MODELING THE FORBIDDEN TOPIC

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1922 Colorado River Compact

Upper Basin States

- Colorado
- New Mexico
- Utah
- Wyoming

Lower Basin States

- Arizona
- California
- Nevada

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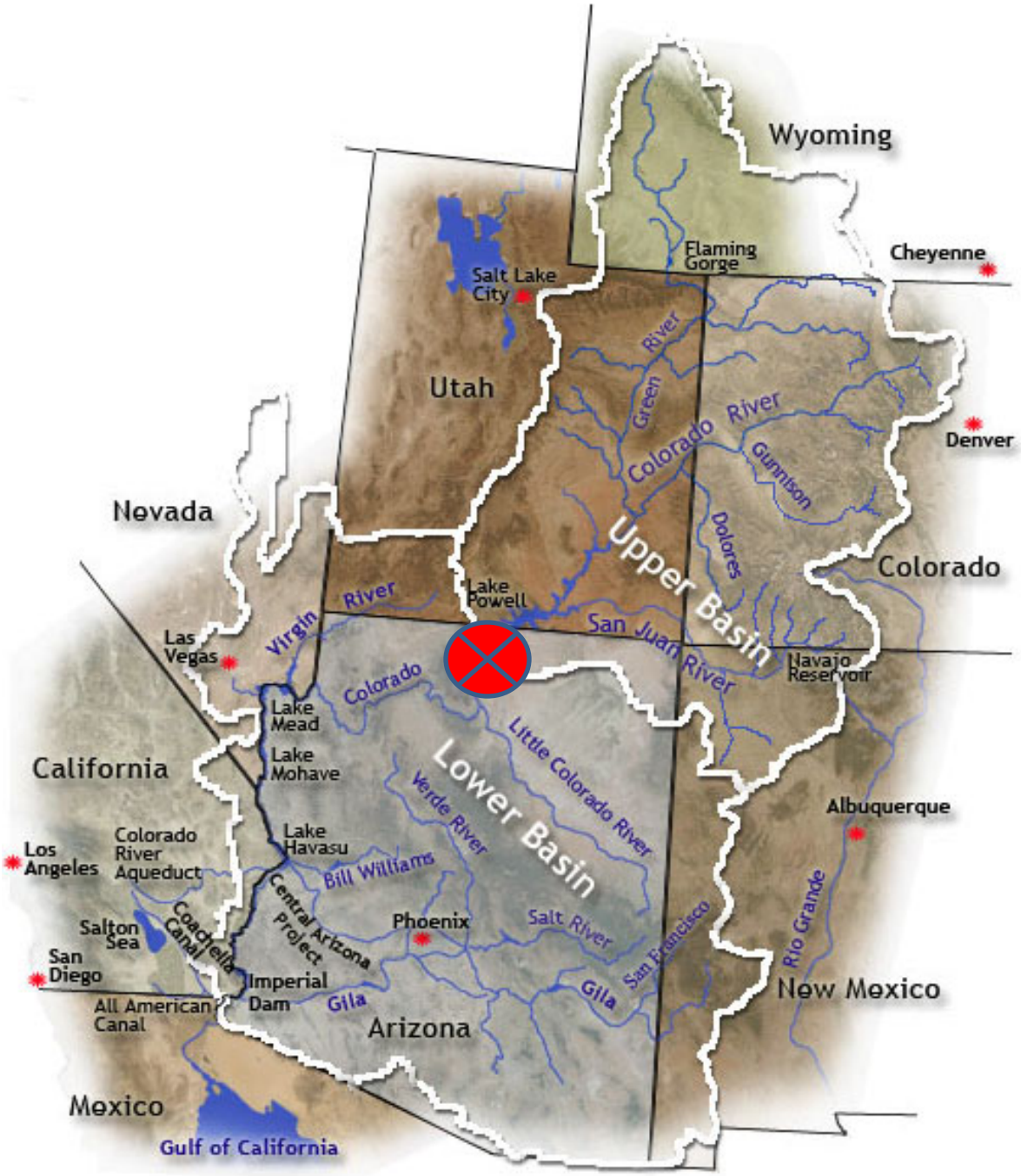
Colorado River Basin

Lee's Ferry Compact Point



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Colorado River Compact

(a) There is hereby apportioned from the Colorado River System in perpetuity to the **Upper Basin** and to the **Lower Basin**, respectively, the exclusive beneficial **consumptive use of 7,500,000 acre-feet** of water per annum, which shall include all water necessary for the supply of any rights which may now exist.

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Colorado River Compact

(d) The States of the Upper Division will **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** reckoned in continuing progressive series beginning with the first day of October next succeeding the ratification of this compact.

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Colorado River Compact

(c) If, as a matter of international comity, the United States of America shall hereafter **recognize in the United States of Mexico any right to the use of any waters of the Colorado River System**, such waters shall be supplied **first from the waters which are surplus** over and above the aggregate of the quantities specified in paragraphs (a) and (b); and if such surplus shall prove insufficient for this purpose, then, **the burden of such deficiency shall be equally borne by the Upper Basin and the Lower Basin**, and whenever necessary **the States of the Upper Division shall deliver at Lee Ferry water to supply one-half of the deficiency** so recognized in addition to that provided in paragraph (d).

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Colorado River Simulation System (CRSS)

- Long-Term Planning Model - Monthly Time Step
- Focus on Operations Between Lake Mead and Lake Powell
- Used for Surplus, Shortage Environmental Impact Statements

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CRSS Limitations

- ESA Flow targets are not operated
  - Flaming Gorge, Aspinall, Navajo
- Model Does **Not** Include:
  - Represent regulation from
    - Granby/Shadow/Grand, Windy Gap, Williams Fork, Green Mountain, Dillon, Wolford, Stagecoach, Elkhead, Willow Creek, Ruedi, etc.
- Compact Obligations to Lower Basin
  - Does not try to meet 1922 Compact obligations
  - Measures non-compliance at Lee's Ferry
    - misleading as "probability of call"

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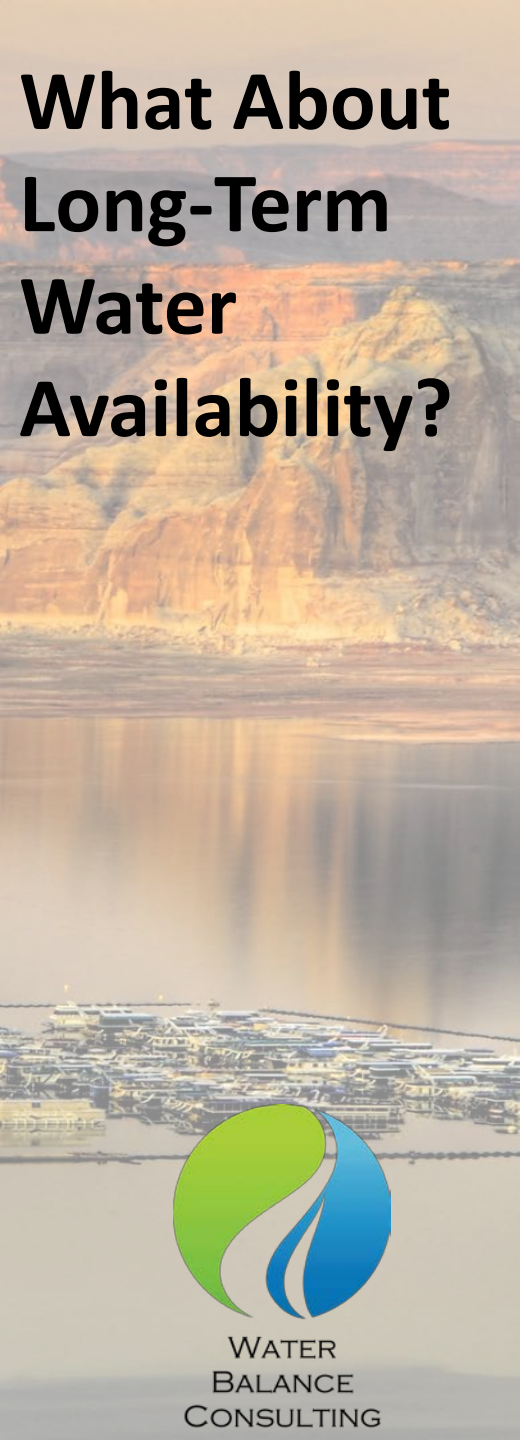
What About Long-Term Water Availability?



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Independent Projects

- Colorado River Water Availability Study (CRWAS)
- State of Colorado Compact Compliance Study
- Collaborative Water Bank Work Group
- USBR Basin Study
- NGO E-Flows Shadow Modeling of Basin Study

E-Flows Model:
NGO Shadow Modeling

- Phase 1:
  - NGO's
  - CADSWES
  - USBR
- Phase 2:
  - NGO's
  - Water Balance Consulting

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E-Flows Model Phase 1

- Extend Coordinated Operations Beyond 2026
- Reverse Rule Execution Order
- Upper Basin Reservoirs Operated Reflect Actual Operations & ESA Compliance
  - Fontenelle, Flaming Gorge, Navajo
- Explicit Representation of “Hard” and “Soft” Flow Target Locations

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E-Flows Model Phase 2

- Implement Compact Obligations to Lower Basin Using CRWAS Method
- Quantify the Magnitude and Frequency of Compact Deficiencies
- Explore Methods to Mitigate Compact Deficiencies

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How Do You Model Compact Calls With Such Political Sensitivity?

- Compact Call Amount?
  - 75 million acre-feet over 10 years
  - 82.5 million acre-feet over 10 years
- Where Does the Water Come From?
  - Increased Supply
  - Demand Management
    - Who in the Upper Basin Gets Reduced?
      - Distribution Among States
      - Which Water Rights are Subject to the Compact?
      - Pre 1922 vs. Post 1922

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Goals

Develop a method that it useful enough to:

1. Assess water availability in the Upper Basin
2. General enough to avoid political conflicts

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Modeling Assumptions

- Hydrologic Inputs
  - Historical Index Sequential
  - Truncated Historical Hydrology
  - Climate Change Hydrology
- Water User Demands
  - 2007 Upper Basin UCRC

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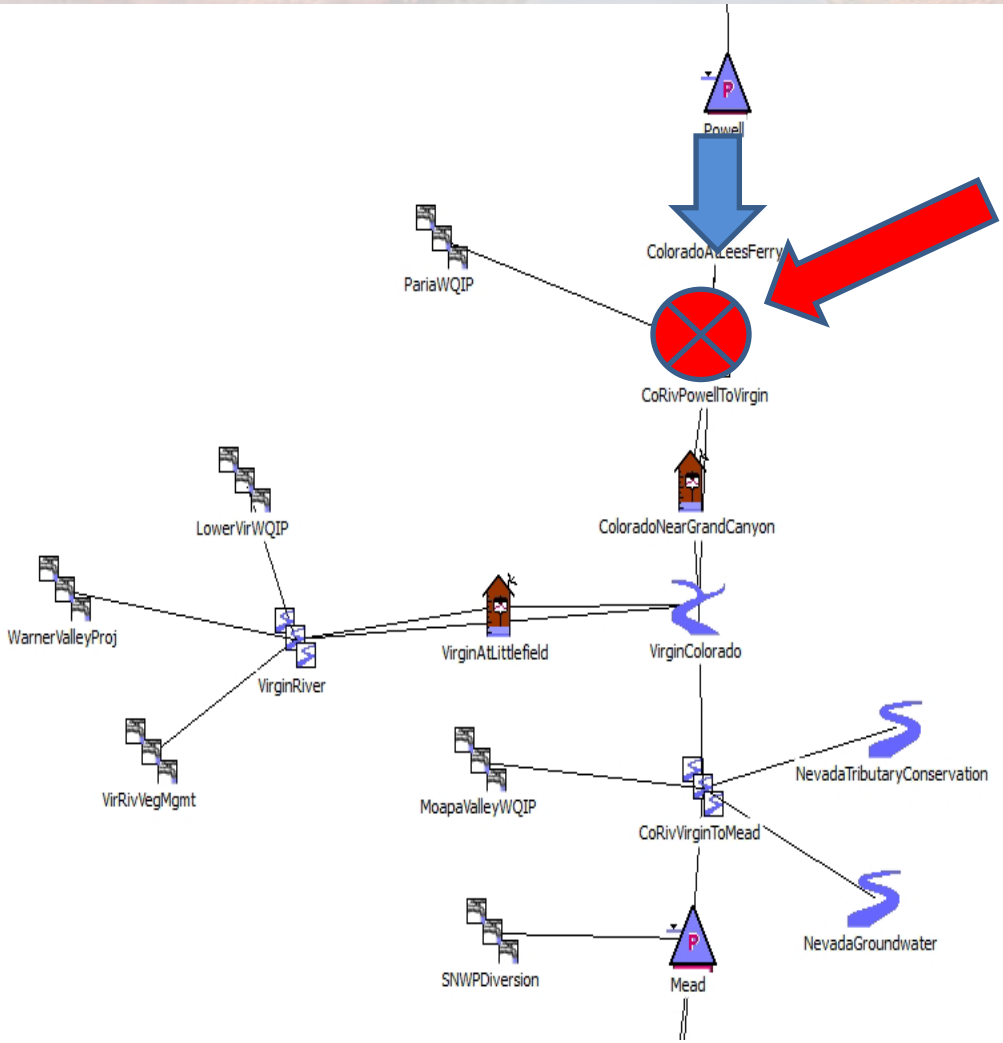
CRWAS Compact Modeling Method

1. Measures monthly non-compliance at Lee's Ferry
2. Increase Release from Lake Powell
3. Add Supplement Water



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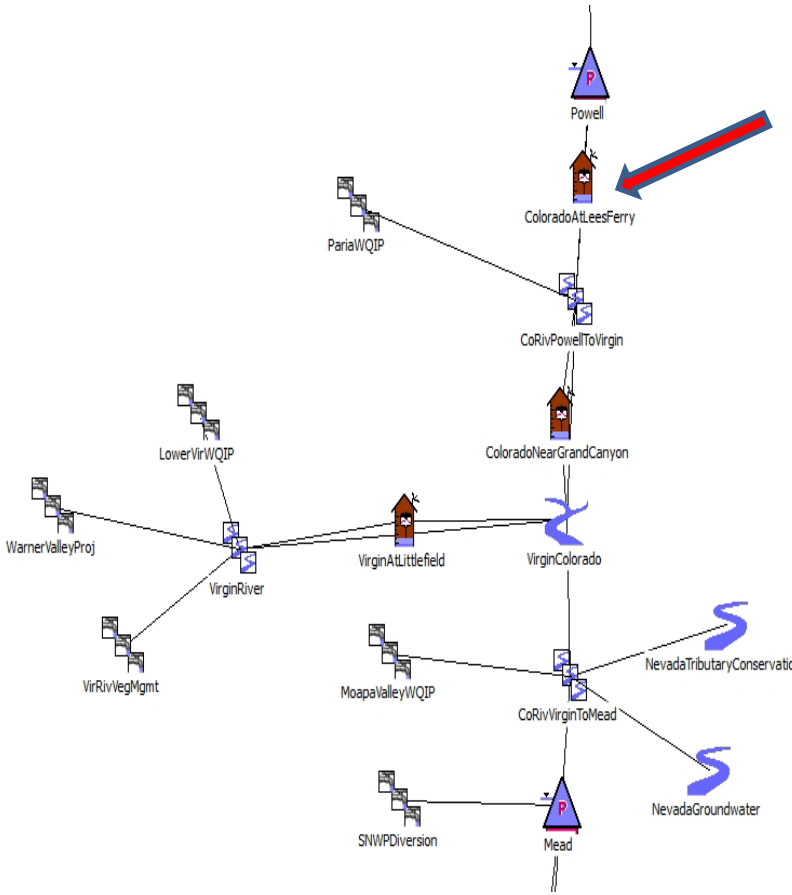
CRWAS Supplemental Water Concept

- Measures Shortfall/Required Compact Delivery from UB to LB
- Derive Water Availability to the Upper Basin
- Doesn't Maintain Mass Balance



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Six “Baseline” Scenarios

	75 maf Target	82.5 maf Target
Historical ISM	X	X
Truncated Historical ISM	X	X
Climate Change	X	X

Determine Compact Supplement for Each Scenario

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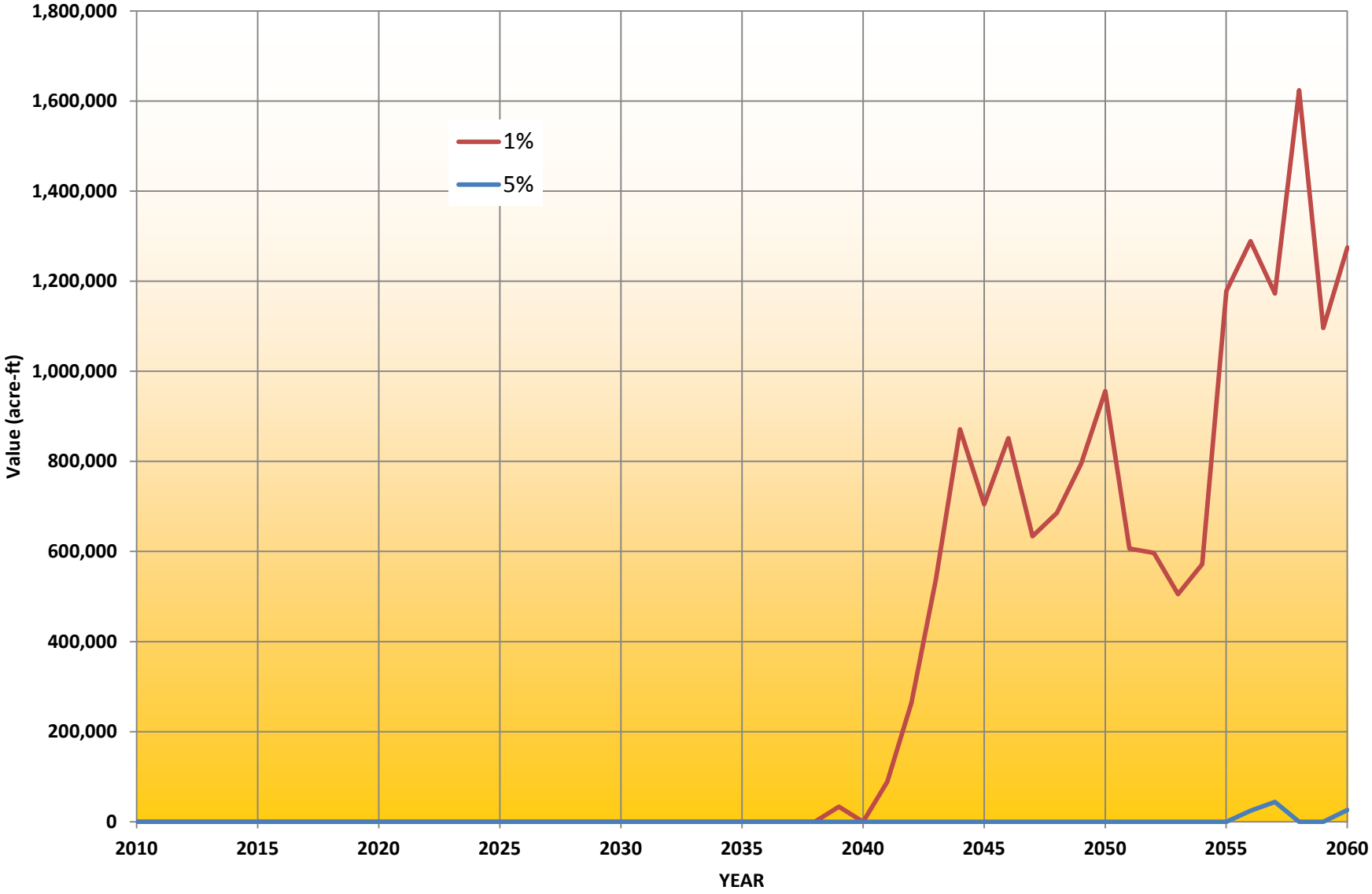
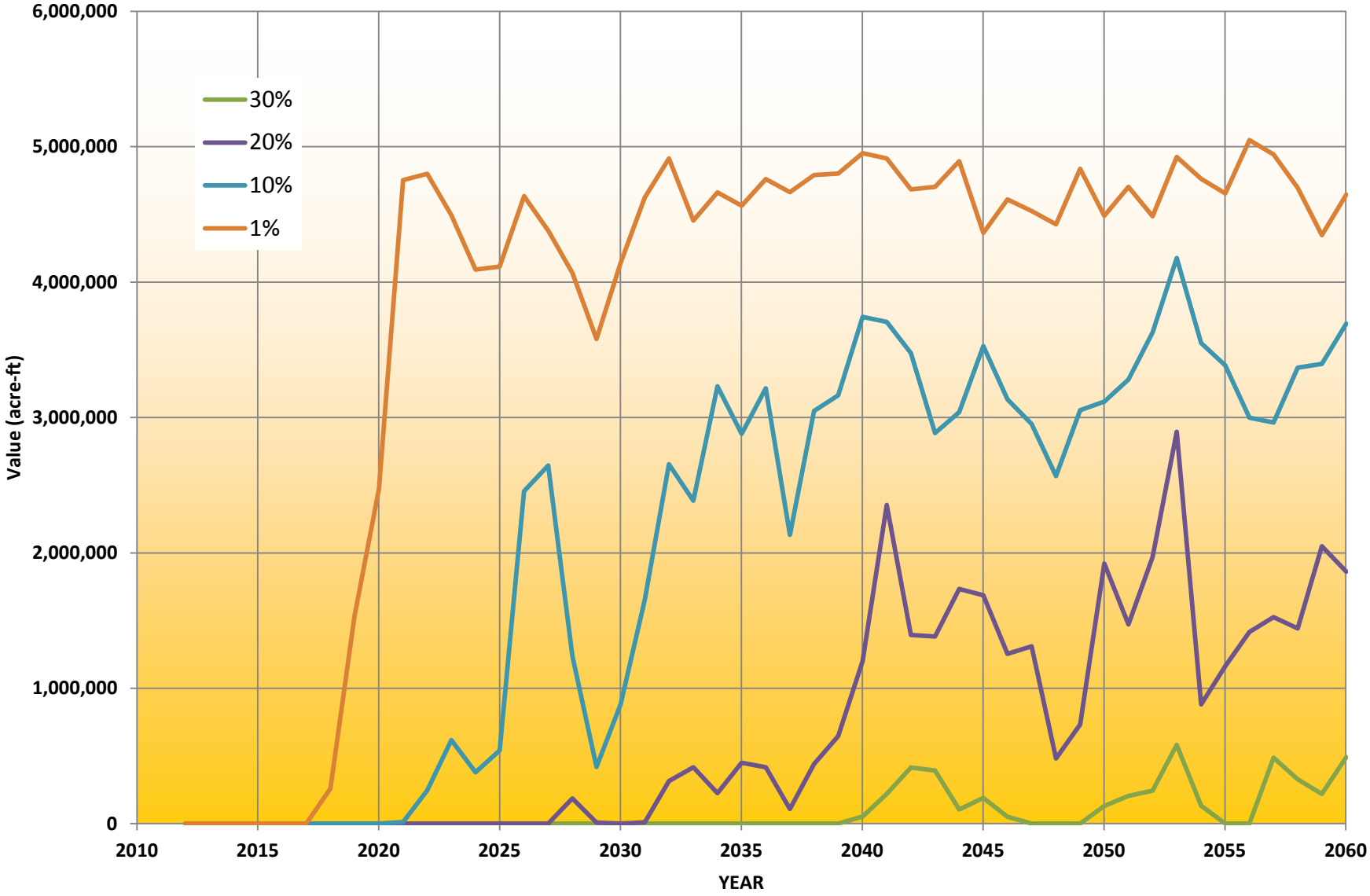
Magnitude of a Compact Deficit by Probability
Historical Hydrology, 82.5 maf Target



Probability and Annual Volume of Compact Supplement Required
82.5 maf compact Target - Climate Change Hydrology



Satisfying Compact Obligations

- Reactive Measures
  - "Supplement Water" concept
  - Emergency Fallowing
- Proactive Measures
  - Annual Agricultural Fallowing
    - Dry Years
    - Wet Years
    - All Years
  - Where/How to Store Water

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Banked Water Locations

- In Lake Powell
  1) Subject to Coordinated Operations
  2) Not Subject to Coordinated Operations
     - "Dedicated Compact Bank"
- Store Banked Water In Upper Basin Reservoirs
  - Reoperation of Upper Basin Reservoirs

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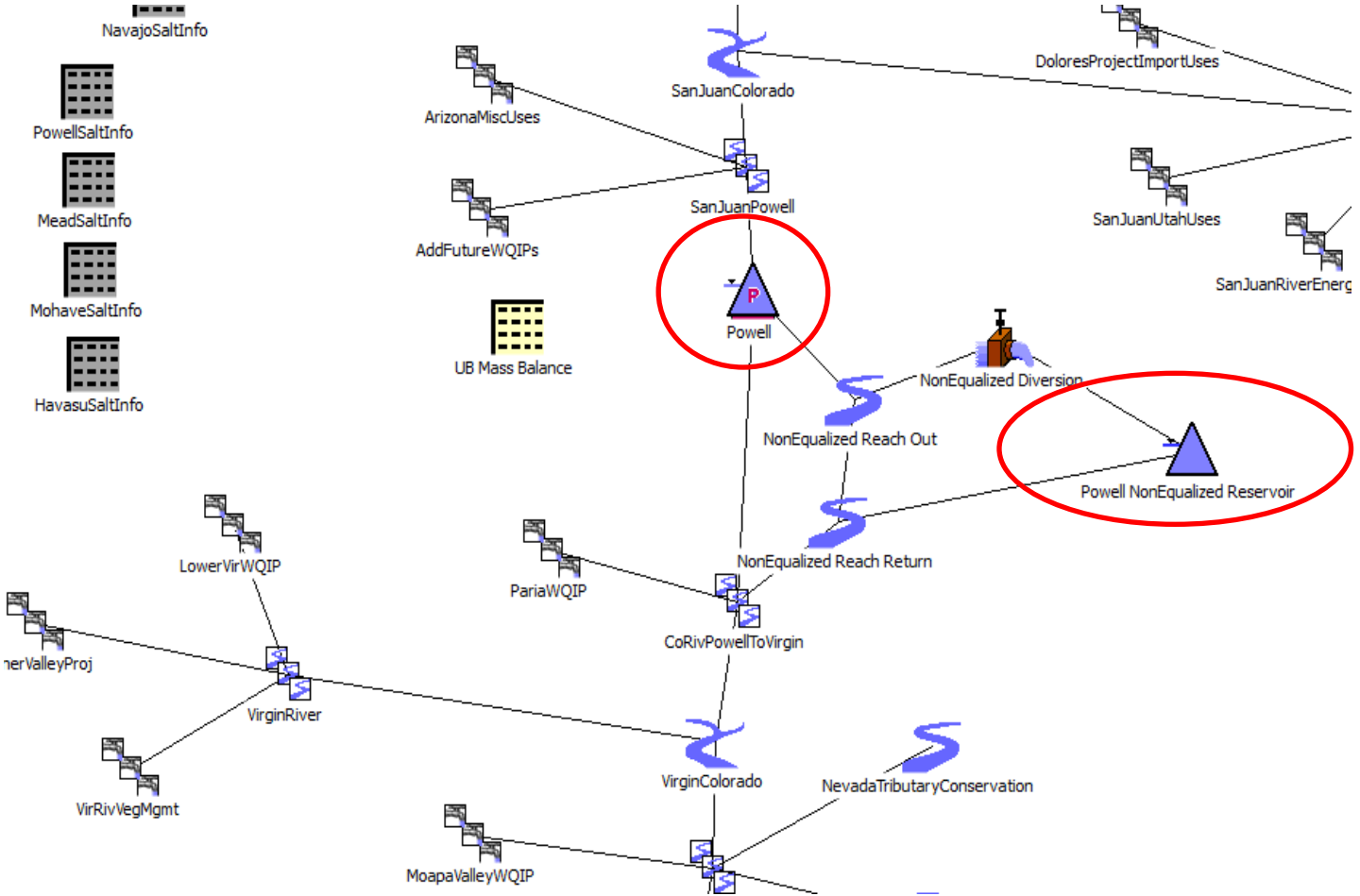
Powell Banking Locations



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E-Flows Banking Method

1. Proactively Fallow Water from Upper Basin Users
2. Deposit Water into
   A. Lake Powell
   B. Dedicated Compact Bank

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3. Use water from Dedicated Compact Bank
4. Increase Flow from Lake Powell
5. Add Reactive Water a.k.a. “Supplemental Water”

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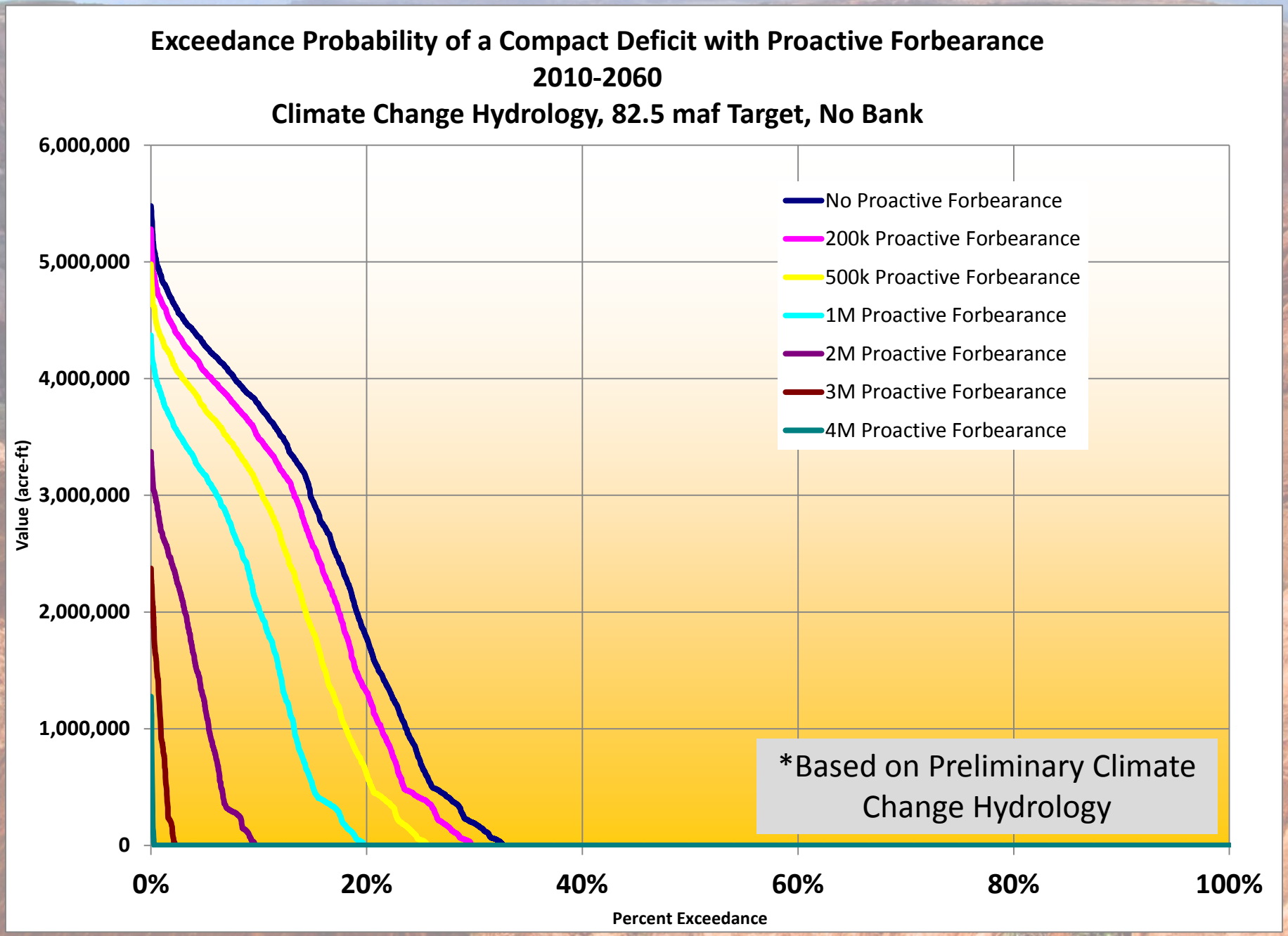
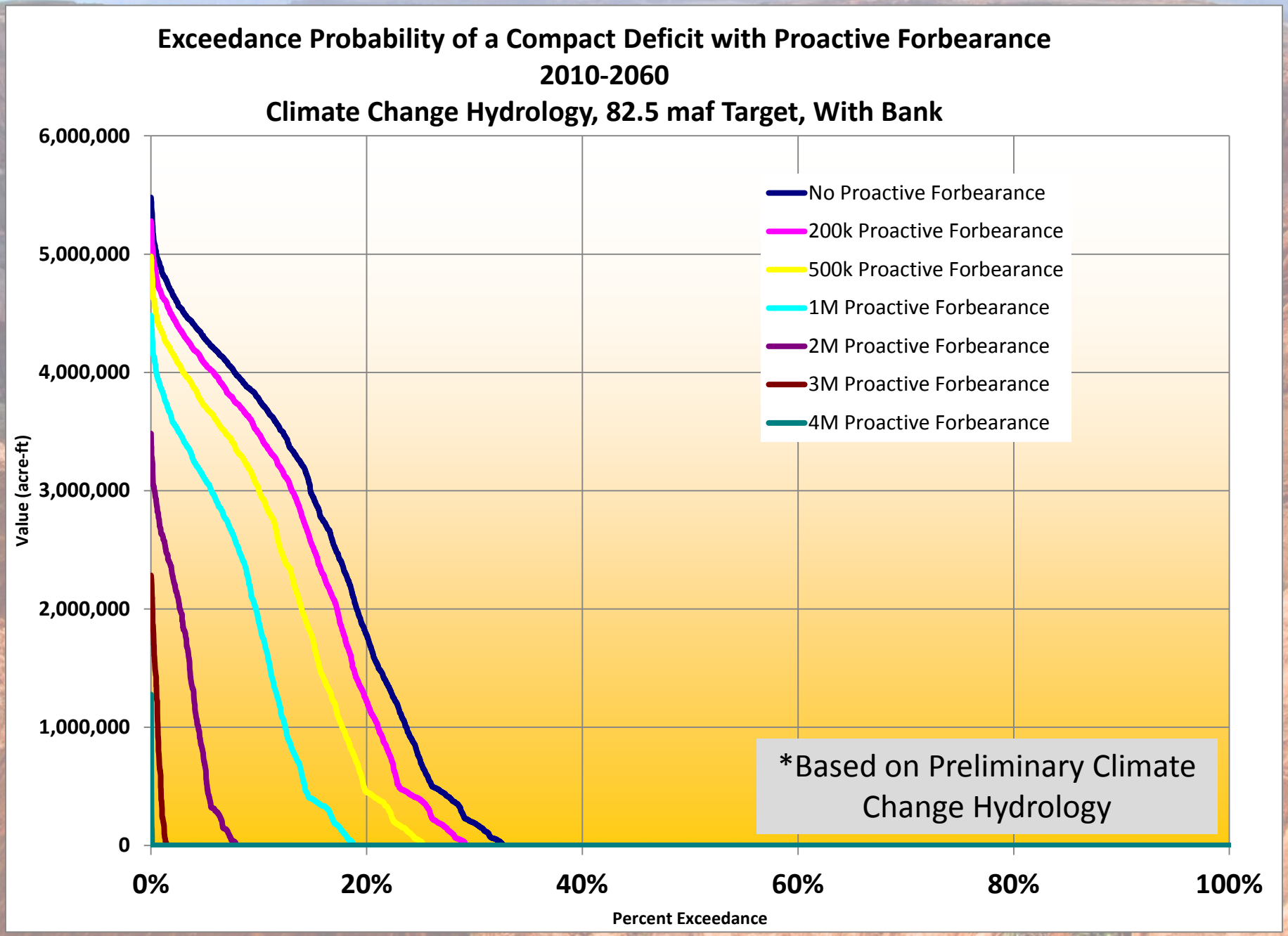

Exceedance Probability of a Compact Deficit with Proactive Forbearance
2010-2060
Climate Change Hydrology, 82.5 maf Target, No Bank
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Value (acre-ft)
0%
20%
40%
60%
80%
100%
Percent Exceedance
No Proactive Forbearance
200k Proactive Forbearance
500k Proactive Forbearance
1M Proactive Forbearance
2M Proactive Forbearance
3M Proactive Forbearance
4M Proactive Forbearance
*Based on Preliminary Climate Change Hydrology


Exceedance Probability of a Compact Deficit with Proactive Forbearance
2010-2060
Climate Change Hydrology, 82.5 maf Target, With Bank
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Value (acre-ft)
0%
20%
40%
60%
80%
100%
Percent Exceedance
No Proactive Forbearance
200k Proactive Forbearance
500k Proactive Forbearance
1M Proactive Forbearance
2M Proactive Forbearance
3M Proactive Forbearance
4M Proactive Forbearance
*Based on Preliminary Climate Change Hydrology

New Directions

- What is the most efficient combination of Proactive vs. Reactive Forbearance?
- Limit Reactive Forbearance to Protect Pre-1922 Water Rights
- Exploration of Numerous Potential Forbearance Arrangements

Questions?

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