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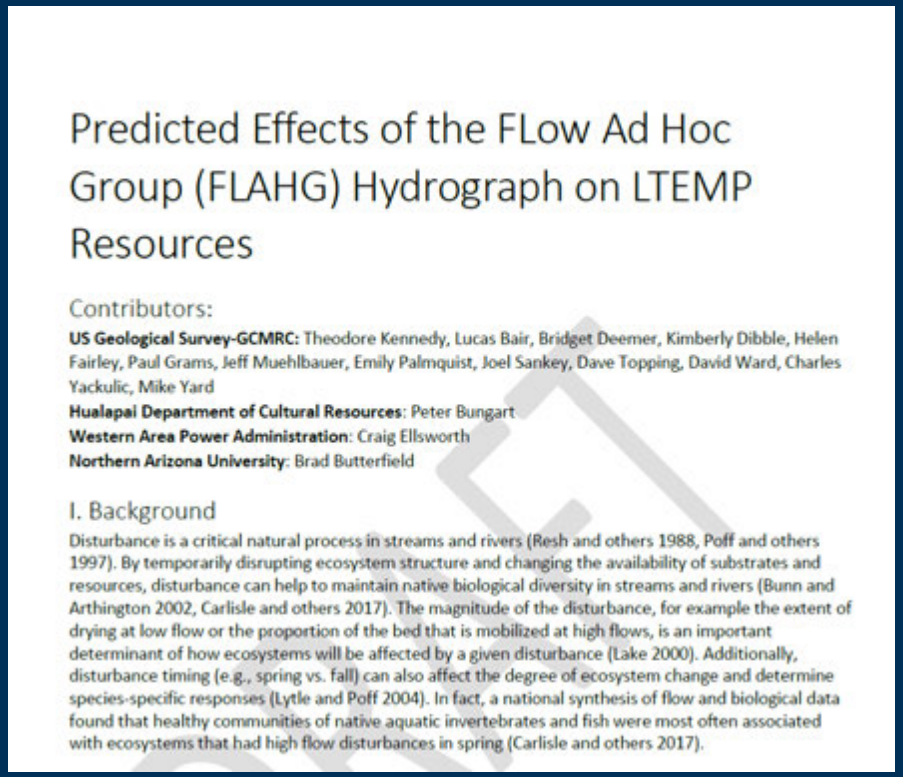
The FLAHG Hydrograph



Predicted Effects of the FLow Ad Hoc Group (FLAHG) Hydrograph on LTEMP Resources

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Hualapai Department of Cultural Resources: Peter Bungart

Western Area Power Administration: Craig Ellsworth

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I. Background

Disturbance is a critical natural process in streams and rivers (Resh and others 1988, Poff and others 1997). By temporarily disrupting ecosystem structure and changing the availability of substrates and resources, disturbance can help to maintain native biological diversity in streams and rivers (Bunn and Arthington 2002, Carlisle and others 2017). The magnitude of the disturbance, for example the extent of drying at low flow or the proportion of the bed that is mobilized at high flows, is an important determinant of how ecosystems will be affected by a given disturbance (Lake 2000). Additionally, disturbance timing (e.g., spring vs. fall) can also affect the degree of ecosystem change and determine species-specific responses (Lytle and Poff 2004). In fact, a national synthesis of flow and biological data found that healthy communities of native aquatic invertebrates and fish were most often associated with ecosystems that had high flow disturbances in spring (Carlisle and others 2017).

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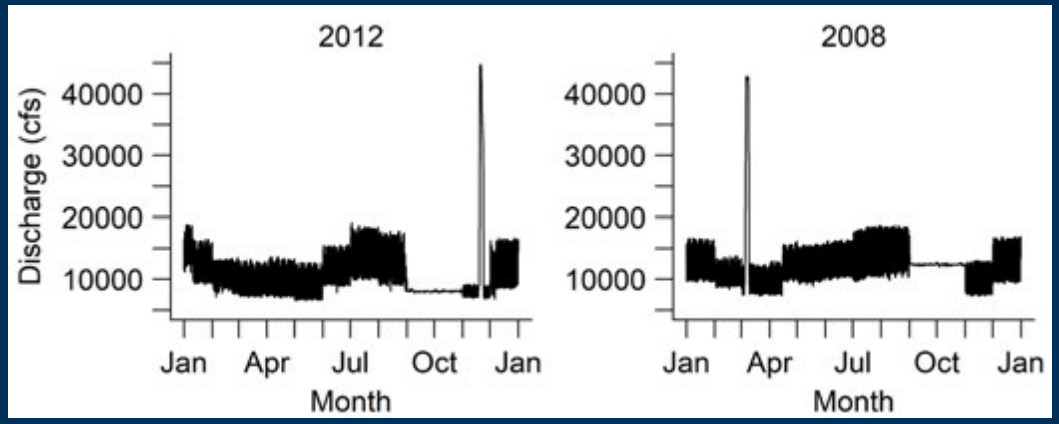
Western Area Power Administration-Craig Ellsworth

*-presenting today

Why a FLow Ad Hoc Group (FLAHG)?

- Limited testing of spring HFEs
  - 2011 HFE protocol initially prohibited spring HFEs
  - LTEMP extended prohibition thru 2019
- Spring sediment trigger unlikely
  - Winter Paria storms↓
  - No 'carryover' in sediment accounting
    - See Grams and Topping, June 2020 TWG presentation
- <u>Because Dr. Petty said so!</u>



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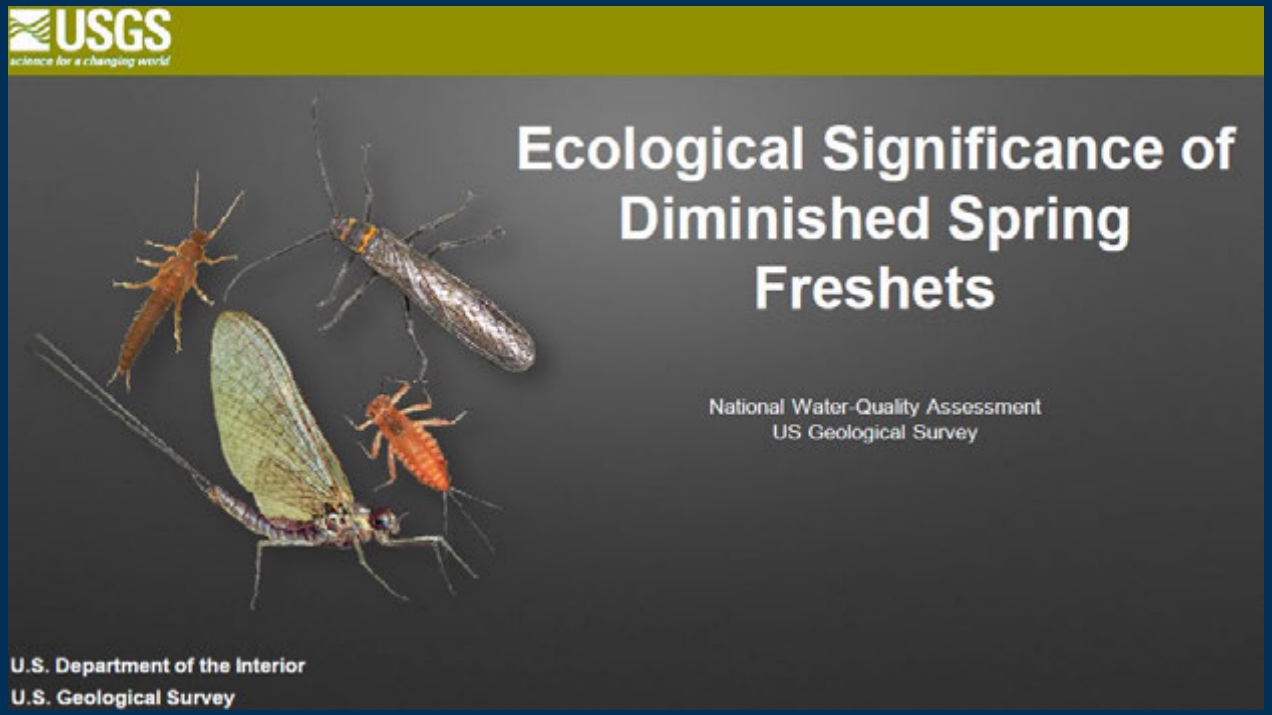
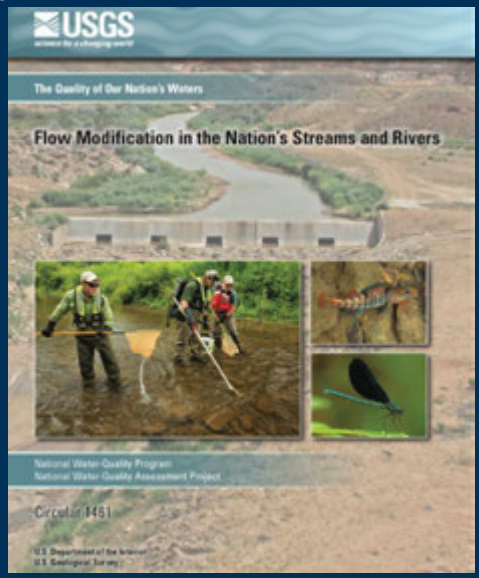
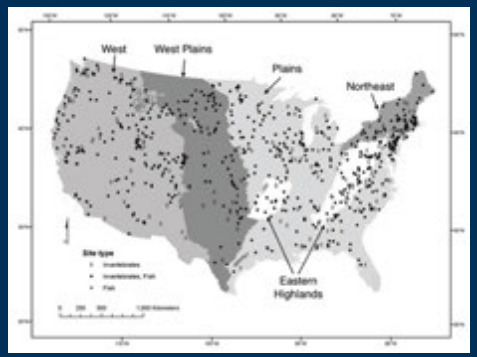
<u>Fun fact: There have been 8 HFEs total (6 Fall, 2 Spring)</u>

But spring floods = healthy ecosystems

"…the apparent nationwide importance of high flows in spring (March, April, May) also indicates that the timing…of high flows is critical." Carlisle, D. M., Grantham, T. E., Eng, K., & Wolock, D. M. (2017). Biological relevance of streamflow metrics: regional and national perspectives. *Freshwater Science*, *36*(4), 927-940.







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Daren Carlisle, June 2020 TWG Presentation

2017 Knowledge Assessment

- TWG Steering Committee Ad Hoc Group (SCAHG) provided oversight
- Science Advisors facilitated
- Teams of experts conducted assessment
  - 11 Resource Areas

Strength of Effect		Direction of Effect		Confidence in Strength & Direction Assessments	
	Strong Effect	⇧	Positive (Beneficial) Effect	◯	High
	Moderate Effect	⇔	No Effect	◯	Medium
	Weak Effect	⇩	Negative (Detrimental) Effect	◯	Low
	Strength of Effect Unknown	.....	Direction of Effect Unknown	(n/a)	

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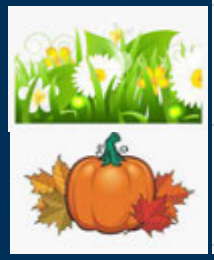
http://gcdamp.com/index.php?title=2017_Knowledge_Assessment

2017 Knowledge Assessment: Lots of upside to Spring HFEs



	Archaeological and Cultural	Natural Processes	Humpback chub	Hydropower and Energy	Other Native Fish Species	Recreational Experience	Sediment	Tribal Resources	Rainbow Trout Fishery	Nonnative Invasive Species	Riparian Vegetation
Spring HFE	⇔	↑	↑	↓		⇔	↑		↑	.....	↑
Fall HFE	⇔	↓	↑	↓		⇔	↑			↓	↓

	Benefit ↑	No effect ⇔	Negative ↓
Spring HFE	5 ↑↑↑↑↑	2 ⇔⇔	1 ↓
Fall HFE	2 ↑↑	2 ⇔⇔	4 ↓↓↓↓

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http://gcdamp.com/index.php?title=2017_Knowledge_Assessment

A Path Forward

FLow Ad Hoc Group (FLAHG) formed in 2019

"As a starting point, the FLAHG shall consider the benefits of and opportunities for conducting higher spring releases within power plant capacity" **–FLAHG charge**

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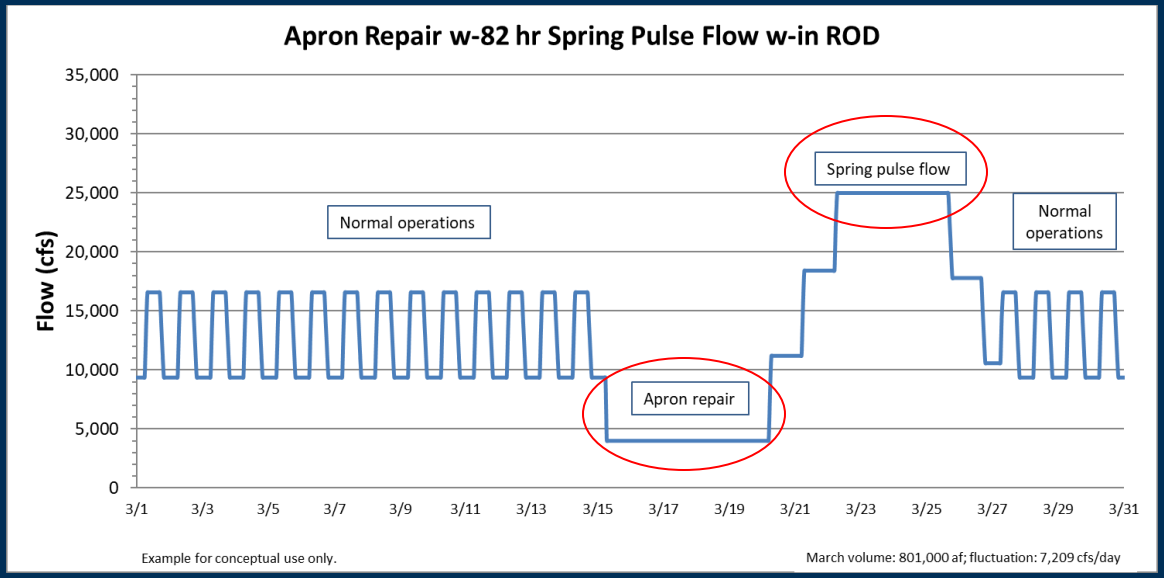
Proposed FLAHG hydrograph

- Spring flow disturbance (March proposed)
- Apron repair is unique opportunity
  - 5 days at 4,000 ft^3/s for dam maintenance
  - Low flows = disturbance
- Combine with spring pulse flow disturbance
  - low + pulse >> low OR pulse alone

To estimate impacts, need to know:

1) Percent of habitat desiccated at low flow?
2) Scour potential at 20,000 cfs vs. 25,000 cfs?



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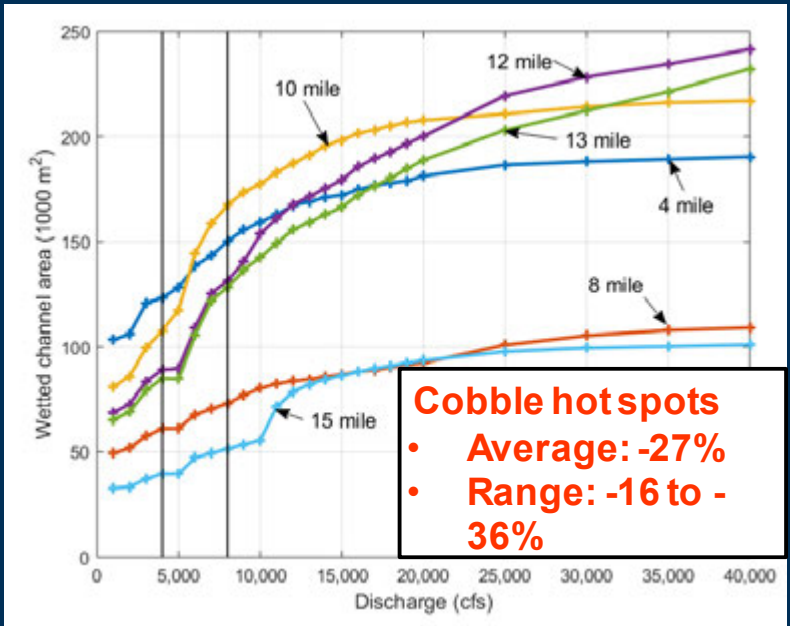
Preliminary results subject to review and revision

Desiccation & scour potential

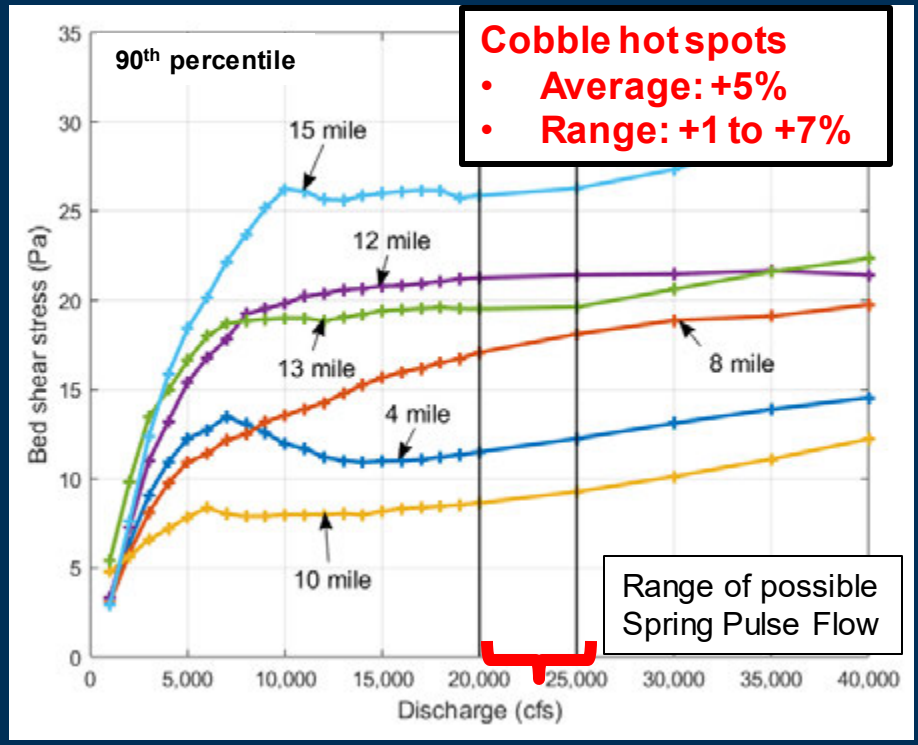
Low Flow = Desiccation

In a nutshell
Large area change btwn 4,000 and 8,000 cfs
-Change in area = metric of drying potential
Cobble hotspots:
27% of habitat exposed to drying
Reach wide:
12% of habitat exposed
Fun fact: Flow of 4000 cfs last occurred in early 90s



Pulse Flow =Scour

In a nutshell
Shear stress = shearing force of water on bed
-Direct measure of scour potential
Cobble hotspots:
~5% increase in scour at 20,000 vs. 25,000 cfs
Reach wide: ~13% increase in scour
Fun fact: Since '96, flows of 20,000 cfs or greater have occurred just ~7% of the time.



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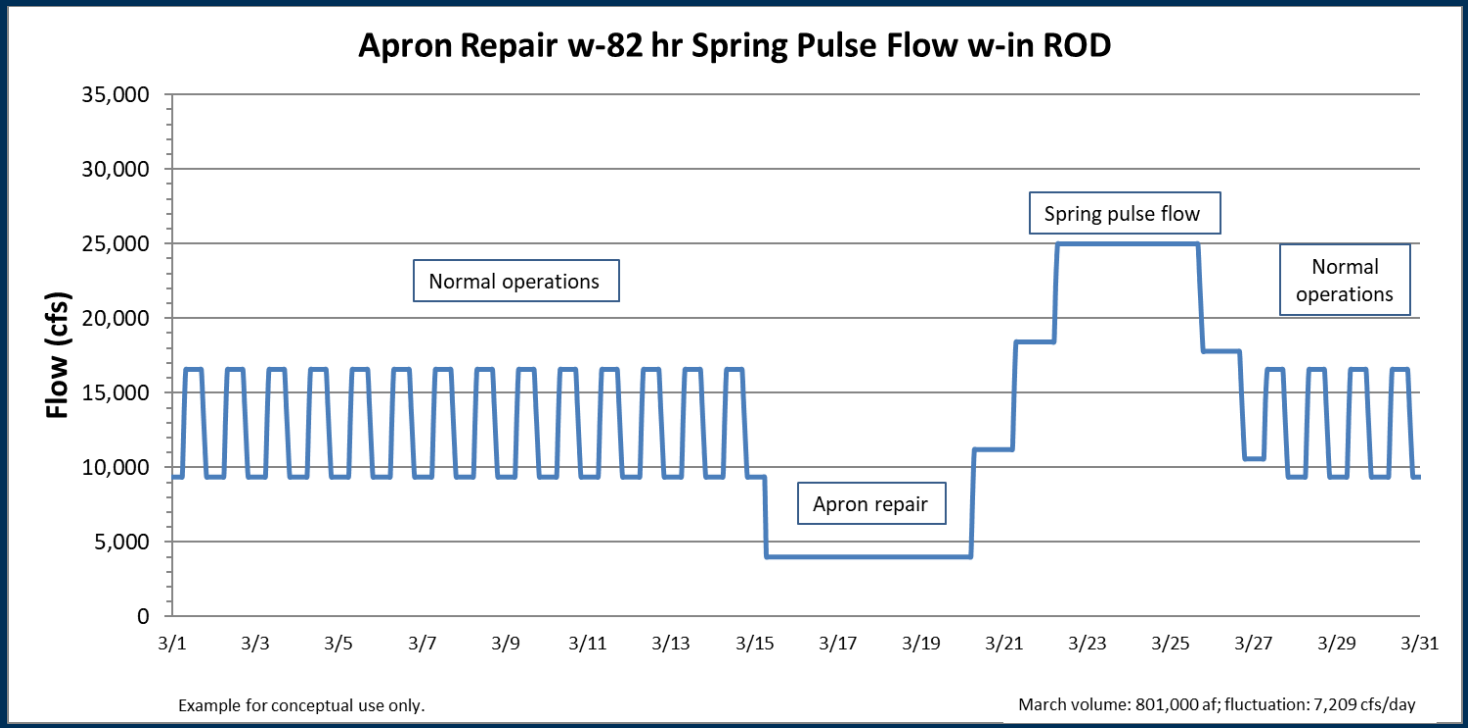
Preliminary results subject to review and revision; pers comm Scott Wright

FLAHG hydrograph summary

"The spring timing and combination of drying & scour makes this an especially interesting and promising hydrograph to test"

–general sentiment among co-authors



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FLAHG Hydrograph: Essential Context

- Provides 'contrast' to last 5 fall HFEs
  - Many biology projects did not exist in 2008
  - Only 5 of 16 co-authors involved in AMP in 2008

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2010	2011	2012	2013	2014	2015	2016	2017	2018	2019


2009-Juvenile chub monitoring (JCM) starts


2010-Gross primary production monitoring starts


2012-Citizen science insect monitoring starts


Spring HFE


Fall HFE

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FLAHG Hydrograph: Some Hypothesized Benefits

- **Tribal Resources**
  - Improved Ecosystem Health
  - Spring timing aligns with
  - Earth's calendar
- **Natural Processes**
  - ↑Algae and insect diversity
  - Spring timing aligns with native fish life history
- **Recreational Experience**
  - ↑Navigation in Western GC
  - ↑Camp-ability of sandbars
  - Spring timing aligns with human calendar






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No red flags evident but stayed tuned. More analysis coming…

Preliminary results subject to review and revision

Next Steps for FLAHG

Consider how the FLAHG will use the summary of Predicted Effects (e.g., Knowledge Assessment) in the decision process?

	Benefit ↑	No effect ↔	Negative ↓
Spring HFE	5	2	1
Fall HFE	2	2	4
FLAHG hydrograph	Next Steps for FLAHG… Determine what combination of ↑ ↓ ↔ is acceptable vs. unacceptable?