above the water table level and even, at times, rise above the surface without the aid of a pump. This type of borehole creates an artesian well. However, when groundwater is not confined under pressure, "it is described as being under water-table conditions. Water-table aquifers generally are recharged locally, and water tables in shallow aquifers may fluctuate up and down directly in unison with precipitation and stream flow."*Id*.

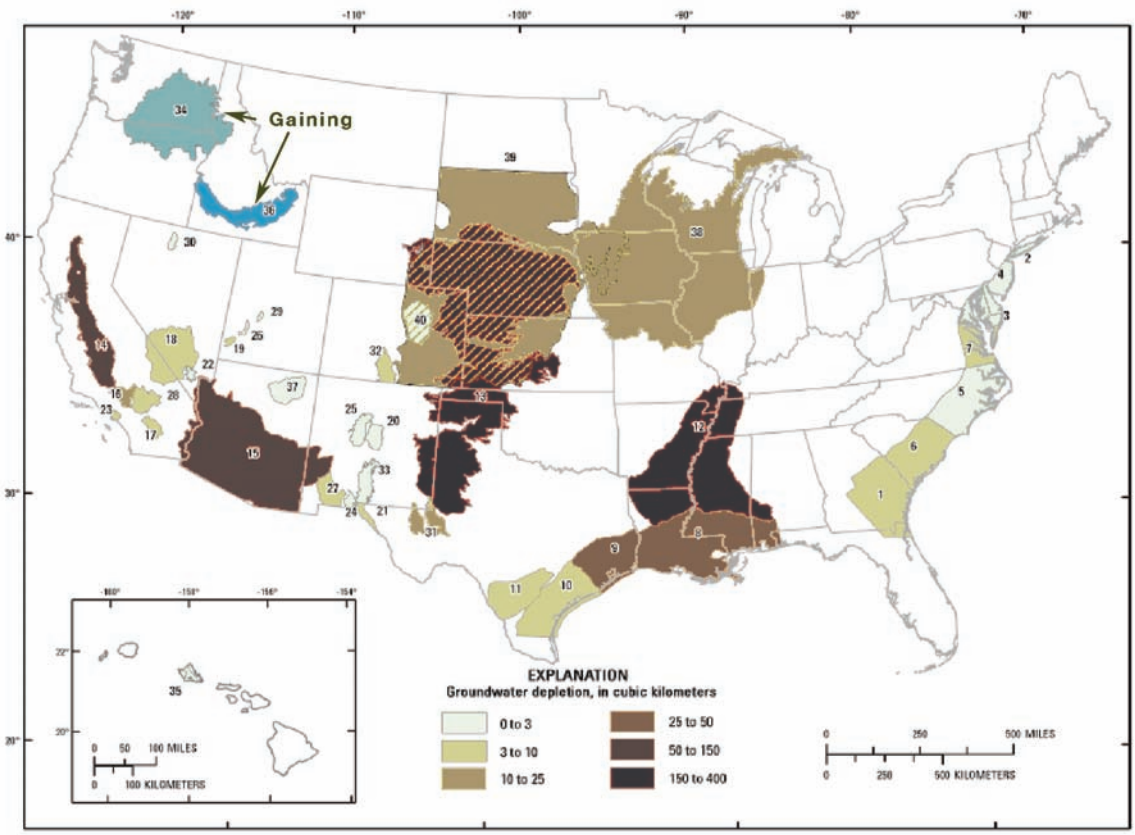
Aquifer Depletion & Recharge

Increasing Groundwater Use

Groundwater use has been increasing for agricultural, drinking, and industrial supplies across the western US, due in large part to the increasing population demand. In addition, the development of a new type of groundwater pump in the 1950's combined with the availability of cheap rural electricity led many irrigators to begin using groundwater instead of surface water. Many irrigators preferred groundwater because there was seemingly never a shortage of supply which was available even if it did not rain all year. As a result of this increased groundwater pumping, many aquifers have been dwindling at an alarming rate. The amount of water that may be extracted from an aquifer without causing depletion is primarily dependent upon the amount of groundwater recharge to that aquifer.

Aquifer Recharge

Figure 1
US Groundwater Depletion



Map of the United States (excluding Alaska) showing cumulative groundwater depletion, 1900 through 2008, in 40 assessed aquifer systems or subareas. Colors are hatched in the Dakota aquifer (area 39) where the aquifer overlaps with other aquifers having different values of depletion.

Recharge Purposes

Managed Aquifer Recharge

In order to thwart the depletion of aquifers, many public and private entities have used a technique known as managed aquifer recharge. Managed aquifer recharge refers to the "the movement of water via man-made systems from the surface of the earth to underground water-bearing strata where it may be stored for future use." *See Aquifer Recharge and Aquifer Storage and Recovery Wells,* EPA (1999), page 2. According to the US Environmental Protection Agency (EPA), "[managed aquifer] recharge may be conducted for ground water resource management, water storage and recovery, prevention of salt water intrusion into fresh water aquifers, and subsidence control, among other purposes... ." *Id*. at 2-3.

It is important to note that, to ensure the active and proficient operation of a managed aquifer recharge project, a detailed and comprehensive hydrogeologic study must be conducted before selecting the site and method of recharge.

Necessary Considerations

Necessary managed aquifer recharge considerations, include:

- locations of geologic and hydraulic boundaries
- ground transmissivity (permeability multiplied by saturated thickness)
- depth to the aquifer
- lithology (rock characteristics)
- storage capacity
- porosity
- hydraulic conductivity (ease of fluid movement)
- availability of land
- surrounding land use and topography
- quality and quantity of water to be recharged
- economic and legal aspects governing recharge
- level of public acceptance
- natural inflow and outflow of water to the aquifer

Three Methods

While often difficult to ascertain, the exact amount of recharge actually received by the aquifer is the most important figure required for management of groundwater resources.

In general, managed aquifer recharge utilizes one of three different methods:1) surface spreading; 2) smaller infiltration pits/basins; or 3) injection wells.

Aquifer Recharge

Surface Spreading

Surface spreading is intentionally spreading water over a permeable strata of soil that will allow water to percolate down to the unconfined aquifer below. The majority of existing large-scale artificial recharge operations use surface spreading, which typically employs infiltration basins to enhance the natural percolation of water into the subsurface. This method's effectiveness relies on factors such as the climate, the acreage available, hydrogeology of the available land and the aquifer below, and whether the water is local or imported. With surface spreading, the larger the area of recharge and the longer the water has contact with the soil, the better the rate of recharge. Moreover, surface spreading generally has relatively low construction costs and is easy to operate and maintain.

Artificial Recharge

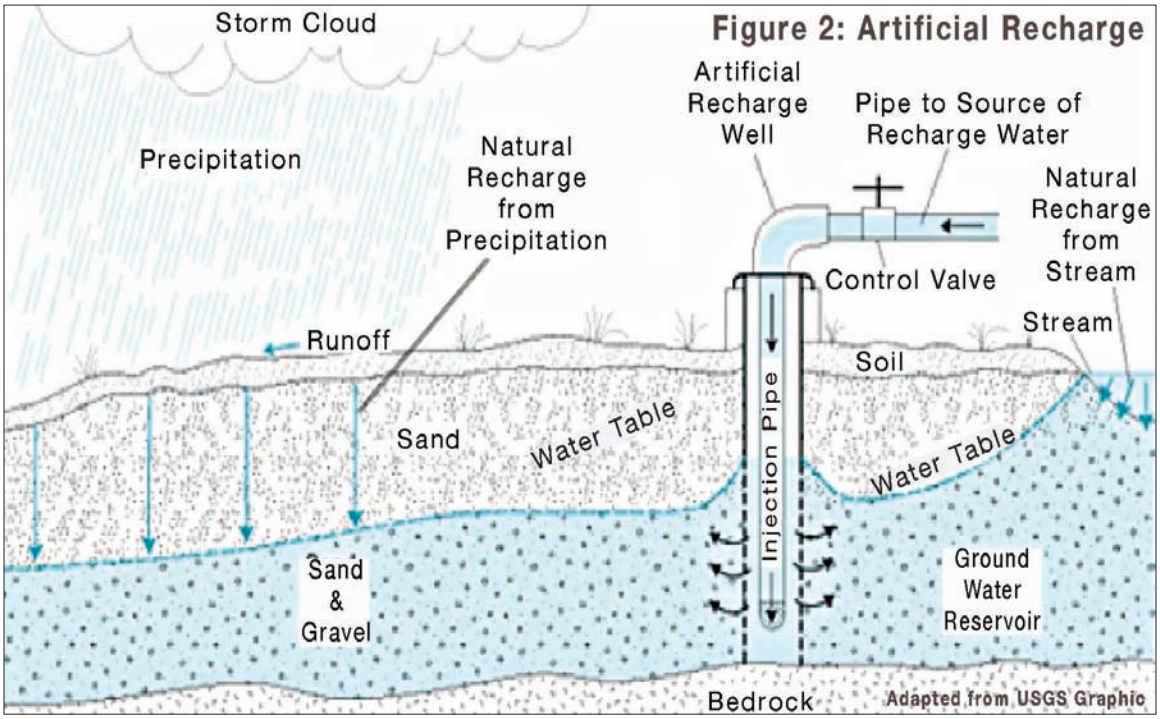


Figure 2: Artificial Recharge

Infiltration Pits & Basins

While surface spreading and infiltration pits are very similar in concept, infiltration pits and basins are often used in areas where less acreage is available. These recharge systems are generally smaller than surface spreading systems and are commonly used to manage stormwater in municipalities and irrigation control in canal management. An infiltration basin does not normally have a structural outlet to discharge runoff from stormwater. Instead, outflow from an infiltration basin is through the surrounding soils. "*New Jersey Stormwater Best Management Practices Manual*," New Jersey Dept. of Environmental Protection, (April 2004). For this reason, infiltration pits and basins also serve a dual purpose of water quality management. Water pollutant removal may be achieved by the filtration of the runoff through the soil as well as biological and chemical activity within the soil. *Id*.

Injection Wells

Injection wells can be drilled to deliver water into an aquifer. "Injection wells are the selected method of artificial recharge in areas where the existence of impermeable strata between the surface and the aquifer makes recharge by surface infiltration impractical or in areas where land for surface spreading is limited." *Aquifer Recharge and Aquifer Storage, supra* at 3. Also referred to as "direct subsurface recharge," injection wells convey water directly into an aquifer and therefore the quality of the recharged water is of major concern. This is due in large part to the fact that injection wells put water into the aquifer without filtration and oxidation that occurs through the natural percolation of the water through the soil. Injection wells generally inject water directly into water supply aquifers and so, under EPA regulations, they are considered Class V injection wells. These wells are subject to regulation for groundwater quality by EPA or EPA-authorized state agencies with regulations as least as stringent as federal standards (Underground Injection Control). *See* 40 CFR 146.5(e)(6).

ASR Wells

There are different types of injection wells. In the last 30 years, **a**quifer **s**torage **r**ecovery (ASR) wells have increased in usage. ASR wells are used to not only recharge the water into the aquifer, but also to retrieve the recharged water from the same well. In other words, the well has a dual-purpose: recharge and recovery. Generally, ASR wells are expensive and prone to clogging by suspended solids, biological activity, or chemical impurities. *Artificial Recharge of Groundwater, supra.* For these reasons, ASR wells are more expensive to construct and maintain and thus used less often for managed aquifer recharge.

Aquifer Recharge

Snake River Basin

Unique Aquifer

Sprinkler Irrigation

Drinking Water Source

GROUNDWATER LAWS: A FOUR STATES COMPARISON

A number of different legislative approaches have arisen to address groundwater management. Each state's approach reflects that state's unique history and geology and each has unique strengths and weaknesses. A brief examination of approaches in California, Colorado, Arizona, and Idaho will help illuminate a number of the similarities and differences across the western states. This examination includes: a history of groundwater laws in each state; current groundwater laws and administration; water quality legislation; and the differing hydrogeology of each state.

Idaho

Idaho encompasses five major drainage basins. The majority of the State's population lives in the largest of these basins, the Snake River Basin. The Snake River Basin also provides most of the irrigation water for the vast agricultural infrastructure Idaho boasts. While the amount of land devoted to agriculture has declined over the years, irrigation remains the largest single user of both surface and groundwater in Idaho. *Estimated Use of Water in the United States in 2005*, USGS Circular 1344 (2009). A few areas, notably Butte and Camas Counties, have suffered significant groundwater level declines — ranging from one foot to fifty feet. *Groundwater Management in the West*, Ashley and Smith (1999), page 102.

Applicable Idaho Law

As with the other state's of the American West, water usage in Idaho is administered under the "first in time, first in right" principle of western water law's Prior Appropriation Doctrine. Idaho's version of this Doctrine is well developed, as reflected in Idaho's constitution, statues, administrative code, and case law.

This examination of Idaho law will focus largely on the Snake River Plain Aquifer and its nearly finished adjudication of water rights. The Eastern Snake Plain Aquifer (ESPA) has unique characteristics with regard to groundwater recharge. ESPA's size is comparable to Lake Erie. It is one of the largest and most productive aquifers in the world. Recharge into the ESPA is "predominantly from infiltration of applied irrigation water, infiltration of stream flow, and ground-water inflow from adjoining mountain drainage basins. Some recharge may be from direct infiltration of precipitation, however the hot, arid climate of the Plain make this a minimal contribution." Digital Geology of Idaho at: http://geology.isu.edu/Digital_Geology_Idaho/Module15/mod15.htm.

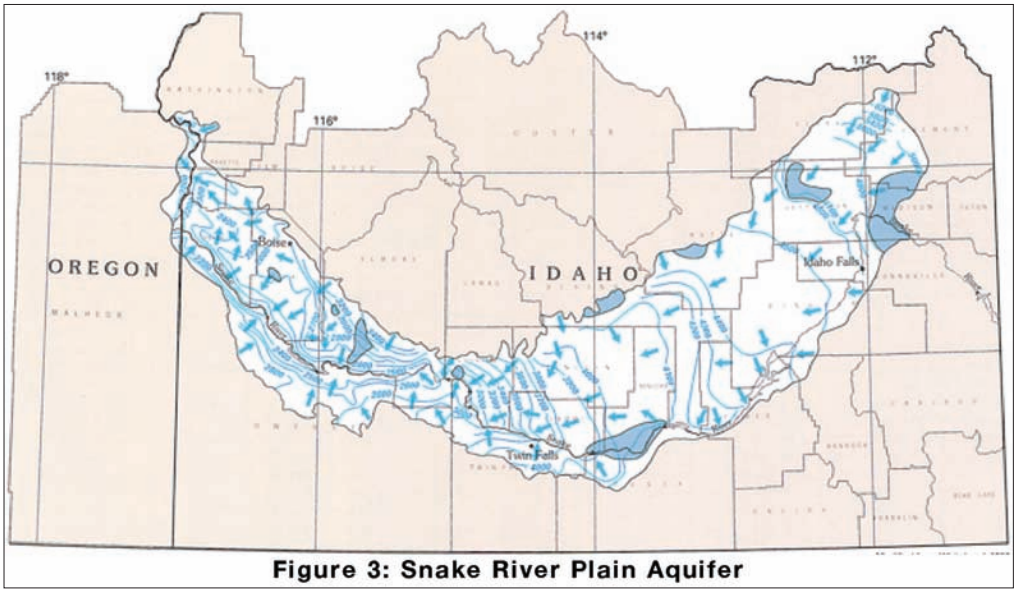


Figure 3: Snake River Plain Aquifer

The change from flood irrigation to sprinklers throughout the mid-1900's created increased efficiency in the use of water. However, expanded irrigated acreage and other changes to agricultural practices also led to a decrease in the irrigated water that is returned to the aquifer. (The US Supreme Court recently discussed some of the problems arising from the increased efficiency of sprinkler irrigation in *Montana v. Wyoming*, 131 S.Ct. 1765 (2011)).

ESPA water is also the sole source of drinking water for nearly three hundred thousand Idaho residents, gaining it a "sole source aquifer" designation from EPA. Carlquist, *supra* at 147. Groundwater pumping has increased due to an ever-increasing population and the corresponding increase of overall water demand. Fortunately for Idahoans, this increased usage has resulted in an approximate decrease in overall aquifer storage of only 3%. Digital Geology, *supra*.

Aquifer Recharge

The ESPA is an unconfined aquifer that has a strong hydrological connection with the Snake River and its many tributaries. Generally, the aquifer, as well as the river above, flows in a southwestern direction. In the upper 150 meters of the aquifer elevation, the storage capacity has been estimated at 200 million acre-feet to 300 million acre-feet. *Id*. Ultimately, the ESPA culminates at two main areas of natural discharge: 1) springs along the Snake River near American Falls Reservoir, which discharge at about 2600 **c**ubic **f**eet per **s**econd (cfs); and 2) Thousand Springs, west of Twin Falls, where the collective discharge is about 5200 cfs.

Well Permits

As is true in many western states, domestic wells have been exempted from the permit process. All other appropriations require a water right permit and license and are defined by source quantity, date of priority, point of diversion, purpose of use, season of use, and place of use. Idaho Code Ann. § 42-1411. Groundwater is defined as all water under the surface of the ground, whatever the geological structure in which it is standing or moving. Idaho Code Ann. § 42-230(a).

"Two River" Concept

Idaho water policy on the Snake River has long centered on the notion that there is a "two-river" concept. Beginning in 1986, the Idaho Code has stated that "for the purpose of the determination and administration of rights to the use of the water of the Snake River or its tributaries downstream from Milner Dam, no portion of the water of the Snake River or surface or groundwater tributary to the Snake River upstream from Milner Dam shall be considered." Idaho Code Ann. § 42-203B(2). This effectively splits the Snake River into two different sections in which the administration of one does not affect the other. As a practical matter, water users downstream from Milner Dam are precluded from making "calls" for priority regulation of water above Milner, even if they have senior priority rights. Tuthill, David. *Conjunctive Management in Idaho*, *The Water Report* #108, page 2 (Feb. 15, 2013).

Conjunctive Use Administration

Starting in 1951, the Idaho Legislature determined that groundwater was subject to the Doctrine of Prior Appropriation under the Ground Water Act. Idaho Code Ann. § 42-229. The 1951 Act is significant because it stated that "while the doctrine of 'first in time is first in right' is recognized, a reasonable exercise of this right *shall not block full economic development of underground water resources*." Idaho Code Ann. § 42-226 (emphasis added). The Idaho Supreme Court thoroughly interpreted the Ground Water Act in *Baker v. Ore-Ida Foods, Inc*., 95 Idaho 575, 513 P.2d 627 (1973). *Baker* was the first Idaho Supreme Court analysis of the Ground Water Act as it related to the removal of groundwater in excess of the aquifer's recharge rate. *Baker* held that the Ground Water Act seeks to promote "full economic development" of Idaho's groundwater resources and used the phrase "reasonable pumping levels" — therefore, senior appropriators are "not necessarily entitled to maintenance of historic pumping levels."

"Reasonable" Pumping Levels

> A senior appropriator is only entitled to be protected to the extent of the "reasonable ground water pumping levels" as established by the IDWA. I.C. § 42-226. A senior appropriator is not absolutely protected in either his historic water level or his historic means of diversion. Our Ground Water Act contemplates that in some situations senior appropriators may have to accept some modification of their rights in order to achieve the goal of full economic development.

Id. at 635.

Aquifer Mining Forbidden

Baker also held that the Ground Water Act "forbids mining of an aquifer." *Id*. Thus, the Ground Water Act provided that "ground water usage must be administered to protect both affected senior-priority rights — i.e., both ground and surface water — and to avoid mining of the source aquifer (use existing recharge)." Tuthill, *supra* at 3.

Groundwater Regulation

Idaho water, surface and ground alike, is administered by the Idaho Department of Water Resources (IDWR) pursuant to Idaho Code §42-604. Within IDWR is the Water Resources Board (Board), which is responsible for implementing a comprehensive state water plan for conservation, development, management, and optimum use of all unappropriated water resources and waterways in the public interest subject to legislative approval. Idaho Code Ann. § 42-1734A. Board members are appointed by the governor to serve four-year terms. Moreover, they have specifically mandated functions and responsibilities that are outside the IDWR (*see* www.idwr.idaho.gov/waterboard). While the Director of IDWR (Director) has direction and control of the distribution of all Idaho waters, the actual distribution is accomplished by watermasters who act under the supervision of the Director. Tuthill, *supra* at 2. Historically, watermasters were only in charge of surface water but in 2002 and 2003 the Director obtained authorization from the Snake River Basin Adjudication District Court to exercise authority over groundwater. *Id*. Since this initial authorization, the Director has established water districts across Eastern Idaho with watermasters responsible for distributing water from the ESPA.

Conjunctive Use Rules

In response to pressure for more administrative action, the Director promulgated Rules for Conjunctive Management of Surface and Ground Water Resources (CM Rules) in 1994. *See* Idaho Admin. Code 37.03.11.001-.999 (2014). The CM Rules provide procedures that govern IDWR's response to a delivery call "made by the holder of a senior-priority surface or ground water right against the holder

Aquifer Recharge

Material Injury

Mitigation Plans

Stored Water Mitigation

Injury Prevention

Agency Discretion

Beneficial Use

Water Quality Regulation

of junior-priority ground water right in an area having a common ground water supply." Idaho Admin. Code 37.03.11.001 (2014). The CM Rules also integrate the administration and use of all surface and groundwater in a manner consistent with the traditional state policies of reasonable use. Idaho Admin. Code 37.03.11.020(03) (2014). The CM Rules provide numerous factors that must be considered to determine whether a senior priority user has actually suffered a material injury from the pumping of a junior-priority groundwater user. *See* Conjunctive Management Rule 42 for the list of factors at: http://adminrules.idaho.gov/rules/current/37/0311.pdf.

While the priority system in Idaho is absolute, the CM Rules make it clear that priority can only be asserted if there is injury to a senior appropriator. "The CM Rules state that the seniors' actual needs and uses, rather than the diversion rate or volume stated on their licenses or decrees, will determine the extent to which they may obtain priority administration against junior ground water users." Jeffrey C. Fereday & Michael C. Creamer, *The Maximum Use Doctrine and Its Relevance to Water Rights Administration in Idaho's Lower Boise River Basin*, 47 Idaho L. Rev. 67, 75 (2010). Also, the CM Rules allow for a mitigation plan, which is very similar to "augmentation" in Colorado (*see* below). Idaho defines a mitigation plan as a "document submitted by the holder(s) of a junior-priority ground water right and approved by the Director as provided in Rule 043 that identifies actions and measures to prevent, or compensate holders of senior-priority water rights for, material injury caused by the diversion and use of water by the holders of junior-priority ground water rights within an area having a common ground water supply." Idaho Admin. Proc. Code 37.03.11.010.15, located at: http://adminrules.idaho.gov/rules/current/37/0311.pdf.

A recent example of the mitigation plan process in Idaho involves a plan submitted by Idaho Ground Water Appropriators, Inc. (IGWA) . The plan generally proposed "supplying water stored in Snake River reservoirs to the Surface Water Coalition" to mitigate for the impact of groundwater pumping on surface water users. *See* "*Order Approving Mitigation Plan*" (*In the Matter of the Idaho Ground Water Appropriators, Inc.'s Mitigation Plan in Response to the Surface Water Coalition's Water Delivery Call*). Although a number of the IGWA's specific conditions were rejected by the Director, the plan itself was approved. The Director took a methodical approach applying the expressly enumerated factors in CM Rule 43.03, regarding what a proposed mitigation plan entails and how to determine whether the plan will prevent injury to senior rights. The Director took issue with IGWA's proposal to supply the mitigation water *after* irrigation season is over. The Director allowed IGWA to rent storage water or acquire an option to rent water *prior* to irrigation season. Overall, this Order supports the over-arching policy goal of full economic development of the state's water resources by increasing the overall beneficial use of the water throughout the state.

The Idaho Supreme Court affords the Director significant discretion when applying the CM rules. For example, in *American Falls Reservoir Dist. No. 2 v. IDWR*, 143 Idaho 862, 154 P.3d 433 (2007), the Court held that the CM Rules are constitutional on their face and that an as-applied challenge was premature prior to the exhaustion of all administrative remedies. The Court found that "somewhere between the absolute right to use a decreed water right and an obligation not to waste it and to protect the public's interest in this valuable commodity, lies an area for the exercise of discretion by the Director." *Id*. at 451. Further, as recently as 2011, the Court again sided with a Director's curtailment decision stating that the Director's use of the "best available science" was within his discretion and within the "legal standards applicable" and an "exercise of reason." *Clear Springs Foods, Inc. v. Spackman*, 252 P.3d 71, 98 (Idaho 2011).

Managed Aquifer Recharge in Idaho

In regard to managed aquifer recharge, the Idaho Legislature has declared that the appropriation and underground storage of water for purposes of groundwater recharge is a beneficial purpose. Idaho Code Ann. § 42-234. This allows IDWR to issue permits for managed aquifer recharge. The Legislature also specified that incidental recharge cannot be used as the basis for a claim of a separate or expanded water right. *Id*. Also, the Legislature gave the Idaho Water Resource Board authority to approve all groundwater recharge projects that exceeded 10,000 acre-feet on an average annual basis. Tuthill, *supra* at 3. In 1997 the Legislature enacted a pilot aquifer recharge program for four counties: Jerome, Lincoln, Gooding and Twin Falls counties. Idaho Code Ann. § 42-4201. As noted above, in 2014 the Legislature passed House Bill 547, directing five million dollars annually from Cigarette Tax revenue to be used for statewide aquifer stabilization.

Water quality in Idaho is regulated by the Idaho Department of Environmental Quality (IDEQ). IDEQ's rulemaking body — the Board of Environmental Quality — created the Ground Water Quality Rules. *See* IDAPA 58.11.01.000. These Rules give IDEQ the power to categorize Idaho aquifers based on: vulnerability of the groundwater; existing and future beneficial uses of the groundwater; existing water quality; and social and economic considerations. IDAPA 58.01.11.150.02. An aquifer can be designated a sensitive, general, or other resource. Sensitive aquifers require the strongest level. Injection wells are regulated by IDWR but recharge through surface spreading is IDEQ's responsibility. When surface waters are put into a surface spreading project with the intent to recharge the underlying aquifer, no permit is

Aquifer Recharge

Wastewater Recharge

"Tax" Crediting

required. *See* www.deq.idaho.gov/water-quality/ground-water/monitoring/managed-recharge.aspx. There is, however, authorization for the IDEQ to monitor groundwater quality under the Wastewater Rules if surface waters are land applied. IDAPA 58.01.16.600. These monitoring plans must include water quality sampling, frequency, and reporting to the IDEQ. *See* www.deq.idaho.gov/water-quality/ground-water/monitoring/managed-recharge.aspx. If the water being used to recharge is wastewater, a DEQ permit is required. IDAPA 58.01.17. Lastly, Idaho also has rules governing drinking water quality that would come into play if managed aquifer activities impact drinking water supplies. IDAPA 58.01.0; *see* http://adminrules.idaho.gov/rules/current/58/0108.pdf .

Overall, Idaho is relatively new to the managed aquifer recharge scene. Idaho does, however, seem to have most of the necessary legislative "pieces" in place. To complete the managed aquifer recharge puzzle, Idaho may need to establish a way to credit any private effort at managed aquifer recharge for the water recharged, minus some unrecoverable amount. Also, Idaho needs to consider whether they want to "tax" crediting of recharged water for the long-term goal of aquifer stabilization, by requiring that a portion of the recharged water be left in the aquifer for aquifer stabilization. Arizona has enacted such a "tax" as part of its program for groundwater recharge credits (see below). As Idaho becomes one of the first states to finish a massive aquifer-wide adjudication (Snake River Basin Adjudication), it seems poised to move on to the daunting challenge of aquifer stabilization in the Eastern Snake River Aquifer.

Colorado

Applicable Colorado Law

"Pure Appropriation" State

While most of early Colorado water law dealt with surface water, over the past half-century Colorado has developed a complex statutory framework to administer its groundwater resources. Indeed, it has been referred to as the "pure appropriation" state because of its free transferability of water rights, integration of surface and groundwater, and active water market/water transfer environment. The Colorado Supreme Court has also proclaimed the maximum utilization of the waters of the state a constitutional water law doctrine. *Fellhauer v. People*, 447 P.2d 986, 994-95 (Colo. 1968).

1965 Act

"Mining" Addressed

In 1965, the Colorado Legislature passed the 1965 Colorado Ground Water Management Act (1965 Act), which was the first major Colorado statute to deal exclusively with groundwater. The 1965 Act focused on areas where the main source of supply was groundwater rather than surface water in order to address the problem of groundwater "mining." The statutory provisions for "designated ground water basins" created designated areas managed by local districts, subject to the jurisdiction of the Ground Water Commission. Colorado Ground Water Management Act of 1965, ch. 319, § 148-18-1, 1965 Colo. Sess. Laws 1246, 1246; codified at Colo. Rev. Stat. §§ 37-90-101 to -143 (1997).

Designated Groundwater Areas

Notably, the 1965 Act provided a procedure for establishing designated groundwater areas within the state. Currently, groundwater may be subject to designation if: 1) groundwater, in its natural course, would not be available to and required for the fulfillment of decreed surface rights; or 2) the groundwater is in an area not adjacent to a continuously flowing natural stream and groundwater withdrawals in that area have constituted the principal source of water for at least 15 years prior to the date of the first hearing on designating that basin. Interestingly, designated groundwater basins are essentially legal-political boundaries and do not always correspond with the hydrologic boundaries of the aquifer. Patrick and Archer (1994) at 143; Colo. Rev. Stat. Ann. § 37-90-103 (2014). According to the Ground Water Commission, designated basins are generally areas in the eastern plains with "very little surface water where users rely primarily on ground water as their source of water supply." *See* http://water.state.co.us/groundwater/CGWC/Pages/default.aspx.

Management Districts

Once a basin is designated, resident tax-paying electors have the option to petition the Ground Water Commission to conduct an election on whether to form a groundwater management district, which is a quasi-municipal corporation akin to a water and sanitation district. These districts have the power to tax, regulate, research, and administer the designated groundwater. Currently, there are eight designated basins, with thirteen Ground Water Management Districts within those basins. *See* http://water.state.co.us/groundwater/CGWC/Pages/ManagementDistricts.aspx.

"Tributary" & "Non-Tributary" Distinction

Colorado also distinguishes between tributary and non-tributary groundwater basins. Groundwater is tributary to surface water if its withdrawal would "within one hundred years, deplete the flow of a natural stream…at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal." Colo. Rev. Stat. Ann. § 37-90-103 (2014). All other non-designated groundwater is considered non-tributary, except the Denver Basin which is an exception to the exception. *See Synopsis of Colorado Water Law*, Colorado Division of Water Resources (2011). If there is not a sufficient scientific or factual understanding of groundwater to meet the tributary definition, Colorado presumes that all groundwater is tributary to surface water. However, water users who believe otherwise may rebut this presumption. *See Synopsis of Colorado Water Law*, for further explanations regarding the myriad terms of art in Colorado water law.

Aquifer Recharge

Denver Basin

The Denver Basin Aquifer System is a complicated story beyond the scope of this article. Briefly, the Denver Basin is composed of deep groundwater located within the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers. Groundwater from these four bedrock aquifers is allocated to overlying landowners at a rate of one percent per year, assuming a one-hundred year life of the aquifer. *See Citizen's Guide to Colorado Water Law*, Colorado Foundation for Water Education (2004), page 11. For those interested in a more detailed breakdown of the unique complexities of the Denver Basin aquifer system, please see http://water.state.co.us/groundwater/GWAdmin/DenverBasin/Pages/DenverBasin.aspx.

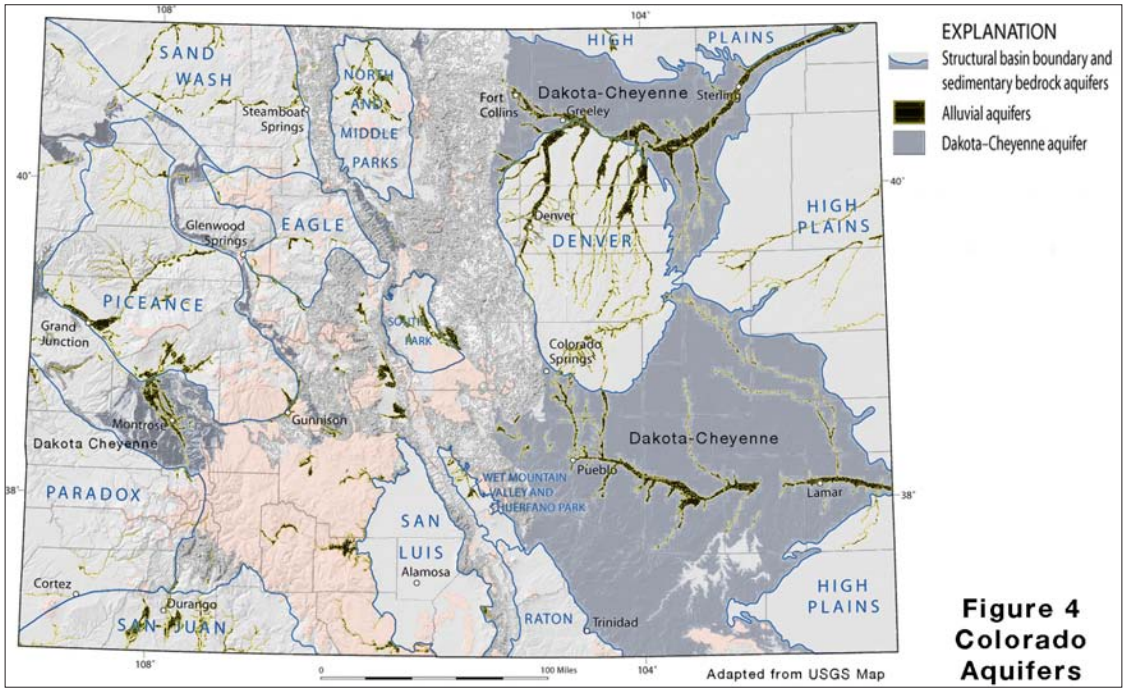


Figure 4 Colorado Aquifers

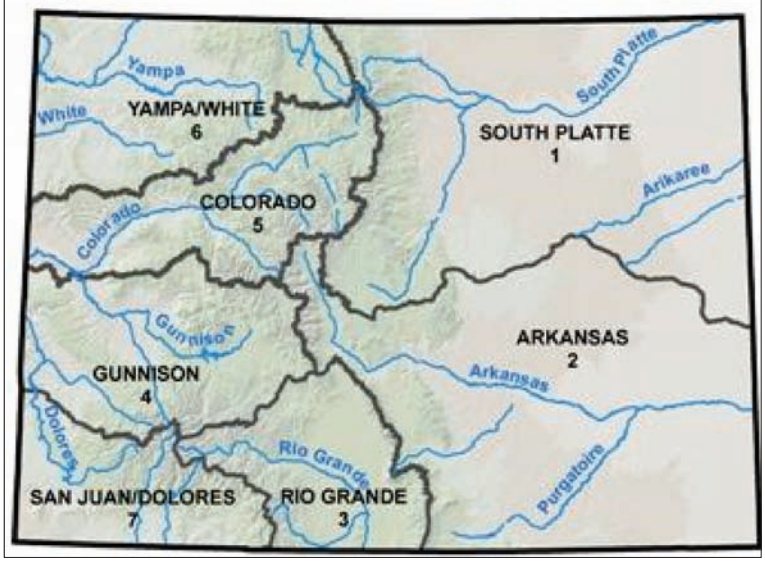
Water Courts

In contrast to most western states that use a water right permit system, Colorado courts play a central role in the administration of Colorado groundwater. Water courts "have jurisdiction over all water right decree applications for surface water, tributary groundwater, nontributary [groundwater], Denver Basin groundwater outside of designated groundwater basins, and geothermal resources." The water courts also have jurisdiction to review cases where the state engineers refused to enforce a call placed on junior users. *Citizen's Guide*, *supra* at 12. Any appeal of a water court decision goes directly to the Colorado Supreme Court. *Id*. Currently, there are seven different water courts across Colorado that were created based upon the drainage patterns of the rivers in Colorado. Water Courts, Colorado Judicial Branch website at: www.courts.state.co.us/Courts/Water/Index.cfm.

Commission

Meanwhile, for designated groundwater basins, the Colorado Ground Water Commission is the regulatory and permitting agency. It manages and controls the groundwater resources in designated basins. The Commission has the authority to hold rulemaking and court hearings. Commission decisions on cases by the Commission are then subject to judicial review by the District Court for the county where the water right is located. *See* the Commission's website at: www.water.state.co.us/cgwc.

Figure 5: Colorado Water Court Jurisdictions



Similar to many other western states, Colorado requires well owners, who make out-of-priority diversions that interfere with senior users, to substitute their depletions with an approved substitute supply or augmentation plan. Substitution plans are short-term plans that are approved by the State Engineer and usually take place within the course of yearly administration. An augmentation plan, on the other hand, is a court-approved plan, which is designed to protect existing water rights by replacing water used in a new project. The augmentation plan must be approved by the water court prior to the new water use. *See Guide to Colorado Well Permits, Water Rights, and Water Administration, Sept. 2012* (Citizen's Guide), pages 12-13 at: http://water.state.co.us/DWRIPub/Documents/wellpermitguide.pdf. It is important that the replacement water meet the needs of the senior water

Aquifer Recharge

Augmentation Plan

Water Market

Water Quality Policy

Augmentation Recharge

Recharge Credits

Groundwater Regulation Lacking

Surface Water v. Groundwater

rights holders at the time, place, quantity, and quality that they would otherwise enjoy absent the out-of-priority diversions. Citizen's Guide, *supra* at 16. An augmentation plan must identify the structures, diversions, beneficial uses, timing, and amount of depletion to be replaced, along with how and when the replacement water will be supplied and how the augmentation plan will be operated. *Id*.

Colorado treats water rights as real property rights and thus allows water rights to be conveyed by deed. As a real property right, the water right is another "stick in the bundle," that may be severed from the land, and bought and sold. Carolyn F. Burr et. al., *Water: The Fuel for Colorado Energy*, 15 U. Denver Water L. Rev. 275, 280 (2012). This has created a well-developed market for water rights in Colorado. This is good news for junior appropriators because it allows them to acquire sufficient water rights for new developments, even in an over-appropriated basin. However, the cost of purchasing the rights, changing them through the water court application process, and dealing with the local regulatory agency can be quite high, and at times impracticable. *Id*. at 280.

In regard to water quality, the Colorado Water Quality Control Act states that it is the policy of Colorado to: "conserve state waters and to protect, maintain, and improve, where necessary and reasonable, the quality thereof for public water supplies, for protection and propagation of wildlife and aquatic life, for domestic, agricultural, industrial and recreational uses, and for other beneficial uses, taking into consideration the requirements of such uses;...[and] to provide for the prevention, abatement, and control of new or existing water pollution... ." C.R.S. §25-8-102. This Act also created the Water Quality Control Commission, which is charged with maintaining a comprehensive and effective program for prevention, control, and abatement of water pollution and to ensure the conveyance of safe drinking water by public water systems. The complete text of the Colorado Water Quality Control Act is available at: www.colorado.gov/pacific/sites/default/files/T1_WQCC_Colorado-Water-Quality-Control-Act_2013.pdf.

Managed Aquifer Recharge in Colorado

Colorado currently has numerous decreed augmentation plans that use managed aquifer recharge as a court-approved substitute supply. For example, in the South Platte River basin, mutual ditch companies, irrigation districts, farmers, and other entities have developed managed aquifer recharge projects to replace water that is taken out-of-priority by well pumping. These projects involve the use of unlined irrigation ditches and surface spreading ponds that are filled during times of excess to recharge the groundwater aquifers that slowly feed back to the South Platte River. Citizen's Guide, *supra* at 16. Often the recharge locations are specifically situated and managed in such a way that the bulk of the recharged water often returns to the river during the peak demand times, thus allowing out-of-priority wells to continue pumping when otherwise they would have been shut down. William Blomquist, Tanya Heikkila & Edella Schlager, *Institutions and Conjunctive Water Management Among Three Western States*, 41 Nat. Resources J. 653, 679 (2001). These different entities receive credits for the water recharged and, furthermore, any water in excess of what is needed to cover the out-of-priority well pumping may be transferred and sold. *Id*. This market approach allows individual water rights holders to engage in managed aquifer recharge with the expectation that they will receive the full benefits. Moreover, allowing the buying and selling of these recharge credits helps utilize all of the water of the state, both surface and ground, in accordance with the constitutional mandate of maximum utilization.

While Colorado's water court system is complex, it incorporates a surprising amount of flexibility and continues to adapt to the state's ever-increasing water demands.

California

California is dependent upon a massive and intricate system of state and federal waterworks that store and transport water for use throughout the state. California leads the US in groundwater pumping, taking eleven billion gallons of water from the ground each day — which is more than 13% of total US groundwater extraction. Most of the groundwater withdrawals are used for irrigation and domestic supply. Peculiarly, California is one of only two western states that do not have state-level groundwater regulation, with Texas being the other. John Hedges*, Currents in California Water Law: The Push to Integrate Groundwater and Surface Water Management Through the Courts*, 14 U. Denver Water L. Rev. 375, 377 (2011).

Applicable California Law

Uniquely, California differentiates between "surface water" — which for water rights purposes includes both surface streams and subterranean streams — and percolating groundwater. Ruth Langridge, *Confronting Drought: Water Supply Planning and the Establishment of A Strategic Groundwater Reserve*, 12 U. Denver Water L. Rev. 295, 303 (2009). Surface waters are subject to state-level permitting and regulation under the riparian and appropriative doctrines while groundwater — defined as "percolating groundwater" — is not subject to permitting by any state agency. Hedges*, supra* at 380. Consequently, the regulation of California's percolating groundwater has been left largely to local governments and the courts. Cal. Water Code Ann. § 1200 (2014).

Aquifer Recharge

"Reasonable & Beneficial Use"

California's constitution, however, does proclaim that "the water resources of the State be put to *beneficial use* to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the *reasonable and beneficial use* thereof in the interest of the people and for the public welfare." Cal. Const. art. X, § 2 (emphasis added). This "reasonable and beneficial standard" overlies all local regulations. The California Supreme Court held that this requirement applied to all water in the state, including groundwater, in *Joslin v. Marin Mun. Water Dist.,* 429 P. 2d 889, 893 (Cal. 1967).

Public Trust Doctrine

The California Supreme Court has also declared that all water rights are merely usufructory and thus only confer the right to use the water, not the actual private ownership of the water. *Nat'l Audubon Soc'y v. Superior Court of Alpine County*, 658 P.2d 709, 724 (Cal. 1983). In that same case, the Court applied the Public Trust Doctrine and proclaimed that "the state has an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible." *Id.* at 728. Thus, while California generally confers the power to regulate groundwater to local governments, it retains authority under the Public Trust Doctrine and the constitutional requirement of "reasonable and beneficial use" to regulate some groundwater pumping. An example of the curtailment of groundwater pumping is pumping that may adversely affect surface instream benefits, i.e, fish populations and riparian values. Landridge, *supra* at 313.

Correlative Rights

With regard to percolating groundwater, California follows a dual system of rules. The statutory differentiation arises based on who is using the water — i.e., whether it be the overlying landowner or an exporter. California was the first state to adopt a system of "correlative" rights with regard to groundwater for overlying landowners. Joseph W. Delapenna, *Quantitative Groundwater Law,* 4 Waters and Water Rights § 21.03 (Robert E. Beck & Amy K. Kelley, eds., 3rd ed. 2010). This doctrine gives owners of land overlying a groundwater basin equal rights to the groundwater. This is, of course, subject to California's "reasonable and beneficial" use requirement and therefore requires all owners to cut back their use in times of shortage. Hedges, *supra* at 380. During drought years, overlying landowners must share in the shortages equally as no correlative right is greater than another. Any use of groundwater on land that does not overly the source, however, is subject to appropriative priority rights, and groundwater exporters must yield to overlying users during water shortages. *Id*. In other words, groundwater exporters follow the appropriative doctrine of "first in time, first in right" and are limited to water that overlying landowners do not need. During times of shortage, correlative rights are more valuable than an appropriative right because the shortage is, at most, shared with other landowners, while the appropriative right of an exporter can be curtailed in full.

Groundwater Exporters

Conserved Water

To incentivize the use or sale of conserved water, California's Water Code allows conserved water to be transferred and its purpose of use, place or use, and point of diversion changed, just like any other water right. *Id*. "Water, or the right to the use of water, the use of which has ceased or been reduced as the result of water conservation efforts as described in subdivision (a), may be sold, leased, exchanged, or otherwise transferred pursuant to any provision of law relating to the transfer of water or water rights, including, but not limited to, provisions of law governing any change in point of diversion, place of use, and purpose of use due to the transfer." Cal. Water Code §1011(b).

Temporary Changes

In order to make water supply more responsive to demand across the state, California set deadlines for its State Water Resource Control Board for temporary water right changes, i.e. those that last for one year or less. Under this statute, the State Water Resource Control Board must review petitions within ten days of receiving them and make a final decision whether the change would harm another user within 35 days. Cal. Water Code §1726. This accelerated process has made for a more responsive usage of water and has aided the state in water short years.

Conveyance Facilities

California also protects against third parties delaying transfer of water rights. In a 1986 statute, the legislature prohibited state, regional, or local agencies from denying the transfer of water through conveyance facilities that have unused capacity, so long as fair compensation is paid for that use. Cal. Water Code Ann. § 1810. This legislation has resulted in the number of buyers and sellers with access to one another to dramatically increase as conveyance methods that were once "off the market" are now available to be used in water transfers. This allows water transfers to occur over much greater distances, between numerous differing parties, while guaranteeing the maximum viable usage of the water resource infrastructure.

Local Management

Adding to the complexity of California groundwater is the fact that city and county governments manage the vast majority of the basins and the regulations vary across the state. California is considered the "great exception" in the western US because it has continued to promote local management of aquifers. Currently, approximately twenty-eight out of fifty-six counties, overlying the majority of California's groundwater resources, have enacted some kind of groundwater regulation. Hedges, *supra* at 381.

California courts have also recognized the concept that local control of groundwater is clearly California law. In *Baldwin v. County of Tehama* 36 Cal. Rptr. 2d 886, 888 (Cal. App. 3d Dist. 1994),

Aquifer Recharge

State v. Local Control

Regulatory Complexity

Recharge "Beneficial"

Local Control

Pending Sustainability Legislation

a landowner in Tehama claimed that a county ordinance that regulated the pumping practices and uses of groundwater was preempted by "provisions of the [State] Water Code and uncodified statutes concerning water use." The question before the court was whether a county is precluded from the regulation of groundwater because state law has preempted the field. The court held that state law, "while regulating aspects of groundwater, does not wholly preclude county regulation" and that local governments may regulate groundwater through their inherent police power. *Id*. Similar to the ordinance at controversy in *Tehama*, the majority of local ordinances in California focus on efforts to discourage, or altogether preclude, groundwater export to outside users. *An Overview of California Groundwater Law & Management*, 2011 Water Quality Coordinating Committee, Prof. Richard Frank (2011) at: www.waterboards.ca.gov/board_reference/2011fall/frank_wqcc_gw2011.pdf.

The complexity of groundwater regulation throughout California has led to efforts for comprehensive statewide legislation concerning California's groundwater resource. A comprehensive and consistent reporting of the exact amounts of groundwater extraction, coupled with local agency regulation subject to statewide standards set by the State Water Resource Control Board (SWRCB), is needed to reduce groundwater contamination, overdraft, and saltwater intrusion, according to Professor Richard Frank. *Id*. California has been taking small steps in statewide administration of groundwater monitoring. For example, in 2009 the Legislature amended the state Water Code and created a monitoring program to track trends in groundwater elevations and groundwater quality in California's groundwater basins. It was the intent of the Legislature to establish a groundwater monitoring program that included significant cooperation with local groundwater monitoring entities to provide the information to the public. *See* www.water.ca.gov/groundwater/casgem/.

Managed Aquifer Recharge in California

California considers managed aquifer recharge a "beneficial use" so long as the water is subsequently recovered and put to the beneficial use for which it was being stored. Cal. Water Code §1242. Users are given ten years to pump the stored water for use but a different deadline may be allowed if applied for under the storage permit. Adam Schempp, *Western Water in the 21st Century: Policies and Programs That Stretch Supplies in A Prior Appropriation World*, 40 Envtl. L. Rep. News & Analysis 10394, 10404 (2010).

While the groundwater monitoring program mentioned above is a step towards statewide administration of groundwater, local control over groundwater is not likely to disappear anytime soon. In fact, California recently provided financial incentives to local agencies for the acquisition and construction of groundwater recharge facilities. More than $120 million was awarded in grants and loans to local agencies in the first two years of the Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act of 2000 (Proposition 13). Cal. Water Code §§ 79161, 79171. The Local Groundwater Management Assistance Act of 2000 provided more than $15 million to local agencies for seventy-one different groundwater projects. Cal. Water Code §10795. In the 2013-14 regular session, the California Legislature passed AB 1739, which deals directly with groundwater basin management across the state. AB 1739 requires a "sustainable groundwater management plan to be adopted…for each high or medium priority groundwater basin by any [local] groundwater management." This bill requires all local agencies to meet certain requirements in order to "achieve sustainable groundwater management in the ground water basin within 20 years of the implantation of the plan." *See* www.leginfo.ca.gov/pub/13-14/bill/asm/ab_1701-1750/ab_1739_bill_20140422_amended_asm_v98.pdf. As noted above, the three-bill package which includes AB 1739 is awaiting Governor Brown's signature (see sidebar, below).

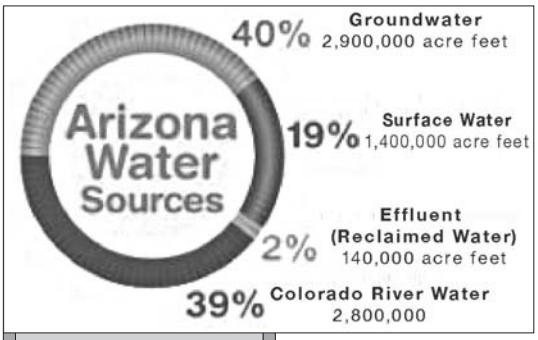
Overall, California has one of the most complex and unique approaches to managing and administering groundwater in the western US. Its combination of correlative and appropriative rights creates complexity that even experts constantly aim to decipher. In order to promote continuity and stability across the state, many people are calling for a legislative takeover of all groundwater management. While a statewide annexation of groundwater management is unlikely to occur in the near future, California continues to remain a very active participant in managed groundwater recharge and an example of how local entities can help, as well as hinder, managed aquifer recharge.

Pending California Groundwater Legislation

A three bill package that would significantly change groundwater management in California passed the California Legislature on August 29 and has been sent to Governor Jerry Brown for his signature. SB 1168 (Pavley), AB 1739 (Dickison), and SB 1319 (Pavley) are the three bills awaiting signature. The bills would initiate groundwater sustainability planning and programs for California's most critical basins. The bill package would create a framework for local and regional groundwater management — providing for the creation of local and regional groundwater sustainability agencies throughout the state. The bills focus on high priority basins which are in the most critical overdraft.

For info:

Bills available at: www.legislature.ca.gov/the_state_legislature/bill_information/bill_information.html



Arizona

Throughout the 1900's groundwater pumping became exceedingly prevalent across Arizona, resulting in the overdraft of aquifers across the state. While increased groundwater pumping was not exclusive to Arizona, its unique arid climate and increasing population made groundwater usage more extensive than some other western states. In fact, in some basins the amount of water pumped from aquifers exceeded its natural recharge by a factor of three or more. *Layperson's Guide to Arizona Water*, Water Education Foundation & Arizona Water Resources Research Center (2007), page 13. Over time, the need for regulated management and statewide control has grown.

Aquifer Recharge

Applicable Arizona Law

Statewide groundwater administration has been occurring in Arizona for decades. Arizona water law has its roots in the Prior Appropriation Doctrine and the judicially decreed "beneficial use" doctrine.

> Until the enactment of the Arizona Groundwater Management Act of 1980, landowners were at liberty to freely pump groundwater from above land that was being put to a "beneficial use." The Groundwater Management Act was a monumental occurrence in the history of Arizona water law, preserving certain rights of active users before its enactment and placing restrictions and use limitations for new groundwater users…Groundwater pumping is now governed by the reasonable use doctrine, which permits overlying landowners to obtain as much groundwater as can be "reasonably" used for the land. This subsequently relieves these landowners from liability when another user's supply is diminished as a result of such pumping. Unfortunately, the lacking oversight and determination of what constitutes "reasonable," as an always ambiguous term in the law, contributes significantly to the depletion of water resources.

Allison Evans, *The Groundwater/Surface Water Dilemma in Arizona: A Look Back and A Look Ahead Towards Conjunctive Management Reform*, 3 Phoenix L. Rev. 269, 278 (2010) (footnotes omitted).

"Reasonable" Use

1980 Act (Code)

Years of work by various entities, led to the 1980 Arizona Groundwater Management Act. *Id*. The 1980 Act, commonly referred to as the Arizona Groundwater Management Code (Code), significantly changed groundwater law in Arizona and laid the foundation for managing Arizona's water resource in a clear, logical, and coherent way. It is still considered one of the most innovative and effective strategies for managing groundwater in the US. In fact, the Ford Foundation recognized the Code as one of the "10 most innovative programs in state and local government."

Policy Goals

The three goals of the Arizona Groundwater Management Code were to:

1) control severe overdraft occurring in many parts of the state
2) provide a means to allocate the state's limited groundwater resources to most effectively meet changing needs
3) augment Arizona's groundwater through water supply development

"AMAs"

In order to achieve these lofty goals, the Code established a number of significant provisions. Initially, the Code created the Arizona Department of Water Resources (ADWR), which is in charge of administering the Code statewide. Kenneth A. Hodson & Maxine Becker, *The Constitutionality of Intrastate Ground Water Management: Arizona-A Case Study*, 49 Ariz. L. Rev. 385, 390 (2007). Additionally, the Code designated many overdrafted basins as Active Management Areas (AMAs). With almost eighty-five percent of Arizona's population residing within one of the five different AMAs, most of Arizona's population had their water rights significantly affected by the Code. *Layperson's Guide*, *supra*.

"Safe-Yield"

Having an area designated an AMA imposes significant restrictions and regulation on the use of groundwater within those areas. Ariz. Rev. Stat. Ann. §§ 45-561 to -578 (2014). Among other provisions, the Code requires ADWR to adopt and enforce management plans that are designed to implement rigorous conservation efforts for each AMA. These plans are to help the AMAs reach a "safe-yield" by 2025. Hodson, *supra* at 392. "Safe-yield" is defined in the Code as "a groundwater management goal which attempts to achieve and thereafter maintain a long-term balance between the amount of groundwater withdrawn in an [AMA] and the annual amount of natural and artificial recharge in the [AMA]." A.R.S. § 45-561(12). Essentially, the Code required conservation by agricultural, industrial, and municipal users in AMAs and a reduction in overdraft of the aquifer. *Layperson's Guide*, *supra*.

100 Year Supply Assurance

The Code provides that, under the Assured Water Supply Program, a proposed development must verify that it has secured enough water, of sufficient quality, to meet the needs of the new residents for 100 years. In the exact words of the Code, the water must be "physically, continuously and legally available for one-hundred years." On top of that, the Assured Water Supply Program also requires developers to show

Aquifer Recharge

Outside AMAs

the financial capability to construct the necessary water systems for such a supply. Patrick & Archer (1994) at 139. While these requirements have created an impediment for some developers, the program has, indeed, created an assured water supply for the Arizona people.

Outside of AMAs, Arizona's groundwater management is far less regulated, even being described as minimal. The only material restriction outside of AMAs, provided by the Code, is the restriction on transportation of groundwater between different sub-basins. Hodson, *supra* at 394. In general, groundwater may be pumped and withdrawn but only if used reasonably and for a beneficial purpose, similar to surface water. Evans, *supra* at 279. A lack of regulatory uniformity clearly exists between the AMAs and rural areas, which adds uncertainty to numerous statewide water transactions. This often leads to increased legal fees due to the complexity of many intrastate transactions.

Water Quality Discharge Permits

With regard to water quality, the Arizona Department of Environmental Quality requires any person who discharges or who owns or operates a facility that "discharges" to obtain an aquifer protection permit from the agency's Director. The list of "discharge" facilities include underground water storage facilities, injection wells, and surface impoundments. Ariz. Rev. Stat. Ann. § 49-241 (2014). There are some exemptions listed under Arizona Statute §49-250.

Specific Groundwater Recharge Statutes

Recharge Credits

Arizona created its first groundwater recharge statutes in 1986 with the passage of the Underground Water Storage, Savings and Replenishment Program (UWSP), Act effective April 25, 1994, 1994 Ariz. Sess. Laws, ch. 291, § 32 (codified at Ariz. Rev. Stat. Ann. §§ 45-801.04 to -898.01). The main goal of the UWSP was to create a "flexible and effective regulatory program for underground storage." Ariz. Rev. Stat. Ann. § 45-801.01. This occurred through the creation of "long-term storage credits" that must be stored for more than a year and may be recovered in the future to be used for number of reasons, including "establishing an assured water supply or fulfilling replenishment obligations." *See* Ariz. Rev. Stat. Ann. § 45-853.01.

Source Water Character

Recharged water maintains the legal character of the original source water. Stored water is usually eligible for long-term storage credits when: 1) the water cannot reasonably be used directly; 2) the water was not recovered on an annual basis; and 3) the water would not have been naturally recharged within an AMA. Ariz. Rev. Stat. Ann. § 45-852.01(B). Recharged water also maintains the legal character of the original source water, regardless of where it is recovered or how it is used. Thus, if Central Arizona Project (CAP) water is stored, no matter where recovery occurs the water is considered to be CAP water when recovered and it may be used in any way that CAP water could be used. Ariz. Rev. Stat. Ann. § 45-832.01(A).

CAP Recharge Projects

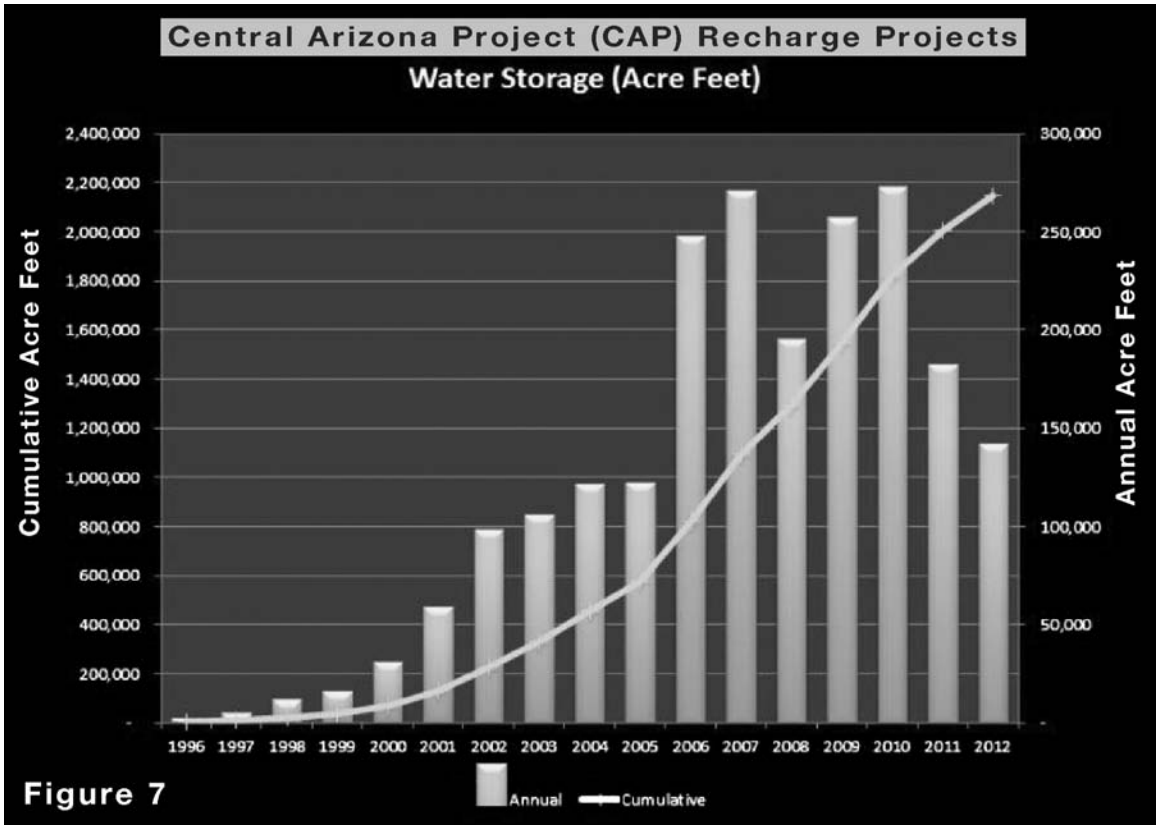


Figure 7

Aquifer Recharge

"Cut" Tax

Under certain permitted recharge activities, the UWSP requires that a percentage of the recharge water be made non-recoverable, as a "general benefit" to the aquifer. This is commonly referred to as a "cut" and can be conceptualized as a tax for the general welfare of the aquifer. Currently, the cut to the aquifer required for long-term storage credits is five percent. Also, cuts do not apply to water that is stored and recovered annually, but is only required for long-term storage credits. A.R.S. § 45-852.01; *see* Recharge Credits and Accounting (ADWR) at: www.azwater.gov/azdwr/WaterManagement/Recharge/RechargeCreditsandAccounting.htm; and Water Management, Basic Terminology at: www.azwater.gov/AzDWR/WaterManagement/Recharge/BasicRechargeTerminology.htm.

There are, however, proposals to modify the percentage of the cut. These proposals are being analyzed by ADWR.

Alternative "Cuts" Proposed

Under these proposals, cut percentages could be determined relative to:

- the distance from the recharge facility
- boundaries of the groundwater savings facilities
- whether the water was recovered from a different sub basin
- whether the recharged water would "uniquely benefit" the aquifer

See ADWR Enhanced Aquifer Management (Alternative Cuts to the Aquifer) Proposal at: *www.azwater.gov/azdwr/WaterManagement/AMAs/EnhancedAquiferManagementStakeholderGroup.htm*

Managed Aquifer Recharge in Arizona

Colorado River Water

Large-scale artificial recharge projects, formed by both public and private entities, have been used in Arizona for decades to recharge groundwater across the state. On the public level, Arizona created a number of statewide agencies to, in large part, use all of its water guaranteed under the Colorado River Compact, as apportioned by Congress. (*See Arizona v. California*, 376 U.S. 340 (1963) for a detailed breakdown of the interstate apportionment of the Colorado River). For example, the Arizona Water Banking Authority (AWBA) was created because Arizona was not using all of its original allocation of the Colorado River. *See* Ariz. Rev. Stat. Ann. § 45-2401. The AWBA pays the delivery and storage costs to bring excess Colorado River water to recharge and storage facilities operated by municipalities, water companies, and other entities, which recharge the water for long-term storage. Hodson, *supra* at 393. These differing entities are given long-term storage credits for the water they recharge and are allowed to use them on the open water market. Underground Water Storage, Savings and Replenishment Program Act effective April 25, 1994, 1994 Ariz. Sess. Laws, ch. 291, § 32 (codified at Ariz. Rev. Stat. Ann. §§ 45-801.04 to -898.01). The AWBA also contracts with the States of Nevada and California to store some of their apportionments of the Colorado River. Hodson, *supra*. The water utilized by the AWBA comes for use of the Central Arizona Project (CAP). CAP has also created a number of different recharge project across the state.

Recharge Projects

On the private side, numerous companies have brokered multi-million dollar water deals throughout Arizona. Some market consultants predict that Arizona will see more water privatization in the future. *See* Verde River Basin Partnership's website at: http://vrbp.org/uncategorized/trading-water/. Companies such as Vidler Water Company (Vidler) have been integrating themselves into Arizona's water system for years. Vidler was the first private company to reach an agreement with the AWBA for underground storage. Vidler has a recharge facility outside Phoenix that can store up to a one million acre-feet of CAP water. *Id*. According to their website, Vidler has stored approximately 250,000 acre-feet of water in that facility. Add this to the approximately 157,000 acre-feet stored in five sites in Phoenix and Vidler clearly has a large water supply as its disposal. Given the increasing demand for water in Arizona, the value of their stored water is also increasing as time goes by. Vidler is a good example of a profitable company that also works in close connection with numerous public entities, such as AWBA and CAP, to provide much needed water across Arizona.

Storage Privatization

Arizona is leading the western US in managed aquifer recharge in many different aspects. Due in large part to the unique conditions of its population growth and minimal precipitation, it was imperative for Arizona's future to utilize most of its apportionment of the Colorado River. Therefore, in order to not let any water be lost, Arizona incentivizes public and private entities to recharge water across the state through a stable and reliable set of statutory guidelines. Using aquifers for storage has allowed continued growth throughout Arizona, even with the stringent 100-year supply requirement. As noted above, Arizona has numerous examples of successfully managed aquifer recharge projects, in both the public and private sectors. *See* ADWR summary at: www.azwater.gov/AzDWR/WaterManagement/Recharge/documents/2013LTSASummary_08.7.2014.pdf. Arizona also continues to discuss and improve their groundwater management system through mandated management plans. Other western states would do well to undertake a detailed examination of Arizona groundwater recharge laws.

Aquifer Recharge Leader

Aquifer Recharge

CONCLUSION

The complexities of the technical aspects of groundwater and groundwater recharge have led to different approaches in the western states, in addition to each state's development of the law as it relates to groundwater use. Comparing the four states to one another, in addition to looking at approaches utilized by one's own state, is instructive as we move toward sustainable and reasonable use of the groundwater resources we all rely on.

Building on the background information presented in this article, a future issue of *The Water Report* will examine the legal aspects of groundwater recharge in the western United States and how practitioners deal with the legal requirements. A third article will then discuss utilizing public/private partnerships for groundwater recharge projects and their potential for implementation.

The author would like to acknowledge and thank Dave Tuthill and Phil Rassier of Idaho Water Engineering (Boise, ID) and Professor Barbara Cosens of the University of Idaho's College of Law for their guidance and contributions in helping to produce this article.

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References:

Technical Aspects
- *Aquifer Recharge and Aquifer Storage and Recovery Wells,* EPA (1999) at: http://water.epa.gov/type/groundwater/uic/class5/upload/2007_12_12_uic_class5_study_uic-class5_classvstudy_volume21-aquiferrecharge.pdf.
- *Artificial Recharge of Groundwater,* United Nations Environment Programme at: www.unep.or.jp/ietc/publications/techpublications/techpub-8e/artificial.asp .
- *A Survey of Methods for Groundwater Recharge in Arid and Semi-arid Regions*, United Nations Environment Programme (2002) at: www.unep.org/PDF/groundwaterrecharge.pdf

State Comparisons

Idaho
- *Groundwater Management in the West*, Jeffrey S. Ashley and Zachary Alden Smith (1999)
- Jennifer M. Carlquist, *Conjunctive Management: A New Battle of Priority in Idaho Water Law*, 45 Idaho L. Rev. 143, 147 (2008)

Colorado
- Kevin L. Patrick & Kelly E. Archer, *A Comparison of State Groundwater Laws*, 30 Tulsa L.J. 123, 124 (1994)
- Ari J. Stiller-Shulman, *No Seat at the Water Table: Colorado's New Groundwater Basin Statute Leaves Senior Surface Rights in the Lurch*, 84 U. Colo. L. Rev. 819, 828 (2013)
- David Harrison, Veronica A. Sperling & Steven O. Sims, *Intro to Ground Water Law in Colorado and Surface-Groundwater Conflicts in the South Platte*, in Groundwater in the West (NRLC, Univ. of Colo. Sch. of Law, 2004)
- Barton H. Thompson, Jr., *Beyond Connections: Pursuing Multidimensional Conjunctive Management*, 47 Idaho L. Rev. 265, 274 (2011)
- *Colorado Water Law: An Historical Overview*, Justice Gregory J. Hobbs, 1 U. Denver Water L. Rev. 1, 21 (1997)
- William Blomquist, Tanya Heikkila & Edella Schlager, *Institutions and Conjunctive Water Management Among Three Western States*, 41 Nat. Resources J. 653, 682 (2001).

California
- Groundwater Information Center, California Dept. of Water Resources at: www.water.ca.gov/groundwater/
- Adjudicated Groundwater Basins (2011) at: www.water.ca.gov/pubs/groundwater/adjudicated_ground_water_basins_in_california__water_facts_3_/water_fact_3_7.11.pdf

Arizona
- "*History of Water Management in Arizona*" at: www.azwater.gov/AzDWR/PublicInformationOfficer/history.htm
- *Layperson's Guide to Arizona Water*, Water Education Foundation & Arizona Water Resources Research Center (2007) at www.arizonawine.org/Docs/Layperson'sGuidetoArizonaWater.pdf
- Arizona's Ground Water Management Code (Code) at: www.azwater.gov/AzDWR/WaterManagement/documents/Groundwater_Code.pdf
- Enhanced Aquifer Managemnt*: see* www.azwater.gov/AZDWR/Watermanagement/AMAs/documents/EnhancedAquiferManagement.pdf.
- Vidler Water Company website: www.vidlerwater.com/html/recharge_storage_facility.html
- Aquifer Protection Permit: www.azdeq.gov/environ/water/permits/app.html#exempt_

Contract Breach

"Expectancy" Damages

"Cover" Damages

Damages Standard

Contract Amounts

Fishery Requirements

Breach Allegation

Minimum Allocation

FEDERAL BREACH OF CONTRACT

RECLAMATION LOSES APPEAL ON BREACH OF CONTRACT CLAIM

by David Moon, Editor

Introduction

A California irrigation district has won a significant victory against the United States, which could result in millions of dollars in damages. On August 1, the US Court of Appeals for the Federal Circuit (Court of Appeals) ruled in favor of Central San Joaquin Water Conservation District (Central) in its breach of contract claims against the US Bureau of Reclamation (Reclamation). *Stockton East Water District, et al. v. United States*, No. 2013-5078, 2014 U.S. App. LEXIS 14764 (Fed. Cir. Aug. 1, 2014). The Court of Appeals held that the trial court should determine the amount of "expectancy damages" Central is entitled to recover.

The Court of Appeals also affirmed the trial court's award of $149,950 for "cover damages" to Central. Those damages are for the cost Central incurred to obtain water, being "the difference between the total amount Central paid to SSJID [South San Joaquin Irrigation District] for water and the total amount Central would have paid to Reclamation for the water in 2002–2004." *Id*. at 9.

Based on this decision, Reclamation could be compelled to pay substantial damages to Central for the breach-of-contract "expectancy damages" due to its failure to deliver water to Central from New Melones Reservoir. The case was remanded to the trial court (US Court of Federal Claims) for a determination of the "expectancy damages" in accordance with the decision. "To analyze expectancy damages one looks at what would have happened 'had the contract been performed.' Restatement (Second) of Contracts §344(a);" *Id*. at 14 (other citations omitted).

Background

Central entered into a contract with Reclamation in 1983 for water stored in the New Melones Reservoir, which is part of the Central Valley Project. New Melones Reservoir, located in California's San Joaquin Valley, is the main source of surface water for Central.

Central's contract "was intended, following a ten-year buildup period, to make available to Central a maximum of 80,000 acre-feet and a minimum of 56,000 acre-feet of surface water per year from the New Melones Unit of the Central Valley Project ('CVP')…The water was to be used to support agricultural enterprise in the San Joaquin Valley. Under the contract, Central would submit a schedule each year indicating the amounts of water required monthly, with the first schedule to be submitted two months prior to the initial delivery of water." *Id*. at 4.

In 1992, Congress enacted the Central Valley Project Improvement Act (CVPIA), "which imposed on Reclamation a new requirement to dedicate annually 800,000 acre-feet of water from the CVP for fish, wildlife, and habitat restoration needs. …In the spring of 1993, in a meeting with the Districts, Reclamation made it clear that 'this prescription [under the CVPIA] would continue and in only the wettest years might [the Districts] see some water.'"*Id*. at 5 (citations omitted). Following that announcement, Central sued the US for injunctive and declaratory relief, plus damages, thus starting this lengthy litigation. Central asserted that the reallocation of water for fish protection purposes left little or no water to satisfy its contractual obligations and was therefore a breach by Reclamation of the contract. The case was eventually transferred from federal district court to the Court of Federal Claims, with a trial on liability held in 2006.

Eventually, the Court of Appeals heard an appeal on the breach of contract claims and reversed the trial court, finding that breaches had occurred in certain years and remanding the proceedings to the trial court for a determination of damages. *Stockton E. Water Dist. v. United States*, 583 F.3d 1344 (Fed. Cir. 2009), reh'g en banc granted in part, aff'd, 638 F.3d 781. The trial court on remand awarded Central $149,950 for the cost of cover damages, but denied any expectancy damages.

Stockton East Water District (Stockton East) is named in the title of the case because Stockton East also entered into a contract with Reclamation for storage water from New Melones Reservoir in 1983. *Stockton E. Water Dist. v. United States*, 109 Fed. Cl. 460, 464 (2013). Stockton East's damages trial proceeded separately and the trial court issued a separate opinion regarding it's contract damages. *Id*. at 465.

Addressing the water actually delivered, the Court of Appeals stated that "the amount of water made available to Central (and to Stockton East) by Reclamation varied significantly." *Slip Op*. at 5. The Court of Appeals decision provides an excellent synopsis of the water delivered and events that occurred beginning in 1993 (*see Id*. at 5-8). For the years 1999 through 2004, the Court of Appeals found, "[I]n each of these years, the terms of the contract called for a minimum allocation of 56,000 acre-feet of water to

Contract Breach

Central alone…After it was clear Reclamation would not meet these allocations, Central purchased water from the South San Joaquin Irrigation District ("SSJID"), in order to make up for the shortage of water from Reclamation in the years 2002 through 2004." *Id*. at 8 (citations omitted).

"Expectancy Damages" - Breach of Contract Claim

Parties' Conduct

The current case deals with breach of contract claims. Earlier "takings" claims that the plaintiffs raised were not at issue before the Court of Appeals. The case ended up turning on contractual law and the conduct of the parties, not just during the years of the breach of contract (1999-2004) when the damages occurred, but for the entire relevant period of the parties' actions. The decision ultimately was based on the finding concerning Reclamation's actions that took place prior to the actual breach at issue: "…the trial court should have considered not just the conduct of the parties during the years for which liability has been found (1999–2004), but also the effect of the announcements in 1993 (and afterward) that, because of the 1992 legislation, Reclamation was not going to make available the minimum contractual allocations. Instead, the trial court improperly declined to consider this evidence and other evidence related to Reclamation's poor performance prior to 1999, focusing its damages analysis on Central's failure to request at least the minimum amount of water specified in the contract in the years following Reclamation's non-performance announcements." *Id*. at 14 (citation omitted).

Reclamation Announcements

As noted above, the 1992 legislation required Reclamation to dedicate 800,000 acre-feet of water each year from the CVP for fish, wildlife, and habitat restoration needs. Reclamation stated in 1993 that there would not be sufficient water available to meet the contract minimums for Central. In each of the years leading up to 1999, Reclamation continued to announce that less than the minimum amount of water would be available. "The trial court misconstrued our earlier decision and the law of contracts. We did not hold that, just because liability for breach was found only for 1999–2004, the determination of the hypothetical non-breach world must disregard the effect of conduct occurring before 1999. To analyze expectancy damages one looks at what would have happened 'had the contract been performed.' Restatement (Second) of Contracts § 344(a);" *Id*. at 14.

Pre-Breach Conduct

Trial Court Errors

The Court of Appeals explained how the trial court's reliance on key assumptions caused its incorrect decision regarding damages. "The trial court assumed, erroneously, and without considering the lingering impact of the pre-1999 announcements, that Central's failure to request the contractual minimum quantity of water every year was because there was insufficient demand for the water from Central's potential customers. Absent actual demand, the assumption was that no economic loss to Central could be attributed to Reclamation's failure to make available the contracted-for amounts of water." *Id*. at 15.

"Stop Asking"

The Court of Appeals then went on to reiterate what it clearly viewed as a common sense interpretation of the facts in the case. "By 1994, and certainly by 1999, Central and its farmer clients were on notice that Reclamation was not going to supply the contractual quantities of water, whether or not circumstances conspired to provide Reclamation legal excuses in certain years. At some point most people stop asking for what they have been told they are not going to get, and they make other plans to meet their needs." *Id*.

Failure to Request

The plaintiff's failure to officially request its minimum allocation of water from Reclamation, that it was contractually entitled to during the breach years of 1999-2004 was not enough for the Court of Appeals to deny damages for those years, given Reclamation's announcements earlier in time. The Court of Appeals summarized what it characterized as a "legally erroneous limitation on the required analysis" and provided guidance to the trial court on remand. *See Id*. at 16.

Conclusion

The Court of Appeals concluded that "the trial court erred by not properly considering the effect of Reclamation's announced breaches on the amount of water that Central may have expected to need to meet demand. This caused the trial court to discount Central's arguments regarding what would have happened in the non-breach world." *Id*. at 3.

"Expectancy" Determination

The trial court is now left with a narrowed damages determination in order to decide what the value of Central's "expectancy" damages should be for 1999-2004, with guidance from the Court of Appeals. No trial date has been set as of the date of publication of this article. The trial court, however, must still determine if the record should be reopened to allow additional evidence relevant to the damages. Given the fact that the case has been ongoing since 1993, if the parties aren't able to reach a settlement, it's hard to predict when a conclusion to this long, drawn-out lawsuit will finally be reached.

For Additional Information:
Decision available at: www.cafc.uscourts.gov/opinions-orders/0/all/stockton-east

WATER BRIEFS

BUREC FLOW RELEASES CA/OR
KLAMATH RIVER SUPPLEMENT

Following pressure from the Yurok, Karuk, and Hoopa Valley tribes and the Klamath Justice Coalition — including a demonstration on August 19 at the Reclamation office in Sacramento — Reclamation announced it would release additional water from Trinity Reservoir to supplement flows in the lower Klamath River to help protect returning Chinook salmon. Reclamation's announcement of the increased releases came on August 22. Trinity Reservoir is located on the Trinity River in Northern California and water from the reservoir is also part of the supply for farmers in the Central Valley of California. The Trinity River is the main tributary of the Lower Klamath River.

"We have determined that unprecedented conditions over the past few weeks in the lower Klamath River require us to take emergency measures to help reduce the potential for a large-scale fish die-off," said Mid-Pacific Regional Director David Murillo.

The supporters of the increased releases were pushing for the release of water due to low flow conditions, hoping to prevent a major fish kill, similar to one that occurred in 2002. The Tribes noted that over 60,000 fall Chinook were lost in 2002, due to low flows and warm water temperatures which allowed disease and other trauma to negatively impact the fish.

Reclamation's scheduled releases from Lewiston Dam began on August 23, increasing releases from approximately 450 **c**ubic **f**eet per **s**econd (cfs) to approximately 950 cfs, to achieve a flow rate of 2,500 cfs in the lower Klamath River. On August 25, releases from Lewiston Dam were planned to increase to approximately 2,450 cfs to achieve a flow rate of approximately 4,000 cfs in the lower Klamath River. That release was to be maintained for approximately 24 hours before returning to approximately 950 cfs, to thereafter be regulated at approximately that level as necessary to maintain lower Klamath River flows at 2,500 cfs until approximately September 14. Reclamation planned to continuously monitor river and fishery conditions, with those conditions determining the duration and amount of dam releases.

Reclamation will continue to work with NOAA Fisheries and other federal agencies to comply with applicable provisions of the Endangered Species Act and the National Environmental Policy Act.

Meanwhile, a lawsuit brought to stop the increased releases was unsuccessful in obtaining a temporary restraining order. The injunction was sought by Westlands Water District and the San Luis & Delta-Mendota Water Authority in an action filed in federal district court before US District Judge Lawrence J. O'Neill in Fresno, California. Judge O'Neill denied the request on August 27, ruling that the potential harm to salmon this year from the current drought conditions on the river outweighs any potential harm to the water contractors next year due to reduced storage in the reservoir. "The potential harm to the Plaintiffs from the potential, but far from certain, loss of added water supply in 2015 does not outweigh the potentially catastrophic damage that 'more likely than not' will occur to this year's salmon runs in the absence of the 2014 FARs [Flow Augmentation Releases]." Memorandum Decision at 15-16. The Judge also noted that the flow augmentation could increase: "In addition to the current releases, Reclamation has indicated that if there is evidence of a disease outbreak, Reclamation will increase releases from Lewiston Reservoir to double flow in the lower Klamath River for one week." *Id*. at 6.

Judge O'Neill's decision was based on the potential environmental harm if augmention releases were not permitted. "On the other side of the balance, the flow augmentation releases are designed to prevent a potentially serious fish die-off from impacting salmon populations entering the Klamath River estuary… There is no dispute — and the record clearly reflects — that the 2002 fish kill had severe impacts on commercial fishing interests and tribal fishing rights, and that another fish kill would likely have similar impacts." *Id*. at 8 (citations omitted). The Memorandum Decision contains a detailed discussion by the Judge concerning the specific factual reasons for his conclusions.
For info: Louis Moore, Reclamation, 916/ 978-5100; S. Craig Tucker, Karuk Tribe, 916/ 207-8294; Injunction Decision at: MemoDecisionDenyTRODoc175.pdf

DRINKING WATER CO/MA
EPA FUNDS INNOVATION CENTERS

On September 9, EPA announced that it is continuing its commitment to improving America's drinking water by providing over $8 million to create two national centers for research and innovation in small to medium sized drinking water systems. The recipients are the University of Colorado Boulder's Design of Risk Reducing, Innovative Implementable Small System Knowledge (DeRISK) Center, and the University of Massachusetts Amherst's Water Innovation Network for Sustainable Small Systems (WINSSS) Center. These two EPA funded centers will develop and test advanced, low cost methods to reduce, control, and eliminate groups of water contaminants.
For info: Cathy Milbourn, EPA, 202/ 564-7849 or milbourn.cathy@epa.gov

LAKE POWELL RELEASES WEST
WATER TO LAKE MEAD INCREASED

Reclamation announced on August 13 that the water release from Lake Powell to Lake Mead for water year 2015 will be 8.23 **m**illion **a**cre-**f**eet (maf), based on the August 24-Month Study (Reclamation's monthly operational study). This represents an increase from the 2014 release of 7.48 maf, which was the lowest release since Lake Powell filled in the 1960s.

Based on the August 24-Month Study, Lake Mead will operate under normal conditions in calendar year 2015, with water users in the Lower Colorado River Basin and Mexico receiving their full water orders. The August 24-Month Study projections are used in accordance with the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead (2007 Interim Guidelines) to determine the amount of water released from Lake Powell to Lake Mead for each water year (October 1 to September 30). The August 24-Month Study was published on August 13 and is available on Reclamation's website for the Lower Colorado Region (below).

The 2007 Interim Guidelines allow water managers in the seven Colorado Basin states to plan ahead for varying Colorado River reservoir levels, with a greater degree of certainty about annual water deliveries. The 2007 Interim Guidelines also define the reservoir levels that would trigger delivery

WATER BRIEFS

shortages and specify the reduced delivery amounts in the Lower Colorado River Basin.

The Upper Colorado River Basin runoff in 2014 was 94% of average, compared to only 47% in 2013 and 45% in 2012. Despite this near-average runoff, Lake Mead is at elevation 1,081.3 feet (as of Sept.8), near its lowest elevation since the lake filled in the 1930s, due to the 15-year drought that began in 2000.

Under the 2007 Interim Guidelines, another review of the conditions at Lake Powell and Lake Mead will occur in April 2015. Based on an analysis of those projections in the April 24-Month Study, Lake Powell's water releases could be increased to 9.0 maf for water year 2015, but then reduced to 7.48 maf in water year 2016.

Despite a greater release of 8.23 maf from Lake Powell, the elevation of Lake Mead is projected to continue to decrease in 2015. Currently the longer-term projections from Reclamation's hydrologic models show the first chance of reduced water deliveries in the Lower Basin in 2016.

For info: Rose Davis, Reclamation, 702/ 293-8421; Reclamation website for the Lower Colorado Region at: www.usbr.gov/lc/region/g4000/24mo/index.html

PESTICIDE BUFFERS CA/OR/WA

STREAM BUFFERS FINALIZED

On August 13, EPA finalized a settlement agreement to restore no-spray buffer zones around waterways to protect imperiled salmon and steelhead from five toxic pesticides. The settlement stems from a lawsuit brought by a coalition of conservation organizations, advocates for alternatives to pesticides, and fishing groups which demanded reasonable protections for fish from the insecticides.

The buffers apply to salmon habitat throughout California, Oregon, and Washington to prohibit aerial spraying of broad-spectrum pesticides diazinon, chlorpyrifos, malathion, carbaryl, and methomyl within 300 feet of salmon habitat and prohibit ground-based applications within 60 feet. The agreement provides detailed notice to state regulators, pesticide applicators, farmers, and the public about the required no-spray buffer zones. These buffers will remain in place until the National Marine Fisheries Service (Fisheries Service) completes analyses of the impacts of these five pesticides on the fish. At that point, EPA must implement permanent protections grounded in the Fisheries Service's findings.

The buffers reinstated under the agreement were previously required by a 2004 court order after the federal courts ordered EPA to consult with the Fisheries Service over the impacts of these chemicals on imperiled salmon. That injunction expired when the Fisheries Service completed its analysis of these chemicals in 2008 and 2009. While the Fisheries Service required EPA to adopt extensive permanent protections to keep these chemicals out of salmon streams within one year, EPA failed to take action, leaving salmon and steelhead with no protection from these neurotoxic chemicals. The agreement resolves litigation filed by these groups in 2010 to compel EPA to adopt permanent protective measures in line with the Fisheries Service's findings.

For info: Settlement Agreement at: http://earthjustice.org/sites/default/files/files/2078%20final%20settlement.pdf

WQ TRADING ID/WA/OR

PILOT PROJECTS IN 2014

Water quality agency staff from Idaho, Oregon, and Washington, U.S. EPA Region 10, Willamette Partnership, and The Freshwater Trust released draft recommendations on approaches to water quality trading in the Pacific Northwest. The recommendations are based on the group's evaluation of policies, practices and programs across the country, which helped to identify some common principles and practices to guide consistent approaches to water quality trading in the region. Willamette Partnership facilitated the group through a US Department of Agriculture Conservation Innovation Grant. *See* Sanneman, et al., *TWR* #125.

Water quality trading is a market-based approach to achieving water quality goals for pollutants such as nitrogen, phosphorus and temperature. Through trading, some permitted emitters with high costs of reducing pollution are able to negotiate equal or greater pollution reductions from sources with lower costs. This effort focused specifically around trading between non-point and point sources.

The participating states have committed to testing their recommendations and are currently working to identify pilot projects this year. The states and EPA will then reconvene in late 2014 or early 2015 to discuss their pilot experiences and, if needed, refine the guiding principles and draft recommendations for water quality trading by the fall of 2015. Since the documents produced from this process are not guidance or policy, the respective state participants that choose to develop trading guidance or rules in the future will do so according to their individual state processes.

For info: Documents at: http://willamettepartnership.org/ >> News; Helen Bresler, Ecology, 360/ 407-6180 or hbre461@ecy.wa.gov; Ranei Nomura, ODEQ, 541/ 686-7799; Marti Bridges, IDEQ, marti.bridges@deq.idaho.gov; Bobby Cochran, WP, 503/ 208-3448 or cochran@willamettepartnership.org; Joe Furia, TFT, 503/ 222-9091 x45 or furia@thefreshwatertrust.org

WETLANDS SETTLEMENT CA

CWA VIOLATIONS/PENALTIES

On August 14, EPA announced a settlement with the owners of Anchordoguy Ranch for violations of the Clean Water Act (CWA) that destroyed more than 80 acres of rare vernal pool wetlands and streams in Tehama County, California. Ranch owners have agreed to pay $795,000 for wetlands preservation and $300,000 in penalties. The proposed settlement is subject to a 30-day public comment period and final court approval.

Matthew Anchordoguy, John Barlow, and Anchordoguy and Company LP own and operate the 1,036-acre Anchordoguy Ranch in Tehama County, California. Coyote Creek, a tributary of the Sacramento River, crosses the ranch. Between 2008 and 2010, the owners illegally deep-ripped 872 acres of the ranch to make room for more orchards, destroying 80 acres of vernal pool wetlands and damaging two acres of Coyote Creek. The activities were carried out without a required CWA 404 permit from the US Army Corps.

In addition to $300,000 in civil penalties, the ranch owners are required to off-set the ecological losses of the destroyed vernal pool wetlands and streams. Ranch owners agreed to provide $795,000 to The Nature Conservancy (TNC) to preserve vernal pool and salmon habitats in the

WATER BRIEFS

Sacramento River watershed. This funding will include the purchase of a conservation easement on the 515-acre Foor Ranch — property rich in vernal pool wetlands and connected to a much larger vernal pool conservation area. The easement will complete one of the last pieces of TNC's 4,600-acre Vina Plains Preserve, a prime vernal pools and grasslands conservation, research and educational site on the upper terrace of the Sacramento Valley.

Vernal pools are shallow depressions with an underlying layer of impermeable subsoil, which fill with water during the rainy season. These wetlands look barren in summer and fall, but after winter rains begin they are home to endangered and threatened fairy shrimp and native and migratory birds that feed on the shrimp. In spring, they bloom with uniquely adapted wetland plants creating rings of wildflowers at the pools' edges as the water recedes. California is one of the few places in the world where vernal pool ecosystems are found. Once common in the Central Valley, vernal pools have been reduced to less than 10 percent of their original range. Vernal pools and other wetlands help moderate seasonal flooding during storm events and also remove contaminants from the water, including agricultural and urban runoff.

For info: Settlement at www.usdoj.gov/enrd/Consent_Decrees.html; TNC's Vina Plains Preserve website: www.nature.org/california/placesweprotect/vina-plains-preserve.xml

WATER RIGHTS CA

STATE OVER ALLOCATION

Researchers from the University of California have concluded that California has allocated five times more surface water than the state actually has, making it hard for regulators to tell whose supplies should be cut during a drought. The scientists concluded that the State Water Resources Control Board, California's water-rights regulator, needs a systematic overhaul of policies and procedures to bridge the gaping disparity, but lacks the legislative authority and funding to do so. "California's legal framework for managing its water resources is largely compatible with needed reforms, but additional public investment is required to enhance the capacity of the state's water management institutions to effectively track and regulate water rights." *100 years of California's Water Rights System: Patterns, Trends and Uncertainty*, T. Grantham and J. Viers, Environmental Research Letters (Aug. 19, 2014), at 1.

The Study states that "inaccurate and incomplete accounting of water rights has made the state ill-equipped to satisfy growing societal demands for water supply reliability and healthy ecosystems." The scope of their report is intended to provide "the first comprehensive evaluation of appropriative water rights to identify where, and to what extent, water has been dedicated to human uses relative to natural supplies." *Id*. at 1.

In the Study's Abstract, the authors summarize some of their pertinent conclusions. "The results show that water right allocations total 400 billion cubic meters, approximately five times the state's mean annual runoff. In the state's major river basins, water rights account for up to 1000% of natural surface water supplies, with the greatest degree of appropriation observed in tributaries to the Sacramento and San Joaquin Rivers and in coastal streams in southern California. Comparisons with water supplies and estimates of actual use indicate substantial uncertainty in how water rights are exercised. In arid regions such as California, over-allocation of surface water coupled with trends of decreasing supply suggest that new water demands will be met by re-allocation from existing uses. Without improvements to the water rights system, growing human and environmental demands portend an intensification of regional water scarcity and social conflict." *Id*.

Grantham and Viers verified that water-rights allocations exceed the state's actual surface water supply by about 300 million acre-feet, enough to fill Lake Tahoe about 2.5 times. The state has allocated a total maximum allowable use of 370 million acre-feet of surface water — more than five times the 70 million acre-feet available in a year of good precipitation, according to the researchers' review of active water rights on record. Viers and Grantham, now with the US Geological Survey, are working to iron out issues with the database and make the information available to policymakers.

For info: Study at: https://watershed.ucdavis.edu/files/biblio/WaterRights_UCDavis_study.pdf

ESA LISTING DECISION MT

ARCTIC GRAYLING NOT LISTED

On August 19, Montana's Governor Steve Bullock issued a press release touting "a rewarding validation of years of successful collaboration between private landowners, non-governmental organizations, and state and federal agencies" — which resulted in a decision by the US Fish and Wildlife Service (USFWS) that the Montana Arctic grayling would not be listed as a threatened or endangered species under the federal Endangered Species Act.

Montana is the only state in the lower 48 in which the arctic grayling are native. USFWS noted in their decision that habitat quality, population trends, and genetic diversity are stable and increasing for most Montana Arctic grayling populations.

According to the Governor, one of the most successful grayling restoration efforts has been in the Big Hole Valley where private landowners have teamed with state and federal agency partners to work together to protect the fish. The decade-long program encourages non-federal landowners to voluntarily manage their land to remove threats to Arctic grayling. Landowners worked with state agencies, USFWS, and Natural Resource Conservation Service to restore high quality riparian habitat along the Big Hole River and its tributaries, and to improve water flows during critical times of the year for Arctic grayling.

The Center for Biological Diversity, on the other hand, expressed disappointment with the decision. "In yet another political bow to states opposed to protection for some of the nation's most endangered species, the U.S. Fish and Wildlife Service reversed course today and announced the Montana grayling will not get Endangered Species Act protection. The Service first determined the grayling warranted federal protection in 1994 and reaffirmed that conclusion in 2010. Now rather than provide protection long acknowledged to be needed, the agency says voluntary state efforts are enough to protect the beautiful fish." Press Release, 8/18/14.

For info: Jeff Hagener, Director, MFWP, 406/ 444-3186; John Tubbs, Director MDNRC, 406/ 444-1948; Noah Greenwald, Center for Biological Diversity, 503/ 484-7495 or www.biologicaldiversity.org

CALENDAR

September 17 WA
5th Annual Fisheries & Hatcheries Seminar, Seattle. City University of Seattle, 521 Wall Street. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

September 17 CA
The Challenge of Sustainable Groundwater Management in California - Meeting & Dinner, Berkeley. Spenger's Fresh Fish Grotto. Presented by Groundwater Resources Ass'n of California. For info: www.grac.org/branches/sanfrancisco.asp

September 18-19 OH
Ohio Surface Water Conference, Cleveland. Marriott Downtown at Key Center. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

September 18-19 CA
Endangered Species Act Conference, San Francisco. Hotel Nikko. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

September 18-21 NM
10th Annual Gila River Festival, Silver City. Presented by Gila Conservation Coalition. For info: 575/ 538-8078 or www.gilaconservation.org

September 19-20 CO
25th Headwaters Conference: The Working Wild, Gunnison. Western State Colorado University. For info: jhausdoerffer@western.edu or www.western.edu/headwaters

September 19-20 OR
2014 Desert Conference, Bend. Downtown. Presented by Oregon Natural Desert Ass'n. For info: http://onda.org/get-involved/2014-desert-conference-registration-panelists-schedule

September 21-26 Portugal
World Water Congress & Exhibition: Shaping Our Water Future, Lisbon. Lisbon Congress Centre. Presented by the Int'l Water Ass'n. For info: www.iwua2014lisbon.org

September 22-23 WA
International Columbia River Seminar, Seattle. Renaissance Seattle Hotel. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

September 22-23 TX
Texas Water Law Conference, Austin. Radisson Hotel. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

September 22-24 VA
Fish Consumption: Health Risks & Benefits (National Forum), Alexandria. Westin Alexandria Hotel. Presented by EPA. For info: http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/fishforum2014.cfm

September 24 CA
Central & Southern Delta Water Availability & Use Workshop, Sacramento. Cal/EPA HQ, 1001 I Street. Presented by State Water Resources Control Board. For info: www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/wrkshp092414/092414_notice.pdf

September 25-26 CA
GIS for Watershed Analysis: Beginning (Course), Davis. UC Davis, 1137 Lab - Plant & Environmental Sciences. For info: UC Davis Extension, http://extension.ucdavis.edu/

September 27-Oct. 1 LA
WEFTEC 2014: Where the Greatest Minds in Water Meet (Conference), New Orleans. Morial Convention Ctr. Presented by Water Environment Federation. For info: www.weftec.org

September 28 LA
One Water Innovations Gala, New Orleans. The Republic. Presented by WateReuse Ass'n. For info: www.watereuse.org/node/3226

September 29 CO
Hydraulic Fracturing Conference, Denver. Grand Hyatt. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

September 30-Oct. 2 KY
2014 America's Watershed Initiative Summit, Louisville. Galt House Hotel. For info: http://conference.ifas.ufl.edu/awi/

October 1-3 CO
Colorado Water Officials Ass'n Conference, Steamboat Springs. For info: Brian Romig, Steamboat Springs Water Commissioner, 970/ 846-0036 or brian.romig@state.co.us

October 2 WA
Re-Using Contaminated Land Conference, Seattle. DoubleTree Seattle Airport Hotel. Presented by NW Environmental Business Council. For info: www.nebc.org

October 2-3 AZ
Arizona Riparian Council Annual Meeting, Tucson. Riverpark Inn. For info: http://azriparian.org/2014/07/09/save-the-date-arizona-riparian-council-annual-meeting/

October 2-3 CA
Water 101 Workshop, Rancho Cucamonga. Cucamonga Valley Water District's Frontier Project. Presented by Water Education Foundation. For info: http://watereducation.ddsandbox.net/foundation-event/water-101-workshop

October 3 UT
Utah Water Law Conference, Salt Lake City. Marriott Hotel. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

October 5-8 WA
Groundwater Protection Council Annual Forum, Seattle. WA State Convention Ctr. For info: www.gwpc.org/events/annual-forum

October 6 CA
California Environmental Quality Act Seminar, Santa Monica. DoubleTree Guest Suites. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

October 6-7 CA
CalDesal 3rd Annual Conference, Monterey. Portola Hotel. For info: Ron Davis, CalDesal, 916/ 492-6082, rond@caldesal.org or www.caldesal.org

October 7 CA
Hydrology and the Law Seminar, Santa Monica. DoubleTree Guest Suites. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

October 7 NV
WaterSmart Innovations Conference (Pre-Show Workshops), Las Vegas. South Point Hotel & Conf. Ctr. See October 8-10 Event. For info: www.snwa.com/about/news_wsi.html

October 7-9 MT
81st Annual Fall Water School, Bozeman. Montana State University. For info: www.msun.edu/grants/metc/training.asp

October 8-10 AZ
Western States Water Council's 176th (Fall) Council Meeting, Scottsdale. Talking Stick Resort. For info: www.westernstateswater.org/upcoming-meetings/

October 8-10 MT
Floods, Forests & the Flathead - MT AWRA Conference, Kalispell. Hilton Garden Inn. Field Trip on 10/8.. For info: www.montanaawra.org/

October 8-10 NV
Water Smart Innovations Conference & Expo, Las Vegas. South Point Hotel & Conf. Ctr. Presented by the Southern Nevada Water Authority. For info: www.watersmartinnovations.com

October 8-11 FL
Environmental, Energy & Resources Law 22nd Fall Conference, Miami. Presented by the ABA. For info: http://shop.americanbar.org/ebus/ABAEventsCalendar/EventDetails.aspx?productId=180095&sc_cid=NR1410-A4

October 9 WA
Comprehensive Review of Hydropower in the Northwest Seminar, Seattle. Hotel 1000. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or www.theseminargroup.net

October 9 WEB
Flood Risk & Aging Inland Waterway Infrastructure, Webinar. Presented by AWRA. For info: www.awra.org/webinars/index.html

October 9-10 MT
Montana AWRA Conference, Kalispell. Hilton Garden Inn. For info: Nancy Hystad, MT Water Center, 406/ 994-6690, nancy.hystad@montana.edu or www.montanaawra.org/

October 9-10 CA
Russian River Tour, Santa Rosa. Presented by Water Education Foundation. For info: www.watereducation.org/toursdoc.asp?id=2979

October 13-16 PA
Fracture Trace & Lineament Analysis: Application to Groundwater Characterization & Protection Course, State College. Presented by Nat'l Groundwater Ass'n. For info: www.ngwa.org/Events-Education/shortcourses/Pages/241oct14.aspx

October 14 CA
6th Annual Santa Ana River Watershed Conference: "Keeping Our Cool", Riverside. Riverside Convention Ctr. Convened by Santa Ana Watershed Project Authority. For info: www.watereducation.org/sawpa2014

October 15 CA
Understanding the Sacramento-San Joaquin Delta: An Overview of Delta Governance & Regulation Course, Sacramento. Sutter Square Galleria, 2901 K Street. For info: UC Davis Extension, http://extension.ucdavis.edu/

October 16 CA
Clean & Drinking Water State Revolving Funds Workshop: Paying for Water Infrastructure, Sacramento. Cal/EPA HQ, 1001 I Street. Presented by EPA Region 9 & State Water Board. For info: State Water Board, 916/ 327-9978 or CleanWaterSRF@waterboards.ca.gov

October 16-17 NV
Tribal Water Law Conference: Perspectives from DC & Around the West, Las Vegas. Planet Hollywood. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

October 17 CA
Ass'n of California Water Agencies Regions 6 & 7 Water Forum, Visalia. Holiday Inn Visalia. For info: Katie Dahl, ACWA, 916-441-4545 or katied@acwa.com

October 18-22 LA
WEFTEC: 87th Annual Water Environment Federation Technical Exhibition & Conference, New Orleans. For info: Water Environment Federation, 800/ 666-0206 or WEFTEC website: www.weftec.org

October 19-22 WA
Water for Food 2014 Global Conference: Harnessing the Data Revolution: Ensuring Water & Food Secuirty from Field to Global Scales, Bellevue. Hyatt Regency Bellevue. Hosted by the Robert B. Daugherty Water for Food Institute at the University of Nebraska and the Bill & Melinda Gates Foundation. For info: http://waterforfood.nebraska.edu/wff2014/

October 19-22 CA
Ass'n of Metropolitan Water Agencies Annual Meeting, Newport Beach. Balboa Bay Resort. For info: www.amwa.net/cs/conferences/future

October 20 AZ
Colorado River Conference, Phoenix. The Arizona Biltmore. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

October 20 WA
Wetlands in Washington Seminar, Seattle. WA State Convention Ctr or WEB. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

October 21-23 WA
Columbia River Basin: Learning from our Past to Shape our Future Conference, Spokane. Fourth International Transboundary Columbia River Conference. Presented by Northwest Power & Conservation Council & Columbia Basin Trust. For info: http://columbiabasin-2014conference.org/

The Water Report
Water Rights, Water Quality & Water Solutions in the West
260 N. Polk Street • Eugene, OR 97402

CALENDAR

(continued from previous page)

October 22-24 CA
Northern California Tour, Sacramento. Presented by Water Education Foundation. For info: www.watereducation.org/toursdoc.asp?id=2979

October 23 CA
SCWC's Annual Meeting & Dinner, Universal City. Sheraton Universal Hotel. Presented by Southern California Water Committee. For info: www.socalwater.org/images/Updated_Save_the_Date_With_Location.pdf

October 23-24 MT
14th Annual Montana Water Law Seminar, Helena. Great Northern Hotel. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

October 24 OR
Environmental Law Year in Review (Annual) CLE, Troutdale. McMenamin's Edgefield Manor. Presented by Oregon State Bar Environmental & Natural Resources Section. For info: www.osbar.org

October 27-29 Austria
European River Restoration Conference 6th Edition, Vienna. TechGate. For info: http://errc2014.eu/

October 29-31 France
International Water & Energy Conference: Preserving the Flow of Life, Lyon. Cite Internationale. For info: www.preserving-the-flow.com

October 30 CO
7th Annual Energy Innovation Schultz Lecturship Series, Boulder. Wolf Law Bldg., University of Colorado. Presented by Getches-Wilkinson Center. For info: www.colorado.edu/law/research/gwc

October 30 CA
Dealing in Drought: Development, Legislation & Litigation Seminar, Los Angeles. DoubleTree by Hilton Downtown. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

November 3-4 CA
California Water Law Conference, San Francisco. Hotel Nikko. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

November 3-6 VA
2014 AWRA Annual Conference: 50 Years of Water Resources Management, Tysons Corner. Sheraton Premier Hotel. Presented by American Water Resources Ass'n. For info: www.awra.org

November 5-6 WA
Washington State Municipal Stormwater Conference, Puyallup. The Pavillion. Presented by the Washington Stormwater Center, Dept. of Ecology & City of Puyallup. For info: www.wastormwatercenter.org

November 6-7 CA
San Joaquin River Restoration Tour, Fresno. Presented by Water Education Foundation. For info: www.watereducation.org/toursdoc.asp?id=2979

November 6-7 OR
23rd Annual Oregon Water Law Conference, Portland. The Benson Hotel. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net or www.theseminargroup.net

November 6-7 AZ
Energy & Mineral Development in Indian Country Institute, Tucson. Marriott Tucson University Park Hotel. Presented by Rocky Mt. Mineral Law Foundation. For info: www.rmmlf.org