Summary of Scripp's Institution Report

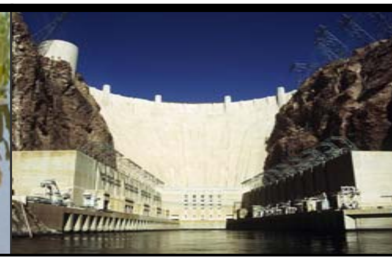
"When will Lake Mead go dry?"

Presented to the Lake Mead Water Quality Forum

September 16, 2008

Nicole A. Everett
Natural Resource Analyst
Colorado River Commission of Nevada





Scripp's Institution Report: When will Lake Mead go dry?

- Purpose
- Assumptions
- Methods
- Results
- Discussion

Purpose of the Study

- Current science indicates global warming will contribute to a decrease in runoff over Southwestern United States
- Estimated reduction in runoff: 10-30% over the next 30-50 years
- For Colorado River system = 1.5 – 4.5 maf/yr reduction in runoff assuming a 15 maf/yr natural flow

When and how reduced runoff will impact people:

When will Lake Mead go dry?

50% chance Lake Mead will go dry by 2021

Assumptions of the Study

- Consider Lake Powell and Lake Mead to be a single storage unit and "perfect" management
- "Going dry" = when live storage in Lakes Mead and Powell becomes exhausted (dead pool = 3.9 maf)
- No changes in water management and sector-specific consumptive use

Assumptions of the Study (cont'd)

- Initial condition = 25.7 maf of storage (June 2007)
- Natural flow = 15 maf/yr (1906-2005)
- 10%-30% reduction in runoff (linear over time)
- Annual evaporation/infiltration = 1.7 maf/yr
- Future depletions = USBR schedules (13.5 maf/yr in 2008→14.1 maf/yr by 2030→14.5 maf/yr by 2060)

Methods of the Study

- Water Balance Model:
  Inflow – Outflow = ΔStorage
- Deterministic Analysis – isolate effect of climate change
- Probabilistic Analysis – includes effects of natural variability, evaporation & infiltration
  - Generated synthetic time series of Colorado River flow + linear runoff trend → cumulative dist. functions

Results-Deterministic Analysis

- Assumed current condition of steady state (inflow=outflow)
- 10-30% runoff reduction over 50 years; constant consumption
- Live storage depleted:

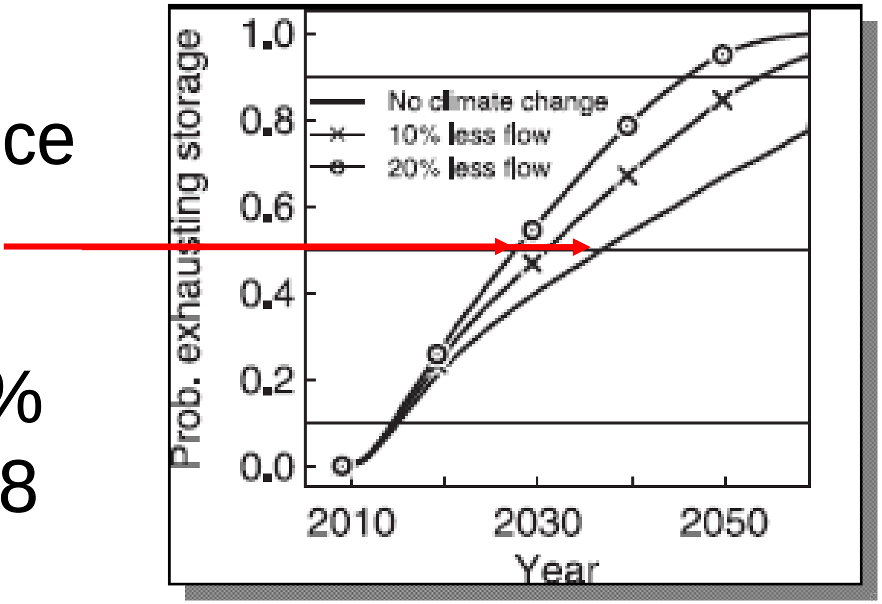
% Reduction in Runoff	Year Depleted
10%	2047
20%	2036
30%	2030

- 50% chance that minimum power pool elevation reached around 2021

Results – Probabilistic Analysis

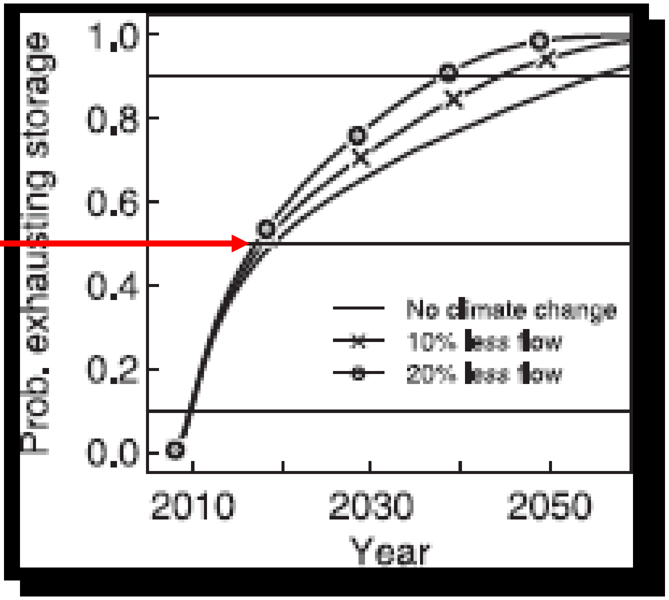
- No runoff reduction due to climate change - 50% chance system will go dry by 2037

- 20% runoff reduction – 50% chance of going dry by 2028



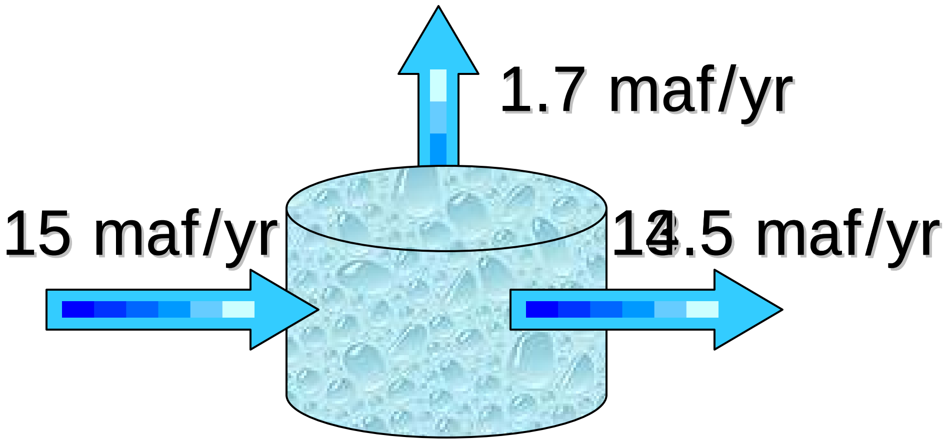
Results – Probabilistic Analysis

- 50% chance of dropping below minimum power pool elevations by 2017



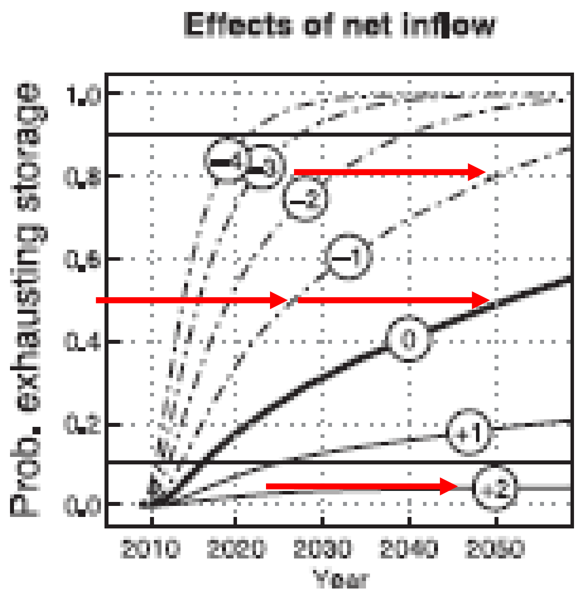
Results – Sensitivity to Net Inflow

- Net inflow = long-term inflow – long-term consumption + evaporation/infiltration
- System, as a whole, has a negative net inflow

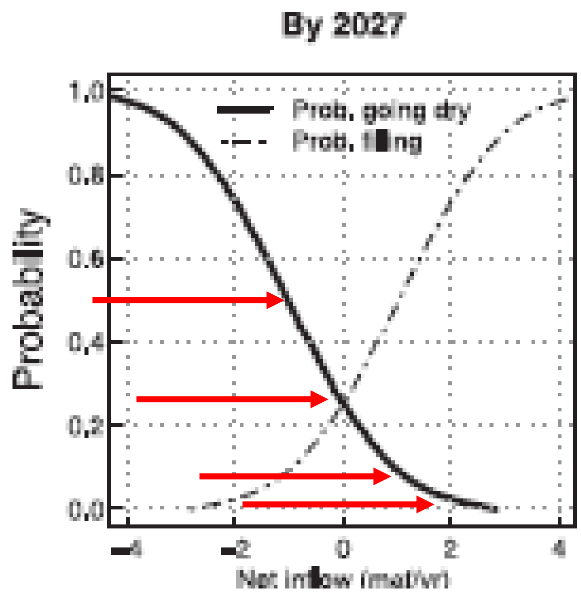


2060: -1.15 maf/yr

Results – Sensitivity to Net Inflow



Does not include effects of climate change



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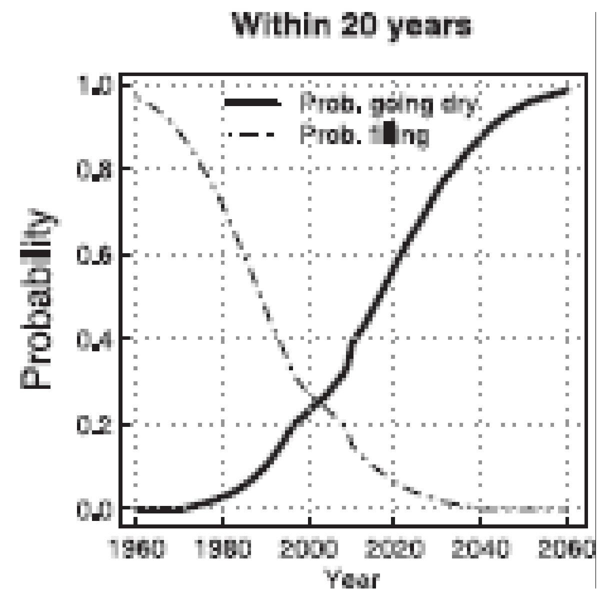
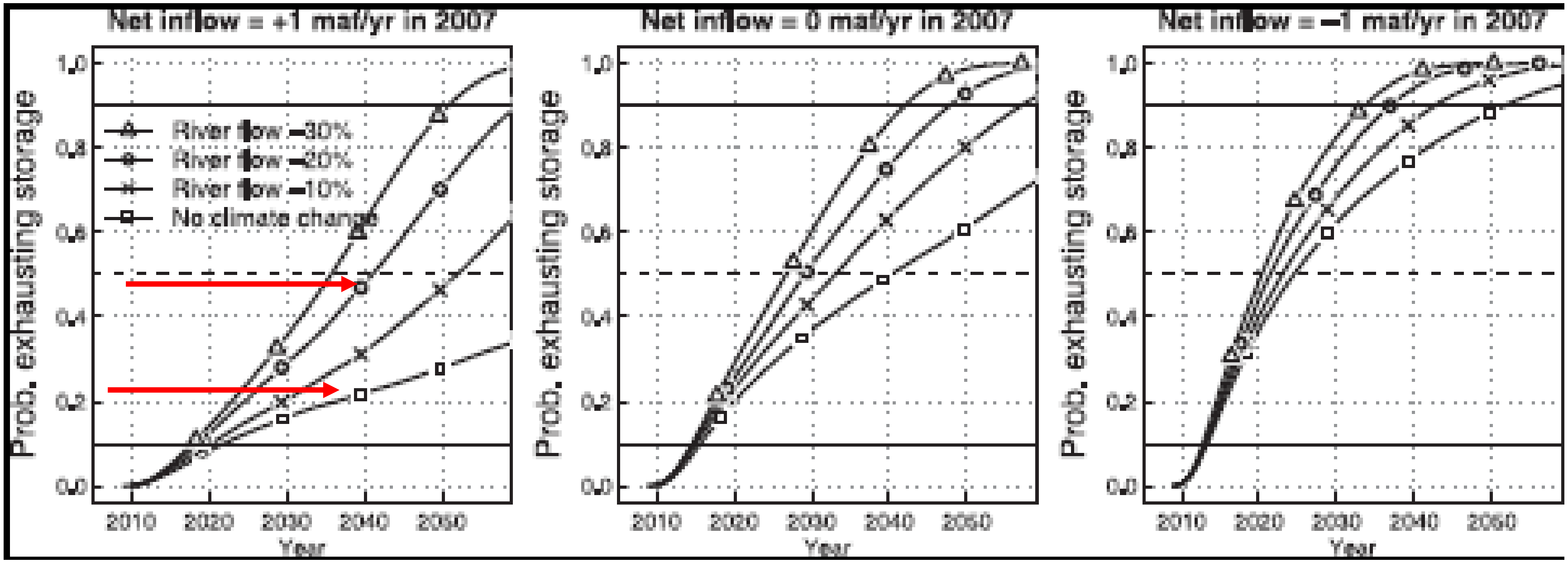


Assumes a 20% reduction in runoff due to climate change

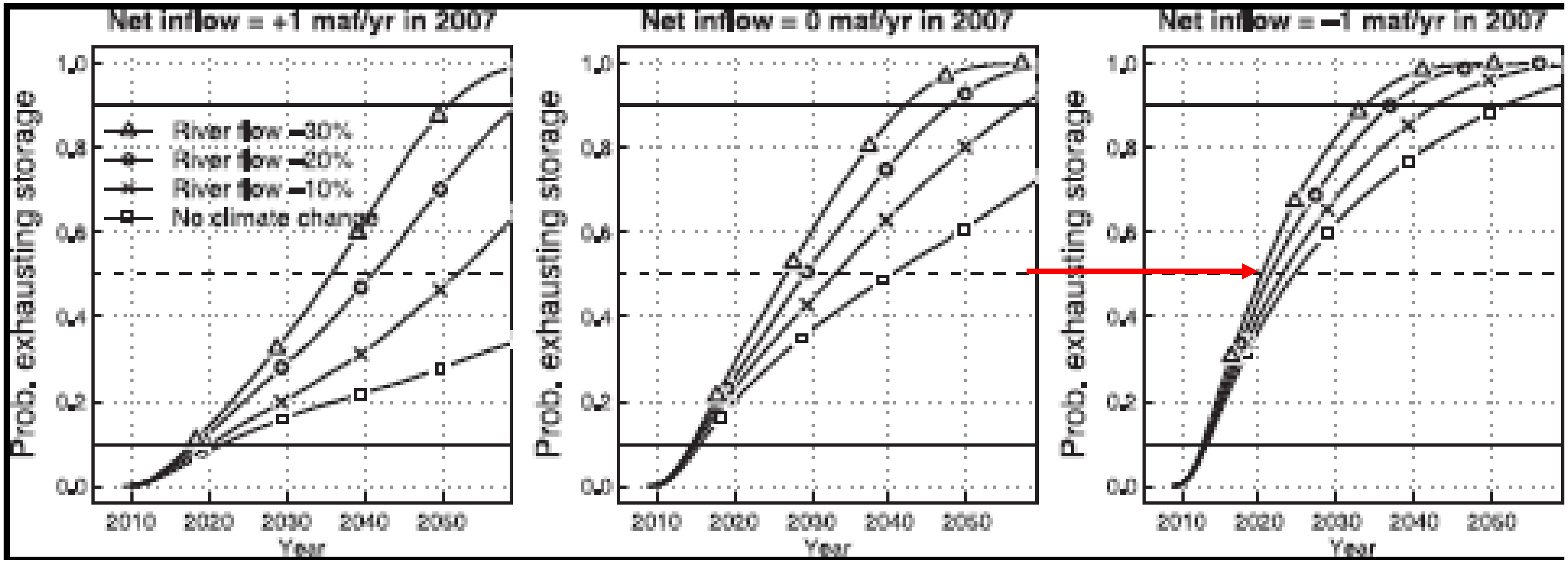
- System storage more rapidly exhausted as net inflow decreases
- Rate of increase in senstivity becomes more rapid as net inflow approaches zero
- Probability of going dry increases into the future

Results-Sensitivity to Net Inflow



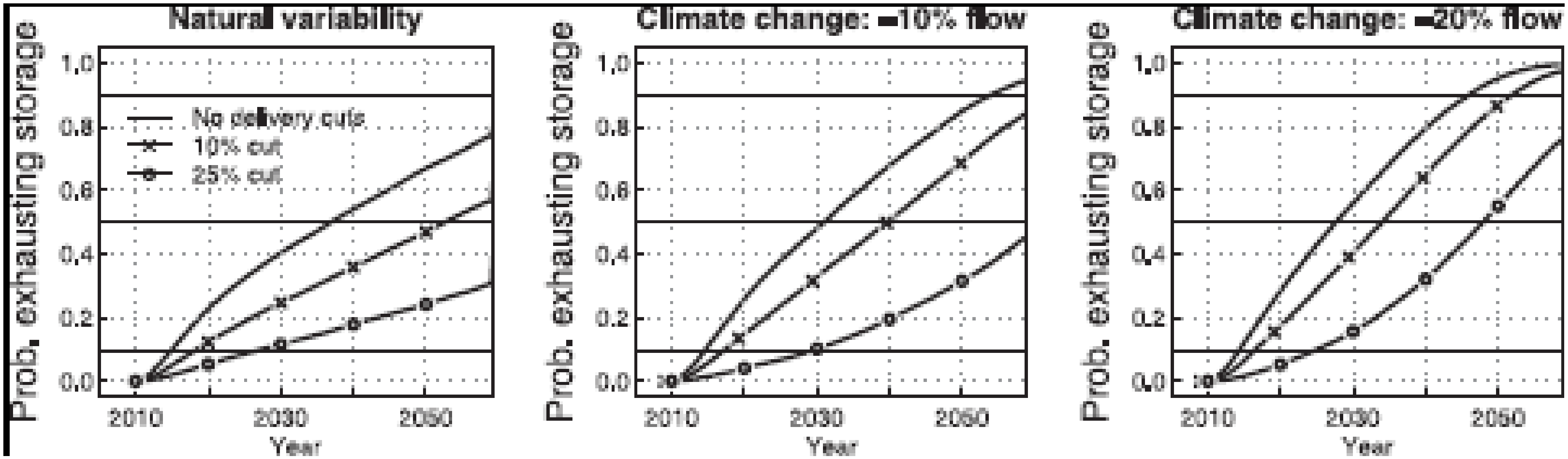
- Assuming a +1 maf/yr net inflow and no impact due to climate change = 20% chance of going dry by 2040
- Assuming a +1 maf/yr net inflow and a 20% reduction in runoff due to climate change = 45% chance of going dry by 2040

Results-Sensitivity to Net Inflow



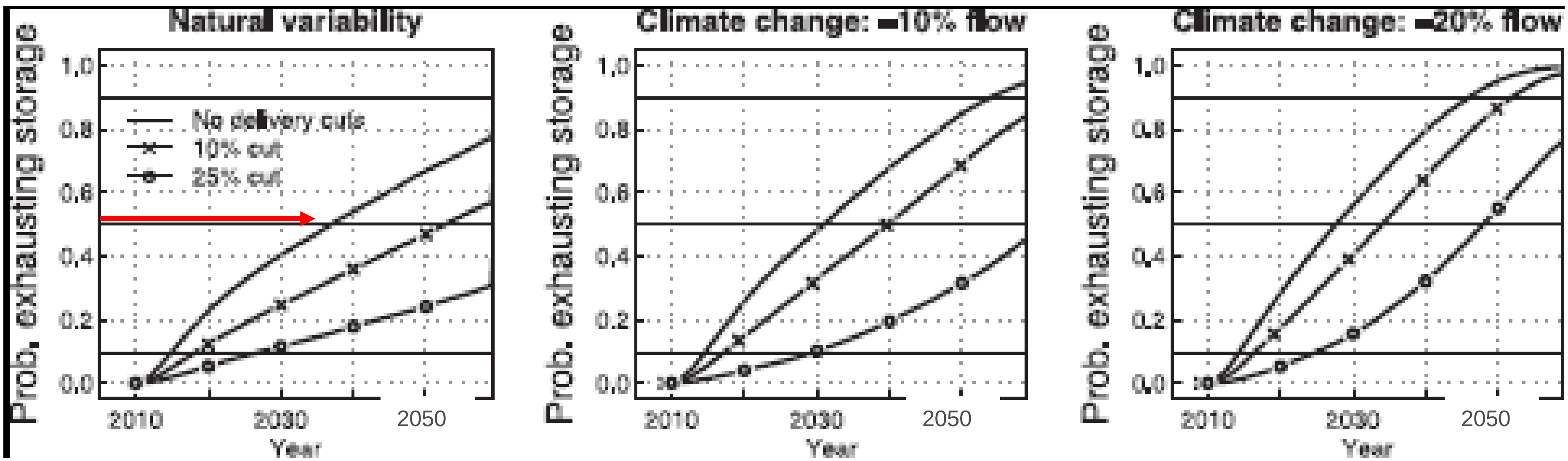
- Assuming a -1 maf/yr net inflow and 20% reduction in runoff due to climate change = "**50% chance of going dry by 2021**"

Results – Water shortage options



- Water deliveries reduced by 10% and 25% of **current demand** (1.5 maf/yr and 3.75 maf/yr, respectively)
- Reductions assumed to start when combined reservoir storage falls below 15 maf

Results – Water shortage options

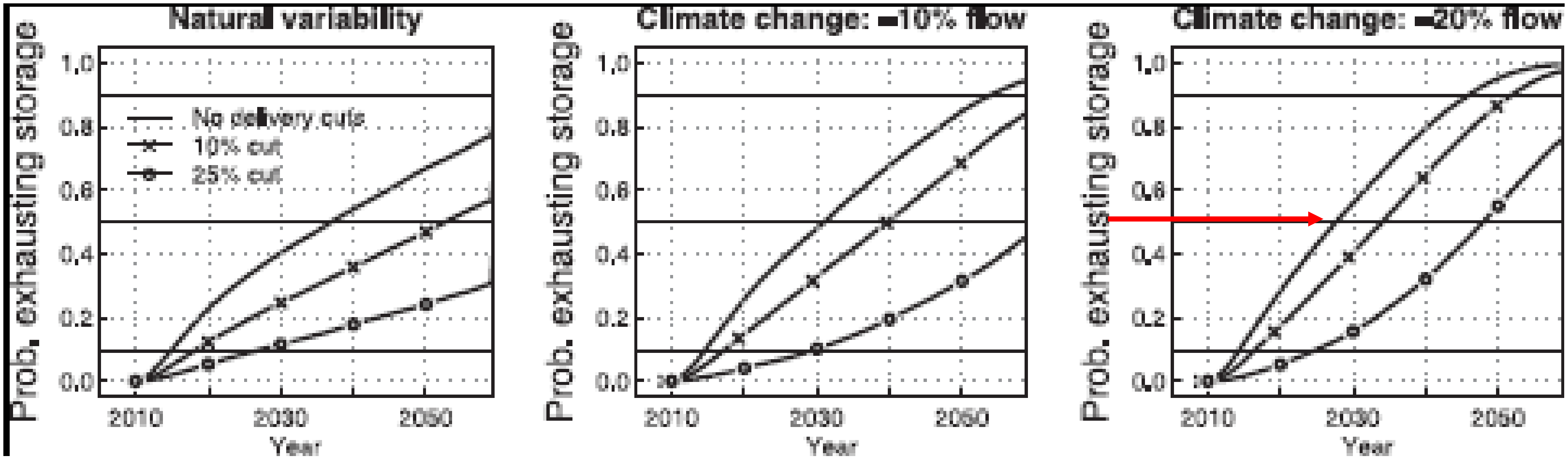


- Assuming no effects due to climate change, system has a 50% chance of going dry by:
    - 2037 with no reductions in deliveries
    - 2053 with a 10% reduction in deliveries
    - >2070 with a 25% reduction in deliveries



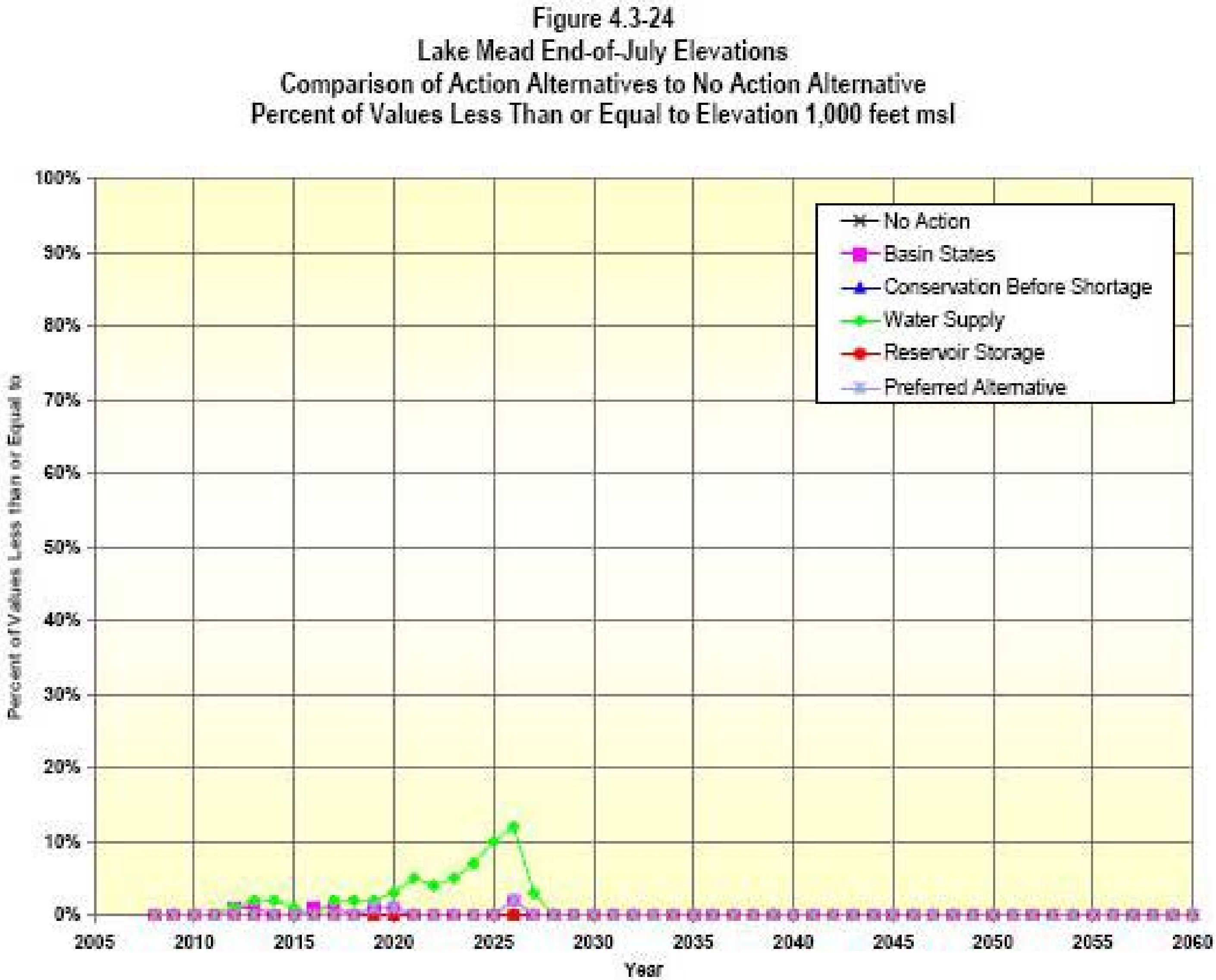


Results – Water shortage options



- Assuming a 20% reduction due to climate change, system has a 50% chance of going dry by:
  - 2028 with no reductions in deliveries
  - 2034 with a 10% reduction in deliveries
  - 2048 with a 25% reduction in deliveries

USBR Modeling (FEIS)



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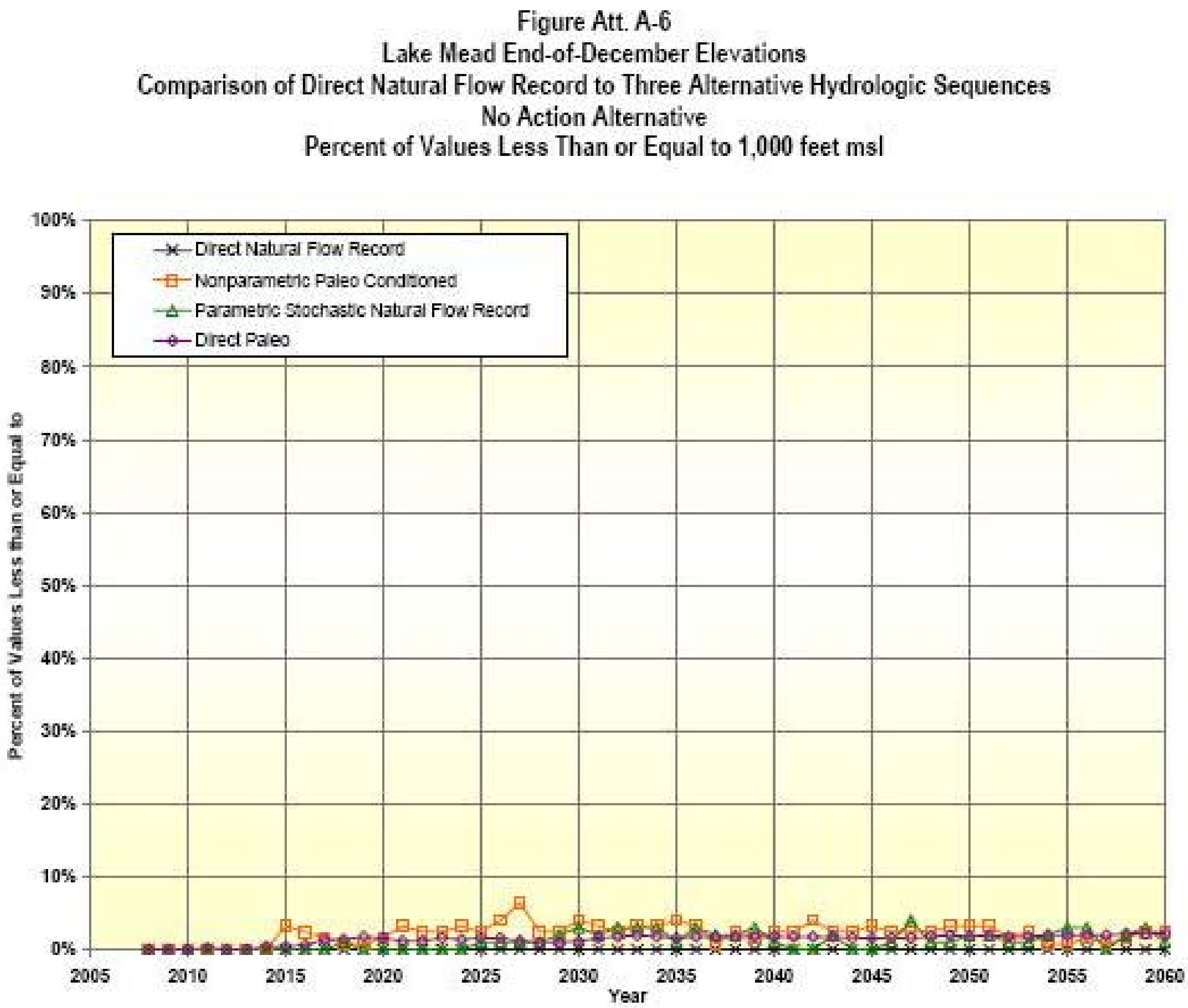
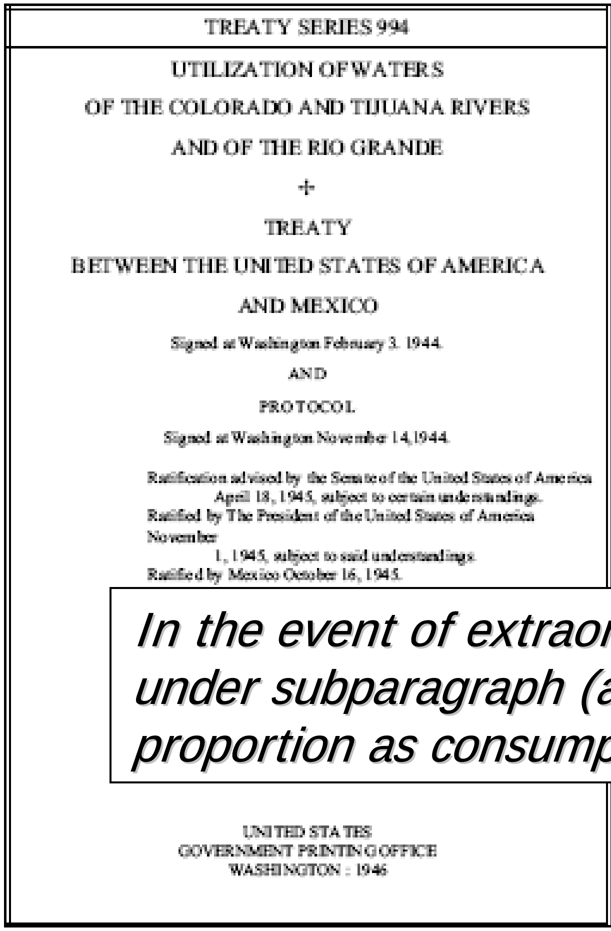


Comments

- Consideration of single reservoir is an oversimplification of the reservoir system
- Not taking into account all reservoirs in the system underestimates storage
- Authors assume a 10-30% reduction in runoff

Comments



TREATY SERIES 994

UTILIZATION OF WATERS
OF THE COLORADO AND TIJUANA RIVERS
AND OF THE RIO GRANDE

+

TREATY
BETWEEN THE UNITED STATES OF AMERICA
AND MEXICO

Signed at Washington February 3, 1944.

AND

PROTOCOL

Signed at Washington November 14, 1944.

Ratification advised by the Senate of the United States of America
April 18, 1945, subject to certain understandings.
Ratified by The President of the United States of America
November
1, 1945, subject to said understandings.
Ratified by Mexico October 16, 1945.

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1946

- l no change in water
  ategies & sector-specific use in
  ;0% by 2021 finding
- ake into account Secretary's
  onsult when Lake Mead

In the event of extraordinary drought … the water allotted to Mexico under subparagraph (a) of this Article will be reduced in the same proportion as consumptive uses in the United States are reduced.

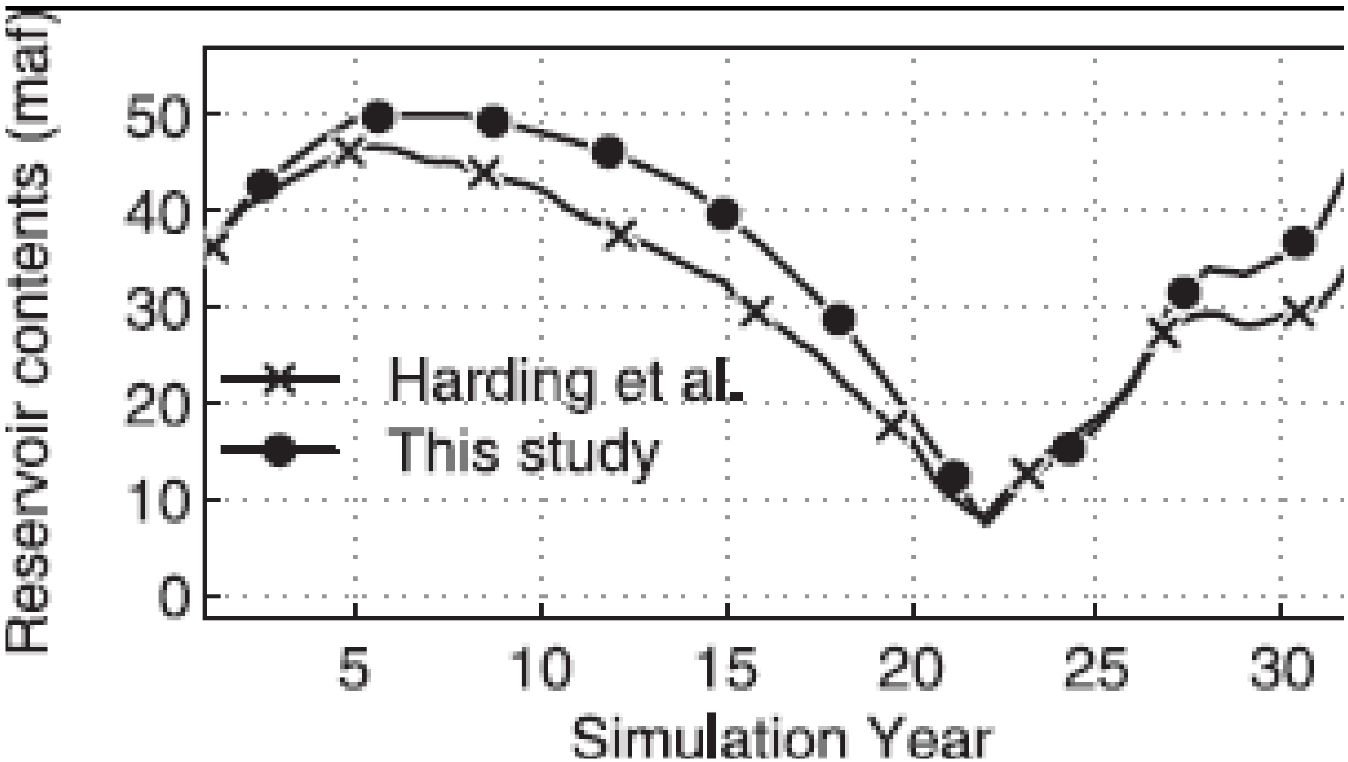
- constant deliveries to Mexico

Comments

- Study doesn’t take into account management measures such as conservation, ICS and off-stream banking
- Study doesn’t consider efforts currently being undertaken by the states to augment the Colorado River system’s water supply

Discussion

Comparison with *Harding et al. (1995)*



Reconstruction of combined Lake Powell/Mead storage (maf) during the "sustained severe drought" episode of the late 1500s