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HARD TIMES ON THE COLORADO RIVER: GROWTH, DROUGHT AND THE FUTURE OF THE COMPACT.
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CONFERENCE PRIMER (DRAFT 3.0):[1]

PREPARED USING SUPPORT FROM THE ROCKY MOUNTAIN MINERAL LAW FOUNDATION

AN INTRODUCTION TO KEY FACTS AND ISSUES REGARDING THE ALLOCATION AND USE OF THE COLORADO RIVER

The Colorado River is approaching a crossroads. For the first time in its history, human demands for water supply realistically threaten to surpass the physical limits of the resource. True, human demands long ago surpassed the capacity of the system when the full spectrum of environmental needs is considered, and that problem remains. And several users, particularly in Southern California, long ago ran up against their legal apportionments of Colorado River water and power. Additionally, many users, particularly during droughts and before completion of infrastructure projects, have gone without water. These hardships are not in dispute, and are not to be forgotten or dismissed as insignificant. But today, we are approaching a situation where the legally recognized water demands of users in one state might only be met by formally imposing shortages on current users in another state: essentially, an interstate "call" on the river. Trouble of this type and at this scale is new to the Colorado River. This situation arises despite a wealth of water storage and delivery infrastructure designed to at least delay (if not eliminate entirely) this eventuality, and despite a complex body of interstate (and international) law and policy—the so-called Law of the River—that has adeptly allocated available flows for many decades, but is oddly quiet on how to manage shortages. How soon this threat might materialize is unknown; if the next couple of years are as wet as the past years have been dry, then there is no immediate crisis. But as long as human population and water needs

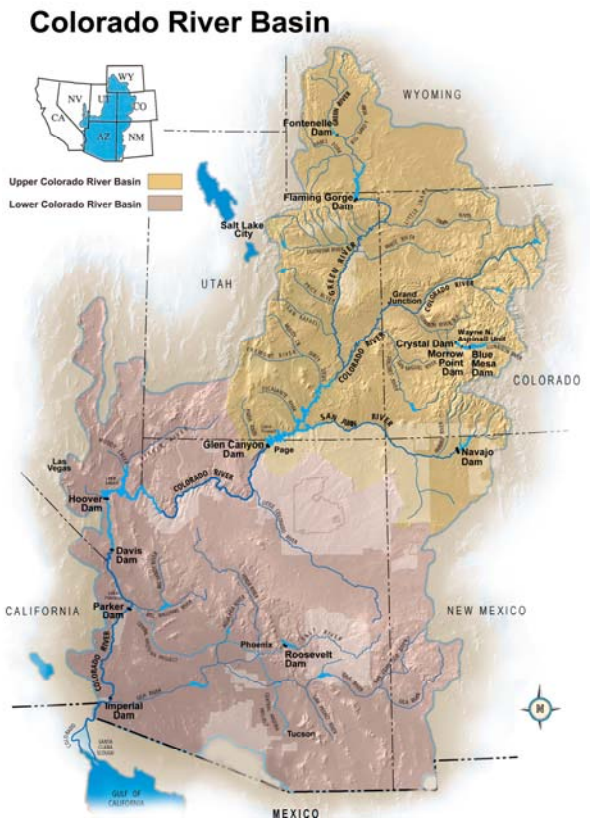
[1] The intent of the document is to provide background information about key facts and issues that will form the starting point of conference discussions. As such, it will not necessarily be of value to all participants, but is offered in the hope of avoiding confusion among those least familiar with the issues covered. This document is a draft that will be significantly revised and expanded following completion of the conference. While every effort was made to be accurate and fair in the description of factual information, it is acknowledged that errors and omissions likely exist, and several issues presented support multiple interpretations. Please send corrections/edits to the conference organizer (Doug Kenney, Douglas.kenney@colorado.edu). The Rocky Mountain Mineral Law Foundation generously provided financial support for the development of this primer, but is in no way responsible for its content.

continue to grow, and as long as climate variability threatens even the Colorado River's robust water system, management of the river will remain challenging and will require innovative new approaches to satisfying the variety of demands.

This paper addresses some of the major issues facing the Colorado River, and focuses on the challenge of providing the full legal apportionments to water users in each of the basin states and Mexico. This document is intended as a primer, and specifically, as the substantive backdrop to the conference: "*Hard Times on the Colorado River: Drought, Growth and the Future of the Compact*" (June 8-10, 2005). It begins, in Section I with a brief introduction to the Colorado and the ongoing challenge of balancing supplies, demands, and apportionments. This is followed, in Section II, by a historical review of the Law of the River, as this is the institutional backdrop against which the water issues—both short-term and long-term—are defined and addressed. This sets up the discussion in Section III focusing on modern issues and activities. A brief conclusion is offered in Section IV.

PART I: INTRODUCTION

The Colorado River has been called the "lifeline" of the Southwest. The multitude of communities it serves and the variety of uses for which it is appropriated justify the designation. The major headwaters of the nearly 1,400-mile river originate in Colorado and Wyoming, from which the river flows southwest. Inflows from New Mexico and Utah contribute to the formation of the main channel which slices through parts of Arizona, Nevada and California on its way to Mexico and, in unusually wet years, the Sea of Cortez (Figure 1).



Along its path the Colorado drains a watershed of approximately 246,000 square miles, creating unsurpassed geologic and environmental amenities, and providing water and power for at least 25 million people in Sunbelt cities including Los Angeles, Phoenix, Las Vegas, Denver, Albuquerque, and Salt Lake City. Throughout the basin, Colorado River water is also used extensively for agriculture, including the irrigation of nearly 1.5 million acres of land in California and Arizona, aiding in the production of crops as diverse as alfalfa, cotton, lettuce, wheat, citrus fruits, barley,

and cauliflower.[2] Additionally, the Colorado River carves out a natural wonder, the Grand Canyon, and it provides numerous recreational opportunities including fishing, rafting, swimming, and wildlife viewing.

Meeting the multiple demands on the river has been accomplished through the construction of a highly elaborate plumbing system, punctuated by the two major storage reservoirs on the system: Lake Powell formed by Glen Canyon Dam near the Utah-Arizona border, and Lake Mead, formed by Hoover Dam along the Arizona-Nevada border.[3] Several smaller projects also contribute storage. They include the Aspinall (i.e., Curencanti) Unit in Colorado (particularly Blue Mesa Reservoir); Flaming Gorge and Fontanelle along the Green River in Wyoming and upper Utah; and a series of smaller diversion dams downstream along the Arizona-Nevada and Arizona-California border, including: Davis, Parker, Palo Verde, Imperial, Senator Wash, and Laguna. Along the US-Mexican border, Morelos Dam diverts the remainder of the Colorado River for use in Mexico. Overall, these facilities can store over 3 years of average flow, an astonishing ratio.[4]

Consumptive uses of the Colorado River vary from season to season and from year to year, and are difficult to quantify for a variety of reasons. Nonetheless, estimates of total consumption are provided below as part of Table 1. Tables 2 and 3 list legal apportionments and various measures of the river's water yield. Understanding the origins and limits of each of these numbers is useful (and fascinating) background, some of which is provided in the table footnotes and in the remainder of the primer, but for now it is sufficient just to notice the inconsistencies in the numbers—specifically, the disparities between apportioned and actual yields; the importance of how evaporation, tributary uses and regulatory wastes are accounted for; and the influence of climate variability (especially the recent drought).[5] In short, the river is allocated to the tune of 17.5 MAF (million acre-feet), total mainstem depletions average 15.4 to 19.1 MAF (depending upon whether you account for tributary uses and regulatory wastes), whereas the observed average yield is 14.8 MAF (1896-2004), and tree-ring reconstructions suggest a longer-term average yield of 13.5 MAF (1520-1961).

[2] The Colorado River Water Users Association website, http://www.crwua.org, provides statistics on river usage in individual states.
[3] The Bureau of Reclamation website, http://www.usbr.gov/dataweb/dams, provides detailed information on all of the dams along the Colorado River.
[4] By comparison, storage on the Columbia River is roughly 0.3 years of flow, a much more typical storage-to-flow ratio even for highly developed rivers.
[5] Note that many long-term climate predictions are not encouraging. One of the leading studies suggests that Colorado River flows could drop by about 18% by mid-century (Christensen et al., 2004).

Table 1. Consumptive Uses of Colorado River Flows (1996-2000 average)

[all figures in acre-feet/year][a]

MAINSTEM USES		
Upper Basin:	Colorado	2,064,000
	Wyoming	433,000
	New Mexico	383,000
	Utah	803,000
	Arizona (as UB state)[b]	34,000
	Total:	3,717,000
Lower Basin:	Nevada	269,000
	Arizona	2,578,000
	California	5,141,000
	Total:	7,989,000
Mexican Deliveries		1,660,000
TOTAL MAINSTEM USES (without mainstem reservoir evaporation)		13,365,000
Mainstem Reservoir Evaporation		
Upper Basin		682,000
Lower Basin		1,321,000
Total:		2,003,000
TOTAL MAINSTEM DEPLETIONS[c]		15,368,000
USE OF LOWER BASIN TRIBUTARIES		
Arizona		2,221,000
Nevada		123,000
New Mexico		27,000
Utah		137,000
Total:		2,508,000
ADDITIONAL DELIVERIES TO MEXICO[d]		1,246,000
TOTAL SYSTEMWIDE USE[e]		19,123,000

Notes:

a = All figures are from the U.S. Bureau of Reclamation, "Colorado River System Consumptive Uses and Losses Report, 1996-2000" issued (after revision) in December 2004 [Bureau of Reclamation, 2004]. Historically, the states have refused to accept these figures as fully accurate or binding, but rather are working estimates.

b = Arizona is primarily a Lower Basin state, but nonetheless has a small allocation (50,000 a.f.) in the Upper Basin compact to account for lands above Lee's Ferry.

c = Note that 15.368 MAF (million acre feet) of Total Mainstem Depletions is only slightly above the 20th century average for mainstem flows (of 15.1 MAF; see Table 3), however, this figure does not include regulatory wastes (inadvertent discharges to Mexico of over 1 MAF), and occurs while consumptive uses in the Upper Basin are roughly half the basin's 7.5 MAF apportionment.

d = These over-deliveries are primarily categorized in the Consumptive Uses and Losses Report as "regulatory waste" which includes Gila River flood releases, flood control releases from the mainstem, and rejected water orders. These values fluctuate dramatically, from 5,000 a.f. in 1996 to over 3 MAF in 1998. The figure also includes roughly 100,000 a.f. associated with Minutes 218, 241 and 242.

e = Note that of this total, 16,217 MAF occurs in the United States and 2,906 MAF is associated with Mexico.

Table 2. Legal Apportionments and Estimates of the River's Yield

Lower Basin Apportionment[a]		
Nevada	300,000 a.f.[b]	
Arizona	2.8 MAF[b]	
California	4.4 MAF[b]	
Sub-Total	7.5 MAF	
Additional Lower Basin Apportionment[c]		
Total	1.0 MAF	
Mexican Delivery	1.5 MAF	
Upper Basin	Apportionment of 7.5 MAF (as available)[d]	
Colorado (51.75%)	3.855 MAF	[or 3.079 MAF assuming 6.0 MAF total]
Wyoming (14%)	1.043 MAF	[or 833,000 a.f. assuming 6.0 MAF total]
New Mexico (11.25%)	838,125 a.f.	[or 669,375 a.f. assuming 6.0 MAF total]
Utah (23%)	1.714 MAF	[or 1.369 MAF assuming 6.0 MAF total]
Arizona (as UB state)	50,000 a.f.	(firm under any yield scenario)
Sub-Total	7.5 MAF	
TOTAL APPORTIONMENT	17.5 MAF[e]	

Notes:

a = As discussed later, the 7.5 MAF (million acre-feet) apportionment is provided in Article III(a) of the Compact.

b = As discussed later, this is the Lower Basin apportionment that was pre-approved in the Boulder Canyon Project Act and later affirmed through water delivery contracts with the Secretary of the Interior and the *Arizona v. California* (1963) decision.

c = The additional 1.0 MAF is provided in Article III(b). Presumably, this a reference to Lower Basin tributary use, although this is a point of contention given the *Arizona v. California* (1963) decision and the operational practices on the river.

d = As discussed later, Article III(a) of the Compact provides the Upper Basin with an apportionment of 7.5 MAF, but also in Article III(d) requires the Upper Basin to "not cause the flow of the river" at Lee Ferry to be depleted below 75 MAF over any 10-year period. During periods of severe drought, it could be impossible for the Upper Basin to consume 7.5 MAF (which would be far above current uses; see Table 1) and still meet the 75 MAF/10-years requirement. For this reason, many federal and Upper Basin planners assume a "practical" Upper Basin apportionment of 6.0 MAF, although even this figure may be ambitious. The Upper Basin apportionment is allocated among the states using a percentage system, as shown.

e = This is the apportionment for "consumptive use." The appropriate mechanism for assigning evaporation and system losses against these figures is in dispute.

Table 3. River Yields (at Lee Ferry) in Million Acre-Feet (MAF)/Year

Long-Term Averages	
Twentieth Century (1900-1999)	15.1[a]
Total Gaged Record (1896 – 2004):	14.8[b]
Historical Average (from tree ring reconstructions: 1520-1961):	13.5[c]
Other Periods of Note:	
Gage Records Prior to Compact Negotiation	16.8[d]
Major Droughts in the Modern Era[e]	
1931 - 1935	11.4
1953 - 1956	10.2
1959 - 1964	11.4
1988 - 1992	10.9
2000 - 2004	9.9 (estimated)

Notes:

a = Calculated from values provided in Table 3 (page 23) of the 2004 Annual Report of the Upper Colorado River Commission (Upper Basin Compact Commission, 2004).

b = From Table 3 (page 23) of the 2004 Annual Report of the Upper Colorado River Commission (Upper Basin Compact Commission, 2004).

c = Based on the period 1520-1961 as reconstructed in the classic tree-ring study by Stockton and Jacoby (1976). Flow estimates are currently being refined based on updated tree-ring sampling and improved methods for reconstructing flows based on this data.

d = This is the value suggested by gage records from 1896 – 1921. Note that a gage at Lee Ferry was not constructed until 1921. Thus, these figures are reconstructions based on data from other stations (e.g., Yuma). There is evidence to suggest that many of the negotiators thought this estimate was conservative (i.e., low). (For gage data, see Upper Basin Compact Commission, 2004: 22-25). Note that negotiators of the Upper Basin Compact of 1948 used records from 1914 to 1945, which suggests a long-term average of 15.6 MAF (Upper Basin Compact Commission, 2004: 26).

e = Figures provided by the Bureau of Reclamation, Boulder City Operations Office.

PART II. EVOLUTION OF THE LAW OF THE RIVER: A HISTORY

Although many ancient civilizations in the Southwest used water from the Colorado and its tributaries, the river remained largely untouched by human activity until large-scale agricultural development began in the late 1800s along the California-Arizona border. Abundant water, warm climates, and fertile soils provided the obvious ingredients for successful irrigation, but the temperamental nature of the lower Colorado impeded many efforts. Spring brought heavy, silt-laden floods while the summer often reduced the river to a trickle (Hundley Jr., 1986). Such fluctuations inspired settlers to seek some control over the Colorado. Calls for river development were especially vociferous after floodwaters in 1905 breached the Alamo Canal in California, temporarily diverting the river into the Imperial Valley and creating the Salton Sea—California's largest lake by surface area. An additional concern was the gravity fed canal that delivered water to Imperial Valley farmers along a route that went through Mexico (necessary to bypass a ridge) and left the US vulnerable to Mexican claims on half of the water carried by the system. By 1922, federal engineers had already offered a solution to these problems that called for a multi-purpose dam and reservoir upstream at Boulder Canyon (eventually named Hoover Dam and Lake Mead) and an "All-American" agricultural canal downstream, thereby addressing problems of high and low flows, siltation, and the diplomatic concern with Mexico.[6] California aggressively pushed for these projects, but before congressional approval could be secured, interstate concerns needed to be addressed about how the benefits of the Colorado River would be shared among the basin states.

The 1922 Colorado River Compact, considered the foundation of the "Law of the River" (see Table 4), emerged out of the growing tensions between the states of the Upper Basin (Colorado, New Mexico, Utah and Wyoming) and those of the Lower Basin (Arizona, California and Nevada). Of particular urgency was the concern that the immediate need for water and water development in the Lower Basin would potentially preclude later development and water use upstream. Upper Basin fears of a rapidly developing Lower Basin were fueled by the precedent emerging from the *Wyoming v. Colorado*[7] litigation (involving the Laramie river), in which the Supreme Court held that the rule of prior appropriation[8] governed the use of river water where claimants from different states both asserted rights to its use. If applied to the Colorado, structures such as the proposed Boulder (Hoover) Dam and the All-American Canal would provide California with a significant head-start in the race for Colorado River water. The solution, proposed by Delph Carpenter of Colorado, was an interstate water allocation compact—the first of its kind—that would provide a firm and perpetual allocation of river water among the seven basin states, thereby allowing California to move forward immediately with water

[6] These plans were outlined in the Fall-Davis report, commissioned by Congress, which argued for an All-American canal as well as a storage reservoir at or near the Boulder Canyon. Hydroelectric power would also be developed, in part to repay the cost of the project. California legislators introduced a bill in April 1922 to implement this recommendation.

[7] *Wyoming v. Colorado*, 259 US 419 (1922).

[8] Prior appropriation gives the legal right for water use to the first person to divert the water. It is known as the "first in time, first in right" doctrine.

development, but eliminating the need for the other states to race forward with development prematurely.

Table 4. Some Key Elements of the Law of the River	
Colorado River Compact	1922
Boulder Canyon Project Act	1928
Mexican Water Treaty	1944
Upper Colorado River Basin Compact	1948
Colorado River Storage Project Act	1956
Arizona v. California decision	1963
Colorado River Basin Project Act	1968
Minute 242 of the International Boundary and Water Commission	1973
Colorado River Basin Salinity Control Act	1974
Grand Canyon Protection Act	1992

Signed on November 24, 1922, the Compact allotted consumptive use rights to the Colorado River between the seven basin states.[9] Realizing that individual state allocations would be difficult to determine (and was perhaps premature), the Colorado River Commission[10] settled on apportionment between the upper and lower basins, an idea typically credited to Commerce Secretary (and future president) Herbert Hoover, who chaired the negotiations on behalf of the federal government. Lee Ferry, located in northern Arizona (just downstream of modern-day Glen Canyon Dam), was selected as the point separating the Upper and Lower Basins. Article III(d) of the Compact calls on the Upper Basin to send downstream to the Lower Basin at least 75 million acre-feet (MAF) every 10 years. The 10-year requirement was drafted to accommodate the sometimes severe annual fluctuations in river flows.[11] The Lower Basin states were also awarded an additional 1 MAF to reflect the contribution of tributaries in their states (Hundley Jr., 1986: 18).[12] The Compact negotiators also foresaw future "surplus" allotments to both Basins (Getches et al., 1995: 825). The Compact gave highest priority for use to agricultural and domestic uses, assigned lesser priority to hydroelectric power and navigation purposes, and the interests of Mexicans and Native Americans were largely ignored—issues to be negotiated and litigated in the future.

One of the more infamous elements of the apportionment is that it was negotiated during an unusually wet period. Compact negotiators only had about 2 decades of streamflow records upon which to judge the river's flow. These records were thought to suggest an

[9] The text of the Colorado River Compact may be viewed at http://ssl.csg.org/compactlaws/comlistlinks.html.
[10] The Colorado River Commission was the name given to the delegates sent from each state and the federal government to negotiate the compact.
[11] In the past 100 years, these flows have ranged from a high of 24.5 MAF in 1984 to a low of 5.6 MAF in 1934 (Upper Basin Commission, 2004: 22-23).
[12] As mentioned later, the degree to which tributaries should or should not be counted as part of the Lower Basin apportionment is a point of contention between the Upper and Lower Basins (and historically, between Arizona and California as well). The major tributary of concern is the Gila River which originates in western New Mexico and flows across southern Arizona joining the Colorado at Yuma only in wet years. Given natural and human depletions in the lower portions of the river, the Gila rarely contributes much inflow to the Colorado, but is nonetheless the source of significant consumptive uses further upstream within Arizona.

average annual flow of at least 16.8 MAF; the Bureau of Reclamation offered a somewhat more conservative estimate of 16.4 MAF, but many others offered higher numbers. By the end of the 20th century, streamflow records suggest a long-term average of approximately 15 MAF, which while low, is considerably rosier than the results of tree-ring studies that can estimate river flows back to the 1500s. Those records suggest a long-term average of 13.5 MAF. (This information was provided earlier in Table 3.) Given that the compact essentially uses a delivery obligation framework[13], the burden of this problem falls predominately on the Upper Basin states.[14] This remains an ongoing (and growing) issue in the basin.

Through some unusual legislative maneuvering, the Compact went into effect soon after the passage of the Boulder Canyon Project Act[15] (which included the Boulder Dam and All-American Canal authorizations) even though Arizona refused to ratify the agreement until 1944.[16] Arizona's delay grew out of her concern that California would develop first, thereby claiming an excessive share of the Lower Basin entitlement (Hundley Jr., 1986: 20). This concern mirrored the fears of the Upper Basin states, which the compact effectively addressed by establishing the Upper Basin apportionment in perpetuity. Arizona's concern had been at least partially addressed in the congressional debate over the Swing-Johnson Bill (later to become the Boulder Canyon Project Act).[17] Amendments included a provision giving congressional pre-approval to any subsequent Lower Basin agreement apportioning 4.4 MAF for California, 2.8 MAF for Arizona, and 0.3 MAF for Nevada, and limiting California to one-half of any surplus waters unapportioned by the Compact (Hundley Jr., 1986: 22). It wasn't entirely clear if the intra-basin apportionment would be binding without subsequent state action until the Supreme Court upheld it in 1963 as the first (and still only) example of congressional river apportionment.[18]

Having brokered a measure of agreement with and between the states, and having initiated the large-scale development of the Colorado, the federal government faced another challenge in negotiating the management of the river with regard to Mexico. Irrigation was required for agriculture in the Mexicali valley and Mexico was demanding access to more of the Colorado River flow. Mexico's bargaining chip was the location of key Lower Rio Grande tributaries within its borders. In the Mexican Water Treaty of 1944, the United States agreed to a "trade" and guaranteed delivery of 1.5 MAF of Colorado River water to

[13] As mentioned later, the Upper Basin obligation is "not to deplete" rather than to deliver, which is a potentially salient distinction in terms of drought response.
[14] The classic studies on this topic are by Tipton and Kalmbach, Inc. (1965) and the papers of the severe sustained drought project (see the special issue of the Water Resources Bulletin, 31(5), October 1995; papers available online at http://www.hydrosphere.com/publications/ssd/ssd_overview.htm).
[15] Boulder Canyon Project Act , 43 U.S.C.A. § 617 (1928).
[16] By 1944, Arizona had decided that its refusal to ratify the compact was hindering its ability to compete for federal water development funds. Thus, Arizona ratified the compact and chose to resolve its concerns over the compact in the Supreme Court.
[17] The "Swing-Johnson Bill" was named for its sponsors, Congressman Phillip Swing and Senator Hiram Johnson (both from California). The bill was amended four times before being signed into law as the Boulder Canyon Project Act of 1928. Section 617(c) of the Act addresses the intra-basin apportionment.
[18] *Arizona v. California*, 373 U.S. 546 (1963).

Mexico each year (Hundley Jr., 1986: 27).[19] Additionally, the treaty provided that if the Secretary of the Interior determined the availability of a surplus, up to 200,000 additional acre-feet would be delivered to Mexico. In return, the United States would have continued access to waters from the Lower Rio Grande. The arrangement between the two countries also arguably made Mexico's allocation a "first call" on the river (Getches et al., 1995: 826). While the treaty settled some of the issues between the United States and Mexico, it raised new tensions between the Upper and Lower Basins as each worried that the obligation to Mexico would diminish its own supply of water.[20]

The next milestone in the development of the Law of the River was the Upper Colorado River Basin Compact of 1948,[21] prompted largely by the desire of the Upper Basin states to attract Bureau of Reclamation projects, but limited by the federal conclusion that no coordinated storage or management of the river would be feasible without first establishing the division of waters among the states in the Upper Basin. Having learned from the inaccurate flow estimates used in the Colorado River Compact, the Upper Basin Compact uses percentages to allocate the water available to the Upper Basin states. In theory, this was originally expected to average roughly 7.5 MAF—the same amount provided to the Lower Basin—although the inaccurate flow estimates and the Mexican obligation has made this unrealistic. The agreement allocates the available Upper Basin share as follows: 51.75% to Colorado, 11.25% to New Mexico, 23% to Utah, and 14% to Wyoming. A fixed allocation of 50,000 acre-feet was also provided to Arizona in order to account for water demands in the extreme northeast corner of the state technically above the Upper Basin-Lower Basin dividing line. The Upper Colorado River Basin Compact also established the Upper Colorado River Commission, unusual in its inclusion of a federal member as a full voting party and the provision that allows decisions to be made by a four/fifths majority. The Commission represents the interests of the Upper Basin in Mexican Treaty issues, federal reservoir construction, supply and development issues arising in the Lower Basin, and in federal legislation affecting the Basin.

One such effort was the Colorado River Storage Project Act of 1956.[22] Storage in the Upper Basin was sought not only to store water for a long list of proposed irrigation projects, but also to manage the compact-mandated delivery obligation at Lee Ferry and to generate the hydropower revenues needed to pay for irrigation projects (that otherwise are not economically viable).[23] These concerns were addressed in the 1956 legislation, which authorized the construction of the Curecanti Unit in Colorado along the Gunnison River (better known as the Aspinall Unit), Flaming Gorge on the Green River in Utah, Navajo on the San Juan River in New Mexico, and the centerpiece of the Act, Glen Canyon Dam on

[19] Treaty between the United States of America and Mexico respecting utilization of waters of the Colorado and Tijuana Rivers and of the Rio Grande, Feb. 3, 1944, U.S.-Mexico (59 Stat. 1219).
[20] By 1944, it was becoming apparent that the flow of the river had likely been significantly overstated in the original compact negotiations.
[21] The text of the Upper Colorado River Basin Compact may be viewed at http://ssl.csg.org/compactlaws/uppercoloradoriverbasin.html.
[22] Colorado River Storage Project Act, 43 U.S.C.A. § 620 (1956).
[23] The Act created the Upper Colorado River Basin Fund to collect power revenues that are credited against the costs of the Act's projects (Lochhead, 2001: 313).

the Colorado mainstem near Page, Arizona. Several "participating projects" were also authorized, about half of which were eventually built.

With the Colorado River Storage Project Act authorized, the political battles in the region again oscillated back to the Lower Basin where tensions between Arizona and California remained strong. The primary source of disagreement was the proposed Central Arizona Project (CAP). The CAP is an ambitious aqueduct project that can transport approximately 1.5 MAF of water from the Colorado mainstem (along the Arizona-California border at Parker Dam) as far into central Arizona as Tucson, approximately 336 miles (and 1,286 feet up in elevation).[24] The original CAP proposal called for two massive hydroelectric dams at Bridge (Hualapai) and Marble Canyons[25] to generate electricity and hydropower revenues, necessary to pay for CAP construction and operation of the necessary pumping facilities. California opposed the scheme on two grounds: (1) a concern that Arizona was taking more than its share of the Lower Basin's apportionment, and (2) financial inequity.[26] Specifically, California argued that Arizona's use of the Gila River should count against its allotment of the Colorado River. Therefore, California asserted that Arizona's use of the Gila coupled with the water diverted by the CAP would exceed Arizona's portion of the Lower Basin's allotment. While the financial issues were settled over time in a variety of political negotiations, the more critical issue of Arizona's apportionment required litigation that culminated in the 1963 Supreme Court decision in *Arizona v. California*.[27] The landmark decision essentially concluded that Arizona's apportionment in section III(a)[28] of the Compact did not include its use of Gila River water and that section III(b) of the Compact reserved the use of the Gila for Arizona exclusively. If California was to block the CAP proposal, it would need a political, rather than legal, strategy.

Aside from moving the CAP dispute forward, the *Arizona v. California* decision influenced Colorado River law and policy in several other important ways. For example, the Court reiterated that it was congressional intent for questions of interstate allocation to primarily be resolved by the Secretary of the Interior, pursuant of course to the Law of the River, including any questions regarding the management of shortages should they occur. Perhaps even more salient, the *Arizona v. California* decision also included a strong affirmation of Indian water rights and, more generally, all forms of federal reserved water rights.[29] The Court's decision immediately provided an allotment of approximately 900,000 acre-feet to several Colorado River tribes (Getches et al., 1995: 828). In

[24] See http://www.usbr.gov/dataweb/html/crbpcap.html
[25] The original proposal only called for the Bridge Canyon dam. Together, the two proposed dams bracketed the Grand Canyon National Park.
[26] Repayment of CAP costs, to the federal government, was scheduled to occur over 75 years. Under the law at the time, repayment was supposed to be completed within 40 years. Additionally, the federal government would not be collecting its usual 2.5-3% interest rate. These are legitimate concerns, but the reality is that almost all federal western water projects—except the hydroelectric dams—are highly subsidized by almost any accounting standard. Reports by the Water Resources Council and the General Accounting Office, for example, typically place the subsidy in the range of 82 to 98 percent system wide, and even higher for many projects in the Upper Colorado Basin (GAO, 1981, 1996; WRC, 1975).
[27] 373 U.S. 546 (1963).
[28] Section III(a) apportioned 7.5 MAF to the Lower Basin.
[29] The federal government introduced these issues into the lawsuit.

providing the allotted water to the tribes, the Court held that such allocations would be deducted from the total state apportionment for the state in which the tribe is located.[30] Further, the Court indicated that future adjudications would be based on a "practicably irrigable acreage" standard.[31]

Despite the outcome in *Arizona v. California*, Arizona was still not assured of completion of the CAP. California's resistance to approval for the project hardened as it worried that the needs of California residents might go unfulfilled while Arizona enjoyed what California perceived to be Arizona's disproportionately large allotment of the Lower Basin's apportionment. Additionally, the environmental community rallied behind the goal of keeping all dams out of the Grand Canyon. Ultimately, these issues were addressed through compromise and concession. Regarding California's concern, Arizona conceded that CAP flows would be junior to California's full 4.4 MAF entitlement in periods of shortage. Second, instead of one or more dams in or near the Grand Canyon to generate power for the CAP, a coal-fired power plant was authorized on Navajo lands not far from Glen Canyon Dam. Several smaller deals were also included to generate a critical mass of support for the legislation.[32]

The CAP was finally authorized as part of the Colorado River Basin Project Act of 1968.[33] Other key elements of the legislation require the Secretary to prepare an Annual Operating Plan (AOP) providing for the coordinated operation of the basin reservoirs, primarily Lakes Powell and Mead, and to account for each state's beneficial uses of the Colorado River.[34] In order to ensure that reservoir operations comply with the delivery release in the Colorado River Compact, it is AOP tradition to feature a minimum objective release 8.23 MAF of water annually from Lake Powell. It is assumed that this figure comes from 7.5 MAF to satisfy the delivery obligation (which is actually 75 MAF every 10 years) plus 0.75 MAF to account for half the Mexican delivery obligation (the other half is taken from Lower Basin reservoirs), minus an Upper Basin credit of 20,000 acre-feet to account for inflows from the Paria River, which is downstream of Glen Canyon but still upstream from Lee Ferry. Additionally, an equalization rule (602(a)) provides that if storage in Lake Powell exceeds that in Lake Mead and if Powell contains sufficient storage to more than meet anticipated Upper Basin demands, then releases are made to equalize the reservoirs, thereby providing surplus waters normally used by California. Other elements of the release schedule aim to maximize hydropower benefits, although some modifications have

[30] 373 U.S. 546, 601.

[31] This means that the water right of a tribe is quantified based on the amount of water that would be necessary to irrigate all the lands that, due to physical features, could be practicably irrigated. For large reservations in arid lands, such as the Navajo Reservation, the PIA standard can be interpreted to yield huge awards—perhaps comprising the entire flow of the river! As a practical matter, most tribal water right adjudications in the region are done through negotiated agreements that provide for a much smaller apportionment than might be expected through a rigid application of the PIA standard, but which also provide funds for water development and other tribal needs.

[32] A full description of the complex deal is provided by Ingram (1990).

[33] The Colorado River Basin Project Act, 43 U.S.C.A. § 1521 (1968).

[34] The Act also required the Secretary to establish, in consultation with the Basin states, long range operating criteria for the Colorado River system. Such criteria were published in 1970. See http://www.usbr.gov/lc/region/pao/pdfiles/opcriter.pdf for more detail on The Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs of 1970.

been made over time in response to the impact of hydropower release cycles on environmental resources in the Grand Canyon.

Having addressed many of the apportionment, storage, and management issues regarding the Colorado River, the Basin states and federal government continued to tackle related challenges. By the 1970s, environmental and water quality issues began to take center stage. The increasing salinity of the water in the Colorado River is one such issue. The salinity increases as the water travels downstream due to irrigation runoff, evaporation from reservoirs, and out-of-basin export of fresh water in the Upper Basin. The cost of purifying the saltier water and the resulting harm to agriculture eventually led to protests from Mexico, which claimed that the water had become too salty for irrigation. This concern was addressed in 1973, as Minute 242 of the International Boundary and Water Commission regarding the US-Mexico Treaty, which requires deliveries at the international border to meet a numerical salinity standard (Hundley Jr., 1986: 38-39). Additionally, the Colorado River Basin Salinity Control Act of 1974[35] established a program for reducing the causes of increasing salinity in the entire Basin. Under the 1974 Act, the Environmental Protection Agency administers a regional water quality program with input from the states via the Colorado River Basin Salinity Control Forum. The efforts implemented include the construction of a desalinization plant at Yuma (which is not operated due to cost concerns and to flood-damaged intakes) and salt-control projects.

Environmental statutes crafted to protect endangered species, wildlife habitat, aesthetic values, and recreational opportunities have also modified the management of the Colorado River. The many dams on the river have greatly altered the timing and magnitude of flows, and have transformed the water downstream of reservoirs from warm and muddy to cold and clear. Among the many environmental casualties have been native fisheries. Among the native fish listed as endangered are the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail chub. Recovery programs for these fish have existed in the Upper Basin since 1988[36], and have recently been addressed in the Lower Basin. The Lower Colorado River Multi-Species Conservation Program (MSCP) was officially adopted on April 4, 2005. Other salient federal environmental legislation, such as the Grand Canyon Protection Act of 1992,[37] address issues specific to the internationally valued ecological, aesthetic and recreational resource between Glen Canyon and Hoover Dams. Efforts to restore the Colorado River Delta—the historic terminus of the river at the Sea of Cortez in Mexico—are also under consideration. Since completion of Glen Canyon Dam, the river rarely reaches the delta. Today, the only consistent source of water is about

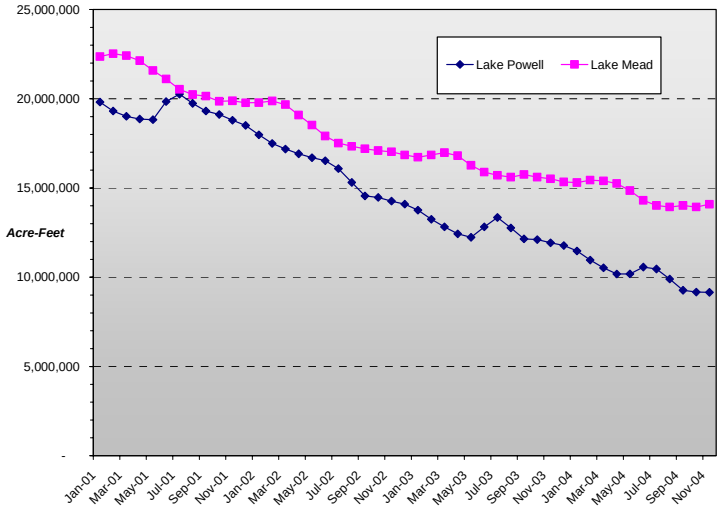
[35] Colorado River Basin Salinity Control Act, 43 U.S.C.A. § 1571 (1974).
[36] See http://coloradoriverrecovery.fws.gov/
[37] The Grand Canyon Protection Act is section 1801 of the Reclamation Projects Authorization and Adjustment Act of 1992. The Act mandates that the Secretary of the Interior must manage the Glen Canyon Dam in such a way as to "protect, mitigate adverse impacts to and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established." Note the recent actions taken under the Glen Canyon Adaptive Management Plan to remove non-native fishes from the River, and the steps taken to increase critical sediment in the Grand Canyon to protect cultural and archaeological resources while strengthening critical riverine habitat. *See* Deputy Secretary of the Interior, J. Steven Griles, Address to the Colorado River Water Users Association, December 17, 2004 (hereafter cited as Griles, 2004). The address may be viewed at http://www.crwua.org/news/norton2004.html.

200,000 acre-feet of highly saline drainage water routed directly to the delta region in order to minimize the impacts of salinity on irrigation activities (Pitt et al., 2000: 830).

PART III: MODERN ISSUES AND ACTIVITIES

While the Law of the River has been refined over the past eight decades to ensure more successful implementation and administration of the Compact and to accommodate the more extensive use of the Colorado River, the Basin states are still searching for solutions to several management difficulties. One of the immediate threats to continued administration of the river in accordance with the Law of the River is the current drought affecting the region and the associated decline of the amount of stored water in the Colorado River's reservoirs. The drought, caused by below average snowfall amounts for the past five years (notwithstanding our recent wet spring), started in 1999 and has been described as the worst in a century (see Table 3). By the end of 2004, Lake Powell's reserves stood at one-third of the reservoir's capacity; storage in Lake Mead was approximately half full (Figure 2).

Figure 2. Storage in Lake Powell and Lake Mead (2001 through 2004)



Colorado River water users have suffered remarkably few real impacts yet from this drought, although power production has already been reduced by the lower flows, and the potential drawdown of reservoirs below the minimum power pool would dramatically worsen the situation.[38] Interior Secretary Norton has already eliminated Lower Basin access to surplus water supplies and the Interior Department now faces the challenge of administering a shortage of water (and power) in accordance with the dictates of the Law of the River. The Interior Department has challenged the basin states to devise their own plan for sharing shortages; those negotiations are already behind schedule, but are ongoing.[39]

[38] Minimum power pool for Lake Powell is approximately 4 MAF and at Mead is approximately 7.5 MAF. These are rough estimates, as Reclamation specifies minimum power pool in terms of reservoir elevations, rather than in volumetric terms. If reservoir declines continue, an important management decision will be the extent to which efforts are made to protect the hydropower head at both reservoirs, beginning with Lake Powell (as Powell is draining fastest). The Law of the River is clear in subordinating power generation to off-stream uses, including agriculture, but the actual management of the river has always had a strong hydropower focus.

[39] Deadlines of April 1st and 30th given to the states have passed without significant progress. It increasingly looks like both short-term and long-term rules for administering shortages may come from the Interior Department. The Department now reportedly hopes to have Lower Basin Shortage Guidelines by 2007. Note that the special master's report in the *Arizona v. California* litigation contained a proposal for the

Furthermore, even if the recent drought should ease today, the reservoirs are unlikely to fill rapidly, and long-term, most studies agree that the estimates upon which the Law of the River is premised are unrealistically high. As mentioned earlier (see Table 3), the years preceding the negotiation of the 1922 Compact witnessed unusually high levels of precipitation—the wettest 20-year period this century[40]—resulting in an overestimation of the amount of water that would be present in the Colorado at Lee Ferry in most years. The problem of over-allocation has been worsened over time by the post-compact apportionment to Mexico, the tendency to define tributaries as now being outside the scope of the apportionment, and by the dramatic increase in evaporative losses associated with the completion of major storage projects (particularly Mead and Powell).[41] The unmistakably reality is that the allotments to which the basin states have agreed to and have come to rely upon are based on assumptions that are, at best, problematic, and at worst, untenable.

The storage facilities constructed by the Bureau of Reclamation provide a tremendous buffer to this problem by capturing the water during higher flows and ensuring that surplus is saved when possible. However, the ability of these facilities to offset a severe, sustained drought continues to decline, as growth in regional water demands removes the remaining slack from the system. The southwestern US remains the fastest growing region of the country, with 4 Colorado River states (Nevada, Arizona, Colorado and Utah) leading the nation in percentage growth during the 1990s, while another basin state (California) led in terms of absolute population growth (Census Bureau, 2001). The size of the population relying on water from the Colorado River has increased by 26% in the past decade (Griles, 2004). Many growing Upper Basin municipalities plan on tapping the remaining Upper Basin apportionment. The Upper Basin Compact Commission projects these depletions (i.e., consumptive uses plus evaporation) will climb from roughly 4.7 MAF in 2000 to 5.5 MAF in 2030 and 5.9 MAF by 2060 (Upper Basin Compact Commission, 1999). This schedule gets the Upper Basin almost up to its "assumed practical limit" of 6.0 MAF, although the current stress on the river leads many to suggest that this level of additional Upper Basin development is not realistic. In fact, the net result of additional Upper Basin development might be to increase the possibility of region-wide shortages and reservoir declines, thereby increasing the probably of Upper Basin "curtailments" that might threaten already developed Colorado River water.

Regardless of the pace of Upper Basin development, growth ensures that shortages on the system are a certainty; the question is when they will occur, how big they will be, and on whom the burden will fall. While these questions implicate the hydro-climate and engineering sciences, they are ultimately legal and political in nature. As stated earlier, the Secretary of the Interior was charged with managing such shortages through a variety of Law of the River statutes and through the Supreme Court's *Arizona v. California* decision.

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proportional sharing of Lower Basin shortages (with California bearing 4.4/7.5 of shortages, Arizona bearing 2.8/7.5, and Nevada bearing 0.3/7.5), but it was rejected by the Supreme Court in lieu of leaving the discretion with the Interior Department.

[40] See the U.S. Geological Survey Factsheet, "Climatic Fluctuations, Drought, and Flow in the Colorado River Basin" at http://water.usgs.gov/pubs/fs/2004/3062 (USGS, 2004).

[41] See the Bureau of Reclamation Colorado River System Consumptive Uses and Losses Report which may be accessed at http://www.usbr.gov/uc/library/envdocs/reports/crs/pdfs/crs962000.pdf.

However, formal guidelines for shortage administration have never been promulgated and many ambiguities in the Law of the River will affect any such regulations. Determination of who bears the burden of shortages is one of the primary questions requiring resolution. The 1944 treaty with Mexico, for example, recognized that the United States' obligation to deliver Mexico's apportionment of the Colorado River is of the highest priority, but how this federal obligation is imposed on the basin states remains unclear (Getches et al., 1995: 826). Since this water is supposed to come from surplus flows, the Upper Basin contends it has no obligation to provide any flows to Mexico as long as total Lower Basin consumptive uses (presumably including tributaries and evaporation) exceeds 8.5 MAF—a position obviously not shared in the Lower Basin. The Interior Department has requested that the State Department address the possibility of allocating shortages between the two countries in negotiations with Mexico (Griles, 2004), however, no decisions have been made. Managing the interstate conflicts is already a formidable challenge without the international complication; however, the two regional scales are inextricably linked.

As stated earlier, the Secretary has indicated a preference for the states to negotiate shortage guidelines (for the interstate component of the dispute), but all parties acknowledge that this will be difficult. Part of the challenge stems from the many ambiguities in the Law of the River. One example is found in Article III(d) of the Compact that obligates the Upper Basin to "not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre feet for any period of ten consecutive years…." This language immediately suggests two areas for debate. First, the 10-year running average component of the compact is very different from the AOP (annual operating plan) minimum objective release of 8.23 MAF. Currently, the Upper Basin states have delivered far more than 75 MAF in the past decade (actually over 100 MAF), so the Upper Basin is seeking a reduced release target from Lake Powell, so far without success.[42] Secondly, the language calling on the Upper Basin to "not cause" a violation of the 75 MAF/10-year standard perhaps suggests that a shortage that results from drought is not the responsibility of the Upper Basin, as drought is a natural phenomenon.[43]

Whether or not these and other arguments are compelling in a negotiation or courtroom is speculation at this point, but it is generally accepted that the Law of the River places the burden of severe shortages primarily on the entitlements of the Upper Basin states. Again, this has not been an issue in the past as Upper Basin demands have been low and severe droughts have been rare. But those days are limited.

To impose a shortage on Upper Basin water users would be complex both administratively and politically. Presumably, this would entail an interbasin compact call (or "curtailment") between the Upper and Lower Basins under the Colorado River Compact, which in turn

[42] Recently (May 2), Secretary Norton rejected the Upper Basin proposal to reduce the 8.23 MAF minimum objective release target this year.

[43] The language of Article III(a), apportioning the "exclusive beneficial consumptive use of 7.5 MAF of water per annum" to both Basins is difficult to reconcile with Article III(d)'s assurances that the Upper Division is not to cause the flow of the river to be depleted below an aggregate of 75 MAF for any 10 year period; accordingly, it remains to be determined which of these 2 provisions is controlling. See http://wwa.colorado.edu/in_focus/colorado_river/kuhn_compact_presentation_may04.pdf for a discussion of this question in a presentation by the General Manager of the Colorado River Water Conservation District.

could necessitate an intra-basin Upper Basin call among the four states party to the Upper Basin Compact. Exactly how this might work is highly uncertain—it has never happened before—although it is described in some detail in the Upper Basin Compact which calls first for states that have overused their entitlements to "pay back" the overage, and second for cutbacks to be imposed on states in proportion to consumptive use in the preceding year.[44] Conceptually this may seem viable, but in practice, the approach might be unworkable given the inability to effectively calculate depletions in each state (let alone in almost real time). Within the Upper Basin states, it is likely that the priority system would dictate the allocation of intrastate shortages, although emergency rules and deals may take precedence. In Colorado, for example, some of the junior users include municipal customers along the Front Range. The extent to which these users are vulnerable to a shortage on the Colorado River mainstem is clouded by a variety of hydrologic and legal uncertainties, but suffice it to say that the issue is receiving increased attention.[45] Similarly, the extent to which the Upper Basin states still have room to grow based on unused Colorado River apportionments is a question that merits reexamination.

This is not to suggest that the Lower Basin is immune from the impacts of potential Colorado River shortages. Past research done as part of the "Severe Sustained Drought in the Southwestern US" study in the early 1990s highlighted the vulnerability of southern California municipal users dependent upon surplus flows. California has regularly been consuming in excess of 4.4 MAF since 1953, and by the 1990s annual use often exceeded 5.2 MAF.[46] This level of use was made possible by unused Upper Basin apportionments and by wet weather. In recent decades the other basin states and the federal government became highly concerned over this chronic use of surplus water, and pressured California to devise a plan to live within the 4.4 MAF apportionment. The resulting 4.4 Plan, formulated in 2000-2001, is designed to achieve this goal through water conservation, water transfers from agricultural to urban users, fallowing of agricultural land in drought years, and development of methods for groundwater storage. Key to implementing the plan is the Quantification Settlement Agreement (QSA)[47], adopted in October of 2003 after arduous negotiations, which conserves and reallocates Colorado River water among several southern California water agencies. The great irony is that the basin states agreed to aid California in making this transition by agreeing that the state could continue to take designated surplus waters for fifteen years while the plan is implemented—the so-called "soft landing."[48] Given the current drought, this no longer appears possible. Nonetheless, California continues to make significant progress.

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[44] These terms are primarily spelled out in Articles IV(b-c) of the Upper Basin Compact.

[45] The Colorado State Engineer has started the process of developing criteria for imposing Colorado River shortages if necessary, perhaps following a scheme other than strict priority.

[46] See http://www.usbr.gov/lc/region/g4000/uses.html

[47] The QSA is formally titled The Colorado River Water Delivery Agreement (text available at http://www.saltonsea.water.ca.gov/docs/crqsa/crwda.pdf) and it quantifies the entitlements of the California water agencies to portions of the state's Colorado River allotment (modifying the original 7-party agreement of 1931). It also provides for the voluntary transfer of water from the irrigation districts to urban users and establishes a plan of compensation to the agricultural users. Additionally, the final plan addresses concerns about the environmental impact of the transfers upon the Salton Sea.

[48] The 2001 Colorado River Interim Surplus Guidelines were drafted to allow the Lower Basin, particularly California, access to surplus waters for 15 years in order to meet municipal and industrial needs. However,

Implementation of the plan is complicated by efforts to protect the Salton Sea. Since its accidental creation in 1905, the Salton Sea has served numerous functions: a national wildlife refuge critical for maintaining avian biodiversity and home to endangered fish species, a geothermal power source, a recreation site, a fishery site, and a drainage site for agricultural runoff. The lake is a terminal water body, with water and salinity levels determined by the interplay of incoming agricultural drainage water and losses to evaporation. Efforts to increase water-use efficiency in agriculture and to transfer irrigation water to distant cities have the potential to reduce lake levels and to further increase salinity, already 25% greater than ocean water. The QSA calls on the California Secretary for Resources to prepare an ecosystem restoration plan by the end of 2006 and for the Department of Fish and Game to manage a fund, supported by revenues from water transfers, to implement conservation measures. Several other efforts are underway to protect the resource.[49]

Another Lower Basin entity increasingly concerned about shortages is the Central Arizona Project (CAP), which is junior to California's 4.4 MAF apportionment. Full utilization of the CAP has been made possible, in part, through the use of CAP water in many tribal water rights settlements[50], and through the operation of water banks that allows Arizona to conjunctively use Colorado River water and central Arizona groundwater, using CAP and recharge facilities as the key infrastructure. The mechanism, administered by the Arizona Water Banking Authority (created in 1996), allows Arizona to use its full Colorado River entitlement today, which is expected by 2030 to allow the state to recharge approximately 14 MAF in water that would otherwise have remained available to other users—particularly southern California.[51] As of 2000, the water banking authority recharged approximately 294,000 acre-feet/year of water.[52] Water banking allows for full use of the CAP, eases groundwater overdrafting, provides environmentally-friendly water storage, and provides Arizona with some protection against future shortages. In doing so, however, it increases current demands on the river, and it means that there are real and immediate consequences if Colorado River managers have to curtail deliveries of Arizona's CAP apportionment, as contemplated by CAP's junior status.[53] Water banking also raises

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the guidelines also offered some security for the other Basin states in providing that the amount of water provided to meet those needs would be reduced in the case of drought conditions.

[49] The Salton Sea Authority was formed in 1993 by the Imperial Irrigation District, the Coachella Valley Water District, Imperial County, and Riverside County and it works with the state and federal governments to mainly address pollution problems in the Sea associated with the build-up of minerals, pesticides, and nutrients from fertilizer. In 1998, Congress passed the Salton Sea Reclamation Act and directed the Interior Department to propose plans for restoration of the lake. Some of the proposed actions focused on maintaining the entire sea at its present salinity levels, but such plans were rejected because of their high costs and the difficulty their implementation would pose. Accordingly, the restoration study underway in compliance with the QSA is exploring a variety of other alternatives.

[50] The latest (November 2004) is the Gila River Indian Community Water Rights Settlement Act (43 U.S.C.A. §1501), which provides for a settlement of long-outstanding operational and financial issues on the Central Arizona Project and allows all users on the CAP to know who has rights to specific amounts of CAP project water (Griles, 2004).

[51] See http://www.awba.state.az.us/backgrnd/exec_sum.html.

[52] See http://www.awba.state.az.us/backgrnd/update.html

[53] A major policy goal of the CAP is to have this junior status revoked. See

Compact issues; namely, the Upper Basin is prohibited from withholding unused water that can legitimately serve existing downstream users, but does the storage of groundwater in Arizona for later use qualify as a purpose for which interbasin releases can be requested?

Banking of Colorado River water is not an idea limited to Arizona. In Nevada, water is stored instate via the Southern Nevada Water Bank as well as in water banks operated jointly with California and Arizona, pursuant to interstate water banking guidelines issued in 1997 by former Secretary of the Interior Bruce Babbitt. Nevada reached an agreement with California in October 2004, to which the Bureau of Reclamation, the Southern Nevada Water Authority and the Metropolitan Water District of Southern California are parties, that allows Nevada's unused apportionment to flow into California. Under the agreement, California stores that water and will return up to 30,000 acre feet of it per year to Nevada when needed, upon six month advance notice.[54] The arrangement is advantageous to California in improving water quality by blending more Colorado River water with water received from Northern California and allowing extra water left in California's aqueducts to be utilized by the state; and it serves Nevada's needs by allowing for future use of any currently unused allotments. The agreement also benefits both California and Nevada by allowing for capture during periods of high flow. Nevada also agreed to a water banking pact with Arizona in December 2004, amending a 2001 agreement, whereby Nevada pays Arizona to store unused water from Nevada's apportionment in Arizona's groundwater aquifers for Nevada's future use. This agreement quantifies the amount of water to be stored as 1.25 MAF and allows Nevada to withdraw between 20,000 and 40,000 acre feet of water per year when needed.

An additional Lower Basin concern is the increasingly difficult challenge of fully utilizing the river given the region's many endangered species. An innovative approach to reconciling the goals of river development with the requirements of the Endangered Species Act (ESA) is the Lower Basin Multi-Species Conservation Program (MSCP), prompted by the Fish and Wildlife Service's designation, in 1994, of the Basin as critical habitat for the four endangered fish species previously mentioned. The $626 million 50-year plan stretches from Glen Canyon to the Mexican border[55] and is overseen by a diverse 27-member steering committee[56]—designated as an Ecosystem Recovery and Implementation Team under the ESA. The MSCP is to ensure compliance with the ESA's requirements for inter-agency consultation for proposed federal actions in the area (ESA Section 7) and incidental take authorization for projects undertaken in the region (Section

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http://www.cap-az.com/colorado/index.cfm?action=cover&subSection=75.

[54] California does not physically move water back to Nevada, but allows Nevada to withdraw water from Lake Mead out of California's apportionment. The Bureau of Reclamation administers the exchange.

[55] The exact program boundaries follow the 100-year floodplain and the reservoir full-pool elevations.

[56] A partial list of program participants include: the U.S. Department of Interior, U.S. Fish and Wildlife Service, Bureau of Reclamation, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, U.S. Department of Energy, Western Area Power Administration, several Arizona state agencies, several California state agencies, several Nevada state agencies, the Lower Colorado River Tribal Coalition, Colorado River Indian Tribes, Hualapai Tribe, Cocopah Tribe, Quechan Tribe, Chemehuevi Tribe, Fort Mohave Tribe, Trout Unlimited, National Wildlife Federation, and the Quadstate County Government Coaltion. See http://lcrmscp.org/Description.html for a full list of participants including all involved state agencies.

10). The Program's goal is to restore 8,100 acres of habitat for 26 species while ensuring continued water access for irrigation and hydroelectric power needs.[57]

A somewhat analogous program has existed in the Upper Basin since 1988. The Upper Colorado River Endangered Fish Recovery Program arose from a coalition of federal agencies, state governments, conservation organizations, and power providers dedicated to achieving the dual goals of fish recovery and continued water development for agricultural, municipal, and hydroelectric purposes. The program seeks to recover endangered fish through a strategy emphasizing research, ensuring adequate river flows, improving and conserving fish habitat, managing non-native fish species, and utilizing hatcheries to stock fish in the river.[58]

PART IV: CONCLUSIONS

As a part of the efforts to develop and use the Colorado River, a complex political history has produced an equally complex body of law to address issues of interstate allocation, reservoir management, international relations, water quality, and related concerns. The expanding population in the western states and the resulting increase in human demands for the Colorado River's water, when coupled with recent climate conditions and environmental protection mandates, are placing great stress on the system, forcing a long overdue re-evaluation of the institutional framework designed to manage the water body. "*Hard Times on the Colorado River: Drought, Growth and the Future of the Compact*" will help to focus our thinking regarding this challenge, as continued utilization of the Colorado will require a renewed commitment to innovation, cooperation, reassessment of priorities, and a willingness to adapt to the requirements of managing one of the most famous and infamous rivers in the world.

[57] A Memorandum of Agreement was signed in September 2004 to initiate the plan, an Environmental Impact Statement was prepared in compliance with the National Environmental Policy Act in December 2004, and implementation of the program began in April 2005. For more information on the MSCP, see: http://www.sci.sdsu.edu/salton/LowerColoradoRiverMSCP.html or Dean E. Murphy, "$626 Million to Protect Wildlife Along Colorado River," New York Times, April 5, 2005.

[58] See http://coloradoriverrecovery.fws.gov/ for more information on the Upper Colorado River Endangered Fish Recovery Program.

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Treaty between the United States of America and Mexico respecting utilization of waters of the Colorado and Tijuana Rivers and of the Rio Grande, Feb. 3, 1944, U.S.-Mexico, 59 Stat. 1219.

Upper Colorado River Basin Compact, C.R.S.A. §37-62-101 (63 Stat. 31 (1949)).

Wyoming v. Colorado, 259 US 419 (1922).

Note: Additional Colorado River materials can be found online at: http://wwa.colorado.edu/coloradoriver and on the conference CD.