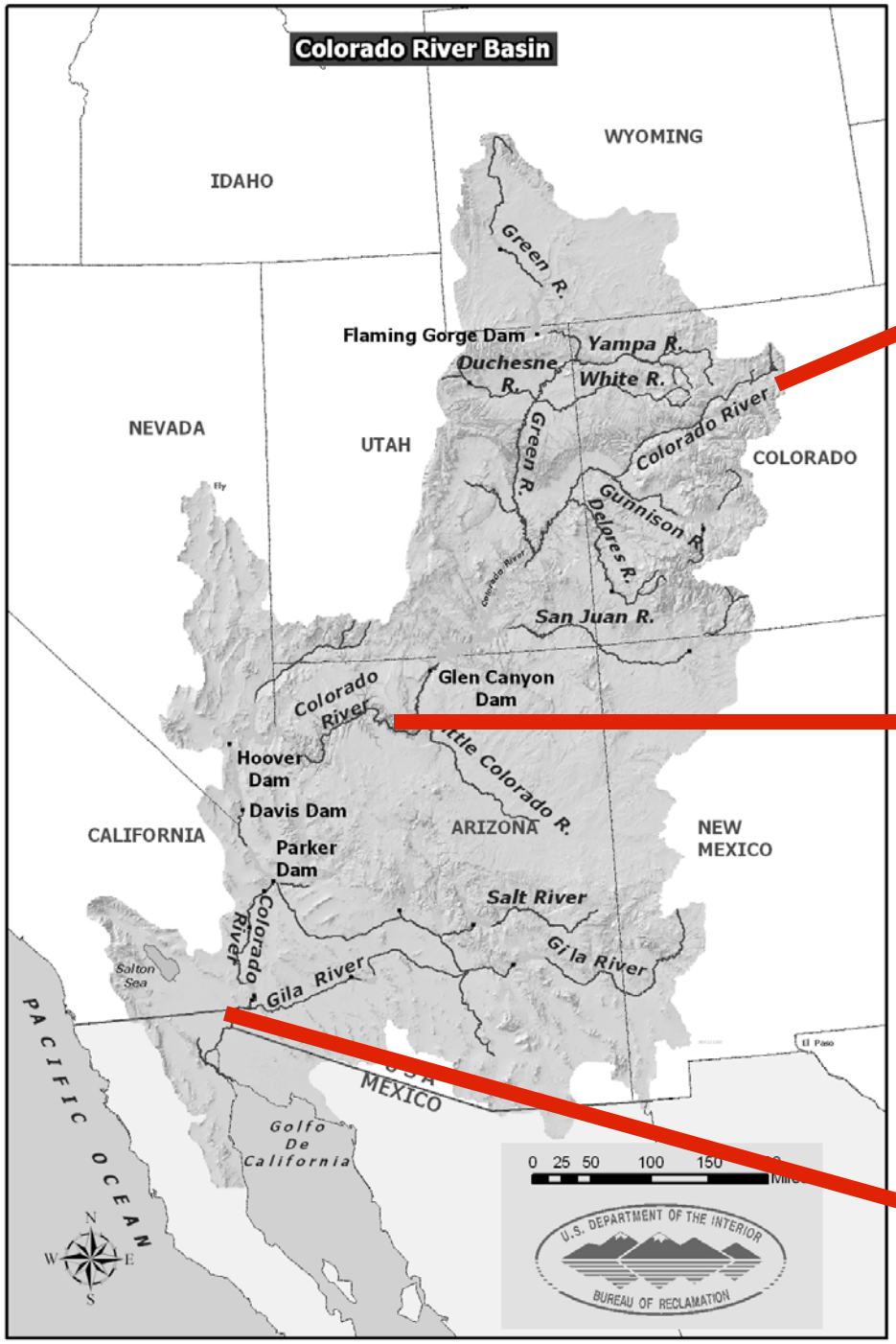
Water Supply Reliability in the Colorado River Basin

American Council of Engineering Companies

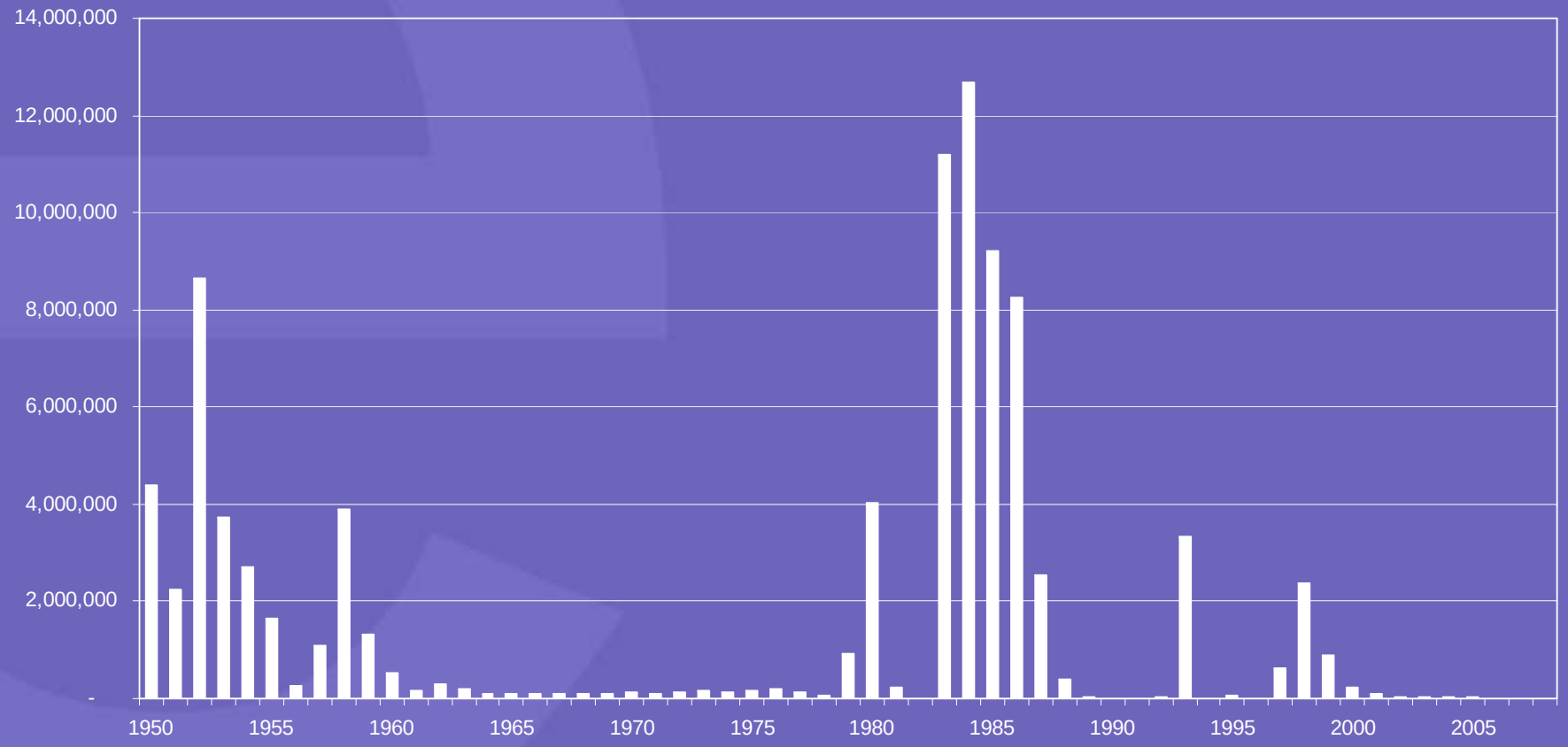
August 7, 2009

ENVIRONMENTAL DEFENSE FUND

finding the ways that work


Colorado River Basin
WYOMING
IDAHO
NEVADA
UTAH
COLORADO
CALIFORNIA
ARIZONA
NEW MEXICO
MEXICO
Green R.
Flaming Gorge Dam
Yampa R.
Duchesne R.
White R.
Green R.
Colorado River
Gunnison R.
Delores R.
San Juan R.
Colorado River
Glen Canyon Dam
Little Colorado R.
Hoover Dam
Davis Dam
Parker Dam
Salt River
Gila River
Colorado River
Gila River
Salton Sea
Golfo De California
PACIFIC OCEAN
El Paso
0 25 50 100 150
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Flows Below Morelos Dam 1950-2008

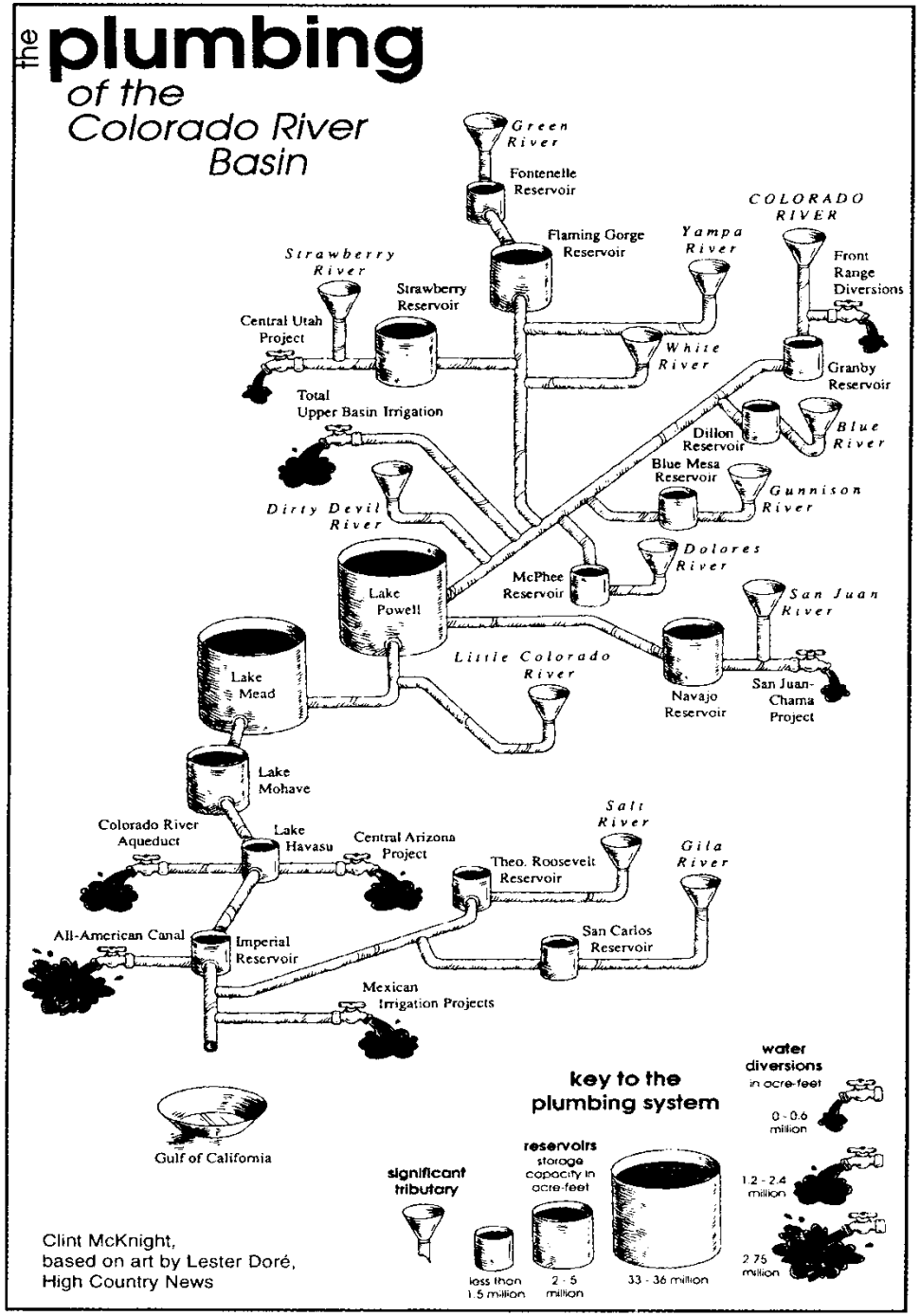


Water Supply Reliability

Reliability: are we running out of water?

- Delta is dry
- Climate change already drying basin and impacts will increase
- Growing cities, energy development and environment all present new demands

- Prior appropriation favors historic uses and 80%+ Colorado River water is used in agriculture
- Large potential for conservation (ag *and* urban)
- Augmentation



- Colorado River legally over-allocated

  16.5 MAF accounted for in the Law of the River; +/- 13.5 MAF is reconstructed natural flow (or yield) at Lee Ferry based on tree ring studies

  Annual use = 12.7-13.5 MAF

- Storage > 4x annual yield
- Complex “Law of the River”
- Challenge: developing a 21st century set of agreements to provide reliable water to people and the environment in the face of population growth and climate change

Water Supply Reliability

Upper Basin Math Problem

Upper Basin (WY, CO, UT, NM) obligated by the Colorado River Compact to deliver at least 75 MAF to the Lower Basin every 10 years (7.5 MAF), plus ½ of Mexico's Treaty entitlement

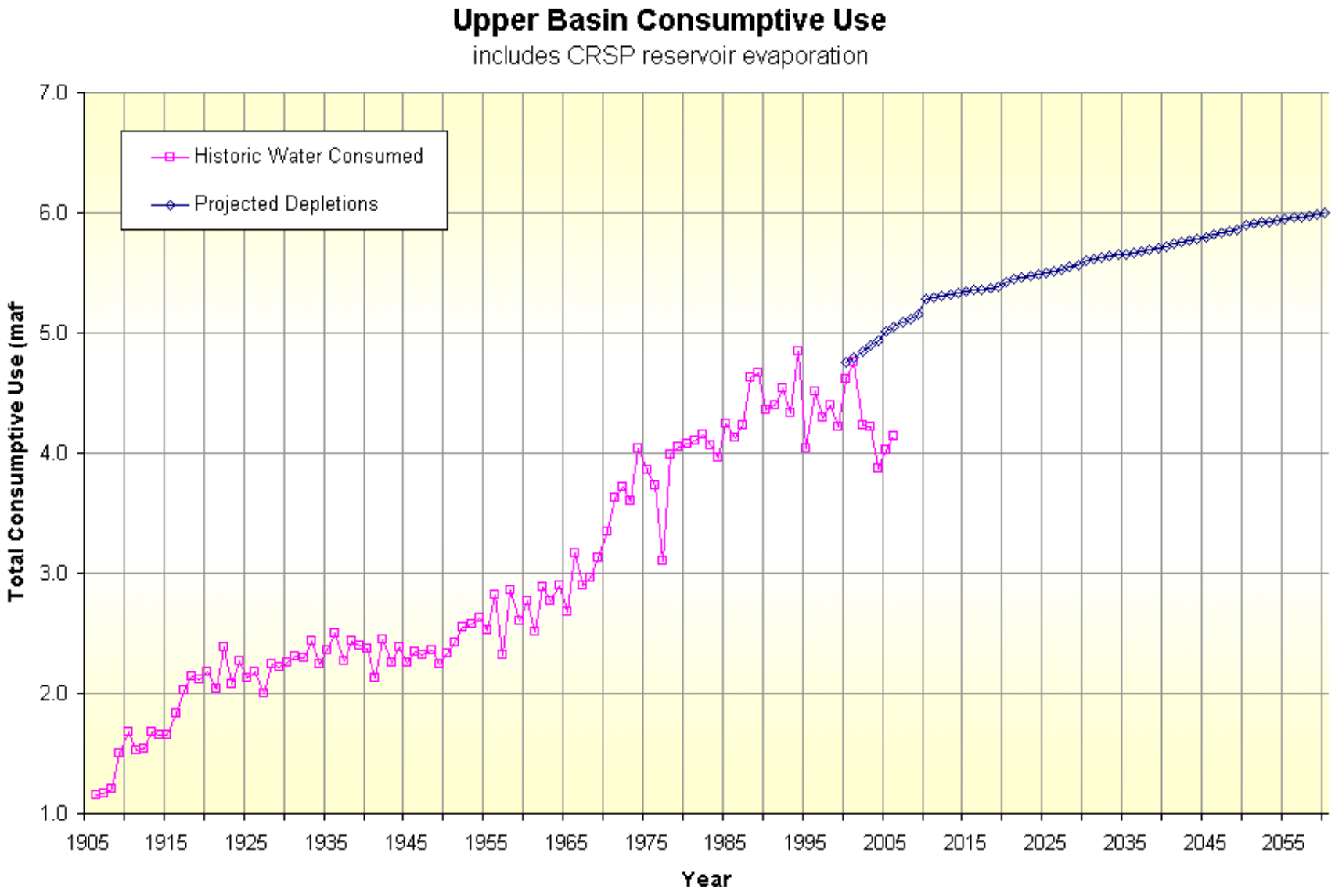
- Upper Basin thus bears the risk of over-allocation and cannot develop more water than is physically available above these amounts (and far less than its 7.5 MAF Compact share)
- The Upper Basin has maximized its water development plans by maintaining schedule for future development that exceeds historic yields, even before climate change is considered.

Future Development in the Upper Basin

- 1988 (and subsequent) USBR “hydrologic determinations” modeled maximum possible depletions and concluded that Upper Basin has +/- 6.0 MAF available for development (including evaporation)
- Climate change could impose a significantly longer or drier critical period or undermine other assumptions, resulting in determination of less than 6.0 MAF

  Range of GCM projections is 10-20% decrease in total basin yield by midcentury

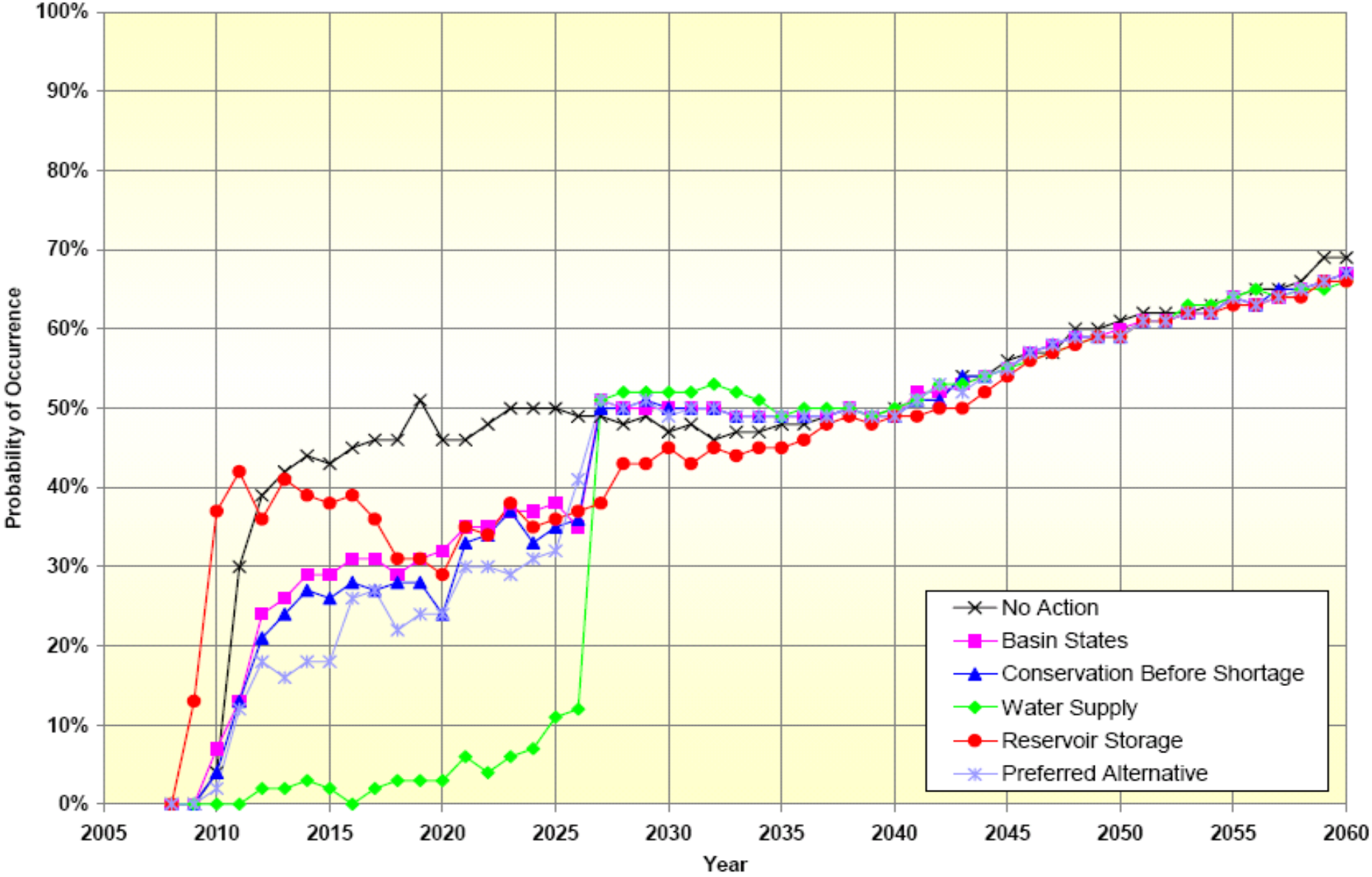
Upper Basin Depletion Schedule

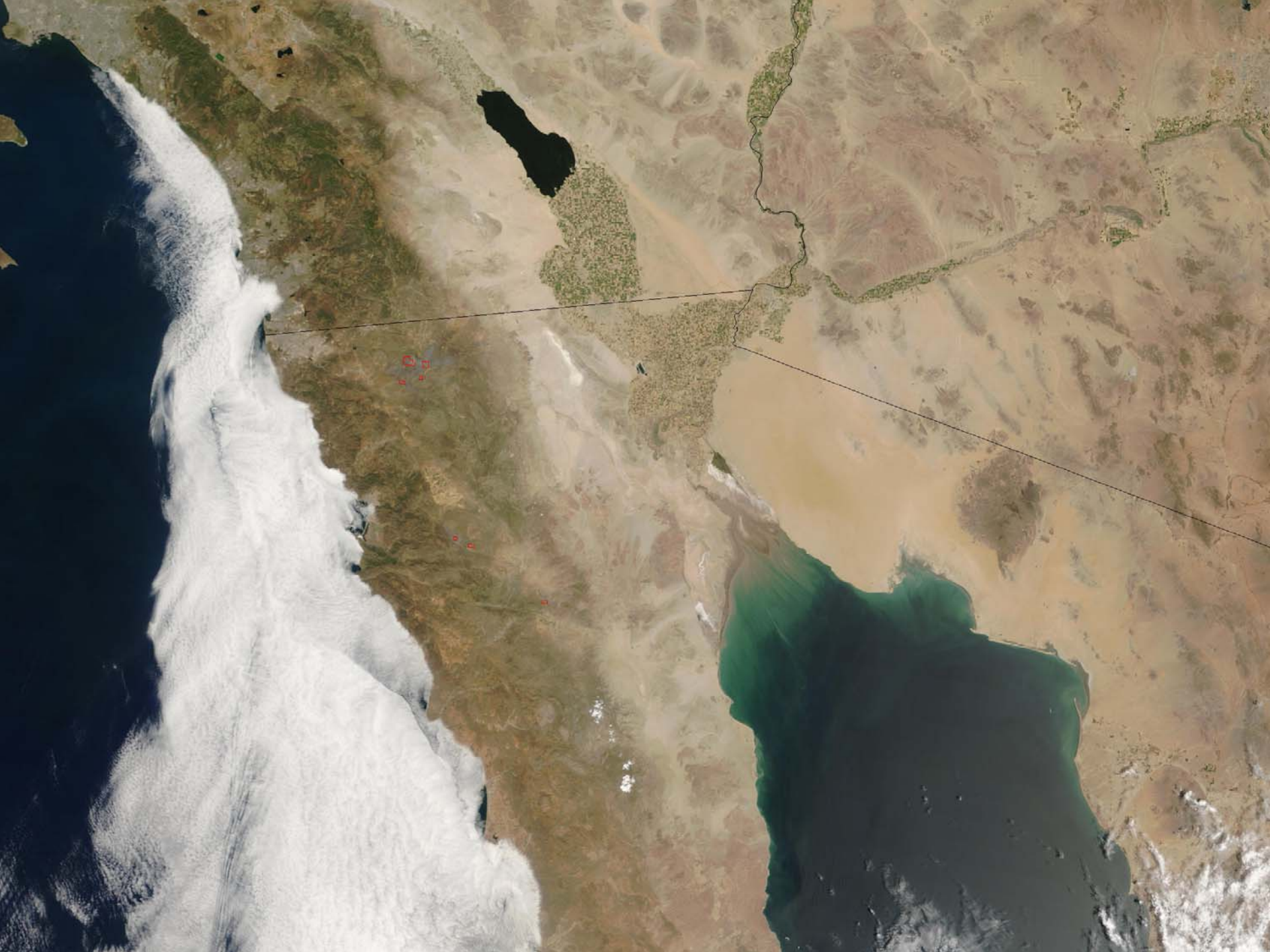


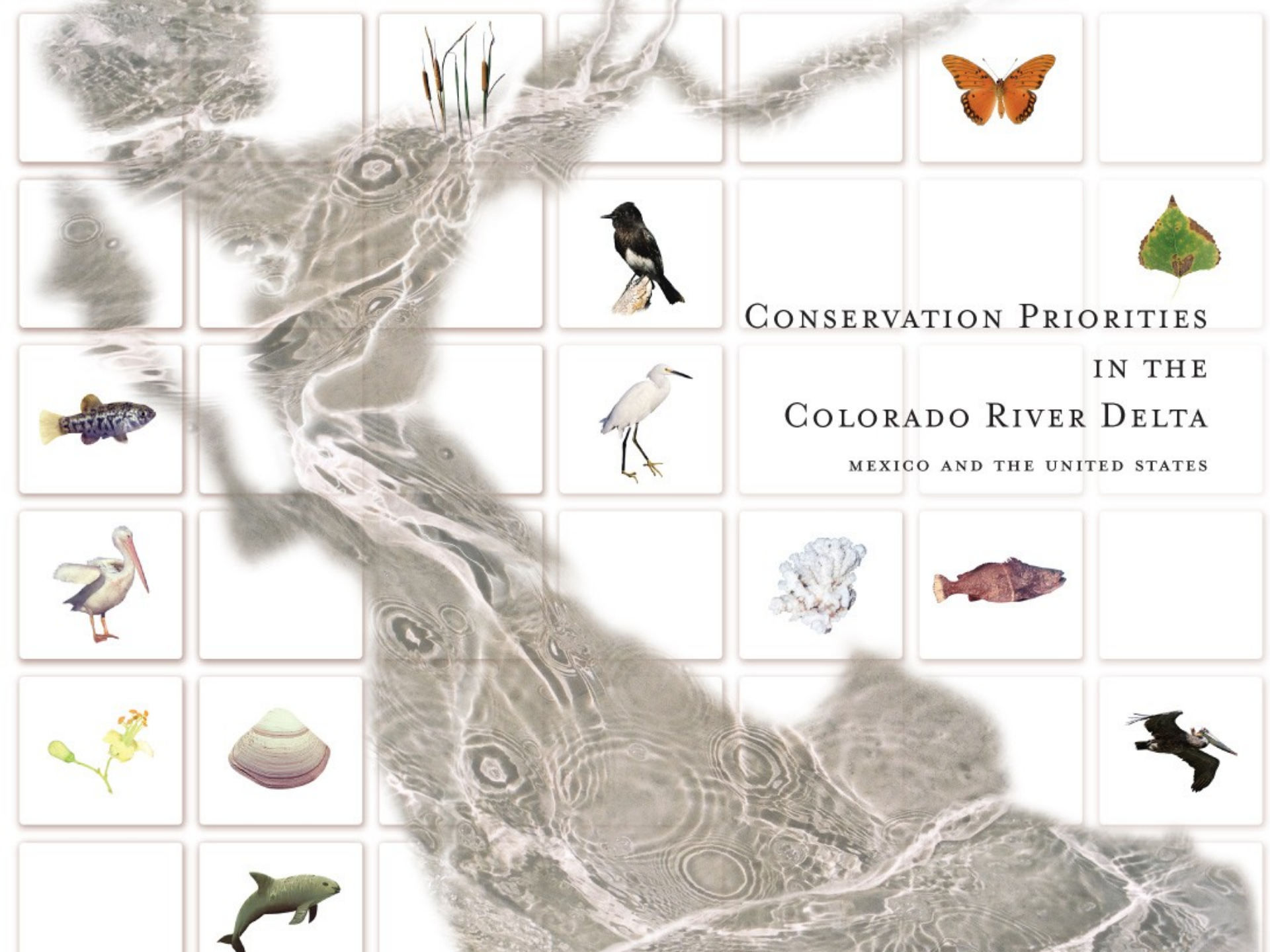
Lower Basin Math Problem

- Lower Basin allocations (CA: 4.4 MAF, AZ: 2.8 MAF, NV: 0.3 MAF) do not account for other system demands such as reservoir evaporation
- After accounting for tributary inputs, even in a year when the Upper Basin delivers normal flows, Mead operates at a +/-1 MAF deficit
  - Normal Lower Basin deliveries therefore dependent on frequent “equalization”/surplus releases from Powell
    - Current Upper Basin depletion schedule results in fewer equalization releases in future
  - Result: rapidly increasing shortage probabilities in Lower Basin

Probability of Shortage in Lower Basin







Conservation Priorities in the Colorado River Delta

Mexico and the United States

Morelos Dam:

last diversion point on the Colorado River

Water Supply Reliability

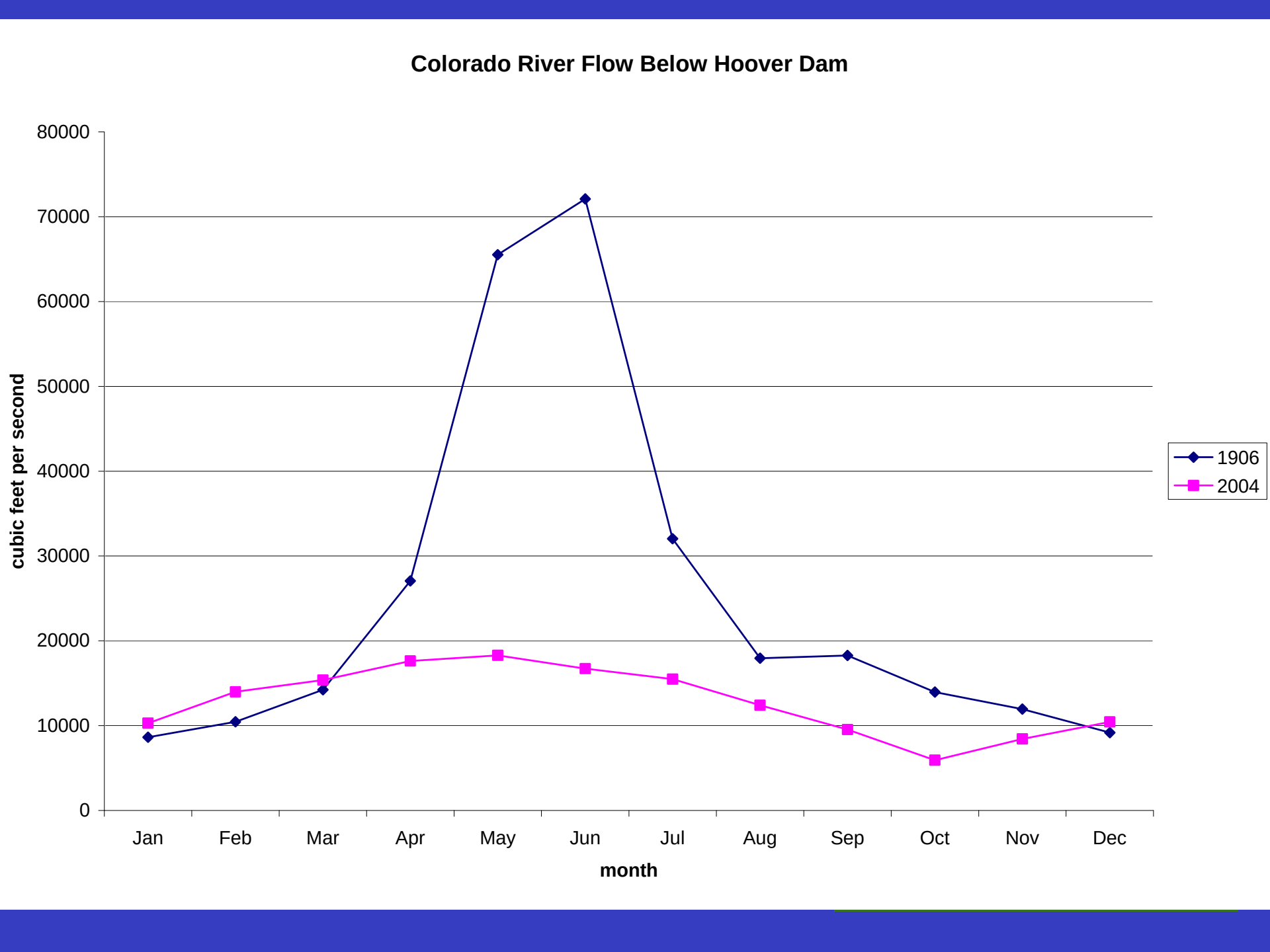
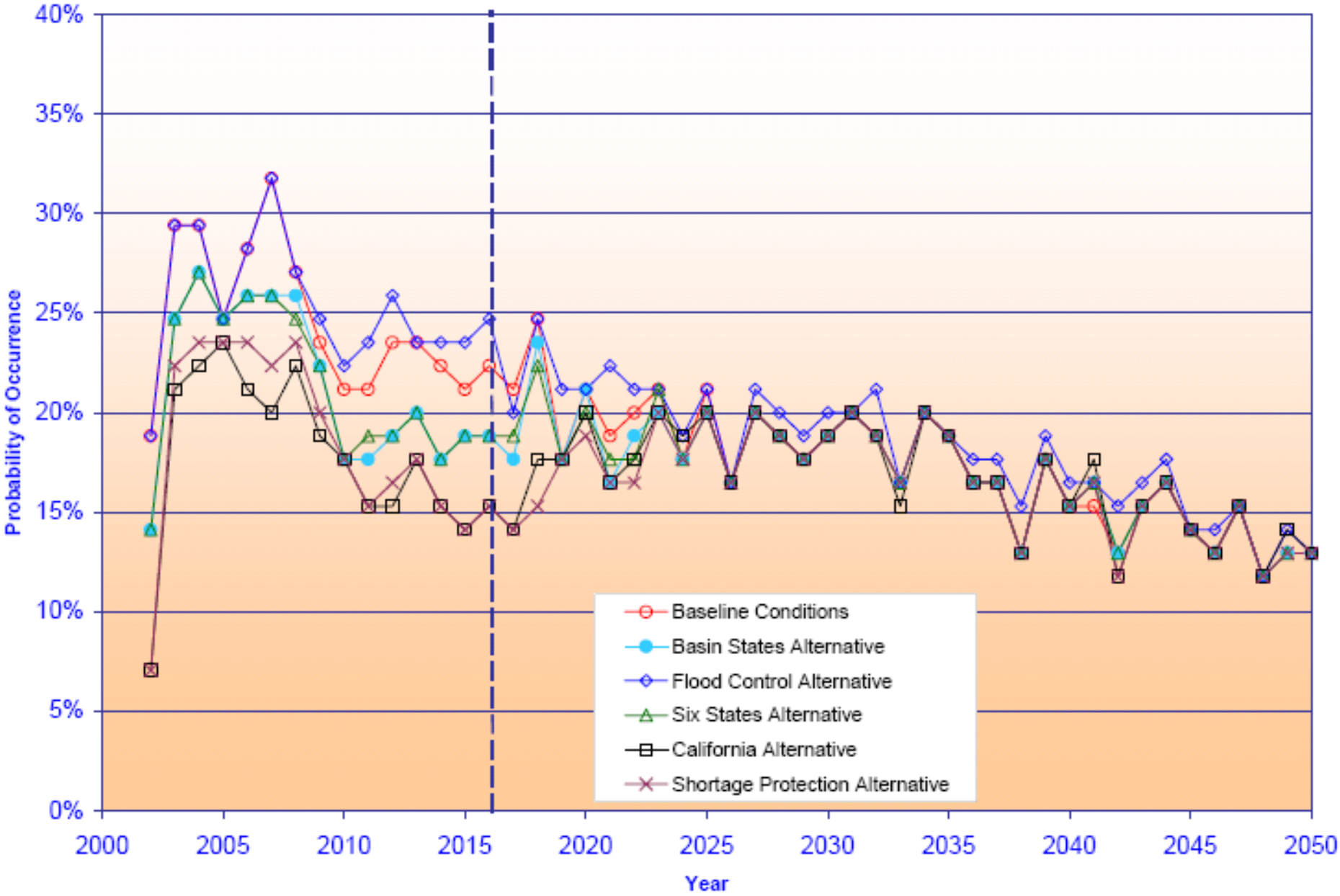

Colorado River Flow Below Hoover Dam
80000
70000
60000
50000
40000
30000
20000
10000
0
cubic feet per second
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
month
1906
2004

Figure 3.16-2
Potential Magnitude of Excess Flows Greater than 250,000 Acre-Feet
Below Mexico Diversions at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions



Mexico's Water Needs

- Mexico likely to be able meet its foreseeable future water supply needs within its 1.5 MAF Treaty entitlement
- Delta restoration efforts generally assume that major environmental water needs can be accommodated within the Mexican Treaty allocation (with substantial ag conversion/efficiency)
- key exceptions:
  - Environmental "pulse flows" will require access to U.S. reservoir storage
  - Imposed shortages could decrease reliably available water supply in Mexico by 100,000 AF or more

New Flexibilities

- ✓ NGOs created water trust for delta (use of market to acquire water for delta instream flows)
- ? US and Mexico in discussions regarding voluntary Mexican banking of water at Lake Mead to manage during dry periods and to provide environmental pulse flows (as well as possible exchanges with US water users)

Need for Water Budgeting in the Colorado River Basin

- New demands in the context of a river where all water is already in use generates enormous, long-term tradeoffs between and among human and environmental water needs
  - Climate change will only further increase pressures on water resources
- "SECURE Water Act" P.L. requires quantitative study of climate change impacts, an opportunity for federal examination of supply and demand including environmental demands
- CO discussions of "Compact Bank" to use markets to forestall Lower Basin call and protect critical urban needs

Environmental Water Needs

- Most Colorado River infrastructure developed and water uses established before environmental legislation and exempt from regulation except when modified
- Successful creation and protection of environmental flows will come from anticipation of trades by water users and the crafting of solutions that leverage these changes to create environmental benefits
- Opportunities to acquire water