United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To:
FWS/R2/ES-ARD/ 080647

Kathleen Callister
LTEMP SEIS Project Manager
Bureau of Reclamation, Upper Colorado Basin
125 South State Street, Suite 800
Salt Lake City, Utah 84138

Dear Ms. Callister:

The U.S. Fish and Wildlife Service (Service) appreciates this opportunity to comment on the Bureau of Reclamation's (Reclamation) Glen canyon Dam Long-Term Experimental and Management Plan (LTEMP) Draft Supplemental Environmental Impact Statement (SEIS) as announced in the Federal Register on Feb 9, 2024 (89 FR 9147). The Service has prepared comments to address issues related to this action and its compliance with the Endangered Species Act of 1973 (16 U.S.C. *et seq.*) (ESA), as amended. The Service previously provided comments during the January 2024 Cooperating Agency review and appreciates the significant work Reclamation has completed to incorporate, address, and respond to those comments.

We are at a critical juncture in time to prevent the establishment of smallmouth bass (*Micropterus dolomieu*) and other warm water invasive fish species downstream of Glen Canyon Dam in the Colorado River. As you are aware, approximately 90% of all known federally listed humpback chub (*Gila cypha*) occur within the Grand Canyon reach of the Colorado River. The Service recently downlisted the humpback chub from "endangered" to "threatened" (86 FR 57588; November 17, 2021) due to the population of humpback chub below Glen Canyon Dam being mostly free of impacts from predatory nonnatives as well as the commitment to invasive fish removal efforts in the Upper Basin, including flow alterations at the Upper Basin dams. Establishment of warm water predatory nonnative invasive fish within the Grand Canyon reach would constitute a significant new threat to humpback chub. Consistent with the Department of the Interior's 2021-2025 Invasive Species Strategic Plan, it is imperative to address invasive species while they are early in the invasion process to prevent full establishment and spread (U. S. Department of Interior 2021). The Service sent Reclamation letters on September 27, 2023,

and January 12, 2024, expressing our concerns about smallmouth bass establishment and the urgency of addressing this issue.

The Service has documented how quickly smallmouth bass can invade, become established, and impact federally listed aquatic species, from their invasion in the Upper Colorado River (Breton et al. 2014). It took less than 5 years following the initial invasion in 2002 for smallmouth bass to become established in hundreds of miles of river in the Upper Colorado River basin (Haines and Modde, 2007). Similar smallmouth bass invasion and impacts patterns are documented worldwide by Loppnow et al. (2013), who noted that management agencies have been mostly unsuccessful controlling these invasive fish, that eradication has not been successful even when expensive and intensive techniques were used, and that an important part of control should emphasize efforts to prevent smallmouth bass introductions. There is evidence from the Upper Colorado River Endangered Fish Recovery Program (UCREFRP) that smallmouth bass cannot co-exist with native fish species (Bestgen and Tuttle, 2022). The UCREFRP reports that in areas where smallmouth bass are present they observe no native juvenile or subadult chub species, postulating that predation from smallmouth bass halts recruitment of those native fish species. The UCREFRP views smallmouth bass as the primary nonnative predator in the basin and as a result, smallmouth bass are the focus of the vast majority of removal efforts. The program spends more than $2 million annually in removing smallmouth bass and even with those targeted efforts they continue to see smallmouth bass populations increase or remain stable (Breton et al 2015, UCREFRP annual reports at www.coloradoriverrecovery.org/uc).

Smallmouth bass populations in the Grand Canyon reach are currently small and geographically confined in a relatively small section of river. Previous invasion patterns suggest that the window to eradicate invasion is closing. Many partners are invested in our native fish recovery programs in the Colorado river, and the humpback chub downlisting exemplifies those efforts and partnerships. Smallmouth bass establishment in the Lower Colorado River could reverse those accomplishments within a short timeframe as occurred in the Upper Colorado River basin. It is essential that all Colorado River agencies and partners take all possible actions as frequently as possible in 2024 to prevent the establishment of smallmouth bass in the Lower Colorado River, including responding swiftly to bass detections and monitoring the effectiveness of actions taken. Implementing the most effective alternative(s) from the LTEMP SEIS will be critical in creating conditions that disrupt or prevent spawning to prevent smallmouth bass establishment.

The attached excel spreadsheet contains 91 unique comments. For ease of review, the comments have been color coded into categories: 19 editorial comments (grey), 43 clarifying comments (green), and 29 substantive comments (orange). The clarifying comments are typically seeking additional information to explain the "why" behind a conclusion drawn and not necessarily requesting a change in the conclusion. Some substantive comment themes are summarized below.

Smallmouth Bass Flow Alternatives Population Growth Rate Model

The Service is pleased at the incorporation of the Eppehimer and Yackulic smallmouth bass

model in Appendix A assessing the potential for smallmouth population growth rate under each of the flow alternatives. The Service recommends expanding these discussions within the SEIS to provide more context and understanding for the reader on what the lambda values mean and how to compare them for effectiveness across the different flow alternatives. This model is the most powerful tool available to interpret and evaluate potential success of the alternatives and needs to be presented in a way that is simple for readers to understand, such as in tabular format.

The Service also suggests asking the authors to add an analysis where they compare the lambda of each flow alternative using only the hydrological traces where a flow alternative would be triggered due to anticipated river temperatures. Breaking out lambda values specifically for the years in which the temperature is modeled to be above the trigger of 15.5 degrees Celsius will help to better tease out the effectiveness of each flow alternative and allow a better comparison across alternatives. As currently analyzed, an alternative flow option will only be triggered in 17 percent of the 30 modeled hydrological traces; no alternative flows would be triggered in 83 percent of the modeled scenarios. The high percentage of hydrological models that would not trigger an alternative flow swamps out the effectiveness of each modeled flow alternative in the hydrological scenarios where a flow would be triggered. Adding an analysis that removes the excess signal will more clearly demonstrate which flow alternatives meet the purpose and need. At the current scale it is very difficult to tell if adding a flow spike(s) adds any additional effectiveness as compared to the same flow alternative without flow spike(s). This information also needs to be added to the summary table in Chapter 2.

Purpose and Need

The draft SEIS defines the need as “to disrupt the establishment of smallmouth bass below Glen Canyon Dam by limiting additional recruitment, which could threaten populations of threatened humpback chub below the dam (page 1-6, section 1-4)”. The Service remains concerned that the Non-Bypass flow alternative does not meet this stated need. This alternative focuses on impacting the nest guarding behaviors of male smallmouth bass and reducing survivorship of eggs and fry. These impacts occur after a successful spawn and do not prevent spawning. The Eppehimer and Yackulic smallmouth bass population growth model indicates that the Non-Bypass flow option never reduces the smallmouth bass population growth below 1. In every modeled hydrological trace in which an additional flow option would be needed (17 traces), the Non-Bypass alternative appears to function equivalently to the No Action Alternative in terms of meeting the purpose/need of the SEIS. The model demonstrates that smallmouth bass would continue to recruit, and population would grow, and therefore establishment will still occur. The Service recommends removing the Non-Bypass flow option from further consideration as it does not meet the purpose and need of the SEIS, nor does it meet the needed management for the ecological issue stressing the stability of the humpback chub population.

Preferred Alternative

It is unclear within the document if Reclamation is considering selecting one alternative from

those analyzed or if multiple alternatives may be implemented under different scenarios. If one alternative will be selected, the Service strongly suggests using modeling to evaluate impacts to lambda as a way to prioritize alternatives based on effectiveness. The data presented in this SEIS demonstrate that only the Cool Mix and Cool Mix with Flow Spike are effective at reducing lambda below 1 under all hydrologic scenarios analyzed, suggesting this should be the preferred alternative as it best meets the purpose and need of the SEIS.

If after this SEIS process Reclamation decides to maintain all 5 smallmouth bass flow alternatives as a "menu" of options for use, the Service strongly recommends running the smallmouth bass model for the particular hydrology presenting in any given year and limiting menu "choices" to only flow alternatives that reduce lambda to below 1 for that specific hydrological scenario. Specifically, the Service recommends only implementing flow alternatives that are likely to reduce lambda to 0.96 or lower due to model uncertainties when the modeled lambda is very close to "1" in value. This could also be done to model hydropower costs of the different flow options for a given hydrological scenario in any given year where temperatures are anticipated to rise above the trigger of 15.5 degrees Celsius. If Reclamation is considering utilizing multiple alternatives, the Service encourages Reclamation to cooperatively develop any hybrid alternatives with the Service and other partners and to still prioritize options based on anticipated effectiveness during peak smallmouth bass spawning timeframes. It is essential to use the most effective alternatives to prevent establishment in 2024.

Timeframe

Currently the plan states that smallmouth bass flow alternatives would end in 2027. The document implies this decision is predicated on the assumption that other tools may be available that would be effective by 2027. However, given uncertainties the Service recommends extending the timeframe for allowing smallmouth bass flow alternatives to be implemented through the lifetime of the original LTEMP, in case other tools or options are not available by 2027, or if other tools prove ineffective. If the smallmouth bass flow alternatives are effective, it will be important to be able to continue to implement them when needed to address smallmouth bass and the threat they pose to humpback chub.

ESA Requirements

There is a long consultation history between the Service and Reclamation involving operations at Glen Canyon Dam. A full list of consultations is on file in the Arizona Ecological Services Field Office. Consultation histories and summaries can also be found in the 2016 Biological Opinion for the LTEMP. In evaluating the various flow alternatives presented in the draft SEIS it appears that several alternatives may require re-initiation of Section 7 consultation. For example, the low flows associated with the Non-Bypass Alternative (2,000 cfs) are well below the flows analyzed in current ESA compliance documents for the LTEMP and are reminiscent of hydropeaking flows from the 1990's. Hydropeaking does disadvantage the early life history stages of fish, however that disadvantage affects all fish species. Data from that time (see 1995 EIS and 2016 LTEMP EIS) demonstrated negative impacts to federally listed native fish species, particularly if

those flows occur during the spawning season of native fish and/or their macroinvertebrate prey. Further, the 2016 Biological Opinion analyzed up to two High Flow Experiments annually and up to 38 HFEs over the 20-year LTEMP period. If the various flow alternatives could result in more High Flow Experiments in a given year or over the lifetime of the LTEMP that may not be analyzed in existing consultations. If Reclamation chooses to implement such flows, Section 7 consultation would likely need to be reinitiated and would likely need to include updates to the baseline for humpback chub.

Monitoring

The preliminary draft SEIS contains many assumptions based on smallmouth bass detections and/or other sampling efforts that would need to occur in conjunction with the various alternatives as well as scenarios where flow alternatives may be curtailed or halted. The Service would like additional information about how those decisions will be made and if there will be input from cooperating agencies. As we enter into Glen Canyon Dam Adaptive Management Working Group (AMWG) Triennial Work Planning, time is of the essence to ensure sampling and removal efforts are prioritized and fully funded. The Service also strongly recommends monitoring of the effectiveness of implementing any flow alternatives.

Conclusion

Thank you again for the opportunity to comment on this important issue. The Service recognizes the breadth of challenges facing Reclamation as you work to balance water demand and water availability, federally listed species and habitat needs, and dam safety and integrity. The Service continues to believe that it is critical that all Colorado River partners do everything possible to prevent the establishment of smallmouth bass in the Lower Colorado River. It is essential that agencies and partners swiftly respond to bass detections and monitor the effectiveness of actions taken to remain flexible in approaches and respond nimbly to changing conditions. Completing this process by late spring 2024 is imperative to prevent smallmouth bass establishment below the Glen Canyon Dam to protect native and federally listed fish when river temperatures increase above 15.5 degrees Celsius. The Service encourages Reclamation to act with urgency to identify the most effective tools starting in June 2024 to mitigate invading smallmouth bass populations close to Glen Canyon Dam. The Service recognizes that Western Area Power Administration recently submitted additional modeling for consideration. The Service believes the current document contains sufficient information in the existing draft and urges Reclamation to complete the SEIS on the timeline agreed to during Cooperator Agency calls. The Service stands committed and ready to assist Reclamation with all phases of this SEIS and the other concurrent NEPA planning processes. Please include the Service as early as possible so that we can provide input and be responsive to time intensive aspects of project requirements.

If we can be of further assistance, please contact Jonna Polk, Assistant Regional Director, Ecological Services, at Jonna_polk@fws.gov or 918-408-0850. If you need any further clarification of our comments, please contact Deborah Williams, Colorado River Special Assistant, at Deborah_williams@fws.gov or 575-517-6091.

Sincerely,

Regional Director

Enclosure

cc: Paul Souza, Region 8 Regional Director, Business Office paul_souza@fws.gov
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Bureau of Reclamation General Email for
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Literature Cited

Bestgen, K. R., and D. Tuttle. 2022. Evaluating effects of non-native predator removal on native fishes in the Yampa River, Colorado. Project 140 annual report submitted to the Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins. Larval Fish Laboratory.

Breton, A. R, D. L. Winkelman, J. A. Hawkins, and K. R. Bestgen. 2014. Population trends of smallmouth bass in the upper Colorado River basin with an evaluation of removal effects. Final report to the Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. Larval Fish Laboratory Contribution 169.

Breton, A. R, D. L. Winkelman, K. R. Bestgen, and J. A. Hawkins. 2015. Population dynamics modeling of introduced smallmouth bass in the upper Colorado River basin. Final report to the Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. Larval Fish Laboratory Contribution 186.

Haines, G. and T. Modde. 2007. A review of smallmouth bass removal in Yampa Canyon, with

Loppnow, G. L., K. Vascotto, and P. A. Venturelli. 2013. Invasive smallmouth bass (*Micropterus dolomieu*): history, impacts, and control. Management of Biological Invasions 4:191–206.

U. S. Department of Interior. 2021. Invasive Species Strategic Plan 2021 - 2025. Pages 1–54. Washington, D.C., United States.

USFWS Comment Color:	Editorial Comment (typos)	Clarifying Comment - we are asking for a correction or addition of more info to give better context to statement	Substantive Comment		
Cmt #	**Section #**	**Page #**	**Table or Figure #**	**Comment**	**Response (reviewers leave blank)**
1	Entire			Please add a description of what the lambdas mean and how to compare them across the different SMB flow alternatives. There is no context in the document to help a reader who is not already involved in lambda type discussion to understand how to interpret the information being presented and its value in decision making. It is the most powerful success based tool in the document but isn't presented as such. Also this information needs to be added and highlighted in the summary table. A lambda over 1 indicates that this alternative fails to limit additional recruitment of SMB which could continue to threaten humpback chub below the dam.	
2	Entire			Suggest emphasizing and repeating information on page 1-3 that in 20 years of mechanical removal of smallmouth bass in the upper basin there has been limited success in reducing smallmouth bass densities to benefit native fish populations.	
3	Entire			The Need is to disrupt the establishment of smallmouth bass below Glen Canyon Dam by limiting additional recruitment, which could threaten populations of threatened humpback chub below the dam (page 1-6, section 1-4). A lambda over 1 indicates that this alternative fails to limit additional recruitment of SMB which could continue to threaten humpback chub below the dam. The Non Bypass option does not meet this stated need of the SEIS. The population growth model indicates that in every modeled hydrological trace in which temperatures would indicate that an additional flow option would be needed, the modeled lambda (population growth) is still above 1 for all 17 traces. This is the same overall result of the No Action Alternative. This result indicates that in all of the modeled traces where a flow option would be needed, the smallmouth bass would continue to recruit and population would grow. This result does not meet the need of the SEIS, nor does it meet the ecological needs of the issue. The Service recommends removing this option from further consideration as it does not meet the purpose and need of the SEIS. The Non bypass alternative also does not address or provide the needed management for the ecological issue stressing the stability of the humpback chub population.	

4	Entire			Recommend adding an analysis where you look at the effectiveness of lambda only in the years where a an additional flow option is triggered due to anticipated temperatures. This will help to better tease out the effectiveness of each tool and allow a better comparison across tools. As currently analyzed, an alternative flow option will only be triggered in 17 percent of the 30 modeled hydrological traces; no alternative flows would be triggered in 83 percent of the modeled scenarios. The high percentage of hydrological models that would not trigger an alternative flow swamps out the effectiveness of each modeled flow alternative in the hydrological scenarios where a flow would be triggered. Adding an analysis that removes the excess signal will more clearly demonstrate which flow alternatives meet the purpose and need. Further breaking out lambda values specifically for the years in which the temperature is modeled to be above the trigger of 15.5 degrees Celsius will better tease out alternative effectiveness. At the current scale it is very difficult to tell if adding a flow spike(s) adds any additional effectiveness as compared to the same flow alternative without flow spike(s).Further, this will affect the hydropower cost analysis associated with each flow alternative. Finally at the scale as described in the current analysis it's very difficult to tell if adding a flow spike(s) is needed or adds additional effectiveness as compared to the same flow alternative without flow spike(s). This information also needs to be added to the summary table in Chapter 2.	
5	Entire			If after this SEIS process Reclamation decides to maintain all 5 SMB flow alternatives as a "menu" of options for use, the Service strongly recommends running the SMB model for the particular hydrology presenting in any given year and limiting menu "choices" to ONLY flow alternatives that reduce lambda to below 1 for that given hydrological scenario. Specifically, the Service recommends only implementing flow alternatives that are likely to reduce lambda to 0.96 or lower due to model uncertainties when the modeled lambda is very close to "1" in value. This could also be done to model hydropower costs of the different flow options for a given hydrological scenario in any given year where temperatures are anticipated to rise above the trigger of 15.5 degrees Celsius. If Reclamation is considering utilizing multiple alternatives, the Service encourages Reclamation to cooperatively develop any hybrid alternatives with the Service and other partners and to still prioritize options based on anticipated effectiveness during peak smallmouth bass spawning timeframes. It is essential to use the most effective alternatives to prevent establishment in 2024.	
6	Entire			Currently the plan states that smallmouth bass flow alternatives would end in 2027. The document implies this decision is predicated on the assumption that other tools may be available that would be effective by 2027. However, given uncertainties the Service recommends extending the timeframe for allowing smallmouth bass flow alternatives to be implemented through the lifetime of the original LTEMP, in case other tools or options are not available by 2027, or if other tools prove ineffective. If the smallmouth bass flow alternatives are effective, it will be important to be able to continue to implement them when needed to address smallmouth bass and the threat they pose to humpback chub.	
7	Entire			The SEIS lacks an analysis in the effects section to native and non-natives fish based on the lambda modeling (pp3-85 to 3-96). The effects analysis does not appear to have been updated following the addition of the lambda modeling. The effects analyses should also include effects to native fish if the flow alternative is not likely to be successful in years where the temperature modeling indicates temperatures will rise above 15.5 degrees celcious and trigger that flow alternative. A less effective alternative will allow population growth of smallmouth bass and have negative impacts to native fish. It looks like it was all written before the lambda modeling and didn't get it incorporated into the effects at all.	

8	Entire			Completing this process by late spring 2024 is imperative to prevent smallmouth bass establishment and to protect native and federally listed fish by having the most effective tools available when river temperatures increase. Reclamation should avoid any delays to this process that would result in the loss of the opportunity to use the most effective tools starting in June 2024. If there are delays or we don't select the most effective tools; we will lose a year and lose the advantage of the invading population having a restricted distribution close the dam. Many of these tools will be less effective the longer we wait to use them.	
9	Entire			Suggest updating references used throughout the document. There is a lot of newer peer reviewed information that can be incorporated. Suggest coordinating with GRMRC and NPS to get updated references.	
10	2	2-3		Statement that river mile targets for implementation could vary depending on where bass are located could use more specifics or an example to be fully understood. It would be helpful if a realistic example were provided regarding how this may be exhibited.	
11	2	2-3		Missing Space in Header Title	
12	2	2-4		GCD Operational constraints - the modeling assumed a minimum flow of 2,000 cfs through the penstocks in every flow alternative. In a public webinar it was shared that this operational constraint may be increased to 3,500 cfs based on recommendations from an upcoming cavitation report. If the operational constraint gets increased the Service recommend re-running the SMB lambda model to investigate if that operational constraint has any modeled impact to the likelihood of success (defined as reducing the lambda to below 1) for hydrological traces that would trigger a flow alternative.	
13	2	2-10		Sentence regarding the endangered species status of humpback chub population requires a "because" statement. Indicating a causal mechanism here and the result would strengthen the argument.	
14	2	2-17		Missing Space in Header Title	
15	2	2-17		The description of the Non-Bypass Alternative states that it is centered on substantial river stage changes that are targeted along the Lees Ferry reach. That would correspond to the RM 15. The other flow options are analyzed for effectiveness at RM 15 and RM 61. Recent survey efforts have detected SMB all the way at the confluence of the Little Colorado River. Humpback chub congregations begin at RM 30. If this alternative is not designed to impact those locations it should not be considered as meeting the purpose and need of the SEIS.	
16	2	2-17		The document sites McKinney et al. 1999a in stating that the Non-Bypass Alternative "is predicted on the "flow fluctuations that reduced rainbow trout reproduction during the pre-ROD period (1965-1991) to the point where the fishery could only be maintained through stocking." What does this statement mean for potential impacts to rainbow trout and why?	
17	2	2-20	2-1	Recommend adding statements to address how each of these alternatives will or won't be modified and effective at the two river miles analyzed throughout the rest of the document (RM 15 and 61). A reminder of the RM's where SMB have been recently detected would be helpful to the reader.	
18	2	2-23	2-2	This table is not congruent with all the information presented in the rest of the document and needs to be thoroughly reviewed and updated. It should include the SMB lambda information as that is the most significant data to help compare the effectiveness of the different alternatives. Also for those modeled traces where an alternative flow would be needed, the table should also reflect and summarize what the impacts of the positive lambdas means for all the species and resources analyzed in this SEIS.	
19	2	2-25	2-2	Recommend adding details in this document validating and demonstrating how the Non-Bypass Alternative "could allow the area's landscape character to appear more natural". This statement appears to be unsupported.	

20	2	2-26	2-2	Recommend adding details within this document that supports and validates the conclusion that small mouth bass spawning could be disrupted while not impacting native fish spawning. Data suggests that native fish occur and spawn at RM 30 and SMB occur and spawn all the way to RM 61. Also suggest adding modeled lambda information and explanation that demonstrates that in years where a tools would be warranted that this tool would actually impact lambda and reduce modeled population growth to below 1. Please add substantive information supporting the conclusion that the Non By-pass alternative would not impact aquatic food base items in the Lees Ferry and Marble Canyon areas. This document later states that these areas have the highest aquatic invertebrate food production of the river between GCD and Hoover dam. Please add information on potential impacts to rainbow trout to this table.	
21	2	2-27	2-2	Recommend adding details in the Special Status Species section on the modeled lambda effectiveness of each alternative in the hydrologic traces that indicated a flow alternative would be needed. This is needed to adequately compare the analysis. Additionally, add information explaining what will likely happen in those years/traces where the lambda stays above 1. Also in the document it appears that this section may actually be sub header "Threatened and Endangered Species" and not "Special Status Species"	
22	2	2-28	2-2	Recommend adding information to indicate if the economic analyses are run representing any given year a flow alternative is needed or if they are run as if a flow alternative is needed in every given year.	
23	3	3-3		Editorial strikethrough should be removed in 3.2.2	
24	3	3-14		The Non-Bypass Flow Alternative section references research flows from the early 1990's where flows as low as 1,000 cfs, is there anything that we learned from those research flows that we should be referencing and including in the descriptions of potential impacts of these flows on aquatic resources?	
25	3	3-22		Editorial spacing error in impact analysis area - word "these"	
26	3	3-50		The first paragraph of the macroinvertebrate section implies that the highest macroinvertebrate production below GCD occurs in the GCD reach. The next paragraph indicates that cold water can prevent eggs from hatching and limit success - recommend adding what temperature these impacts are related to. The paragraph continues to state that varial zone increases associated with hydropower production leads to desiccation-induced mortality of eggs. This information should be described appropriately in impacts analyses of the appropriate flow alternatives and added to the summary table (Kennedy 2016).	
27	3	3-51		The section also states that Kennedy (2016) hypothesizes that dam operations may constrain abundance of aquatic insects…thereby limiting amount of prey available for native fish. How does this conclusion align with the Non-Bypass alternative, could there be even greater impacts to macroinvertebrates? Please explain this further and update summary table as appropriate.	
28	3	3-51		Please add more information about findings of the "bug flows" and if food base was enhanced by steadier flows.	
29	3	3-54		Food Web Dynamics section - recommend expanding the analysis describing potential effects of fluctuating flows from power plant releases and the results of "bug flows". The section has one statement concerning a 400 percent increase in caddisflies but minimizes that increase as it could have been due to low sediment or steady flows. Expand this section to support that conclusion but also demonstrate that the steady flows may have caused a 400 percent increase (this is not stated). Recommend adding analysis of what this data may mean when considering non bypass alternative flows and potential impacts to the food web in the most productive section of the river below GCD, where these flows will impact the varial zone during macroinvertebrate production peak times. Please include these risks in the summary table.	

30	3	3-59		Flannelmouth sucker Life History - any conclusions about the variability reported by long-term fish monitoring by AZGFD and catch per unit effort? The document describes some significant variability among years. Are there any hypotheses on what might be driving that inter-year variability and therefore are there any potential connections to the different flow alternatives being analyzed?	
31	3	3-63	3-30	Please add a column to this table indicating the Threat Levels per non-native fish as identified in the NPS 2013a Comprehensive Fisheries Management Plan. This would help the reader understand the magnitude of concern associated with each species in this table. Also consider adding a column indicating the prey base of the species and/or it's piscivorous nature.	
32	3	3-63	3-30	Several spacing issues between words throughout this table in the Presence in Project Area column.	
33	3	3-69		Please add clarifying information in the "Proposal to Manage Smallmouth Bass in the Grand Canyon" section on whether each of the flow alternatives can be adapted (or can't be) to be effective at both RM 15 and RM 61. From reading the flow alternatives description it doesn't sound like the Non Bypass Alternative could impact SMB all the way to RM 61. Where does the trough attenuate? Also please include description here about the modeled lambdas for each flow alternative and communicate what those values mean for the reader and how effective flows will be in the individual modeled traces where a flow alternative is triggered.	
34	3	3-75		Brown Trout section - The Runge 2018 cited paper concludes that brown trout management flows will not be an effective strategy - extrapolating from that conclusion - please explain why or why not the same types of flows (the non-by-pass alternative) is anticipated to be effective for SMB. Also please update the incentivized harvest section with the most recent data. This can be found in notes from Jeff Arnold's presentations to AMWG and the TWG.	
35	3	3-81		Mis-spelling of "few" and "trout" in first paragraph on page.	
36	3	3-82		Font issue in second paragraph.	
37	3	3-85		Recommend expanding this entire section to better explain what the lambdas in Appendix A mean in terms of comparing the various alternatives. Add a description of what the lambdas mean and how to compare them across the different SMB flow alternatives. There is no context in the document to help a reader who is not already involved in lambda type discussion to understand how to interpret the information being presented and its value in decision making. It is the most powerful success based tool in the document but isn't presented as such. Recommend adding an analysis where you look at the effectiveness of lambda only in the years where a an additional flow option is triggered due to anticipated temperatures. This will help to better tease out the effectiveness of each tool and allow a better comparison across tools. Breaking out lambda values specifically for the years in which the temperature is modeled to be above the trigger of 15.5 degrees Celsius will help to better tease out the effectiveness of each flow alternative and allow a better comparison across alternatives. As currently analyzed, an alternative flow option will only be triggered in a few of the 30 modeled hydrological traces, leading to SMB population growth on anticipated in a no action alternative in 17 percent of the traces. This means in 83 percent of all the modeled hydrological scenarios, no alternative flow would even be triggered. This can swamp out clearly demonstrating the effectiveness of each modeled flow alternative. Removing the excess signal will more clearly demonstrate that some flow alternatives do not meet the purpose and need of the SEIS. Further, this will affect the hydropower cost analysis associated with each flow alternative. Finally at the scale as described in the current analysis it's very difficult to tell if adding a flow spike(s) is needed or adds additional effectiveness as compared to the same flow alternative without flow spike(s).	
38	3	3-86		Please explain how warmer water releases under the no action alternative could increase growth rates of rainbow trout and/or place that information in context of overall concerns of warmer waters decreasing trout populations.	

39	3	3-86		The Nonnative and native fish paragraphs seem inaccurate for the no action alternative and read more like response to flow increases.	
40	3	3-87		The paragraph on Spring HFE seems out of place in a section on the No Action alternative.	
41	3	3-88		Recommend additional emphasis on pointing out that the cool mix alternative is the only flow alternative in which the modeled lambda is always below 1 no matter what hydrological trace is used in the model and how that relates to its anticipated effectiveness. This is clearly the most effective flow alternative analyzed in terms of meeting the purpose and need. A lambda over 1 indicates that this alternative fails to limit additional recruitment of SMB which could continue to threaten humpback chub below the dam. In general explaining lambda in plain language will help readers less familiar with the subject matter understand the science being presented.	
42	3	3-89		If the model anticipates that cooling can be accomplished to RM 15 or RM 30, what about RM 61 and if it's not to RM 61 then why are all the economic analyses carried to RM 61? This is internally inconsistent and confusing and should be addressed. Later sections of this chapter indicate that cooling can be achieved at RM 61.	
43	3	3-89		In the cool mix with flow sike alternative section please correct the phrase "cold release" to "cold spike" for clarity.	
44	3	3-90		Please explain the SMB lambdas further in this section. If you limited the analysis to just hydrological traces where a flow alternative would be triggered - is there any modeled difference in success between cold mix and cold mix with a flow spike? Breaking out lambda values specifically for the years in which the temperature is modeled to be above the trigger of 15.5 degrees Celsius will help to better tease out the effectiveness of each flow alternative and allow a better comparison across alternatives.	
45	3	3-91		Strongly recommend adding some information for the reader to help interpret the difference in the lambdas between the cool mix and cold shock alternatives. This is important both in giving context of modeled effectiveness but also in understanding differences in other potential negative impacts of the two alternatives, including the increase in risk of SMB population growth. Add analysis and explanation that breaks out lambda values specifically for the years in which the temperature is modeled to be above the trigger of 15.5 degrees Celsius - this will help to better tease out the effectiveness of each flow alternative and allow a better comparison across alternatives.	
46	3	3-92		The aquatic food base section details anticipated negative impacts to the aquatic food base associated with magnitude of releases and the persistence of those impacts weekly for 12 weeks. These same effects should be in the Non-By Pass alternative based on velocities, number of weeks and repetitive nature of that alternative.	
47	3	3-92		Please add how many spike flows are anticipated. The Cool Mix section states that "up to 3 cold shocks" may occur.	
48	3	3-93		Describe any measurable difference in the modeled lambda for the cold shock with spike flow alternative that would justify including spike flows in addition to the cold shock given the potential negative impacts associated with the spike flows. Limiting the lambda analysis to just hydrological traces where a flow is actually triggered may help to elucidate those differences such that they can be better described.	
49	3	3-94		The Non Bypass Alternative is described as an "experiment" and according to the SMB model and associated lambdas - this alternative performs no better than the no action alternative. All associated lambdas are above 1 in all of the hydrological traces in which a flow alternative would be triggered for the 30 hydrological regimes analyzed. Therefore, the Service does not believe that this alternative meets the Purpose and Need of this LTEMP SEIS and recommends it be removed from further consideration.	

50	3	3-95		The Non By-Pass Alternative was designed with low flows down to 2,000 cfs. With the new potential operational restrictions of maintaining penstock flows at least 3,000 cfs or perhaps even 3,500 cfs; how would those guidelines affect the modeled lambdas?	
51	3	3-95		The "triggers" for initiating a Non-By-pass flow appear to be different from the triggers for the other flow alternatives. This description ties the temperature trigger to 12 mile slough and reads as if written by a different author. Recommend ensuring the trigger for a flow alternative is the same for all alternatives.	
52	3	3-96		The potential impacts to Aquatic Food Base paragraph should be coordinated with species expert Ted Kennedy as on face value it does not seem to account for all the potential impacts as outlined in previous sections of the SEIS.	
53	3	3-105		Based on the Amphibian and Reptile section, would the Non-By-pass alternative potentially cause any desiccation of amphibian eggs? If yes please add this to the analysis. If no please explain why those potential impacts are not expected.	
54	3	3-114		Humpback chub section has repeated words on one sentence (river flows).	
55	3	3-116	3-29	Font/spacing issue in figure heading.	
56	3	3-117	3-30	Font/spacing issue in figure heading.	
57	3	3-118	3-31	Font/spacing issue in figure heading.	
58	3	3-118	3-31	In figure caption or in text please describe the "buffer" that is identified in the legend. Also please add confidence intervals to the caption.	
59	3	3-123		In Distribution and Abundance section please add information on recently augmented populations of razorback sucker in GCNP	
60	3	3-123		Please add information in this first paragraph indicating temperature effects at various RM along the river. These impacts are not equal.	
61	3	3-131	Section	For the entire section of Issue 2 - recommend adding context of the lambda analysis for the different flow alternatives as described in other comments. Give context to what lambda means, how many traces actually would trigger a flow alternative and then the difference in the modeled ability of an alternative to impact lambda within a trace in which it is triggered. This will give the reader better context for understanding the effectiveness of the different alternative. Breaking out lambda values specifically for the years in which the temperature is modeled to be above the trigger of 15.5 degrees Celsius will help to better tease out the effectiveness of each flow alternative and allow a better comparison across alternatives. Please also add analysis explaining the differences in risks for those traces where a flow alternative would be triggered but lambda stays above 1. This will help the reader understand the difference in the continued threat of SMB establishment per alternative. Also please add information explaining how quickly bass can become established (as compared to other nonnative fish species). There is ample information from the Upper Basin Recovery programs that can be provided upon request demonstrating establishment in less than 5 years. This could also be done to model hydropower costs of the different flow options for a given hydrological scenario in any given year where temperatures are anticipated to rise above the trigger of 15.5 degrees Celsius.	
62		3-132		Low water temperature swimming impairment is described here. It would be helpful to know the extent of this effect. For instance, can there be a proportion or other value be provided that would indicate how many young fish may be impacted?	
63	3	3-133		Here impacts of cold shock are suggested to be less due to distance from the dam. Can there be a value applied, roughly or estimable, that would demonstrate this pattern? Without data or citation this statement appears to be arbitrary.	

64	3	3-134		Add any potential impacts to humpback chub egg and fry from the Non-Bypass Alternative. There is a congregation of humpback chub at RM 30 that does not appear to have the impacts to their fry and eggs analyzed at all. The non bypass alternative anticipates up to 26 big fluctuations between May-Oct. It doesn't look like the fluctuations dissipate by the 30 mile humpback chub aggregation. Impacts to these fish, eggs and fry need to be analyzed and are not analyzed in any existing consultations.	
65	3	3-135		The following quote/conclusion does not seem to be supported by Appendix A (Figure 1): "The alternatives with the most potential effect for disrupting smallmouth bass spawning are the Cool Mix with Flow Spike and the Cold Shock with Flow Spike Alternatives; this is because these alternatives disrupt both the physical habitat of smallmouth bass nesting and the suitable and necessary temperature regimes." In contrast, Appendix A suggests that it is the Cool Mix and Cool Mix with Flow Spike are the alternatives with the most potential effect. We recommend revising this statement so that it is congruent with Appendix A.	
66	3	3-157	3-35	Font/spacing issue in figure heading.	
67	3	3-161	3-37	Font/spacing issue in figure heading.	
68	1.2	1-4		Add a definition of high-flow experiments for readers not familiar with the LTEMP. Consider summarizing the description of HFE in Section 3.4.1 on page 3-37.	
69	1.2	1-4		Add information about why BOR conducted the 3-day HFE in April 2023 for context.	
70	1.2	1-5		Add what specific sediment conditions are you trying to improve in the Grand Canyon (i.e. transport from one area to another).	
71	1.2	1-5		Define "sub-annual flow options."	
72	1			This section needs a clearer definition of the project area versus the analysis area. If the analysis area is different for each resource, then define the analysis area for each resource somewhere in the document.	
73	1			It would be good to define the terms "sediment account period" and "implementation window" early on in the document. Consider adding some clarity on the purpose/need concerning the sediment accounting window. For a reader not familiar with the issues its confusing to seem to have to different "needs" for the SEIS.	
74	1.3	1-6		Define the term "slough modifications," and either put the location of the slough on a map or provide a narrative description of the slough.	
75	2.6	2-11		The following sentence is very confusing to a reader not familiar with the issue. Consider re-phrasing. "To align with actual implementation without necessitating multiple weeks of hydropower maximization (that is, the operation of the hydropower system to generate the maximum amount of electrical power) within each month, daily bypass estimates from the smallmouth bass model were post-processed. Flows were simulated to occur all month, if they were triggered before the month's halfway mark, and start in the subsequent month, if they were triggered after the halfway mark. Additionally, all days within a month would have bypass equal to the median of the month, with minimal changes observed in overall bypass across traces (USGS 2022)."	
76	2.7	2-12		Explain the difference between an HFE and a flow spike.	
77			Figure 2-2	Is jet tube the same as river outlet works and the same as Bypass? If so, please select one term and try to use the same term throughout the document.	
78	3.2.2	3-16		This sentence is missing some words: "Overall elevation changes in Lake Powell under the action alternatives are relatively minor, and water."	
79		3-56		A sentence is the first paragraph says that roundtail chub were extirpated from the Colorado River. It would be more accurate to say that the project area is outside the current and historic range of the species, according to the species status assessment. https://ecos.fws.gov/ServCat/DownloadFile/215366	

80			Table 3-29	Column 3. If you're going to name these places, please make sure they're on a map somewhere in the document, or otherwise described (such as RM #), so that the reader doesn't have to google the places.	
81	3.5.2			Consider adding information about the effects of the alternatives on the New Zealand mud snail population size and distribution.	
82	3.7.2	3-109		Correct header "species status species"	
83	3.7.2	3-110		"HFE releases and flow spikes may enhance germination for certain riparian plant species and prevent establishment of other species, changing composition in ways that could have beneficial impacts on invertebrate biodiversity and abundance." Please provide a citation for this statement.	
84	3.7.2/special-status birds	3-113		This section says that the alternatives would affect none of the birds protected under MBTA, because these birds aren't in riparian areas. This is not correct. Many birds protected under MBTA nest in riparian areas. Please prove clarifying statement of the MBTA assemblage expected in this area.	
85	3.9.1	3-135		"If less electricity is unavailable at Glen Canyon Dam…" Change to "If less electricity is available at Glen Canyon Dam…"	
86		3-143	Tables 3-36 and 3-37	The titles of these tables say "5-year total emissions" of the pollutants, but these values aren't the total emissions. They appear to be the change in emissions compared to the No Action. Please revise as appropriate	
87	3.11.2/Issue 3	3-161		Please explain why the concentration of 5.2 mg/L of DO is important.	
88	3.12.2	3-172		Please add additional clarifying language explaining the rationale behind the statement that the cold-water alternatives would have the same impacts as the No Action.	
89	3.12.2	3-173		Please explain why aeolian transport of sand is important for cultural resources. Will it increase the area of sand bars, or decrease?	
90	3.12.2	3-173		Please add clarifying language explaining the rationale behind the statements that the alternatives would be similar to the No Action or one another, with regard to sediment transport.	
91	4.5	4-3		Please update the second paragraph - as currently written it does not accurately reflect where we are currently in consultation on this SEIS.	