

Sand Trigger for High-flow Experimental Protocol

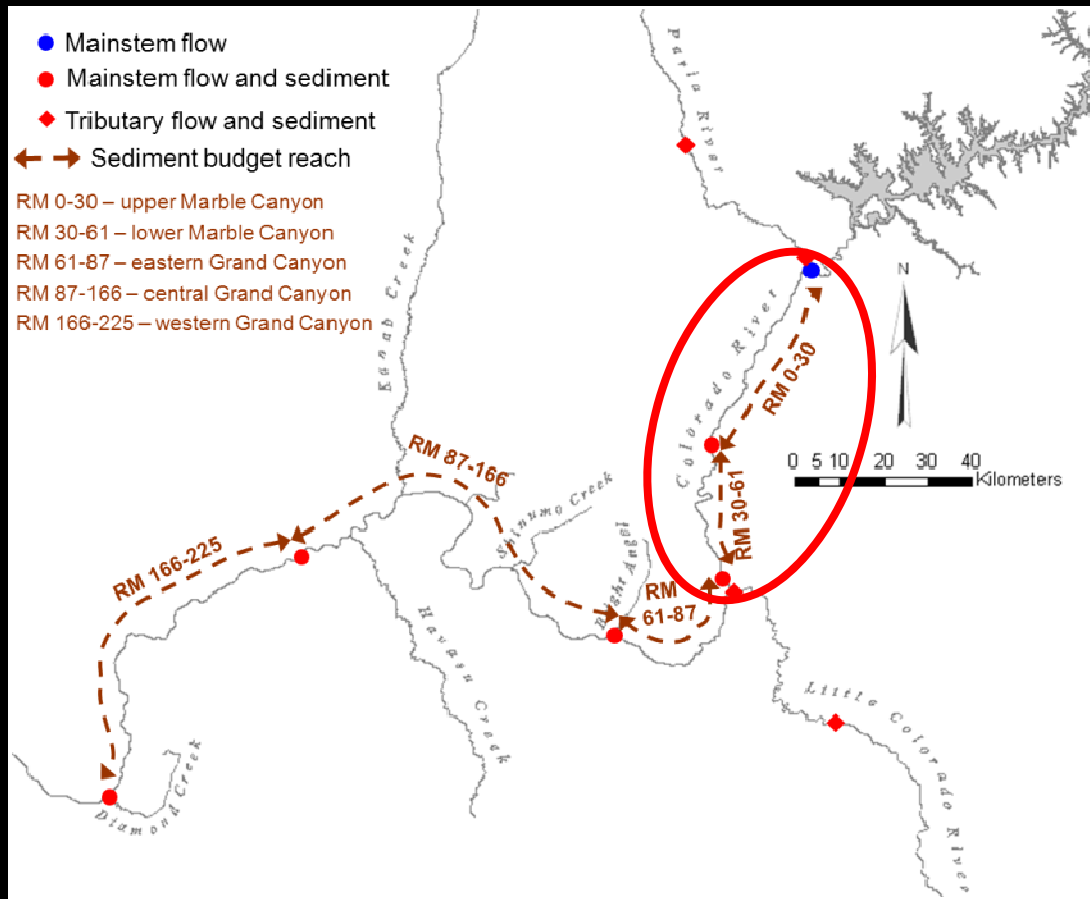


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TWG Meeting
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Implementation of HFE Protocol



- **GCMRC Project 2 Sediment Flux Monitoring Program**
 - Tracks tributary sediment inputs and mainstem transport
 - Website provides the information on inputs and accumulation in Marble Canyon during accounting period.
- **Shifting rating curve sand routing model by Wright et al.**
 - Used by Reclamation to determine magnitude and duration of high flow to “match” sand inputs.

Sand Input Triggering Strategy: HFEs follow Historical Timing of Paria and Little Colorado River Floods (Fall & Spring)

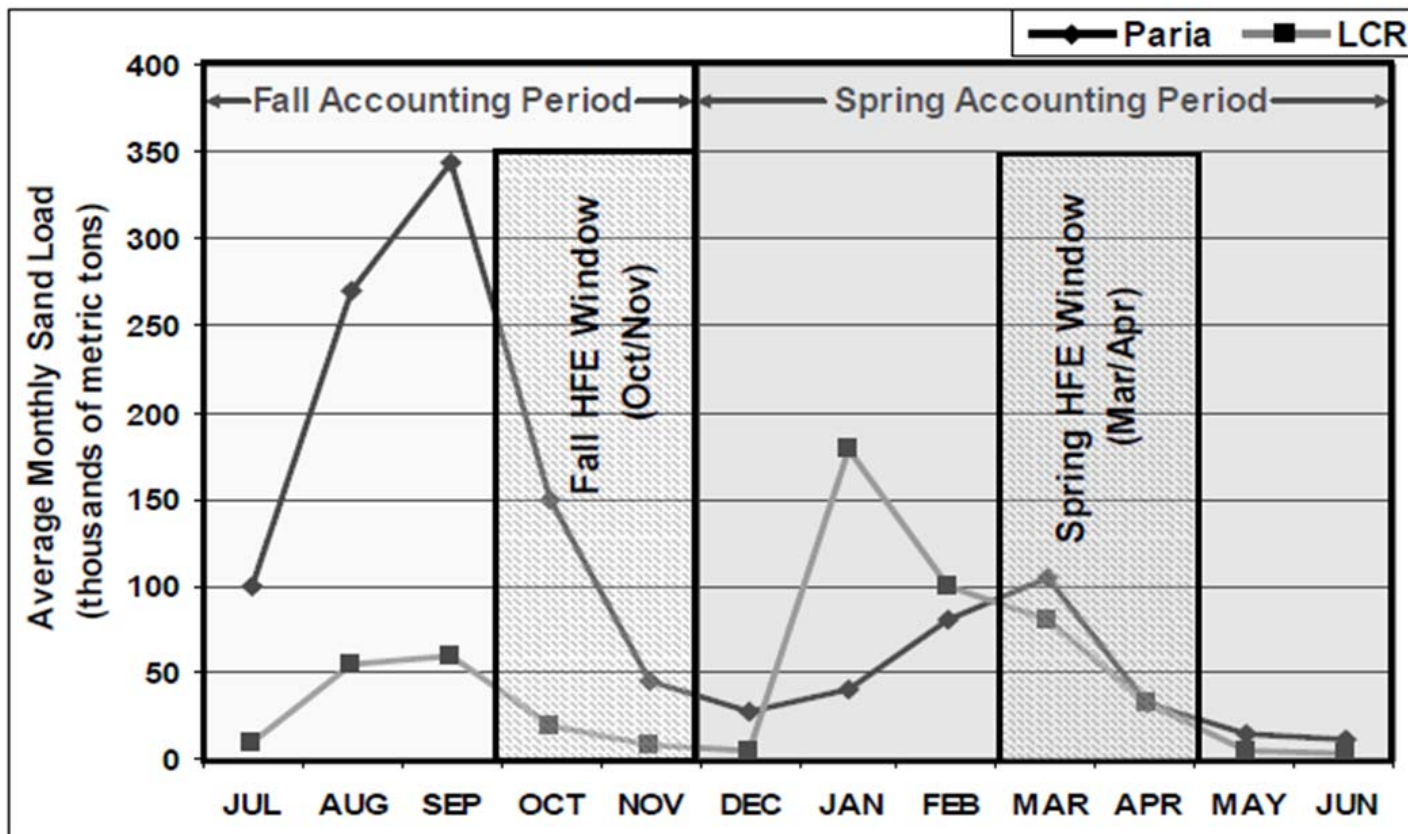


Figure 4. The two sand accounting periods and the two high-release periods with average monthly sand loads for the Paria River and the Little Colorado River (adopted from Scott Wright, U.S. Geological Survey, personal communication, and Wright and Kennedy 2011).

(High Flow Protocol EA)

Fall & Spring Timing has Historical Precedent in Pattern of Natural Floods during Pre-Dam Record

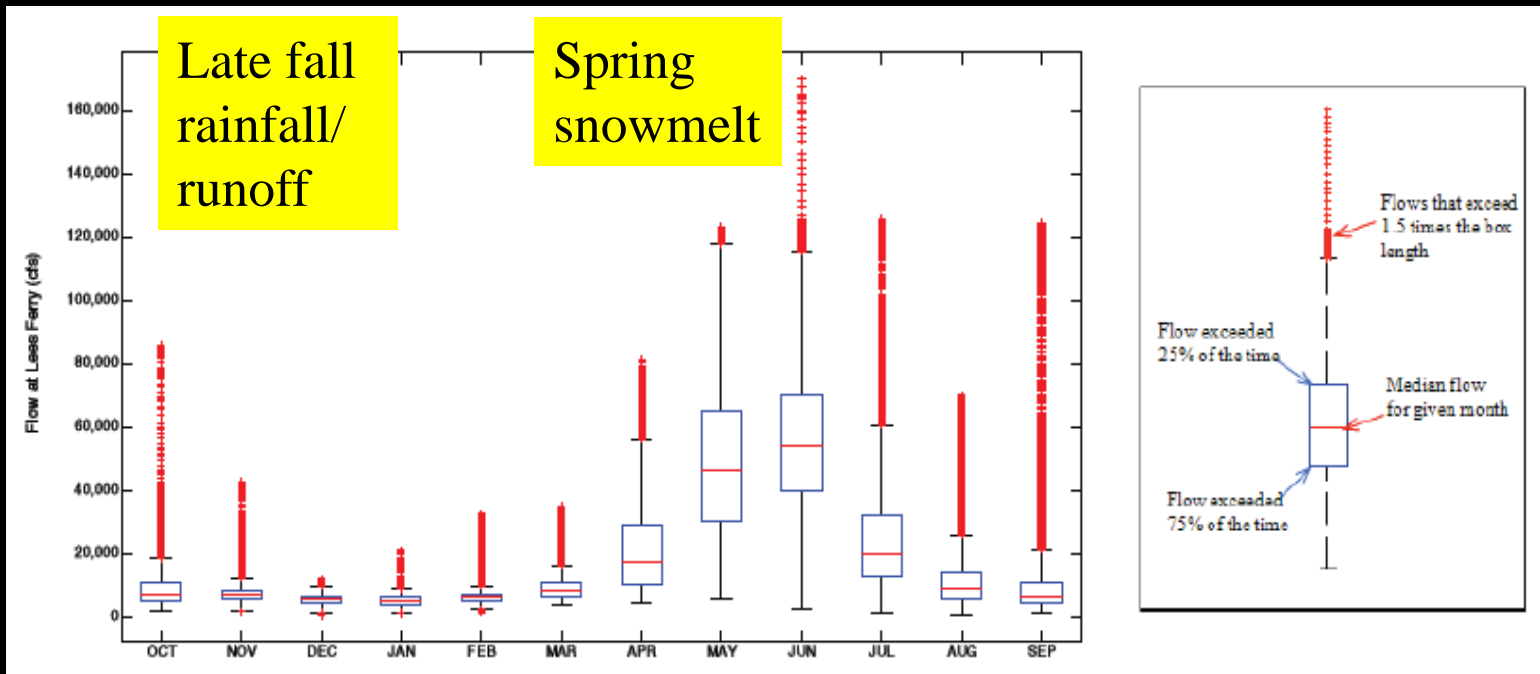
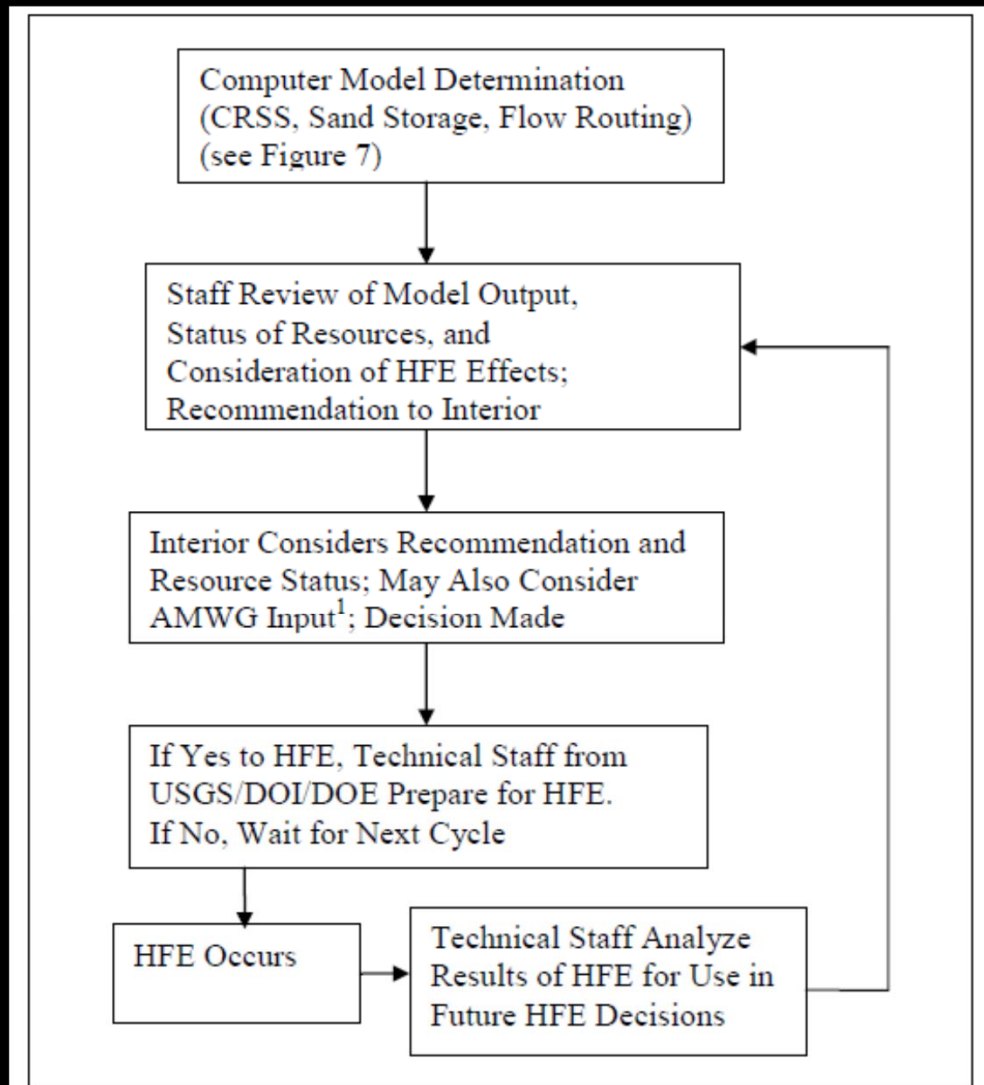


Figure 6. The pre-dam flow regime on the Colorado River at Lees Ferry (data from Topping and others, 2003). The plot shows box-and-whisker diagrams for each month of all instantaneous flow measurements from the beginning of the record (1921) to the beginning of flow regulation by Glen Canyon Dam (1963). The plot illustrates the strong snowmelt signal from APR – JUL as well as the higher flows in the late summer and early fall.

HFE Implementation Decision Process



¹Issues and concerns expressed at AMWG meetings, as appropriate.

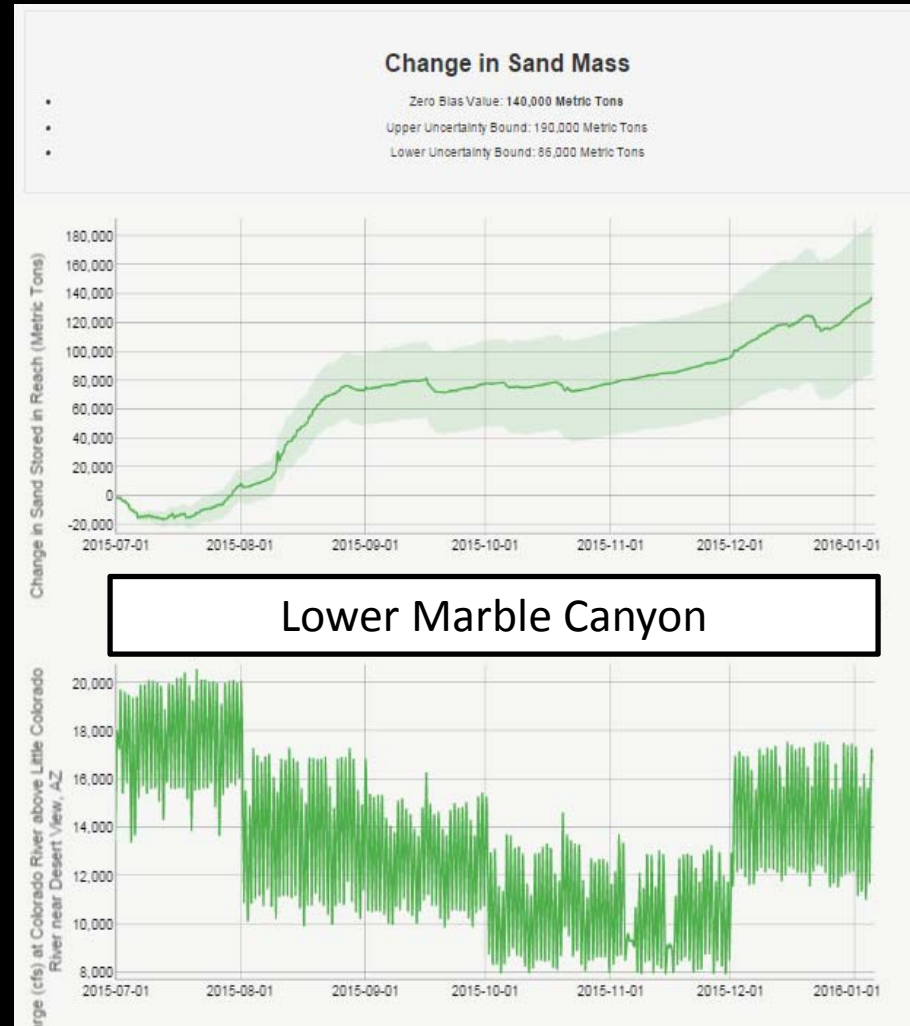
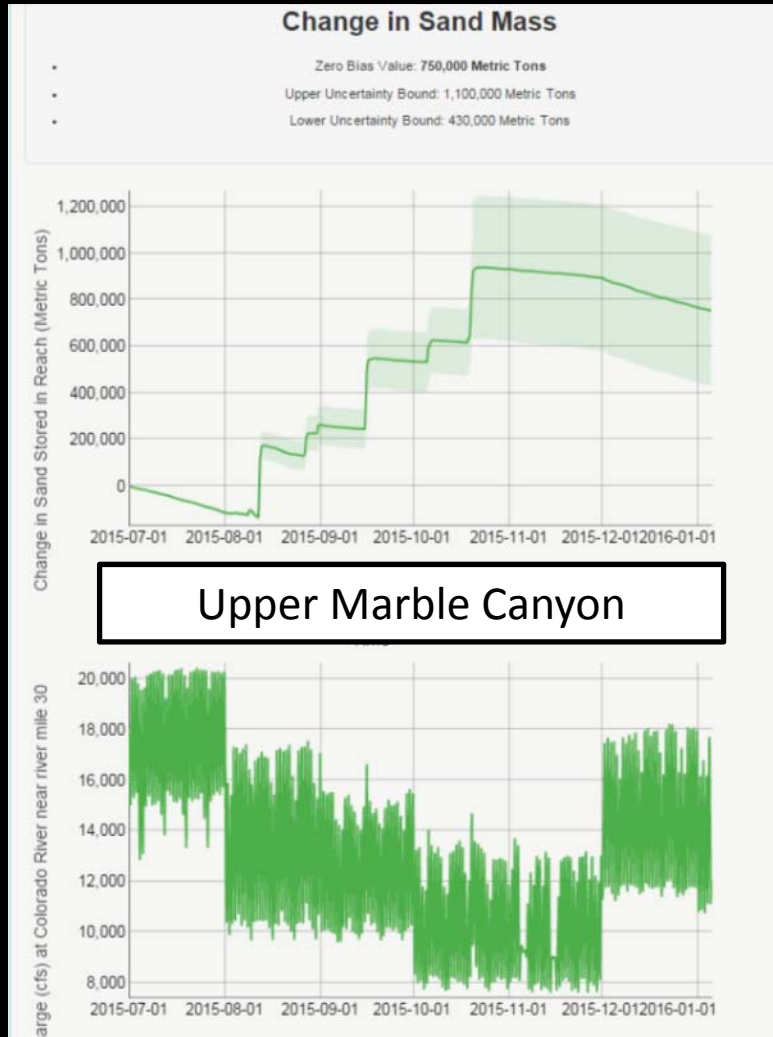
Figure 5. Decision and implementation component of HFE protocol.

(High Flow Protocol EA)

Anticipated Frequency of HFEs

- **Wright and Kennedy in HFE Circular**
 - Frequent fall (nearly every year)
 - Much less frequent spring HFEs
- **HFE Protocol EA (analyzed range of input conditions and hydrology)**
 - Fall: 4 to 8 HFEs in 10 years
 - Spring: 3 to 6 HFEs in 10 years
- **LTEMP Alternatives (that extend protocol to 20 years)**
 - 17 to 25 HFEs in 20 years (maximum of 30 to 40)
 - 77% in Fall

Current Marble Canyon sand accumulation relative to recent HFEs



Marble Canyon mass balance at + 990,000 metric tons for July 1, 2015 to Jan. 6, 2016

2012-2014 HFE's triggered at accumulations of 600,000 to 2,000,000 metric tons.