

**GCDAMP Knowledge Assessment: Effects of Experimental & Management Actions**

Resource Topic:	Recreational experience
Preparer(s):	Ben Reeder, Chris Budwig, Kevin Dahl, David Rogowski, Lucas Bair
Version Date:	2/15/2017 by Recreation team, with "Campsite area" additions from Sediment team 3/15/2017 and

Resource Characteristic	Specific Measure	Exper or Mgt Action	Strength	Direction	Confidence	Rationale: Strength & Direction	Rationale: Confidence	Recommendations
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
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Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Fall HFEs > 96-hr duration	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Trout management flows	Strong	Negative Effect	Low	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Macroinvertebrate production flows	Moderate	Negative Effect	Low	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling access and safety	Annual average difference from daily mean flow of 10 kcfs, over water year	Riparian vegetation restoration	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling trout condition	Annual average daily rainbow trout catch > 16 inches, per angler, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Moderate	Positive Effect	Low	Increase in foodbase diversity and secondary production to have a positive impact on rainbow trout condition.	Foodbase improves rainbow trout condition (i.e., growth) Dodrill et al. 2016.	Design management actions to minimize impacts to and manage for foodbase while addressing downstream resource objectives.
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Glen Canyon walk-in angling trout condition	Annual average daily rainbow trout catch > 16 inches, per angler, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action not to impact foodbase	N/A	N/A
Glen Canyon walk-in angling trout condition	Annual average daily rainbow trout catch > 16 inches, per angler, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action not to impact foodbase	N/A	N/A
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Glen Canyon walk-in angling trout abundance	Annual average daily rainbow trout catch > 1/hour, per angler, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Moderate	Positive Effect	Medium	Management action has positive impact on rainbow trout recruitment.	Flow impacts on rainbow trout recruitment modeled in the LTEMP EIS and Korman et al. 2012.	Design management actions to minimize impacts to and manage for rainbow trout recruitment while addressing downstream resource objectives.
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Flatwater floating in Glen Canyon NRA	Annual accessibility (i.e., lost visitor days during HFEs), over water year	Spring HFEs ≤ 45,000 cfs in March or April	Strong	Negative Effect	High	High flow experiments preclude day-use flatwater floating trips in GCNRA.	Day-use trips do not occur during HFEs	Design management actions (e.g., flow magnitude and duration) to minimize impacts to day-use flatwater floaters in Glen Canyon.
Flatwater floating in Glen Canyon NRA	Annual accessibility (i.e., lost visitor days during HFEs), over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Strong	Negative Effect	High	High flow experiments preclude day-use flatwater floating trips in GCNRA.	Day-use trips do not occur during HFEs	Design management actions (e.g., flow magnitude and duration) to minimize impacts to day-use flatwater floaters in Glen Canyon.
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Flatwater floating in Glen Canyon NRA	Annual accessibility (i.e., lost visitor days during HFEs), over water year	Trout management flows	Unknown	Unknown	Low	TMFs, depending on design, may or maybe have an impact of day-use flatwater floating trips in GCNRA.	Unknown	Design management actions (e.g., flow magnitude and duration) to minimize impacts to day-use flatwater floaters in Glen Canyon.
Flatwater floating in Glen Canyon NRA	Annual accessibility (i.e., lost visitor days during HFEs), over water year	Macroinvertebrate production flows	Unknown	Unknown	Low	MPPs, depending on design, may or maybe have an impact of day-use flatwater floating trips in GCNRA.	Unknown	Design management actions (e.g., flow magnitude and duration) to minimize impacts to day-use flatwater floaters in Glen Canyon.
Flatwater floating in Glen Canyon NRA	Annual accessibility (i.e., lost visitor days during HFEs), over water year	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on day-use flatwater floating trips in GCNRA..	N/A	N/A
Flatwater floating in Glen Canyon NRA	Annual accessibility (i.e., lost visitor days during HFEs), over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on day-use flatwater floating trips in GCNRA..	N/A	N/A
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Flatwater floating in Glen Canyon NRA	Annual accessibility (i.e., lost visitor days during HFEs), over water year	Riparian vegetation restoration	Weak	No Effect	High	Management action has no known impact on day-use flatwater floating trips in GCNRA..	N/A	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Spring HFEs ≤ 45,000 cfs in March or April	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Short-duration, sediment-enriched HFE's have consistently resulted in deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Effect will depend on degree of sediment enrichment, which may vary for proactive HFE's.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Fall HFEs ≤ 45,000 cfs in October or November	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Short-duration, sediment-enriched HFE's have consistently resulted in deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Fall HFEs > 96-hr duration	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Effect will depend on degree of sediment enrichment-- sand supply could be exhausted during extended duration HFE, which may result in less sandbar deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Trout management flows	Moderate	Negative Effect	Low	Sandbar erosion expected to cause decrease in campsite area.	Confidence is low, because the magnitude of fluctuations is not clear and the frequency or duration of trout management flows is not known.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Macroinvertebrate production flows	Moderate	Positive Effect	Low	Sandbar deposition expected to cause increase in campsite area.	Confidence is low, because it is not clear how frequently these flows will occur.	Design management actions (e.g., flow magnitude and duration) to minimize impacts to usable campsite area.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater usable campsite area.	N/A	N/A

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Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater usable campsite area.	N/A	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater usable campsite area.	N/A	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater usable campsite area.	N/A	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, critical reaches	Riparian vegetation restoration	Strong	Positive Effect	Low	Targeted removal of vegetation should directly affect campsite area.	Although direct removal of vegetation is expected to result in an immediate increase of campsite area, the long-term result is uncertain. If vegetation quickly re-establishes, the effect could be short-lived.	Develop plan for vegetation management that targets sites where re-establishment is least likely and monitor results.
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Strong	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Strong	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Strong	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Fall HFEs > 96-hr duration	Strong	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Trout management flows	Moderate	Negative Effect	Medium	Under the TMF, the 3 days at 20 kcfs would not be the issue, it would be the unrestricted downramp to 5-8 kcfs that would be problematic for boating.	Dropping flows down to 8 kcfs would not be nearly as severe as 5 kcfs.	Consider 8 kcfs as the minimum flow.
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Macroinvertebrate production flows	Moderate	Negative Effect	Medium	As long as MPFs have a minimum of flow of 8 kcfs, there will be little impact to whitewater trips.	While most boaters prefer higher flows, 8 kcfs is adequate water flows for rafting in the Grand Canyon.	Based on results from 2017 ARM meeting, consider phosphate inputs to boost macroinvertebrate production.
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater river running experience.	N/A	N/A
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater river running experience.	N/A	N/A
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater river running experience.	N/A	N/A
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater river running experience.	N/A	N/A
Whitewater river running experience (i.e., rapids)	Annual average difference from daily mean flow of 22 kcfs, over water year	Riparian vegetation restoration	Weak	No Effect	High	Management action has no known impact on whitewater river running experience.	N/A	N/A
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Strong	Positive Effect	High	High flows make for easy river miles, and more time for off-river recreation.	Based on the flow velocity between lower flows and higher flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.

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Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Strong	Positive Effect	High	High flows make for easy river miles, and more time for off-river recreation.	Based on the flow velocity between lower flows and higher flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Strong	Positive Effect	High	High flows make for easy river miles, and more time for off-river recreation.	Based on the flow velocity between lower flows and higher flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Fall HFEs > 96-hr duration	Strong	Positive Effect	High	High flows make for easy river miles, and more time for off-river recreation.	Based on the flow velocity between lower flows and higher flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Trout management flows	Moderate	Positive Effect	Low	TMFs would have a positive effect for the 3 day duration of 20 kcfs, then a negative effect on the unrestricted down ramp, followed by 6 hours at low flow.	Depending on how fast the down ramp rate is, and how low the flow is for the 6 hour duration.	Consider 8 kcfs as the minimum flow, and slowing down ramp rates as much as reasonable for this experiment to be effective.
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Macroinvertebrate production flows	Moderate	Unknown	Medium	Could have a significant impact for lower monthly releases.	Depends on the monthly release.	Consider 8 kcfs as the minimum flow.
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater time on river.	N/A	N/A
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater time on river.	N/A	N/A
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater time on river.	N/A	N/A
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater time on river.	N/A	N/A
Whitewater time on river (i.e., less time on river leads to more off-river recreational time)	Annual average daily mean flow less than 22 kcfs, over water year	Riparian vegetation restoration	Weak	No Effect	High	Management action has no known impact on whitewater time on river.	N/A	N/A
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Fall HFEs > 96-hr duration	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Trout management flows	Strong	Negative Effect	High	Under the TMF, the 3 days at 20 kcfs would not be the issue, it would be the unrestricted downramp to 5-8 kcfs that would be problematic for boating.	Depending on how fast the down ramp rate is, and how low the flow is for the 6 hour duration.	Consider 8 kcfs as the minimum flow, and slowing down ramp rates as much as reasonable for this experiment to be effective.
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Macroinvertebrate production flows	Strong	Positive Effect	High	With steady weekend flow, chances of beaching boats goes down considerably.	Steady flows don't impact whitewater boat mooring.	Conduct a cost benefit analysis on effects to hydropower to operate dam without daily fluctuations.
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A

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Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A
Whitewater boat mooring (i.e., reduced beaching risk)	Annual average daily flow range greater than 10 kcfs, over water year	Riparian vegetation restoration	Weak	No Effect	High	Management action has no known impact on whitewater boat mooring.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Moderate	Positive Effect	Medium	High flows make it easier to travel long distances, flexibility for camping sites, and off-river attraction sites, reducing crowding.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Moderate	Positive Effect	Medium	High flows make it easier to travel long distances, flexibility for camping sites, and off-river attraction sites, reducing crowding.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Moderate	Positive Effect	Medium	High flows make it easier to travel long distances, flexibility for camping sites, and off-river attraction sites, reducing crowding.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Fall HFEs > 96-hr duration	Moderate	Positive Effect	Medium	High flows make it easier to travel long distances, flexibility for camping sites, and off-river attraction sites, reducing crowding.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Trout management flows	Moderate	Positive Effect	Medium	TMFs would have a positive effect for the 3 day duration of 20 kcfs, then a negative effect on the unrestricted down ramp, followed by 6 hours at low flow.	Based on low weekend flows under MLFF.	Consider 8 kcfs as the minimum flow, and slowing down ramp rates as much as reasonable for this experiment to be effective.
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Macroinvertebrate production flows	Strong	Negative Effect	High	For steady flows under 8 kcfs, whitewater rafting trips are likely to become congested above big rapids as trips wait for higher water.	Based on low weekend flows under MLFF.	Consider 8 kcfs as the minimum flow.
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual days with minimum flow less than 8 kcfs, over water year	Riparian vegetation restoration	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Moderate	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Moderate	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Moderate	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.



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Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Fall HFEs > 96-hr duration	Moderate	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Trout management flows	Moderate	Positive Effect	Medium	While preferences of water levels differ between rafting trips, higher flows are favorable for rapids.	Low flows following the period of 20 kcfs would have a negative impact on river trips.	Consider 8 cfs as the minimum flow, and slowing down ramp rates as much as reasonable for this experiment to be effective.
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Macroinvertebrate production flows	Strong	Negative Effect	High	Low flows (below 8 kcfs) show an increase in accidents for whitewater rafting trips.	Below 8 kcfs, many more rocks are exposed as obstacles in the current to avoid.	Consider 8 kcfs as the minimum flow.
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	N/A	N/A
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	N/A	N/A
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	N/A	N/A
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	N/A	N/A
Whitewater navigational risk	Annual days with minimum flow less than 8 kcfs, over water year	Riparian vegetation restoration	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	N/A	N/A
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Spring HFEs ≤ 45,000 cfs in March or April	Unknown	No Effect	Low	HFEs cause sediment deposition in the Colorado River channel below diamond creek	Research required on the topic	Research required on the topic
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Unknown	No Effect	Low	HFEs cause sediment deposition in the Colorado River channel below diamond creek	Research required on the topic	Research required on the topic
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Fall HFEs ≤ 45,000 cfs in October or November	Unknown	No Effect	Low	HFEs cause sediment deposition in the Colorado River channel below diamond creek	Research required on the topic	Research required on the topic
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Fall HFEs > 96-hr duration	Unknown	No Effect	Low	HFEs cause sediment deposition in the Colorado River channel below diamond creek	Research required on the topic	Research required on the topic
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Trout management flows	Weak	No Effect	Low	Management action has no known impact on whitewater navigational risk.	Research required on the topic	Research required on the topic
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Macroinvertebrate production flows	Weak	No Effect	Low	Management action has no known impact on whitewater navigational risk.	Research required on the topic	Research required on the topic
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	Management action does not have flow impacts.	N/A
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	Management action does not have flow impacts.	N/A
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	Management action does not have flow impacts.	N/A
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	Management action does not have flow impacts.	N/A
Whitewater navigational risk Diamond down	Percent change in suspended sediment, Diamond down	Riparian vegetation restoration	Weak	No Effect	High	Management action has no known impact on whitewater navigational risk.	Management action does not have flow impacts.	N/A
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Spring HFEs ≤ 45,000 cfs in March or April	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Short-duration, sediment-enriched HFE's have consistently resulted in deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Effect will depend on degree of sediment enrichment, which may vary for proactive HFE's.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Fall HFEs ≤ 45,000 cfs in October or November	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Short-duration, sediment-enriched HFE's have consistently resulted in deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Fall HFEs > 96-hr duration	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Effect will depend on degree of sediment enrichment--sand supply could be exhausted during extended duration HFE, which may result in less sandbar deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.

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Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Trout management flows	Moderate	Negative Effect	Low	Sandbar erosion expected to cause decrease in campsite area.	Confidence is low, because the magnitude of fluctuations is not clear and the frequency or duration of trout management flows is not known.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Macroinvertebrate production flows	Moderate	Positive Effect	Low	Sandbar deposition expected to cause increase in campsite area.	Confidence is low, because it is not clear how frequently these flows will occur.	Design management actions (e.g., flow magnitude and duration) to minimize impacts to usable campsite area.
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on backpacking/day-use usable campsite area.	N/A	N/A
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on backpacking/day-use usable campsite area.	N/A	N/A
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on backpacking/day-use usable campsite area.	N/A	N/A
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on backpacking/day-use usable campsite area.	N/A	N/A
Backpacking/day-use usable campsite area	Total usable campsite area (meters squared) during summer months	Riparian vegetation restoration	Strong	Positive Effect	Low	Targeted removal of vegetation should directly affect campsite area.	Although direct removal of vegetation is expected to result in an immediate increase of campsite area, the long-term result is uncertain. If vegetation quickly re-establishes, the effect could be short-lived.	Develop plan for vegetation management that targets sites where re-establishment is least likely and monitor results.
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows greater than 10 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows greater than 10 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows greater than 10 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Fall HFEs > 96-hr duration	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows greater than 10 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Trout management flows	Strong	Negative Effect	Low	Management action increases average daily flow to greater than 10 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows greater than 10 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Macroinvertebrate production flows	Strong	Positive Effect	Low	Management action increases the probability that average daily flow isn't greater than 10 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows greater than 10 kcfs during experimental flows (including during week days) while meeting downstream resource objectives
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	Management action does not have a flow impact.	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action does not have a flow impact.	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action does not have a flow impact.	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	Management action does not have a flow impact.	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A

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Backpacking/day-use shore access	Annual average daily mean flow greater than 10 kcfs, over water year	Riparian vegetation restoration	Strong	Positive Effect	Low	Targeted removal of vegetation should directly affect shore access.	Although direct removal of vegetation is expected to result in an immediate increase of shore access, the long-term result is uncertain. If vegetation quickly re-establishes, the effect could be short-lived.	Develop plan for vegetation management that targets sites where re-establishment is least likely and monitor results.
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Weak	No Effect	Medium	Management action not to impact daily fluctuations	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily fluctuations greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Weak	No Effect	Medium	Management action not to impact daily fluctuations	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily fluctuations greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Weak	No Effect	Medium	Management action not to impact daily fluctuations	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily fluctuations greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Fall HFEs > 96-hr duration	Weak	No Effect	Medium	Management action not to impact daily fluctuations	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily fluctuations greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Trout management flows	Weak	Negative Effect	Low	Management action increases the probability that average daily fluctuation greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily fluctuations greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Macroinvertebrate production flows	Weak	Negative Effect	Low	Management action increases the probability that average daily fluctuation greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily fluctuations greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	Management action does not have a flow impact.	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action does not have a flow impact.	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action does not have a flow impact.	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	Management action does not have a flow impact.	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Backpacking/day-use shore availability	Annual average daily flow range greater than 5 kcfs, over water year	Riparian vegetation restoration	Strong	Positive Effect	Low	Targeted removal of vegetation should directly affect shore availability.	Although direct removal of vegetation is expected to result in an immediate increase of shore availability, the long-term result is uncertain. If vegetation quickly re-establishes, the effect could be short-lived.	Develop plan for vegetation management that targets sites where re-establishment is least likely and monitor results.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.

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Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Fall HFEs > 96-hr duration	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Trout management flows	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Macroinvertebrate production flows	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Humpback chub translocation	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Mechanical removal of invasive fish species	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Larval humpback chub head-start program	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual whitewater and aircraft launches for resource management, research, and transportation activity, over water year	Riparian vegetation restoration	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Fall HFEs > 96-hr duration	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives

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Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Trout management flows	Strong	Negative Effect	Low	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Macroinvertebrate production flows	Moderate	Negative Effect	Low	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon walk-in angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Riparian vegetation restoration	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Fall HFEs > 96-hr duration	Strong	Negative Effect	High	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Trout management flows	Strong	Negative Effect	Low	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Macroinvertebrate production flows	Moderate	Negative Effect	Low	Management action increases average daily flow to greater than 10 kcfs and daily flow ranges to greater than 5 kcfs	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	Minimize daily mean flows different than 10 kcfs and flow ranges greater than 5 kcfs during experimental flows while meeting downstream resource objectives
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Humpback chub translocation	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A

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Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Larval humpback chub head-start program	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Glen Canyon watercraft angling access and safety	Annual average daily flow range greater than 5 kcfs, over water year	Riparian vegetation restoration	Weak	No Effect	High	No flow impact at Lees Ferry	The LTEMP EIS specifies operational and management action flows as part of the preferred alternative.	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Spring HFEs $\leq$ 45,000 cfs in March or April	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Short-duration, sediment-enriched HFE's have consistently resulted in deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Proactive Spring HFEs $\leq$ 45,000 cfs in April, May, or June	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Effect will depend on degree of sediment enrichment, which may vary for proactive HFE's.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Fall HFEs $\leq$ 45,000 cfs in October or November	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Short-duration, sediment-enriched HFE's have consistently resulted in deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Fall HFEs > 96-hr duration	Moderate	Positive Effect	Medium	Sandbar deposition expected to cause increase in campsite area.	Effect will depend on degree of sediment enrichment--sand supply could be exhausted during extended duration HFE, which may result in less sandbar deposition.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Trout management flows	Moderate	Negative Effect	Low	Sandbar erosion expected to cause decrease in campsite area.	Confidence is low, because the magnitude of fluctuations is not clear and the frequency or duration of trout management flows is not known.	If campsite areas continue to decline, consider actions in addition to high flows if larger campsites are required.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Macroinvertebrate production flows	Moderate	Positive Effect	Low	Sandbar deposition expected to cause increase in campsite area.	Confidence is low, because it is not clear how frequently these flows will occur.	Design management actions (e.g., flow magnitude and duration) to minimize impacts to usable campsite area.
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater usable campsite area.	N/A	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater usable campsite area.	N/A	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater usable campsite area.	N/A	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater usable campsite area.	N/A	N/A
Whitewater usable campsite area	Total usable campsite area (meters squared) during summer months, non-critical reaches	Riparian vegetation restoration	Strong	Positive Effect	Low	Targeted removal of vegetation should directly affect campsite area.	Although direct removal of vegetation is expected to result in an immediate increase of campsite area, the long-term result is uncertain. If vegetation quickly re-establishes, the effect could be short-lived.	Develop plan for vegetation management that targets sites where re-establishment is least likely and monitor results.
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Spring HFEs $\leq$ 45,000 cfs in March or April	Moderate	Positive Effect	Medium	High flows make it easier to travel long distances, flexibility for camping sites, and off-river attraction sites, reducing crowding.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.

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Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Moderate	Positive Effect	Medium	High flows make it easier to travel long distances, flexibility for camping sites, and off-river attraction sites, reducing crowding.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Moderate	Positive Effect	Medium	High flows make it easier to travel long distances, flexibility for camping sites, and off-river attraction sites, reducing crowding.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Fall HFEs > 96-hr duration	Moderate	Positive Effect	Medium	High flows make it easier to travel long distances, flexibility for camping sites, and off-river attraction sites, reducing crowding.	Some trips (rowing, paddle, private trip launches) are more likely to prefer moderate flows.	Conduct HFEs whenever conditions are appropriate. Whitewater boaters recognize the positive beach building effects even with the inconvenience of very high flows.
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Trout management flows	Moderate	Positive Effect	Medium	TMFs would have a positive effect for the 3 day duration of 20 kcfs, then a negative effect on the unrestricted down ramp, followed by 6 hours at low flow.	Based on low weekend flows under MLFF.	Consider 8 kcfs as the minimum flow, and slowing down ramp rates as much as reasonable for this experiment to be effective.
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Macroinvertebrate production flows	Strong	Negative Effect	High	For steady flows under 8 kcfs, whitewater rafting trips are likely to become congested above big rapids as trips wait for higher water.	Based on low weekend flows under MLFF.	Consider 8 kcfs as the minimum flow.
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Humpback chub translocation	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Mechanical removal of invasive fish species	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Larval humpback chub head-start program	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Whitewater river crowding (i.e., rapids, beaches)	Annual recreational whitewater visitor launches, over water year	Riparian vegetation restoration	Weak	No Effect	High	Management action has no known impact on whitewater river crowding.	N/A	N/A
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Spring HFEs ≤ 45,000 cfs in March or April	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Fall HFEs ≤ 45,000 cfs in October or November	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Fall HFEs > 96-hr duration	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Trout management flows	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Macroinvertebrate production flows	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Humpback chub translocation	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Mechanical removal of rainbow trout from LCR reach	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Mechanical removal of invasive fish species	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.

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Wilderness experience	Annual recreational whitewater visitor launches, over water year	Larval humpback chub head-start program	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.
Wilderness experience	Annual recreational whitewater visitor launches, over water year	Riparian vegetation restoration	Weak	Positive Effect	Low	Management action may improve wilderness characteristics of Glen and Grand Canyons.	Research needed on the topic.	Management action recommended to improve wilderness characteristics of Glen and Grand Canyons.