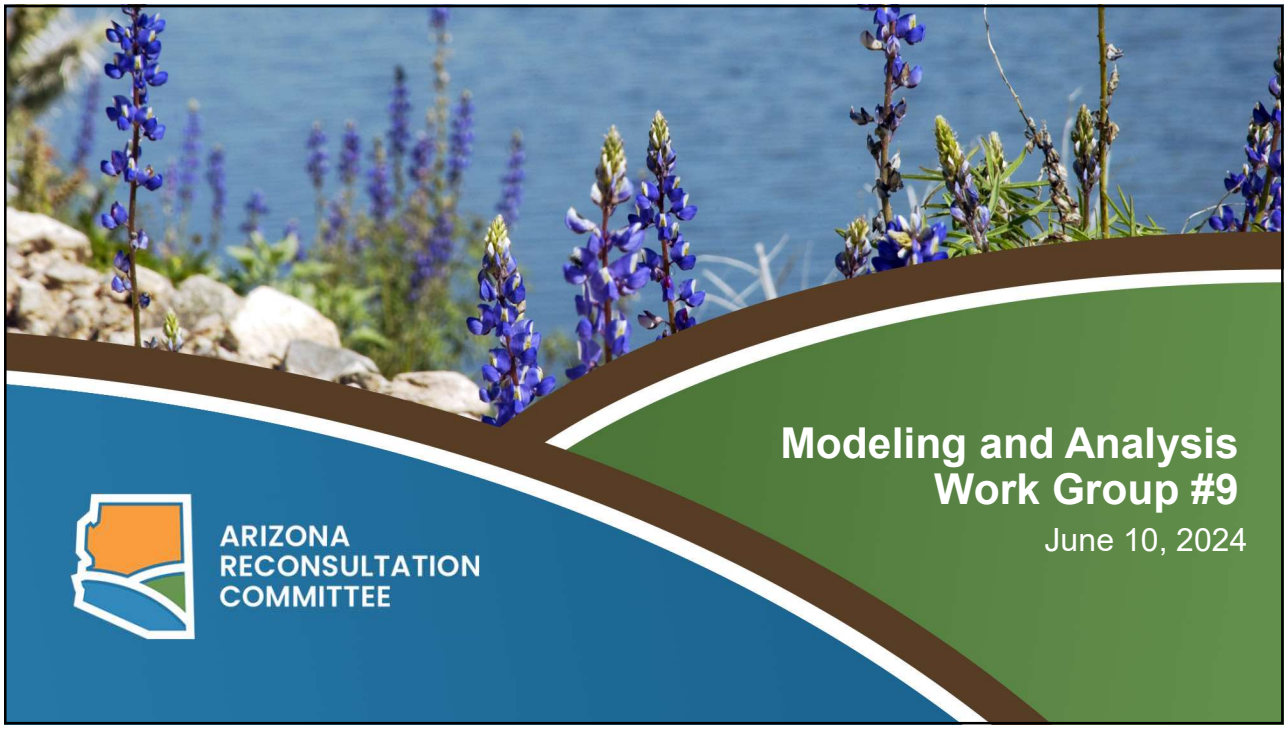

1

Meeting Logistics Summary

- Roll Call
  - Members will unmute and acknowledge their attendance when their name is called.
- Modeling and Analysis Workgroup Members
  - If in the room, please raise your hand.
  - If online, use the Teams “raise hand” feature to request to speak or ask questions.
  - Wait to be recognized before speaking to ensure clear communication and remain muted when not speaking.

2

MAWG #9 Meeting Agenda

- Welcome and Introductions
- MAWG Overview and Purpose
- Post-2026 Lower Basin Alternative Components
  - Powell Releases
  - Storage as presented at 3/6/2024 ARC
- Post-2026 Lower Basin Alternative Additional Analysis
- MAWG Next Steps

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3

MAWG #9 Purpose and Goals

- Lower Basin States Alternative was submitted to Bureau of Reclamation on March 6, 2024
- MAWG #8 held on March 11, 2024 to discuss technical details of the Lower Basin States Alternative, with a focus on reductions
- MAWG #9 is convened to further discuss technical details of the Lower Basin States Alternative, including Powell releases and additional evaluation of reductions
- Additional analysis of Lower Basin Alternative

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4

Post-2026 Lower Basin Alternative Components

5

Elements of the Lower Basin Alternative

MAWG #8

- Water use as a function of the system contents approach
  - Surplus, Normal and Reduction conditions

MAWG #9

- Lake Powell releases to Lake Mead
- Additional analysis of Lower Basin alternative

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6

Lower Basin Alternative – Lake Powell Releases

The Colorado River Basin States Representatives of Arizona, California, and Nevada

March 6, 2024

The Honorable Camille Calimlim Touton
Commissioner
Bureau of Reclamation
1849 C Street, NW
Washington, DC 20240

Re: Lower Basin Alternative for the Post-2026 Coordinated Operation of the Colorado River Basin

Dear Commissioner Touton:

The undersigned Governors' Representatives of Arizona, California, and Nevada (Lower Division States) appreciate the opportunity to submit the attached alternative (Lower Basin Alternative) for the Bureau of Reclamation (Reclamation) to analyze as part of Reclamation's National Environmental Policy Act (NEPA) review to adopt guidelines and coordinated reservoir management strategies to address future operations of Lake Powell and Lake Mead. These new guidelines will take effect when the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead (2007 Interim Guidelines) expire in 2026 as described in the Scoping Report for Post-2026 Colorado River Reservoir Operations (88 FR 72535, October 20, 2023) (Scoping Report).

This Lower Basin Alternative is designed to provide for the sustainable management of the Colorado River system and its resources under a wide range of potential future system conditions due to a changing climate, consistent with the Scoping Report. Since Reclamation initiated this action in June 2023, the Colorado River Basin States (Basin States) have been working to develop a consensus alternative, as noted in the Basin States' August 15, 2023, scoping letter. Although there is agreement among the Basin States regarding the need to provide for operations of Lake Powell and Lake Mead under a wide range of potential future system conditions due to a changing climate, at this point the seven Basin States have been unable to agree on a consensus alternative. The Lower Division States look forward to further discussions with the Upper Division States, as well as Tribes, non-governmental organizations, and other stakeholders, to develop a consensus while Reclamation evaluates alternatives.

- Considerate of Compact requirements
- Lake Powell release to Lake Mead determined primarily by a combination of Flaming Gorge, Blue Mesa, Navajo, and Powell (CRSP) live capacity and by Upper Basin (UB) depletions under certain release regimes
  - Equalization
  - "Hydrologic Shortage"* based release
  - Reduced release
  - Static release

*"Hydrologic shortage" is used to describe a broad range of factors that affect water supply availability in the Upper Division States without taking a position on which of these factors are "shortages."

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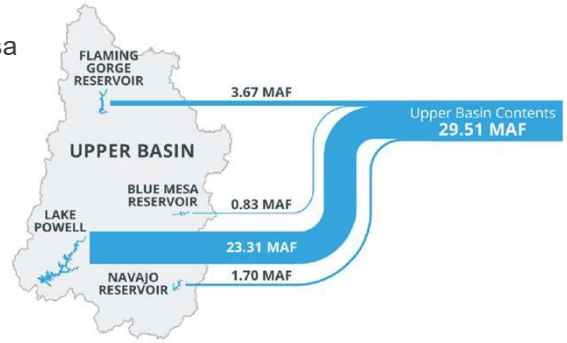
7

Lower Basin Alternative – Lake Powell Releases

CRSP Reservoirs Live Capacity %

- Lake Powell, Flaming Gorge, Navajo, Blue Mesa

CRSP Contents		
Reservoir	Storage (1000 acre-ft)	Percent of Total Storage (%)
Lake Powell	23,313	79.0%
Flaming Gorge Reservoir	3,670	12.4%
Navajo Reservoir	1,700	5.8%
Blue Mesa Reservoir	830	2.8%
Total	**29,513**	**100%**



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8

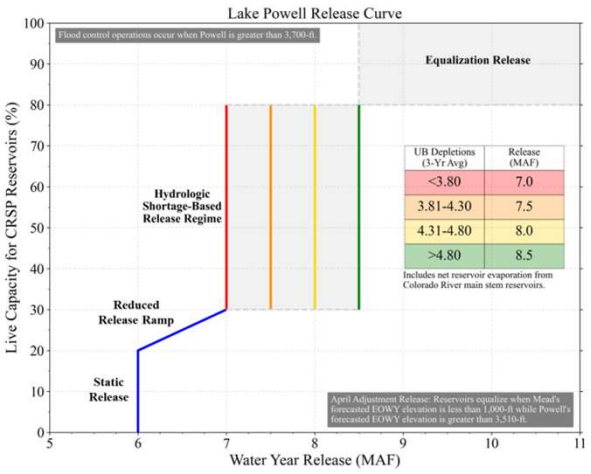
Lower Basin Alternative – Lake Powell Releases

Upper Basin (UB) Depletions

- Water User depletions
  - and -
  Reservoir evaporation

Release (MAF)

- Water Year release from Powell to Mead per year



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9

Lower Basin Alternative – Lake Powell Releases

Equalization Release: CRSP Live Capacity > 80%

- Balance contents of Powell and Mead with releases between 8.5 MAF to 11.0 MAF

"Hydrologic Shortage"-Based Release: 30% < CRSP Live Capacity ≤ 80%

- Releases vary between 7.0 MAF and 8.5 MAF depending on quantification of Upper Basin "hydrologic shortage"

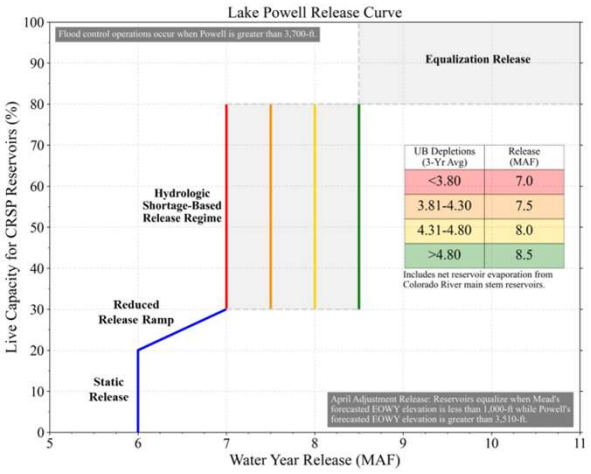
Reduced Release Ramp: 20% < CRSP Live Capacity ≤ 30%

- Release between 6.0 MAF to 7.0 MAF, determined as a linear function

Static Release: CRSP Live Capacity ≤ 20%

- Release 6.0 MAF

April Adjustment: If on April 1, Lake Mead is projected EOWY < 1,000 ft AND Lake Powell is projected EOWY > 3,510 ft, the release will be adjusted to 8.5 MAF and 11.0 MAF to balance contents of Powell and Mead as practicable at EOWY.



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10

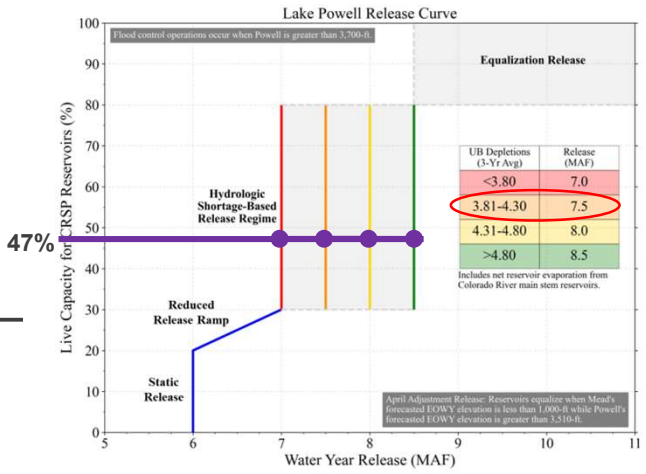
Lower Basin Alternative – Lake Powell Releases

Contents as of October 1, 2023

Lake Powell	8.79 MAF
Flaming Gorge Reservoir	3.26 MAF
Blue Mesa Reservoir	0.63 MAF
Navajo Reservoir	1.15 MAF
	13.83 MAF

$$\frac{13.83\ \text{MAF}}{29.51\ \text{MAF}} \times 100\% = 47\%$$

	UB Depletion (MAF)
2021	3.93
2022	4.05
2023	4.71
3-year Average	**4.23**



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11

Conservation, Augmentation and Storage

- **Existing Intentionally Created Surplus (ICS) program**
  - Existing rules for post-2026 management of ICS created prior to 2027
  - Can be used to meet reductions (with limitations)
  - Transition with new program TBD
- **New Storage Program -** New program to incentivize conservation, augmentation and storage with new rules
  - Delivery of stored water should not allow any state to exceed their basic apportionment when reductions apply in the Lower Basin (except limited inadvertent overruns, augmentation, and tributary conservation water)
  - The volume of water stored should be subtracted from the total system contents before reductions are calculated, to not diminish the volume of reduction that would otherwise occur absent the stored water
  - Can be used toward meeting reduction obligations, operational flexibility and wet water deliveries (with limitations)
  - Larger (5-10 MAF) cumulative limit
  - Other provisions TBD

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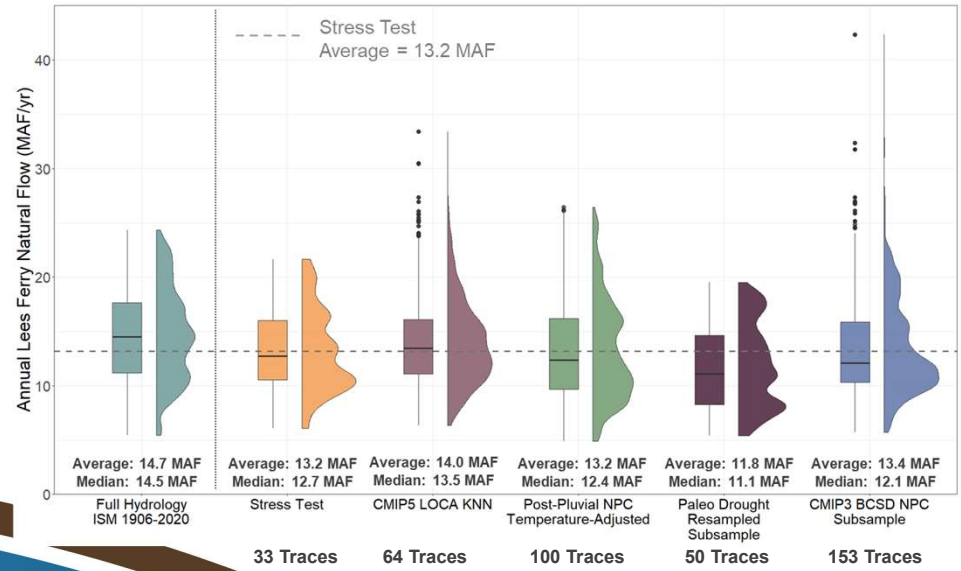
12

Post-2026 Lower Basin Alternative Performance

13

Post-2026 Hydrologies

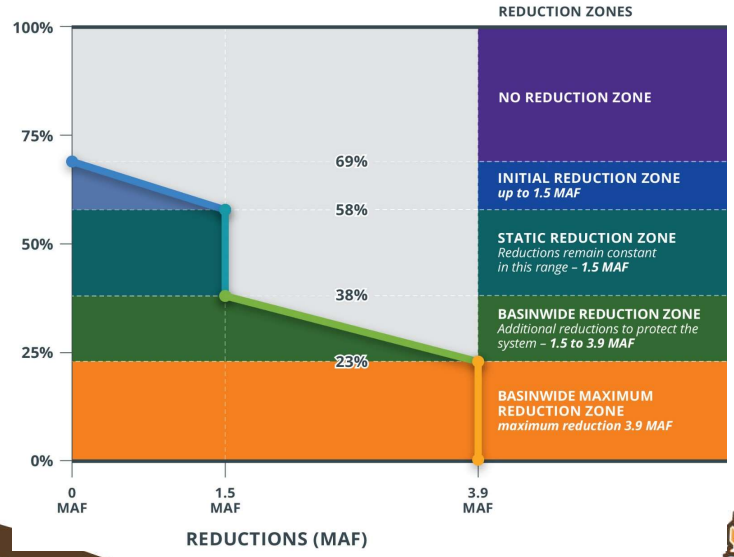


14

MAWG Meeting #9 June 10, 2024

14

Lower Basin Alternative Reduction Concept



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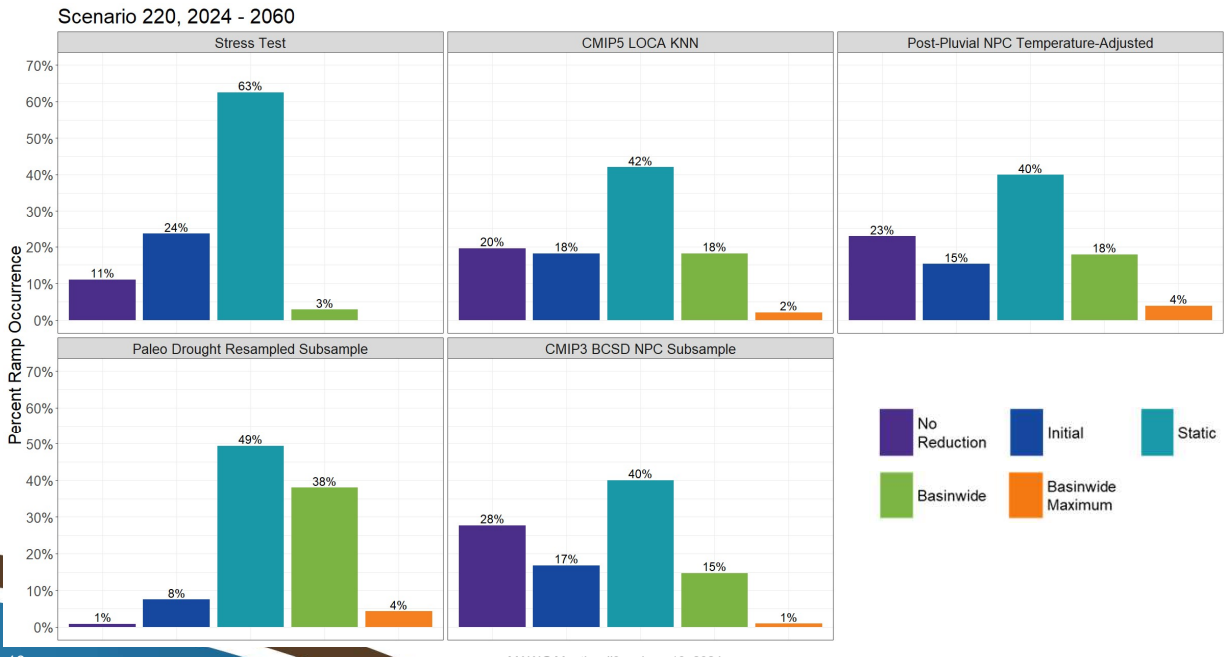
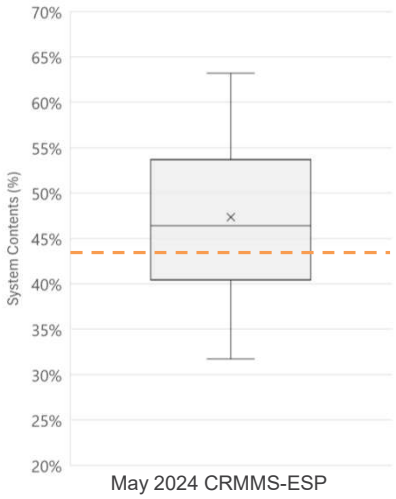
15



16

Scenario 220

- Run Duration = 30 Years = 2024 to 2053
- Initialization:
  - EOCY 2023 System Contents = 42%
  - August 2023 System Contents determination = 44%; Reduction = 1.5 MAF
- Comparison with May 2024 CRMMS-ESP projection for August 1, 2026 contents
  - 20 of 30 Traces > 44%
  - 26 of 30 Traces > 38% (Static)



May 2024 CRMMS-ESP
August 1, 2026 Projections

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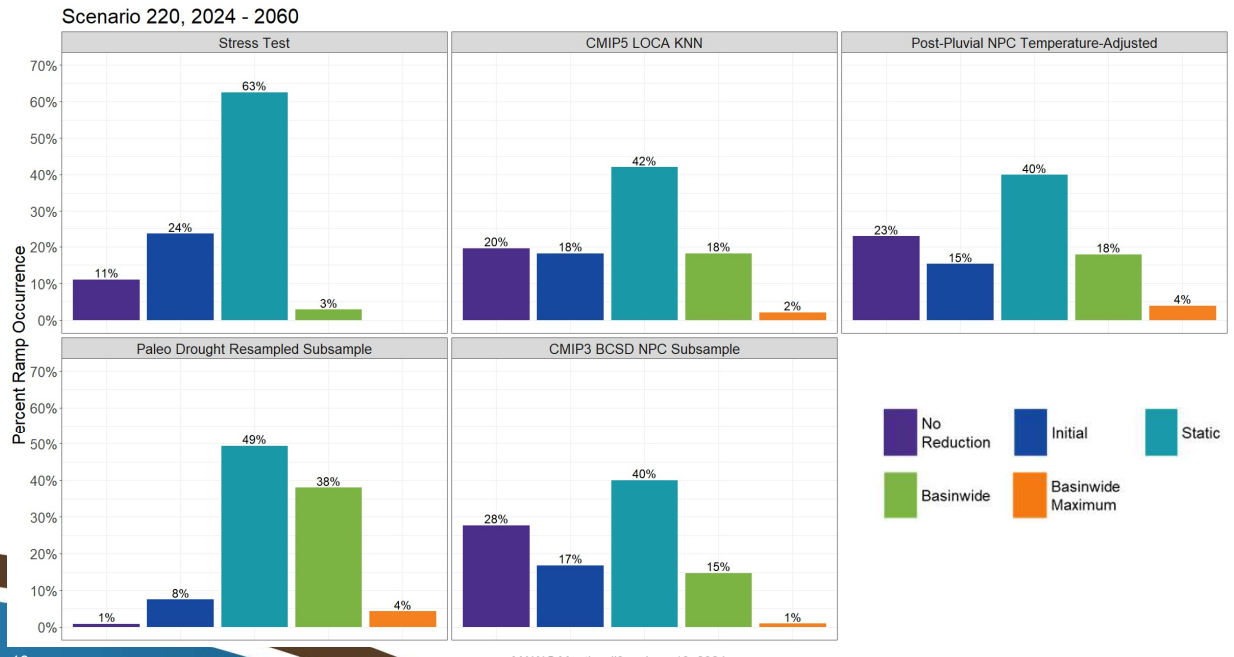
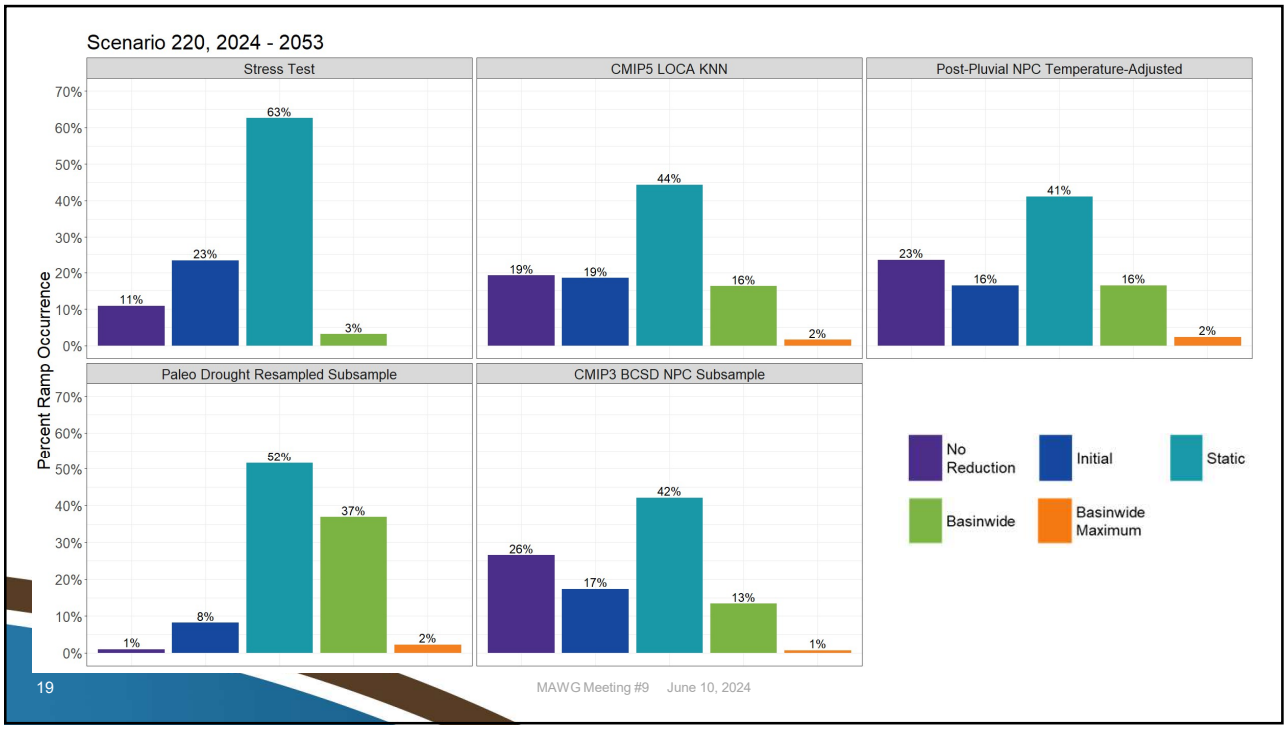
17



18



19

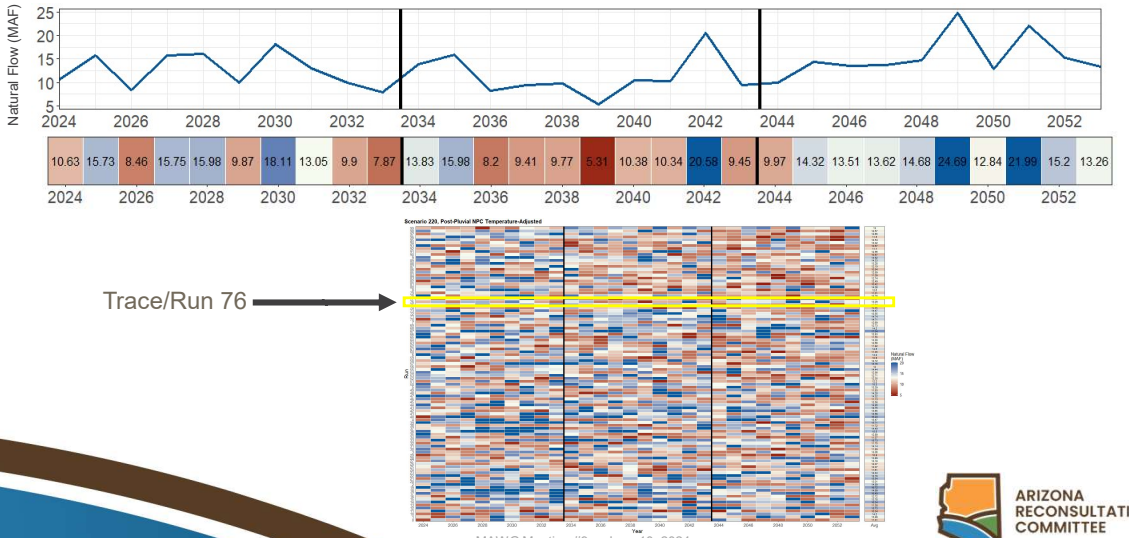
Additional Analysis of Reductions

- The histograms show the distribution of observations for a particular input hydrology
- Additional analysis and visualization helps with understanding:
  - Variability within each hydrology, including extended, subsequent dry periods
  - Evaluating frequency, magnitude and duration of reductions greater than 1.5 MAF under these hydrologies

20

Heat maps:

Post-Pluvial NPC Temperature-Adjusted, 100 Traces/Runs



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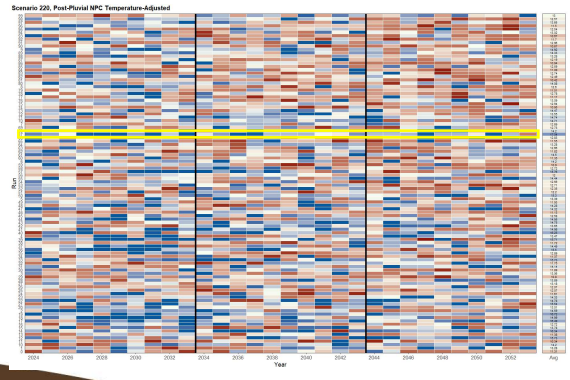
21

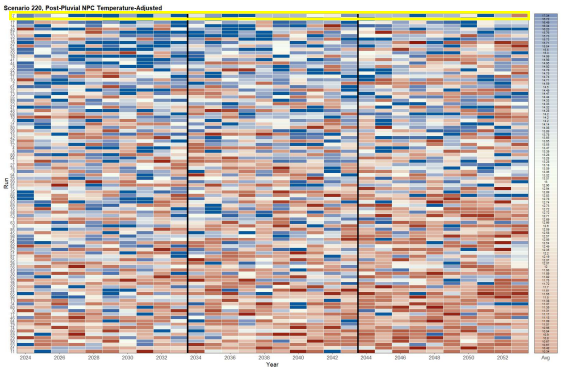
Heat maps:

Post-Pluvial NPC Temperature-Adjusted, 100 Traces/Runs

UNSORTED



SORTED



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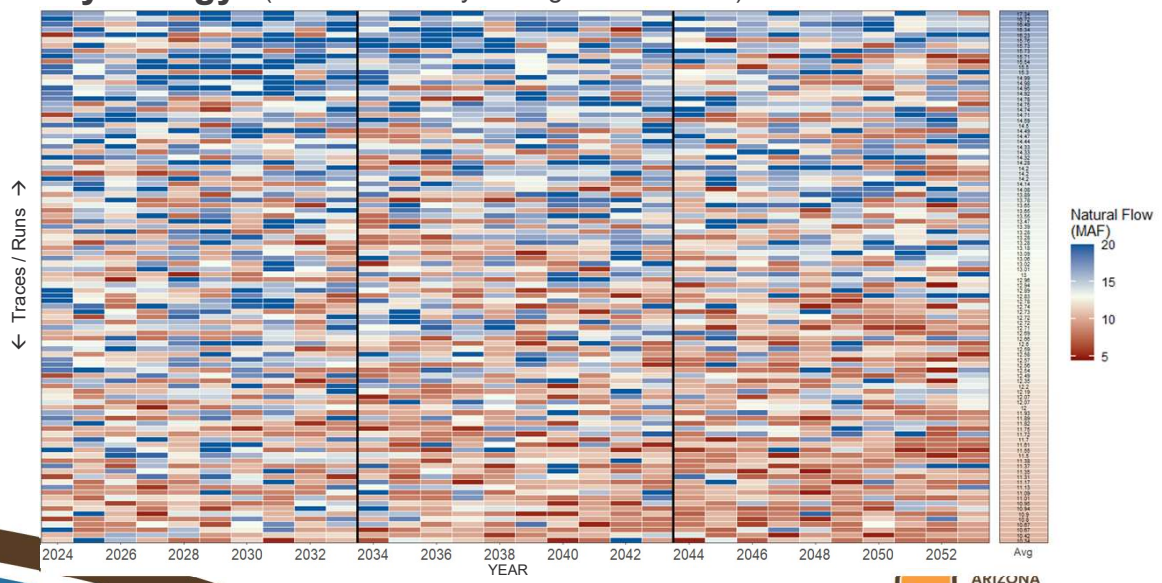
22

Input Hydrology* (Traces Sorted by Average Natural Flow)



* Scenario 220; Post-Pluvial NPC Temperature-Adjusted

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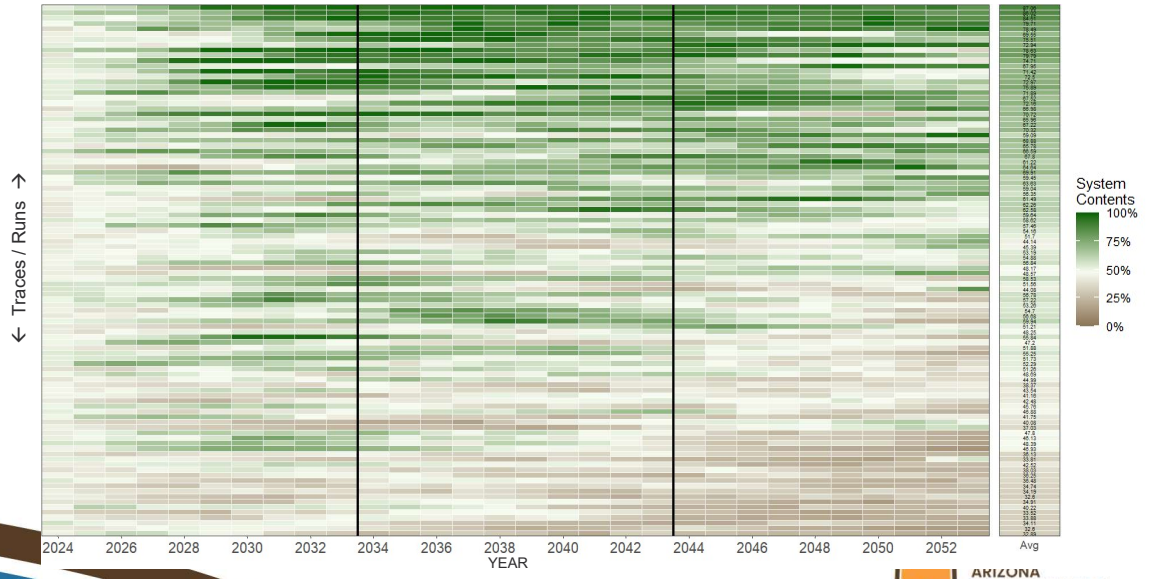
23

Total System Contents (Traces Sorted by Average Natural Flow)



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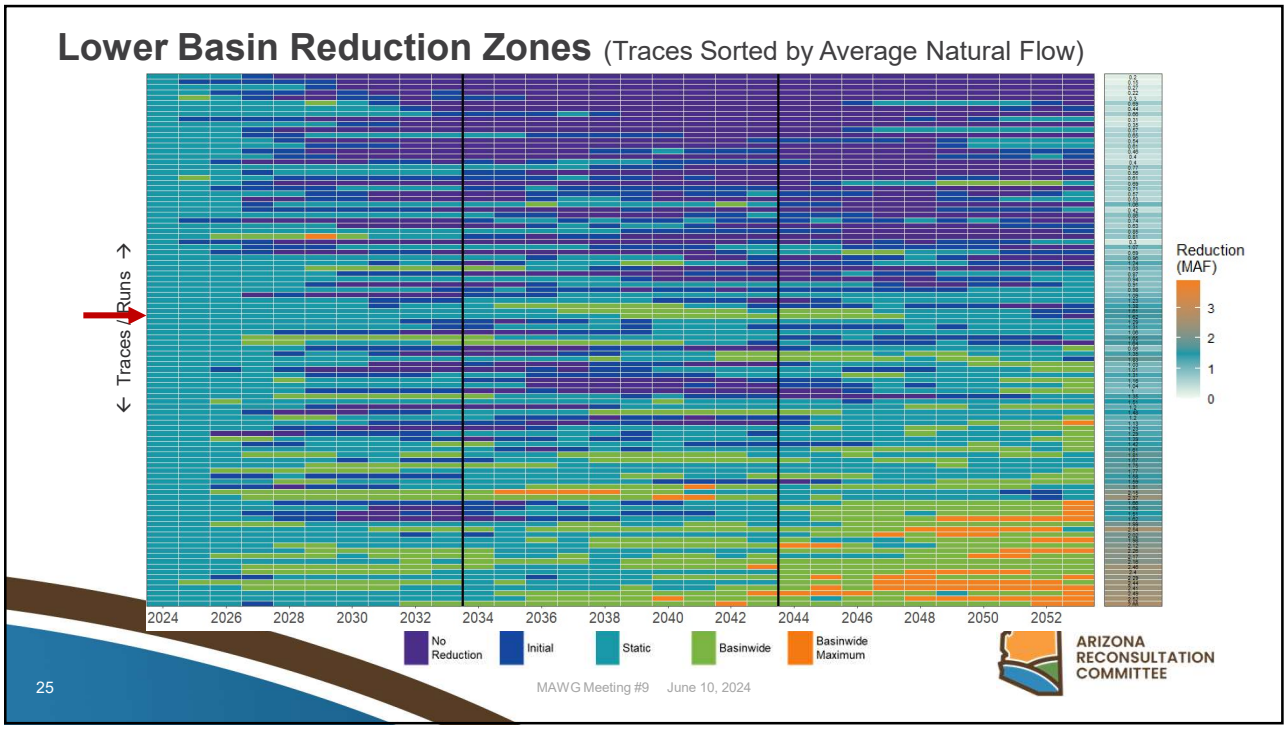
24


Lower Basin Reduction Zones (Traces Sorted by Average Natural Flow)
← Traces / Runs →
Reduction (MAF)
3
2
1
0
2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050 2052
No Reduction
Initial
Static
Basinwide
Basinwide Maximum
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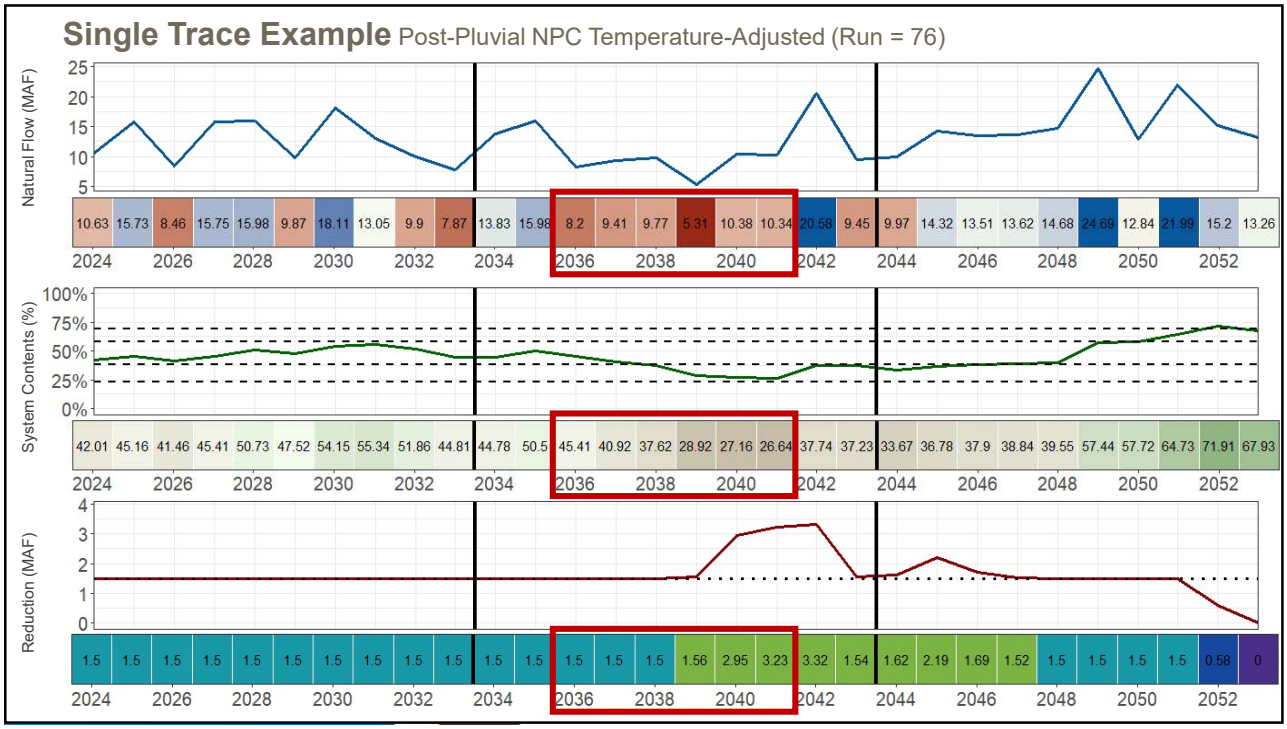
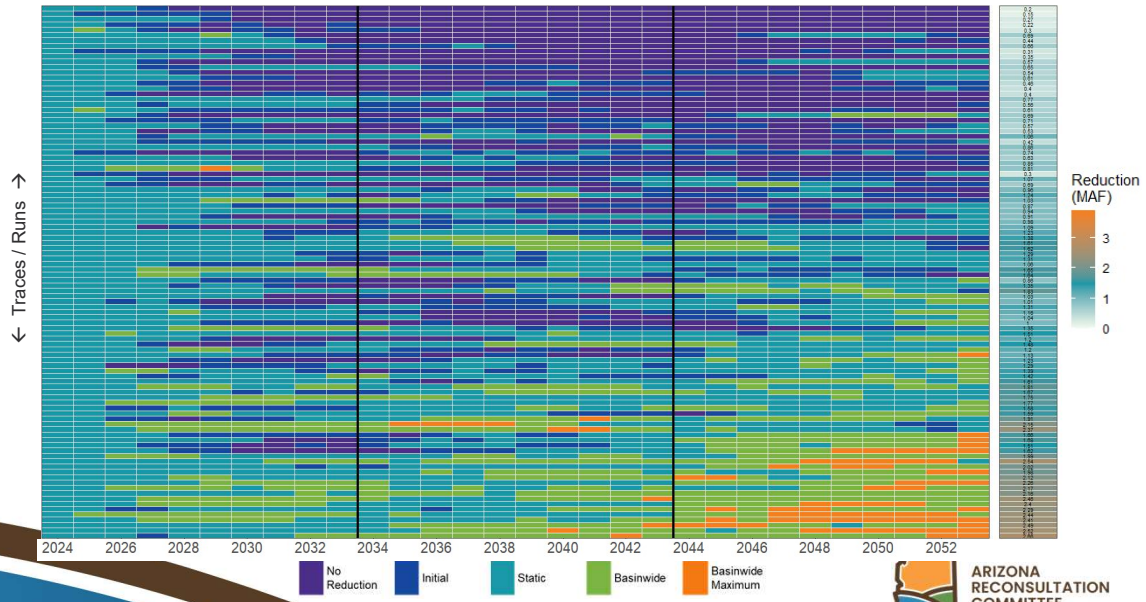
25
MAWG Meeting #9 June 10, 2024

25


Single Trace Example Post-Pluvial NPC Temperature-Adjusted (Run = 76)
Natural Flow (MAF)
25
20
15
10
5
10.63 15.73 8.46 15.75 15.98 9.87 18.11 13.05 9.9 7.87 13.83 15.98 8.2 9.41 9.77 5.31 10.38 10.34 20.58 9.45 9.97 14.32 13.51 13.62 14.68 24.69 12.84 21.99 15.2 13.26
System Contents (%)
100%
75%
50%
25%
0%
42.01 45.16 41.46 45.41 50.73 47.52 54.15 55.34 51.86 44.81 44.78 50.5 45.41 40.92 37.62 28.92 27.16 26.64 37.74 37.23 33.67 36.78 37.9 38.84 39.55 57.44 57.72 64.73 71.91 67.93
Reduction (MAF)
4
3
2
1
0
1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.56 2.95 3.23 3.32 1.54 1.62 2.19 1.69 1.52 1.5 1.5 1.5 1.5 0.58 0
2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050 2052

26

Lower Basin Reduction Zones (Traces Sorted by Average Natural Flow)



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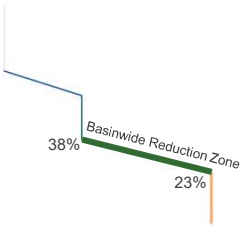
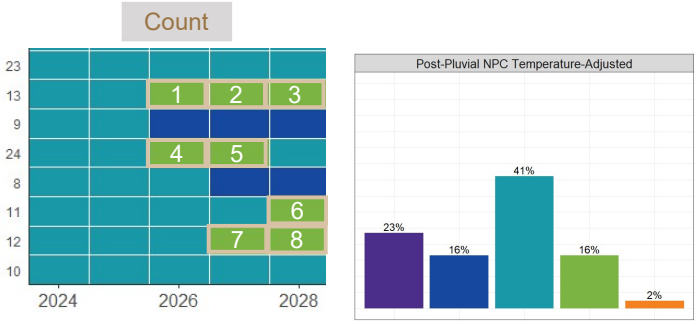
27

Frequency, Duration, and Magnitude

Yearly Statistics by ***Reduction Category***





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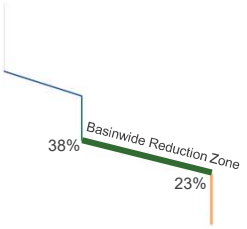
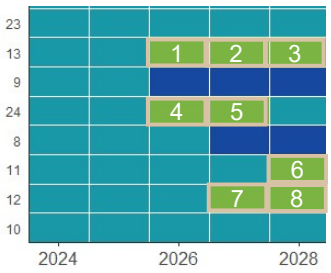
28

Frequency, Duration, and Magnitude

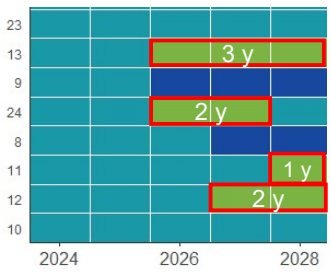
Yearly Statistics by ***Reduction Category***



Count



Duration



$$= Average\ Duration$$

$$= \frac{3\ yr + 2\ yr + 1\ yr + 2\ yr}{4}$$

$$= \frac{8\ yr}{4}$$

$$= 2\ yr$$

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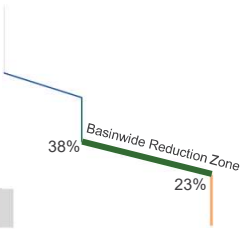
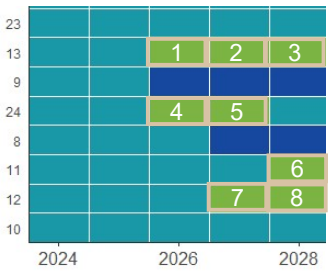
29

Frequency, Duration, and Magnitude

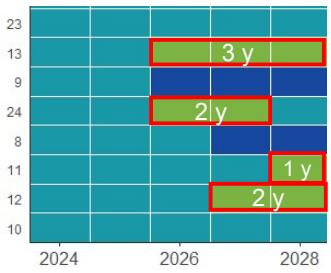
Yearly Statistics by ***Reduction Category***



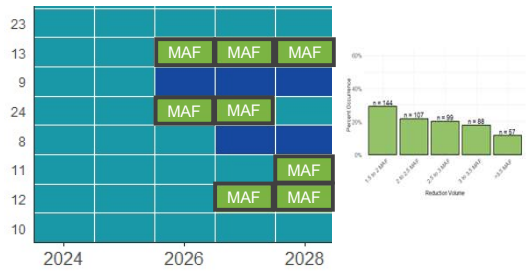
Count



Duration



Magnitude



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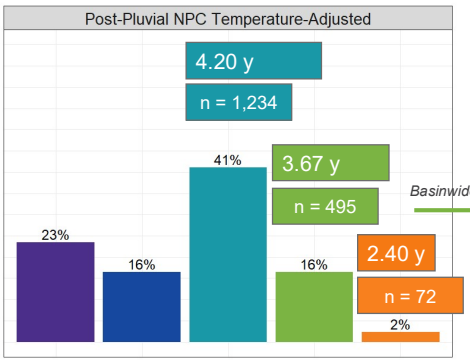
30

Post-Pluvial NPC Temperature-Adjusted:

30 Years & **100 Runs**, Total # of obs. = **3,000**

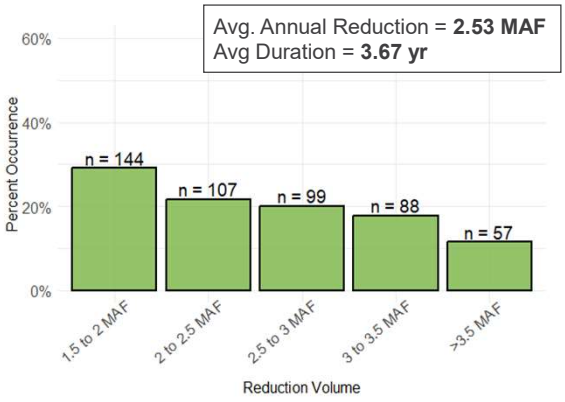
Duration

Count



Basinwide Reduction Zone

Avg. Annual Reduction = **2.53 MAF**
Avg Duration = **3.67 yr**



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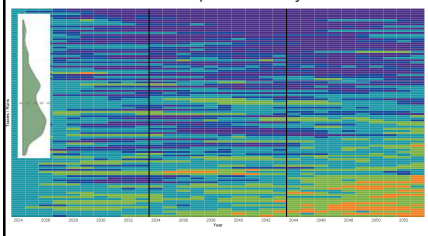
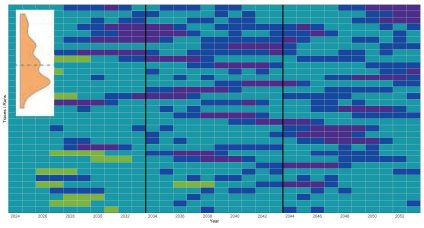
31

Reduction Zone Maps by Hydrology

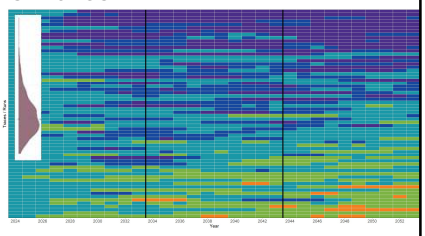
Post-Pluvial NPC Temperature-Adjusted



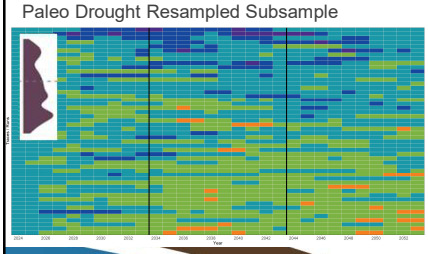
Stress Test



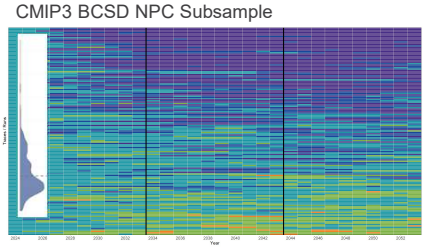
CMIP5 LOCA KNN



Paleo Drought Resampled Subsample



CMIP3 BCSD NPC Subsample



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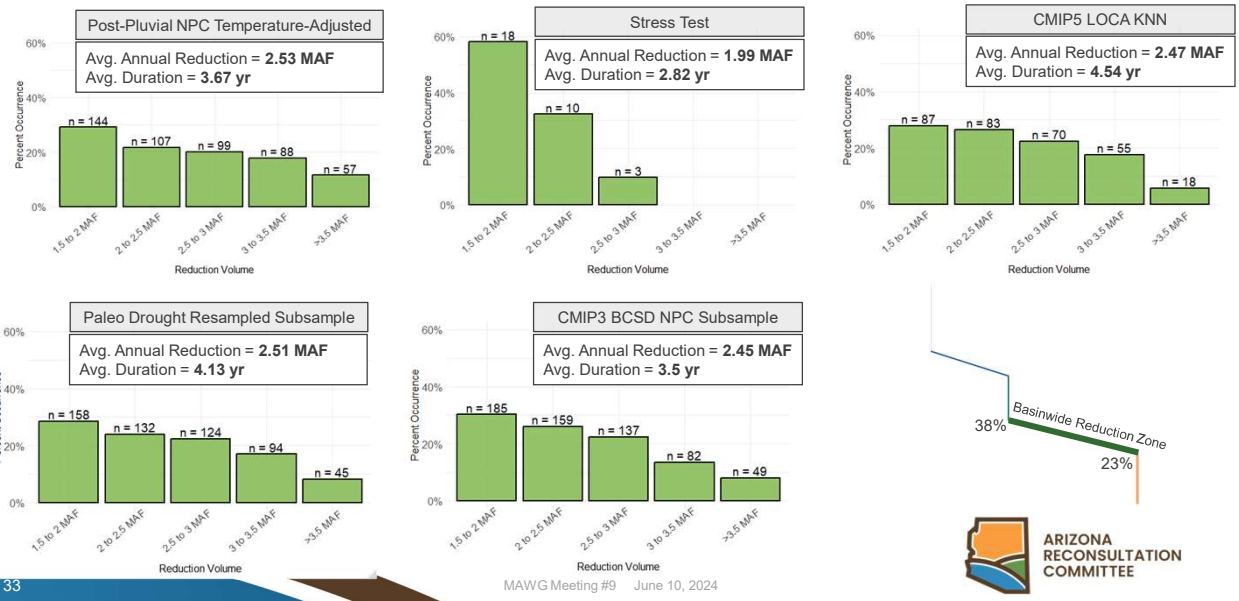
32

Basinwide Reduction Zone Statistics



33

Key Takeaways

- Hydrology is highly uncertain and drives the system
- System Contents approach helps smooth the variability of inflows
- Reduction concept helps prevent extreme changes in reductions over a short period of time, and allows water users to adapt to reductions over time
  - Static Reductions help stabilize contents over many hydrologic conditions
  - In wetter traces the system builds storage and reductions diminish
  - In the driest hydrologic traces, System Contents decline over time, and reductions increase as the system seeks equilibrium

34

Discussions/Questions

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35

36