The Amazing Colorado River

What Are the Messages for the West Slope from the Basin Study?

> June 27, 2013 Eric Kuhn





The Storyline of the Colorado River: Limited Supplies, Competing and Growing Demands and Overarching Compacts





Colorado River Basin Today Seven Basin States Almost 300,000 square miles • 35 Million People and growing **Up to 5.5 Million Irrigated Acres 10 Autonomous / Sovereign Tribes 2** Countries **Colorado River District** Protecting Western Colorado Water Since 1937

Colorado River Basin Tomorrow Seven Basin States Almost 300,000 square miles 80 Million People (increase of 91%?) 4.6 Million Irrigated Acres (decrease of 15%?) **10 Autonomous / Sovereign Tribes 2** Countries **Colorado River District** Protecting Western Colorado Water Since 1937

How Does the Colorado River Measure up?



All data in acre-feet/year



Water = Conflicts







Transmountain diversions (to east) and downstream demands (to west)

6,000,000 to 8,000,000 acrefeet / yr





Planning for the Future

- Colorado River Water Supply and Demand Study aka "Basin Study"
- Cooperative planning study
- Co-sponsored by US Bureau of Reclamation and 7-basin states
- Over ~\$4 Million; ~3 years; released to public on 12/12/12



Basin Study - What is it:

- Scenario-based planning study to assess water supplies and demands over next 50 years
- 24 combinations of supply and demand scenarios: 4 different future water supply inputs
 - 6 different future water demands inputs
- Key Assumptions:

↑ Demands (due to pop. growth but at differing rates)
↓ Supplies (due to more projected droughts, drying climate)



Basin Study Purpose

- Define current and future imbalances in the water supply and demand for Colorado River water through 2060
- Develop and evaluate opportunities to resolve those imbalances
- Not a decisional document but a foundation
- Really a call to action ("wake up call"?) to look at next steps for the Colorado River basin



Bottom Lines:

- Current basinwide demands (15.3 MAF/yr) outstrip supplies (14.9 MAF/yr)
- Current basinwide gap is covered by storage; significant future actions needed
- Gap is greatest in Lower Basin, shortages are 'when, not if'
- Gap in Upper Basin more uncertain; but shortage risk real and Chance of Curtailment > 0 in future



Bottom Line Summary:

From Study Report:

- "Imbalances will grow in the future if the potential effects of climate change are realized and demands continue to increase.
- A combination of options, including conservation and reuse, development of local groundwater supplies, desalination, augmentation, and the transfer of water from agricultural to urban uses, will likely be needed.
- Foundation and common platform developed upon which future discussions will occur to refine recommendations and implementations to sustain the environment, people, and economy of this region."



Water Supply vs. Water Use (10-year Running Average)



Projected Future Colorado River Basin Water Supply and Demand

- Average supply-demand imbalances by 2060 are approximately 3.2 million acre-feet
- This imbalance may be more or less depending on the nature of the particular supply and demand scenario
- Imbalances have occurred in the past and deliveries have been met due to reservoir storage



Notes:

Water Supply represents natural flow as measured at the Colorado River above Imperial Dam, Arizona

Water Use and Demand include deliveries to Mexico in accordance with the 1944 Treaty with Mexico and losses such as those due to reservoir evaporation, native vegetation, and operational inefficiencies.

Projected Water Supply is computed as the average 10th, 50th (median), and 90th percentiles of the Study's 4 water supply scenarios. The average of the medians is indicated by the darker shading.

Projected Water Demand is represented by the Study's 6 water demand scenarios. The median of the scenarios is indicated by the darker shading.



Law of the River Allocations

- 7.5 MAF to Upper Basin (%'s)¹
- 7.5 MAF to Lower Basin (4.4 CA; 2.8 AZ; 0.3 NV)²
- 1.0 MAF additional to Lower Basin³

(i.e., tributary development)

• <u>1.5 MAF to Mexico</u>⁴

17.5 MAF Total Allocated 'on paper'

¹ 1922 Colorado River Compact, 1948 Upper Colorado River Compact ² Colorado River Compact, 1929 Black Canyon Project Act, 1964 AZ v. CA Colorado River District ³ 1922 Colorado River Compact ⁴ Treaty of 1944

Water Supply Assessments (Observed)

- Warming trend in both the Upper and Lower Basins since the 1970s, consistent with observed North American and global trends;
- Widespread decreases in springtime snowpack observed; such losses of snow water equivalent (SWE) tend to be largest at low elevations and strongly suggest a temperature-related effect;
- Natural inter-annual variability in streamflow tends to be more dominant than observed trends;
- The recent deficit (difference between the 2-year running average flow and the long-term mean annual flow) since 2000 is more severe than any other deficit in the observed period (9 years and 28 maf);
- The paleo reconstruction (762–2005) contains deficits that are longer in duration and larger (16 years and as much as 35 maf). Thus, deficits of greater severity than the recent deficit are possible (and possibly likely).



Water Supply Assessments (Future)

- Warming is projected to increase across the Basin, with the largest changes in spring and summer and with larger changes in the Upper Basin than in the Lower Basin.
- Regional and temporal drying trends projected
 - some increases in precipitation in higher elevations and northern basins; dryer springs and summers, although some Lower Basin areas may have slight increases in precipitation, due to the monsoonal influence in this region. Upper Basin precipitation may increase in the fall and winter;
- More precipitation falls as rain rather than snow and warmer temperatures cause an earlier melt;
- Runoff (both direct and baseflow) is spatially diverse, but is generally projected to decrease, except in the northern Rockies



Comparison of Flow Scenarios

- 20 year mean 1988-2007* 13.2 MAF/year
- 25 year mean 1988-2012* 13.3 MAF/year
- Basin Study Climate Change
 - 13.6 MAF/year
- 60-year mean 1953-2012 * 14.0 MAF/year

QUESTION? What flows should we use for planning purposes?

*Source: UCRC ANNUAL REPORTS (2012 ESTIMATE) FOR NATURAL FLOWS AT LEE FERRY, AZ COLORADO RIVER DISTRICT Protecting Western Colorado Water Since 1937

Policy Questions / Implications

1. Do new, broader market –based solutions represent our future?

(i.e., conservation with transfers between sectors? Between states? Between basins?)

- 2. Can the Law of the River be enhanced to enable new conservation transfers mechanisms and still survive?
- 3. How do we mitigate risks of future development on existing uses / economies in the future?

Risk Management through:

- Upper Basin Water Bank?
- New classes of water rights?
- Different administration schema?

All parties will need to be engaged, informed, creative and flexible as we travel this path



Indicators of Vulnerability

- Vulnerability performance below desired level
- Indicators
 - -e.g., Compact Curtailment
 - "Lee Ferry Deficit"
 - if flows into Lake Powell are less than 75 MAF over 10 years then

Vulnerable Condition -> Potential Curtailment



Colorado River Compact of 1922

Colorado, like all Upper Division states, shares obligations to the Lower Division

III (d) the Upper Division shall "not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any ten consecutive years."

III (c) regarding Mexico...the Upper Division must "deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in paragraph (d)."



Important Implications

Article VIII of the 1922 Compact:

"...present perfected rights to the beneficial use of waters of the Colorado River System are unimpaired by this compact."

Article IV(c) of the 1948 Compact:

excludes water rights perfected prior to Nov. 24, 1922 from curtailment

NOTE: The 1964 *Arizona v. California* Supreme Court decree includes a definition of "present perfected rights" that MAY apply.



The Upper Basin does not have a delivery obligation to the Lower Basin

Instead, a subtle but important difference: The States of the Upper Division are required to *limit their post-compact development* of water so that their actions *do not cause the flow* at Lee Ferry to drop below the 10-year running average of 75MAF



Vulnerability: Lee Ferry Deficit



Highlighted Scenario Names

Paleo Conditioned, Enhanced Environment (D1)
Paleo Conditioned, Current Projected (A)
Observed Resampled, Rapid Growth (C1)
Downscaled GCM Projected, Enhanced Environment (D1)
Downscaled GCM Projected, Rapid Growth (C1)
All Other Scenarios

'Workable' Options / Strategies

- Conservation (e.g., water use efficiency, fallowing, transfers and re-use, re-cycling)
- Augmentation (e.g., importation, weather mod, desalination)
- Governance (aka enhancing 'Law of he River, e.g., water banking, interstate / interbasin transfers)?
- Combination of the above (e.g., portfolio approach)?



Augmentation

- Cloud seeding (aka weather modification)
- Non-native plant eradication / management
- Dust management / mitigation
- Smaller scale desalinization (coastal cities & brackish groundwater)
- Larger efforts on water re-use / recycling
- Imports from other basins (Mississippi & Snake)
- Large scale desalinization



West Slope Message

- Long term, the math does not add up
- Increase in demand vs. potential long term drought
- Climate change will decrease runoff (even though precipitation may increase)
- Compact curtailment is punitive
- Risk of curtailment requires careful development of remaining entitlement









What is a Water Bank?

- Two Basic Water Bank Strategies
- Use Bank to Avoid a Curtailment
- 2. Use Bank to Survive a Curtailment

- Irrigators paid to reduce consumptive uses – deficit irrigation or fallowing
- Savings "banked" in a reservoir



Many - Many Questions

- Economics are there sufficient willing buyers and sellers?
- How are secondary economic & environmental impacts addressed?
- How do we address the water rights implications?
- Colorado shares the Lee Ferry Obligations with three other states.



Compact Development



"C'mon, c'mon—it's either one or the other."



ColoradoRiverDistrict.org