

Glen Canyon Dam Adaptive Management Program:
Preliminary Comments on Draft
Triennial Budget and Work Plan

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Presentation Objectives

- Purpose: Initial feedback on draft triennial work plans and budgets for FY 2018-2020
- Key themes
 - Requirements for adaptive management under LTEMP
 - Implications of 2017 Knowledge Assessment (KA) results
- Outline
 - Unknowns and uncertainties indicated in KA results
 - LTEMP resource-specific objectives/learning needs
 - Unique constraints of CRE adaptive management
 - Comments on GCMRC and Reclamation work plans

KA Unknowns and Uncertainties: Status and Trend Results

Resource	Unknown Status AND Unknown Trend AND Low Confidence	Unknown Status OR Unknown Trend AND Low Confidence	Known Status AND Known Trend BUT Low Confidence	Unknown Status OR Unknown Trend BUT NOT Low Confidence	Unknown Status OR Unknown Trend OR Low Confidence
Aquatic food base	0.0%	0.0%	0.0%	20.0%	20.0%
Archaeological and cultural resources	0.0%	0.0%	0.0%	0.0%	0.0%
Humpback chub	0.0%	0.0%	25.0%	0.0%	25.0%
Hydropower and energy	0.0%	0.0%	12.5%	0.0%	12.5%
Invasive fish species	0.0%	3.6%	14.3%	3.6%	21.4%
Rainbow trout fishery	0.0%	5.3%	0.0%	52.6%	57.9%
Recreational experience	16.0%	0.0%	0.0%	0.0%	16.0%
Riparian vegetation	37.5%	0.0%	25.0%	12.5%	75.0%
Sediment	0.0%	0.0%	31.3%	6.3%	37.5%
Water quality	28.6%	28.6%	0.0%	42.9%	100.0%
Grand Total	7.4%	3.3%	10.7%	13.9%	35.2%

KA Unknowns and Uncertainties: Drivers and Constraints Results

Resource	Unknown Strength AND Unknown Direction AND Low Confidence	Unknown Strength OR Unknown Direction AND Low Confidence	Known Strength AND Known Direction BUT Low Confidence	Unknown Strength OR Unknown Direction BUT NOT Low Confidence	Unknown Strength OR Unknown Direction OR Low Confidence
Aquatic food base	0.0%	13.6%	50.0%	0.0%	63.6%
Archaeological and cultural resources	0.0%	0.0%	0.0%	0.0%	0.0%
Humpback chub	0.0%	21.4%	7.1%	7.1%	35.7%
Hydropower and energy	0.0%	0.0%	0.0%	23.6%	23.6%
Invasive fish species	0.0%	0.0%	0.0%	0.0%	0.0%
Rainbow trout fishery	0.0%	0.0%	64.3%	0.0%	64.3%
Recreational experience	0.0%	0.0%	0.0%	0.0%	0.0%
Riparian vegetation	0.0%	12.5%	37.5%	45.8%	95.8%
Sediment	0.0%	0.0%	0.0%	12.5%	12.5%
Water quality	16.7%	20.8%	8.3%	33.3%	79.2%
Grand Total	1.8%	6.4%	14.5%	15.9%	38.6%

KA Unknowns and Uncertainties: LTEMP Exp'l. & Mgt. Actions Results

Resource	Unknown Strength AND Unknown Direction AND Low Confidence	Unknown Strength OR Unknown Direction AND Low Confidence	Known Strength AND Known Direction BUT Low Confidence	Unknown Strength OR Unknown Direction BUT NOT Low Confidence	Unknown Strength OR Unknown Direction OR Low Confidence
Aquatic food base	0.0%	0.0%	54.5%	0.0%	54.5%
Archaeological and cultural resources	0.0%	0.0%	0.0%	7.7%	7.7%
Humpback chub	25.0%	33.3%	16.7%	0.0%	75.0%
Hydropower and energy	4.5%	0.0%	0.0%	3.4%	8.0%
Invasive fish species	71.8%	0.0%	10.3%	5.1%	87.2%
Rainbow trout fishery	0.0%	70.0%	10.0%	0.0%	80.0%
Recreational experience	2.4%	2.4%	23.7%	0.4%	28.9%
Riparian vegetation	28.6%	26.8%	16.1%	10.7%	82.1%
Sediment	0.0%	7.1%	17.9%	21.4%	46.4%
Water quality	89.7%	0.0%	0.0%	10.3%	100.0%
Grand Total	16.1%	5.9%	16.2%	4.2%	42.4%



LTEMP Resource-Specific Objectives (1)

1. *Archaeological and Cultural Resources.* Maintain the integrity of potentially affected NRHP-eligible or listed historic properties in place, where possible, with preservation methods employed on a site-specific basis.
2. *Natural Processes.* Restore, to the extent practicable, ecological patterns and processes within their range of natural variability, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems.
3. *Humpback Chub.* Meet humpback chub recovery goals, including maintaining a self-sustaining population, spawning habitat, and aggregations in the Colorado River and its tributaries below the Glen Canyon Dam.
4. *Hydropower and Energy.* Maintain or increase Glen Canyon Dam electric energy generation, load following capability, and ramp rate capability, and minimize emissions and costs to the greatest extent practicable, consistent with improvement and long-term sustainability of downstream resources.



LTEMP Resource-Specific Objectives (2)

5. *Other Native Fish*. Maintain self-sustaining native fish species populations and their habitats in their natural ranges on the Colorado River and its tributaries.
6. *Recreational Experience*. Maintain and improve the quality of recreational experiences for the users of the Colorado River Ecosystem. Recreation includes, but is not limited to, flatwater and whitewater boating, river corridor camping, and angling in Glen Canyon.
7. *Sediment*. Increase and retain fine sediment volume, area, and distribution in the Glen, Marble, and Grand Canyon reaches above the elevation of the average base flow for ecological, cultural, and recreational purposes.
8. *Tribal Resources*. Maintain the diverse values and resources of traditionally associated Tribes along the Colorado River corridor through Glen, Marble, and Grand Canyons.



LTEMP Resource-Specific Objectives (3)

9. *Rainbow Trout Fishery*. Achieve a healthy high-quality recreational rainbow trout fishery in GCNRA and reduce or eliminate downstream trout migration consistent with NPS fish management and ESA compliance.
10. *Nonnative Invasive Species*. Minimize or reduce the presence and expansion of aquatic nonnative invasive species.
11. *Riparian Vegetation*. Maintain native vegetation and wildlife habitat, in various stages of maturity, such that they are diverse, healthy, productive, self-sustaining, and ecologically appropriate.

LTEMP Experimental & Management

Actions: Foci of Adaptive Management

- Fall HFEs > 96-hr duration (≤ 45 k cfs, in October or November)
- Fall HFEs ≤ 96 -hr duration (≤ 45 k cfs, in October or November)
- Humpback chub translocation
- Larval humpback chub head-start program
- Macroinvertebrate production flows
- Mechanical removal of invasive fish species
- Mechanical removal of rainbow trout from LCR reach
- Proactive Spring HFEs ≤ 45 k cfs in April, May, or June
- Riparian vegetation restoration
- Spring HFEs ≤ 45 k cfs in March or April
- Trout management flows
- Summer LFEs (*second decade only*)

LTEMP Adaptive Management Learning Matrix

Resource Topics →	Archaeological and Cultural Resources	Natural Processes (incl. food web & WQ)	Humpback Chub	Hydropower and Energy	Other Native Fish	Recreational Experience	Sediment	Tribal Resources	Rainbow Trout Fishery	Nonnative [aquatic] Invasive Species	Riparian Vegetation
WY 2017-2026 LTEMP Experimental & Management Actions ↓											
Fall HFEs > 96-hr duration, ≤ 45k cfs, in Oct. or Nov.	2			2		2	1				
Fall HFEs ≤ 96-hr duration, ≤ 45k cfs, in Oct. or Nov.	2			2		2	1				
Humpback chub translocation			1							2	
Larval humpback chub head-start program			1								
Macroinvertebrate production flows		1	1	2	1				1	1	
Mechanical removal of invasive fish species			1						1	1	
Mechanical removal of rainbow trout from LCR reach			1						1		
Proactive Spring HFEs ≤ 45k cfs in April, May, or June	2			2		2	1				
Riparian vegetation restoration	2	2				2				2	1
Spring HFEs ≤ 45k cfs in March or April	2			2		2	1				
Trout management flows				2					1		

LTEMP Adaptive Management Learning Matrix

Explanatory notes (per ROD)

- ① Effects of action on resource are explicit, primary concern of experiment; also may be trigger or off-ramp criteria
- ② Effects are explicit, secondary concern of experiment
 - *All other effects of all actions covered implicitly in mandate to monitor for “... long-term unacceptable adverse impacts on the [listed] resources...”*

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WY 2017-2026 LTEMP Experimental & Management Actions ↓											
Fall HFEs > 96-hr duration, ≤ 45k cfs, in Oct. or Nov.	②			②		②	①				
Fall HFEs ≤ 96-hr duration, ≤ 45k cfs, in Oct. or Nov.	②			②		②	①				
Humpback chub translocation			①							②	
Larval humpback chub head-start program			①								
Macroinvertebrate production flows		①	①	②	①				①	①	
Mechanical removal of invasive fish species			①						①	①	
Mechanical removal of rainbow trout from LCR reach			①						①		
Proactive Spring HFEs ≤ 45k cfs in April, May, or June	②			②		②	①				
Riparian vegetation restoration	②	②				②				②	①
Spring HFEs ≤ 45k cfs in March or April	②			②		②	①				
Trout management flows				②					①		



Key Constraints on CRE Adaptive Management

- “Classic” A/M follows “B.A.C.I.” design principles
 - *Before-After, Control-Impact* experimental design
 - Multiple observations to filter out effects of other factors
- CRE constraints
 - One dam, one river, one canyon
 - *Control-Impact* comparisons *mostly* impossible
 - Observation frequency highly constrained
 - Most actions require specific triggering conditions; other considerations may also apply
 - No ability to control for or sample across other factors



Requirements for Successful LTEMP A/M Learning

- Clear hypotheses about “other factors” that can affect experimental outcomes
 - *aka* “antecedent conditions” and “drivers and constraints”
- Effective monitoring (with appropriate sampling) of:
 - Condition (key characteristics or criteria)
 - Drivers and constraints
 - Antecedent conditions
- Clear objectives for all focal resources and threats
 - Must be specific; qualitative or quantitative
 - Crucial for assessing what “works” (or not) relative to overall program goals

LTEMP Adaptive Management Learning Matrix

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Larval humpback chub head-start program			1								
Macroinvertebrate production flows		1	1	2	1				1	1	
Mechanical removal of invasive fish species			1						1	1	
Mechanical removal of rainbow trout from LCR reach			1						1		
Proactive Spring HFEs ≤ 45k cfs in April, May, or June	2			2		2	1				
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Trout management flows				2					1		

LTEMP Adaptive Management Learning Matrix

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Trout management flows				2					1		



Potential IRP Topics for FY18-20

- Riparian vegetation restoration “learning management” objectives under LTEMP
- Incorporation of tribal traditional cultural values into GCDAMP adaptive management and learning processes
- Socioeconomic assessment of non-hydropower values – the value of these studies for the AMP and alternative approaches that might be considered
- Opportunities and constraints for taking a broader-ecosystem perspective on the resources affected by GCD operations and experiments
- How the larger landscape affects what goes on within the canyons, both shaping and interacting with the effects of dam operations

Questions?