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## **On Markets and Water Security**

Water Resources Research Center, University of Arizona  
Conference “Water Security from the Ground Up,” March 5, 2013

## What is Water Security and What is it not?

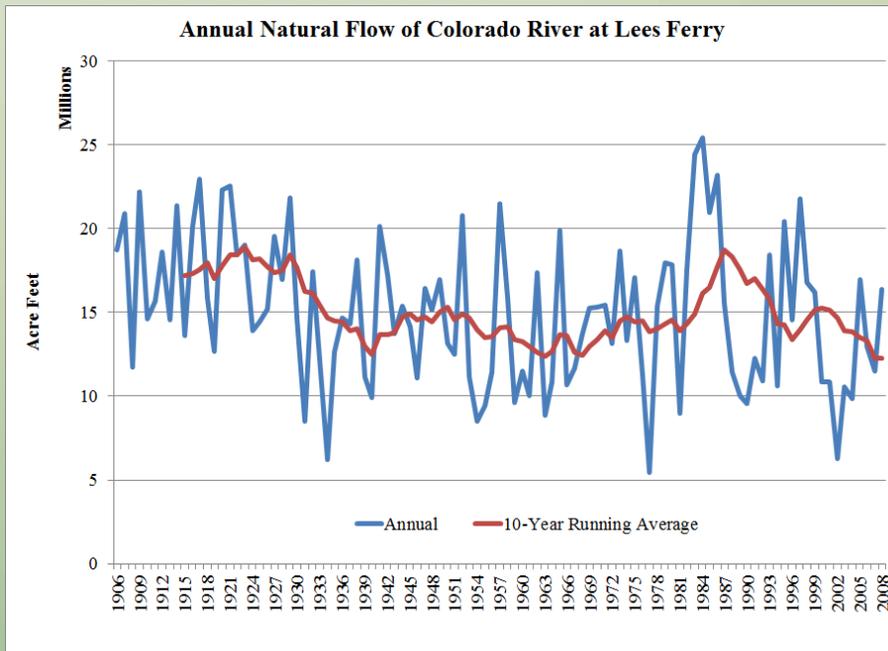
- “Water security constitutes the sustainable availability of adequate quantities and qualities of water for resilient societies and ecosystems in the face of uncertain global change” (*Varday and Scott, emphasis added*)
- A missing link: resource risk management (humans and institutions)
  - ✓ Sustainable: longevity and survivability
  - ✓ Availability: reliability (robustness to realization of risk factors)
  - ✓ Uncertain: risks even in the absence of global change

## Water Security is an Elusive Goal

- How is risk currently allocated?
- How may risk be reallocated?
- How may we mitigate (reduce) risk?
- How do we quantify risk and measure how it changes to improve water security?
- Explore these questions using the hydrologic risk of the Colorado River

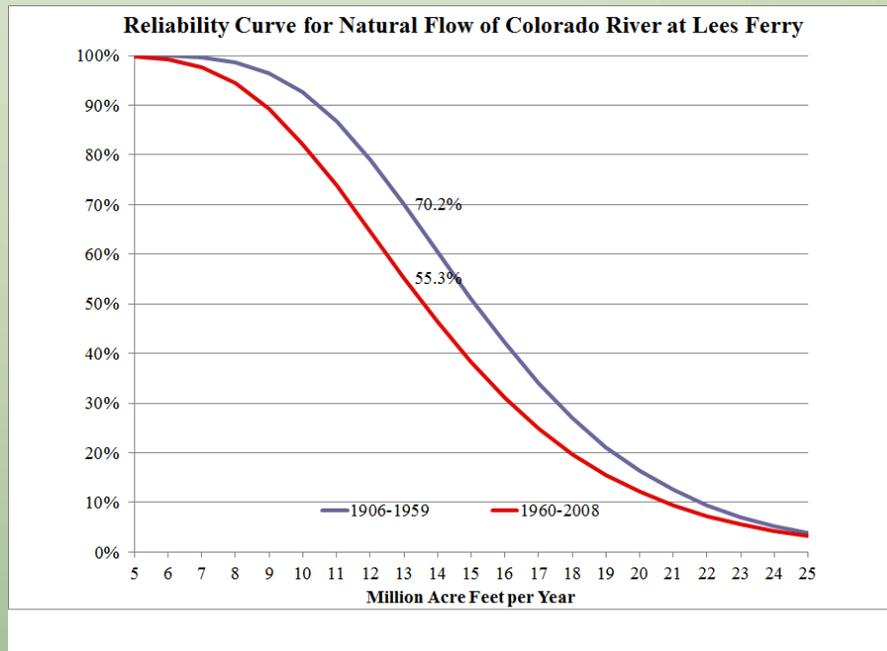
# **Hydrologic Risk on the Colorado River**

## Earlier Part of 20<sup>th</sup> Century Unusually Wet Period



- Until 1930s, annual flow averaged 18 million acre feet
- 1922 Compact allocated 15 million acre feet/year
- 1944 Treaty allocated 1.5 million acre feet/year to Mexico
- Tree ring studies suggest long-term average flow 13.5 million acre feet

## Probability that Annual Natural Flow Exceed 13 Million Acre Feet has declined from 70% to 55% during 20<sup>th</sup> Century



- Decline in reliability of annual flows means less likely that there are sufficient supplies to meet all rights
- Storage helps firm up supplies, but need excess supplies in high-flow years to store water for use during low flow years (more below)

# **How is Risk of Low Supplies Allocated Today?**

## Prior Appropriation Doctrine

- First in time, first in right
- With agricultural uses developed earlier in time than municipal uses, agriculture generally has “senior right” and municipal uses “junior rights”
- Risk of declining availability and reliability of water supplies borne by municipal water users

## How System Works for Colorado River in Arizona

- Arizona sustains the first 1.5 million acre feet per year cutbacks in the Lower Basin
- Within Arizona, Central Arizona Project takes first shortages
- Agricultural water users on Colorado River have 782,900 acre feet of water rights senior to Central Arizona Project

# **How to Improve Water Security for Arizona Municipal Water Users?**

## Tools of Risk Management: Risk Allocation

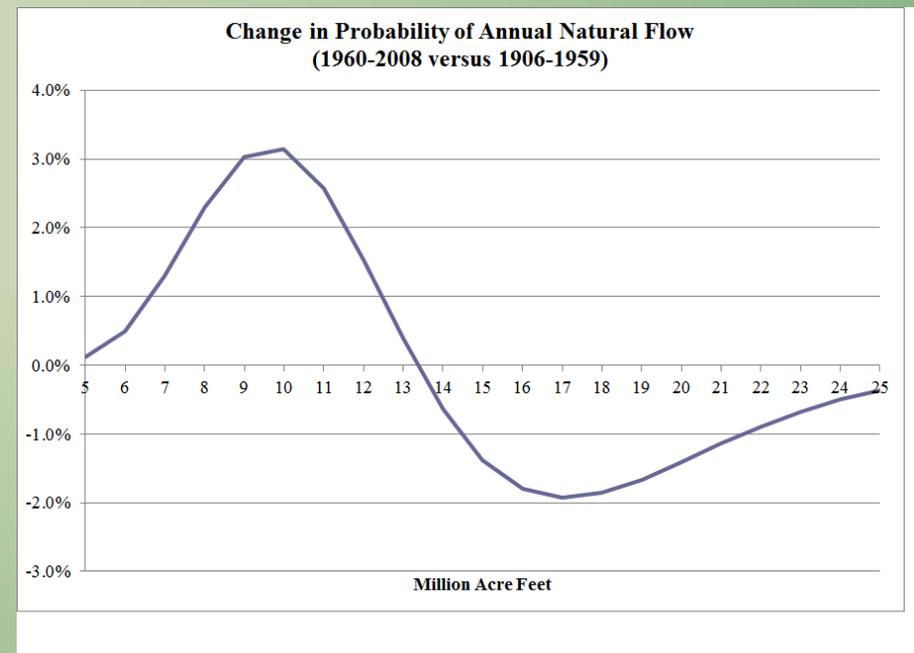
- Involuntary (litigation/legislation)
  - Delay, transaction costs, uncertain outcome
  - Add litigation lottery/political risk to resource risk
- Voluntary (water transfers)
  - Palo Verde Irrigation District/Metropolitan Water District fallowing program reallocates supply reductions from junior to senior priorities when needed—money for water

## Tools of Risk Management: Risk Reduction by Conservation

- Imperial Irrigation District/San Diego County Water Authority agreement based on long-term water conservation to allow more uses of water available from senior water right—money for water
- Water conservation by junior right holders: “move up” the supply reliability curve of the underlying resource
  - ✓ Reducing the bet on higher flow years/storage needed to meet higher demands—money to reduce need for water

# Tools of Risk Management: Risk Reduction by Storage

- Colorado River System has storage to improve supply reliability
- Active storage capacity about 3x 16.5 million acre feet
- Water in storage 2x 16.5 million acre feet today
- Changing hydrologic risk on Colorado River means more frequent demand for stored water and less frequent opportunities for storage



# **Quantifying and Understanding Risks**

## Current Approaches: Wisdom of Experts

- Looking into the Rearview Mirror: hydrologic history
- Using Black Boxes: computer resource models (see “Blind Men, Elephants and Zen: Approaching Basin Evaluation Like a Cup of Tea”, Larry Fanning, *Water Strategist Community Blog* ([www.wscommunityblog.com](http://www.wscommunityblog.com)), posted January 23, 2013)
- While these tools continue to evolve in meaningful and useful ways, run risk of lack of buy-in of policy and broader community (witness the climate change debate)

## “Market of Ideas” Solution: Wisdom of Crowds

- What are prediction markets and what do they do?
  - ✓ trade contracts about defined future outcomes
  - ✓ thousands of public and private sector markets successfully predict the frequency of traded events actually occurring
  - ✓ aggregate information, analysis and beliefs of participants
- What can prediction markets do for water security?
  - ✓ inform choices by assessing risks and magnitude of consequences of future events (policy outcomes, hydrology, projects, agreements, litigation)

## Conclusion

- We don't live in a riskless world nor can we create one
- We can improve water security through prudent risk management
- Risk management is forward-looking and based on objective factors, but is also subjective
- Decision making will improve from broadening the dialogue with alternative views about risks and future outcome with a way to balance them
- Prediction markets can harness the wisdom of the industry crowd's well-known diverse set of (often conflicting) interests, knowledge and information
- By improving understanding of future risks, prediction markets can help us secure a better water future

# For More Information

- “Increasing Hydrologic Risk on the Colorado River Basin”, Rodney T. Smith *Water Strategist Community Blog* ([www.wscommunityblog.com](http://www.wscommunityblog.com)), posted January 28, 2013
- For ongoing commentary on western water policy, [www.wscommunityblog.com](http://www.wscommunityblog.com). Join the dialogue as a blogger, commentator, or reader
- For emergence of water policy prediction markets, keep your eye out for [www.waterpolicymarkets.com](http://www.waterpolicymarkets.com) (under development). Use “contact us” on the *Water Strategist Community Blog* to let us know if you want to receive information about roll out and how to participate once we go live