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Managing Water in the West

Colorado River Basin: State of the System and Current Research Efforts

Colorado River District Annual Seminar 2019

September 18, 2019

Grand Junction, Colorado

Presentation Overview

- State of the System
  - Current Status
  - Future Projections
  - Drought Contingency Plans
  - Evolving Risk & Hydrologic Uncertainty
- Research
  - Background
  - Short-, mid-, and long-term studies
  - State of the Science Report

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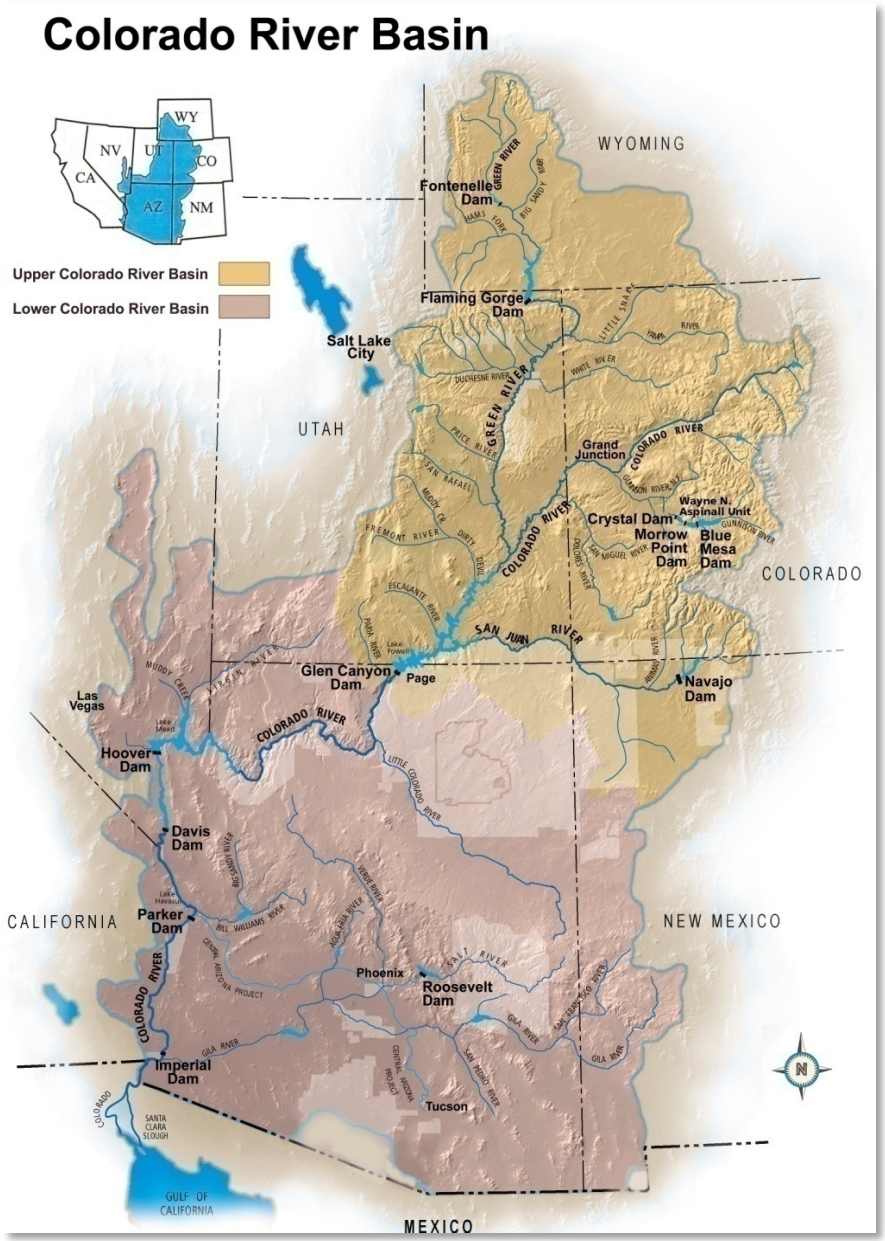
Colorado River Basin

- 16.5 million acre-feet (maf) allocated annually
  - 7.5 maf each to Upper and Lower Basins
  - 1.5 maf to Mexico
- ~16 maf average annual “natural flow” (from historical record)
  - 14.8 maf in the Upper Basin and 1.3 maf in the Lower Basin
- Inflows are highly variable year to year
- 60 maf of storage (~4 times the annual average inflow)
- Operations and water deliveries are governed by the “Law of the River”



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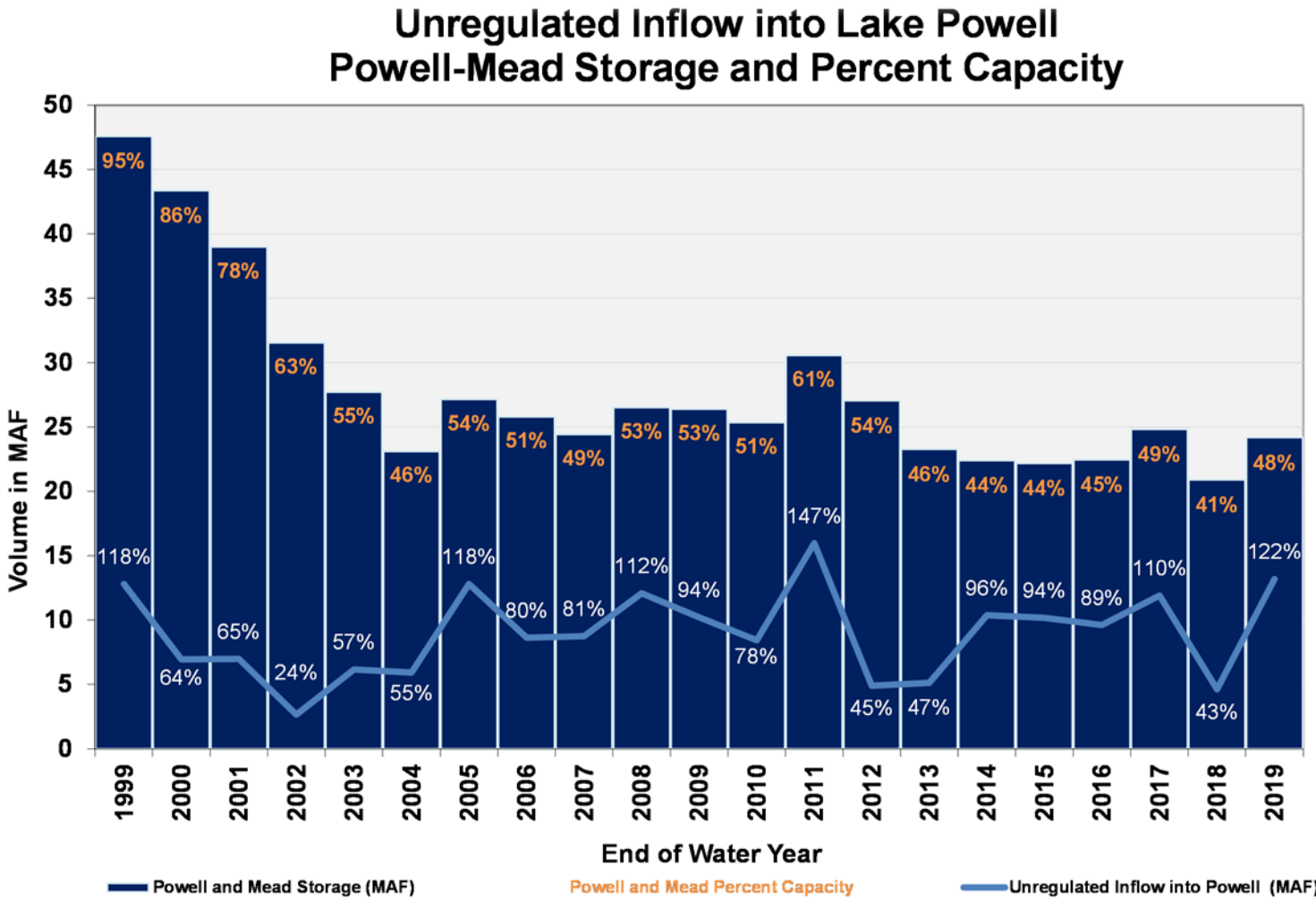
System Status

State of the System (Water Years 1999-2019)[1,2]



[1]Values for Water Year 2019 are projected. Unregulated inflow is based on the latest CBRFC forecast dated September 3, 2019. Storage and percent capacity are based on the August 2019 24-Month Study.

[2]Percentages on the light blue line represent percent of average unregulated inflow into Lake Powell for a given water year. The percent of average is based on the period of record from 1981-2010.

Current Projections

Lake Powell Elevations*

End of CY 2019 Projections

Most Probable: 3,618.6 feet (56% full)

Prob Maximum: 3,619.3 feet (56% full)
Prob Minimum: 3,617.9 feet (56% full)

End of CY 2020 Projections

Most Probable: 3,635.5 feet (43% full)

Prob Maximum: 3,657.6 feet (75% full)
Prob Minimum: 3,596.8 feet (47% full)

Lake Mead Elevations*

End of CY 2019 Projections

Most Probable: 1,089.4 feet (41% full)

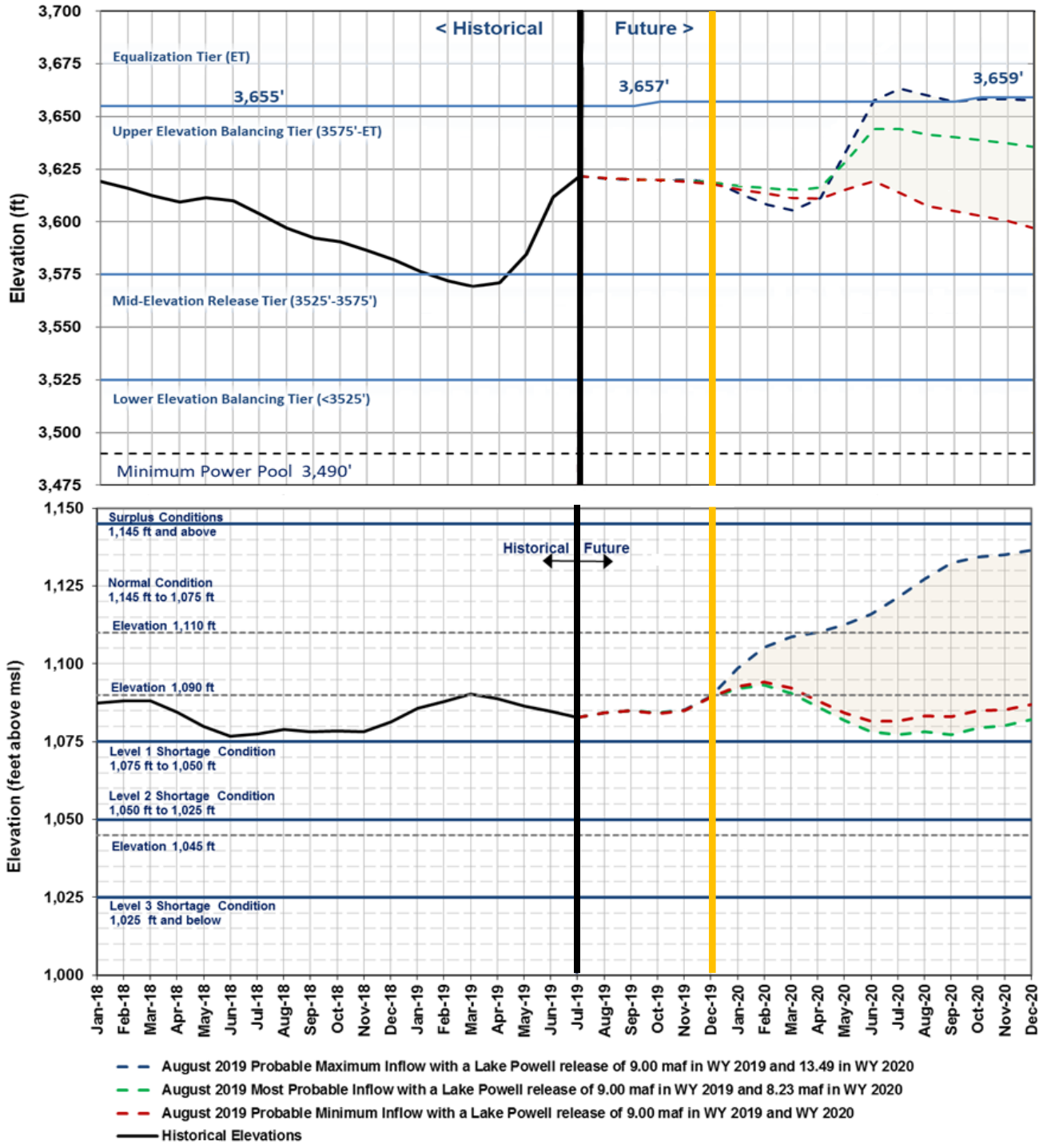
Prob Maximum: 1,089.6 feet (41% full)
Prob Minimum: 1,089.3 feet (41% full)

End of CY 2020 Projections

Most Probable: 1,082.1 feet (39% full)

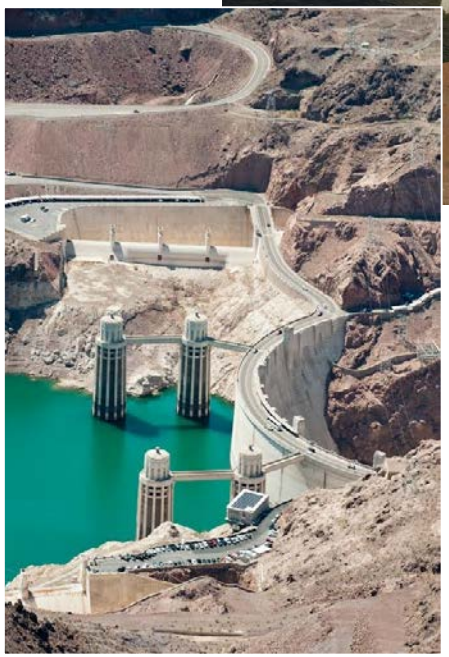
Prob Maximum: 1,136.6 feet (58% full)
Prob Minimum: 1,087.0 feet (41% full)

***Projections from August 2019 24-Month Study Inflow Scenarios**



Drought Contingency Planning

- Actions are in addition to the 2007 Interim Guidelines
- Goals:
  - Reduce risk of Lake Mead and Lake Powell reaching critically low elevations (1,020 feet and 3,490/3,525 feet, respectively)
- Key Elements:
  - Additional contributions of water by Lower Basin States
  - Additional flexibility for water storage and recovery to incentivize conservation
  - Drought operations and demand management in Upper Basin



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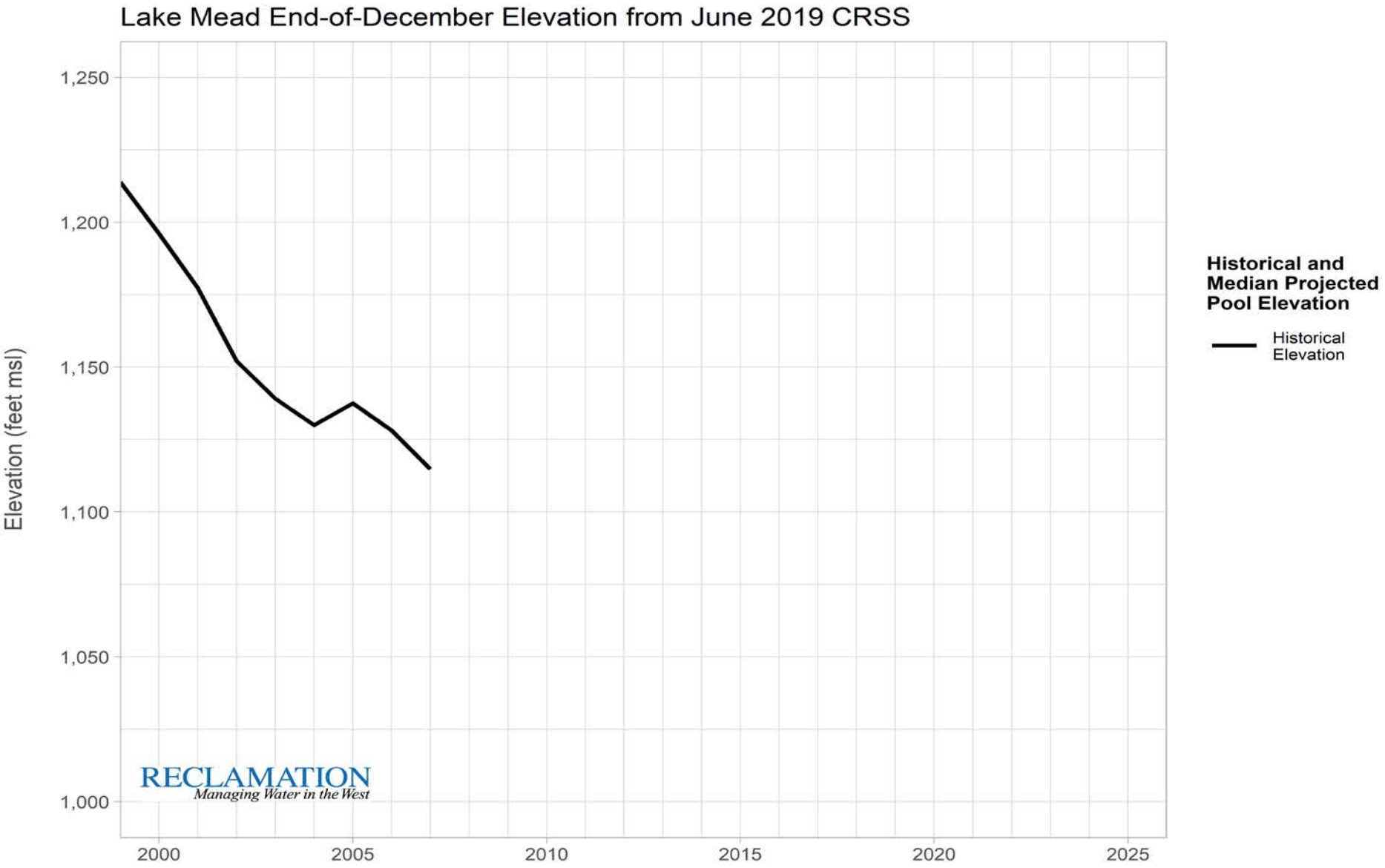
Evolving Risk Since Adoption of the 2007 Interim Guidelines



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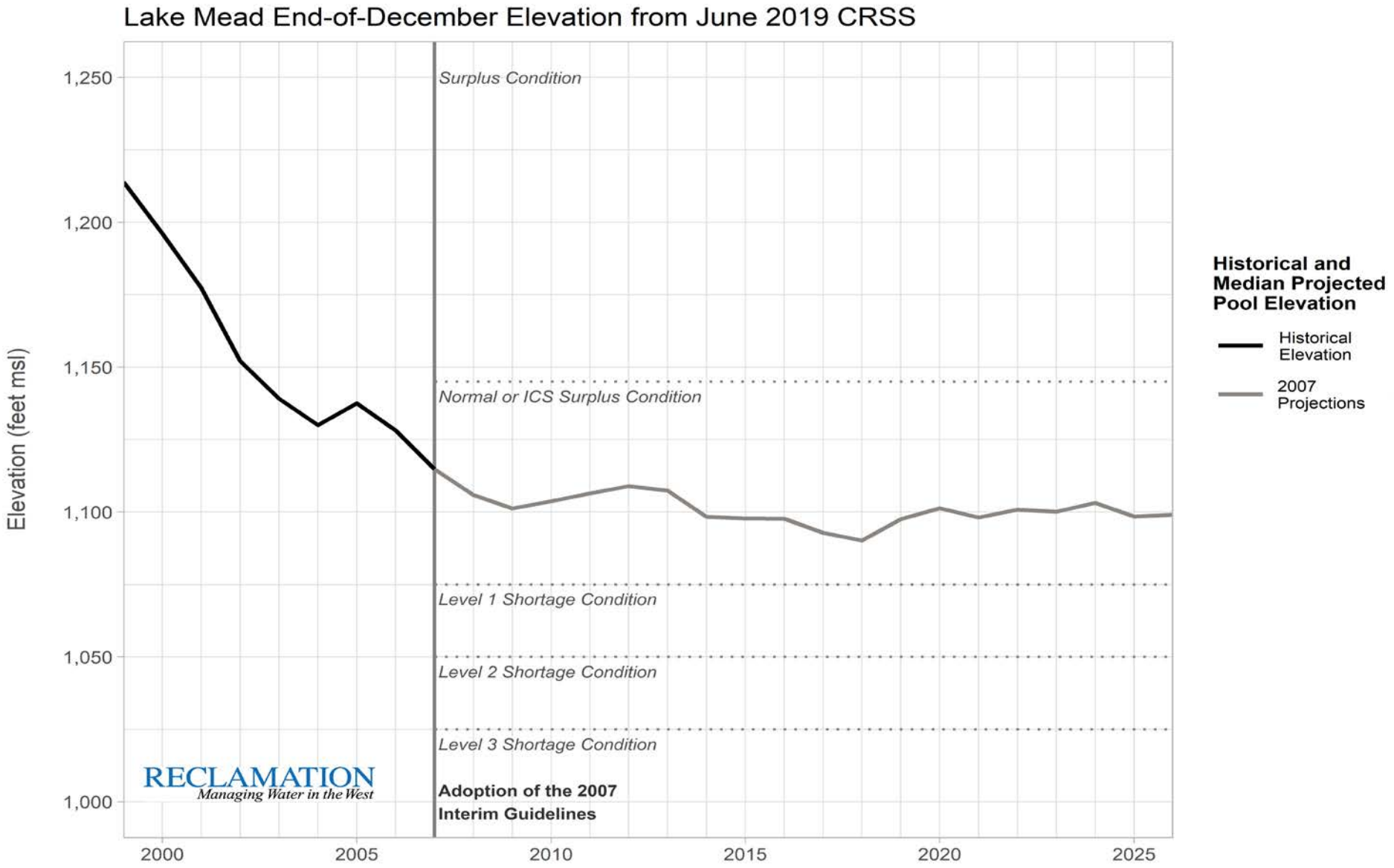

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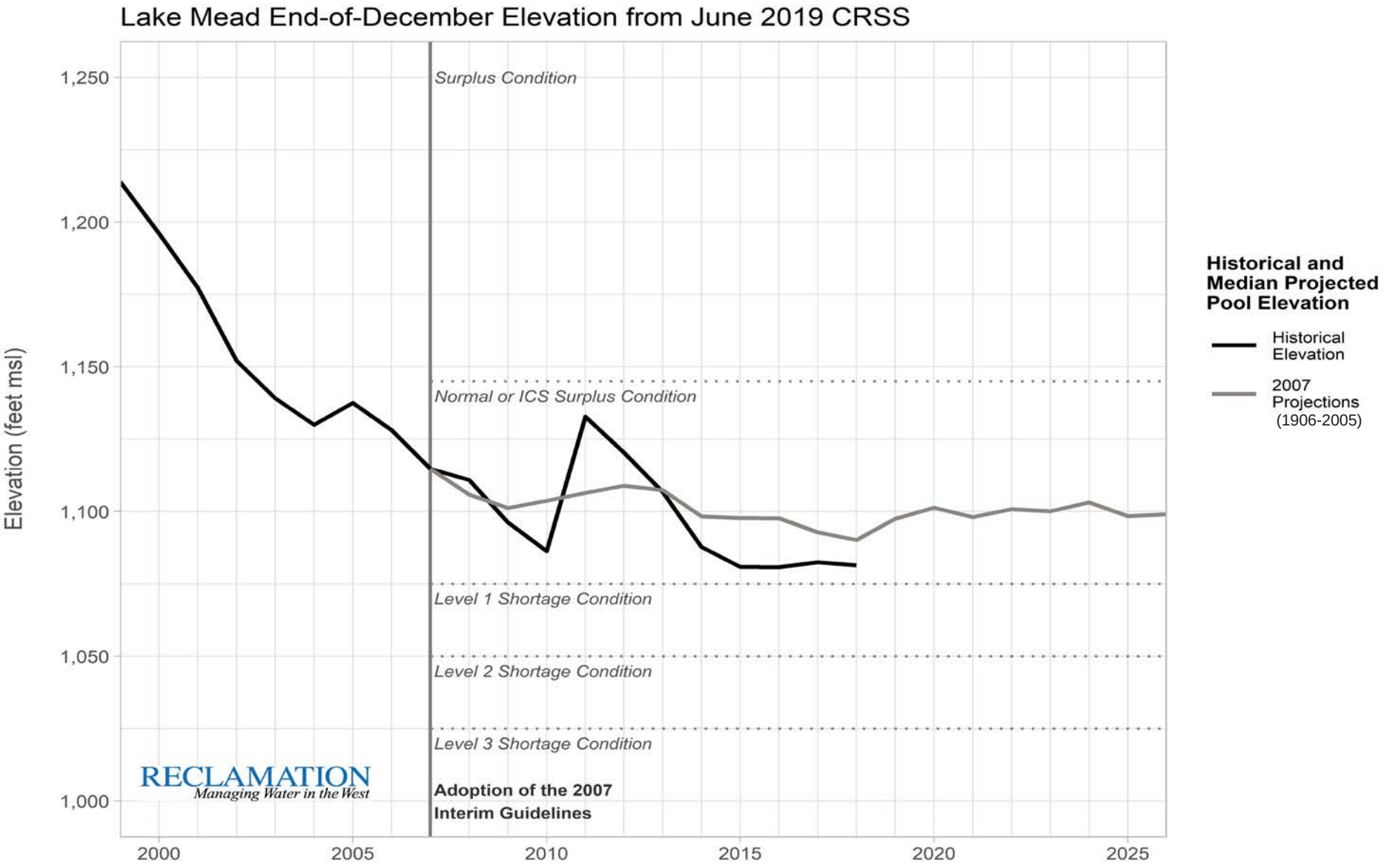

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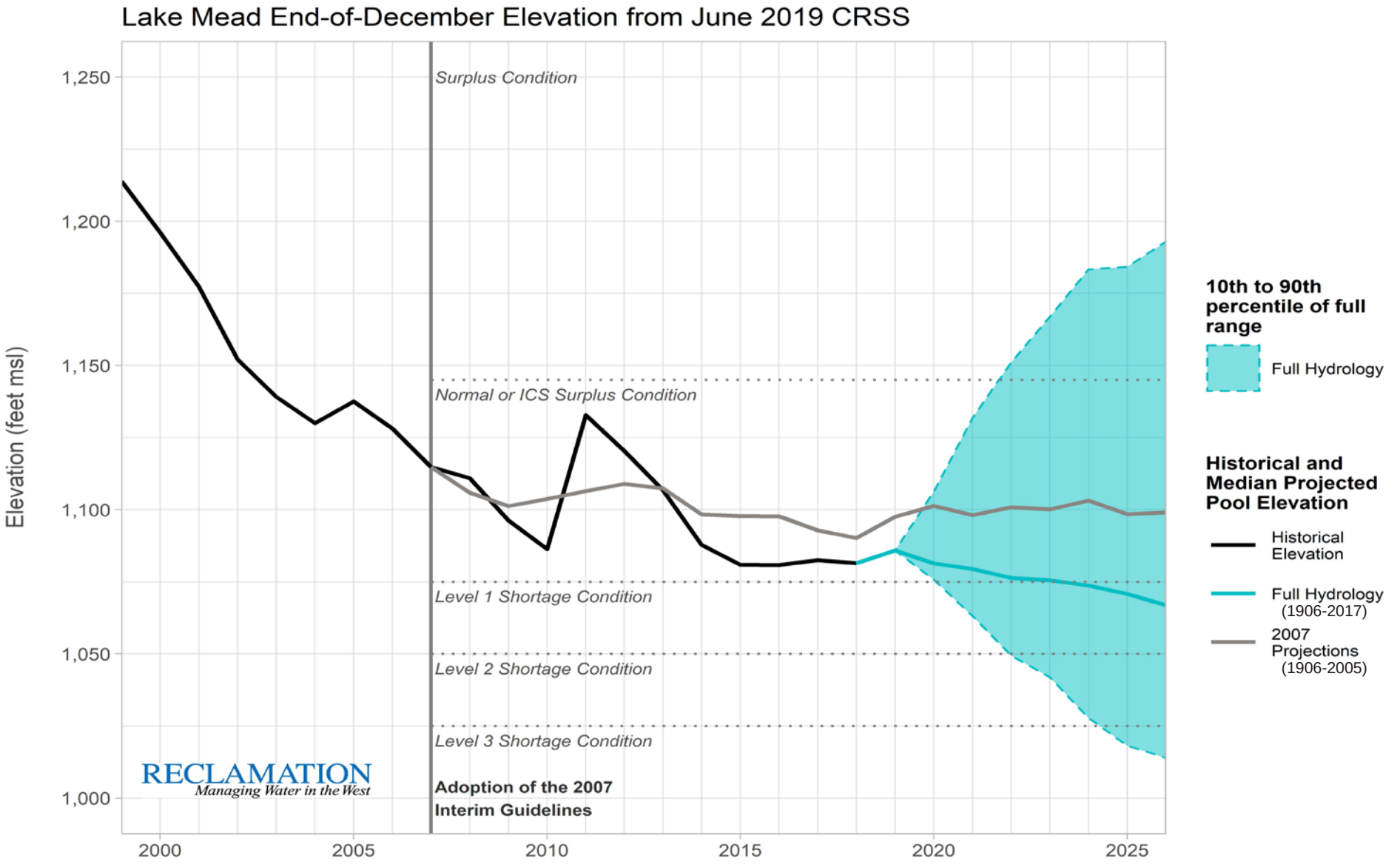

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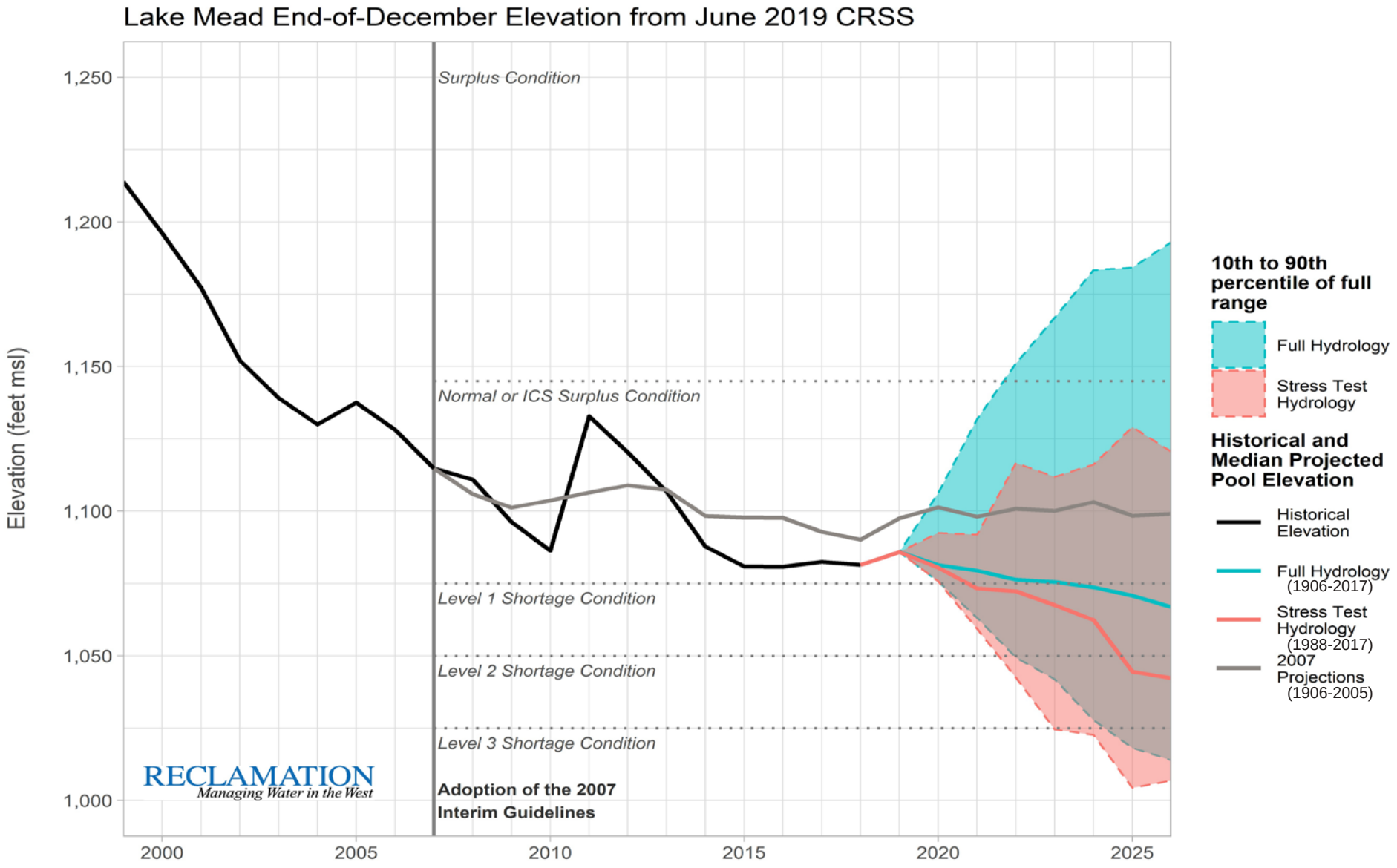
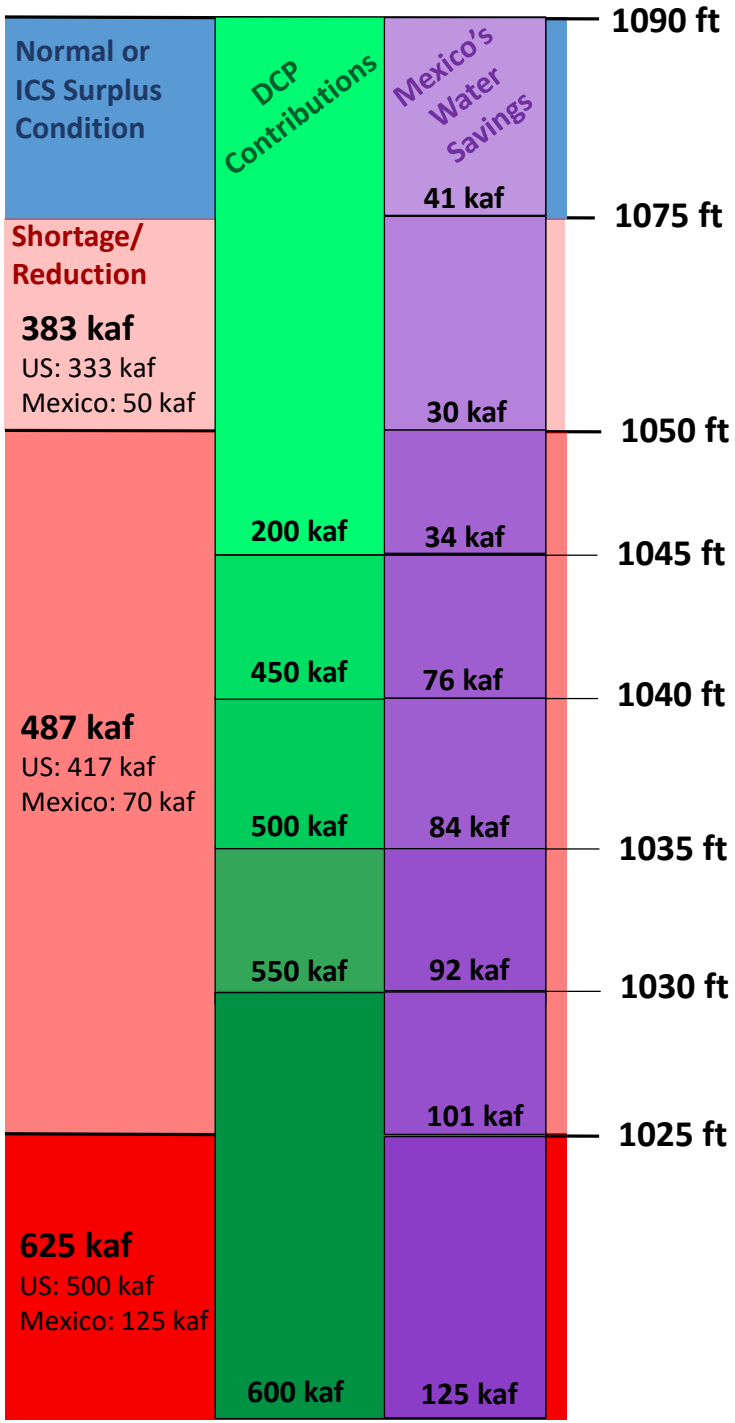
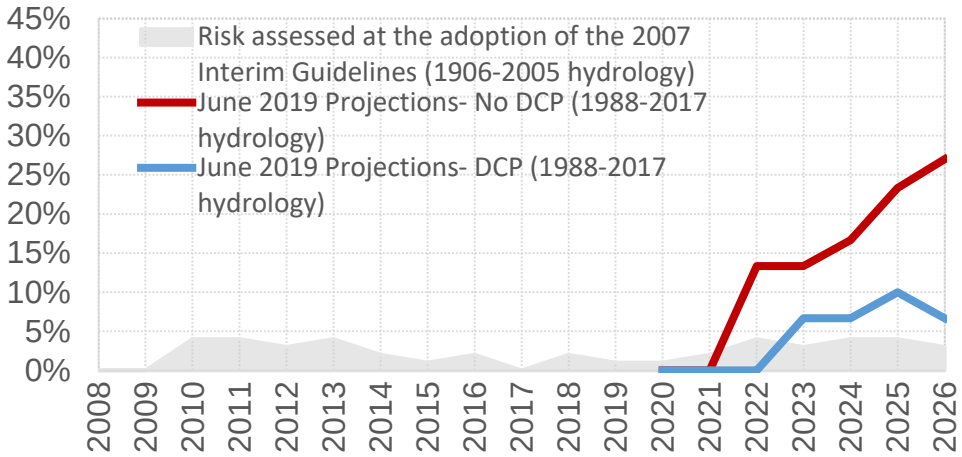


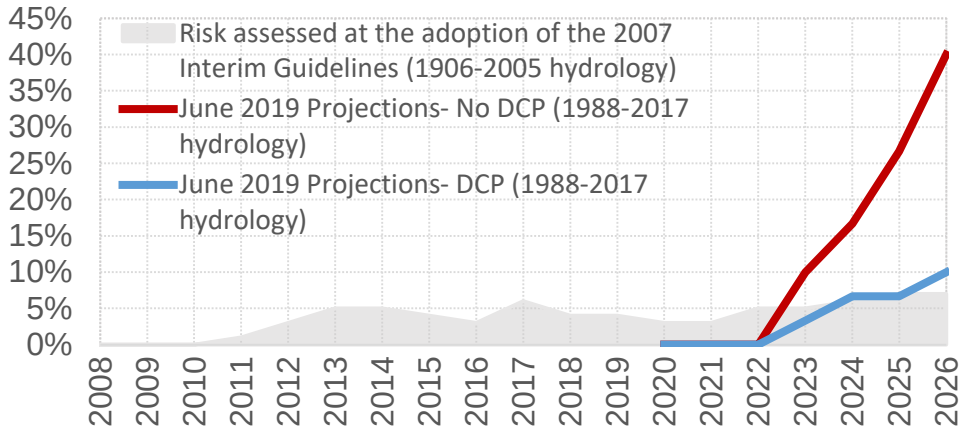


Impact of DCP on Risk

Lake Powell < 3,525' in December



Lake Mead < 1,025' in December



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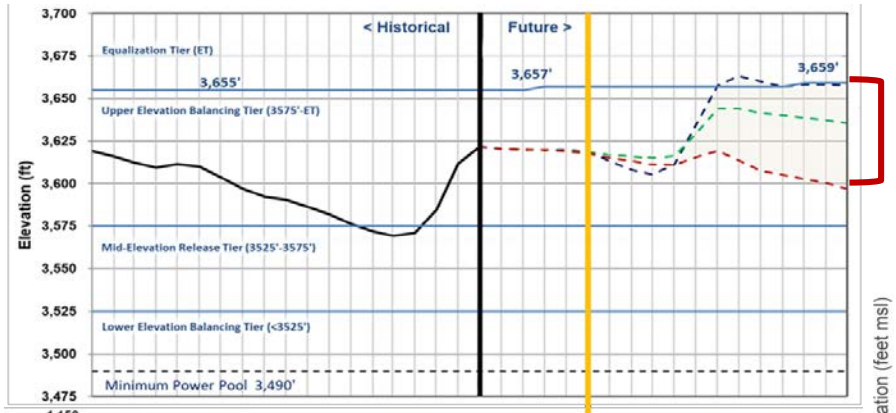
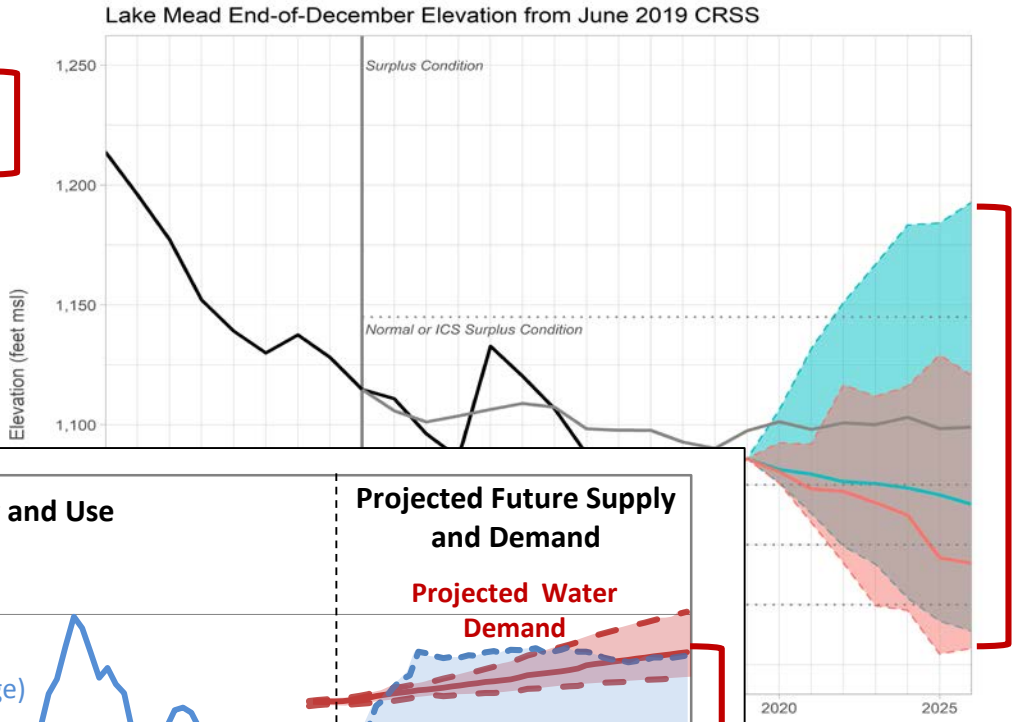
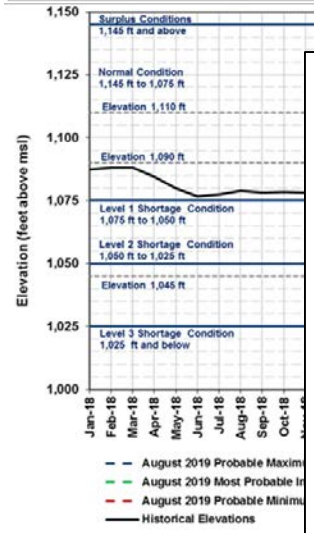
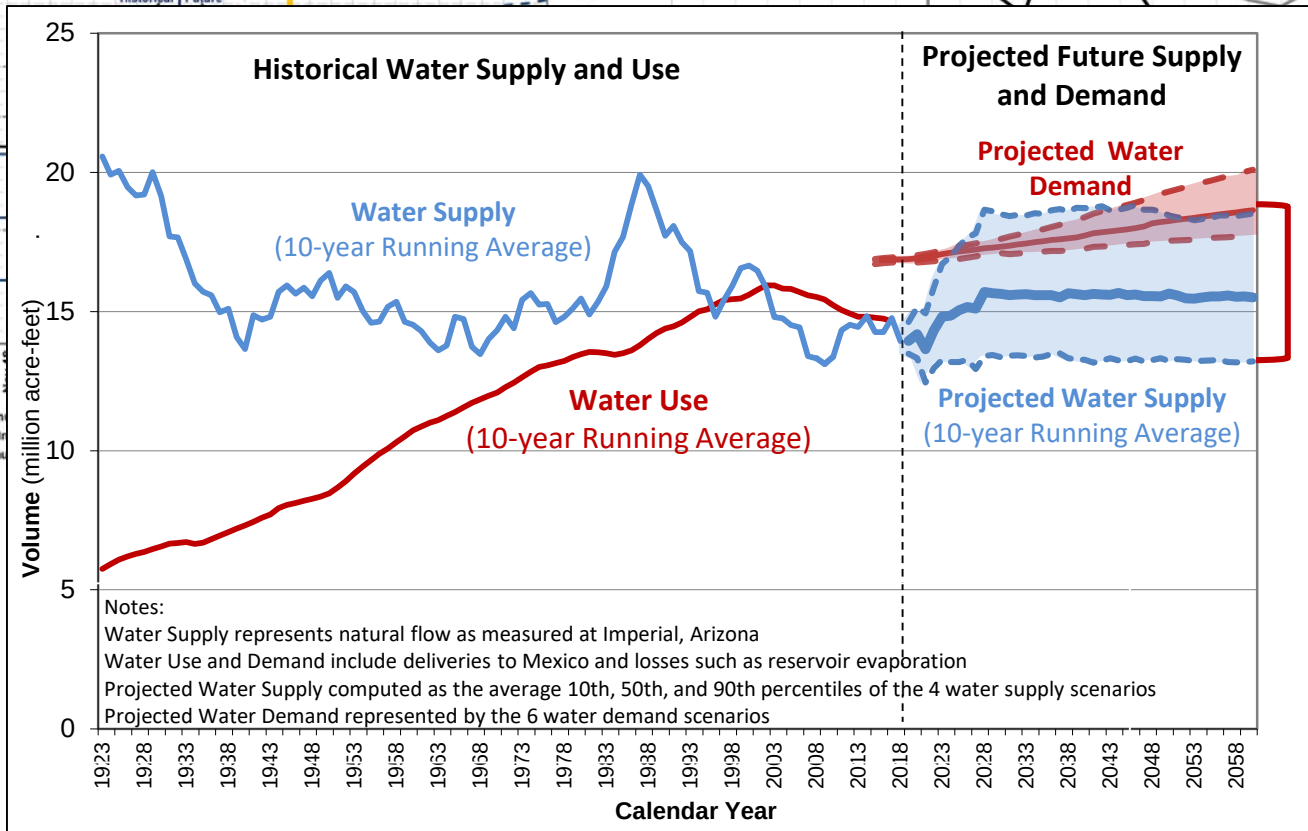
Hydrologic Uncertainty in the Basin









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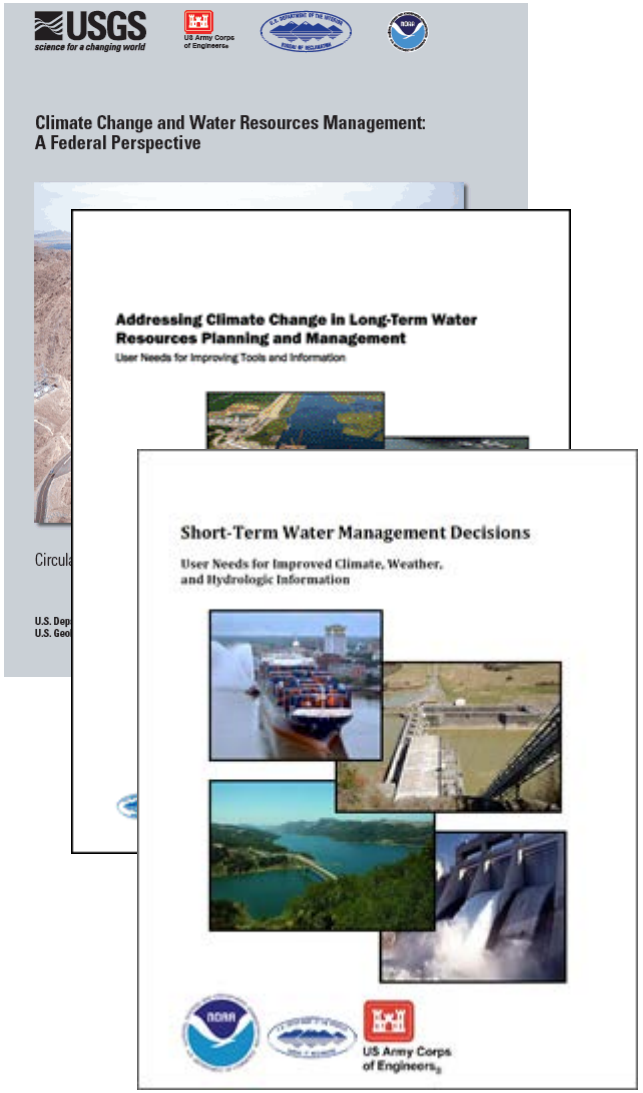
Origins of Reclamation's Colorado River Basin Research Program

- Launched in 2004, collaboration between Upper and Lower Colorado regions
- Early research incorporated in 2007 Interim Guidelines EIS
  - Appendix N: analysis of alternative hydrologic scenarios
  - Appendix U: state of climate science, needs assessment, and research recommendations
- Informed by Reclamation-wide Long-term and Short-term Needs
- Exclusive climate and hydrology focus



Colorado River Basin Research-to-Operations (CRB R2O) Program

- Improving transition from research to experimentation to application
  - Building in-house capacity to test research in operational context
  - Emphasizing testing as part of research scope
- Collaborating w/ variety of scientists, gov't agencies, and stakeholders to scope, fund, and perform research
- Exploring decision science in addition to climate and hydrology
- Projects addressing short-, mid-, and long-term needs

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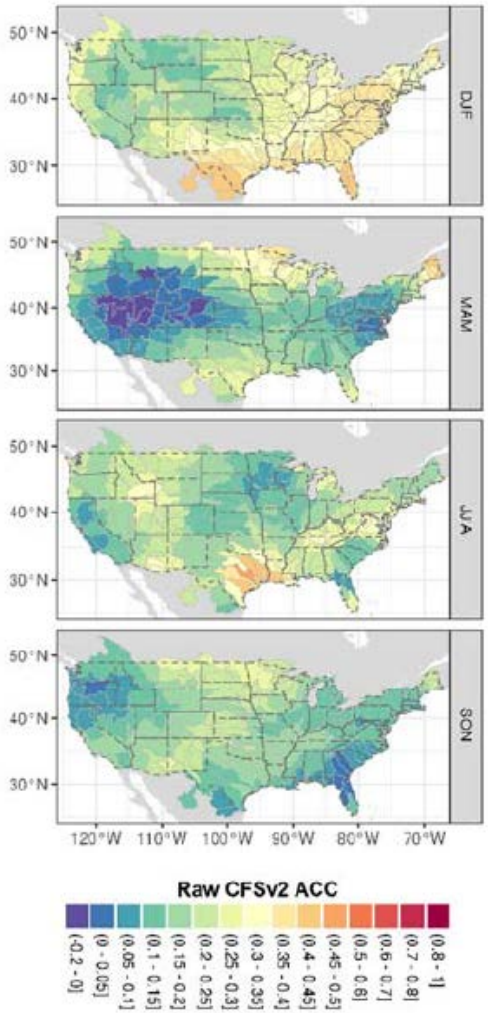
Short-term CRB R2O Research

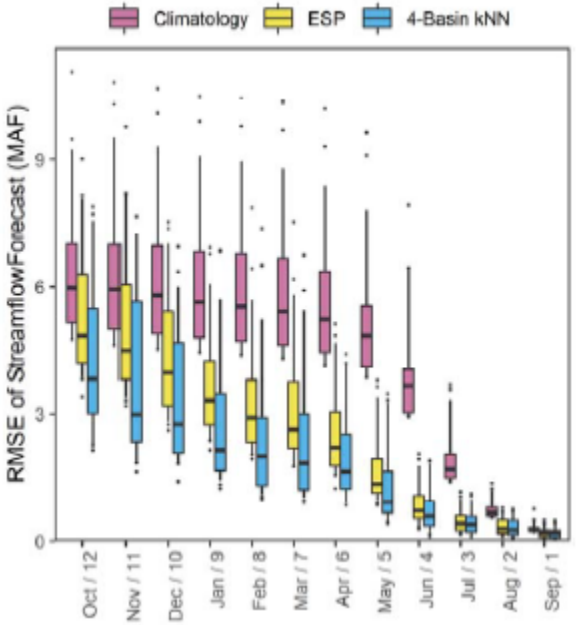
- 3-month to 2-year horizon; impacts studies using 24-Month Study model
- *Climate-informed subseasonal-to-seasonal forecasts*
  - Can skillful weekly-to-monthly climate data products improve streamflow forecasts?
- *Consumptive use modeling for the Colorado Basin River Forecast Center (CBRFC)*
  - Can use of additional data sources improve CBRFC's water supply forecasts?



Skill results for 3-4 week temp forecasts on a seasonal basis. From "Development of Sub-seasonal to Seasonal Watershed-scale Hydroclimate Forecast Techniques to Support Water Management" MS Thesis by S. Baker

Mid-term CRB R2O Research

- 2- to 5-year horizon; impacts studies using Mid-Term probabilistic Operations Model (MTOM)
- *Colorado Basin Streamflow Forecast Testbed*
  - Create an objective and structured approach to compare the skill of currently-used and experimental streamflow forecasts
- *Temperature-informed streamflow projections*
  - How has temperature affected historical streamflow and can skillful temperature predictions improve mid-term streamflow projections?



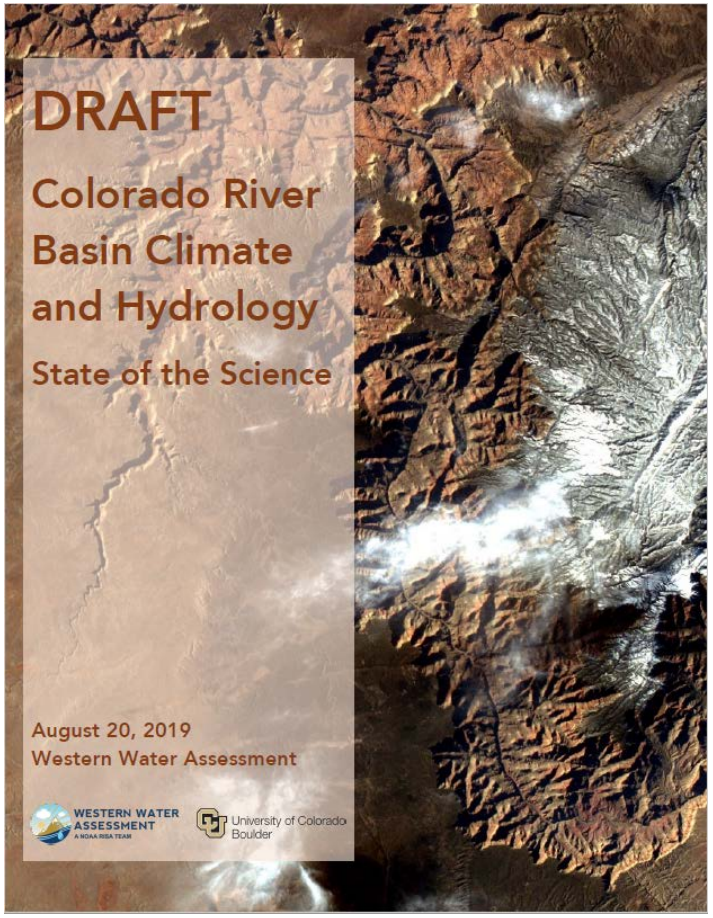
Skill comparison of water year unregulated inflow into Lake Powell from three forecasts. From "Development of Sub-seasonal to Seasonal Watershed-scale Hydroclimate Forecast Techniques to Support Water Management" MS Thesis by S. Baker

Long-term CRB R2O Research

- 5- to 50-year horizon; impacts studies using CRSS
- *Exploring CMIP5 projections*
  - How do CMIP3 and CMIP5 compare in skill, climate, hydrology, and resulting system impacts?
  - How do two different GCM downscaling methods affect flows?
- *Comparing different climate projection downscaling methods*
  - How do (another) two different GCM downscaling methods affect flows?
- *Many Objective Robust Decision Making (MORDM) for long-term planning*
  - Can a new decision making approach help address the challenges of long-term planning in the face of deep (irreducible) uncertainty?

Colorado River Basin Climate and Hydrology State of the Science Report

- Update to 2007 Interim Guidelines EIS Appendix U
- Jointly funded by Reclamation and group of stakeholders
- Lead authors: Jeff Lukas and Liz Payton of Western Water Assessment
- Resource for everyone interested in the Colorado River Basin: Reclamation, stakeholders, and scientists
- December 2019 expected publication



Summary

- Hydrologic certainty has been and will continue to be a challenge in Colorado River Basin planning
- The DCP illustrates a successful response to ongoing drought, reducing risk of reaching critical elevations through 2026
- Reclamation launched a research program in 2004 focused on hydrologic uncertainty- that program has evolved and is exploring research to inform ongoing and future Reclamation activities, including the renegotiations of the 2007 Interim Guidelines
- For more info about our research and the CRB R2O Program
  - Visit our website:

    https://www.usbr.gov/lc/region/programs/CRB-R2O-homepage.html
  - Email us: CRB-R2O@usbr.gov