



U.S. Department of the Interior
U.S. Geological Survey

April 2023 High-Flow Experiment Update on Impacts to Sediment and Sandbars

Glen Canyon Dam Adaptive Management Program
Adaptive Management Work Group Meeting
November 7, 2023

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Southwest Biological Science Center
Grand Canyon Monitoring and Research Center

This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.

Acknowledgements

Website:

Bob Tusso

<https://www.usgs.gov/apps/sandbar/>

Or

www.gcmrc.gov/sandbar/

Suspended Sediment:

David Topping and Project A staff

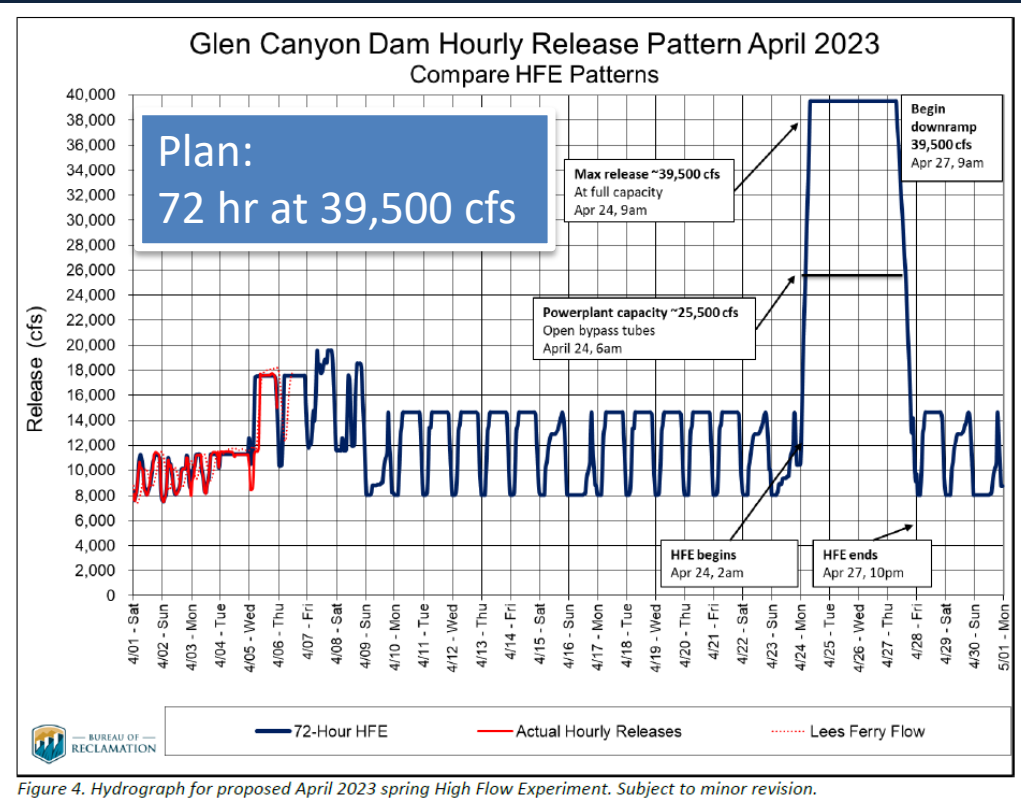
Remote Camera Downloads:

Bob Tusso and Katie Chapman

Columbine Reach Surveys:

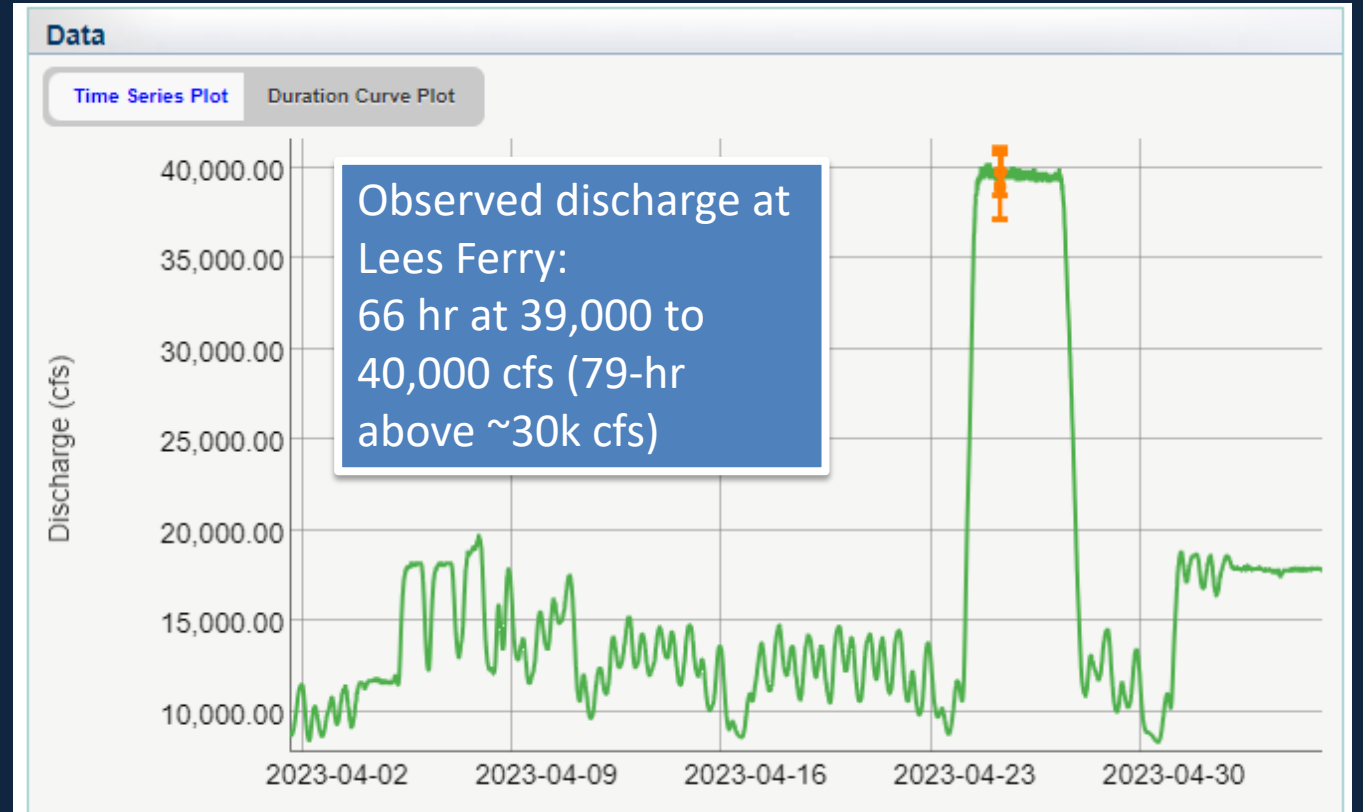
Paul Grams, Katie Chapman, Matt Kaplinski, Erica Byerley, Gerard Salter, Shannon Sartain, Karen Koestner, and Keith Kohl

April 2023 HFE – Planned and observed discharge



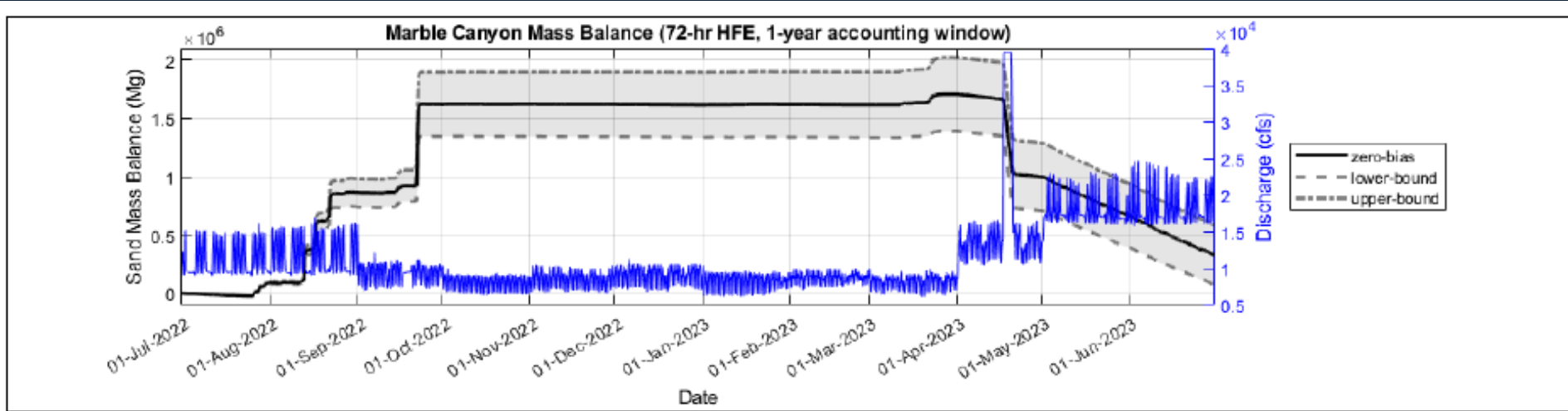
<https://www.usbr.gov/uc/progact/amp/ltemp.html>

5,000 cfs of tributary inflows during HFE!



- ~40,000 cfs at Lees Ferry, RM 30, and RM 61
- ~42,000 cfs at RM 87
- ~45,000 cfs at RM 165 and 225

April 2023 HFE – modeled vs. observed sediment balance

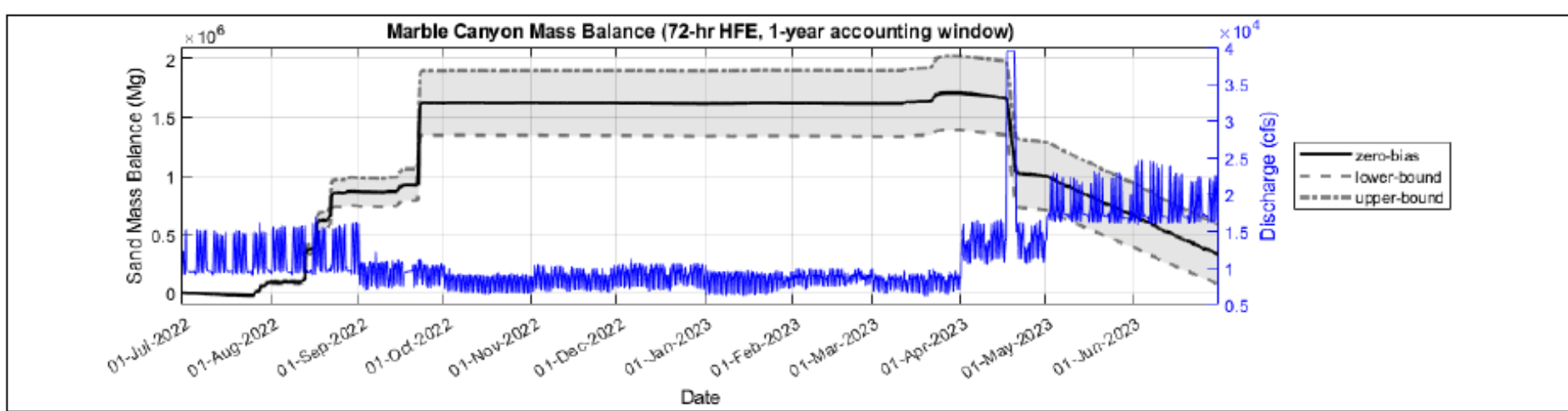


Model-predicted 1-year
sediment budget
(7/1/2022 to 7/1/2023)

Figure 3. Mass balance in Marble Canyon predicted by the Sand Routing Model (Wright et al. 2010) with a 1-year accounting window and a 72-hour HFE in April with a maximum magnitude of 39,500 cfs.

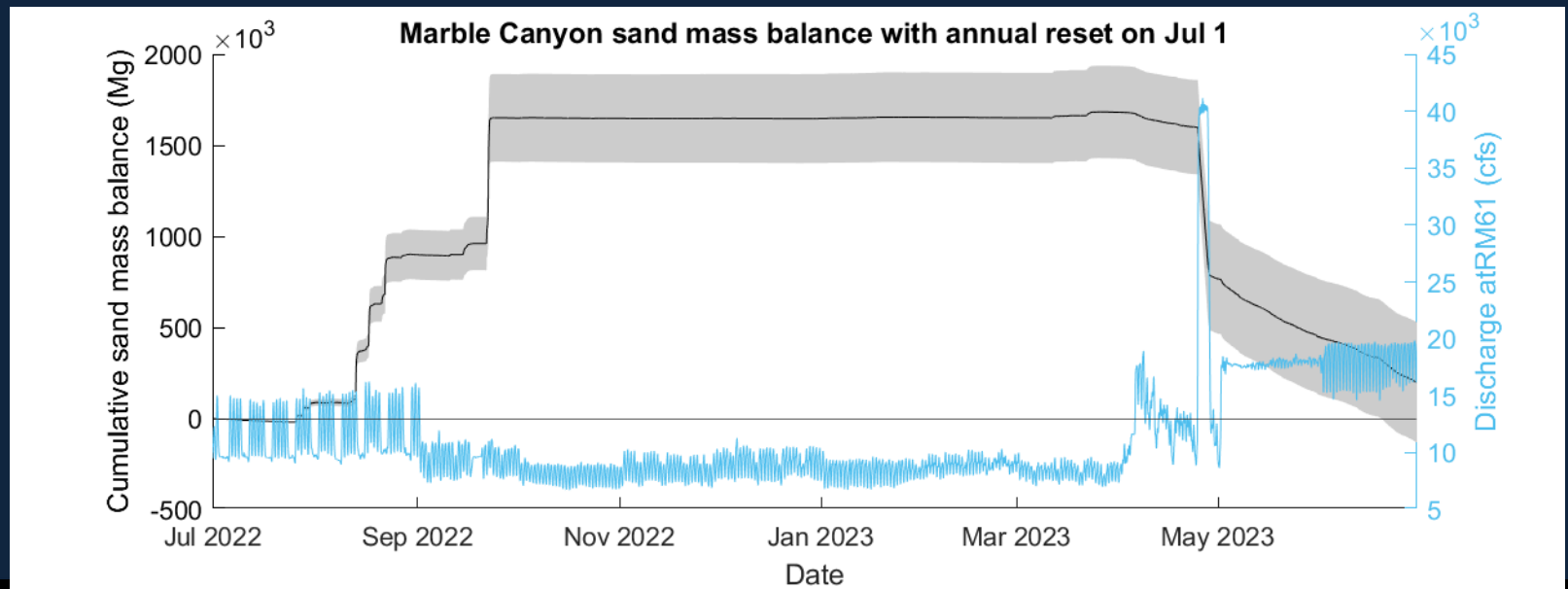
- HFE for 72-hours at ~40,000 cfs was designed based on sand that accumulated in Marble Canyon from July 1, 2022 through October 2022 and remained in Marble Canyon during the low winter 2022/2023 releases.

April 2023 HFE – modeled vs. observed sediment balance



Model-predicted 1-year sediment budget (7/1/2022 to 7/1/2023)

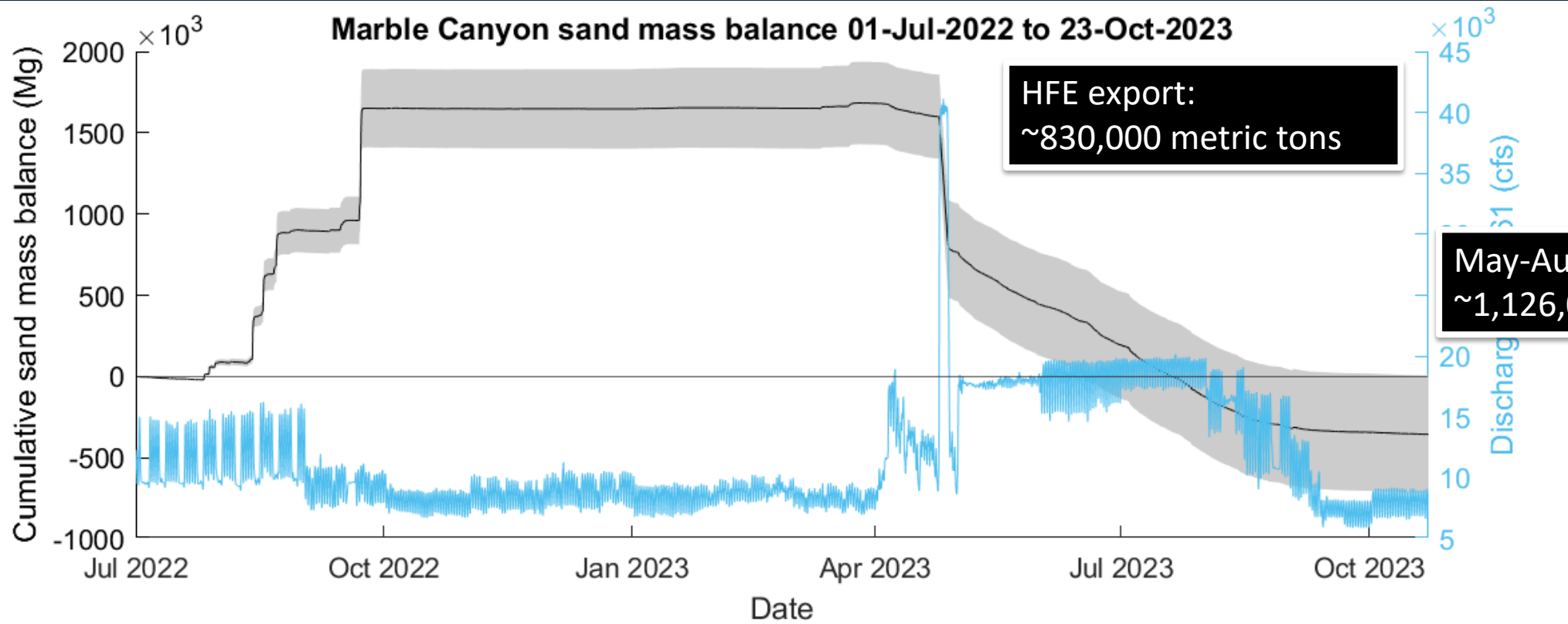
Figure 3. Mass balance in Marble Canyon predicted by the Sand Routing Model (Wright et al. 2010) with a 1-year accounting window and a 72-hour HFE in April with a maximum magnitude of 39,500 cfs.



Measured 1-year sediment budget (7/1/2022 to 7/1/2023)

Modeled and measured budgets agree within uncertainty

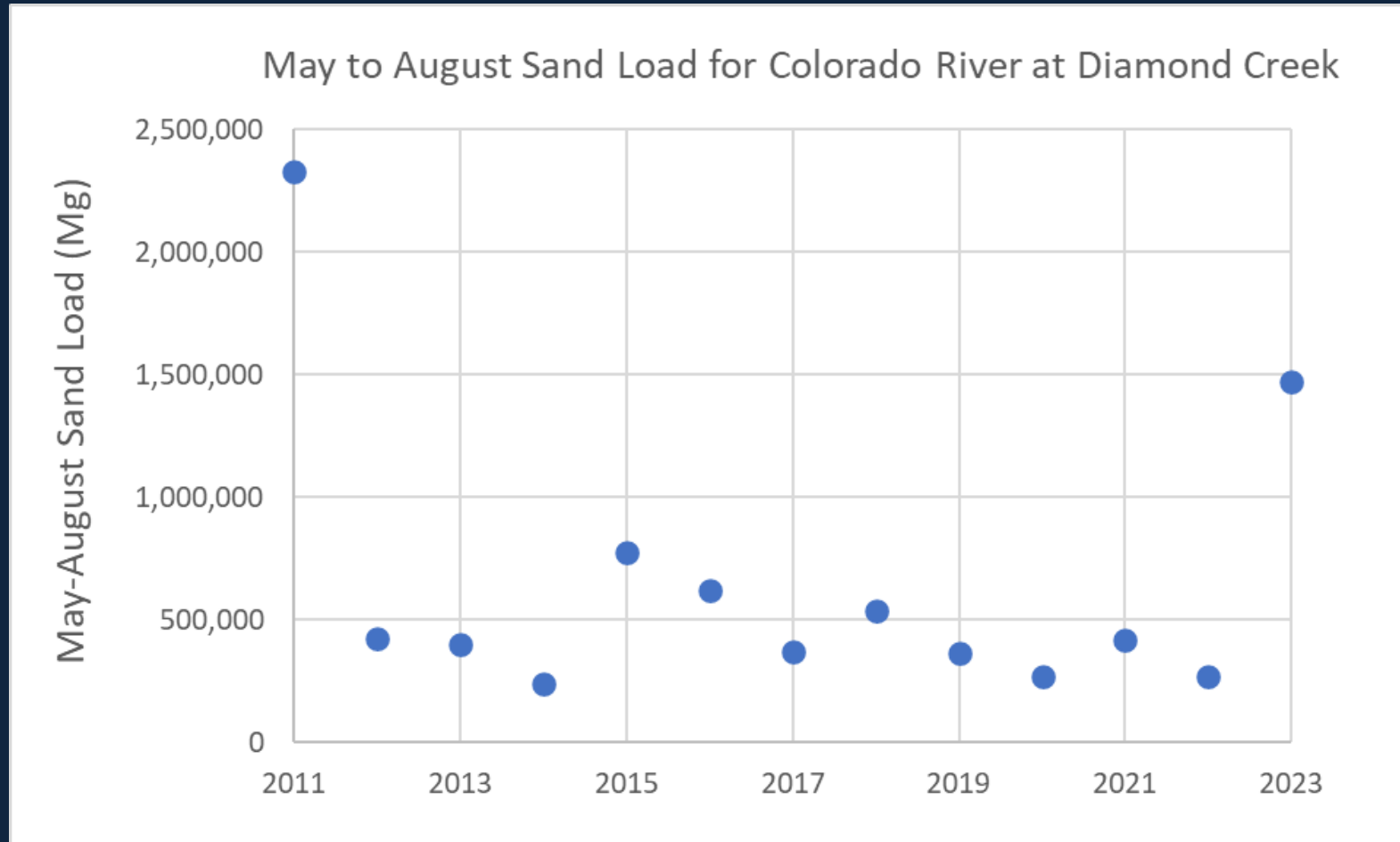
Summer reservoir balancing releases exported more sand from Marble Canyon than April HFE



The sand exported by HFEs is the “cost” for accomplishing the goal of building sandbars at high-elevations

The sand exported during May-Aug releases includes erosion of some of the HFE deposits and some redeposition at lower elevations

Reservoir equalization/balancing releases export 3 to 5 times more sand than average summer releases



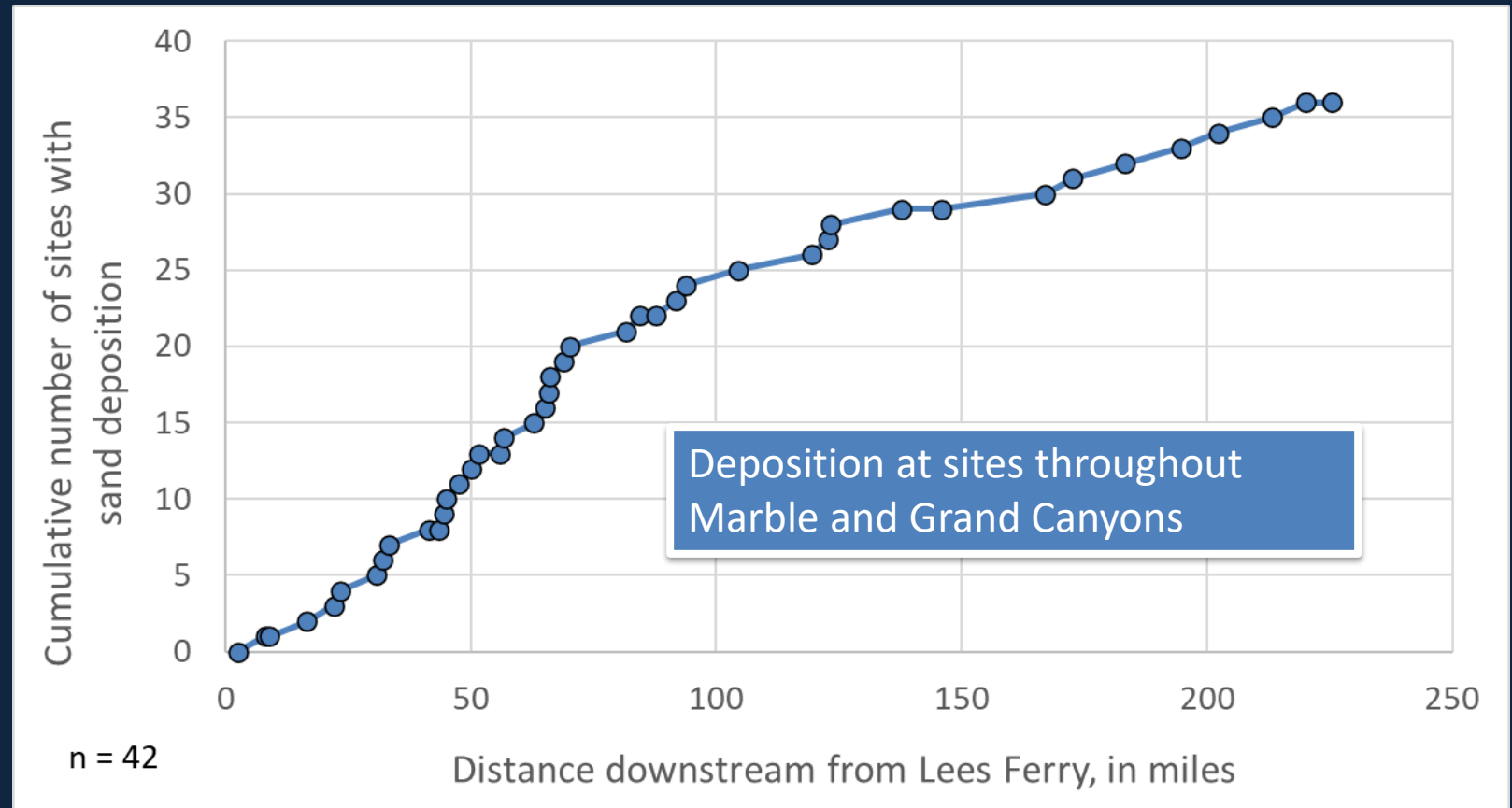
May-Aug sand load in 2011 was ~2.3 million metric tons

May-Aug sand load in 2023 was ~1.5 million metric tons

Average May-Aug sand load for 2012-2022 was 428,000 metric tons

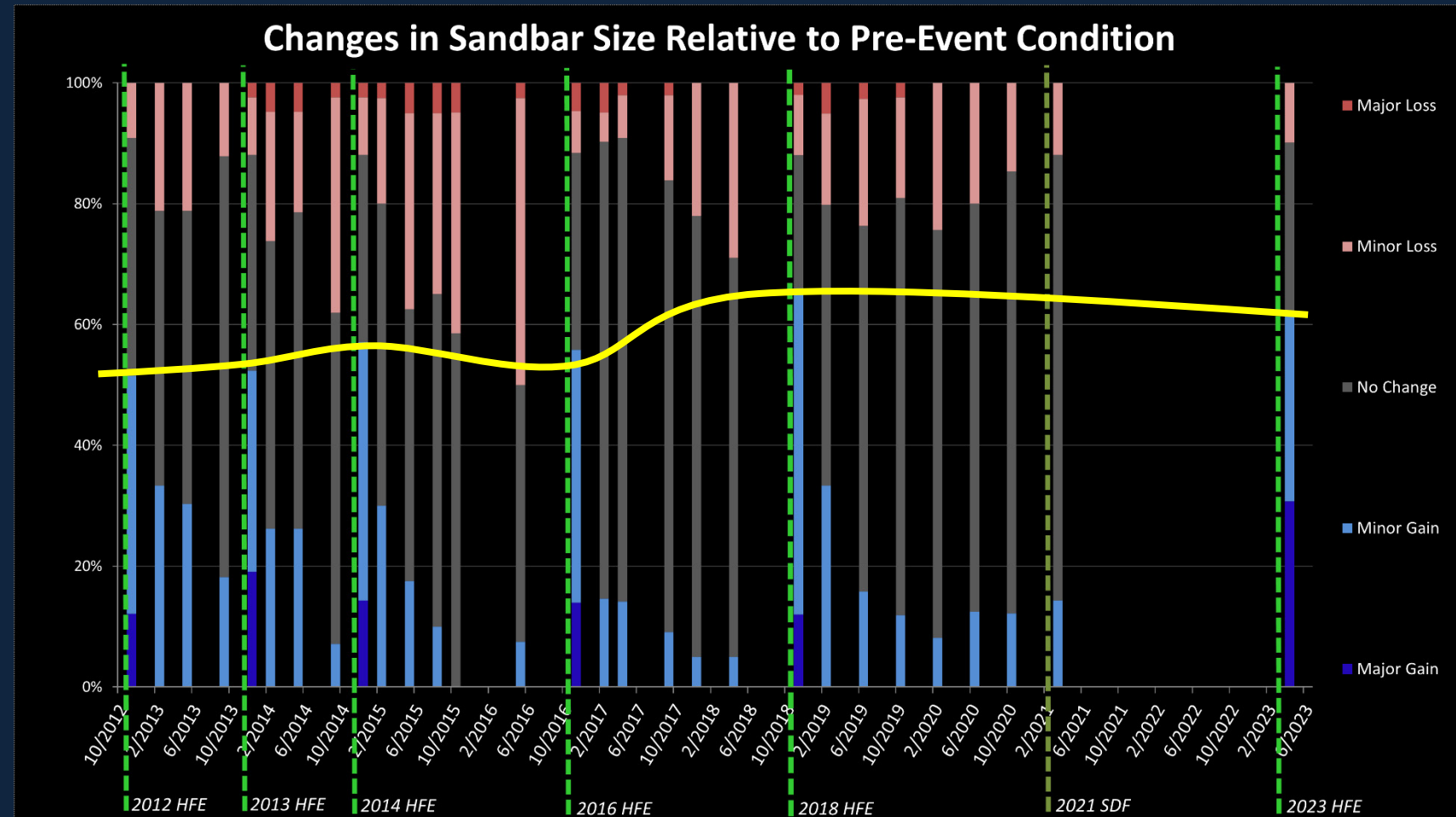
Preliminary Remote Camera Results from April HFE

- At least some deposition at more than 85% of monitoring sites with remote cameras
- At some sites, deposition was offset by erosion
- Vegetation scour or burial at many sites
- Gullies eroded by monsoon storms filled
- *Similar number of gainers compared to previous HFEs.*
 - *Different water levels make comparison with previous HFEs difficult*



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Number of sand "gainers" for each HFE

Lone Cedar Camp – River Mile 24.5, Left

April 23, 2023



Preliminary results, subject to review and revision, please do not cite

Lone Cedar Camp – River Mile 24.5, Left

April 28, 2023



HFE resulted in high-elevation deposition and filled gullies

Lone Cedar Camp – River Mile 24.5, Left

October 3, 2023



Preliminary results, subject to review and revision, please do not cite

Lone Cedar Camp – River Mile 24.5, Left

October 3, 2023



High-elevation HFE deposits remain.

Mid-elevation HFE deposits eroded.

Big Dune Camp – River Mile 119, Left

April 24, 2023



Preliminary results, subject to review and revision, please do not cite

Big Dune Camp – River Mile 119, Left

April 29, 2023



HFE resulted in high-elevation deposition and scoured/buried vegetation

Big Dune Camp – River Mile 119, Left

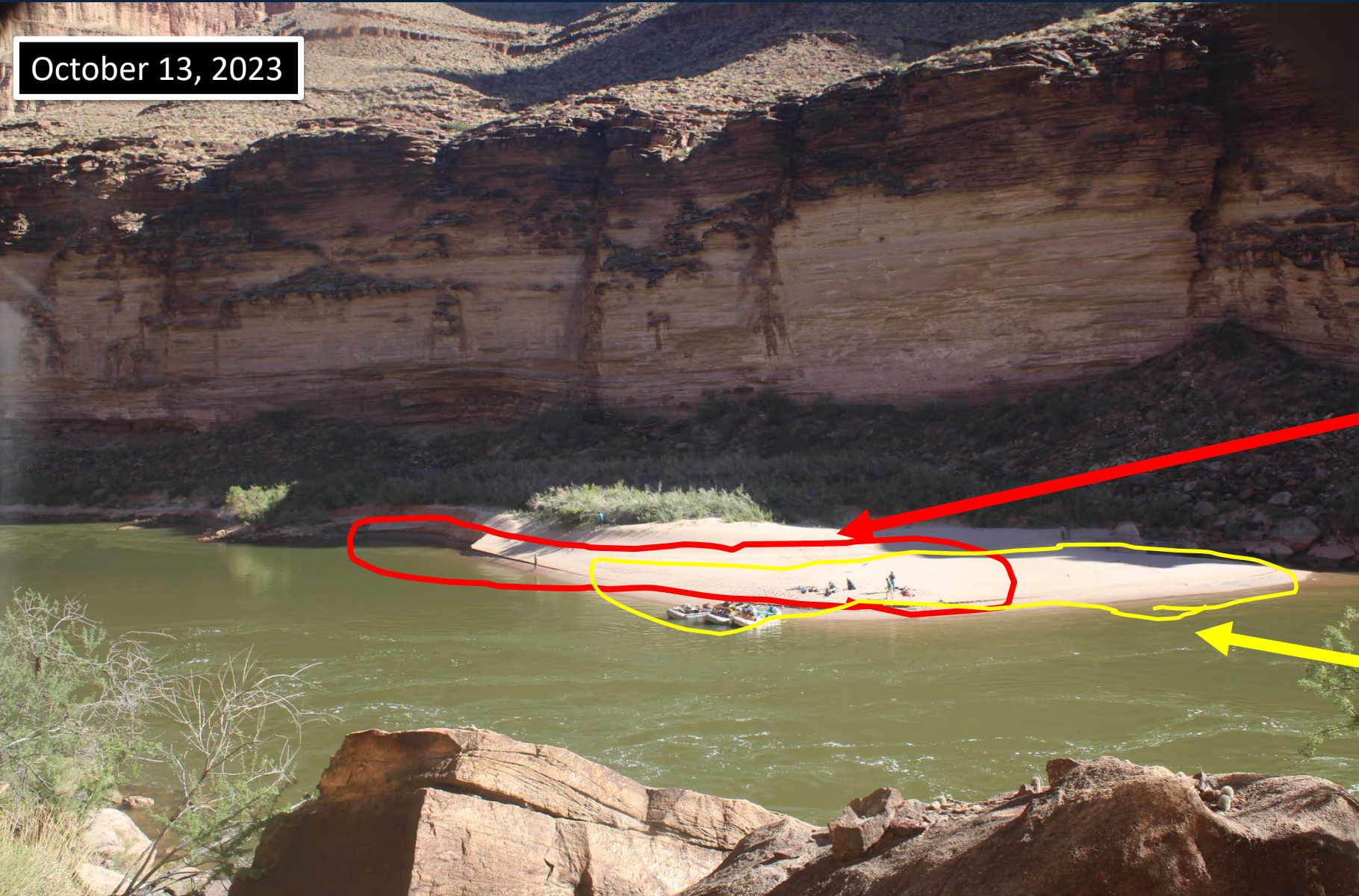
October 13, 2023



Preliminary results, subject to review and revision, please do not cite

Big Dune Camp – River Mile 119, Left

October 13, 2023



High-elevation HFE deposits eroded.

Replaced by low-elevation deposit

Pumpkin Springs Camp – River Mile 213, Left

April 25, 2023



Preliminary results, subject to review and revision, please do not cite

Pumpkin Springs Camp – River Mile 213, Left

April 30, 2023



HFE resulted in high-elevation deposition and scoured/buried vegetation

Pumpkin Springs Camp – River Mile 213, Left

October 18, 2023



High-elevation HFE deposits eroded.

Summary

- Substantial deposition at most sites from Upper Marble Canyon to Diamond Creek
- Magnitude of sandbar building was comparable to previous HFEs
- Reservoir balancing flows in May-August exported ~1.5 million tons (+/-20%) of sand past Diamond Creek, 3 times more than average for that period
- High dam releases caused substantial erosion, but HFE deposits do remain
- Low releases in September and October exposed low-elevation sand deposits
- We will report on results from October sandbar survey at Annual Reporting Meeting

Website:

<https://www.usgs.gov/apps/sandbar/>